U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL WEATHER SERVICE

May 04 2005

MEMORANDUM FOR: Distribution

FROM: W/OPS2 - /s/ Jerald J. Dinges, acting

SUBJECT: Operational Acceptance Test Plan for the National Digital Forecast Database (NDFD) Central Server System (CSS) Redundant NDFD Server Cluster, Redundant IFPS Service Backup System, May 2005

The attached plan describes how the National Weather Service (NWS) will conduct an Operational Acceptance Test (OAT) of the National Digital Forecast Database (NDFD) Central Server System (CSS) Redundant NDFD Server Cluster, Redundant Interactive Forecast Preparation System (IFPS) Service Backup System. The OAT is scheduled for June 6 through July 15, 2005. If the Redundant IFPS Service Backup System is not ready for test at the same time as the Redundant NDFD Server Cluster, the backup system will be tested when it is ready and the server cluster portion of the OAT will be conducted according to the schedule.

The plan describes the equipment, OAT sites, personnel and resource requirements, methodology, schedule, and reporting for this OAT. Mary Buckingham, W/OPS24, is the OAT director. Questions or comments should be directed to Mary by e-mail at Mary.Buckingham@noaa.gov, facsimile 301-713-0912, or telephone 301-713-0326 x137.

Attachment

Distribution:
W/CIO13 - A. Darling
W/OPS24 - M. Buckingham
W/OST11 - L. Anderson
W/OST2 - H. Glahn
W/OST21 - D. Ruth
W/OST31 - F. Zichy
W/OS2 - L. Spayd
W/OS3 - G. Austin
W/OS61 - S. White
W/CR41x2 - W. Gery
W/ERx2 - I. Dickman
W/SR41x2 - E. Howieson
W/WR41 - J. Walker
W/PR11 - B. Ward
W/AR41x3 - Philip Mieczynski

cc:
W/OCIO1 - P. Chan
W/OCIO1 - L. Curran
W/OCIO11 - R. Chambers
W/OCIO12 - D. Starosta
W/OCIO12 - S. Murphy
W/OS22 - J. Lee
W/OS32 - J. Zimmerman
W/OS5 - W. Lerner
W/OS61 - J. Vogel
W/OS7 - A. Horvitz
W/OHD - G. Carter
W/OST - J. Hayes
W/OSTx1 - J. Valdez
W/OST1 - F. Kelly
W/OST1 - C. Piercy
W/OST11 - W. Scott
W/OST2 - T. Boyer
W/OST2 - T. Kempisty
W/OST3 - D. Jones
W/OST31 - J. Barna
W/OST31 - T. Hopkins
W/OST32 - J. Tuell
W/OPS - J. McNulty
W/OPS1 - M. Paese
W/OPS21 - V. Baer
W/OPS21 - T. Ulinsky
W/OPS22 - J. Facundo
W/OPS23 - R. Thomas
W/OPS24 - J. Dinges
W/ER1 - J. Guiney
W/ER2 - P. Gabrielsen
W/ER3 - K. Johnson
W/ER4 - T. Wilk
W/WR1 - R. Douglas
W/WR2 - R. Tibi
W/WR3 - A. Edman
W/WR4 - R. Diaz

W/AR1 - J. Partain
W/AR2 - R. Radlein
W/AR4 - F. Peters

W/PRx1 - A. Samori
W/PR1 - E. Young
W/PR11 - J. Delcano
W/PR11 - B. Ward

OPERATIONAL ACCEPTANCE TEST PLAN

for the

National Digital Forecast Database (NDFD) Central Server System (CSS)

Redundant NDFD Server Cluster
Redundant IFPS Service Backup System

March 2005

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Weather Service/Office of Systems Operations
Systems Integration Division/Field Systems Branch

Executive Summary

This document describes the plan the National Weather Service (NWS) will follow in conducting an Operational Acceptance Test (OAT) of the National Digital Forecast Database (NDFD) Central Server System (CSS) reconfigured to include a Redundant NDFD Server Cluster and a Redundant IFPS Service Backup System. The plan includes information about the OAT participants, key NWS personnel involved in the project, and the methodology for conducting the OAT and reporting the results.

The purpose of the OAT is to provide measurements and analysis of system performance and related information for use in determining the operational effectiveness and suitability of the NDFD CSS in meeting the needs of its users for timely and reliable access to its mosaic products. The results of the OAT will be used, along with other factors, by NWS management to ensure the NDFD CSS upgrades do not negatively impact operational use.

The NWS Test and Evaluation Branch (TEB, OPS24) will conduct the OAT for a continuous six week period during June and July 2005. The TEB-developed Product Availability Monitoring System (PAMS) software will be used to collect and analyze NDFD CSS performance data to support the performance analysis.

