NREL
NATIONAL RENEWABLE ENERGY LABORATORY

ARM Radiometer Ventilator DC Fan Upgrades Ventilation Configuration Evaluations

2015 ASR Science Team Meeting

by

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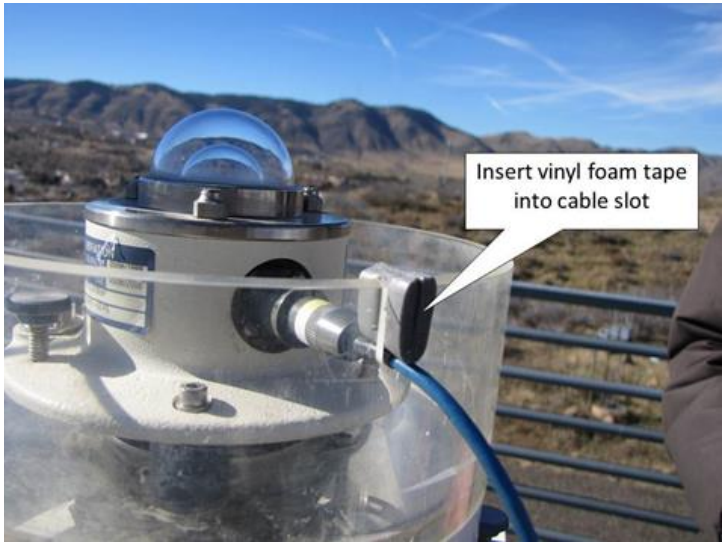
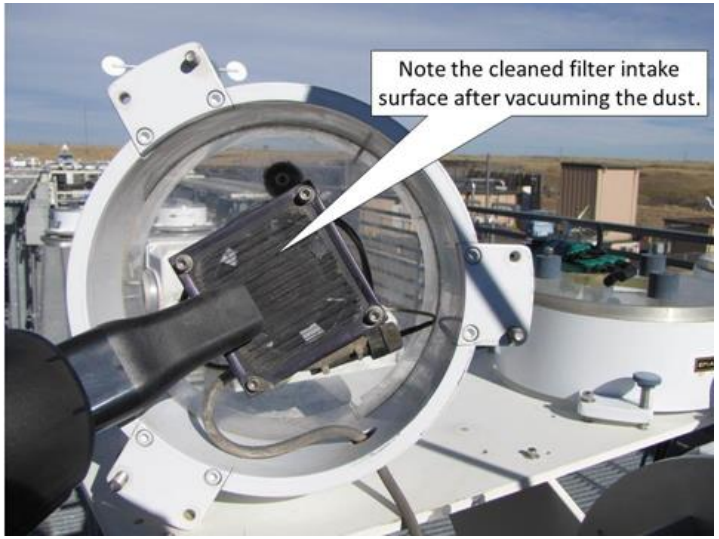
Topics Overview

- Ventilator flow maintenance.
- DC fan evaluation and selection.
- Installation of DC fans in SGP RCF ventilators prior to 2014 BORCAL.
- Perform 2014 SGP BORCAL using the new DC fans.
- Installation of DC fans and newly calibrated radiometers in ventilators at sites.
- Testing of modified tracker support plates and screen configurations.
- Results of transition from AC to DC fans in radiometer ventilators at sites.
- Tracker plate modification and Single Radiometer Configuration.

Ventilator Flow Maintenance

- The “SIRS HANDBOOK ADDENDUM PSP, 8-48, AND PIR VENTILATOR FLOW MAINTENANCE” document was provided to site operators in December, 2013.
- Information and examples regarding checking/correcting ventilator leaks, and performing routine flow checks were included in document.

