



25570 Rye Canyon Road Unit J • Valencia, California 91355 • (661)-294-1103 fax (661)-294-0236

Site: Bishop Paiute Reservation

Audit Date: September 29, 2020

Instrumentation Audited: Ozone, Meteorology and Particulate Matter

Key Person(s): Emma Ruppell

Auditor: David Yoho

Technical & Business Systems, Inc.  
25570 Rye Canyon Rd., Unit J  
Valencia, CA 91355

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The purpose of this summary is to provide a report of significant audit findings at the Bishop Paiute Reservation in Bishop, California. Key elements of the audit are identified below. Results of the performance audit comparisons are included.

**GENERAL COMMENTS**

No comments were noted at the time of the audit.

**KEY AUDIT FINDINGS**

**Ozone**

No performance problems were noted.

**Meteorology**

1. An audit of the tipping bucket rain gauge had results that do not meet the recommended criteria.
2. The audit results of the barometric pressure sensor were outside of the recommended audit criteria. The datalogger program offset was adjusted which brought the sensor response back within criteria.
3. The wind direction sensor 360-degree point indicated 337 degrees on the DAS when the vane was completely still. When the wind vane was slightly rotated to the left and right of 360 degrees the DAS showed 360 degrees. The Climatronics wind direction and wind speed sensors were replaced with a new RM Young 0530 Wind Monitor AQ sensor. The audit verification for the new sensor is included below.

**Particulate Matter (PM<sub>10</sub> and PM<sub>2.5</sub>)**

No performance problems were noted.

**AUDIT RECORD**



25570 Rye Cyn Rd., Unit J  
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**OZONE**

Date: **09/29/20**  
Start: **7:45 PST**  
Finish: **9:45 PST**  
Auditor: **David Yoho**  
Witness: **Emma Ruppell**

Site Name: **Bishop Paiute**  
Operator: **Emma Ruppell**  
Project: **QA**

Analyzer make: **Thermo Electron**  
Serial No.: **630719320**  
Sample flow: **0.608/0.552 lpm**  
Slope Set Point: **1.000**  
Zero Set Point: **-0.40**  
Range: **0.5 ppm**

Model: **49i**  
Filter: **NA**  
Ozone Measure: **74282**  
Ozone Ref: **103192**  
Last Calibrated: **NA**

O <sub>3</sub> Audit Point	PPM Input (X)	PPM DAS (Y)	PPM Dif (%)
1	0.000	0.001	
2	0.030	0.029	-3.3
3	0.080	0.077	-3.8
4	0.180	0.176	-2.2

Linear Regression: (Y=PPM Corrected, X=PPM Input)

Audit Statistics	
Slope:	0.974
Intercept:	0.000
Correlation:	0.9999

Comments: No problems were noted.

Audit Equipment	Make	Model	ID	Certification Date
Dilution System:	API	M700EU	83	9/9/20
Ozone Standard:	API	M700EU	83	09/09/20
Zero Air System:	API	701	2427	NA

Ozone Transfer Standard	
Sample Freq: NA	Cell Temperature: NA deg C
Control Freq: NA	Ambient Pressure: NA "Hg
Span Setting: NA	Certification Slope: 0.9956
	Certification Intercept: 0.0000 ppm

**AUDIT RECORD**



25570 Rye Cyn Rd., Unit J  
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**HORIZONTAL WIND SPEED**

Date: **09/29/20**  
Start: **10:00 PST**  
Finish: **13:30 PST**  
Auditor: **David Yoho**  
Witness: **Emma Ruppell**

Site Name: **Bishop Paiute**  
Operator: **Emma Ruppell**  
Project: **QA**

Manufacturer: **Climatronics**  
Serial No.: **4924**  
K factor: **1.4**  
Range: **0 - 125 mph**  
Last Calibrated: **NA**

Model: **100075**  
Sensor Ht.: **10 meters**  
Starting torque: **0.1 gm cm**  
Starting threshold: **0.60 mph**  
Starting threshold criteria: **1.1 mph**

Audit Point	Input MPH	DAS MPH	Diff. MPH
1	0.30	0.30	0.00
2	8.19	8.22	0.03

*Audit Criteria:  $\pm 5.6$  MPH; ws  $\leq 11.2$  MPH*

Audit Point	Input MPH	DAS MPH	Diff. %
3	16.08	16.08	0.0
4	31.86	31.88	0.1
5	47.64	47.66	0.0

*Audit Criteria:  $\pm 5\%$ ; ws  $> 11.2$  MPH*

Comments: No problems were noted. Following the audit, the wind speed sensor was replaced with a RM Young 05305 Wind Monitor AQ sensor.

