U.S. Department of Energy
Energy Efficiency and Renewable Energy
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Parabolic Trough Receiver IR Camera Field Test Results

Golden, Colorado

November 10, 2005

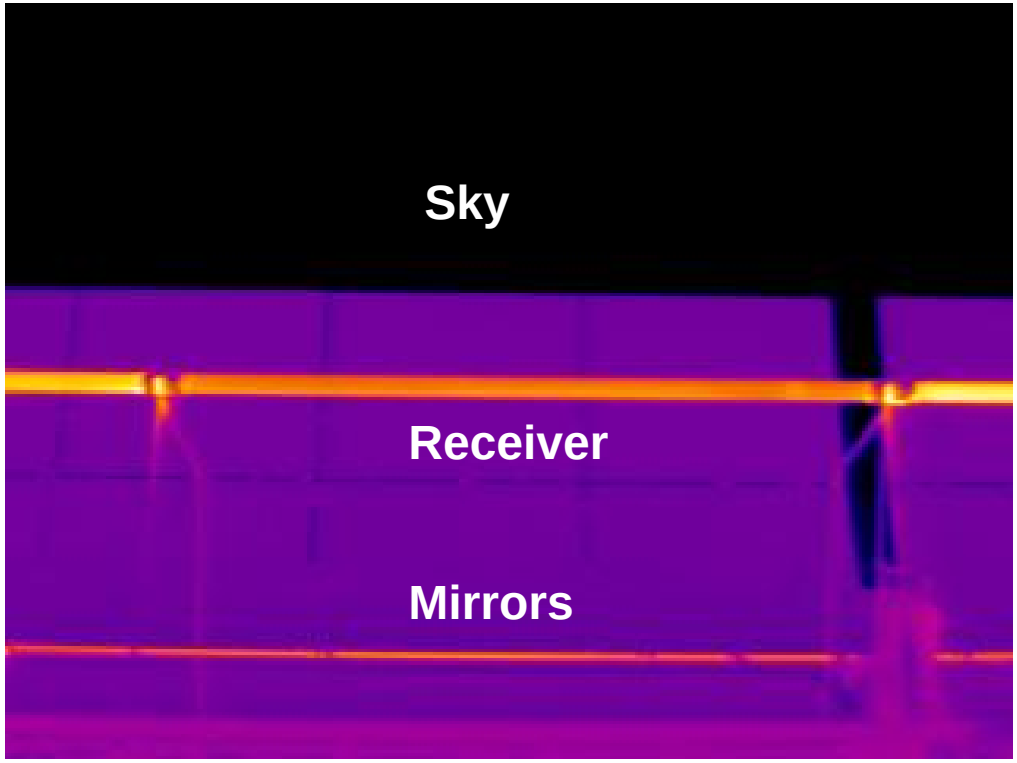
Sandia National Laboratories

CONCENTRATING•SOLAR•POWER
Sun•Lab
Sandia National Laboratories, Albuquerque, NM
National Renewable Energy Laboratory, Golden CO

