VALIDATION OF REFLECT

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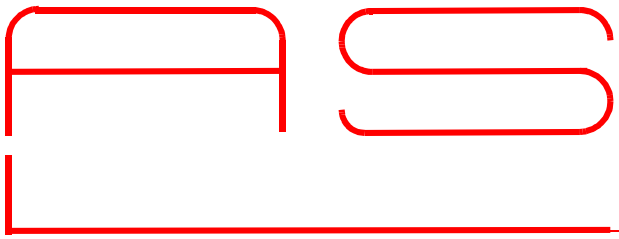
ASL Report 14



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1 INTRODUCTION

A recent study [5-1] contained a series of measurements of a Quasi-Optics system at 480 GHz and predictions derived from several software packages. The agreement between the measurements and the software package GRASP [5-2] which is based on Physical Optics (PO) was very good.

The data on the geometry supplied in the report [5-1] is sufficiently detailed for a validation exercise to be carried and the Physical Optics/Physical Theory of Diffraction program, REFLECT has been run on this problem.[5-3].

2 GEOMETRY

The geometry is shown in Figure 2-1. The feed horn is corrugated. Mirrors MAM1 and MAM3 are standard elliptical mirrors. MAM2 is a reversed elliptical mirror, that is, reflection takes place from the convex surface.

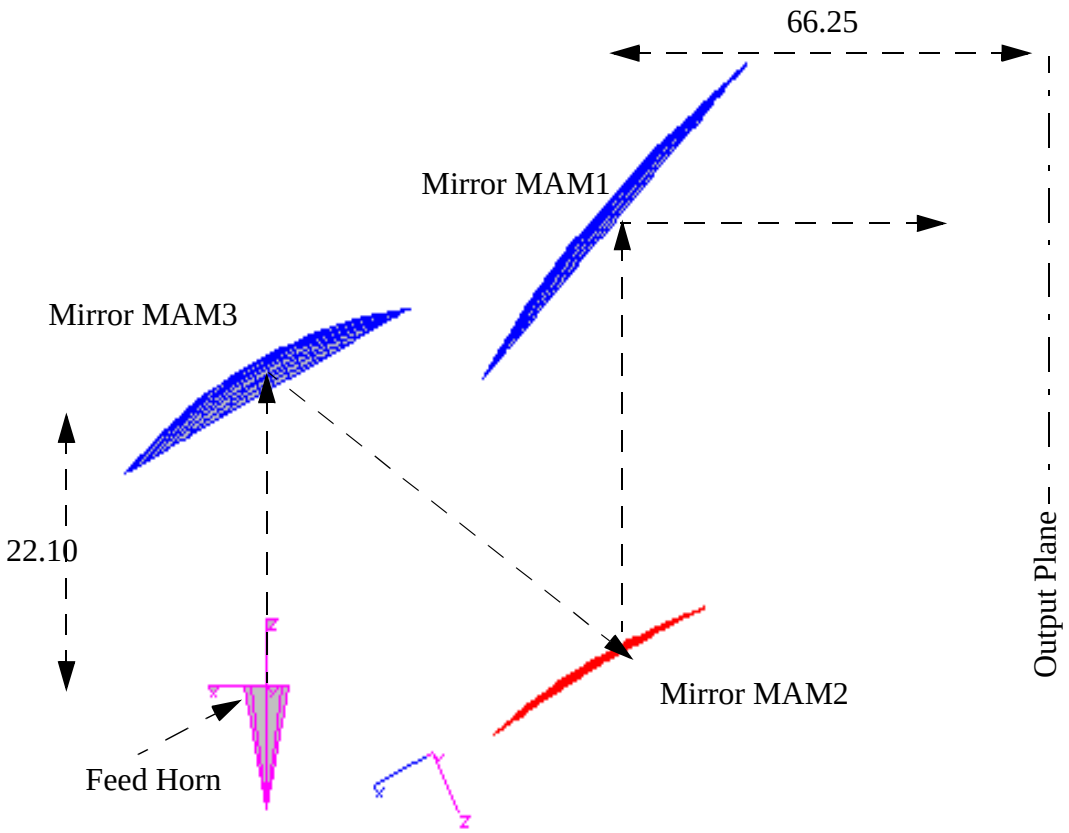

Figure 2-1 Geometry of Test Set-up, showing central ray path. Taken from REFLECT.

