3rd QUARTER 2006
AIR QUALITY AND METEOROLOGICAL MONITORING AUDIT REPORT

PREPARED FOR:

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REGION 9
REMEDIAL PROJECT MANAGER

YERINGTON/ANACONDA MINE SITE
YERINGTON, NEVADA

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1.0 Oversight and Audit Summary

On behalf of the US Environmental Protection Agency (EPA), Tetra Tech EM Inc. (Tetra Tech) personnel are providing ongoing regulatory support for the Yerington Mine air quality and meteorological monitoring program. Atlantic Richfield Company's (ARC) environmental contractor, Brown and Caldwell (B & C), are currently performing all aspects of this program. Tetra Tech reviewed and provided comments and feedback on the Air Quality Monitoring Work Plan for the Yerington Mine Site (AQMWP), Authored by B & C.

The AQMWP provides details on proposed actions for air quality and meteorological monitoring at the Yerington site. The air quality-monitoring component of the AQMWP included the installation and operation of seven Hi-Volume (Hi-Vol) particulate matter less than 10 microns (PM_{10}) samplers and six Hi-Vol total suspended particulate (TSP) samplers at sample locations approved by ARC, B&C, EPA, and Tetra Tech. The meteorological monitoring component of the AQMWP includes the continued operation of an existing 10-foot meteorological tower.

On June 16, 2006, EPA approved an ARC request to modify and reduce the air monitoring program at the Yerington site. The reduction consisted of eliminating PM_{10} sampling at sites AM-2, AM-4, and AM-5 and eliminating TSP sampling at sites AM-1, AM-2, AM-3, AM-4, and AM-5 beginning July 1, 2006 and eliminating specific metals and radio chemicals from the analyte list. The revised air quality and meteorological monitoring parameters and instrumentation for the Yerington Mine Site are summarized in Table 1-1.

Table 1-1
Air Quality and Meteorological Monitoring Parameters for Yerington Mine Site

Parameter	Instrument Description-Model	Instrument Location
Wind Speed	RM Young Model 05305 AQ	10 feetAGL
Wind Direction	RM Young Model 05305 AQ	10 feet AGL
Ambient Temperature	Vaisala Temperature/Humidity Probe	7 feet AGL
Relative Humidity	Vaisala Temperature/Humidity Probe	7 feet AGL
Solar Radiation	Licor Model LI200X	9 feet AGL

Table 1-1 (Continued)

Station Barometric Pressure Sensor	Vaisala Barometric Pressure Sensor	Meteorological Tower Enclosure Cabinet
Meteorological Tower Datalogger	Campbell Scientific CR10X	Meteorological Tower Enclosure Cabinet
PM_{10} Hi-Volume FRM Sampler	Tisch Environmental, Inc. Model TE-6070D	4 Total samplers at 3 locations
TSP Hi-Volume FRM Sampler	Tisch Environmental, Inc. Model TE-5170D	1 Total sampler at 1 location

Notes:

AGL	Above ground level
FRM	Federal Reference Method
PM_{10}	Particulate matter less than 10 microns in diameter
TSP	Total suspended particulate

Tetra Tech personnel coordinated with B&C personnel to meet at the site and perform EPA-reference method audit procedures on four PM_{10} samplers, one TSP sampler, and the on-site meteorological tower. PM_{10} and TSP Audits were performed using a certified Hi-flow audit orifice and the meteorological tower was audited using certified reference sensors where required.

Mr. Doug Herlocker of Tetra Tech conducted the audit procedures at the Yerington site on July 10 through 11, 2006. The following tasks were performed:

- EPA and manufacturer-approved audit of four PM_{10} Hi-Vol samplers and one TSP Hi-Vol sampler using certified audit orifice (Completed July 11, 2006)

- Prevention of Significant Deterioration (PSD)-quality audit of 10-foot meteorological tower (Completed July 10, 2006)

All PM_{10} and TSP samplers audited on July 11, 2006, successfully passed all audit criteria. No equipment failures, leaks, or anomalies were observed during the audit procedure.

At the time of the meteorological tower audit on July 10, 2006, all sensors were operating within PSD-audit criteria. However, the left tipping bucket mechanism on the precipitation sensor was tipping prematurely at approximately 7.6 milliliters (mL). The sensor is in need of adjustment so that the left bucket will tip at the designed rate of 8.3 mL per tip, but the audit criteria for accuracy of plus/minus 10 percent or from 7.5 to 9.1 mL was not exceeded.

While on-site performing the meteorological tower audit on July 10, 2006, Mr. Herlocker observed that the PM_{10} samplers were not operating. However, July 10, 2006 was a designated air sample day and PM_{10} samplers at AM-1, AM-3, and AM-6 were expected to be operating.

Mr. Herlocker discussed this observation with B & C personnel on the morning of July 11, 2006 and was told that apparently these samplers were incorrectly programmed to collect the PM_{10} samples on July 9, 2006. Mr. Guy Graening of B & C provided an e-mail response to this error and a copy of the e-mail correspondence is included in Appendix C.

Details of the quality oversight and audit summary are presented in the following sections and appendices:

- Section 2.0 PM_{10}, TSP, and Meteorological Audit Methods
- Section 3.0 Audit Equipment Reference Standards
- Section 4.0 Meteorological and Air Quality Audit Summary of Results and Comments
- Appendix A Quality Assurance Audit Data Tables
- Appendix B Audit Equipment Standards Certifications and Field Logbook Notes
- Appendix C Copy of E-mail Correspondence from Brown & Caldwell Regarding Air Sampler Programming Error

2.0 PM_{10} TSP, and Meteorological Audit Methods

Based on the revised air monitoring program that was initiated by ARC on July 1, 2006, Tetra Tech personnel audited four PM_{10} samplers, one TSP sampler, and the 10-foot meteorological tower on July 10 through 11, 2006.

The Yerington 10-foot meteorological tower sensors were audited in their normal operating modes. The accuracy of all sensors was verified using National Institute of Standards and Technology (NIST) or Certified Reference Material (CRM) traceable transfer standard reference audit sensors.

A description of audit procedures and methods is presented below.