Table of Contents

Attachments

Figures

Tables

Acronyms

CONUS	Conterminous U.S.
CSS	Central Server System
FSOC	Field Systems Operations Center
FTP	File Transfer Protocol
FTP	File Transfer Protocol
IFPS	Interactive Forecast Preparation System
IOC	Initial Operating Capability
IOC	Initial Operating Capability
NCDC	National Climatic Data Center
NCEP	National Centers for Environmental Prediction
NDFD	National Digital Forecast Database
NRC	National Research Council's
NWS	National Weather Service
NWSTG	NWS Telecommunications Gateway
OAT	Operational Acceptance Test
OOS	Office of Operational Systems
OS	Office of Climate, Water, and Weather Services
PAMS	Product Availability and Monitoring System
SBN	AWIPS Satellite Broadcast Network
TEB	Test and Evaluation Branch
TOC	Telecommunication Operating Center
TRG	Test Review Group
WDE	Weather Data Exchange
WFO	Weather Forecast Office
WMO	World Meteorological Organization
WSH	NWS Headquarters

PART I: Overview

1. Introduction

The mission of the National Weather Service (NWS) described in the ***National Weather Service Strategic Plan for FY2003 - FY 2008***, includes the objective of improving the accessibility and availability of weather information by posting NWS products and data on the Internet in graphic-oriented format. The NWS is embarking on a major change in how it creates and presents its forecasts to the public. Central to this change is the Interactive Forecast Preparation System (IFPS).

Earlier in 2003, the NWS conducted an Operational Acceptance Test (OAT) of the IFPS to meet the Initial Operating Capability (IOC) requirements for that system. The IFPS creates NWS forecasts based on forecaster digital manipulation of data at each NWS Weather Forecast Office (WFO). Each WFO creates a series of gridded forecasts as needed but at least once per day and sends them to a system located at NWS Headquarters (WSH) called the National Digital Forecast Database (NDFD). NDFD is a means to exploit technology to make a seamless suite of NWS forecasts available efficiently, and in a convenient and understandable form to best meet the needs of other governmental agencies, the private sector, the public, and the global community. The NDFD Central Server System (CSS) receives all these WFO gridded products and merges them into mosaic products for the national and regional geographic areas. It is the intent of the NWS to present the NDFD-generated mosaic graphic products as the official user products for the WFO forecasts.

In June through July 2004, an OAT was conducted to measure the performance of the NDFD CSS and the communication path which receives and processes the WFO files and delivers the mosaic products to the public by storming them onto the NWS Telecommunications Gateway (NWSTG). The system failed to meet its required timeliness about half the hours the mosaic products were sent. The reliability of the system in producing and receiving the required files exceeded the requirement. The system failed to swap reliably when one of its servers failed. The mosaic gridded products produced by the NDFD CSS for three elements (maximum and minimum temperatures, and probability of precipitation) were declared official December 1, 2004.

To address the performance deficiencies, the NWS is undertaking a modification to the existing NDFD CSS architecture. The new architecture will add a second server pair to the existing pair to function as a backup in the event both the servers in the primary pair fail and will provide continuous service during major system upgrades and maintenance. In addition, a new and much faster storage device will be installed to address the timeliness deficiencies.

To address the Operations Committee for the IFPS requirement for a 24 x 7, 365 days a year IFPS Service Backup operational availability, a second NetApp is needed to provide backup service in the event of a primary file server failure or scheduled/unscheduled maintenance downtime for the IFPS service backup site files.

The NWS will conduct an OAT of the NDFD CSS reconfigured to include a Redundant NDFD Server Cluster and a Redundant IFPS Service Backup System to ensure these changes do not negatively impact the operations. While the Redundant IFPS Service Backup System is independent of the Redundant NDFD Server Cluster, both are related to the IFPS and both are expected to be ready for OAT at the same time. Therefore, this plan will combine the two projects into a single OAT. In the event one of the systems is not ready in time, the one that is ready will proceed with OAT and the other system will start its OAT when it is ready following this plan.

2. Purpose

The OAT for the Redundant NDFD Server Cluster and the Redundant IFPS Service Backup System will provide NWS management with measurements of system and communication performance and reliability, information about the operational and maintenance impact, and performance over a six-week period. This information will be used by NWS management to determine whether the upgrades to the NDFD CSS and the Redundant IFPS Service Backup System meet the objectives and requirements for these systems.

3. Objectives

The principal objective of the operations OAT is to measure the timeliness and reliability of access to the mosaic products available on the NWSTG File Transfer Protocol (FTP) server.

The following are the explicit objectives of the Redundant NDFD Server Cluster OAT:

1. Verify the NDFD receives and stores WFO grids with adequate timeliness and reliability.

2. Verify the NDFD creates the NDFD mosaic grids and transmits them to the NWSTG FTP server with adequate timeliness and reliability (All mosaic files are stored on the NWSTG FTP server within 15 minutes of the beginning of the mosaic generation process).

3. Verify the NDFD failover processes function correctly with no loss of data.

4. Verify recovery from degraded operations does not interrupt NDFD data.

5. Verify the Advanced Weather Interactive Processing System (AWIPS Network Control Facility (NCF) [or Telecommunication Operating Center (TOC)] is able to detect NDFD failure conditions and respond according to the support required of them (restore operations within one hour of failure).

The following are the explicit objectives of the Redundant IFPS Service Backup System OAT:

1. Verify the Redundant IFPS Service Backup System reliably stores all the sites's service backup files sent with 99.95% availiblity.

2. Verify a failure in the primary IFPS Service Backup System automatically allows the sites to retrieve the needed service backup files from the Redundant IFPS Service Backup System.

4. Background

In response to the ***National Weather Service Strategic Plan for FY2003 - FY 2008*** objective of improving the accessibility and availability of weather information , the NDFD CSS was developed to collect, process, and distribute high-resolution digital forecast data. The NDFD CSS creates mosaics of WFO forecast data elements and transmits them to the NWSTG FTP server where they are available as official user products to the public. These mosaics are also retrieved from the FTP server and processed for display on a NWS web server. Anyone can retrieve the products from the NWSTG FTP server. Only the mosaic products created by the NDFD CSS will be available to the public. The WFO grids upon which the mosaics are based are not distributed outside the NWS. The Mosaic gridded products produced by the NDFD CSS for three elements (temperature maximum and minimum, and probability of precipitation) were declared official December 1, 2004.