**AUDIT RECORD**



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**HORIZONTAL WIND SPEED**

Date: **09/29/20**  
Start: **10:00 PST**  
Finish: **13:30 PST**  
Auditor: **David Yoho**  
Witness: **Emma Ruppell**

Site Name: **Bishop Paiute**  
Operator: **Emma Ruppell**  
Project: **QA**

Manufacturer: **RM Young** Model: **05305**  
Serial No.: **179042** Sensor Ht.: **10 meters**  
K factor: **3.8** Starting torque: **0.1 gm cm**  
Range: **0 - 125 mph** Starting threshold: **0.36 mph**  
Last Calibrated: **NA** Starting threshold criteria: **1.1 mph**

Audit Point	Input MPH	DAS MPH	Diff. MPH
1	0.00	0.00	0.00
2	5.73	5.73	0.00

*Audit Criteria: ±.56 MPH; ws ≤ 11.2 MPH*

Audit Point	Input MPH	DAS MPH	Diff. %
3	17.18	17.18	0.0
4	28.63	28.63	0.0
5	40.08	40.08	0.0
6	51.53	51.53	0.0
7	62.98	62.98	0.0
8	74.43	74.43	0.0

*Audit Criteria: ± 5%; ws > 11.2 MPH*

Comments: No problems were noted with the replacement sensor.

**AUDIT RECORD**



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**HORIZONTAL WIND DIRECTION**

Date: **09/29/20**  
Start: **10:00 PST**  
Finish: **13:30 PST**  
Auditor: **David Yoho**  
Witness: **Emma Ruppell**

Site Name: **Bishop Paiute**  
Operator: **Emma Ruppell**  
Project: **QA**

Manufacturer: **Climatronics**  
Serial No.: **4678**  
K factor: **30**  
Range: **0 - 360°**  
Crossarm: **180°**  
Last Calibrated: **NA**

Model: **100075**  
Sensor Ht.: **10 meters**  
Starting torque: **4 gm cm**  
Starting threshold: **0.82 mph**  
Starting threshold criteria: **1.1 mph**

Audit Point	Degrees Reference	Degrees DAS	Diff. Degrees
1	360	337	-23
2	90	87	-3
3	180	178	-2
4	270	267	-3

*Audit Criteria: ± 5 degrees*

Comments: The 360 deg point indicated 337 on the DAS when the vane was completely still. When the wind vain was slightly rotated to the left and right of 360 the DAS showed 360 deg. The sensor was replaced with an RM Young 05305 Wind Monitor AQ.

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**HORIZONTAL WIND DIRECTION**

Date: **09/29/20**  
Start: **10:00 PST**  
Finish: **13:30 PST**  
Auditor: **David Yoho**  
Witness: **Emma Ruppell**

Site Name: **Bishop Paiute**  
Operator: **Emma Ruppell**  
Project: **QA**

Manufacturer: **RM Young**  
Serial No.: **179042**  
K factor: **37**  
Range: **0 - 360°**  
Crossarm: **180°**  
Last Calibrated: **NA**

Model: **05305**  
Sensor Ht.: **10 meters**  
Starting torque: **6 gm cm**  
Starting threshold: **0.90 mph**  
Starting threshold criteria: **1.1 mph**

Audit Point	Degrees Reference	Degrees DAS	Diff. Degrees
1	45	46	1
2	90	91	1
3	135	134	-1
4	180	180	0
5	225	226	1
6	270	272	2
7	315	318	3
8	0	2	2

*Audit Criteria: ± 5 degrees*

Comments: No problems were noted with the replacement sensor.

**AUDIT RECORD**



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**AMBIENT TEMPERATURE**

Date: **09/29/20**  
Start: **10:00 PST**  
Finish: **13:30 PST**  
Auditor: **David Yoho**  
Witness: **Emma Ruppell**

Site Name: **Bishop Paiute**  
Operator: **Emma Ruppell**  
Project: **QA**

Manufacturer: **Climatronics**  
Serial No.: **6916**  
Lower Range: **-22**      **Deg F**  
Upper Range: **122**      **Deg F**  
Last Calibrated: **NA**

Model: **62**  
Sensor Ht.: **9 m**

Audit Point	Input Deg F	DAS Deg F	Diff. Deg F
1	32.5	32.7	0.2
2	71.9	71.8	-0.1
3	106.3	106.8	0.5

*Audit Criteria: ± 1.8°F*

Comments: No problems were noted.



**AUDIT RECORD**



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***PRECIPITATION***

Date: **09/29/20**  
Start: **9:00 PST**  
Finish: **10:00 PST**  
Auditor: **David Yoho**  
Witness: **Emma Ruppell**

Site name: **Bishop Paiute**  
Operator: **Emma Ruppell**  
Project: **QA**

Manufacturer: **Climatronics**  
Serial No.: **956**  
Units: **inches**  
Last Calibrated: **NA**

Model: **100508-G1**  
Sensor Ht.: **1.5 m above roof**  
Funnel Diam.: **15.4 cm**

Audit Point	Input Inches	DAS Inches	Diff. %
1	1.06	1.39	31.5

*Audit Criteria: ±10% of input*

Comments: The audit results do not meet the criteria. The site operator was aware of the high response prior to the audit.

