12B.1 THE APPLICATION OF THE NWS OT&E PROCESS TO THE HCN-M

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1. INTRODUCTION

The United States Historical Climatology Network-Modernization (HCN-M) is slated for deployment in support of the National Oceanic and Atmospheric Administration's (NOAA's) mission to provide climate reference data suitable for evaluation of regional climate variability and long-term climate trends. It is envisioned the HCN-M will be jointly managed by the National Weather Service (NWS) and the National Environmental Satellite, Data, and Information Service (NESDIS), with NWS having primary responsibility for operations and management and NESDIS having primary responsibility for data quality and dissemination and for maintenance of historical records. When fully implemented, the system will include approximately 1000 automated surface observing stations.

One project milestone is bringing the system from development to operations. In this paper, we examine the procedures documented in NDS 30-3 *Operational Test and Evaluation* and NWSI 30-302 *Operational Test and Evaluation Process* as a means to systematically qualify the proposed HCN-M and document the readiness of the system for national deployment. OT&E activities may be coordinated with a formal system commissioning, as documented in NDS 80-2 *System Commissioning and Decommissioning* and NWSI 80-201 *System Commissioning Process*, or completed as an independent activity.

2. BACKGROUND

The HCN-M was proposed to modernize and sustain the Historical Climate Network, which is a sub-network of the Cooperative Observer Network (COOP) comprised of stations having a continuous record of over 60 years of climate data. The COOP was developed to provide meteorological observations and a historical record of climate data. The COOP program is managed by the NWS and staffed primarily by citizen volunteers. The program has long been recognized as a valuable resource for climate study (National Research Council 1998). However, the technology supporting COOP is approaching obsolescence: The equipment is difficult to maintain and the number of volunteer observers is decreasing at a rate of 2% to 5% per year. These factors threaten the quality of the data and the long-term continuity of the observational record and motivate the need for the HCN-M.

The goals of the HCN-M follow: 1) Enable continued monitoring and assessment of national and regional climate variability; 2) Sustain the historical climate record; 3) Provide climate observational data, and station and equipment metadata; 4) Improve data quality; 5) Distribute data to customers for current and future use; 6) Provide a flexible and expandable architecture to integrate with NOAA's Global Earth Observing Integrated Data Environment (GEO-IDE); and 7) Optimize as well as modernize the HCN.

The proposed baseline HCN-M stations will include a temperature gauge, a precipitation gauge, and a control and communications component. The HCN-M station will incorporate maintenance records. The site will provide an interface to allow manual entry of supplemental data, and manual down loading of observational data in the case of a prolonged communications outage. The HCN-M station specifications are fully elaborated in the Level 1 Requirements Document.

HCN-M is being completed under supervision of the NWS Operations and Services Improvement Process, as OSIP project 07-005, with the NWS Office of Science and Technology leading the system development effort.

This paper summarizes the ongoing planning activities of the HCN-M Operations and Maintenance Integrated Work Team for the system Operational Test and Evaluation (OT&E) and for commissioning. The draft HCN-M Commissioning Operational Test and Evaluation Plan and the

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HCN-M Commissioning Plan are currently under review.

3. OT&E

OT&E is an independent evaluation of the HCN-M conducted by the NWS, Office of Operational Systems, Field Systems Operational Center, Test and Evaluation Branch (OPS24) to demonstrate the Commissioning Evaluation Criteria (CEC) documented in the HCN-M Commissioning Plan are fully satisfied and the system is ready for national deployment. The OT&E will evaluate the full functionality, stability, and operability of the HCN-M in an operational environment.

The conduct of the OT&E will be overseen by a Test Review Group (TRG) comprised of personnel from NWS National Headquarters, an NWS Employee Organization (NWSEO) representative, a National Climate Data Center (NCDC) focal point, representatives from the Regional Climate Centers and NWS Regional Headquarters, and OT&E site focal points. The OT&E is designed to provide a user perspective on the readiness of the system for deployment.

The OT&E will begin with a Test Readiness Review to confirm all prerequisites for the OT&E have been properly satisfied. Prior to entering OT&E, the HCN-M must be shown to be technically mature, as demonstrated by successful completion of a Developmental Test and Evaluation or other equivalent method; the administrative infrastructure required to implement system configuration management must be fully established; all supporting documentation must be available in draft form; and NWS and contract staff members participating in the OT&E must be trained. The Test Readiness Review is attended by the members of the TRG, hardware and software developers, and other subject matter experts as required to fully assess the readiness of the HCN-M. The OT&E Director provides a checklist of the prerequisites for the OT&E and coordinates presentations by the subject matter experts required to fully establishing the status of HCN-M. The decision to proceed to OT&E is based on the recommendations of the voting members of the TRG.

The OT&E includes field tests of operational HCN-M stations. Field tests will include a period of not less than 90 days of continuous operations at each site to demonstrate the stability and reliability of the proposed HCN-M stations and the communications networks required to transport HCN-M data. The policies implemented for quality control and quality assurance and for the dissemination of products must also be successfully demonstrated during field tests. The Quality Assurance/Quality Control function of the HCN-M has two primary objectives: 1) to ensure data are complete and accurate before archiving; and 2) to monitor HCN-M sites in support of operations and maintenance functions.

The TRG will review the test results, including the status of all trouble reports, upon the completion of the OT&E, and will recommend to the HCN-M Commissioning Manager whether the HCN-M is ready for national deployment. An OT&E report will be prepared to document the results of testing.