PM_{10} Hi-Vol Audit Procedure

Four PM_{10} Hi-Vol samplers are installed at three locations at or near the perimeter of the Yerington mine site. The samplers operate by activation of a pump via a timer system. The audit device consists of a certified audit orifice (orifice) designed for PM_{10}/TSP samplers. The orifice consists of metal plate attached to a flow restriction cylinder, which allows the user to turn a knob and restrict flow to the sampler. In addition, the orifice is equipped with a manometer port to measure pressure drop through the orifice.

The orifice is designed to produce flow ranges of 1.02 to 1.24 cubic meters per minute (m^3/min) based on the design flow rate of the PM_{10} Hi-Vol samplers. Five different flow measurements are obtained using the orifice and resultant manometer readings are recorded. PM_{10} sampler flow readings are also recorded for the five different flow rates. In addition, ambient temperature and pressure are recorded. These site-specific parameters were obtained during the audit using NIST certified devices. A slope, intercept, and correlation coefficient are calculated using the least squares regression method and is based on the five orifice manometer and sampler flow readings. The audit criteria are based on a correlation coefficient of 0.990 or higher. A summary of PM_{10} audit results is presented in Table 2-1. Quality assurance audit data tables are presented in Appendix A.

TABLE 2-1

SUMMARY OF PM_{10} AUDIT RESULTS
YERINGTON MINE SITE
JULY 11, 2006

PM_{10} Sampler/ Location	Sampler Serial Number	Sampler Orifice Serial Number	Audit Orifice Serial Number	Ambient Temperature (^oC)	Ambient Pressure (mm Hg)	Sampler/Audit Orifice Correlation Coefficient
AM1	613	1013	W43	24.5	644.1	0.9909
AM1-DUP	616	1022	W43	24.5	644.1	0.9990
AM3	618	1018	W43	28.1	646.9	0.9914
AM6	615	1020	W43	27.8	649.2	0.9973

Notes:

^oC	Degree Celsius
DUP	Duplicate
mm Hg	Millimeter mercury
PM_{10}	Particulate matter less than 10 microns in diameter

TSP Hi-Vol Audit Procedure

One TSP Hi-Vol sampler is collocated with the PM_{10} sampler at air monitoring site AM-6. The sampler operates by the activation of a pump via a timer system, identical to the PM_{10} samplers. The audit device consists of a certified audit orifice (orifice) designed for PM_{10}/TSP samplers. The orifice consists of metal plate attached to a flow restriction cylinder, which allows the user to turn a knob and restrict flow to the sampler. In addition, the orifice is equipped with a manometer port to measure pressure drop through the orifice.

The orifice is designed to produce flow ranges of 1.10 to 1.70 m^3/min based on the design flow rate of the TSP Hi-Vol samplers. Five different flow measurements are obtained using the orifice and resultant manometer readings are recorded. TSP sampler flow readings are also recorded for the five different flow rates. In addition, ambient temperature and pressure are recorded. These site-specific parameters were obtained during the audit using NIST certified devices. A slope, intercept, and correlation coefficient is calculated using the least squares regression method and is based on the five orifice manometer and sampler flow readings. The audit criteria are based on a correlation coefficient of 0.990 or higher. A summary of TSP audit results is presented in Table 2-2. Quality assurance audit data tables are presented in Appendix A.

TABLE 2-2

SUMMARY OF TSP AUDIT RESULTS
YERINGTON MINE SITE
JULY 11, 2006

TSP Sampler/ Location	Sampler Serial Number	Sampler Orifice Serial Number	Audit Orifice Serial Number	Ambient Temperature (^{o}C)	Ambient Pressure (mm Hg)	Sampler/Audit Orifice Correlation Coefficient
AM6	NA	1021	W43	27.8	649.2	0.9993

Notes:

^{o}C	Degree Celsius
mm Hg	Millimeter mercury
NA	Not available
TSP	Total suspended particulate

Wind Vane Alignment Verification/Audit

The Yerington meteorological tower wind speed/direction sensor is mounted at the top of the tower (10-foot level) on a 1-meter cross arm fixture oriented in a north/south direction, equivalent to a value of zero degrees. The vane alignment audit was achieved using a calibrated compass set on a tripod and corrected for true north offset for the Yerington, Nevada area of approximately 15.3 degrees easterly. An additional audit was achieved using a handheld global positioning system (GPS), which automatically corrects for true north readings. Audit devices were aligned with the cross arm facing north. The orientation of the cross arm was then compared to the audit device reading. The results from the true north vane alignment audit are presented below:

- Audit compass (corrected 15.3 degrees easterly) = 1.3 degrees
- Audit GPS (automatically corrected for true north) = 2 degrees
- Wind direction sensor aligned facing north = 0.8 degrees

Wind Speed Audit

The wind speed audit was achieved using a R.M. Young Motor Drive (Model No. 18802) attached to the wind speed/direction sensor and was rotated at different speeds. The simulated wind speed was compared to datalogger readouts for wind speed accuracy.

In addition, a wind speed starting threshold torque audit was performed using a R.M. Young Torque Disc (Model No. 18310) to verify the sensitivity of the wind speed sensor to fluctuations in wind speed. Acceptance and accuracy criteria are presented in Table 2-3.

Wind Direction Audit

The wind direction audit was achieved using a R.M. Young Wind Direction Linearity Gauge (Model No. 18802) attached to the wind speed/direction sensor and was rotated between 0 and 360 degrees in 30-degree increments. The circular gauge has marks in 1-degree increments that were compared to the datalogger readouts for wind direction accuracy.

In addition, a wind direction starting torque audit was performed using a R.M. Young Wind Direction Torque Gauge (Model No. 18331) to verify the sensitivity of the wind direction sensor to fluctuations in wind speed. Acceptance and accuracy criteria are presented in Table 2-3.

Temperature Audit

The temperature audit was achieved using a NIST traceable reference temperature sensor collocated with the 7-foot temperature sensor. Ambient temperature readings were recorded for both sensors. The NIST traceable reference temperature sensor was compared to the 7-foot sensor for temperature accuracy. Acceptance and accuracy criteria are presented in Table 2-3.