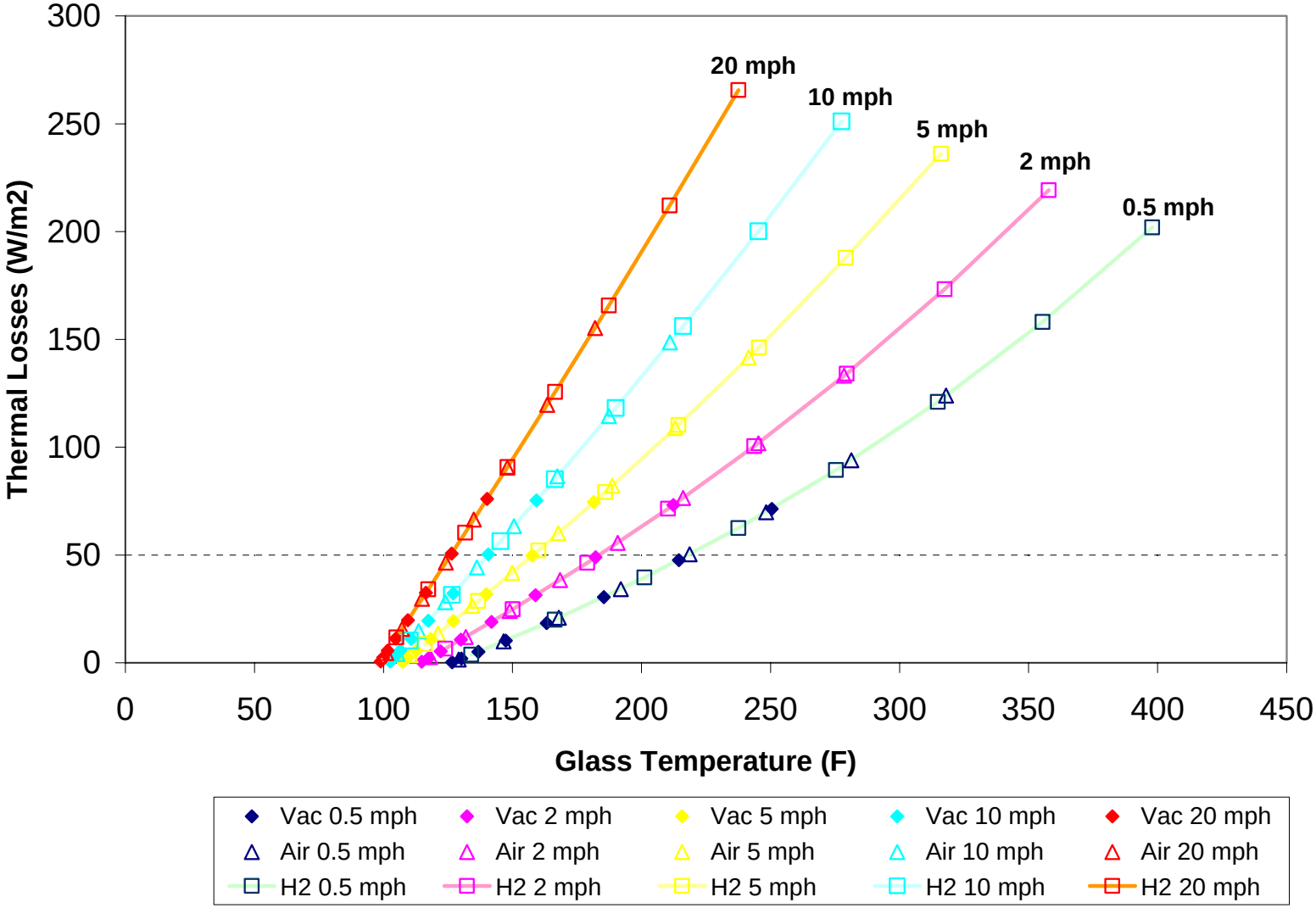
NREL

Receiver Field Survey With Infrared Camera

- Receiver (HCE) thermal losses are directly proportional to the glass temperature for a given wind speed and ambient temperature
  - Does not matter whether HCE has vacuum, air, or hydrogen buildup.
  - Does not matter what type of selective coating.
- HCE thermal losses modeled with SunLab trough receiver model show linear relationship.
  - Forristall HCE Model results shown on next slide.