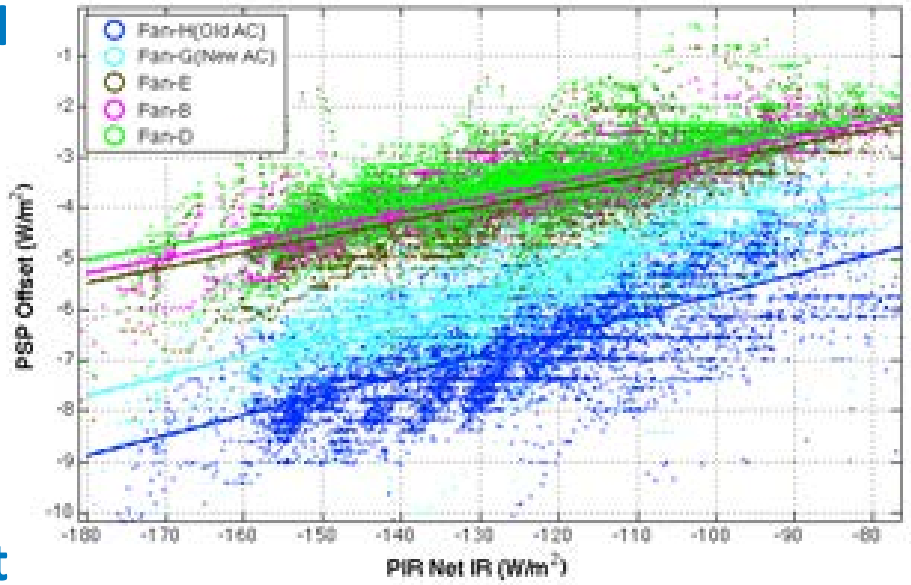




Initial Testing of Candidate 12VDC Fans

- Six 12VDC fans with 50-60cfm rating were evaluated at NREL, with original model AC reference fans during January and February 2014.
- PSP night time offsets vs. netIR from NREL collocated PIR demonstrated offset improvements of ~ 2.5 - 3.0 W/m^2.
- All of the DC fans tested provided higher flows and generally equivalent IR loss reduction.
- Delta Electronics Model FFB0812VH-T500 was selected based on design characteristics.

Nighttime Data Evaluation



Tested AC and DC Fans

Fan Manufacturer	Part Number	Type	Test Designation
Delta Electronics	QFR0812SH-F00	12VDC	A
Sunon	PMD1208PKB1-A.(2).GN	12VDC	B
Delta Electronics	FFB0812VH	12VDC	C
Delta Electronics	FFB0812VHE-F00	12VDC	D
Delta Electronics	**FFB0812VH-T500**	**12VDC**	**E**
Pelonis	K8038L12BPLB2-7	12VDC	F
Sanyo Denki	109-043UL	115VAC Eppley [Former Eppley fan]	G
Comair Rotron	SUZA1 “Sprite”	115VAC Eppley [Original Eppley fan]	H

Installation of 12VDC Fans at SGP BORCAL Facilities

- RCF BORCAL ventilator fan upgrade parts were procured by SGP.
- 12 volt DC fan installation in BORCAL ventilators completed in April, 2014.
- 2014 BORCALs of PSPs ,8-48s performed at SGP RCF with the new DC fans.

ECO-00991 - Deployment of 12VDC Fans at Radiometry Sites

- Procurement information was provided to PNNL.
- Transition to the 12 volt DC fans at SIRS, BRS, ENA, MAO, and TWP C3 sites was performed when the newly calibrated PSP, 8-48, and PIR instruments were installed.
- PSP, 8-48, and PIR ventilator transitions to DC fans performed:
  - ✓ SGP July-August, 2014
  - ✓ TWP C3 September, 2014
  - ✓ ENA December, 2014
  - ✓ MAO February, 2015.

ECO-00991 VENTILATION UPGRADE FAN AND POWER SUPPLY PROCUREMENT				
ARM STATION LOCATIONS	**ITEMS AND QUANTITIES**			
	80mm 12VDC Fan[1]	**12VDC Power Supply[2]**	**80mm Fan Screen[3,4]**	**Fastener Sets[5]**
SGP BRS	3	1	3	3
SGP C1	3	1	3	3
SGP E9- E38 (15 sites)	45	15	45	45
BRS, C1, E9-38 Spares	12	5	12	12
ENA SKYRAD	4 + 2 Spares	1 + 1 Spare	4 + 4 Spares	4 + 4 Spares
MAO SKYRAD	4 + 4 Spares	1 + 1 Spare	4 + 4 Spares	4 + 4 Spares
NSA SKYRAD	4 + 4 Spares	1 + 1 Spare	4[4]	4 + 4 Spares
NSA GNDRAD	2 + 2 Spares		2[4]	2 + 2 Spares
OLI SKYRAD	4 + 4 Spares	1 + 1 Spare	4[4]	4 + 4 Spares
OLI GNDRAD	2 + 2 Spares	1 + 1 Spare	2[4]	2 + 2 Spares
TMP SKYRAD	4 + 4 Spares	1 + 1 Spare	4[4]	4 + 4 Spares
TMP GNDRAD	2 + 2 Spares	1 + 1 Spare	2[4]	2 + 2 Spares
TWP C3[6] SKYRAD	4 + 2 Spares	1 + 1 Spare	0[4]	4 + 4 Spares
TOTALS	119	38	89	

