

**NREL**

National Renewable Energy Laboratory

Memo

To: Daryl Myers and Thomas Stoffel
 From: Afshín M. Andreas
 Date: 24 October 2005

Subject: Calibration of SRRL AOCS Direct Quantum Sensors
 Instruments: Licor LI-190 s/n Q8434 (AOCS Direct Normal).

NREL PV Radiometric Measurements Task monitored the count output of one (1) SRRL LI-190 Quantum Sensors while measuring the spectral distribution of natural sunlight in direct normal incidence mode on 24 October 2005 from 400 nm to 700 nm at 1nm intervals using a LICOR LI-1800 Spectroradiometer w/LICOR Direct limiting tube. The count output from the AOCS sensors were recorded by the AOCS tattletale data logger.

The LI-1800 S/N PRS-158 spectrometer was calibrated against NREL's National Institute of Standards and Technology (NIST) Standard of spectral irradiance F571 on 19 October 2005.

The LICOR "PP" command was used to automatically integrate the spectra between 400 nm and 700 nm and report the result in the Quantum (PAR) units of $\mu\text{mol/s/m}^2$. All data were used to compute the calibration factors shown in Table 1.

Table 1. October 24, 2005 NREL Quantum LI-190 Calibration Summary

Time (MST)	Spectrum $\mu\text{mol/s/m}^2$	Q8434 counts	$\mu\text{mol/s/m}^2/\text{count}$ CF
11:52	2003	489.23	4.0942
11:53	2004	491.11	4.0806
11:54	2010	491.11	4.0928
11:55	2005	491.11	4.0826
11:56	1998	489.09	4.0851
11:57	1998	489.09	4.0851
		Avg.	4.0867
		Sigma	0.0055
	AOCS CF requires:	Photons/s/m²/count	2.461E+18

Note: 1 micromole = 6.022×10^{17} photons.

UNCERTAINTY

The estimated uncertainty in the LI-1800 spectral irradiance calibration is $\pm 4.0\%$ from 400 nm to 700nm. The accuracy of the CR23X data logger was about 0.8%. Estimated uncertainty in the derived calibration factor is $\pm 4.8\%$ (limit of error). Spectral data is plotted below.

Figure 1. Measured Spectral Distributions indicated by LI-1800 Spectroradiometer 24 October 2005