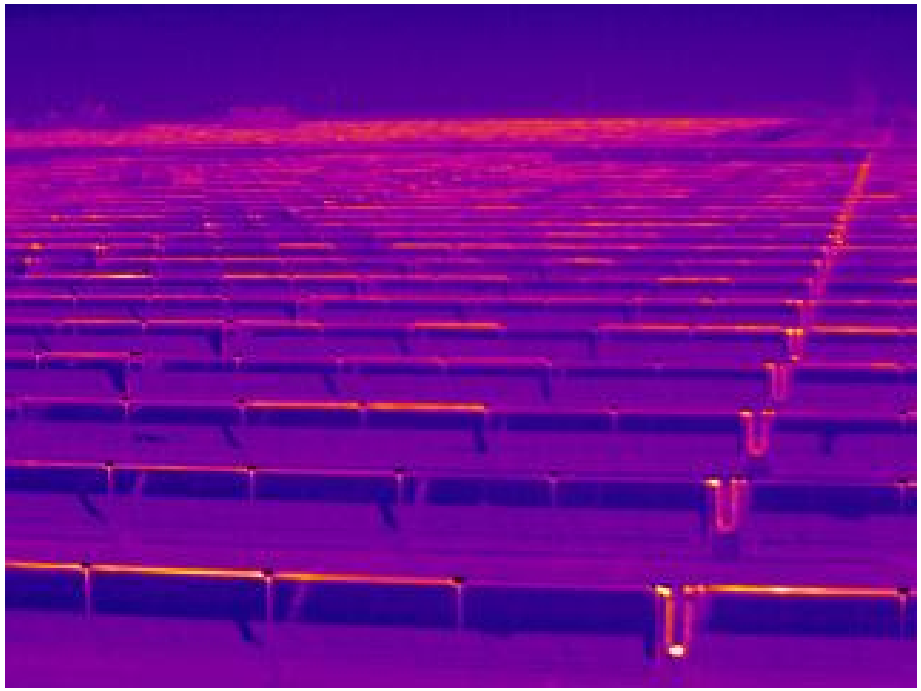


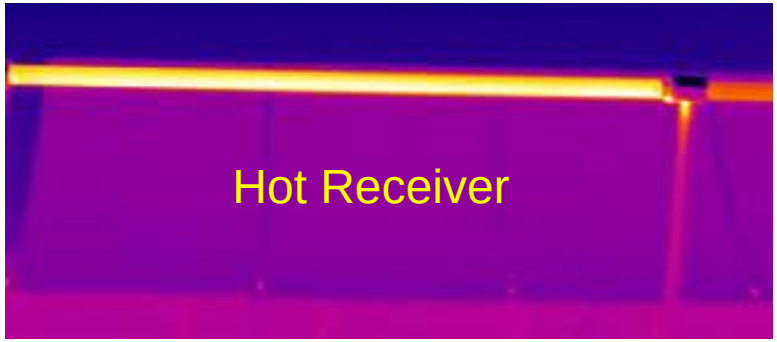
HCE Losses vs. Glass Temperature

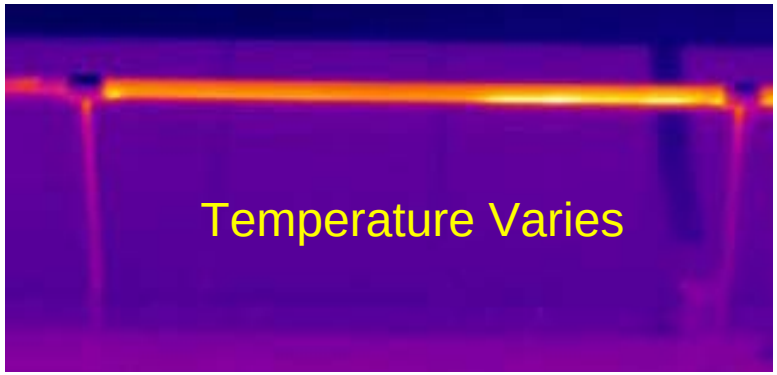


Receiver Field Survey For FPL Energy

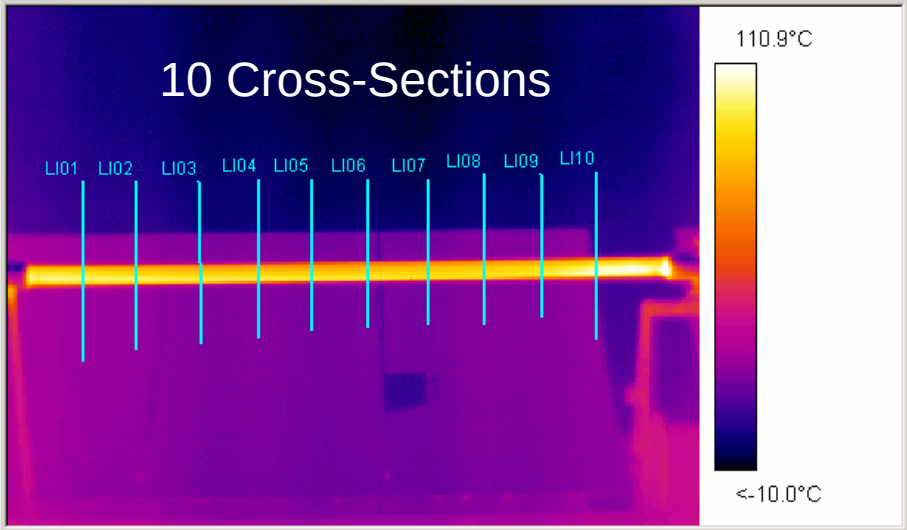
Elevated View of Parabolic Trough Solar Field







IR Camera Analysis Software



