Sheep Mountain Project – Mine Permit 381C

APPENDIX D-4 – CLIMATOLOGY
2011 ADDENDUM

Appendix D10 - Climatology

The Sheep Mountain Project falls within the intermountain semi-desert weather province. The following is a summary of the climatic conditions.

JEFFREY CITY, WYOMING (NWS station 484925)

Period of Record Monthly Climate Summary

2.9.1.1.1 Period of Record : 4/10/1964 to 12/31/2005

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Max. Temperature (F)	31.1	34.0	43.5	54.7	64.5	75.1	84.9	82.8	71.8	59.4	40.1	31.1	56.1
Average Min. Temperature (F)	9.1	10.3	18.5	26.4	34.8	42.5	49.2	48.1	38.2	28.7	16.6	9.5	27.7
Average Total Precipitation (in.)	0.36	0.42	0.79	1.28	2.04	1.07	0.89	0.64	0.78	0.83	0.62	0.40	10.12
Average Total Snow Fall (in.)	5.1	6.6	8.3	9.7	4.0	0.3	0.0	0.0	1.1	5.4	9.7	6.2	56.5
Average Snow Depth (in.)	2	2	1	0	0	0	0	0	0	0	1	2	1

Titan has established an on-site remote weather station which has been recording temperature, precipitation (rain and snow), barometric pressure, wind speed at 1 and 10 meter heights, and other data. Wind speed, direction and shear are critical data input for MILDO monitoring required for the USNRC licensing of the site to predict offsite dispersion of air particulates and radon. The mill site at the Sheep Mountain Project sits in the valley of Crooks Gap. Local topography affects the wind direction. The following report is a summary of on site data through March 31, 2012.

TITAN URANIUM SHEEP MOUNTAIN METEOROLOGICAL MONITORING REPORT

Six-Month Data Summary Report
October 1, 2011 through March 31, 2012

Prepared for:

Titan Uranium Incorporated

Prepared by:

Tetra Tech

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June 2012

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Appendix E: Processed and Validated Meteorological Data and Pdf Copy of Entire Report

LIST OF ACRONYMS AND ABBREVIATIONS

%	Percent
agl	Above ground level
amsl	Above mean sea level
°C	Degree Celsius
CD	Compact disc
CFR	Code of Federal Regulations
Delta-T	Temperature difference between 10-meter and 2-meter levels
EPA	Environmental Protection Agency
ft	Feet
m/s	Meter per second
N/A	Not applicable
NIST	National Institute of Standards and Technology
NRC	U.S. Nuclear Regulatory Commission
PSD	Prevention of Significant Deterioration
RH	Relative humidity
W/m^2	Watts per square meter
WDEQ	Wyoming Department of Environmental Quality

EXECUTIVE SUMMARY

This report provides a summary of the meteorological data collected at Titan Uranium's Sheep Mountain meteorological monitoring station (meteorological station) from October 1, 2011 through March 31, 2012. The meteorological station is located at the Sheep Mountain facility approximately 10 miles from Jeffrey City, Wyoming near the proposed uranium recovery facility, approximately 50 feet east of the access road and 1,000 feet north of the existing process and maintenance buildings. The meteorological station was installed and configured to collect data in accordance with the U.S. Nuclear Regulatory Commission (NRC) Regulatory Guide 3.63, *Onsite Meteorological Measurement for Uranium Recovery Facilities – Data Acquisition and Reporting.*

Tetra Tech installed the meteorological station on August 9-12, 2010 with the assistance from BRS Engineering, Inc (BRS). The meteorological station is configured to collect ambient data for horizontal wind speed, wind direction and wind direction standard deviation (at 10-meters), temperature (at 2 and 10 meters), temperature difference (Delta-T), humidity, solar radiation, and precipitation. The meteorological station was installed, programmed, and calibrated prior to initial operation using National Institute of Standards and Technology (NIST) certified sensors to verify that each sensor was operating in accordance with the accuracy specifications outlined in Section C.3 of NRC Guide 3.63. Once the meteorological station was operational, site visits were conducted approximately twice per month to complete a visual inspection of all sensors and download data to a laptop computer. All "as found" site observations and meteorological sensor output readings were recorded on a site visit form. Copies of the site visit forms are provided in Appendix D.

The Titan Uranium Installation and Initial Calibration Report and *Titan Uranium 1st* and *3rd Quarter 2011 Calibration Reports* were provided in previous data reports and document quality assurance objectives, equipment accuracy specifications and calibration and maintenance results. No quality assurance calibration was conducted by Tetra Tech during the current monitoring period.

