Request for Waiver Form

RFW No:	**VIS-RFW-ATC-00000-0026**	
RFW Title:	**System Image Quality (80% Encircled Energy Diameter)**	
Requesting Contractor:	VPO	
Contract No:	N/A	
Date Requested:	8-Oct-2009	
WBS Structure:	Code: 00000	Name: VISTA Technical Verification Specification
Document/Drawings Infringed:	VIS-SPE-ATC-00000-0008 Requirement 4.9.1.2	
Defective Item:	VISTA (System-level performance)	

Proposed Change and Justification

The System Image Quality (SIQ) is defined as the greater of the (seeing-subtracted) 50% encircled-energy diameter, and the (seeing-subtracted) 80% encircled energy diameter divided by 1.54.

In practice subtracting seeing from images proved an unreliable process. It was found better to use those images taken in the best seeing, where the PSF dominates the seeing. EED50 was measured (20091005-obs216, FWHM=0.7arcsec) at 0.45arcsec (0.42-0.49), comfortably within the requirement of 0.51 (at best – requirement degrades from 0.51 as specified in spec). EED80 was measured at 0.85arcsec (0.8-0.9)=> EED80/1.54 = 0.55arcsec, which is 0.04arcsec outside the requirement of 0.51 (at best – requirement degrades from 0.51 as specified in spec). Alternatively put this is (8%) out of spec.

The 1.54 used in the EED80/1.54 specification was based on the assumption of a Gaussian image profile, and (VPO now understand) was known to be unlikely to be achievable when so specified by the VISTA science committee. Apparently it was so specified in an attempt to force the design make the wings as small as possible. The image profiles achieved in practice on ground-based telescopes are not well described by Gaussians as pointed out by Moffat (A&A 3,455,1969) because the seeing wings are larger than a Gaussian's. The profiles are better described by a Moffat profile of the form I(r) = I(0) (1 + (r/alpha)^2)^-beta where alpha determines the central core width and beta the fall off . In practice it is therefore the value of beta, rather than the value of 1.54 for a Gaussian, which determines EED80/EED50. In particular for a (typical) value of beta=2.5 (beta=2.5 for WFCAM) a Moffat profile which has EED50 of 0.51 the value of EED80/EED50=1.81.

So EED80 was over specified.

For Subaru (g band images with FWHM=0.7arcsec) EED50=0.45 EED80=0.75 => EED80/EED50=1.67
For Moffat profile which has EED50 of 0.51 => EED80/EED50=1.81
For WFCAM (images with FWHM=0.7arcsec) EED50=0.42 EED80=0.78 => EED80/EED50=1.85
For VISTA (images with FWHM=0.7arcsec) EED50=0.45 EED80=0.85 => EED80/EED50=1.89

Had this (more pragmatic) Moffat profile definition been used then EED80/1.81 = 0.46arcsec and the SIQ would be within specification. [Of course the exact value would depend on the beta specified].

Corrective Actions Taken: None – propose to accept as-is.

Documents Attached: VIS-TRE-QMU-00000-0050 which shows measured VISTA profile compared to those of Subaru and WFCAM in images with the same measured FWHM

Waiver, if granted, Adversely Affects: Scientific performance (marginal impact only). The extraction of object parameters from images is heavily dependent on the core size and hardly at all dependent on the outer wings so there will be little or no science impact. Furthermore calculations of VISTA's performance via the Exposure Time Calculator provided through www.vista.ac.uk have always, in effect, assumed a Moffat profile and so the photometric depth achieved is no different from that advertised and assumed by survey PIs. Commissioning and SV data shows these depths are indeed achieved.

Performance:	(marginal)	**Reliability:**		**EMC:**	
Dimensions:		**Safety:**		**SW:**	
Weight:		**Maintenance:**		**Other Risk:**	

Contractor Project Manager	**Bryan Little VISTA Project Manager**	**Signature**	
		Date	
Work Package Manager	**Andy Born VISTA Systems Engineer**	**Signature**	
		Date	

Approved: Jim Emerson **Date** 17/11/09

Digitally signed by Jim Emerson
DN: cn=Jim Emerson, o=Queen Mary University of London, ou=Astronmy Unit, email=j.p.emerson@qmul.ac.k, c=GB
Date: 2009.11.17 16:44:18 Z