Analysis | Position | Obj. Par | Image | Text comment

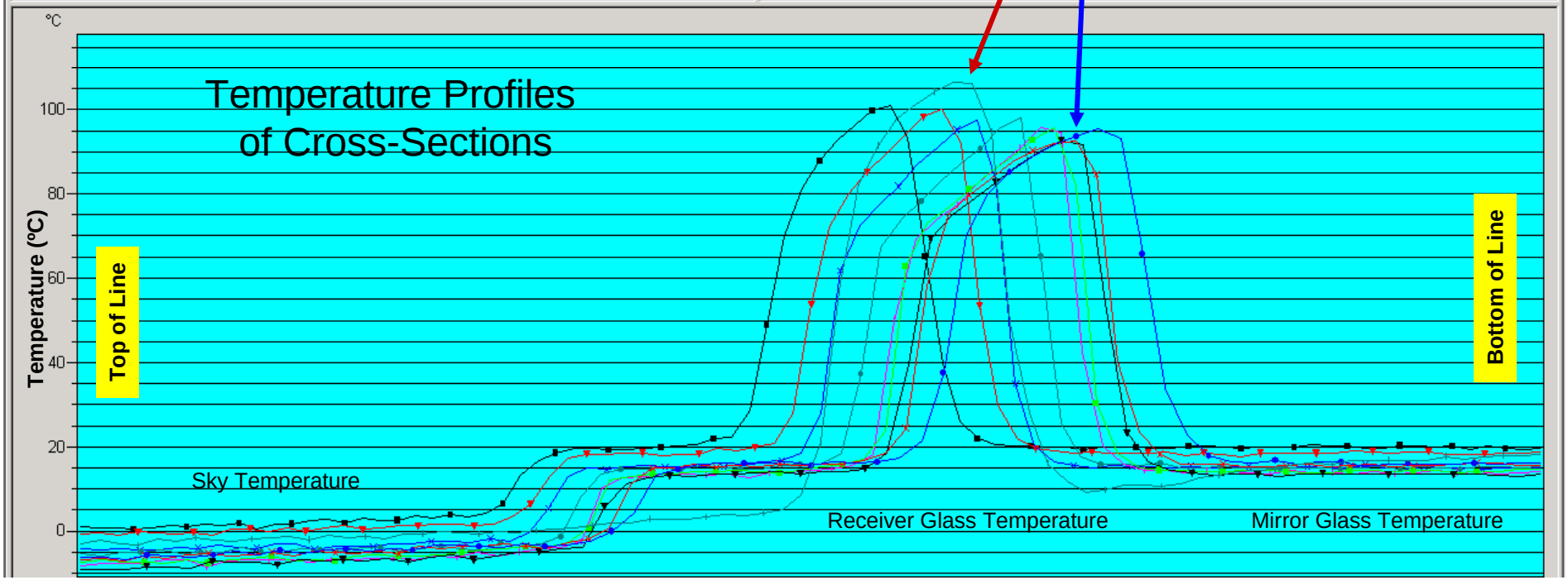
Label	Value [°C]	Min	Max	Max - Min
Image		<-10	130	*140
LI01		0	101	101
LI02		*-1	100	101
LI03		*-5	97	102
LI04		*-6	98	104
LI05		*-9	96	104
LI06		*-8	96	103
LI07		*-9	93	102
LI08		*-7	93	100
LI09		*-7	95	102
LI10		*-3	107	110