In response to the failure of the NDFD CSS to meet the timeliness requirements during the OAT conducted in June-July 2004 (see *National Digital Forecast Database (NDFD Central Server system (CSS Test Report*, June 2004) and to address increased need for speed as sites move to higher resolution grids, a new high speed storage device was added to the system. The long term high availability requirements (99.95%) cannot be meet by a single system. To address this deficiency, a Redundant NDFD Server Cluster is added to the system.

A Netapps appliance stores the IFPS service backup files sent from each WFO to the AWIPS NCF. To address the Operations Committee for the IFPS requirement for a 24 x 7, 365 days a year IFPS Service Backup operational availability, a second NetApp is needed to provide backup service in the event of a primary file server failure or scheduled/unscheduled maintenance downtime for the IFPS service backup site files.

4.1 NDFD CSS System Design

The NDFD CSS receives grids from each WFO. These grids are decoded and stored in a database in the system and are not distributed further. Once per hour, the NDFD runs a program to collect all the current WFO grids and create the mosaic products of ten forecast elements. These mosaic products are the coalesced grids of all the WFO products contained within specified geographical areas. The mosaics are collected into "superheader" collection files, then transmitted to the NWSTG for storage in the FTP server and also sent to an archival system for retention. An application on the NWS HTTP Web Server retrieves the mosaics and creates web pages where they are available for viewing. The current official and experimental products can be found at the following URL: http://www.nws.noaa.gov/forecasts/graphical/. The products stored on the NWSTG FTP server are considered the official user products for WFO forecasts once the individual products are declared operational by WSH.

The NDFD system has three parts:

1. WFO data generation and collection
2. Mosaic product generation
3. Mosaic product dissemination

The following subsections describe the design of the NDFD system. A final subsection describes the concept of operations for the NDFD.

4.1.1 WFO Data Generation and Collection

Grids to the Central Server. Digital forecast information from local IFPS databases will be transmitted to a central server and mosaiced into regional and national grids. The central server will provide "one stop shopping" for external customers; and allow it will allow a "hot link" to WFO servers, as appropriate. The central database storing the geospatially referenced NWSI 10-506 digital forecast information is called the National Digital Forecast Database (NDFD)

The NWS conducted a OAT of the IFPS to meet the Initial Operating Capability (IOC) requirements for that system. The IFPS allows NWS forecasts to be made based on a digital manipulation of forecast data at each NWS WFO. Each WFO creates a series of gridded forecasts as needed but at least once per day and sends them to the NDFD CSS. In addition, each site sends its entire gridded database for the IFPS to the IFPS Service Backup System located in the NCF at WSH each time it is changed.

The NDFD CSS receives the WFO forecast grids in GRIB2 format, decodes them, and stores them into an Informix relational database. A process is kicked off every five minutes from the top of the hour to 45 minutes after to decode the files and store them for processing into the next run of the mosaic generation. The decoder is stopped when the mosaic generation is begun.

4.1.2 Mosaic Product Generation

Hourly processes create and update national mosaics of the WFO grids, generate statistical output, create images and HTML for web pages, and most importantly, encode the mosaics into GRIB2 format and transmits them to the NWSTG for dissemination to the public. A pair of web servers host the internal network web page for NDFD which is visible only to forecasters and other users that have access to the AWIPS network.

At 45 minutes after every hour, the mosaic generation process is started. It first runs the last instance of the decoder process to ensure the latest WFO grids are available for insertion into that hour's mosaics. Tests have shown if a WFO transmits their products by 45 minutes after the hour, they will be decoded in time for that hour's mosaic generation run. The mosaic generation processes take all new data from the WFO database and merge it with the previous run's mosaic data to create the updated mosaics for 10 weather forecast elements. The individual mosaic grids for each element and time period are packaged into 236 "superheader" files. These are stored on the NDFD CSS and sent to the NWSTG for dissemination.

4.1.3 Mosaic Product Dissemination

The NWSTG receives the mosaic superheader files at the pftpgate server and parses them into individual mosaic files in the Weather Data Exchange (WDE) system. A WDE application then writes the mosaic data on the FTP server in folders differentiated by region and data type. Thereafter the mosaics are available for retrieval by anyone who wants them. When the mosaics are stored on the FTP server and made available to the public, it constitutes the public dissemination point. See Figure 1 for a diagram of the transmission path.

The National Climatic Data Center (NCDC) retrieves the mosaic files from the NWSTG and are retained for service records retention requirements. The NWS web servers retrieve the mosaic grid files from the FTP server and use the NDFD CSS software to create interactive images for public use on the NWS Internet pages (http://www.nws.noaa.gov/forecasts/graphical/). Neither of these activities are under test in this OAT.

4.1.3 System Failure and Recovery

The NDFD CSS is designed to continue operations in the event of a system or server failure. This capability is addressed by two architectural features. The first is the dual server configuration comprised of two Dell Poweredge 2650 servers and an Ultrastore RS3160SA 16-bay RAID enclosure. The Dell servers are named ap1 and db1. Under normal operations, the db1 server handles the database functions and ap1 server runs the CSS programs. In the event one or the other of the servers fails or connectivity is lost between them, the surviving server automatically starts the failed server's software and runs the entire CSS function on the single server (i.e., if db1 fails, ap1 runs the packages that were running on db1, and vice versa). Once the failed server is repaired, the system can be restored manually to dual server operations.