The data generated from the Titan Uranium meteorological station is expected to be input to the MILDOS-AREA computer dispersion modeling application. The MILDOS-AREA computer model calculates the radiological dose commitments received by individuals and the general population within an 80-km radius of an operating uranium recovery facility. In addition, air and ground concentrations of radionuclides are estimated for individual locations, as well as for a generalized population grid.
Data collection for the current monitoring period began on October 1, 2011. The data record evaluated from the period of October 1, 2011 through March 31, 2011 was above 90 percent complete for each individual parameter and more than 90 percent complete for joint data recovery for wind speed, wind direction, and atmospheric recovery, as required by Section C.4 of NRC Guide 3.63. All data was archived and screened using an electronic database that compares data to known minimum and maximum values for comparable sites as well as known validation criteria. If data values are found to be outside an acceptable range the values are flagged as suspect and further reviewed. As previously described the data presented in this report represents quality-assured data that has undergone various statistical analyses to facilitate a meaningful presentation and interpretation.

Based on the data review and screening process twenty four (24) hours of relative humidity data (<0.5% of data record evaluated) was invalidated due to erroneous readings. Additionally one (1) hour of precipitation data was invalidated due to maintenance. With the exception of the

precipitation data, all on-site activities during the current monitoring period did not result in any lost or invalidated data.

Tetra Tech personnel provided technical support for site operations, routine site visits, and data screening for this six month monitoring period. BRS personnel conducted routine site visits on a two week to one-month frequency to document and confirm that all systems were operating correctly and download data from the data logger. Data was provided via e-mail to Tetra Tech after each site visit. All data was screened, archived, and incorporated into the Titan meteorological monitoring database.

Meteorological data collected during the monitoring period was characterized by predominant winds from the south, south-east with long periods of sustained high wind events above 11 meters per second. Temperatures at the site were consistent with historical averages and ranged from –22.59 to 24.29 degrees Celsius. Solar radiation at the site was consistent with seasonal patterns with the lowest average monthly solar radiation of 89.5 watts per square meter occurring in December. Relative humidity was also consistent with seasonal patterns with the highest monthly average relative humidity of 78.1 percent occurring in February. The site had much lower than average precipitation, only recording 1.19 inches of precipitation during the monitoring period. The highest total monthly precipitation occurred in October with 1.01 inches. There was no recorded precipitation in February and March but may be attributed to snowfall not captured by the snowmelt adaptor.

1.0 INTRODUCTION

Titan Uranium Inc. (Titan), with assistance from Tetra Tech Inc. (Tetra Tech), installed and operated a 10-meter meteorological monitoring station (meteorological station) at the Sheep Mountain facility 10 miles from Jeffrey City, Wyoming. The station was erected to collect MILDOS-AREA quality data that may be used to meet NRC permitting requirements. This report summarizes data collected between October 1, 2011 and March 31, 2012.

1.1 Description of Meteorological Monitoring Station Location

The meteorological monitoring station is located at the Sheep Mountain facility approximately 10 miles from Jeffrey City, Wyoming. The Site is at approximately 6,840 feet (ft) above mean sea level (amsl) situated on a knoll approximately 50 feet east of the access road and 1,000 feet north of the existing process and maintenance buildings.

1.2 Description of Monitoring Station Parameters

The meteorological station data collection parameters meet NRC requirements as well as U.S. Environmental Protection Agency (EPA) Prevention of Significant Deterioration (PSD) requirements. PSD data collection requirements represent a benchmark for any dispersion modeling, ensuring the data collected is also suitable for regulatory purposes in non-PSD type dispersion modeling. The program described in this document follows guidelines established by the NRC, EPA, and the Wyoming Department of Environmental Quality (WDEQ), Air Quality Division (AQD). Therefore, these data are representative of site conditions and of sufficient quality to be used to support MILDOS-AREA or EPA AERMOD dispersion modeling programs.

The meteorological monitoring station is a 10-meter tower equipped with a CR800 data logger and sensors located at 10-, 2-, and, 1-meters above ground level (agl). The station monitors the following parameters:

- 10-meter horizontal wind speed
- 10-meter horizontal wind direction
- 10-meter horizontal wind direction standard deviation
- 10-meter temperature
- 2-meter temperature
- Delta-T
- 2-meter solar radiation
- 2-meter humidity
- Precipitation (with snow melt adaptor during winter months)
- Battery voltage

Table 1-1 summarizes the monitoring equipment and measurement specifications in use for the Titan Uranium meteorological station for this reporting period. The monitoring system, equipment model, serial number, accuracy specifications, quality assurance program, and data management aspects of the monitoring program are described in the *Titan Uranium Sheep Mountain Meteorological Monitoring Station Installation and Initial Calibration Report (Tetra Tech 2011)*. The meteorological station location is presented in **Figure 1-1**.