Max – Min of Cross-section Maximum 26ºF

Max of Cross-section Maximums 225ºF

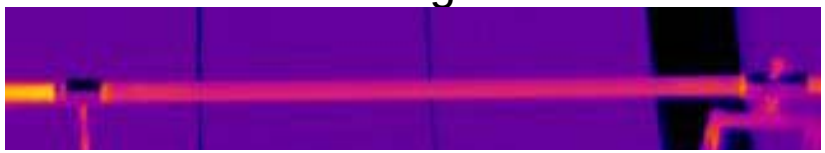
Min of Cross-section Maximums 199ºF

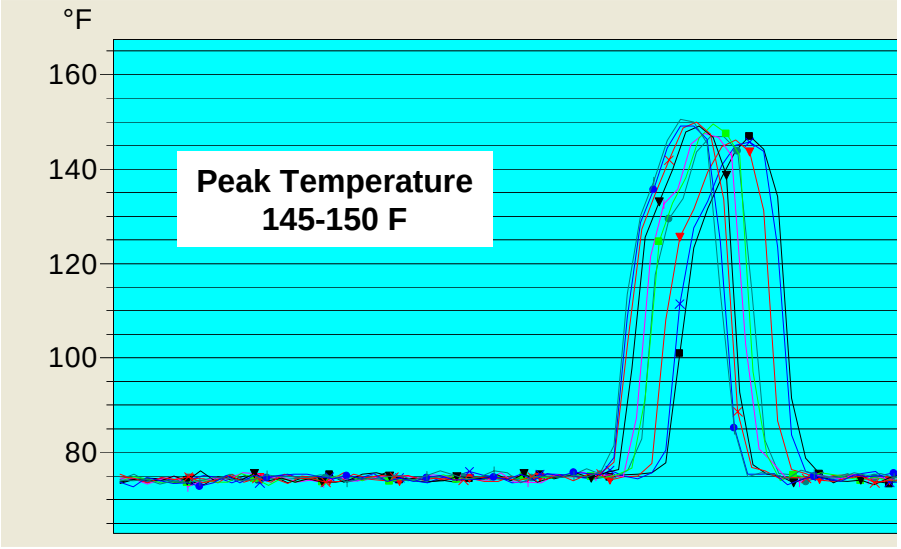
Average of Cross-section Maximums 98ºF



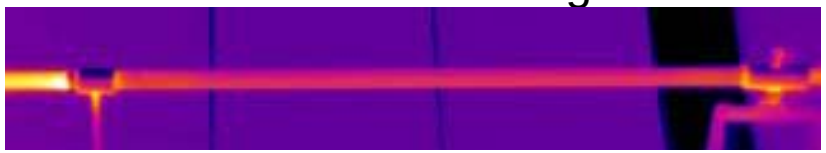
Solel UVAC2 (2 years old) with Vacuum

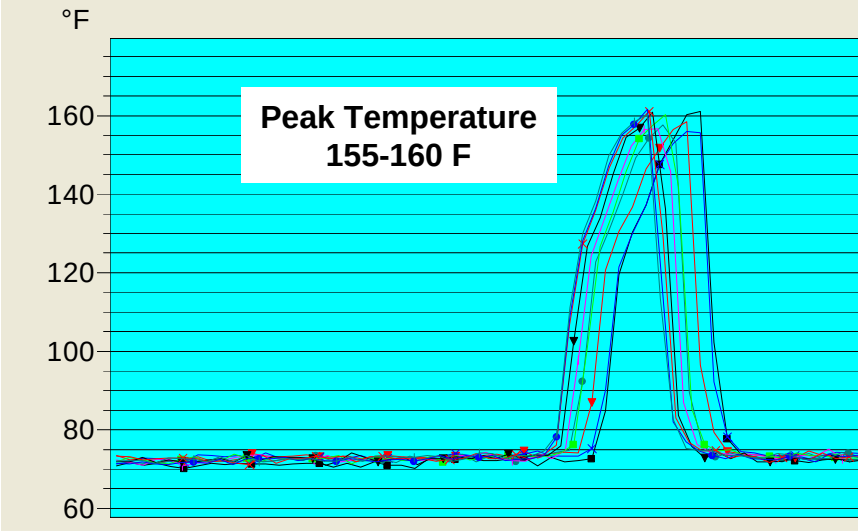
Not- Tracking





Tracking

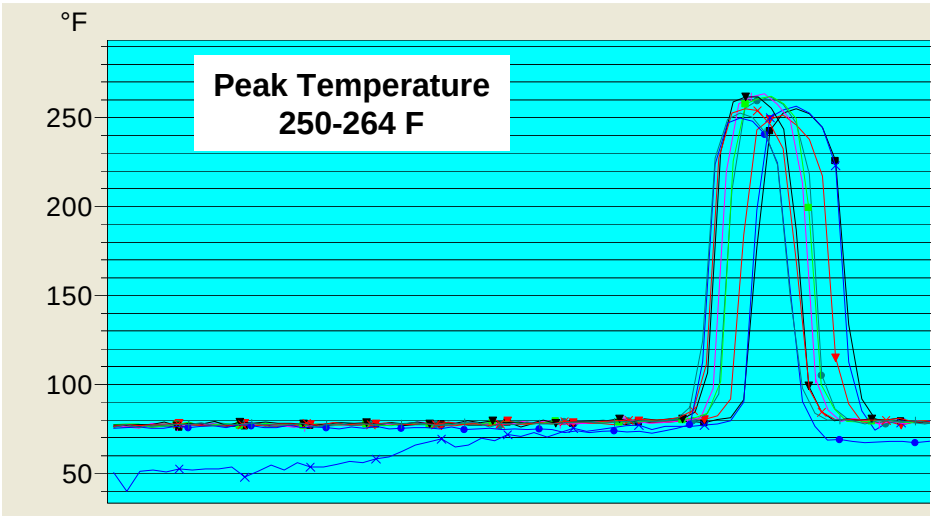




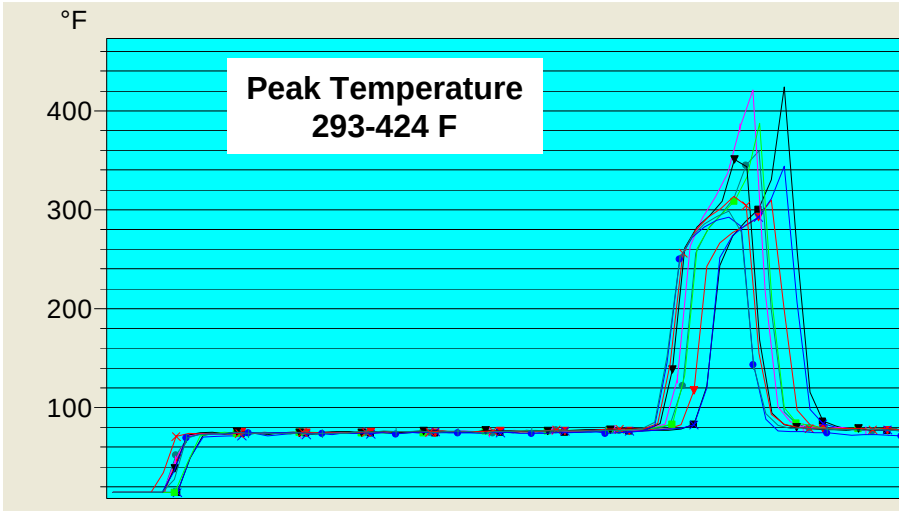
- Very Uniform Temperatures Seen (only 10-15ºF)
- Glass is very clear, no getter dust inside.