3 METHODOLOGY

The methodology is as follows

- Use mode-matching techniques (in this case, the software package, CORRUG [5-4]) to provide the radiation patterns of the corrugated feed horn.
- Translate the radiation patterns into Spherical Wave Expansion coefficients using the software package SPHREX (part of the REFLECT suite)
- Use these SWE coefficients as feed input to REFLECT modelling MAM3. Output the PO currents on MAM3.
- Use these PO currents as input feed to MAM2 plus MAM1 and compare the outputs with the results in [5-1]. The outputs are in a nearfield plane placed at 66.25 mm from MAM1 (Figure 2-1)

4 RESULTS

The farfield radiation patterns from the feed horn, generated using the mode-matching program, CORRUG, are shown in Figure 4-1 and should be compared with those shown in Figure 4-2 which is Figure 4.2 of [5-1]. There is good agreement down to the -50 dB level.

This corrugated horn had a linear taper from throat to aperture with uniform corrugations over the whole length of the horn. The slant length was 15.4 mm and the aperture diameter was 5.0 mm. The semi-flare angle was 9.298 degrees.

The radiation patterns from the Quasi Optics Network have been generated in the same coordinate system as the measurements. The output is taken as linear scans across the main beam at a distance of 66.25 mm in front of MAM1. This is shown in Figure 2-1.

Two sets of results are shown. Figure 4-3 to Figure 4-6 are for the case when the horn is at the focus and Figure 4-7 to Figure 4-10 are for the case when the feed has been moved towards MAM3 by 5 mm. The asymmetric results occur in the plane shown in Figure 2-1 and the symmetric plane is orthogonal to that plane.

Agreement between REFLECT and GRASP is good down to at least the -45 dB level although both REFLECT and GRASP can disagree with the experimental results at this level.

The conclusion is that the REFLECT results are remarkably similar to the GRASP results.

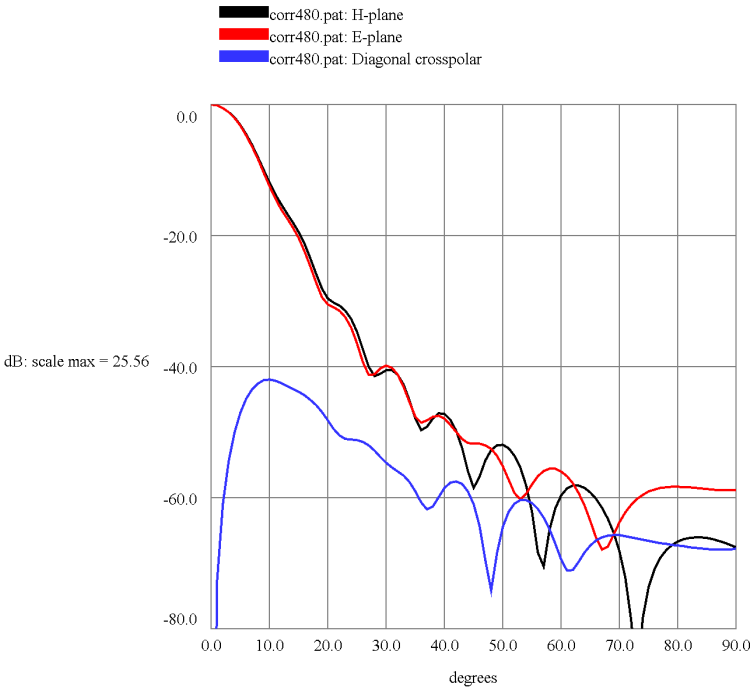

Figure 4-1 Farfield Radiation Patterns from the Corrugated Horn. Generated using CORRUG

