GBT Systems Report on Project Coordination for December 2000
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Lockheed Martin (LM) completed the alignment and reinforcement of the elevation bullgear in November. Two tests were conducted in December to check the gear's integrity and alignment. In the first test, a force was applied to one segment of the bullgear with hydraulic jacks, and the motion of the segment relative to the elevation wheel was measured. The segment did not move when a small force was applied, but it moved by approximately 0.005 inches under the maximum design load of 212,000 pounds (the conditions for the maximum design load occur for an emergency stop at an elevation rate of 20 degrees per minute with a 50 mph wind in the direction of telescope motion). The segment did not return to its original position when the large force was removed. The motion and hysteresis of the gear segment suggest that additional reinforcement of the segments is necessary. LM is investigating possible solutions to this problem. The second test replicated an earlier servo test where the structure was repeatedly tipped in elevation between 5 and 95 degrees at a rate of 10 degrees per minute. Readings from the tachometers on the elevation drive motors were recorded during the experiment. In the original servo test, large spikes occurred in the tachometer data when the gaps between gear segments passed over the drive pinions, indicating that the gaps were expanding. The spikes were not present in the most recent data set, suggesting that the gaps are more secure. However, tachometer data recorded at some gear segment locations appeared noisier than at others, suggesting that the alignment of some segments could be improved. Upon further investigation, it was found that the noise in the data has a 4.2 Hz sinusoidal structure. The structure in the noise is thought to be the natural frequency of the elevation motor mounts. NRAO needs to determine if these sinusoidal oscillations adversely affect telescope pointing.

Additional tests were also made of the azimuth track. The tests show that the track wear strips and baseplates move in the direction of telescope motion. A single wear strip can move by as much as one-eighth of an inch after the four wheels in an azimuth wheel truck pass over it. There was little if any additional motion of the strip as additional wheels passed, suggesting that the "play" in the bolts was taken up by the initial motion of the strip. LM will attempt to prevent the motion of the track by attaching as many as four consecutive sections of the track. Tests of the azimuth track will be repeated at that time. It is also possible that the telescope can be routinely moved in azimuth after the sections are attached.

Recognizing that problems with the bullgear and azimuth track will delay GBT pointing observations, a number of tasks were identified and scheduled to allow the commissioning of the telescope to proceed. These tasks do not require the telescope to point, and include RFI surveys, frequency checks, tests of IF amplitude stability, and spectral baseline checks.

The finite element model of the GBT showed that two structural members in the box structure can become over-stressed in one of the more severe design loads for the telescope (ice on the

structure). LM proposed, and NRAO agreed to, a modification to the members that halves their effective length, and thereby increases their allowable stress by a factor of two.

The servo and optical alignment sections of the GBT Final Acceptance Test Procedure were completed and accepted on November 29. The sections in the test procedure that remain to be completed are HVAC, hoists and manlifts, electrical, and the primary reflector structure, which includes the elevation bullgear.

The GBT project budget was effectively closed in December. The last major purchase in the project was made on December 20 for a data handling workstation and an array of data storage disks. All project consulting agreements have been closed. The major outstanding item for the project budget is an invoice for LM's installation of the conduit and cable tray to the lasers on the lower feedarm. LM will submit the invoice in early January 2001. No additional charges will be made to the project.

LM delivered four compact disks containing all but about 20 of the as-built drawings for the GBT. LM also submitted a technical memorandum on the analysis of the elevation rotating structure (TM-43).

After the feed pressurization manifold was installed in the Receiver Room, it was discovered that the airflow to the L-band and S-band feed horns was insufficient to maintain adequate air pressure within these large horns. Airflow to the horns, and thus the pressure within them, was increased by drilling small holes in the transition sections of the horns and routing additional air lines to the holes. The holes will not affect the RF performance of the horns.

Construction of prime focus receiver 2 progressed during the month of December. A trial fit of the receiver dewar was made to the receiver box. The dewar was then sent to a shop in Alexandria, Virginia for electro-polishing. Phase-shifters for the receiver hybrid network and IF attenuators were purchased.

The feed horns of the X-band and Ku-band receivers were temporarily removed from the Receiver Room so that their phase centers could be measured at the antenna test range. The phase centers of the feed horns on all Gregorian receivers have now been measured with the exception of K-band.

Additional tasks at the GBT have been completed or are ongoing. The local telephone company installed the PBX within an RFI enclosure located in the Servo Room. LM completed the installation of the new elevation cable wrap. LM electricians are installing the conduit and cable trays for the lower feedarm lasers. The HVAC subcontractor was on site in early December to balance fluid flows in the HVAC system again. A serviceman inspected, repaired, tested, and certified the two manlifts on the GBT. However, operational problems continue for the upper manlift.

In early 2000, scientists and engineers at Cornell University expressed an interest in building a "spigot card" and data handling system that will enable the GBT spectrometer to record pulsar search data. Although the project was started at Cornell, progress has been much slower than expected. Consequently, interested parties at Cornell, Caltech, and NRAO-GB entered a preliminary agreement to provide this important functionality for the spectrometer. NRAO's involvement in the project will be to design and build the spigot card and to maintain the system on a long term basis. Ray Escoffier at the CDL has already developed a preliminary design for the spigot card. Caltech will provide an EDT data transfer card, a data handling computer, a computer disk for a modest amount of data storage, and data analysis software. Additional discussions are needed to determine a suitable data storage medium. System integration specifications also need to be developed.