Luz Cermet with Fluorescent Coating Failure

Not- Tracking

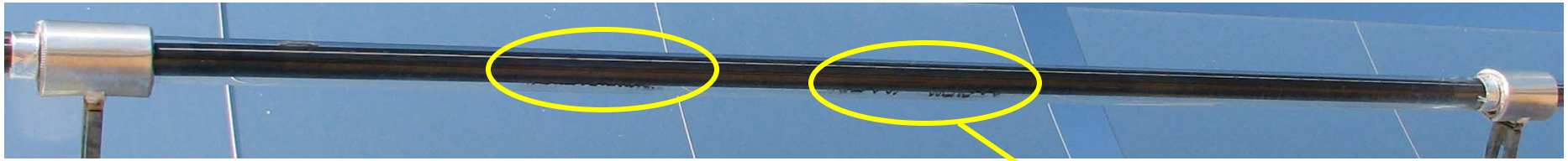


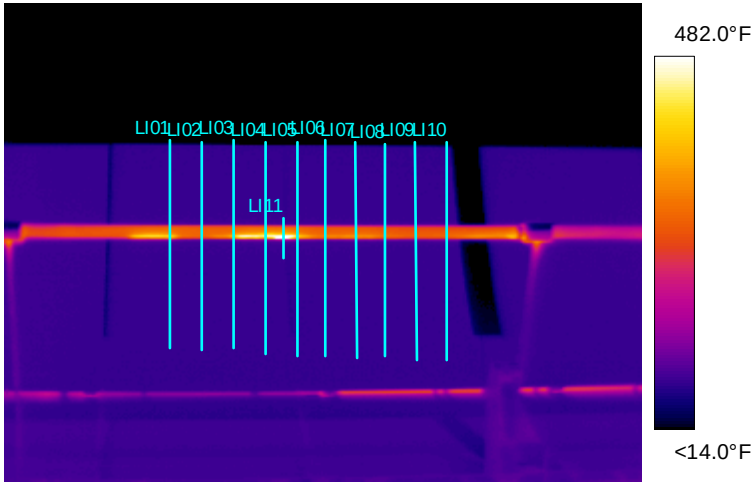
Tracking

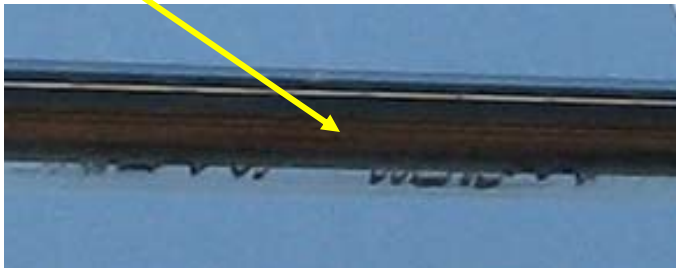


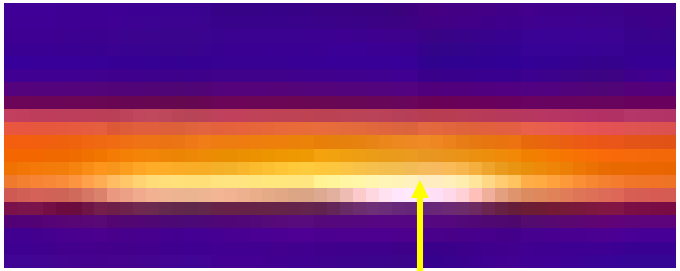
- Fairly uniform temperatures when defocused (only 10-15ºF)
- Very non-uniform temperature when focused (~130ºF).

