A national laboratory of the U.S. Department of Energy
Office of Energy Efficiency & Renewable Energy

National Renewable Energy Laboratory

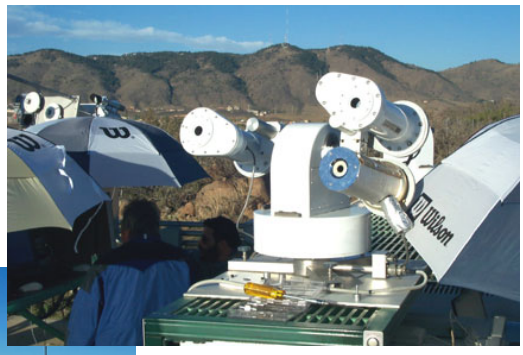
Innovation for Our Energy Future

Welcome!

NREL Pyrheliometer Comparisons 2004

(NPC-2004)

27 September – 8 October 2004



Solar Radiation Research Laboratory

(SRRL)

Latitude:	39.742 N
Longitude:	105.18 W
Elevation:	1828.8 m AMSL
Mean Station Pressure:	820 mBar
Time Zone:	(GMT – 7.0)

Electric & Hydrogen Technologies & Systems Center
Resource Integration Group
Measurement & Instrumentation Team

1617 Cole Blvd. • Golden, CO 80401-3393 • (303) 275-3000
NREL is operated by Midwest Research Institute • Battelle

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NREL Pyrheliometer Comparisons 2004
NPC-2004

Safety

Emergency Phone: Press **1 2 3 4** to call from any NREL extension

Evacuation Assembly Area: North Parking Lot

Security

Phone: 303-384-6811 or Press 6811 from any NREL extension

NREL *Contractor Visitor Badges* issued on first day of NPC at the Site Entrance Building. Please wear badge at all times at SRRL.

Badges will be valid for 5-day interval and renewed as needed.

Communications

Call Tom for Daily Plan – 303-384-6395 after 06:30 each morning
(listen to voice-mail announcement)

SRRL Phone: 303-384-6326 (also rings outside)

Outside Local and Long Distance: Press **9** - Area Code – Number

E-mail access via PC in Electronics Lab (south wall)
User = *********
Password = *********

Food & Beverages

Lunch Menu will be circulated daily by 10:30 MDT

Beverages and snacks provided (donations accepted by Bev)

Equipment Storage

Used designated areas in SRRL and Sea Container.

2004 NREL Pyrheliometer Comparisons (NPC-2004)
Solar Radiation Research Laboratory

Protocol Summary

Tom Stoffel and Ibrahim Reda

Based on past experience, here's a list of issues we need to agree on before we begin the comparisons.

1. Schedule

Daily Please call Tom's voice mail (303-384-6395) for recorded announcement.

Sept. 27th (morning)

a. Visitor check-in at Site Entrance Building.
   Please plan to arrive at NREL between 07:30 and 08:30 MDT.
b. Transport equipment to SRRL (dry weather) or to indoor lab (TBD) if it's wet outside.
   (You should have heard from Bev or Tom about any items received prior to the NPC.)
c. Safety and SRRL orientation briefing.
d. Equipment Installation & tests:
   -ALL personal computers will be ***scanned for viruses*** prior to their use at SRRL. NREL will provide this service.
   -We will have a seating diagram to accommodate operator/solar tracker assignments, but we'll see how this works once every one has arrived.

Sept. 27th (afternoon)

e. Continue equipment tests as needed.
f. Review measurement protocol and procedures.
g. Dry-run(s) of comparison measurements (weather permitting)

Sept. 28th – Oct. 8th (Daily, including weekend):

a. Clear sky = Take Measurements!
   -Arrive at SRRL by 08:00 MDT
   -Equipment warm-up for at least 30-minutes
   -First Cavity Calibration at 08:55 MDT
   -Begin comparison "Runs" by 09:00 MDT (08:00 MST)
   -Continue measurements until sundown or clouds interfere.

b. Cloudy sky = No Measurements, but optionally...
   -Review of previous day's data analyses
   -Technical Briefings on Radiometry, Measurement Network Operations, etc.
   -Equipment Tests
   -NREL Tours
   -Office Time (e-mail connection available)

c. We will determine the need for more measurements at the end of each day.

2. SRRL Coordinates

Program your solar tracker using:

LAT = 39.7425º North
LON = 105.1778º West
ELEV = 1828.8 m Above Mean Sea Level (6,000 ft)
BARO = 820 mBar (average station pressure)

3. Time Keeping

-A time keeper will be identified each day
-All time records will be Mountain Standard Time (MST)
-The NIST atomic clock is a local call: 9-303-499-7111.
-We need to keep our clocks in agreement to better than 2 sec.
-Set your system clock at the daily start-up or as often as needed to keep 2 second accuracy. Check personal computer clocks during the day.