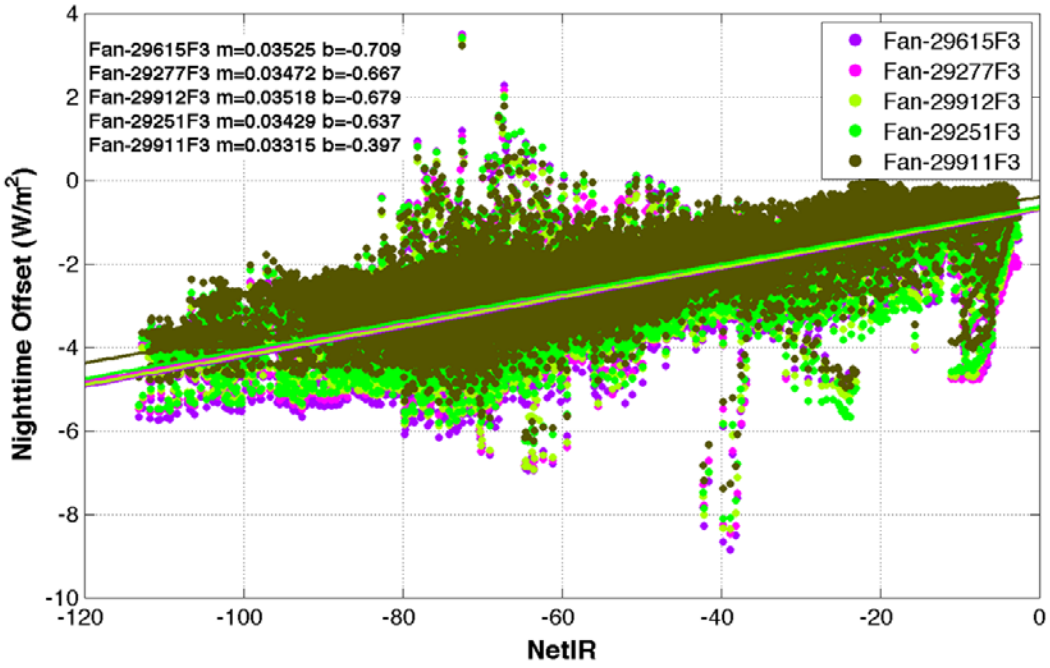
Tracker Plate Modification and Screen Test Configurations

Five configurations of tracker plates and fan air inlet screens were tested at NREL during the 2014-2015 winter period.

EPPLEY VENTILATOR PLATE-SCREEN TEST CONFIGURATION			
VENTILATOR NUMBER	EPPLEY PSP SERIAL NUMBER	SOLAR TRACKER PLATE HOLE SIZE (INCHES)	AIR INTAKE SCREEN SIZE (MM)
V1	29615F3	6	80
V2	29277F3	No Hole	80
V3	29912F3	5	80
V4	29251F3	6.5	120
V5	29911F3	6.5	No Screen

Test Configuration Nighttime Thermal Offset Comparison

- Analysis of thermopile outputs from the ventilated PSPs, relative to SRRL baseline netIR indicate no significant differences among the V1, V2, V3, V4, and V5 tracker plate and air intake test configurations. The V2 configuration is currently used at ARM sites.
- The reduction of PSP nighttime thermal offsets as achieved in the SIRS and SKYRAD DC fan upgrades under ECO-00991 remained consistent with the performance of the five tracker plate and fan air intake screen configurations used with ventilators in this test.