The second tier of continuing operations is addressed by the addition of a second set of Dell 2650 servers (named ap2 and db2) and a second Ultrastore RAID. If both servers in the first pair (ap1 and db1) are incapacitated or are taken down for maintenance, the second pair of servers will run the CSS functions. The second pair also have the same failure capacity as the first pair and will automatically run a failed server's software packages in the same manner as described above. The second pair of servers ingests all the WFO data and runs all the NDFD CSS functions concurrently with the first pair, but only one system at a time transmits the mosaics to the NWSTG. Redirecting the output to the NWSTG from the second pair will require manual intervention.

4.2 NDFD CSS Operations Concept

The concept of operations is summarized from the *NWS Digital Services Operations Concept*, April 29, 2004 and revised December 2004 by OS to include specific performance criteria for the NDFD CSS.

4.2.1 Basis for NDFD Operations

"The NWS mission states "NWS data and products form a national information database and infrastructure which can be used by other governmental agencies, the private sector, the public, and the global community." The National Research Council's (NRC) 2003 report *Fair Weather: Effective Partnerships in the Weather and Climate Services* recommended the NWS take steps to improve the effectiveness of the weather and climate enterprise. The report's recommendation #5 states:

> "The NWS should make its data and products available in Internet-accessible digital form. Information held in digital databases should be based on widely recognized standards, formats, and metadata descriptions to ensure that data from different observing platforms, databases, and models can be integrated and used by all interested parties in the weather and climate enterprise."

NWS Digital Services Program. New digital weather forecast information is created and stored at local offices and National Centers for Environmental Prediction (NCEP), and also transmitted and input to a centralized database known as the National Digital Forecast Database (NDFD)."

4.2.2 Operations Philosophy

"The NWS operational philosophy for local Weather Forecast Offices (WFO) (See Appendix A) embraces three basic themes. The first identifies the WFO forecaster as the local expert, decision maker, and information source for hazardous and high-impact events. The second core function is to ensure the information flow with partners and customers is optimized. Third, collaboration maximizes sharing of hydrometeorological expertise and helps produce the most accurate forecasts and warnings. Forecasters at local NWS offices and regional/national centers work together to construct a national digital database of weather information."

4.2.3 Operational Requirements

"Digital forecast information will be derived from the local digital database maintained at each office. National digital forecast information will be derived from the national database. Requirements for the NDFD and derived products include:

1. Database currency will be maintained through coordinated local updates
2. Standard formats of grids and derived graphical products will be used
3. Standard time and space conventions will be followed
4. Grid files will be completely available 99.95% of the time
5. Grid files will be available by one minute after the top of each hour"

In addition, the Operations Concept specifies backup availability and service benefits required from the system. "The NDFD will have multiple points of entry, with backup capabilities in place in case of system or office outages. This will guarantee a full database is available and current 99.95% of the time. Quality assurance checks at multiple levels in the organization will ensure data completeness and reliability. The system architecture will be designed to provide the

commercial sector with direct access to the digital database to support their business processes. Academia's need to access the digital database will also be satisfied. Agency Commitment - All levels of the organization will continually reassess priorities and redirect appropriate resources to support and meet the growing demand for digital services."

The support for the system is specified in the *Integrated Maintenance and Logistics Support Plan for the National Digital Forecast Database Central Server System*, January 29, 2004. The *NDFD Customer Support* Internet page (http://www.nws.noaa.gov/ndfd/customer.htm) refers to the Telecommunications Operations Center (TOC) for questions or problems regarding data access and availability. The *Customer Support*, April, 15, 2004 document for the NDFD CSS specifies the point of contact for customer queries and how the TOC should handle potential queries. The TOC corrects any problems with the FTP server or web access to the NDFD files and contacts the AWIPS NCF for all other questions or problems. The NCF follows the support instructions in the *Network Control Facility Support Procedures* for minor repair attempts and contacts the development team for full assessment and repair after ensuring the failover occurred correctly. Meteorological questions are referred to the appropriate WFO.

Refer to Section 5.1, Assumptions and Limitations for the items in the concept of operations summary that will not be addressed by this OAT. This OAT is limited to the functioning of the NDFD CSS, its product dissemination to the FTP server, and its related communications processes.

4.3 Change Requirement

The AWIPS change requirements governing the installation and operation of the NDFD CSS are:

RC # AA 537 (NDFD: Install Backup NDFD Central Server at NCF and Upgrade Existing System with Ultrastor)
RC # AA 397 (Operations on Prototype System)
RC # AB 098 (Move the CSS to the PX Hardware Platform)

4.4 PAMS Description

The Product Availability and Monitoring System (PAMS) is used to quantify the effectiveness of the AWIPS communication networks in delivering weather-related products from data sources to field sites, as well as from field sites to field sites. Product logs are collected daily from all the AWIPS commissioned sites, the NWSTG, and the NCF, and additional data sources depending on the test and evaluation needs. PAMS processes and evaluates the large volume of products flowing through the AWIPS Satellite Broadcast Network (SBN). PAMS produces several reports daily, analyzing the previous 24-hour period. The PAMS reports provide information about invalid products, missing products, and delayed products. Together, the reports portray the product throughput in both a quantitative and qualitative manner. The PAMS server generates the reports automatically at night so they are available every day. The reports can be combined to produce detailed analyses of the NWS communication system performance.