4. Minimum Data Set

Our goal for a minimum data set for these comparisons is to measure irradiance during three different days (all day or portion). Historically, we have acquired more 3,000 data values for each participating cavity radiometer. At least 300 data values are needed to provide a valid transfer of the WRR to the participating radiometers.

5. Measurements

Do NOT apply any previous **WRR** correction factors to your measurements.
Use only the **factory calibration factor** to adjust your data beyond any other adjustments you feel are needed to correct your data (e.g., pre- and post-calibration drifts in sensitivity are OK). As in the past, we will use the following terms:

"Calibrate" = Perform electrical calibration and wait for next measurement period to begin

"Reading" = A measurement of direct irradiance within 1 sec of announcement at 20-sec intervals.

"Run" = Collection of 33 readings taken in sequence.

The *Time Keeper* will make the following announcements for each Run:

Next Run Begins at HH:MM (MST) [HH:MM (MDT)]
T minus 6 minutes. Begin calibration
T minus 3 minutes
T minus 2 minutes
T minus 1 minute
T minus 30 sec
T minus 10 sec
T minus 5 - 4 - 3 - 2 - 1 - READ!

Continued countdowns at 20 sec intervals until 33 readings have completed a “Run”

6. Data Transfer

The following *standard data format* will be used by each participant to improve our data processing efficiency.

a. Single instrument per file:

YYYYMMDD,HH:MM:SS,NNNNN,XXXX.XX

b. Multiple instrument per file:

YYYYMMDD,HH:MM:SS,NNNNN,XXXX.XX,NNNNN,XXXX.XX,...

Where,

YYYY =	Year	
MM	=	Month
DD	=	Day of Month
HH	=	Hour (Mountain Standard Time)
MM	=	Minute " " "
SS	=	Second " " "
NNNNN	=	Radiometer Serial Number (<u>not</u> limited to 5 figures)
XXXX.XX	=	Irradiance (Watts per square meter)

After the last daily RUN, but before equipment tear-down, our Data Keeper (Reda) will circulate a *master diskette* for you to copy all of your corrected data. Cavity calibration files are not needed.

7. Data Processing

-Reda has developed an Excel spreadsheet system for reducing the data.

8. Data Reporting

-Our goal is to provide each participant with next-day analyses.
-A final report will be published by NREL within two months of the comparisons.

9. Equipment Storage

-Each participant will be given space to store systems at SRRL.
-Please let us know if you wish to have any electronics connected to AC power while in storage.

10. Courtesies

-Please get permission before touching someone else's equipment (turning off power strips, adjusting trackers, etc.) to prevent inadvertent data loss.
-Please return borrowed tools to owner.

11. Dinner on Friday (September 27th)

Please join us for a home-cooked meal at the Stoffel's!
Tom will give you directions to his home in Louisville, Colorado (about 24 miles north of NREL.

Schedule of Events (overview)

Monday, 27 Sept 2004

Distribute NREL ***Visitor Badges*** (See Tom)

Participants unpack and install equipment for testing
(Please use ***Seating Chart*** on next page)

Tom & Team will review ***important logistics***

Clear Sky?	Take Solar Irradiance Measurements!
Cloudy, but no precipitation?	Take Practice Data

28 September – 8 October:

After 06:00 MDT - Check Tom's Voice-Mail announcement
303-384-6395

SRRL will be OPEN DAILY from 07:00 MDT to at least 17:00 MDT

Clear Sky?	Arrive SRRL by 07:30 MDT Install Equipment and allow electronics to warm up TAKE DATA!
Cloudy Sky?	Arrive SRRL by 09:00 MDT Technical Presentations in SIMTA Conference Room

NREL Pyrheliometer Comparisons 2004
Seating Diagram

EPLAB	NOAA/CMDL
John Hickey Mike Stein	Don Nelson

ATLAS/DSET	ASMI/NASA
Jerry Maybee Erik Naranen	Fred Denn

ARM/SGP/TWP	JRC/ESTI
Craig Webb Bill Porch	Wim Zaaiman

NOAA/SRRB	Sandia Nat'l Labs
Gary Hodges Joe Michalsky	Bill Boyson Phil Thacher

Lockheed Martin	FSEC
Jim Goza Bill Miller	Ly Vo

NREL
Reda

Telephone Numbers:

EMERGENCY	=	**1 2 3 4** (From ***any*** NREL Phone)
SRRL	=	303-384-6326
Daily Schedule	=	303-384-6395 (Tom)
Tom Stoffel	=	303-666-9719 (Home)