Table 1-1

Titan Uranium 10-Meter Meteorological Station Equipment Specifications

Parameter	Instrument Description-Model	Instrument Serial Number	Instrument Accuracy Specifications	Instrument Location
10-Meter Wind Speed	RM Young Model 03002-L (with upgraded bearings)	WM00066721	WS: +/- 0.5 m/s; Starting threshold: 0.5m/s	10 meters AGL
10-Meter Wind Direction	RM Young Model 03002-L (with upgraded bearings)	WM00066721	WD: +/- 5 degrees; Starting threshold: 0.5 m/s	10 meters AGL
2- and 10-Meter Ambient Temperature	RM Young Model 43347-L	2-meter: TS17970 10-meter: TS17971	+/- 0.1 degrees Celsius (NIST calibrated)	2 and 10 meters AGL
2-Meter Relative Humidity	HMP Model 60-L	W5030013	+/- 3% RH (0 to 90% RH); +/- 5% RH (90-98% RH)	2 meters AGL
2-Meter Solar Radiation	Apogee SP110	22118-131	+/- 5% (for daily total radiation)	2 meters AGL
Precipitation	Texas Electronics TE525-L with CS705 Snowfall adaptor (winter months)	TE50512	+/- 1% (up to 1 inch/hour)	1 meter AGL
Meteorological Tower Datalogger	Campbell Scientific CR800	N/A	N/A	Environmental Enclosure
10-Meter Tower	Rohn UT-30 3-Sided Aluminum Lattice Tower with Concrete foundation and 3 UTGUY Anchored Guy Wires	N/A	N/A	N/A
Tower Base	B18 Concrete Mounting Kit (anchored in concrete)	N/A	N/A	N/A

Notes:

%	Percent
°C	Degree Celsius
AGL	Above Ground Level
Hg	Mercury
mm	Millimeters
m/s	Meter per second
N/A	Not applicable
RH	Relative humidity
w/m^2	Watts per square meter
WD	wind direction
WS	wind speed

LEGEND

- SECTION LINE
- SHEEP MOUNTAIN PERMIT BOUNDARY
- EXISTING ROAD
- MET STATION LOCATION

T28N R92W

1 inch = 1500'

BRS ENGINEERING	**FIGURE 1** SCALE: 1"=1500' DRAWN BY: CDS DATE: 8/10/11	**SHEEP MOUNTAIN MINES** **FREMONT COUNTY, WYOMING**	REVISION DATE: 1/31/12 CAD FILENAME: LP2008/PERMITING/MONITOR ALL DWG. NUMBER: FIGURE 1

TITAN URANIUM USA INC

This report summarizes data collected from October 1, 2011 through March 31, 2012. A chronology of project progress and significant events during this time period is presented in Section 2.0. Section 3.0 contains a summary of network performance and data retrieval statistics. The meteorological and air quality data are presented and discussed in Section 4.0.

Appendix A contains the formulae used to determine precision, accuracy, and data retrieval statistics; Appendix B presents the EPA recommended data screening procedures; Appendix C provides the unit vector averaging method for wind directions; Appendix D contains copies of the completed monitoring station site visit forms; and Appendix E contains a compact disc with the processed and validated meteorological data for the semi-annual monitoring period and a PDF copy of this report.

2.0 PROJECT PROGRESS AND SIGNFICANT EVENTS

Program activities conducted during the six month collection period were associated with routine site inspections and data acquisition by BRS. Other activities performed during the period included routine maintenance, and data management. Tetra Tech conducted frequent data management activities during the semi-annual monitoring period, including routine data screening, and validation of the collected data that was provided by BRS. Significant events and activities are summarized in **Table 2-1**.

Table 2-1

Chronology of Activities during the Monitoring Period
Titan Uranium 10-Meter Meteorological Station
October 1, 2011 through March 31, 2012

Date	Description
10/1/2011	Start of data collection
10/18/2011	Routine site visit and data download
11/08/2011	Routine site visit and data download
12/02/2011	Routine site visit and data download
12/31/2011	Routine site visit and data download; maintenance on precipitation sensor/install snowmelt adaptor
1/18/2012	Routine site visit and data download
3/08/2012	Routine site visit and data download
3/31/2012	End of data collection period

3.0 NETWORK PERFORMANCE SUMMARY

The data recovery statistics for each meteorological parameter are presented in this section along with a brief summary of missing data. Program goals for data capture, as specified by PSD requirements, call for quarterly valid data recovery of 90 percent for meteorological parameters.

3.1 Network Data Capture

Meteorological data capture percentages have been calculated on the basis of the total number of valid data hours collected, divided by the total number of hours in the month, multiplied by 100. Hours lost due to routine maintenance, and calibrations have been deleted from the database in the data validation process. The data capture percentages for each parameter are summarized in **Table 3-1**. The only invalidated data included 24 hours of erroneous relative humidity data due to an intermittent data logger processing error. The invalidated relative humidity data typically occurred when relative humidity was at or near 100 percent. The value "jumped" up to between 108 to110 percent. The data was reviewed and determined to be of sufficient quality. However, the problem was isolated to only high humidity events and the sensor accuracy was determined to accurate for the remaining relative humidity data.

