

Welcome! NREL Pyrheliometer Comparisons 2018 NPC-2018

24 September – 5 October



NPC-2017 Participants

15013 Denver West Parkway Golden, CO 80401 Phone 303-275-3000 NREL is a national laboratory of the U.S. Department of Energy Office of Energy Efficiency & Renewable Energy Operated by the Alliance for Sustainable Energy, LLC Radiometers at the Solar Radiation Research Laboratory (SRRL)

Welcome to the 21th NREL Pyrheliometer Comparisons NPC-2018

24 September – 5 October 2018 Solar Radiation Research Laboratory Golden, Colorado

The purpose of this NPC is to provide participants with current World Radiometric Reference (WRR) reduction factors for their absolute cavity radiometers and other reference pyrheliometers based on results from the 12th International Pyrheliometer Comparisons (IPC-XII) conducted 28 September – 16 October 2015 at the Physikalisch-Meteorologisches Observatorium Davos/World Radiation Center (PMOD/WRC). Information about IPC-XII is available from : <u>http://www.pmodwrc.ch/pmod.php?topic=ipcxii</u>

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SRRL Staff

NREL Metrology Laboratory & Sensing and Predictive Analytics (SePA) group

Afshin Andreas	Computer Issues, NREL Cavity C	Operations
Mike Dooraghi	Solar Trackers, Tools, Electronics Operations	s and Hardware, NREL Cavity
Aron Habte	General Assistance, Data collecti	on and compilation
Mark Kutchenreiter	Electrical Power, Tools, Electroni	cs and Hardware
Martina Stoddard	Host (Security, Logistics, Food)	
Ibrahim Reda	NREL Cavity Operations, NPC Date Cavity Assistance	ata Collection & Processing, General
SRRL Location		
	Solar Radiation Research Lal	ooratory
	(SRRL)	
	Latitude:	39.742 N
	Longitude:	105.18 W
	Elevation:	1828.8 m AMSL
	Mean Station Pressure:	820 mBar
	Time Zone:	(GMT – 7.0)
	Phone:	303-384-6326

Emergency Phone:

Telephone Numbers:

EMERGENCY =	-	303-384-6811 Or <u>1 2 3 4</u> (From <i>any</i> NREL Desk Phone)
SRRL		= 303-384-6326

1234 (on-site)

Safety

Emergency Phone: **RED BOX** UNDER INSTRUMENT DECK OR Press **1 2 3 4** from <u>any</u> NREL extension

Evacuation Assembly Area: Northeast Corner of Parking Area

Security

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

NREL *Visitor Badges* issued on first day of NPC at the Visitor Center. Please wear your badge at all times at SRRL.

Communications

Local (Long Distance): 9 - (1) Area Code – Number

Internet Access:

NREL_Wireless was replaced with NREL-Guest. The new system does not require a user ID and password for access. Users, including visitors and partners, *will only need to accept the terms* of the acceptable use policy to gain access. The acceptable use policy will be presented each time your mobile device has been away from NREL for several days.

Food & Beverages

Lunch Menu will be circulated daily by 9:30 MDT (see Martina)

Non-alcoholic Beverages and snacks provided

Equipment Storage

Please use *designated areas* in SRRL staging areas.

Dinner on Tuesday (September 25th)

Please join us for the NPC Dinner!

Dinner will be at **Outback steakhouse**. *Boisterous Australian-themed chain serving steaks, seafood & other hearty steakhouse fare.* Located in: Denver West Village Address: 14295 W Colfax Ave, Lakewood, CO 80401 Menu: places.singleplatform.com We will meet for dinner around 6:30 PM.

1. Schedule

DAY # 1 September 24th

a. Visitor check-in at NREL Site Entrance Building, 15013 Denver West Parkway, Golden, CO 80401.

Please plan to arrive at NREL between 07:00 and 08:00 MDT.

- b. Drive to SRRL Call 303-384-6326 and stay on the phone till the gate opens remotely.
- c. 08:30 MDT Equipment Installation & tests: Dry Weather - See the **outdoor** seating diagram below for your workstation. Wet Weather – Assemble and bench test your equipment inside SRRL. Locate your equipment and review seating charts
- d. Review of NPC Protocol
- e. Review measurement protocol and procedures.
- f. 11:00 to Sunset Practice and/or NPC measurements (weather permitting)

DAYS #2-12: 25 September through 05 October (Daily, including the 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 the 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 Test

- -Office Time (wireless available)
- c. We will determine the need for continued measurements at the end of each day.

2. Time Keeping

-Wim Zaaiman will again be our timekeeper (as long as his voice holds out!)

-All time records will be Mountain Standard Time (MST)

-Outdoor time display is available for guidance *(Wim's time is the Reference Time!)* -We need to keep all PC clocks in agreement to better than 1 sec.

-Set your system clock at the daily start-up or as often as needed to keep 1-second accuracy. Check personal computer clocks during the day.

3. 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 2,000 data values for each participating cavity radiometer. At least <u>300</u> data values are needed to provide a valid transfer of the WRR to the participating radiometers.