The following summarizes the data throughput evaluation method:

1. The PAMS will collect the message handler logs from all Conterminous U.S. (CONUS) NWS WFOs and the NDFD receipt. PAMS will collect the logs from the Gribdecoder process within the NDFD. PAMS will compare the receipt of all products sent from the WFOs, received into the NDFD message handler, and decoded and stored into the NDFD WFO Grid database and report how long each step took and the percent successfully received and stored.

2. The PAMS will glean the World Meteorological Organization (WMO) headers from the NDFD mosaic files sent to the NWSTG and compare those with the grids stored in the NWSTG FTP server where they are made available to the public. PAMS will report how long each step took and the percent successfully received and stored.

3. Any disputed PAMS results will be examined by the OAT team. If errors in the PAMS algorithms are found concerning the functional assumptions made about the operation of the NDFD CSS, the PAMS algorithms will be corrected and the reports regenerated from the original log files.

4.5 OAT Materials

AWIPS NDFD CSS hardware and software - The required equipment as described in Section 4.1 - Part I, System Description and Configuration.

AWIPS NDFD CSS OAT Plan - Used to ensure the uniform conduct and completion of the OAT.

AWIPS NDFD CSS System and User Documentation - Completed drafts of the NDFD CSS system and user documentation of sufficient accuracy to support full operations and support of the system and software.

Network Control Facility Support Procedures
Software Design Document
Concept of Operations
NDFD Official Data Retention Plan
NDFD CSS Operations Manual
NDFD Customer Support Operational Requirements Document

Communication logs for PAMS:

(1) the WAN transmission logs at all AWIPS sites that transmit radar products:
X400_Sites_logs from every WFO

(2) the NDFD CSS logs including the message receipt, the Gribdecoder logs, the Mosaic encoder logs:
PAMS_NDFD_Compare_ap1
PAMS_NDFD_Compare_px2
PAMS_NDFD_Encoder_ap1
PAMS_NDFD_Encoder_px2
PAMS_NDFD_GribDecoder_names_ap1
PAMS_NDFD_GribDecoder_names_px1
PAMS_NDFD_GribDecoder_names_px2

PAMS_NDFD_Ingest_ap1
PAMS_NDFD_Ingest_px2
PAMS_NDFD_Msgh_ap1
PAMS_NDFD_Msgh_px1
PAMS_NDFD_Msgh_px2
PAMS_NDFD_Problem_ap1
PAMS_NDFD_Problem_px2

(3) the NWSTG logs including the WDE logs and the FTP server logs:
NWSTG_Transfer
NWSTG_WDE_NDFD_Input

These logs have been collected for many months prior to the beginning of the OAT for baseline comparison.

5.0 OAT Policies

5.1 Assumptions and Limitations

The following are assumptions and limitations for the OAT.

1. Prior to commencement of the OAT, all system testing must be complete and indicate no critical failures.

2. Requested log files from AWIPS, the NWSTG FTP server, and NDFD CSS must be available along with a method for their timely transmission to the OAT team (see Part II, Section 3).

3. Some of the success criteria were derived from existing overall AWIPS performance and availability requirements where explicit performance requirements were not available in the existing *NWS Instruction 10-506*. Some "threshold" criteria were determined by OS1 as the minimum acceptable performance if the written goals could not be met as stated in the *NWS Instruction 10-506.* OS1 has the overall policy and requirements responsibility for the NWS for this system. This OAT uses the same performance success criteria as the first NDFD CSS OAT.

4. It is assumed the WFOs are performing their tasks in generating the NDFD grids correctly and according to the rules dictated by the *NWS Instruction 10-506, Digital Data Products/Services Specification, Section 6.1.3, Base Digital Forecast Data* and related documents outlining the WFO's responsibility for creation and maintenance of the gridded forecasts.
   A. Therefore, the performance of the NDFD CSS system is measured based on the products sent from each WFO.
   B. Any violation of the rules by WFO staff will not affect the conduct or analysis of the readiness of the NDFD CSS portion of the overall *Digital Data Products/Services* system.

C. Other NWS activities are assessing the WFO portion of the product creation and they will be used along with this OAT by NWS management in making the final decision for declaring the entire process operational.

5. Long-term reliability of the system cannot be assured by a six week OAT, but the initial timeliness and reliability indicators will be established.

8. It is considered outside the scope of this OAT to assess the scientific accuracy of the official user product created by the NDFD CSS. This OAT will assess the accuracy and timeliness in receiving and storing the WFO-generated forecast grids and the accuracy in the system of sending and storing the official mosaic forecast products on the NWSTG FTP server for public access. Currently, there is no known method for assuring the NDFD CSS accurately processes all current WFO grids and inserts them into the mosaic products.

5.2 NWSEO and NWS Working Conditions Impact

This OAT will not affect the working conditions of WFO forecasters. Currently, they are required to verify their products reached the NDFD database via an internal web page updated every 5 minutes.

This OAT will not make any judgement on the accuracy or appropriateness of WFO forecaster products. The OAT assumes the WFO is producing their products correctly and accepts the judgement of the WFO forecasters in deciding when updates are appropriate. No individual forecaster's work will be tracked or identified in any OAT data collection.