Table 3-1

Summary of Data Capture Statistics
Titan Uranium 10-Meter Meteorological Station
October 1, 2011 through March 31, 2012

Parameter	October 2011	November 2011	December 2011	January 2012	February 2011	March 2011	Cumulative Average
10-meter horizontal wind speed	100%	100%	100%	100%	100%	100%	**100%**
10-meter wind direction	100%	100%	100%	100%	100%	100%	**100%**
10-meter sigma-theta	100%	100%	100%	100%	100%	100%	**100%**
10-meter temperature	100%	100%	100%	100%	100%	100%	**100%**
2-meter temperature	100%	100%	100%	100%	100%	100%	**100%**
2-meter relative humidity	100%	100%	100%	100%	99.9%	99.9%	**99.99%**
2-meter solar radiation	100%	100%	100%	100%	100%	100%	**100%**
Precipitation	100%	100%	100%	100%	100%	99.9%	**99.99%**
Battery Voltage	100%	100%	100%	100%	100%	100%	**100%**
Cumulative Average	**100%**	**100%**	**100%**	**100%**	**100%**	**99.99%**	**99.99%**

3.2 Meteorological Data Collection

Table 3-2 summarizes the meteorological data loss during the monitoring period.

Table 3-2

Summary of Data Loss Parameters
Titan Uranium 10-Meter Meteorological Station
August 12, 2010 through March 31, 2011

Date	Hours Lost	Parameter	Reason for Data Loss
2/11/12 – 3/19/12	24	Relative Humidity	Undefined processing error
12/31/11	1	Precipitation	Service

4.0 METEOROLOGICAL DATA SUMMARY

Data collected at the Titan Uranium meteorological station includes 10-meter horizontal wind speed and direction, wind direction standard deviation, 2 and 10-meter temperature, Delta-T, relative humidity, solar radiation, precipitation, and data logger battery voltage. Wind direction standard deviation and Delta-T are programed calculations that are performed by the data logger system. This section summarizes the data collected from October 1, 2011 through March 31, 2012. Processed and validated data is included on the enclosed CD in Appendix E.

4.1 Horizontal Wind Speed Data Summary

Data collected from October 1, 2011 through March 31, 2012 was characterized by predominant and sustained winds blowing from the south, south-east. The average wind speed at the 10-meter level for the monitoring period was 7.8 meters per second (m/s). Average wind speeds per month are listed in **Table 4-1**. The maximum hourly average wind speed recorded during the monitoring period was 20.29 m/s [45.39 miles per hour, (mph)] occurring on March 26, 2012 at 12:00. The maximum hourly average wind speed was recorded at the meteorological station during an eleven hour period of sustained wind speeds of over 11 m/s (24.6 mph) out of the south-southwest on March 26, 2012 between 10:00 and 21:00 hours.

Table 4-1

Average Monthly Wind Speed Summary
Titan Uranium 10-Meter Meteorological Station
October 1, 2011 through March 31, 2012

Parameter	October 2011	November 2011	December 2011	January 2012	February 2012	March 2012
Average Wind Speed	6.55 m/s	8.71 m/s	8.50 m/s	8.89 m/s	6.71 m/s	7.57 m/s

4.2 Horizontal Wind Profile Data Summary

Horizontal wind direction is measured via vane position and is calculated by a potentiometer which determines wind direction. Sensor output is a direct current voltage proportional to vane angle. The horizontal wind direction standard deviation (sigma-theta) is calculated and recorded from a programmed algorithm in the Campbell CR800 data logger. The standard deviation of horizontal wind direction from October 1, 2011 to March 31, 2012 is summarized in **Table 4-2**. Horizontal wind speed and direction data from the same time period is presented in a wind rose plot in **Figure 4-1**. The wind rose demonstrates that the predominant wind pattern is from the south, southeast with the highest recorded wind speeds and 31.8 percent of the data in the quadrant from 146.25 to 168.75 degrees.

The distribution of wind speed is presented in **Figure 4-2**. The wind speed class frequency distribution demonstrates that the largest percentage of wind speeds of 32.5 percent is found in the 5.7 to 8.8 m/s range. Consistent with the documented high winds at this site, 18.7 percent of the wind speed was in excess of 11.1 m/s and 20.4 percent of the wind speed was in the 8.8 to 11.1 m/s during the monitoring period.

Table 4-2

Hourly Standard Deviation of Wind Direction Summary
Titan Uranium 10-Meter Meteorological Station
October 1, 2011 through March 31, 2012