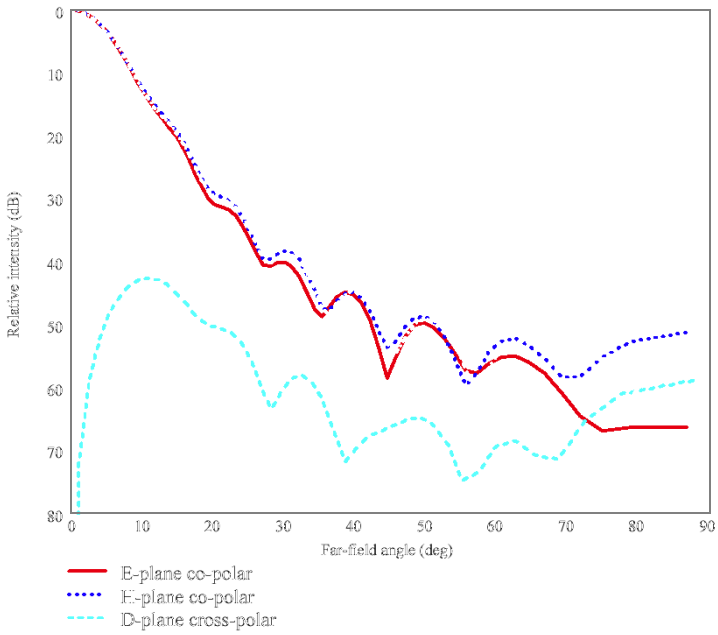

Figure 4-2 Farfield Predicted Radiation Patterns for the corrugated horn. Figure 4.2 of [5-1]