Luz Cermet with Vacuum





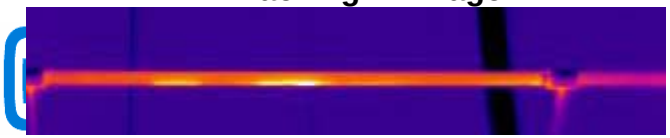




513ºF

Non-Tracking IR Image

Tracking IR Image

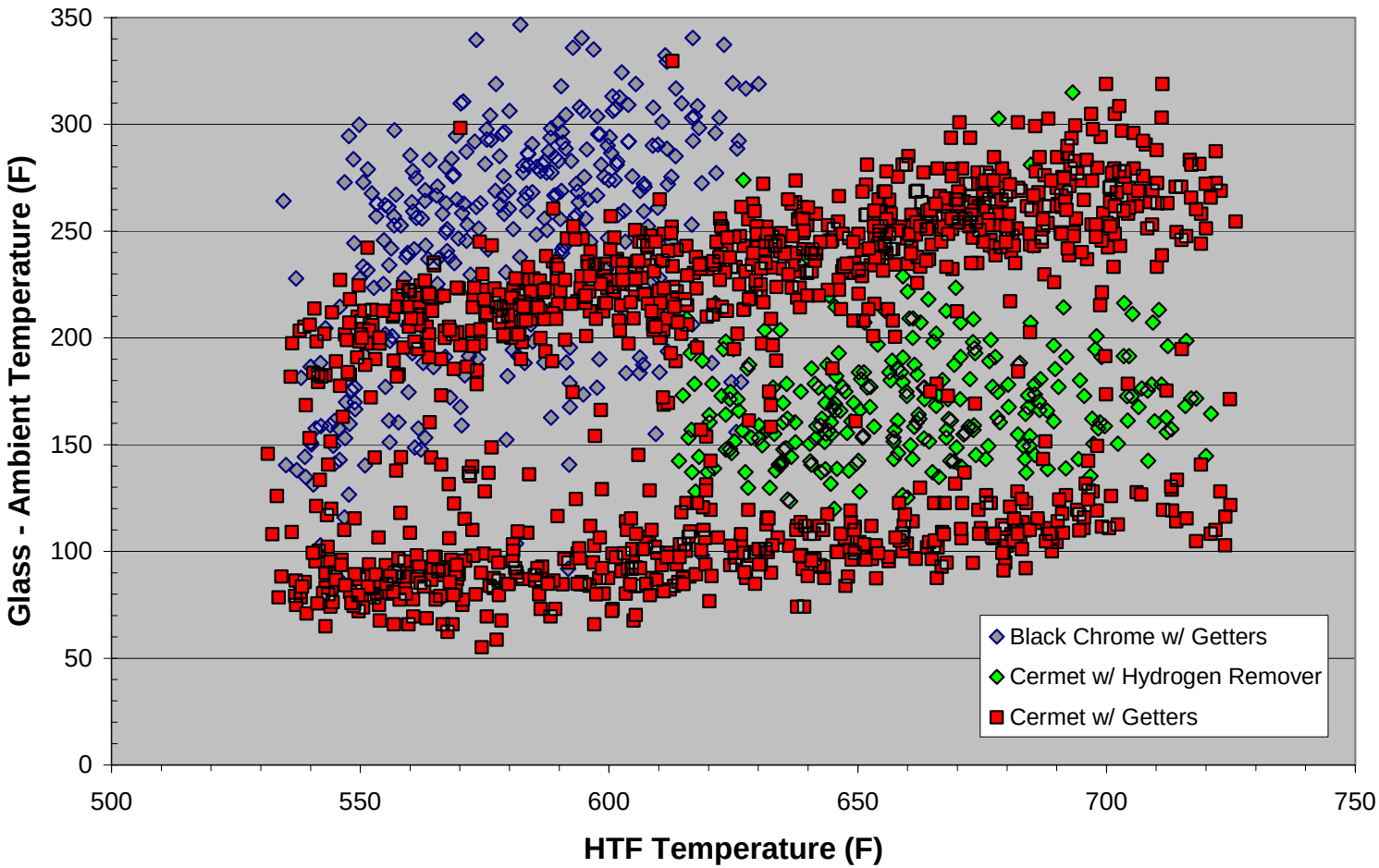


Getter dust inside the tube is causing hot spots on the glass!

