

SUBJECT: WSC VHF-1 Upgrade ORR Minutes

DATE: May 30, 2012

PLACE: Goddard Space Flight Center, B12 / Room N112

TIME CONVENED: 1400

TIME ADJOURNED: 1500

ATTENDANCE

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INTRODUCTION

Mr. Jim Bangerter convened the May 30, 2012, White Sands Complex (WSC) Very High Frequency (VHF)-1 Upgrade Operational Readiness Review (ORR) to review the operational readiness of the WSC VHF-1 upgrade to support Human Spaceflight (HSF) missions (refer to the presentation, *White Sands Complex [WSC] Very High Frequency [VHF]-1 Upgrade Operational Readiness Review [ORR]*).

MEETING ITEMS

A. Welcome/Introduction

1. Ms. Melissa Blizzard reviewed the agenda for the ORR.
2. Mr. Bangerter reviewed the ORR board membership.
 - Ms. Carolyn P. Dent, GSFC/Code 301, Systems Review Office.
 - Mr. Scott A. Greatorex, GSFC/Code 450.1, Chief, Networks Integration Management Office (NIMO) (not in attendance).
 - Mr. John J. Hudiburg, GSFC, Code 599, 450 Senior Technical Authority (Ms. Maria Lecha signing for)
 - Mr. Joseph M. Aquino, JSC/DD13, Manager, Space Communications Integration Office (SCIO).
 - Mr. Marco M. Midon, GSFC/Code 453, Ground Network Project.
 - Mr. Donald W. Shinnors, GSFC/Code 452, Space Network Project.
 - Mr. Michael E. Yettaw, DFRC, Range Technical Monitor, Western Aeronautical Test Range (WATR) (Mr. Russell James signing for).
 - Mr. Jeffrey F. Volosin, GSFC, Code 450.0, Deputy Associate Director for Exploration and Space Communications (ESC).
 - Mr. James A. Bangerter, GSFC/Code 450.1, Human Spaceflight Network Director.

B. History. Ms. Blizzard provided a brief history of the WSC VHF systems.

1. June 1997. VHF-1 station installed at WSC to augment Russian MIR communication coverage. Icom receivers were modified to support 143.625 MHz (not supported by Icom).
2. December 1997. VHF-2 was added to support Soyuz. Two single yagi antennas were added to the VHF-1 quad yagi structure (one was not connected).
3. December 2000. The VHF-1 tower was reconfigured to support dual quad yagi VHF-2 antennas. The single yagi VHF-2 antenna did not provide sufficient link margin to communicate with the Soyuz.
4. September 2001. VHF system was reconfigured to a quad yagi antenna center configuration with a single yagi antenna on each side. VHF-2 transmit was upgraded from 150 watt Power Amplifier (PA) to a 350 watt PA.
5. April 2004. Noise problems were experienced throughout the network. Receivers and transmitter were upgraded to Government Furnished Equipment (GFE) Modular Receiver/Transmitters (MRT).
6. April 2004. Emergency Communications Verification supports at WSC continued to be intermittently noisy. Testing identified a high ground-noise environment. The Spacecraft (S/C) link margin was not met below 20 degrees. The requirements were changed to restrict the scheduling of WSC VHF-1 Emergency Voice Verification supports to passes with a minimum of 20 degrees elevation.