NREL Staff:

Afshin Andreas	Computer Issues (Virus scan, E-mail, Web Site)
Pete Gotseff	Tools, Parts (Electronics and Hardware), Trackers
Bev Kay	Facilities and services (Phone, Mail, Food, Supplies)
Reda	NPC Data Collection & Processing, Cavity Operations
Tom Stoffel	Host (Security, Safety, Logistics)
Steve Wilcox	Computer Issues, Trackers, Cavity Operations

NPC-2004 Technical Discussions: Candidate Topics

The following are simply suggestions for possible presentations and discussions. Please let Tom know if you would like to add a topic!

Summary of the Ninth International Pyrheliometer Comparisons
[Don, Reda, Wim, Tom]

NPC Data Analyses for Determining the WRR Transfer Factor
[Reda]

Relating Solar Radiometers to the SI
[Phil]

Overview of NREL Broadband Outdoor Radiometer Calibrations (BORCAL)
[Tom]

Radiometer Calibration & Characterization (RCC) Software Overview
[Steve]

An Approach for Characterizing Pyranometer Thermal Offsets
[Reda]

Pyrgeometer Blackbody Calibration System Overview
[Reda]

Features of the Measurement & Instrumentation Data Center Web Site
[Tom]

Overview of the Renewable Resource Data Center
[Mary]

Accreditation of Radiometer Calibrations Performed by ATLAS/DSET
[Jerry]

Photovoltaic Performance Characterization at the European Solar Test Installation
[Wim]

The Search for a Diffuse Reference – Results of ARM IOPs
[Joe]

Proper Grounding and Shielding Techniques for Solar Measurement Stations
[Gary]

NREL Pyrheliometer Comparisons (NPC-2004)
27 September - 8 October 2004

Name / Address / Phone / Fax / E-mail — Radiometer(s)

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NREL Staff

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Pete Gotseff	Tools, Parts (Electronics and Hardware), Trackers
Bev Kay	Facilities and services (Phone, Mail, Shipping, Food)
Ibrahim Reda	NPC Data Collection & Processing, Cavity Operations
Tom Stoffel	Host (Security, Safety, Logistics, Food)
Steve Wilcox	Computer Issues, Trackers, Cavity Operations

DRAFT: PLEASE REVIEW AND MAKE CORRECTIONS/ADDITIONS

NREL Pyrheliometer Comparisons 2004

List of Radiometers

No.	Serial No.	Owner / Application
1	AHF 14915	EPLAB / Reference Standard
2	AHF 17142	Atlas Weathering Services-DSET Labs / Reference Standard
3	AHF 23734	NREL / Photovoltaics Program Reference
4	AHF 28553	NOAA Climate Monitoring & Diagnostics Laboratory (CMDL) / Reference
5	AHF 28964	DOE ARM / Southern Great Plains Site Reference
6	AHF 28968	DOE ARM / Program Reference
7	AHF 29220	NREL / Metrology Lab Reference Standard #2
8	AHF 29222	DOE ARM-Southern Great Plains / All-Weather
9	AHF 30494	DOE ARM Tropical Western Pacific Working Standard
10	AHF 30495	DOE ARM-Southern Great Plains Working Standard
11	AHF 30710	NOAA / Surface Radiation Research Branch Reference
12	AHF 30713	NREL / Metrology Lab Working Standard #1
13	AHF 31041	NASA Clouds and the Earth's Radiant Energy System (CERES) / Reference 1
14	AHF 31104	NREL / Metrology Lab Working Standard #2
15	AHF 31105	NASA / CERES Reference 2
16	AHF 31108	Sandia National Laboratories / PV Reference Standard
17	AHF 32455	PMOD/WRC / _____(John/Mike?)
18	AWX 32452	NREL / All-Weather Standard
19	HF 21182	FSEC / Primary Standard
20	PMO6 81109	European Commission Directorate General / Reference Standard
21	PMO6 911204	European Commission Directorate General / Reference Standard
22	TMI 67502	NOAA CMDL / Reference Standard
23	TMI 67603	Sandia National Laboratories / PSL Reference Standard
24	TMI 68017	NREL / SRRL All-Weather BORCAL Working Standard #2
25	TMI 68018	NREL / Metrology Lab Reference Standard #1
26	TMI 68020	Lockheed Martin Technical Operations / Denver Metrology Services Reference
27	TMI 69036	NREL Metrology Lab / BORCAL Working Standard #3
28	NIP 26356E6	NOAA/ARL/SRRB / Research Instrument (5º fov, CaF2 window)