



Welcome!
NREL Pyrheliometer Comparisons 2023
NPC-2023

25 September – 6 October



NPC-2022 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

Welcome to the 24rd NREL Pyrheliometer Comparisons NPC-2023

25 September – 6 October 2023
Solar Radiation Research Laboratory
Golden, Colorado

The purpose of NPCs <https://aim.nrel.gov/npc.html> 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 13th International Pyrheliometer Comparisons (IPC-XIII) conducted 27 September – 15 October 2021 at the Physikalisch-Meteorologisches Observatorium Davos/World Radiation Center (PMOD/WRC). Information about IPC-XIII is available from : <http://www.pmodwrc.ch>

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SRRL Staff

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

Afshin Andreas	NREL Cavity Operations, NPC data processing, Computer Issues
Aron Habte	General Assistance
Shawn Jaker	Electrical Power, Tools, Electronics and Hardware, NREL Cavity Operations, Solar trackers, Computer Issues
Aaron Kepple	Electrical Power, Tools, NREL Cavity Operations
Martina Stoddard	Host (Security, Logistics, Food)
Ibrahim Reda	NPC Data review, General Cavity Assistance

SRRL Location

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)
Phone:	303-384-6326
Emergency Phone:	1234 (on-site)

Telephone Numbers:

EMERGENCY = 303-384-6811
Or
1 2 3 4 (From **any** NREL Desk Phone)

SRRL = 303-384-6326

Safety

Emergency Phone: **RED BOX UNDER INSTRUMENT DECK**
OR Press 1 2 3 4 from any 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

Non-alcoholic Beverages and snacks provided

Equipment Storage

Please use **designated areas** in SRRL staging areas.

Dinner on Tuesday (September 26th)

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 6:00 PM.

NPC Schedule and Protocol Summary

1. Schedule

DAY # 1 September 25th

- 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. 10:00 to Sunset - Practice and/or NPC measurements (weather permitting)

DAYS #2-12: 26 September through 06 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

- All time records will be Mountain Standard Time (MST)**
- Outdoor time display with automated loudspeaker announcements will be available.
- We need to keep all PC clocks in agreement to better than 1 second.
- 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 300 data values are needed to provide a valid transfer of the WRR to the participating radiometers.

4. Measurements

- Do **NOT** apply any previous **WRR** correction factors to your measurements.
- Use **only** 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 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 30 sec intervals until 49 readings have completed a "Run"

6. Data Transfer

The following standard data format will be used by each participant to be accepted by our new data processing software; Link: https://aim.nrel.gov/Calibrations/NPC/data_format.pdf

After the last daily RUN, and **before** equipment tear-down, email your data file to afshin.andreas@nrel.gov and ibrahim.reda@nrel.gov. 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 results next day:

<https://aim.nrel.gov/npcprelim>

-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.

NREL Pyrheliometer Comparisons 2023

Outdoor Seating Diagram

Tracker Info
Organizational Name
Participant Names

Brusag (ARM provided)	Tracker (participant provided)
PMOD/WRC Davos Instruments	OTT HydroMet/Kipp & Zonen
Christian Thomann	Victor Cassella
	Nathan Farrar
Markus Suter	Damon Nitzel

Bench # 1: Breaker # 9

2AP (NREL provided)	SOLYS-GD (NREL provided)
CIEMAT UNAM	King Abdullah City for Atomic and Renewable Energy (KACARE)
Jose Balenzategui	Abdullah Al Adwani
	Abdullah Kalantan
Adriana Gonzalez	Abeer Alharbi
	Mohammed Ababatein
	Abdulmajeed Al Babtin

Bench # 2: Breaker # 7

EKO (participant provided)	Brusag (ARM provided)
EKO Instruments	DOE Atmospheric Radiation Measurement (ARM) Program
Akihito Akiyama	Craig Webb
Taiji Yamashita	James Martin
Wayne Burnett	

Bench # 3: Breaker # 2

Brusag (ARM prov.)
Extra tracker on pole

Eppley (participant provided)	Eppley (participant provided)
NOAA	Eppley Laboratory
Emiel Hall	Tom Kirk
Logan Soldo	Jim Wendell
Allen Jordan	
Laura Riihimaki	
Donald Nelson	

Bench # 4: Breaker # 11

SOLYS2 (participant provided)	Prede (participant provided)
United Kingdom Met Office	Japan Meteorological Agency (JMA)
David Hiscock	Nozomu Ohkawara
John Ludlam	

Bench # 5: Breaker # 3

EKO (participant provided)	Eppley (participant provided)
Campbell Scientific Inc.	Analytical Mechanics Associates (AMA) / NASA Langley
William Beuttell	Frederick Denn
	Bryan Fabbri

Bench # 6: Breaker # 6

SOLYS (NREL provided)	EKO (participant provided)
University of Oregon (extra space for 1 ACR)	ISO-Cal North America
Josh Peterson	Erik Naranen
Elizabeth Bryan	

East Patio (on poles): Breaker # MLP2 - 33 & 35

EKO (NREL provided)
National Renewable Energy Lab (NREL)
Afshin Andreas
Ibrahim Reda
Shawn Jaker
Aaron Kepple

Breaker #1

EKO (participant provided)	EKO (participant provided)	EKO (participant provided)
Sandia National Laboratories (SNL)	Hukseflux Thermal Sensors B.V.	Atlas Material Testing Technology
Charles Robinson	Jorgen Konings	Major McGee
	Michael Donkers	

Table Top Breaker # 5

SRRL Instrument Platform			
Japan Meteorological Agency (JMA)	PMOD	Libyan Center for Solar Energy Research and Studies	
Nozomu Ohkawara	Christian Thomann	Akram Essnid	

Participant Contact Information

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