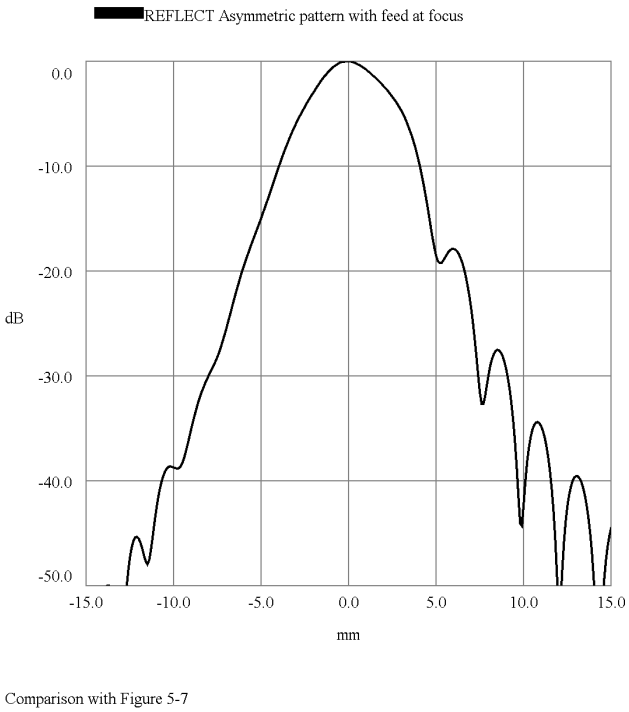

Figure 4-3 Asymmetric cut predicted by REFLECT when horn is at the nominal focus

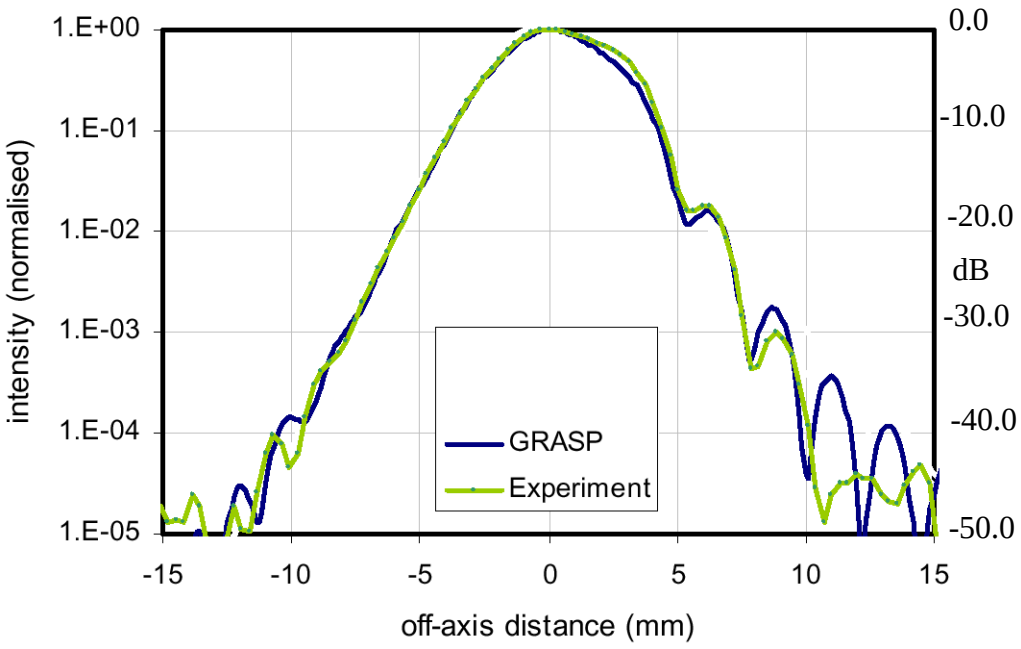

Figure 4-4 Asymmetric cut when horn is at the nominal focus (Figure 5.7 of [5-1])

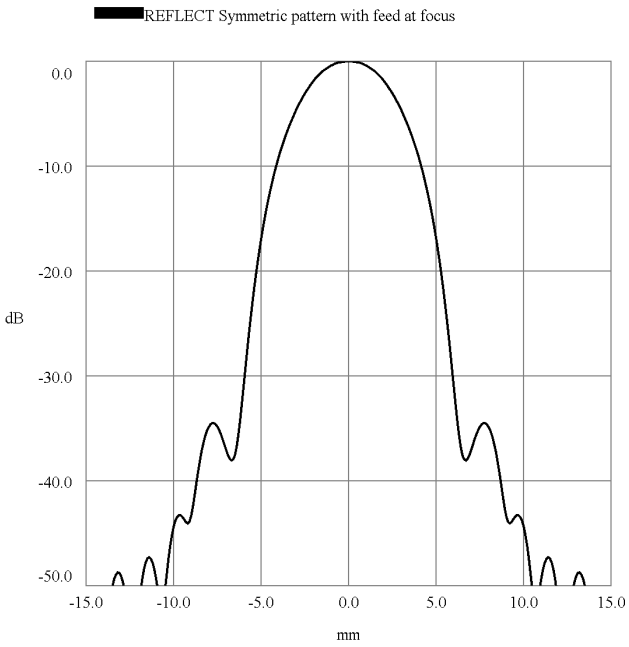

Figure 4-5 Symmetric cut predicted by REFLECT when horn is at the nominal focus

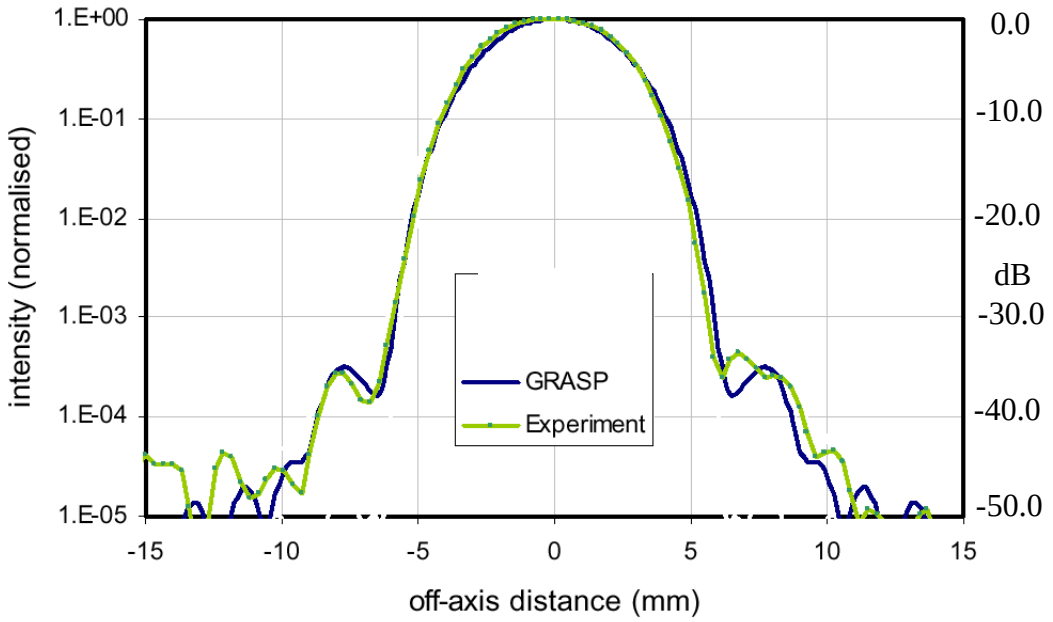

Figure 4-6 Symmetric cut when horn is at the nominal focus (Figure 5.2 of [5-1])