7. 2010 Problems. In 2010 Johnson Space Center (JSC) started reporting problems during supports. There was excessive static and noise. Ms. Blizzard reviewed a table of various supports and the JSC audio quality.
- C. Fault Isolation
1. On 10/15/10 the WSC VHF system status was changed to yellow pending an investigation into the cause of the noisy downlink.
 2. The “B” equipment string was made prime in an attempt to isolate the problem.
 3. The “B” equipment string was a little less noisy than the “A” equipment string, but problems continued on both strings.
 4. New filters were installed but did not alleviate the problems. A new PA was ordered.
- D. System Evaluation. Goddard Space Flight Center (GSFC) Engineers performed an on-site evaluation of the WSC system and several recommendations were made that included:
1. Separate the VHF-1 and VHF-2 systems.
 2. Provide remote system equipment indications (output power and receiver signal strength) to the operations floor (this was implemented in February 2012).
 3. Install a camera and monitor to allow the Operator to observe antenna movement during a support. This will be implemented via Engineering Change (EC)-TO011-02.
- E. System Enhancements. Some changes were made prior to separating the antennas. Changes included installing a new PA in the VHF-1 system, installing directional couplers, relocating the transmit and receive equipment in the racks, and re-cabling the Radio Frequency (RF) equipment in the racks. The cables were replaced with cables specified for VHF support. The re-cabling provided significant improvement. Pre-amps were installed during the system upgrade.
- F. Procurement. A Statement of Work (SOW) was prepared and Request for Proposals (RFP) were initiated. It was unexpected that there was no response from RJ Communications and no bid from Tower and Communications. The decision was made to order the materials from M² and modify the SOW to reflect procurement of installation services only. M² would provide the complete VHF antenna and hardware and Advance Tower Services would erect the tower and install the antenna. Some delays in starting the actual work were experienced.
- G. Installation. Assembly of the tower and antenna was completed in January 2012. Minor issues were experienced during the process: bolt epoxy issues, T-brace spacing problems, components missing from shipments, azimuth drive fuse issues. The VHF-1 equipment was moved to the Extended Tracking and Data Relay Satellite (TDRS) Ground Terminal (ETGT). The White Sands Ground Terminal (WSGT) Ground Communications Electronic (GCE) room racks were modified. Upgraded downlink pre-amps were installed. The interface to the Mission Operations Voice Enhancement (MOVE) system was improved. A cleaner installation was achieved (e.g., neater cabling) (refer to the photos on pages 16 and 17).
- H. VHF-1 Upgrade Components. Ms. Blizzard reviewed a list of components used in the upgrade.
- I. Antenna Components. Ms. Blizzard provided a diagram of the mast and yagi antenna assembly and a list of its components. This is a 14-element antenna.
- J. System Testing. Local testing was completed in January 2012. VHF-1 system testing was completed in February 2012. The antenna was turned Yellow on March 2, 2012.

Further testing was put on hold due to an expired VHF-1 frequency license. Mr. Bangerter stated that the license has been renewed through 2017. System acceptance testing was completed on March 8, 2012. The High Power Amplifier (HPA) power output was low. The HPA can still support the ISS. Mr. Jeff Volosin asked if this was an indication of upcoming failure. Mr. Cliff Baxter responded that the HPAs are old and the Space Network (SN) is not aware of this being an indicator of failure. Mr. Bangerter stated that this is not seen as a trend.

- K. Elevation Positioner Failure and Repair. There was a failure of the elevation positioner and it was found that the up/down elevation limit switches were wired backwards. Mr. J. R. Hendrickson asked if the switches should have been open. Mr. Baxter stated that the up limit was wired to the down port and vice versa; this is being referred to as 'wired backwards'. Ms. Maria Lecha asked if this occurred during the first testing. Mr. Baxter stated that the problem was noticed in early testing. Mr. Ken Clark stated that the antenna was not driven far enough. It was also found that the elevation positioner assembly had been damaged. The vendor was called back to make repairs. A replacement elevation positioner has been received and placed in stock.
- L. System Re-test. Acceptance testing was conducted in May 2012. All tests were successfully completed. There was no radiation testing. HPA-1 failed. It was replaced with a spare. The spare operates below the specification, but is usable.
- M. Discrepancy Reports (DR). Ms. Blizzard reviewed the open DRs. DR 260573 is on HPA-2. The listed closure date is June 1. It was stated that this date should be changed as the issue will not be resolved by June. DR 260578 is on the elevation limit switch and drive problem. This has been resolved and the DR is CLOSED. Ms. Lecha asked if the HPA-1 failure is in the DR table. Mr. Larry Moore stated that it is not, the current DR is updated and there is a Maximo work order. There is a DR for system 1 and a DR for system 2. DR 260698 is used for the HPA-1 failure. The table will be updated. Ms. Dent asked what is required to close DR 260573. Mr. Baxter stated that an HPA that meets specifications is needed. Mr. Volosin asked if the lower power level closes the link and the answer was that it does.
- N. Maintenance. Mechanical Preventive Maintenance (PM) will be performed semi annually per manufacturer specifications. WSC hardware maintenance personnel will perform quarterly PMs. Station Readiness Tests (SRT) will be conducted per the TDRS System (TDRSS) Network Operations Support Plan (TNOSP). The TNOSP needs to be updated.
- O. Spares. All spare parts are on hand. It was noted that the VHF Major Component Spares List should be updated to reflect 0 HPA spares at this time. The spare unit is at the vendor for repair.
- P. Documentation. Ms. Blizzard stated that the TNOSP is being updated. The Maintenance & Operations Manual will require time to update (no date has been set). Local Operating Procedures (LOP) will be updated by the end of July. Mr. Hendrickson asked if the Skills Catalogs will have to be updated. Mr. Moore stated that they will not be updated at this time; only when there is a change in the location of hardware. Mr. Bangerter stated that the catalogs should be updated after the installation of the cameras. Mr. Baxter stated that remote keying and switching details are needed for the LOPs. Mr. Bangerter stated that the LOPs will need to be updated; the VHF-1 system will operate differently than before. Mr. Baxter stated that there are Alert Notices out now for operations.