Humidity Audit

The humidity audit was achieved using a NIST traceable reference humidity sensor (hygrometer) collocated with tower humidity sensor. Ambient humidity conditions were recorded for both sensors and dewpoint temperatures were calculated for the both sensors using ambient temperature and humidity readouts, and were compared for humidity accuracy. Acceptance and accuracy criteria are presented in Table 2-3.

Solar Radiation Audit

The solar radiation audit was achieved using a CRM traceable reference solar radiation sensor collocated with tower sensor. Four short-term solar radiation readouts were recorded for both sensors and were compared for solar radiation accuracy. Acceptance and accuracy criteria are presented in Table 2-3.

Precipitation Audit

The precipitation audit was achieved using a precise liquid dispensing tool to measure the amount of water required to initiate a tip for each tipping bucket mechanism. Three filling runs were performed for each bucket and compared to specified volume required for one tip. Acceptance and accuracy criteria are presented in Table 2-3.

Barometric Pressure Audit

The barometric pressure audit was achieved using a NIST traceable barometric pressure sensor collocated with tower sensor. Three readouts were recorded for both sensors and were compared for barometric pressure accuracy. Acceptance and accuracy criteria are presented in Table 2-3.

All quality assurance audit methods, accuracy requirements, and audit (pass/fail) results for the Yerington meteorological tower are summarized in Table 2-3. Quality assurance audit data tables are presented in Appendix A. Field logbook notes are presented in Appendix B.

Table 2-3

PSD Quality Assurance Audit Methods, Accuracy Requirements, and Results
Yerington Meteorological Tower Audit July 10, 2006

Parameter	**Audit Method**	**Accuracy Requirements** (difference between acceptable criteria and sensor response)	**Within Acceptance Criteria**
10-Foot Wind Speed	Active Rotation with Certified Drive Unit: ws≤5m/s ws>5m/s	≤ ± 0.25 m/s ≤ ± 5.0%	Yes
	Starting Threshold with Torque Disk	≤0.5 m/s (0.3 gm-cm)	Yes
10-Foot Wind Direction	Alignment Verification	≤ ± 5° of True North	Yes
	Internal Check of Vane Linearity using Gauge	≤ ± 3°	Yes
	Starting Threshold with Torque Gauge	≤ 0.5 m/s (9 gm-cm)	Yes
7-Foot Ambient Temperature	Collocated Sensor Comparing Temperatures Using Three Water Baths	≤ ± 0.5 °C	Yes
7-Foot Relative Humidity	Collocated Sensor Comparing Dewpoint Temperatures (T_{dp})	≤ ± 1.5 °C Error in T_{dp}	Yes
2-Meter Solar Radiation	Collocated Sensor Comparison	≤ ± 5.0% Full Scale	Yes
Barometric Pressure	Collocated Sensor Comparison	≤ ± 10 millibars Hg	Yes
Precipitation	Comparison to Precipitation Gauge	≤ ± 10.0%	Yes

Notes:

°	Degree	ws	Wind speed
°C	Degree Celsius		
gm-cm	Gram-centimeter		
Hg	Mercury		
m/s	Meter per second		
PSD	Prevention of significant deterioration		
T_{dp}	Dewpoint temperature		

3.0 Audit Equipment Reference Standards

All audit equipment and reference standards were in current calibration and traceable to the NIST or other authoritative references. Table 3-1 lists specific equipment used and certification dates. Copies of standard certifications for the audit equipment are presented in Appendix B.

Table 3-1

Quality Assurance Audit Equipment
Yerington PM_{10}, TSP, and Meteorological Tower Audit July 10-11, 2006

References/Device	Manufacturer	Model Number	Serial Number	Re-certification Date
PM_{10}/TSP Audit Orifice	Tisch Environmental	TE-5028A	W43	4/10/2007
Humidity	Control Company	11-661-18	41531319	4/13/2007
Thermometer	Control Company	11-661-18	41531319	4/13/2007
Wind Speed Drive	RM Young	18802	CA02612	4/13/2007
Wind Direction Linearity Gauge	RM Young	18212	N/A	N/A
Wind Speed Starting Threshold Torque Disk	RM Young	18310	N/A	N/A
Wind Direction Starting Threshold Torque Gauge	RM Young	18331	N/A	N/A
Solar Radiation	Li-Cor	LI-200SZ	PY47392	4/17/2008
Barometric Pressure	Brunton	Multi-Navigator V 2.16	ACP 010796	4/13/2007

Notes:

N/A Not available
PM_{10} Particulate matter less than 10 microns in diameter
TSP Total suspended particulate

4.0 Meteorological and Air Quality Audit Summary of Results and Recommendations

PM_{10} and TSP Audit Summary:

At the time of the PM_{10} and TSP audit on July 11, 2006, all samplers successfully passed audit parameters and were observed to be operating correctly.

While on-site performing the meteorological tower audit on July 10, 2006, Mr. Herlocker observed that the PM_{10} samplers were not operating. However, July 10, 2006 was a designated air sample day and PM_{10} samplers at AM-1, AM-3, and AM-6 were supposed to be operating.

Mr. Herlocker discussed this observation with B & C personnel on the morning on July 11, 2006 and was told that apparently these samplers were incorrectly programmed to collect the PM_{10} samples on July 9, 2006. Mr. Guy Graening of B & C provided an e-mail response to this error and a copy of the e-mail correspondence is included in Appendix C.

Meteorological Tower Audit:

At the time of the meteorological tower audit on July 10, 2006, all NIST and CRM reference sensors and meteorological tower sensors were compared to the accuracy requirements established in Table 2-3 and all sensors were observed to be operating within accuracy requirements. However, the left tipping bucket mechanism on the precipitation sensor was tipping prematurely at approximately 7.6 mL. The sensor is in need of adjustment so that the left bucket will tip at the designed rate 8.3 mL per tip, but the audit criteria for accuracy of plus/minus 10 percent or from 7.5 to 9.1 mL was not exceeded.