6. OAT Management

6.1 NWS Roles and Responsibilities

This section describes the roles and responsibilities of the NWS in the oversight and management of the OAT. The Office of Operational Systems (OOS), Field Systems Operations Center (FSOC), Test and Evaluation Branch (TEB) has overall responsibility for the NDFD CSS OAT. Names and phone numbers of individuals are included in Attachment 2, NDFD CSS.

OAT Director - (FSOC, TEB, Mary Buckingham, 301-713-0326 x137) Has overall responsibility for organizing and managing the NWS personnel supporting the OAT. Documents the NWS involvement in the OAT in a formal OAT plan. Manages the day-to-day OAT data collection. Documents the results in the OAT report and provides briefings as required. Chairs the NDFD CSS Test Review Group.

OAT Team - Coordinate OAT activities. Complete modifications of TEB's PAMS required to collect and analyze NDFD CSS data. Operate PAMS during the OAT. Collect and analyze the OAT PAMS data. Provide periodic summary reports to the OAT Director, as required. Support the OAT Director in writing the OAT report.

NDFD Project Engineer - (OST SEC, Franz Zichy, 301-713-1570 x143) Reviews the OAT Plan and Report. Participates in the OAT as a NDFD CSS technical resource. The OST SEC has overall engineering responsibility for the NDFD project. This includes the development of the target hardware architecture for the NDFD, by the Analysis Branch and assurance the support, logistics, and maintenance for the system is prepared.

NDFD CSS Program Management - (OST MDL, Dave Ruth, 301-713- x) Reviews drafts of the NDFD CSS OAT plan and final report. Participates in the OAT as an NDFD CSS technical resource.

6.2 NDFD CSS Test Review Group

The NDFD CSS OAT Test Review Group (TRG) will be chaired by the OAT Director and comprised of the NDFD CSS Project Engineer, Program Manager and representatives of the Office of Climate, Water, and Weather Services (OS), the OST and the Office of the Chief Information Officer (CIO). Members of the group are identified in Table 1.

This group will review the OAT activities and problems and discuss them during weekly meetings. They will determine classification of all identified problems and notify the NDFD CSS Program Manager of requirements to develop correction plans.

Table 1. NDFD CSS Test Review Group

Mary Buckingham	OAT Director	OPS24	TRG Chair
Franz Zichy	Project Engineer	OST31	
Andy Horvitz	Service Oversight	OS2	
Allen Darling	TOC Operations	CIO13	
Lee Anderson	IFPS Program Oversight	OST11	
Dave Ruth	Development Manager	OST21	

6.3 Problem Categories

The documented problems will be categorized as:

- **Critical** - does not meet the OAT success criteria (Part II, Section 2.3) and there is no acceptable workaround.
- **Major** - does not meet the OAT success criteria (Part II, Section 2.3) but an acceptable workaround exists.
- **Minor** - meets the OAT success criteria, but the OAT TRG judges the problem sufficient to require future repair.
- **Future Enhancement** - Not required for meeting the OAT success criteria but needed for future data needs or will enhance the usability and efficiency of the system.

- **Watch Item** - item requiring further observation.

The TRG will meet after the OAT to discuss and summarize the OAT findings and make a recommendation whether the NDFD CSS should be recommended for full operations or any actions necessary to meet the criteria for full operations.

PART II: OAT Methodology

1. Introduction

The primary objective of the OAT is to measure the *timeliness* and *reliability* of the NDFD CSS and the communication path in disseminating its products and ensure the backup systems perform reliably. The final dissemination point is access of the mosaic products on the NWSTG File Transfer Protocol (FTP) server. Measurements will be made for each portion of the process of gathering the input forecast products and generating the official user products and disseminating them to the NWSTG FTP server as described in Part I, Section 4.1. Analysis of the measurements will yield summary information for use by NWS management in deciding whether to certify the NDFD CSS meets NWS operational requirements.

2. Approach and Success Criteria

The approach for testing the NDFD CSS will consist of measurement and statistical analysis of how reliably and how timely the NDFD CSS meets the test objectives (Part 1, Section 3). In addition, failure scenarios will be tested to ensure the system performs reliably when encountering likely problems.

The following sections describe the approach taken in obtaining and analyzing measurements of timeliness and reliability.

2.1 Approach

Timeliness and reliability measurements will be analyzed to yield the following summary information:

- The percentage of all WFO NDFD grib2 files transmitted by all CONUS WFOs and successfully stored in the NDFD WFO grid database. The percentage of all NDFD mosaic "superheader" files successfully created on the NDFD CSS and stored on the NWSTG FTP server (dissemination point).
    - The average delivery time along with appropriate standard of deviation statistics;
    - Maximum and minimum delivery time where applicable;
    - Appropriate trend information, as required.