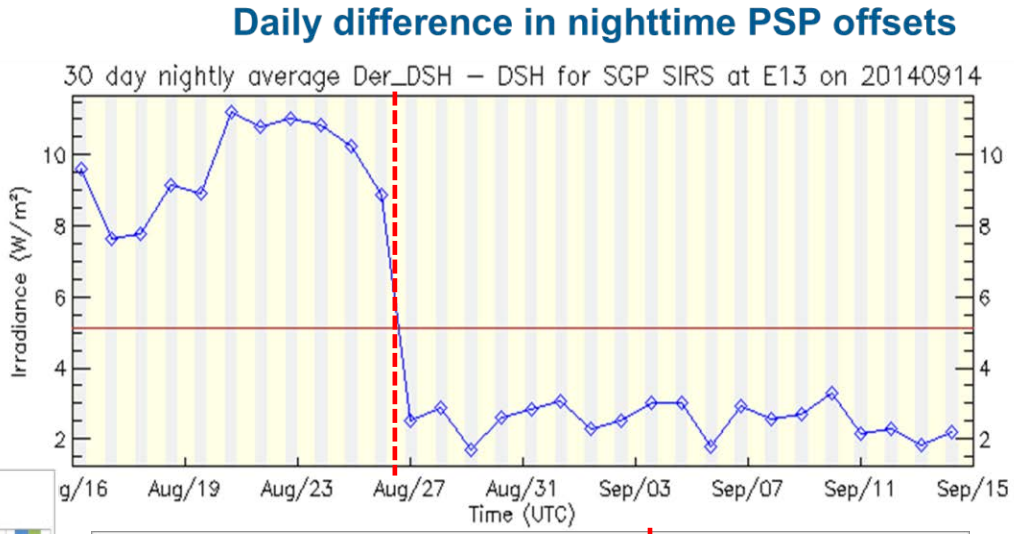


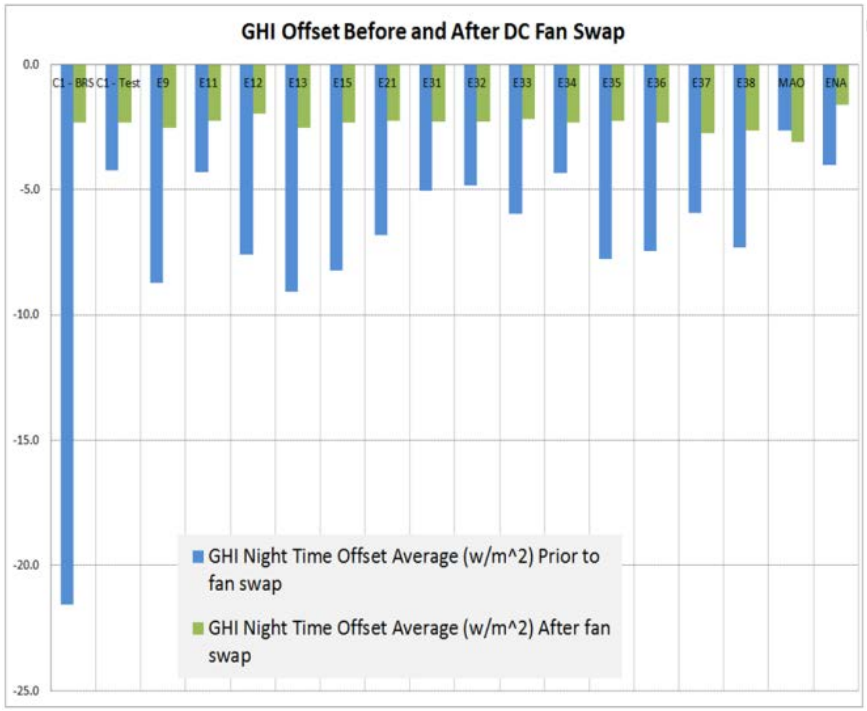
PSP Dome Snow, Frost, Accumulation Prevention/Reduction

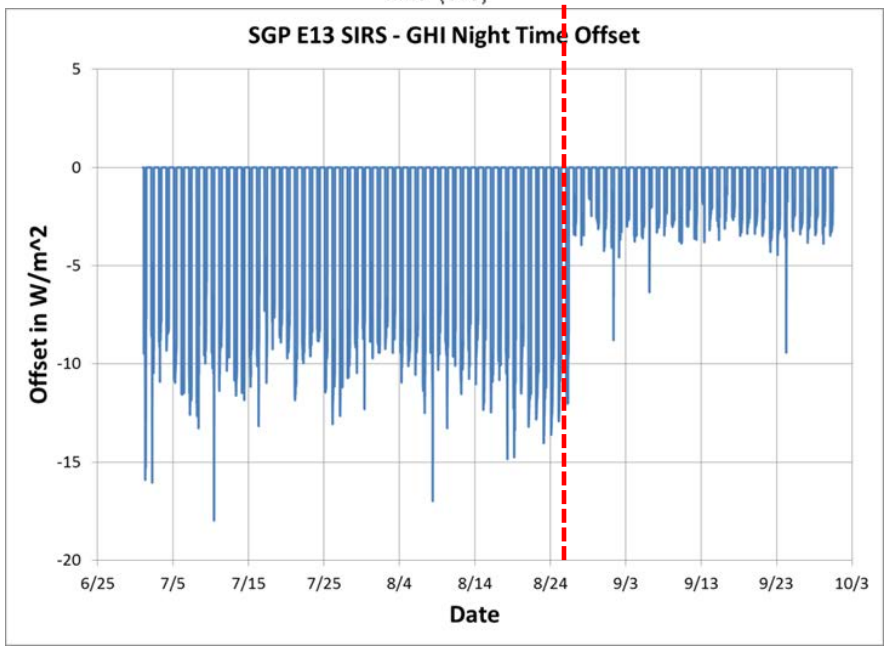
The five ventilator and plate-screen test configurations provided similar performance for prevention/reduction of snow and frost accumulations on PSP domes.