General Recommendations:

Tetra Tech recommends B&C Adjust the precipitation sensor left tipping bucket mechanism so that it will tip at approximately 8.3 mL. Tetra Tech also recommends that B & C continue to perform scheduled bi-weekly site visits to the meteorological tower to download data and visually inspect the sensors. In addition, downloaded data should be screened and evaluated within 48 hours to identify problems and minimize lost data.

APPENDIX A

QUALITY ASSURANCE AUDIT DATA TABLES

TABLE 1
WIND SPEED/DIRECTION RESPONSE AUDIT

YERINGTON METEOROLOGICAL TOWER AUDIT
AUDIT DATE: July 10, 2006
SITE: Yerington Mine Site, Yerington, NV
AUDITED BY: Doug Herlocker, Tetra Tech EM Inc. on behalf of U.S. Environmental Protection Agency (EPA)

WIND SPEED: (MODEL: RM Young 05305 AQ)				WIND DIRECTION: (MODEL: RM Young 05305 AQ)		
Audit Device: RM Young Model 18802 (Serial No. CA02415)				Audit Device: RM Young Model 18212 (Serial No. N/A)		
Acceptable Difference: ws ≤ 11.0 mph = 0.56 mph, ws > 11.0 mph = ≤ 5.0%				Acceptable Difference: +/- 3 degrees		
Clockwise Rotation				Clockwise Rotation		
Calibration Device RPM	Simulated Wind Speed (mph)	ws Sensor[a] *as found* (mph)	Difference[b,c]	Calibration Device (degrees)	wd Sensor *as found* (degrees)	Difference (degrees)
0.0	0.00	0.00	0.00 mph	0.0	1.7	1.7
200.0	2.19	2.28	0.09 mph	30.0	30.3	0.3
400.0	4.38	4.56	0.18 mph	60.0	60.8	0.8
600.0	6.58	6.84	0.26 mph	90.0	91.4	1.4
800.0	8.77	9.12	0.35 mph	120.0	121.0	1.0
1000.0	10.96	11.40	0.44 mph	150.0	150.7	0.7
1600.0	17.54	18.24	4.0 %	180.0	181.3	1.3
2200.0	24.11	25.08	4.0 %	210.0	210.1	0.1
2600.0	28.50	29.64	4.0 %	240.0	240.5	0.5
3000.0	32.88	34.20	4.0 %	270.0	271.8	1.8
Criteria met (yes/no): YES				300.0	301.2	1.2
Adjustment performed (yes/no): NO				330.0	330.9	0.9
				360/0.0	1.40	1.4
				Criteria met (yes/no): YES		
				Adjustment performed (yes/no): NO		

Notes:

[a] RM Young wind speed multiplier used with calibration device: (RPM x 0.01096)=mph, (RPM x 0.005)=m/s

[b] Wind Speed less than or equal to 11 miles per hour are compared to actual simulated wind speed miles per hour

[c] Wind Speed greater than 11 miles per hour are compared to percent difference of simulated wind speed miles per hour

%	Percent
mph	Mile per hour
N/A	Not available
RPM	Revolutions per minute
wd	Wind direction
ws	Wind speed

TABLE 2
WIND DIRECTION/SPEED STARTING THRESHOLD TORQUE AUDIT

YERINGTON METEOROLOGICAL TOWER AUDIT
AUDIT DATE: July 10, 2006
SITE: Yerington Mine Site, Yerington, NV
AUDITED BY: Doug Herlocker, Tetra Tech EM Inc. on behalf of U.S. EPA

WIND SPEED STARTING TORQUE THRESHOLD: (MODEL: RM Young 05305 AQ)		WIND DIRECTION STARTING TORQUE THRESHOLD: (MODEL: RM Young 05305 AQ)	
Audit Device: RM Young Model 18310 (Serial No. N/A)		Audit Device: RM Young Model 18331 (Serial No. N/A)	
Acceptable Difference: ≤ 0.3 g-cm		Acceptable Difference: ≤ 9 g-cm	
Sensor	ws Sensor *as found* (g-cm)	Sensor	wd Sensor *as found* (g-cm)
10 meter ws	0.3	10 meter wd	N/A
Sensor	ws Sensor *as left* (g-cm)	Sensor	wd Sensor *as left* (g-cm)
10 meter ws	0.3	10 meter wd	N/A
Criteria met (yes/no): YES		Criteria met (yes/no): YES	
Adjustment performed (yes/no): NO		Adjustment performed (yes/no): NO	

Notes:

g-cm	Gram-centimeter
N/A	Not available
ws	Wind speed
wd	Wind direction

TABLE 3
HUMIDITY AUDIT

YERINGTON METEOROLOGICAL TOWER AUDIT
AUDIT DATE: July 10, 2006
SITE: Yerington Mine Site, Yerington, NV
AUDITED BY: Doug Herlocker, Tetra Tech EM Inc. on behalf of U.S. Environmental Protection Agency (EPA)

HUMIDITY: Vaisala Model HMP45C with Campbell CR10X Datalogger

Audit Device[a]: Control Company Model No. 11-661-18 (Serial No. 41531319)

Acceptable Difference: +/- 4.1 °F in Dewpoint Temperature

Audit device (% humidity)	Humidity Sensor *as found* (% humidity)	Difference (% humidity	Audit device Dewpoint Temperature (°F)	Humidity Sensor Dewpoint Temperature (°F)	Dewpoint Difference Temperature (°F)
17.1	13.8	-3.3	57.30	53.50	-3.80
Criteria met (yes/no): YES			Adjustment performed (yes/no): NO		

Notes:

[a] **Audit device meets National Institute of Standards and Technology requirements**
% Percent
°F Fahrenheit

TABLE 4
AMBIENT TEMPERATURE AUDIT

YERINGTON METEOROLOGICAL TOWER AUDIT
AUDIT DATE: July 10, 2006
SITE: Yerington Mine Site, Yerington, NV
AUDITED BY: Doug Herlocker, Tetra Tech EM Inc. on behalf of U.S. EPA

TEMPERATURE: Vaisala Model HMP45C with Campbell CR10X Datalogger

Audit Device[a]: Control Company Model No. 11-661-18 (Serial No. 41531319)