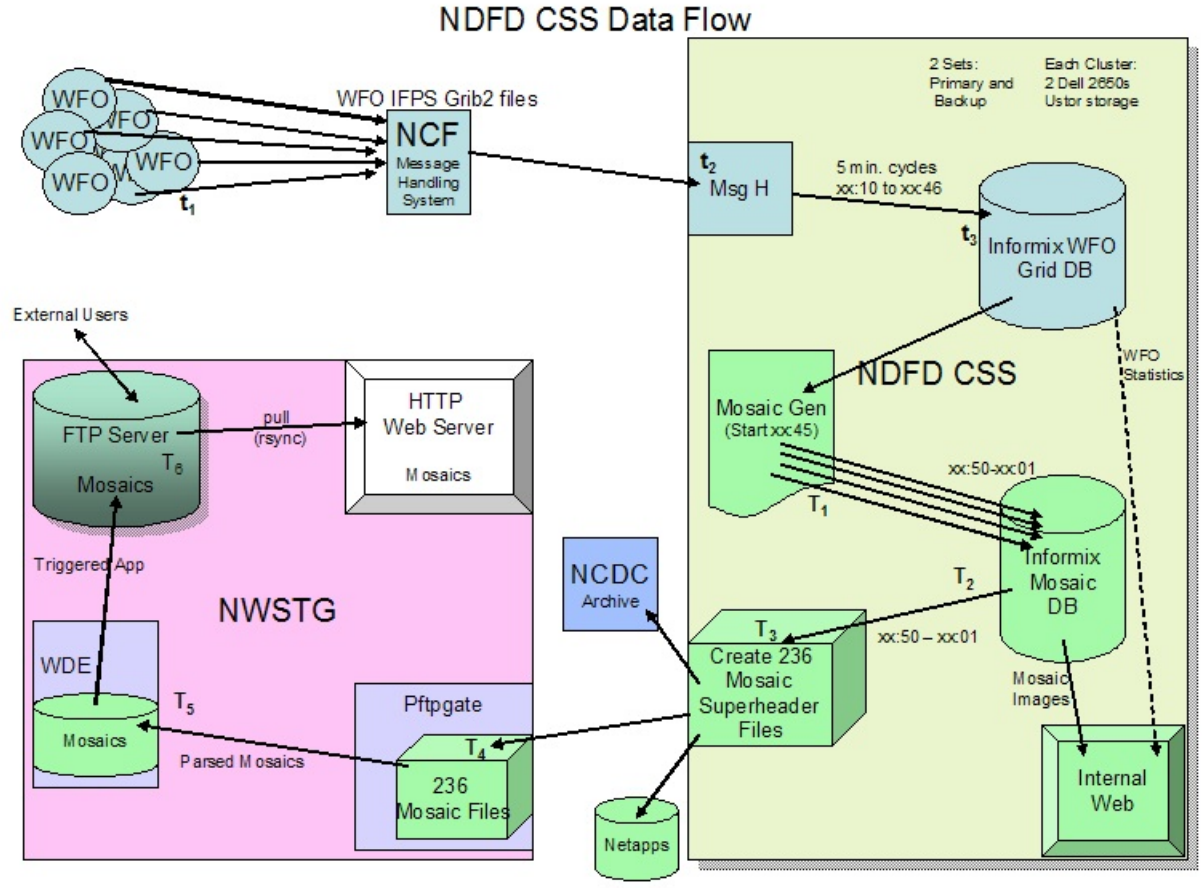
Where appropriate, the above items will also be derived from a combined analysis of all measurements.

Failures of the primary servers will be induced to test the reliability of the backup systems to perform the functions without data loss. The timeliness and reliability measurements will

include induced failure conditions which the system is required to automatically recover or run in its various backup configurations.

2.1.1 Timeliness

Timeliness and reliability will be measured and reported for a 6-week period, 24 hours per day, 7 days per week. Figure 1, NDFD CSS Data Flow, shows the points where log files of the radar products can be acquired and the transmission time calculated. The t_x and T_x notations indicate the points where these log files will be acquired. Lowercase t_x indicates the data stream for the collection of WFO input grids. Uppercase T_x indicates the data flow for the creation and dissemination of the NDFD mosaic products. Table 1 defines the points on the diagram.



NDFD CSS Communication and Data Paths

Table 2. Data Collection Points Identified in Figure 1	
Log Point	Data Collection Points Identified in Figure 2
t_1	Time NDFD WFO Grib2 Products Leave the WFO (x.400 log)
t_2	Time NDFD WFO Grib2 Products arrive at the NDFD CSS Message Handler

t_3	Time NDFD WFO Grib2 Products are decoded and stored into the WFO Grid database.
T_1	Time Mosaic generator starts (clock time at x:45).
T_2	Time Mosaic generator begins to create mosaic grids and transmit files open.
T_3	Time Mosaic transmit files close and are sent to the NWSTG pftpgate.
T_4	Time Mosaic grid transmit files arrive at the NWSTG pftpgate.
T_5	Time Mosaic grids arrive in the NWSTG WDE.
T_6	Time Mosaic grids are stored on the NWSTG FTP server.

2.1.2 Reliability

Reliability will be measured and reported for a 6-week period, 24 hours per day, 7 days per week.

For the WFO gridded forecast acquisition, reliability will be measured by comparing the number of products transmitted by all WFOs to the NDFD CSS with the number of products successfully stored by the NDFD CSS.

For the mosaic generation, reliability will be measured by comparing the number of products created by NDFD CSS each hour with the number of products received by the NWSTG's FTP server.

For the Redundant IFPS Service Backup System, reliability will be measured by comparing the number of products sent from the WFOs to those received by both primary and Redundant IFPS Service Backup System each hour. Timeliness data will also be calculated for information.

2.2 Success Criteria

The success or failure of this OAT will be based exclusively on the analyses of data collected during the OAT and analyzed in accordance with the methodology specified in this plan.

For this OAT to be successful, the following criteria must be met:

1. WFO Grib2 File Transmission

1. 99.95% of WFO Grib2 files are received and stored into the NDFD CSS data base.
2. Grids arrive in time for the hourly mosaic generation. From x-1:46 to x:45, 99.95% WFO grids incorporated into the x hour mosaics.
3. WFO grids are updated as events require (WFO responsibility) and at least 1 time per day by 18Z (verification is beyond the scope of this OAT).