**AUDIT RECORD**

**SOLAR RADIATION**



25570 Rye Cyn Rd., Unit J  
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Date: **9/29/20**  
Start: **10:00 PST**  
Finish: **13:30 PST**  
Auditor: **David Yoho**  
Witness: **Emma Ruppell**

Site name: **Bishop Paiute**  
Operator: **Emma Ruppell**  
Project: **QA**

Sensor Mfg: **K&Z**  
Serial No.: **113299**  
Range: **0 - 2.145 Langleys/min**  
Last Calibrated: **NA**

Model: **SP-Lite**  
Sensor Ht.: **8 meters**

Audit Point	Input L/min	DAS L/min	% Diff
1	0.957	0.912	-4.7
2	0.937	0.890	-5.0

*Criteria: ± 10%*

Comments: No problems were noted.

**AUDIT RECORD**



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**PRESSURE**

Date: **09/29/20**  
Start: **10:00 PST**  
Finish: **13:30 PST**  
Auditor: **David Yoho**  
Witness: **Emma Ruppell**

Site name: **Bishop Paiute**  
Operator: **Emma Ruppell**  
Project: **QA**

Manufacturer: **Climatronics**  
Serial No.: **87**  
Units: **mb**  
Last Calibrated: **NA**

Model: **1022761**  
Sensor Ht.: **2 m**

Audit Point	Input mb	DAS mb	Diff. mb
1	878.4	874.2	-4.2
2	878.4	878.4	0.0

*Audit Criteria: ± 3.0 mb*

Comments: The audit results do not meet criteria. The sensor factor was adjusted in the logger program and audit point 2 is the comparison following the adjustment.

**AUDIT RECORD**

**RELATIVE HUMIDITY**



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Witness: **Emma Ruppell**

Site name: **Bishop Paiute**  
Operator: **Emma Ruppell**  
Project: **QA**

Sensor Mfg: **Climatronics**  
Serial No.: **NA**  
Range: **0-100 %**  
Last Calibrated: **NA**

Model: **NA**  
Sensor Ht.: **9 meters**

Audit Point	Input RH (%)	DAS RH (%)	Diff. %
1	13.6	15.8	2.2
2	12.2	16.1	3.9
3	10.0	14.0	4.0

*Criteria: ± 10%*

Comments: No problems were noted.

**AUDIT RECORD**

**PM<sub>10</sub>**



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Date: **09/29/20**  
Start: **13:30 PST**  
Finish: **14:30 PST**  
Auditor: **David Yoho**  
Witness: **Emma Ruppell**

Site name: **Bishop Paiute**  
Operator: **Emma Ruppell**  
Project: **QA**

Sampler: **TEOM (PM10)**  
Serial No.: **1405A231661508**  
Last Calibrated.: **9/25/20**

Make: **Thermo**  
Model: **1405**

Amb. Press: **25.79 in. Hg**  
Amb. Temp.: **29.5 °C**

Flowmeters  
Model: **Alicat FP25**

T Case (°C): **50.00**  
T Air (°C): **50.00**

T Cap (°C): **50.00**  
F Main (lpm): **3.00**  
F Aux (lpm) **13.70**

	<b>Audit</b>	<b>Site</b>	<b>Diff.</b>
Main	2.81 lpm	3.00 lpm	6.8%
Bypass	13.26 lpm	13.70 lpm	3.3%
Total	16.07 lpm	16.70 lpm	3.9%
Amb T	29.5 °C	29.9 °C	0.4
Amb P	0.864 atm	0.862 atm	-0.002

*Audit Criteria:* Flow - ± 10%; Total 15.00 - 18.34 lpm  
Amb T - ± 2° C  
Amb P - ± 0.013 atm

**Leak Check**

Main: 0.00 lpm      Audit Criteria: <0.15 lpm  
Bypass: -0.02 lpm      <0.60 lpm

**Mass Transducer Calibration Verification**

<b>Cal Filter Weight (g)</b>	<b>Frequency (w/o filter) (Hz)</b>	<b>Frequency (with filter) (Hz)</b>	<b>Audit K<sub>0</sub></b>	<b>Actual K<sub>0</sub></b>	<b>Error (%)</b>
NA	NA	NA	NA	NA	NA

*Audit Criteria:* ± 2.5%

Comments: No problems were noted. A mass transducer calibration verification was not performed.

**AUDIT RECORD**



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**PM<sub>2.5</sub>**

Date: **09/29/20**  
Start: **13:30 PST**  
Finish: **14:30 PST**  
Auditor: **David Yoho**  
Witness: **Emma Ruppell**

Site name: **Bishop Paiute**  
Operator: **Emma Ruppell**  
Project: **QA**

Sampler: **Teledyne API**  
Serial No.: **070600000**  
Last Calibrated.: **09/25/20**

Model: **T640**

Amb. Press: **25.86 in. Hg**  
Amb. Temp.: **33.6 °C**  
Leak Check: **0.000 ug/m3**

Flowmeters  
Model: **Alicat FP25**

	<b>Audit</b>	<b>Site</b>	<b>Diff.</b>
Flowrate:	4.88 lpm	5.00 lpm	2.5%
Amb T (°C)	33.6 °C	33.6 °C	0.0
Amb P (atm)	0.864 atm	0.863 atm	-0.001

*Audit Criteria:*      *Flow - ± 4%*  
                                 *Amb T - ± 2° C*  
                                 *Amb P - ± 0.013 atm*

Comments: No problems were noted.