Acceptable Difference: +/- 1.0 °F Mean Error

Temperature Range	Audit Device Temperature (°F)	Ambient Temperature *as found* (°F)	Difference (°F)
Ambient range	100.2	100.6	0.4
		Mean Error =	0.4
Criteria met (yes/no): YES		Adjustment performed (yes/no): NO	

Notes:

[a] **Audit device meets National Institute of Standards and Technology requirements**
°F Fahrenheit

TABLE 5
SOLAR RADIATION AUDIT

YERINGTON METEOROLOGICAL TOWER AUDIT
AUDIT DATE: July 10, 2006
SITE: Yerington Mine Site, Yerington, NV
AUDITED BY: Doug Herlocker, Tetra Tech EM Inc. on behalf of U.S. EPA

SOLAR RADIATION: Kipp & Zonen with Campbell CR10X Datalogger

Audit Device[a]: Licor Model LI200SZ (Serial No. PY47392)

Acceptable Difference: < 5% (Full Scale)

Audit Device Zero[b] (W/m^2)	Sensor Device Zero[b] (W/m^2)	Audit Device 1st. Reading (W/m^2)	Sensor Device 1st. Reading (W/m^2)	Audit Device 2nd. Reading (W/m^2)	Sensor Device 2nd. Reading (W/m^2)	
0.0	0.0	884.3	863.8	871.9	840.5	
Criteria met (yes/no): YES		Adjustment performed (yes/no): NO				

Notes:

[a] **Audit device meets National Institute of Standards and Technology requirements**
[b] **Audit and sensor devices covered to simulate night time environment**
W/m^2 Watts per meter squared
N/A Not available

TABLE 6
BAROMETRIC PRESSURE AUDIT

YERINGTON METEOROLOGICAL TOWER AUDIT
AUDIT DATE: July 10, 2006
SITE: Yerington Mine Site, Yerington, NV
AUDITED BY: Doug Herlocker, Tetra Tech EM Inc. on behalf of U.S. Environmental Protection Agency

BAROMETRIC PRESSURE: Climatronics Model 102270 (Serial No. 1100) with Campbell CR510 Datalogger (Serial No. 18)

Audit Device[a]: Brunton Multi-Navigator, Version 2.16 (Serial No. ACP 010796)

Acceptable Difference: +/- 0.3 inches Hg

Audit Device (inches Hg)	Barometric Pressure Sensor *as found* (inches Hg)	Difference (inches Hg)
25.46	25.51	0.05
Criteria met (yes/no): YES		Adjustment performed (yes/no): NO

Notes:

[a] Audit device meets National Institute of Standards and Technology requirements
Hg Mercury

TABLE 7
PRECIPITATION AUDIT

YERINGTON METEOROLOGICAL TOWER AUDIT
AUDIT DATE: July 10, 2006
SITE: Yerington Mine Site, Yerington, NV
AUDITED BY: Doug Herlocker, Tetra Tech EM Inc. on behalf of U.S. Environmental Protection Agency

PRECIPITATION: Climatronics Model 100508 (Serial No. 935) with Campbell CR510 Datalogger (Serial No. 18)

Audit device: 10 mL syringe (Serial No. N/A)

Acceptable Difference: +/- 10% (1 tip = 8.3 mL = 0.01 inches of precipitation), <8.0 mL, > 8.6 mL = adjustment recommended

Volume Checks (number)	Left Bucket *as found*	Right Bucket *as found*
1	7.7	8.6
2	7.6	8.7
3	7.5	8.5
Average =	**7.6**	**8.6**
Volume Checks (number)	**Left Bucket *as left***	**Right Bucket *as left***
1	7.7	8.6
2	7.6	8.7
3	7.5	8.5
Average =	**7.6**	**8.6**
	Criteria met (yes/no): YES	Criteria met (yes/no): YES
	Adjustment performed (yes/no): NO	Adjustment performed (yes/no): NO

Notes:

% Percent
mL Milliliter
N/A Not available

APPENDIX B

AUDIT EQUIPMENT STANDARDS CERTIFICATIONS AND FIELD LOGBOOK NOTES

7/10/06 Yerington Met Tower Audit

1420 (PDT) Arrive at site

- observations: Nothing Unusual
- weather conditions: Partly Cloudy; high wind gusts out of E/NE; high 90°(F)

1436(PDT)/1336(PST) Met tower offline for Audit Procedure

1. Barometric Pressure Audit: (1 Point)
   Audit sensor = 25.46" = 646.68 mm Hg
   Tower Sensor = 863.71 mb = 647.87 mm Hg
   diff = + 1.13 mm Hg
   Inches diff = +0.05" Hg
2. Humidity Audit: (2 point Ave)
   Auditsensor = 16.4/17.8 Ave = 17.1 %
   Towersensor = 13.3/14.3 Ave = 13.8
   % diff = -3.3 % Humidity
   → Dewpoint temp to be calculated for each sensor
   Audit temp = 100.5 / 100.5(°F)
   Tower temp = 100.5/100.7(°F)
3. Temperature Audit: (2 point Ave)
   Audit Sensor = 100.3/100.5(°F)
   Tower Sensor = 100.5/100.7(°F)
   Temp degrees diff = 0.2(°F)

7/10/06 Yerington Met Tower Audit (cont)

4. Wind Vane Alignment Verification
   - wind vane Rod placed on Wind Sensor Mount 3 oriented at true North position - Readings taken w/:
   1. Sighting Compass = 1.0° (Corrected)
   2. Correcting Compass = 0°
   3. GPS unit = 2° (corrected)
5. Wind Speed Audit (Data on Excel Sheet)
6. Wind Direction Audit (Data on Excel Sheet)
7. Wind Direction Starting torque Audit:
   Tower Sensor = 7 g/cm (passed)
8. Solar Radiation Audit:
   (Audit Consists of 3 Readings plus zero)
   Reading #1 Audit = 884.3
   Sensor = 863.8
   Reading #2 Audit = 871.9
   Sensor = 840.5
   Reading #3 Audit = 820.5
   Sensor = 801.2
   Reading #4 (Zero) Audit = 0.0
   Sensor 0.0
9. Precipitation Audit: 3 fills of each bucket

7/10/06 Yerington Met tower Audit (cont.)