2. Mosaic Official User Products

1. 99.95% of available WFO Grib files are inserted into the appropriate NDFD mosaic products and available on the NWSTG FTP Server once per hour by xx:01 each hour (unless no WFO sent an update).

2. Mosaic software uses most recent WFO data. The seventh day's forecast must change at 18Z within any 24 hour period. The mosaic products are fully generated (236 superheader files) for each hour for which at least one WFO transmitted new data.

2. Redundant IFPS Service Backup System

1. 99.95% availability of WFO service backup files returned to WFOs upon request.

3. Methodology

NWS measurements of NDFD CSS timeliness and reliability will be made for a period of 44 consecutive days, 24 hours per day, 7 days per week. In addition, various failure scenarios will be tested to ensure the system can recover correctly without loss of data.

3.1 PAMS Monitoring and Analysis

The PAMS will collect appropriate NDFD product data for 6 weeks, 24 hours per day, 7 days per week from:

(1) the WAN transmission logs at all AWIPS sites that transmit radar products:
X400_Sites_logs from every WFO

(2) the NDFD CSS logs including the message receipt, the Gribdecoder logs, the Mosaic encoder logs:
PAMS_NDFD_Compare_ap1
PAMS_NDFD_Compare_px2
PAMS_NDFD_Encoder_ap1
PAMS_NDFD_Encoder_px2
PAMS_NDFD_GribDecoder_names_ap1
PAMS_NDFD_GribDecoder_names_px1
PAMS_NDFD_GribDecoder_names_px2
PAMS_NDFD_Ingest_ap1
PAMS_NDFD_Ingest_px2
PAMS_NDFD_Msgh_ap1
PAMS_NDFD_Msgh_px1
PAMS_NDFD_Msgh_px2
PAMS_NDFD_Problem_ap1
PAMS_NDFD_Problem_px2

(3) the NWSTG logs including the WDE logs and the FTP server logs:
NWSTG_Transfer
NWSTG_WDE_NDFD_Input

The test team will analyze data collected by the PAMS to determine the reliability and timeliness of the NDFD data collection, product generation, and transmission to the FTP server. The analysis will give the averages for the entire 30-day monitoring period.

3.1 System Stability

During the OAT, the system will be tested in various failure scenarios. The test procedures will induce various failures:

1. Induce system failure:
    - Simulate database failure
    - Induce NDFD primary server failure and test the ability of the system to automatically perform failover and continue processing the data
    - Induce LAN connection failure (verify old data are not used for new mosaics)
    - Simulate heartbeat LAN failure
    - Simulate full failure of both servers in the primary rack and the capability of the Redundant NDFD Server Cluster to perform the full function.
2. Verify recovery from degraded operations does not interrupt NDFD data.
    - Procedure to recover
    - PAMS used to verify data
3. Verify the NCF (or TOC) is able to detect NDFD failure conditions and respond according to the support required of them (see *Customer Support* document for the NDFD CSS).
    - Verify during failure scenarios and failover procedures
    - The CSS must be operational and processing data within an hour. Verify degraded operations meets the availability. When backup system is in place, verify transferring operations to backup system meets the availability.
4. Verify the backup configurations run successfully for periods of time commensurate to realistic failure scenarios.
    - Single server operations for at least 3 days to cover a long weekend failure scenario.
    - Operations on backup system for 1 week.

3.1 Redundant IFPS Service Backup System

Verify the Redundant IFPS Service Backup System receives and retains 99.95% of the WFO service backup files sent from each WFO and return them to requesting WFOs. Test procedures will:

1. Verify the IFPS service backup files are received on both the primary and Redundant IFPS Service Backup Systems.
    - Use PAMS to analyze the file is saved reliably
    - Verify the reliability and timeliness of the service backup file transmissions and storage.
2. Induce a failure of the primary IFPS Service Backup System and verify WFOs can reliably retrieve needed service backup files from the backup system. Verify the restoration of the primary IFPS Service Backup System does not interrupt either retrieval or storage of the service backup files.
    - Use PAMS to analyze the file is saved and retrieved reliably
    - Verify the reliability and timeliness of the service backup file transmissions and storage.
    - The timing of the induced failure will coincide with specific WFO schedules for service backup due to installation of another AWIPS upgrade.

PART III: OAT Reporting

1. Introduction

This section describes how the OAT data analyses and reporting will be accomplished.

2. Reports

The test team will immediately bring NDFD CSS performance problems to the attention of the OAT Director and the NDFD CSS Project Engineer. The OAT Director will coordinate all problems for resolution immediately by e-mail with the NDFD CSS TRG (See Part I, Section 6.1.1) to document the issues and the impacts on NDFD CSS users. Any problems deemed critical will constitute a failure. A preliminary report will be issued by e-mail to the program manager within two weeks of the end of the data collection period.

The OAT Team will provide the OAT Director and NDFD CSS Project Engineer with periodic summary status reports. The NDFD CSS OAT report containing OAT details will be coordinated and distributed within 60 days after the end of the OAT.

3. Data Analysis

TEB OAT staff will collect and analyze data as described in PART II, Section 3: Methodology. Data analyses will be accomplished at WSH. The analyses will be used to support summary information about the timeliness and reliability of NDFD CSS performance.

4. Briefings

Briefings will be provided to NWS management if requested.