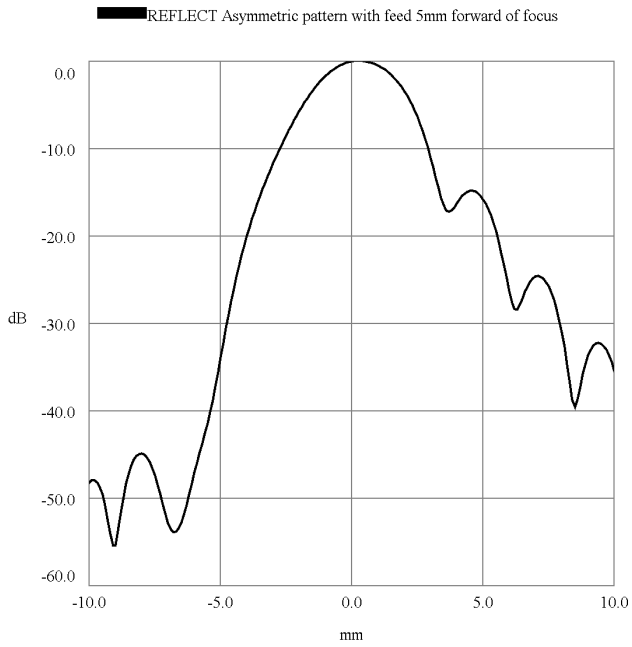

Figure 4-7 Asymmetric cut predicted by REFLECT when horn is 5 mm forward of the nominal focus

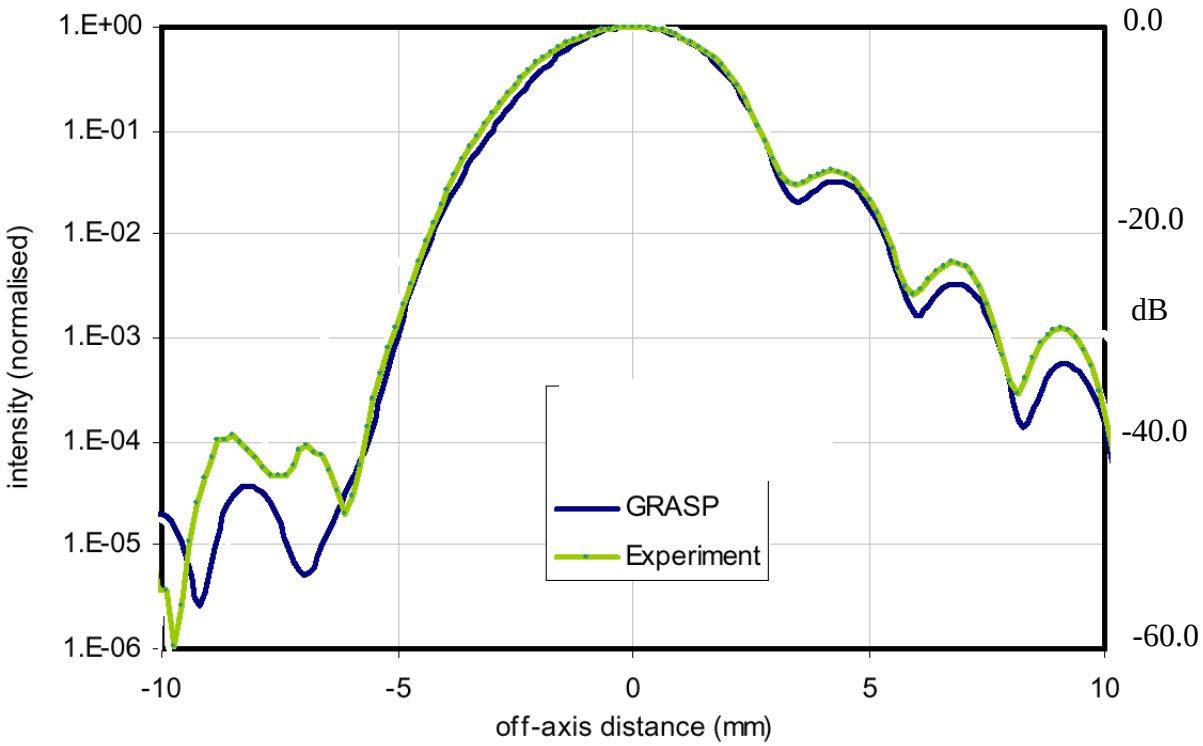

Figure 4-8 Asymmetric cut when horn is 5 mm forward of the nominal focus (Figure 5.5 of [5-1])