Fill #1 left = 7.7 Right = 8.6
Fill #2 left = 7.6 Right = 8.7
Fill #3 Left = 7.5 Right = 8.5
Ave = 7.6 = 8.6

→ Audit criteria 7.5 mL – 9.1 mL
→ Audit Criteria met but adjustment will be Recommended as left bucket close to failing
1640 (PDT) / 1540 (PST) Audit Completed Met tower back online

---

7/11/06
0720 Arrive at Site to meet B&C Air personnel & Audit PM_{10} / ISP Samplers
0745 Arrive at AM-1 and Audit AM-1 & AM-1 DUP (PM_{10})
→ Data on Excel Sheet
0830 Arrive at AM-3 and Audit AM-3 (PM_{10}) → (Data on Excel sheet)
0915 Arrive at AM-6 & Audit AM-6 (PM_{10}) and AM-6 TSP (Data on Excel sheet)
1015 Leave Site

end of Page
D. Hall

TISCH ENVIROMENTAL, INC.
145 SOUTH MIAMI AVE.
VILLAGE OF CLEVES, OH 45002
513.467.9000
877.263.7610 TOLL FREE
513.467.9009 FAX
WWW.TISCH-ENV.COM

AIR POLLUTION MONITORING EQUIPMENT

ORIFICE TRANSFER STANDARD CERTIFICATION WORKSHEET TE-5028A

Date - Apr 10, 2006 Rootsmeter S/N 9833620 Ta (K) - 293
Operator Tisch Orifice I.D. - W43 Pa (mm) - 756.92

PLATE OR VDC #	VOLUME START (m3)	VOLUME STOP (m3)	DIFF VOLUME (m3)	DIFF TIME (min)	METER DIFF Hg (mm)	ORFICE DIFF H2O (in.)
1	NA	NA	1.00	1.2670	4.4	1.50
2	NA	NA	1.00	0.9780	7.3	2.50
3	NA	NA	1.00	0.8940	8.7	3.00
4	NA	NA	1.00	0.8240	10.2	3.50
5	NA	NA	1.00	0.6250	17.3	6.00

DATA TABULATION

Vstd	(x axis) Qstd	(y axis)		Va	(x axis) Qa	(y axis)
1.0070	0.7948	1.2326		0.9942	0.7846	0.7620
1.0031	1.0257	1.5913		0.9903	1.0126	0.9837
1.0013	1.1200	1.7432		0.9885	1.1057	1.0776
0.9993	1.2127	1.8829		0.9865	1.1972	1.1640
0.9898	1.5837	2.4653		0.9771	1.5634	1.5240
Qstd slope (m) =		1.56257		Qa slope (m) =		0.97846
intercept (b) =		-0.00986		intercept (b) =		-0.00610
coefficient (r) =		0.99998		coefficient (r) =		0.99998
y axis = SQRT[H2O(Pa/760)(298/Ta)]				y axis = SQRT[H2O(Ta/Pa)]		

CALCULATIONS

Vstd = Diff. Vol[(Pa-Diff. Hg)/760](298/Ta)
Qstd = Vstd/Time

Va = Diff Vol [(Pa-Diff Hg)/Pa]
Qa = Va/Time

For subsequent flow rate calculations:

Qstd = 1/m{[SQRT(H2O(Pa/760)(298/Ta))]- b}
Qa = 1/m{[SQRT H2O(Ta/Pa)]- b}

Certificate of Accuracy

Transfer Standard Type: Barometric Pressure/Altimeter

Certificate No: B 041306. 01

Transfer standard model: Brunton Multi-Navigator, Version 2.16
Serial number: ACP 010796
submitted by/owner: Tetra Tech EM Inc.
106 N 6th Street
Suite 202
Boise, ID 83702

Was compared to Precision Absolute Reference Barometer:
Model number: 355-AI0900 Serial number: 913930-M1
Certified accuracy of ± 0.007"Hg
NIST traceable to Ruska Deadweight Tester SN 38342/C-85

Date: 04/13/06 Lab temperature 77.5 °F
Lab pressure 656.2 mm Hg

Reference barometer ("Hg)	Transfer Standard ("Hg)	Difference from Reference ("Hg)	Transfer Standard Correction* ("Hg)
25.00	24.98	-0.02	0.02
26.00	25.98	-0.02	0.02
27.00	26.98	-0.02	0.02
28.00	27.98	-0.02	0.02

Note:
If no sign is given on the correction, the true pressure is higher than the indicated pressure. If the sign is negative, the true pressure is lower than the indicated pressure.

Transfer Standard adjustments made? YES ☐ NO ☒
Post-calibration measurements:

Reference barometer ("Hg)	Transfer Standard ("Hg)	Difference from Reference ("Hg)	Transfer Standard Correction* ("Hg)

Reviewed: R L S Date: 4-13-06

Roger L. Sanders, PE

Chinook Engineering
a division of Inter-Mountain Laboratories, Inc.
555 Absaraka Street
Sheridan, Wyoming 82801 USA
(307) 672-7790
chinook@imlinc.com

R.M. Young Company
2801 Aero Park Drive
Traverse City, Michigan 49686 USA

Certificate of Calibration and Testing

Test Unit:			
Model:	18802	Serial Number:	CA02612
Description:	Anemometer Drive - 200 to 15,000 RPM		
	- Comprised of Models 18820A Control Unit & 18830A Motor Assembly		

R.M. Young Company certifies that the above equipment has been inspected and calibrated using standards whose accuracies are traceable to the National Institute of Standards and Technologies (NIST).