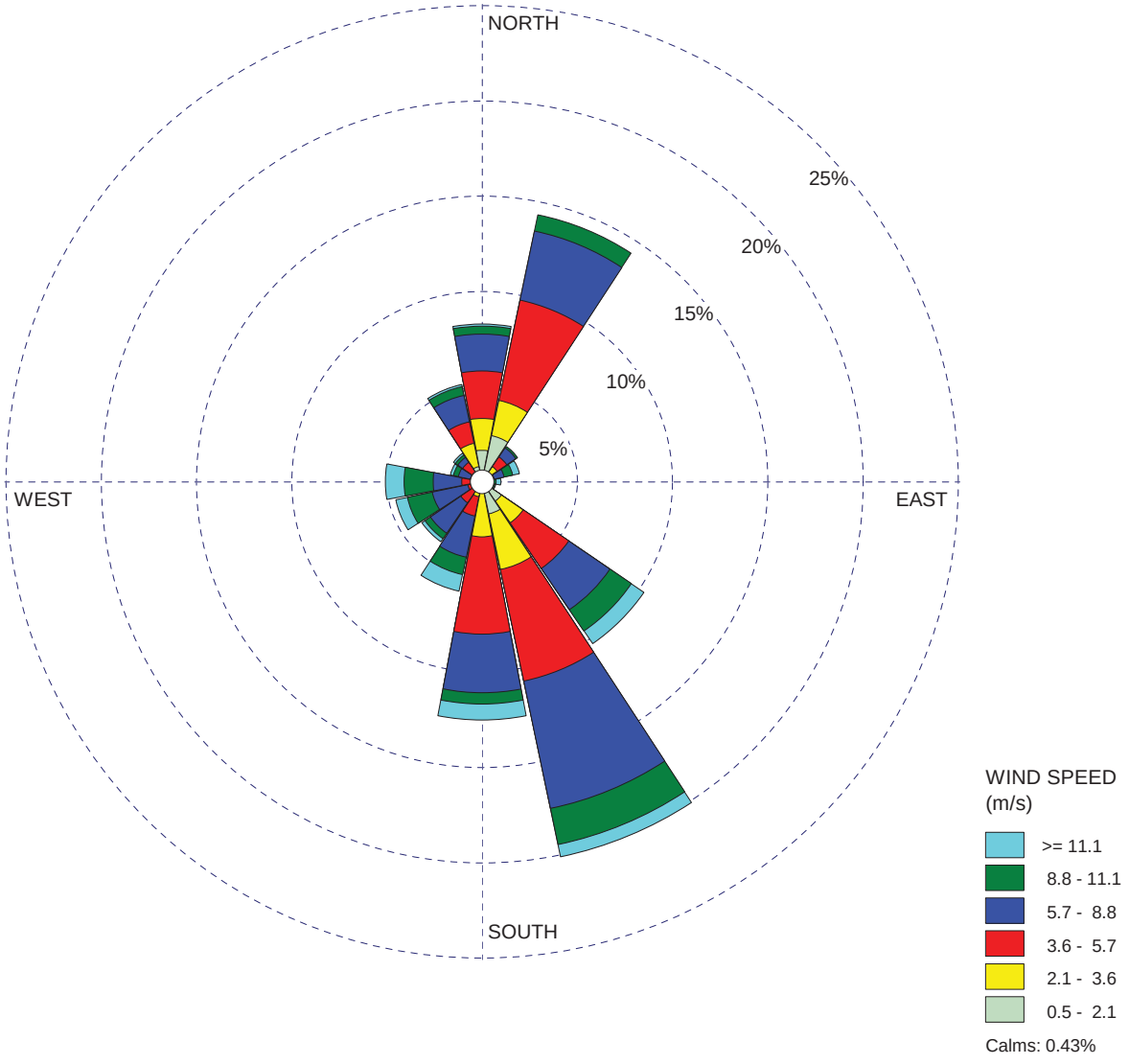
Month	Maximum Standard Deviation of Wind Direction	Date & Time of Occurrence	Minimum Standard Deviation of Wind Direction	Date & Time of Occurrence	Average Standard Deviation of Wind Direction
October 2011	83.00	10/28/11 @ 01:00	0.0	10/8/2011 0:00 – 08:00	16.68
November 2011	84.70	11/30/11 @ 17:00	4.68	11/7/11 @ 02:00	13.78
December 2011	89.60	12/21/11 @ 09:00	4.55	12/25/11 @ 02:00	14.61
January 2012	88.20	1/22/12 @ 04:00	5.02	1/02/12 @ 01:00	18.30
February 2012	89.10	2/07/12 @ 02:00	0.0	2/23/2012 @ 10:00	19.52
March 2012	88.00	3/13/12 @ 20:00	4.24	3/10/12 @ 15:00	16.59

WIND ROSE PLOT:

FIGURE 4-1: Titan Uranium 10-M Met Station Wind Rose Plot
April 1, 2011 Through September 30, 2011

DISPLAY:

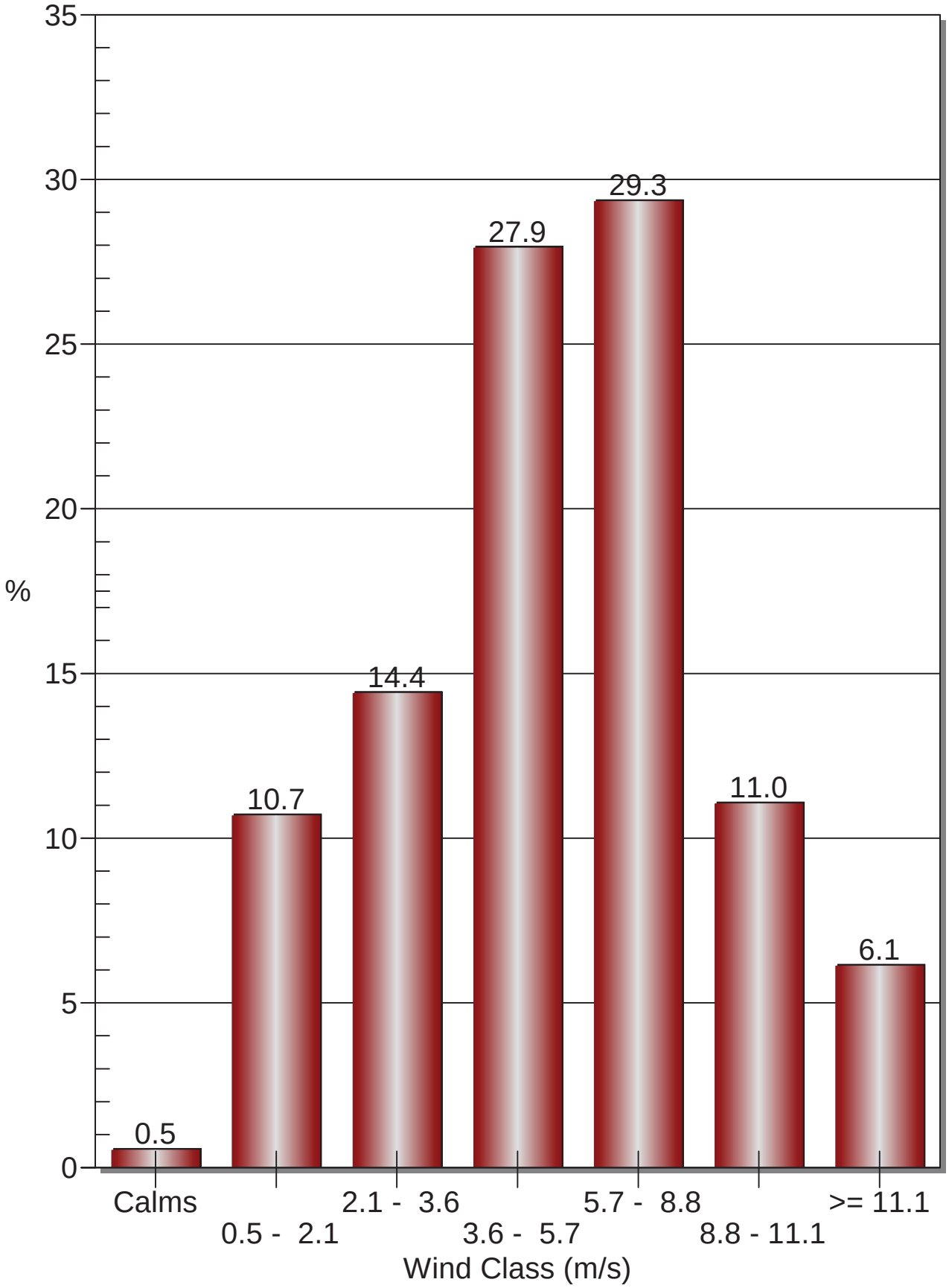
Wind Speed
Direction (blowing from)



COMMENTS:		COMPANY NAME: **Tetra Tech**	
		MODELER: **D. Herlocker**	
	CALM WINDS: **0.43%**	TOTAL COUNT: **3632 hrs.**	
	AVG. WIND SPEED: **5.76 m/s**	DATE: **2/10/2012**	PROJECT NO.:

WRPLOT View - Lakes Environmental Software

Figure 4-2: Titan Uranium 10-M Met Station Wind Speed Frequency Distribution
April 1, 2011 Through September 30, 2011



WRPLOT View Freeware 7.0.0 - Lakes Environmental Software

4.3 Temperature

The temperature data recorded at the Titan Uranium meteorological station during the six month data collection period are summarized in **Table 4-3**. The maximum temperature of 24.29 ºC (75.72 ºF) was recorded on October 1, 2011 at 15:00 on the 2-meter probe. The corresponding temperature on the 10-meter probe was 23.71 ºC (74.68 ºF). The minimum temperature of -22.59 ºC (-8.66 ºF) was recorded on December 5, 2011 at 09:00 on the 2-meter probe. The corresponding temperature on the 10-meter probe was -21.85 ºC (-7.33 ºF). A summary of the Delta-T values are summarized in **Table 4-4**. The Delta-T value is the difference in the temperatures measured at both the 2-meter and 10-meter temperature probes. A positive value in the Delta-T value indicates that an inversion layer may be present with cold air trapped beneath a warmer air layer.