4. Measurements

- Do <u>NOT</u> apply any previous WRR correction factors to your measurements.
- Use <u>only</u> the factory calibration factor to adjust your data. As in the past, we will use the following terms:
- "Calibrate" = Perform electrical calibration and wait for next measurement period to begin
- "Read" = A measurement of direct irradiance within 1 sec of announcement at 30-sec intervals.
- "Run" = Collection of 49 readings taken in sequence (also called a Series).

The *Timekeeper* will make the following announcements for <u>each Run</u>:

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 30 sec intervals until 49 readings have completed a "Run"

6. Data Transfer

The following <u>standard data format</u> will be used by each participant to improve our data processing efficiency. Please see the emailed example file format or see Reda or Mike if you have any questions about the data format.

After the last daily RUN, and **before** equipment tear-down, email your data file to Mike and Reda <u>Mike.dooraghi@nrel.gov</u> and <u>Ibrahim.reda@nrel.gov</u>. Cavity calibration files are not needed.

7. Data Processing

- Described in each NPC published/distributed report.

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.

Don Nelson	Chuck Long	Diane Stanitski	Christian Herrera	Kathy Lantz	NOAA/ESRL/GMD	Attendees W/o
				Tom Stoffel	Solar Resource Solutions, LLC	Attendees without Instruments

NPC-2018

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BORCAL STR32Gs National Renewable Energy Laboratory Metrology, SePA, and Cell & Module Certification Group) Andreas Afshin Ibrahim Reda

	Bonch # 6: Brosker #
	Cornelis Hoogendijk
	Takeuchi Eiji
Charles Robin	Beuttell Will
Bill Boysor	Akihito Akiyama
Sandia National Lab (Photovoltaic Systems Lab)	EKO Instruments
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Deputiding own trackor	Bench # 3: Breaker #		Craig Webb	DOE Atmospheric Radiation Measurement (ARM) Program	ARM-Brusag 1
	6		Wim Zaaiman	European Commission Directorate General JRC	ARM-Brusag 2

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Craig Webb	DCE Atmospheric Radiation Measurement (ARM) Program	ARM-Brusag 1	Participant Names	Organizational Name

		Jim Augustyn	Augustyn & Company	Tracker Not needed	
Peter A. Pyrh 4				NREL-STR32G Deck	

		Jim Augustyn	Augustyn & Company	Tracker Not needed	
Peter A. Pyrh 4				NREL-STR32G Deck	
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SE Patio	SE Patio with EriK N
Erik Naranen	Thijs Nijveldt
пс	
ISO-CAL North America,	Hukseflux Thermel Sensors
ISO CAL supplied tracker	ISO CAL supplied tracker
Top Breaker # 5	Table

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		Adriana Gonzalez	UNAM	NREL-2AP #1
		Jose Balenzategui	CIEMAT	NREL-2AP #1
		Josh Peterson	SRML University of Oregon	NREL-2AP #2
	Mohammed Al Subaie	Mohammed Al Harbi	King Abdullah City for Atomic and Renewable Energy (KACARE)	NREL-2AP #2
		Peter Armstrong	Masdar Institute of Khalifa University	NREL Brusag (Spare)

Day		Gian Mazzadi-Smith	William Miller	Jim Goza	Lockheed Martin	Providing own tracker	
54 # C. Drasbar # 3				Patrick Smith	Atlas Material Testing Technology, LLC	Providing own tracker	
			Bryan Fabbri	Fred Denn	Science Systems & Applications, Inc.	Providing own tracker	

Ben			Alan Nelson	Tim Moss	Sandia National Labs Concentrating Solar Energy)	Providing own tracker
ch#2: Breaker#7		Singh Ajay	Robert Hyatt	Matt Perry	Campbell Scientific Inc.	Providing own tracker
				Anthony Bucholtz	Naval Research Laboratory	Providing own tracker

		Alan Nelson	Tim Moss	Sandia National Labs (Concentrating Solar Energy)	Providing own tracker
	Singh Ajay	Robert Hyatt	Matt Perry	Campbell Scientific Inc.	Providing own tracker
			Anthony	Naval Resear	Providing

Bench #1: Br		Joop Mes	Victor Cassella	ipp & Zonen USA, Inc	NREL-2AP #1	
reaker # 9		Markus Suter	Christian Thomann	PMOD/WRC	ARM-Brusag 3	Wants a trolley reserved

Providing own tracker

Providing own tracker

NOAA/ESRL/GMD

EPPLEY LAB

Jim Wendell Emiel Hall

Tom Kirk

Bench #4: Breaker # 11

Kipp & 2

Tracker Info

Full Name	Affiliation	E-mail	
Patrick Smith	Atlas Material Testing Technology, LLC	patrick.smith@ametek.com	
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Charles Robinson	Sandia National Laboratories (Photovoltaic Systems Evaluation Lab)	<u>cdrobin@sandia.gov</u>	
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Bryan Fabbri	Science Systems & Applications, Inc.	bryan.e.fabbri@nasa.gov
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