Nominal Motor Rpm	27106D Output Frequency Hz (1)	Calculated Rpm (2)	Indicated Rpm (3)
300	50	300	300
2700	450	2700	2700
5100	850	5100	5100
7500	1250	7500	7500
10,200	1700	10200	10200
12,600	2100	12600	12600
15,000	2500	15000	15000
☑ Clockwise and Counterclockwise rotation verified			

(1) Measured frequency output of RM Young Model 27106D standard anemometer attached to motor shaft
(2) 27106D produces 10 pulses per revolution of the anemometer shaft
(3) Indicated on the Control Unit LCD display

*Indicates out of tolerance

☑ No Calibration Adjustments Required ☐ As Found ☐ As Left

Traceable frequency meter used in calibration DP4863

Date of inspection 13 April 2006

Tested By EF

Tel: 231-946-3980 Fax: 231-946-4772 Email: met.sales@youngusa.com Website: www.youngusa.com

CERTIFICATE of CALIBRATION for LI-COR SENSOR

Model Number: LI-200SZ

Serial Number: PY47392 Calibration Date: April 17, 2006

Output: 5.00 millivolts per 1000 watts m^{-2}

57.2 Ω resistor installed in cable.

IMPORTANT: *Read the appropriate instruction manual before using this sensor.*

IMPORTANT: *It is recommended that sensors be recalibrated every two years.*

Calibration Technician: Caron Deschamps

LI-COR Biosciences

LI-COR, Inc. ● Environmental ● 4421 Superior Street ● P.O. Box 4425 ● Lincoln, NE 68504
Phone: 402-467-3576 ● FAX: 402-467-2819 ● Toll-free 1-800-447-3576 (U.S. & Canada)
E-mail: envsales@licor.com ● www.licor.com

Certificate of Accuracy

Transfer Standard Type: Electronic Hygrometer Certificate No: H 041306. 01

Transfer standard, model/type: Control Company Traceable Hygrometer
Serial number: 41531319
submitted by/owner: Tetra Tech EM Inc.
106 N 6th Street
Suite 202
Boise, ID 83702

Was compared to Saturated Salt Solution Standards using ASTM Method E 104 - 02, Standard Practice for Maintaining Constant Relative Humidity by Means of Aqueous Solutions, using Temperature Reference Standard Streamline™ Pro MultiCal™ System Remote Temperature Probe S/N T030301.

Date: 4/11/2006 - 04/13/06

Lab temperature: varies °F
Barometric Pressure: varies mmHG
Lab %RH: varies

Reference Salt Standard	Reference Temperature °C	Reference Standard (%RH)	Transfer Standard (%RH)	Difference from Reference (%RH)	Transfer Standard Correction* (%RH)
Potassium Acetate	21.5	22.9	24.9	2.0	-2.0
Magnesium Nitrate	22.6	53.6	52.3	-1.3	1.3
Sodium Chloride	22.7	75.4	73.3	-2.1	2.1

Temperature Reference Standard (°C)	Transfer Standard (°C)	Difference from Reference (°C)	Transfer Standard Correction* (°C)
21.5	21.7	0.2	-0.2
22.6	23.0	0.4	-0.4
22.7	23.1	0.4	-0.4

Reviewed: R W V Date: 4-13-06

Roger L. Sanders, PE

Chinook Engineering
a division of Inter-Mountain Laboratories, Inc.
555 Absaraka Street
Sheridan, Wyoming 82801 USA
(307) 672-7790
chinook@imlinc.com

Project: Yerington/ARC AQ AM1 PM10 Site

Monitor: Tisch Environmental PM10 Hi-Vol Sampler Model No. TE-6070D

Sampler Serial No.	613	Ta	Temp C	24.5	Orifice Serial No.	w43
Orifice Serial No.	1013	Ta	Temp K	297.65	W43 slope (m)	0.97381
		Pa	Bp mm Hg	644.144	W43 int. (b)	-0.00137
Date: July 11, 2006		Pa	Bp in Hg	25.36		

Point	Orifice Press. Drop (" H2O)	Qa (Orifice) (1.02-1.24)	Chart Response	IC Corrected	Linear Regression	
1	3	1.2105	38	25.8	Slope=	28.3783432
2	2.8	1.1695	36	24.5	Intercept=	-8.6981
3	2.5	1.1051	33	22.4	**Corr. Coeff.=**	**0.9909**
4	2.4	1.0828	32	21.8	SFR=	1.2765
5	2.2	1.0368	31	21.1	SSP=	40.4957

Project: Yerington/ARC AQ AM1 PM10 DUP Site

Monitor: Tisch Environmental PM10 Hi-Vol Sampler Model No. TE-6070D

Sampler Serial No.	616	Ta	Temp C	24.5	Orifice Serial No.	w43
Orifice Serial No.	1022	Ta	Temp K	297.65	W43 slope (m)	0.97381
		Pa	Bp mm Hg	644.144	W43 int. (b)	-0.00137
Date: July 11, 2006		Pa	Bp in Hg	25.36		

Point	Orifice Press. Drop (" H2O)	Qa (Orifice) (1.02-1.24)	Chart Response	IC Corrected	Linear Regression	
1	2.1	1.0130	29	19.7	Slope=	28.46090472
2	2.2	1.0368	30	20.4	Intercept=	-9.0758
3	2.4	1.0828	32	21.8	**Corr. Coeff.=**	**0.9990**
4	2.7	1.1484	35	23.8	SFR=	1.2765
5	3.1	1.2305	38	25.8	SSP=	40.0951

Project: Yerington/ARC AQ AM3 PM10 site

Monitor: **Tisch Environmental PM10 Hi-Vol Sampler Model No. TE-6070D**

Sampler Serial No.	618					**Orifice Serial No.**	**w43**
Orifice Serial No.	1018	**Ta**	**Temp C**	**28.1**		**W43 slope (m)**	**0.97381**
		Ta	**Temp K**	**301.25**		**W43 int. (b)**	**-0.00137**
		Pa	**Bp mm Hg**	**646.938**			
Date: July 11, 2006		**Pa**	**Bp in Hg**	**25.47**			

Point	Orifice Press. Drop (" H2O)	Qa (Orifice) (1.02-1.24)	Chart Response	IC Corrected	Linear Regression	
1	3.0	1.2151	37	25.2	Slope=	20.19906
2	2.6	1.1313	35	23.9	Intercept=	0.7811
3	2.5	1.1094	34	23.2	**Corr. Coeff.=**	**0.9914**
4	2.4	1.0870	33	22.5	SFR=	1.2864
5	2.2	1.0408	32	21.8	SSP=	39.2224