4. COMMISSIONING

System commissioning is the process of applying technical and administrative judgment to determine if the system can be used in support of NWS operations. Commissioning is a significant milestone in the life of a system marking the transition from development to operations. Although consensus regarding the strategy for commissioning the HCN-M into service has not been reached to date, one scenario employs the guidelines provided in NWSPD 80-2, *System Commissioning and Decommissioning*, and NWSI 80-201, *System Commissioning Process*, to demonstrate critical systems engineering criteria have been realized. These methods are well established and were successfully applied, for example, to commission the Advanced Weather Interactive Processing System (AWIPS) into service (Facundo 2000 and Facundo 2001).

4.1 *Commissioning OT&E*

A Commissioning OT&E is coordinated with other commissioning activities to ensure the Commissioning Evaluation Criteria (CEC) are satisfied prior to commissioning the system into NWS operations. The Commissioning Evaluation Criteria established in the *HCN-M Site Component Commissioning Checklist* of the *Site Component Commissioning Plan* elaborate the conditions required for successful demonstration of each system requirement. The general areas evaluated during commissioning are shown schematically in Figure 1. A brief description of the activities conducted to demonstrate each area follows.

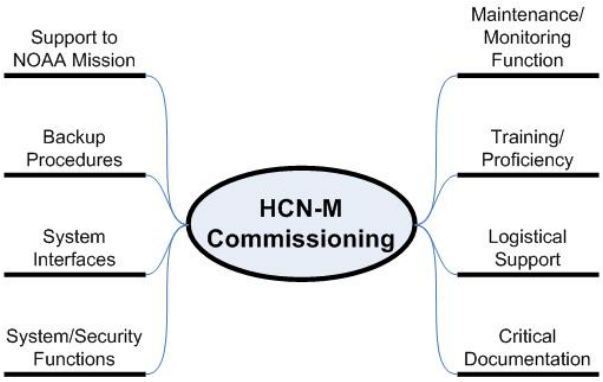

Figure 1. Commissioning OT&E scope.

Support to NOAA Mission The HCN-M must demonstrate the ability to reliably produce quality climate observations prior to national deployment. This objective is best verified through a limited deployment of the HCN-M to select operational sites. The system will first be installed and then closely monitored for a predetermined period to ensure stable and reliable operation. These routine observations may be supplemented with test case procedures designed to exercise specific maintenance procedures and to simulate conditions seldom observed in the field. Ideally, the sites selected for OT&E should expose the HCN-M to the full range of expected climate conditions.

Training/Proficiency This objective requires staff members from affected field offices to be trained to operate and administer the HCN-M. Staff must be proficient in the use of the HCN-M in the performance of their duties. Staff members may receive training through courses offered by the NWS Training Center or training may be performed onsite. A test or checklist may be employed to verify proficiency.

Maintenance and Monitoring Function Maintenance and monitoring capabilities must be functional before the HCN-M can be commissioned. This requirement includes system hardware, software, and the telecommunications network. Maintenance documentation, diagnostic techniques, etc., must be in place and functional at commissioning. OT&E sites will verify the required maintenance functions during the proposed field evaluation.

Critical Documentation Critical documentation includes: user manuals, system administration manuals, technical documentation for local applications development, operations and maintenance manuals, and NWS Directives and Instructions impacted by the introduction of the HCN-M. These documents must be reviewed and updated as required prior to deployment.

Communications System interfaces with HCN-M must be demonstrated to be reliable. Additionally, any reconfiguration of NWS communication networks required to support HCN-M must to be validated during the commissioning process. Performance metrics for product reliability and latency acquired using the Product Availability Monitoring System (PAMS) (Nguyen and Facundo 2000 and Nguyen and Facundo 2001) will be obtained during the field evaluation to verify compliance with system specifications.

Logistics Logistical support for onsite and depot spares and requisite reconditioning and repair activities must be in place before the HCN-M is commissioned. Likewise, if HCN-M support is outsourced, in whole or in part, support contracts must be awarded and in full effect prior to commissioning.

Security This category includes system functions to ensure the integrity of the HCN-M sites, climate data, and the system as a whole. The activities required to demonstrate system security include validating local site conditions; evaluating the methods for archiving and backing up climate data; validating product routing through the NWS telecommunications networks; and ensuring the HCN-M is secure from unauthorized access in accordance with NOAA policies. The HCN-M would likely require Information Technology Certification and Accreditation, which is under the prevue of the Office of the Chief Information Officer and outside the scope of OT&E activities.

Backup Procedures This category includes both system and service components. Since the HCN-M is not intended to provide real-time observational data procedures for service backup are not required, however, the ability to store and recover data in the event of a temporary outage must be demonstrated.

5. DISCUSSION

The process described above contemplates the scenario in which OT&E activities are coordinated with a formal system commissioning, indeed this is the course of action we advocate. However, there are compelling arguments for applying a less rigorous standard: The HCN-M is not in-

tended to provide real-time observations to forecasters, thus the conditions imposed by a formal commissioning on timely delivery of observational data and system reliability may be relaxed somewhat. Since the resources devoted to a task should be commensurate with the requirements, there may be sound administrative reasons for implementing an abbreviated evaluation of the HCN-M during system commissioning.

As indicated, development of the HCN-M is being overseen by OSIP. OSIP is relatively new administrative structure: The implementing NWS Instruction 10-103 was issued in June of 2007. No major system has been commissioned into NWS service under OSIP. Although, in principle, there is no conflict between OSIP and the NWS guidelines for system commissioning, in practice these two activities have never been integrated.

6. CONCLUSION

The HCN-M Commissioning OT&E Plan and the HCN-M Commissioning Plan are currently in draft form and are under internal review. We maintain these plans propose reasonable methods for demonstrating the readiness of the HCN-M for national deployment.

7. ACKNOWLEDGEMENTS

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The views expressed are those of the authors and do not necessarily represent those of the National Oceanic and Atmospheric Administration.

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