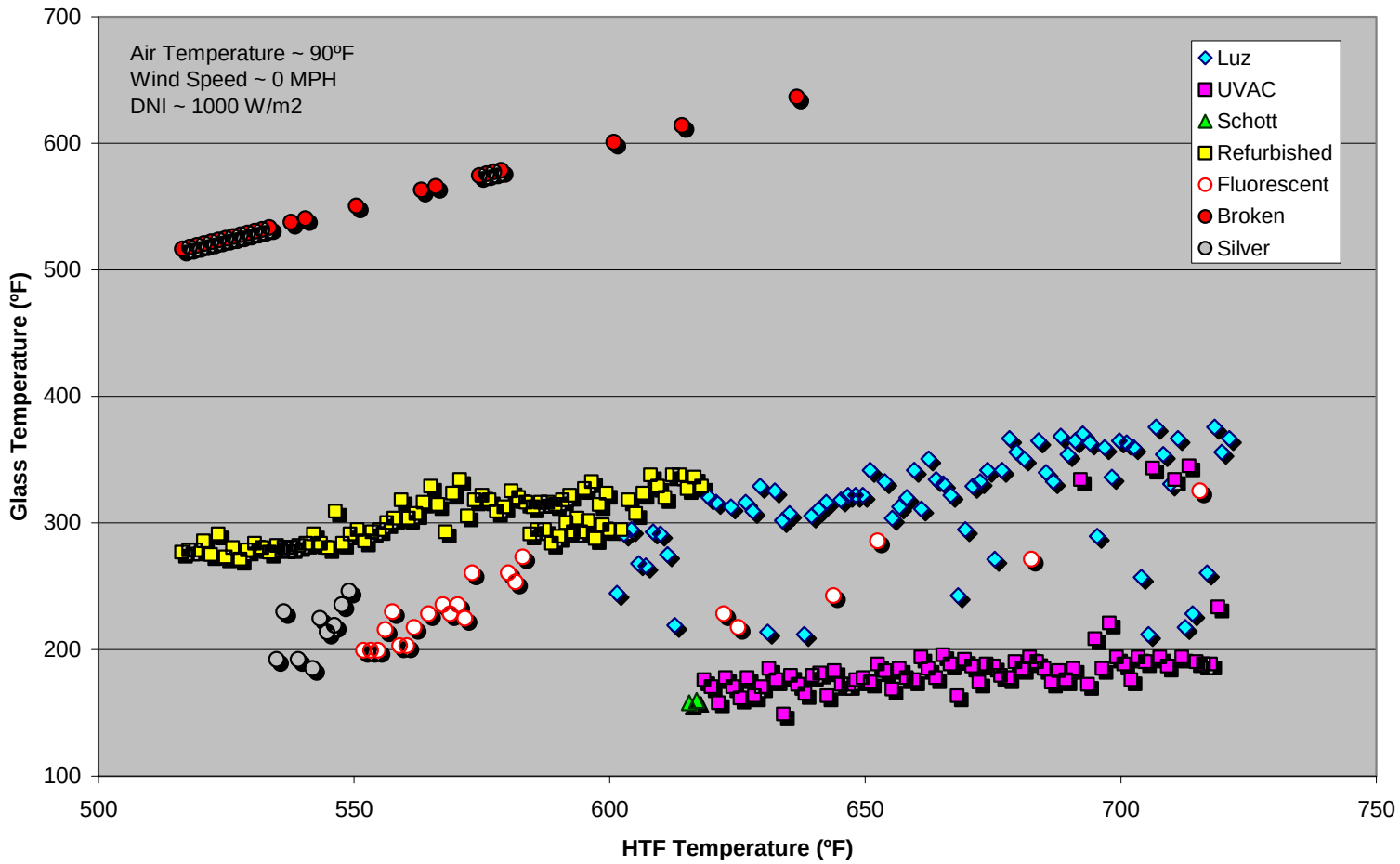
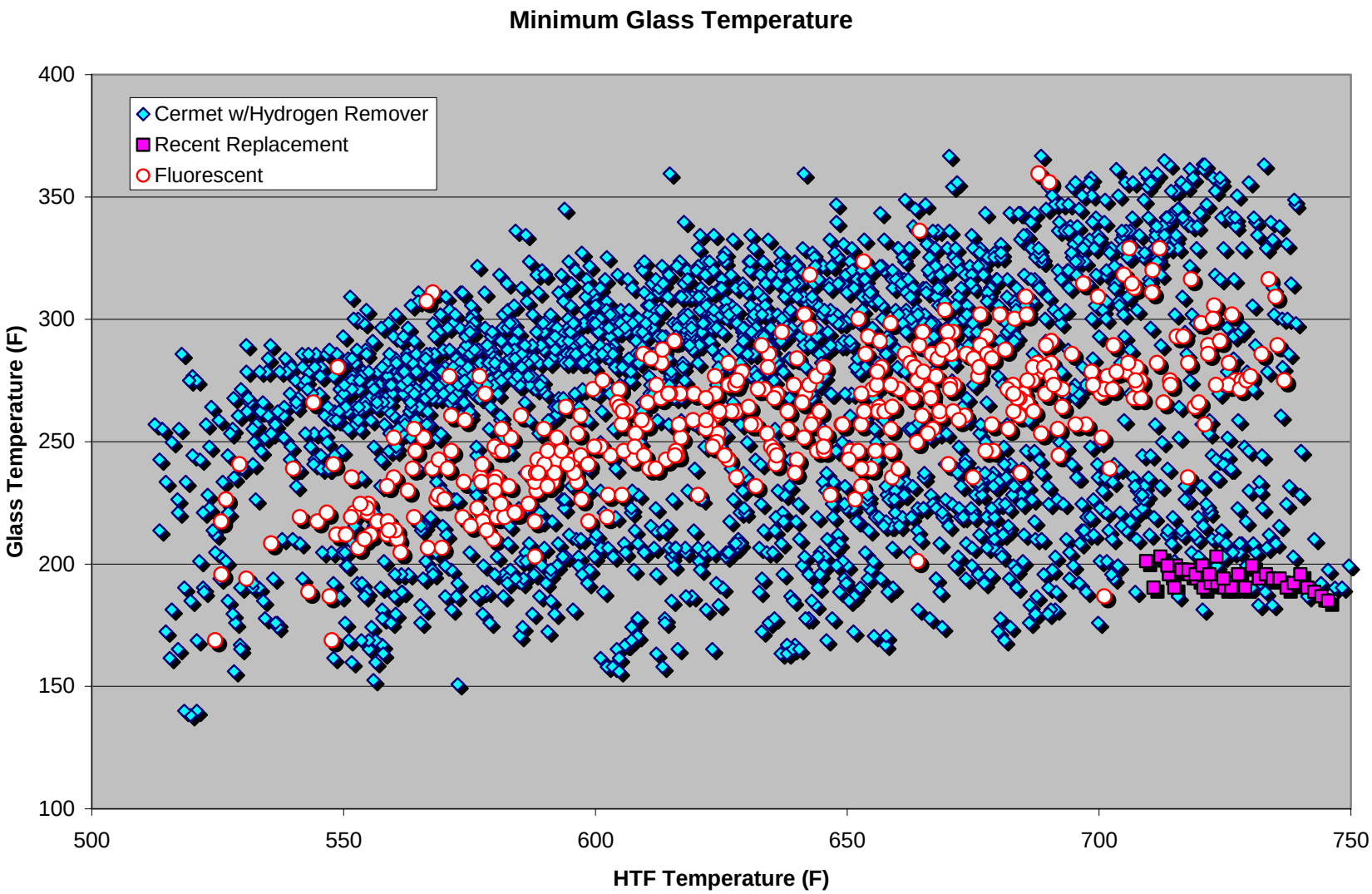
Receiver Field Survey Conclusions

- IR camera provided a good approach for evaluating condition of a large number of receivers in the solar field.
  - A highly automated approach for imaging receiver and analyzing data developed
  - Good agreement between IR camera and thermocouple measurements
  - Able to take measurement while collectors tracking
  - Approximately 12,000 images of receivers taken (out of ~90,000 receivers)
- Results from testing:
  - Able to evaluate performance of various generations of original and replacement receivers.
  - Getter dust, dirt on glass, or fluorescent coating failure cause increased glass temperatures.
  - Using results to assess potential hydrogen build-up in receivers in solar field

Sample IR Results (Minimum Glass Temperature)



Field Test Results
SEGS VIII Test Loop



Field Test Results
SEGS IX