Project: Yerington/ARC AQ AM6 PM10 site

Monitor: Tisch Environmental PM10 Hi-Vol Sampler Model No. TE-6070D

Sampler Serial No.	615	**Ta**	**Temp C**	**27.8**	**Orifice Serial No.**	**w43**
Orifice Serial No.	1020	**Ta**	**Temp K**	**300.95**	**W43 slope (m)**	**0.97381**
		Pa	**Bp mm Hg**	**649.224**	**W43 int. (b)**	**-0.00137**
Date: July 11, 2006		**Pa**	**Bp in Hg**	**25.56**		

Point	Orifice Press. Drop (" H2O)	Qa (Orifice) (1.02-1.24)	Chart Response	IC Corrected	Linear Regression	
1	2.1	1.0146	31	21.1	Slope=	23.9473531
2	2.5	1.1069	34	23.1	Intercept=	-3.2198
3	2.7	1.1502	36	24.5	**Corr. Coeff.=**	**0.9973**
4	2.9	1.1920	37	25.2	SFR=	1.2806
5	3.0	1.2124	38	25.9	SSP=	40.3128

Project: Yerington/ARC AQ AM6 TSP site

Monitor: Tisch Environmental TSP Hi-Vol Sampler Model No. TE-5170D

Sampler Serial No.	NA	**Ta**	**Temp C**	**27.8**	**Orifice Serial No.**	**w43**
Orifice Serial No.	1021	**Ta**	**Temp K**	**300.95**	**W43 slope (m)**	**0.97381**
		Pa	**BP mm Hg**	**649.224**	**W43 int. (b)**	**-0.00137**
Date: July 11, 2006		**Pa**	**Bp in Hg**	**25.56**		

Point	Orifice Press. Drop (" H2O)	Qa (Orifice) (1.10-1.70)	Chart Response	IC Corrected	Linear Regression	
1	3.0	1.2124	37	25.2	Slope=	18.13226513
2	3.8	1.3643	41	27.9	Intercept=	3.1548
3	4.3	1.4512	43	29.3	**Corr. Coeff.=**	**0.9993**
4	4.9	1.5491	46	31.3	SFR=	1.2806
5	5.4	1.6261	48	32.7	SSP=	38.7380

APPENDIX C

COPY OF E-MAIL CORRESPONDENCE FROM BROWN & CALDWELL REGARDING AIR SAMPLER PROGRAMMING ERROR

Herlocker, Douglas -- EMI

From: Graening, Guy [GGraening@BrwnCald.com] **Sent:** Wed 7/12/2006 3:06 PM
To: Herlocker, Douglas -- EMI
Cc: Jim Sickles (E-mail); Early, Victor -- EMI; Zimmerman, Chuck; Sherman, Marne
Subject: RE: Yerington Mine Site July 10 sample run day
Attachments:

Doug,

I looked into the issue and this was a timer programming error that affected Event 89 only. The samples for Event 89 should be considered valid although units AM-6-TSP ran one day later than units AM-1-PM10, AM-1-PM10-DUP, AM-3-PM10, and AM-6-PM10. Here are the events that led up to the error:

- June 12-13: Motor change out on all 13 units and re-calibration of all 13 units. All units were programmed correctly at this time.
- July 3: Turn off units AM-1-TSP, AM-2-PM10, AM-2-TSP, AM-4-PM10, AM-4-TSP, AM-5-PM10, and AM-5-TSP in preparation for new monitoring program beginning with Event 88 on July 4.
- July 4 (Event 88): Units AM-1-PM10, AM-3-PM10, AM-6-PM10, and AM-6-TSP ran on correct day (their timer programming was not changed).
- July 6: After reviewing the sample volumes for the events following the last calibration, the flow rate set points on units AM-1-PM10, AM-3-PM10, and AM-6-PM10 were adjusted slightly (this is a normal procedure and does not affect the calibration of the unit). Re-setting the flow rate set points is a manual adjustment of the set screw that involves turning off the timer and manually starting the unit with a dummy filter. At this point the units were reprogrammed incorrectly and the PM-10 units ran 1 day early. The reason the AM-6-TSP unit ran on the correct day is that normal operation of the TSP units does not involve adjusting the flow rate set point as part of the calibration procedure and the programming on this unit was not modified.
- July 9: Units AM-1-PM10, AM-1-PM10-DUP, AM-3-PM10, and AM-6-PM10 ran one day early for Event 89.
- July 10 (Event 89): Unit AM-6-TSP ran on correct day. The PM-10 units were programmed correctly for Event 90 on July 16.

This error and the explanation will be documented in the 3rd quarter report. I am sorry that this occurred and we will double check our timer programming in the future. For many events, we are on-site the day before or the day after an event runs and this error has not shown up. I do appreciate your audits and they make the air monitoring program that much better.

Sincerely,

Guy J. Graening, P.E.

Brown and Caldwell
10540 White Rock Road, Suite 180
Rancho Cordova, CA 95670
Office: 916-853-5385
Fax: 916-635-8801
Cell: 916-838-3572

From: Herlocker, Douglas -- EMI [mailto:Douglas.Herlocker@ttemi.com]
Sent: Wednesday, July 12, 2006 12:31 PM
To: Graening, Guy
Cc: Jim Sickles (E-mail); Early, Victor
Subject: Yerington Mine Site July 10 sample run day

Guy,

I bet you probably have already been informed of this, but when I was onsite Monday July 10, none of PM10 samplers (at AM1, AM1-Dup, AM3, and AM6) were sampling. The chart recorders showed that samples had already run. However, the TSP sampler at AM6 was running. I will formally address this and my audit findings in my upcoming audit report, but wanted to make you aware of this. My concern is that this may have occured on more than one occasion. If so, this will need to be identified and addressed. In addition, I spoke with Marnie (sp?) about the problem when I was accompanying her on-site yesterday.

Can you please check into this and let me know.

Regards,

Doug

~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~
Doug Herlocker
Senior Air Quality Specialist/
Environmental Project Manager

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