Table 4-3

Hourly Temperature Summary
Titan Uranium 10-Meter Meteorological Station 2-Meter Probe
October 1, 2011 through March 31, 2012

Month	Maximum Temperature	Date & Time of Occurrence	Minimum Temperature	Date & Time of Occurrence	Average Temperature
October 2011	24.29	10/01/11 @ 15:00	-7.25	10/28/11 @ 06:00	6.73
November 2011	8.01	11/04/12 @ 16:00	-12.15	11/20/11 @ 02:00	-2.24
December 2011	5.47	12/30/11 @ 16:00	-22.59	12/05/11 @ 09:00	-6.83
January 2012	6.37	1/05/12 @ 15:00	-18.95	1/11/12 @ 20:00	-4.61
February 2012	4.10	2/22/12 @ 13:00	-17.76	2/07/12 @ 08:00	-7.11
March 2012	19.99	3/31/12 @ 15:00	-14.80	3/02/12 @ 02:00	2.88
Average – October 1, 2011 through March 31, 2012					**-1.81**

Table 4-4

Hourly Delta Temperature Summary
Titan Uranium 10-Meter Meteorological Station
October 1, 2011 through March 31, 2012

Parameter	Value	Date	Time
Average Delta Temperature	0.20 ºC	N/A	N/A
Maximum Delta Temperature	3.15 ºC	2/06/2012	02:00
Minimum Delta Temperature	-1.01 ºC	10/03/2011	11:00

4.4 Solar Radiation

Solar radiation data collected at the Titan Uranium meteorological station is consistent with northern latitude conditions with the highest hourly and total daily solar radiation observed during summer months and decreases during fall, winter, and spring months. The highest hourly average solar radiation during the 6-month monitoring period occurred on March 29, 2012 at 13:00 with 868.0 watts per square meter (W/m^2). The month with the highest total solar radiation was March 2012 with 158,779 W/m^2. The total hourly solar radiation recorded during the six month data collection period was 583,820 W/m^2. **Table 4-5** presents the maximum and minimum hourly solar radiation and average monthly solar radiation during the monitoring period. **Figure 4-3** presents a graphical summary of the total monthly solar radiation.

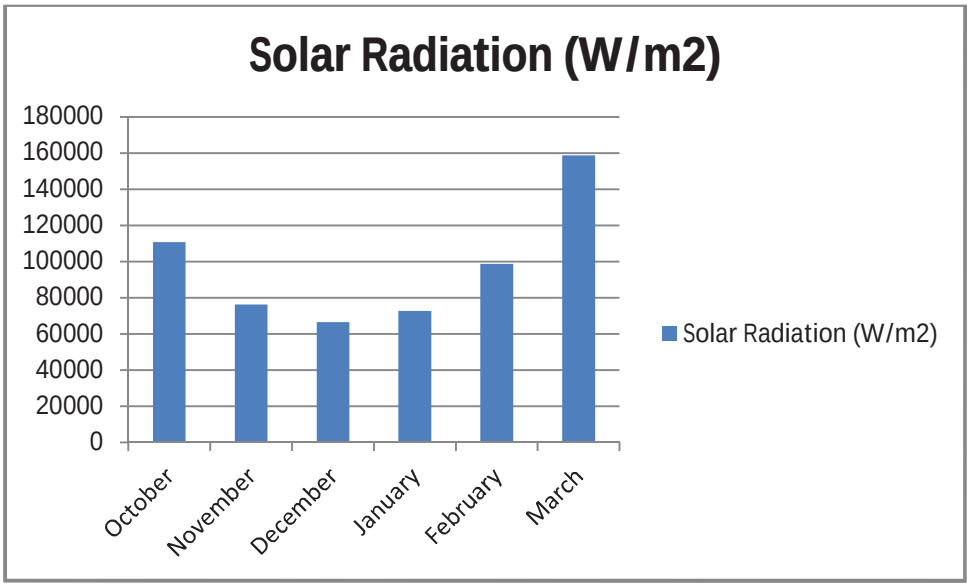
Table 4-5

Monthly Total Solar Radiation Summary
Titan Uranium 10-Meter Meteorological Station
October 1, 2011 through March 31, 2012 Data Collection Period

Month	Maximum Hourly Average Solar Radiation (W/m^2)	Date & Time of Occurrence	Average Solar Radiation (W/m2)
October 2011	720.6	10/01/11 @ 13:00	148.8
November 2011	689.8	11/19/11 @ 12:00	105.9
December 2011	580.0	12/30/11 @ 13:00	89.5
January 2012	559.7	1/31/12 @ 13:00	97.8
February 2012	710.9	2/26/12 @ 13:00	141.9
March 2012	868.0	3/29/11 @ 13:00	213.4
Average – October 1, 2011 through March 31, 2012			**132.9**

Figure 4-3

Monthly Total Solar Radiation Summary
Titan Uranium 10-Meter Meteorological Tower
October 1, 2011 through March 31, 2012



4.5 Relative Humidity

A summary of the relative humidity data from October 1, 2011 through March 31, 2012 is presented in **Table 4-6**. This site is typical of northern latitude climates with increased humidity during spring and fall months. However, monsoonal moisture is common in the summer with months with occasional short intense rain storms that produce high precipitation that results in high relative humidity. The month with the highest average relative humidity was February, 2012 with 78.1 percent. The average relative humidity for the 6-month monitoring period was 65.3 percent.

