Preliminary report on survey of the s-band and other horns.

A survey of the recently installed new s-band receiver/horn and the transmit horn was performed on 31 October 2012. The other feed horns were surveyed on 2 November. The surveys were performed by Lynn Baker and Denis Urbain. This preliminary report primarily discusses the s-band horns. The data taken on the other horns will be reduced and presented later.

After a test shoot on Tues, Oct 30, the secref.dsn file had some unresponsive targets removed so it is shorter than the previous versions of the same file. The new file is named secref1.dsn.

During the survey on Oct 31, there were several more unresponsive targets noted during the survey of the secondary reference. Those targets were removed from the reference file for the survey on 2 Nov. The file was named secref2.dsn There are about 20% of the targets unresponsive, indicating that the target set on the secondary is nearing the end of its useful life.

The target disk for both s-band horns is five targets on a 13" nominal radius mounted on an extension collar which fits in the old horns. An adaptor plate was used to mount the collar on the new horns. The two new horns are slightly different so the adaptor plate has two steps which fit each horn. This means that the offset from the phase center to the center of the target circle is slightly different for the two horns and larger than the old offset.

The offset thickness of the adaptor plate is .375" for the receive horn and .500" for the transmit horn.

On 31 Oct. the secondary reference was measured and then the s-band receive and transmit horns. The horns were measured twice each in the morning trying to minimize the y error by moving the turret floor slightly.

After lunch the new receiver was moved radially outward on the floor to reduce the x error. The range of motion was limited by interference between the horn/waveguide and the floor structure. Any further movement outward on the floor will require significant structural work. New turret angle positions were provided by Phil Perillat which reduced the y offset to a small value.

The reason for the interference problem is the new receive horn is longer than the old horns and the new transmit horn. Both old horns and the new transmit horn are 15.820" overall length. The new receive horn has four more corrugations (each .744") and is 18.796" overall length. Since the phase center is essentially at the mouth of the horn, this means that the back of the horn is almost 3" higher than before. Note that since both transmit horns are the same length, replacing the transmit horn (occurred several years ago) should not disturb the alignment that existed for the old transmit horn.

Both the receive and transmit horns were measured once more after the receiver

was moved and the new turret angles were provided.

The six measurements of the two horns gives the following results for the center of the target circle in each case. The B cases were done after a delay of roughly two hours for lunch and moving the receiver. Note that this is NOT the location of the phase center.

SRX	-248.3755	0.1621	-395.3392
SRXA	-248.3697	-0.0743	-395.3487
SRXB	-247.9661	0.0330	-395.4679
STX	-247.7354	0.4713	-394.4773
STXA	-247.7230	-0.3475	-394.4758
STXB	-247.6803	-0.0704	-394.5427

For an initial estimate of the receive horn errors, make the assumption that the transmit horn is in the correct position. This assumption depends on the old survey of the transmit horn still being correct and the fact that installing the new horn did not disturb that alignment. Compare the B results above, noting the .125" difference in the target height between the two horns. The x position of the receive horn is -.29" relative to the transmit horn. Since +x is uphill, toward the secondary, the receive horn is too far from the secondary and too close to the center of the turret floor. Fixing this requires moving the receiver closer to the edge of the turret floor. The z position of the receive horn is -1.05" relative to the transmit horn which is too low and requires lifting the receiver by that amount.

This initial analysis ignores small angle projections over small distances. In general, lifting the horn will move it in x toward the center of the turret floor. This will be fixed soon in a complete analysis. The horn tilt angles are not calculated yet. This will included in the better analysis.

The assumption that the transmit horn is in the correct position is open to question. Comparison to the older results, late 2003 into 2004, is clouded by the choice of the secondary reference file used in each survey. There are different versions of secref.dsn drawn from different survey/adjustments of the secondary surface. The version used in the surveys here is drawn from horn surveys done in early 2004. Unfortunately, it is not clear which reference set was used to represent the secondary surface at that time.

All of the horns were surveyed on May 2, 2004, including the s-band transmit horn. The center of the target circle then was:

STX:	-247.4860	0.0032	-393.5576	2 May 2004

The x value now is -.19" further from the secondary. Including the .500" adaptor plate height and calculating the difference in z values indicates that the transmit horn is -.49", lower than before. This possibly indicates that the exact correct position of the receive horn is even further away in both x

and z than discussed above. Any structural modifications to the floor should allow for more than .5" of x adjustment outward toward the rim of the turret. The z adjustment should allow for more than 1.5" of upward lift.

Review of videogrammetry files shows that the secondary was surveyed and adjusted in June, 2004 which was after all of the horn surveys done in early 2004. There were two survey/adjust cycles and a final survey. The results of that final survey is the best data available representing the present state of the secondary. Ideally, a secondary reference file should have been drawn from that final survey and used in this feed horn survey. It was not but that is a minor problem. The raw data from the survey is available in the .log files and can be refit to a better reference file and the horn positions calculated based on that data. It will require updating the videogrammetry data reduction software to obtain the improved secondary reference file.

In general, having a secondary reference file is important for checking the quality of the survey during the data acquisition. It allows for checking the RMS of the fit to the measured secondary points and the fit of the targets on the horns to the expected circle. However, the points measured during the survey are all in accurate relative position regardless of the coordinate system used, to the limit accuracy of the total station and the mechanical stability to the dome/reflector structure. Post survey processing can fit the point cloud to any desired reference coordinate system starting with the raw data in .log file.

Summarizing the above into a near term action list:

1. Review, update, document the videogrammetry reduction software to obtain an updated secondary reference file.

2. Review, update, modify, document the horn position reduction software. Redesign it to use the raw data from the horn surveys as standard procedure. Include the new adaptor plate in the offset heights of the s-band horns.

3. Reduce all of the horn data to produce locations of the phase center and tilt angles. Write a summary report of the results.

Following these items are the writing "how-to" manuals, documenting the videogrammetry, documenting and providing the fiducial panel data for both the secondary and tertiary and any other support documentation.

Suggestion: Build a shelf to hold the laptop near the total station, high enough to operate the laptop standing. Then only one operator is needed for the survey.