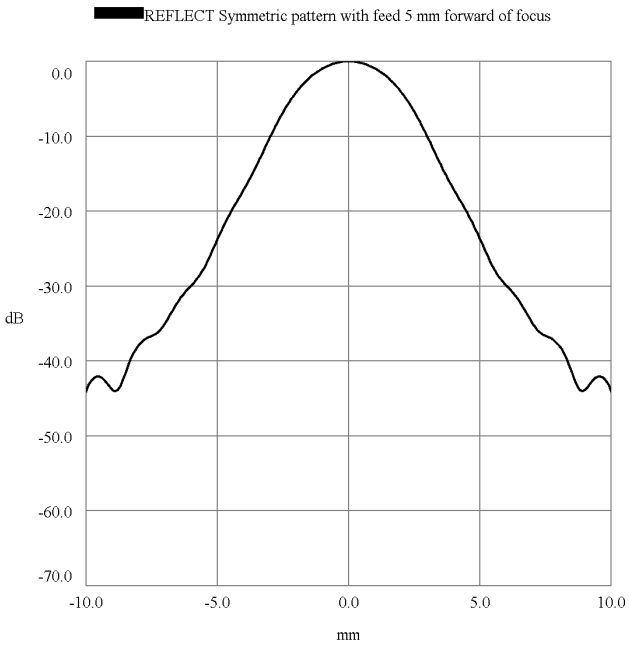

Figure 4-9 Symmetric cut predicted by REFLECT when horn is 5 mm forward of the nominal focus

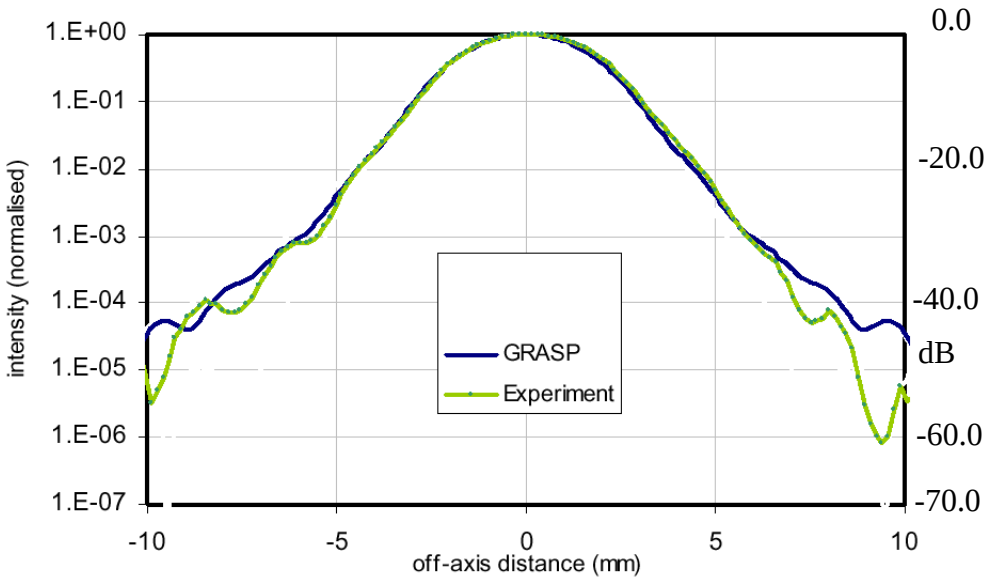

Figure 4-10 Symmetric cut when horn is 5 mm forward of the nominal focus (Figure 5.1 of [5-1])

5 REFERENCES

5-1 FIR Optics Design and Verification Final Report, Phase II ESA TRP Study 13043/98/NL/PB.

5-2 GRASP website at www.ticra.com/g8index.htm

5-3 REFLECT website at www.maasdesign.co.uk/reflect.html

5-4 CORRUG website at www.maasdesign.co.uk/corrug.html