Breakout session:
CPV2
Discussion leaders: Robert McConnell & Ian Aeby

1:00 – Andy Hartzell (3M) – Durability of Optical Materials

1:20 – David Miller (NREL) – Durability of Poly(Methyl Methacrylate) Lenses Used in Concentrated Photovoltaics

1:40 – Discussion of Test Needs for Optics for CPV

2:00 – Mike Ludowise (SolFocus) – Questions about IEC 62108 Implementation

2:20 – Discussion of IEC 62108: Intentions, Interpretation, and Implementation

Durability of Optical Materials

Andy Hartzell (3M)

Testing protocols, especially outdoor, need be carefully planed

Uniform industry definition of Fresnel lens failure would be helpful for vendors

Grades of raw polymers matter

- Will effect crazing

A History of outdoor testing and results was preseented

Questions:

- Crazing near the edges?
- Has not been observed.

Spectra are useful for failure analysis?

- Yes

Abrasion in sandy environments?

- Yes, has been reported in Saudi Arabia and by Sandia

Test other material properties?

- Heading in the direction of combined effects testing and analysis

Durability of PMMA Lenses In CPV

David Miller (NREL)

NREL study:
- Identify key issues for contemporary specimens

Optical durability:
- Evolution of location & distinctness of cut-on frequency

Mechanical durability (K_{IC}, $\partial a/\partial N$):
- Fracture, fatigue strongly depend on M_w
- Embrittlement over time

Soiling:
- Complex issue that may vary significantly over time w/ location

Photodegradation:
- Chain scission $\Rightarrow$ decreased M_w

Thermal decomposition:
- Chain unzipping $\Rightarrow$ decreased mass

SOG:
- Probably physically robust against soiling; limited existing literature

Test Needs for Optics in CPV

Post Session Discussion

- Spectral degradation
- Progressive SOG Delamination?
- Over temperature characterization
  - Lens temp likely to follow ambient temperature
- Cleaning can be a significant source of degradation
  - Are there “standard” cleaning methodologies
  - Techniques may be dictated by geography
  - Extra care may be required for AR coated surfaces
- Is cleaning CPV different between flat plate and CPV?
  - Yes, due to light scattering that may actually be beneficial for PV but is a killer for CPV
- Standard moisture condensation resistance requirements for optics?
- AF for Xenon exposure
- Requirements for reflective optics?

Questions about IEC 62108 Implementation

Mike Ludawise (SolFocus)

- Presented from HCPV integrators viewpoint
- Reiterated that 62108 is the cost of entry for CPV
- PTC test is particularly puzzling
  - Options have not really been explored by the integrators who have executed the standard
- Compared CPV to Flat Plate PV
  - Noted that illuminated and forward biased cells have significantly different current distribution
- Difficulty comes from possible nascent damage that may only be detected in subsequent test legs
- Reiterated the suggestion to use resistive heating in grid lines.
- Recommended a cell qualification standard and a review of the total required qualification test time

IEC 62108 Intentions, Interpretation, and Implementation

Post Session Discussion

- Maybe specify cell temperature as opposed to the method of achieving it
- Need requirements for retest after engineering changes
  - Conflict of interest between test labs and system manufacturers
- Industry may be moving towards standard form factors
- Recommend 25 to 30 cycles per day, at least 10°C/min for thermal cycling
- Need recognition of actual system temperatures for setting stress limits
  - Where did 110°C come from? (IEC 61215 derivative)
- Very difficult to execute PTC on large area (higher power) cells while regulating cell temp within +/- 3°C
- Need test protocols for both cells and receiver packages
- Need to revisit the AFs for the temperature/# of cycles