Ms. Dent asked if the personnel are trained. Mr. Baxter stated that all the crews are trained.

- Q. Requirements Test Matrix. It is not possible to exercise the uplink so the system remains Yellow. VHF-2 is supporting Soyuz. Tracking requirements only apply to VHF-1.
- R. Remaining Work. Ms. Blizzard reviewed the remaining work. Work includes repairing the HPAs with low output, establish the ability to separately record the uplink and downlink audio on MOVE, install the camera, perform RF pattern testing, perform the masking and noise survey; and publish updated procedures. Mr. Baxter stated that the origin of the 250-Watt plus/minus 50 Watts number in the test procedure is unknown. Is the 250 Watt number legitimate? Mr. Scott Greatorax stated that an RF Interface Control Document (ICD) may be needed. Mr. Jim Bangerter accepted an action item to contact Mr. Frank Stocklin to work the development of a VHF-1 RF ICD (action item 053012-VHF1 ORR-01). Ms. Blizzard stated that the only low-power HPA being repaired is the one that failed; the others will be used as is. The EC to install the cameras and the remote switching is scheduled to be complete by the end of August. Design is complete and fabrication is in process. An EC is in work to clean up and document the equipment in the VHF-2 area. It was stated that the survey can be done now that the new license is in place. Ms. Blizzard stated that there is a resource issue. Mr. Bangerter stated that the surveys are important and priorities should be reviewed. Mr. Cliff Baxter accepted an action item to re-arrange the WSC work schedule priorities to elevate the WSC masking and noise survey tasks (action item 053012-VHF1 ORR-02). (Editor's Note: Mr. Baxter provided the following response: Work schedule has been re-arranged and preparations are underway to perform these tests.)
- S. Risks. Ms. Blizzard stated that there are no risks at this time.
- T. Summary. The Flight Dynamics Facility (FDF) database has been updated. The WSC VHF-1 system has been upgraded and thoroughly tested. The system is currently Yellow and will be turned Green upon completion of a successful ISS certification pass. The VHF-1 license has been renewed. All personnel have been trained. Mr. Bangerter stated that the pass should be an Engineering pass and not an Emergency Comm Pass; this is a system checkout pass only. He stated that a script will be needed. Ms. Blizzard stated that Mr. Pifer will work the script with a JSC Ground Controller (GC). Mr. Volosin asked if the ISS has a requirement on the number of passes needed. Mr. Bangerter stated that ISS does not. The ISS Program (ISSP) is good as long as the communications is good. Mr. Volosin stated that there does not seem to be a 'smoking gun' and the cabling did provide significant improvement. He asked if there is any previous data to help evaluate the problems. Mr. Baxter replied that there is no data. It was suggested that the network collect data over the next year. Mr. Cliff Baxter accepted an action item to, over the next year, make a record of VHF Emergency Comm passes data to verify the full VHF-1 capability (action item 053012-VHF1 ORR-03).

BOARD COMMENTS

Ms. Dent polled the Review Board for their comments. All the board members stated that the VHF-1 system is ready to support HSF missions pending closure of the action items and a successful ISS pass.

ACTION ITEM REVIEW

Three action items were assigned at the May 30, 2012, WSC VHF-1 Upgrade ORR.

AI No.	Assignee	Action	Due Date	Status
053012-VHF1 ORR-01	Jim Bangerter/ GSFC/NASA/ HSF ND	Contact Mr. Frank Stocklin to work the development of a VHF-1 RF ICD.	06/15/12	Open
053012-VHF1 ORR-02	Cliff Baxter/ WSC	Re-arrange the WSC work schedule priorities to elevate the WSC masking and noise survey tasks.	06/10/12	Closed
		Response: Work schedule has been re-arranged and preparations are underway to perform these tests.		
053012-VHF1 ORR-03	Cliff Baxter/WSC, Fred Pifer/ GSFC/HSF	Over the next year, make a record of VHF Emergency Comm passes data to verify the full VHF-1 capability.	06/01/13	Open

RFA REVIEW

No RFAs were assigned at the May 30, 2012, WSC VHF-1 Upgrade ORR.

(Original Approved By)
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