Results of DC Fan Deployment at Sites

- Transition to the higher flow 12 volt DC fans in ventilators consistently resulted in the reduction of PSP thermal offset responses.
- Average change in nighttime thermal offset for PSPs from the 18 sites was from -7.0 w/m2 prior to the fan change to -2.3 w/m2 after the fan change.

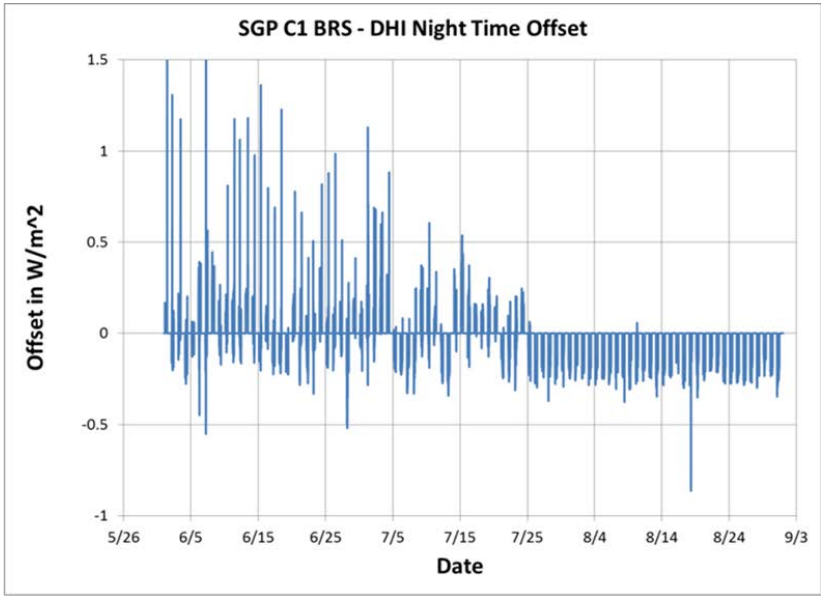


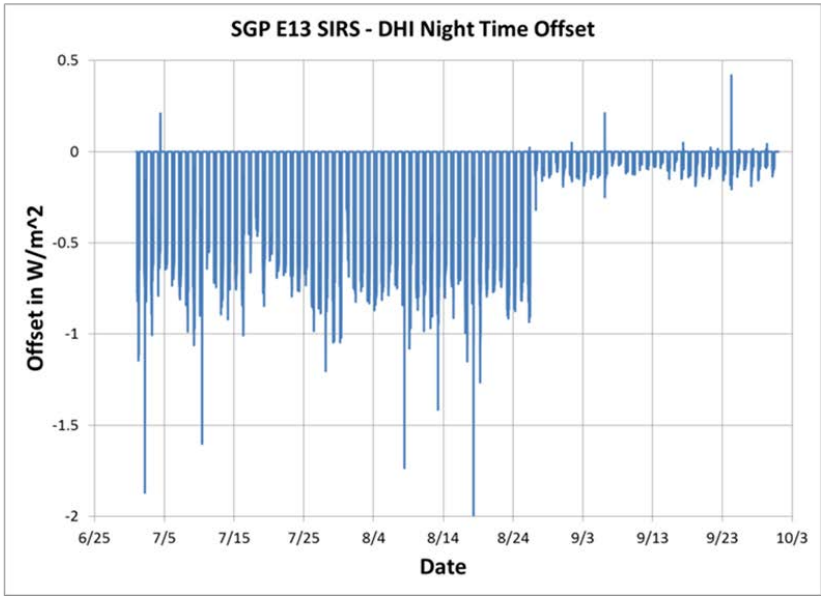




Results of DC Fan Deployment at Sites

- Thermal offset magnitudes were always significantly less for the 8-48s as compared to the PSPs.
- Scatter of the nightly thermal offsets for some sites was reduced; SGP C1 BRS shown.
- The average change in 8-48 nighttime offsets for the 18 sites was from -0.7 w/m2 prior to performing the fan change to -0.3 w/m2 after the fan change.





Future Activities

- **Confirm Single Radiometer Configuration viability for all sites.**
- **Preparation of ECR for combined Single Radiometer Configuration and plate modification for SIRS and SKYRAD sites would include:**
  - **Modify SIRS tracker plates with holes and addition of second PIR**
  - **Modify SKYRAD tracker plates to include holes under ventilators for SKYRAD sites**
  - **Operate SKYRAD and GNDRAD on single logger**
  - **Separate IRTs under ECO-00990.**