Table 4-6

Hourly Relative Humidity Summary
Titan Uranium 10-Meter Meteorological Station
October 1, 2011 through March 31, 2012

Month	Maximum Relative Humidity (percent)	Date & Time Occurred	Minimum Relative Humidity (percent)	Date & Time Occurred	Average Relative Humidity (percent)
October 2011	100	Multiple occurrences	17.5	10/01/11 17:00	55.9
November 2011	100.0	Multiple occurrences	15.7	11/16/11 14:00	66.5
December 2011	100.0	Multiple occurrences	34.8	12/31/11 16:00	74.4
January 2012	100.0	Multiple occurrences	29.6	01/16/12 16:00	65.5
February 2012	100.0	Multiple occurrences	23.1	2/27/12 08:00	78.1
March 2012	100.0	Multiple occurrences	13.1	3/22/12 14:00	52.7
Average – October 1, 2011 through March 31, 2012					**65.3**

4.6 Precipitation

A summary of the precipitation data from October 1, 2011 through March 31, 2012 is presented in Table 4-7. This site is typical of northern latitude climates with increased precipitation during spring and fall months. However, the site experienced lower than normal levels of precipitation during the monitoring period with no measurable precipitation during February and March. The maximum hourly recorded precipitation during the monitoring period was 0.18 inches on October 8, 2011 at 11:00 and the month with the highest total precipitation was October 2011 with a total of 1.01 inches. The total precipitation for the six month monitoring period was 1.19 inches. It must be noted that the precipitation sensor was outfitted with the winter snow melt adaptor on December 31, 2011. Therefore all precipitation occurring between December 31, 2012 and March 31, 2012 accounted for snow accumulation.

Table 4-7

Hourly Precipitation Summary
Titan Uranium 10-Meter Meteorological Station
October 1, 2011 through March 31, 2012

Month	1-Hour Maximum Precipitation (inches)	Date & Time Occurred	Total Monthly Precipitation (inches)
October 2011	0.18	10/08/11 @ 11:00	1.01
November 2011	0.04	11/05/11 @ 08:00	0.15
December 2011	0.01	12/22/11 @ 13:00	0.01
January 2012	0.01	1/21/12 @ 11:00 & 15:00	0.02
February 2012	0.00	N/A	0.0
March 2012	0.00	N/A	0.0
Total – October 1, 2011 through March 31, 2012			**1.19**

5.0 REFERENCES

Environmental Protection Agency (EPA). 2011. *ADDENDUM USER'S GUIDE FOR THE AERMOD METEOROLOGICAL PREPROCESSOR (AERMET)* Draft. Office of Air Quality Planning and Standards. Research Triangle Park, NC. EPA-454/B-03-002. February.

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EPA. 2000. *Meteorological Program Guidance for Regulatory Modeling Applications*. Office of Air and Radiation. Office of Air Quality Planning and Standards. Research Triangle Park, NC. EPA-454/R-99-005. February.

U.S. Nuclear Regulatory Commission (NRC). 1988. *Regulatory Guide 3.63 (Task ES 401-4) Onsite Meteorological Measurement For Uranium Recovery Facilities – Data Acquisition and Reporting.* March.

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APPENDIX A
DATA PROCESSING SPECIFICATIONS AND STATISTICAL FORMULAE

DATA PROCESSING SPECIFICATIONS AND STATISTICAL FORMULAE

A.1 Data Capture Percentage

The total data capture percentage (P_t) for each parameter is determined as follows:

$$P_t = \frac{h_v}{h_t} \times 100$$

where: h_v = number of hours of valid data
h_t = total hours in the period

A.2 Calculation of Hourly Sigma-Theta Values

The hourly values of sigma-theta were calculated from the 15-minute averages using the following equation (EPA 2005):

$$\sigma_\theta(hourly) = \sqrt{\frac{\sum_{i=1}^{n} \sigma^2{}_{\theta i}}{n}}$$

The data logger calculates sigma-theta using the Yamartino method.

APPENDIX B
EPA RECOMMENDED DATA SCREENING PROCEDURES

EPA Recommended Data Screening Procedures

Variable	Screening Criteria: Flag the Data if the Value -
Wind Speed	- is less than zero or greater than 25 m/s - does not vary by more than 0.1 m/s for 3 consecutive hours - does not vary by more than 0.5 m/s for 12 consecutive hours
Wind Direction	- is less than zero or greater than 360 degrees - does not vary by more than 1 degree for more than 3 consecutive hours - does not vary by more than 10 degrees for 18 consecutive hours
Temperature	- is greater than the local record high - is less than the record low - is greater than a 5 °C change from the previous hour - does not vary by more than 0.5 °C for 12 consecutive hours
Solar Radiation	- is greater than zero at night - is greater than the maximum possible for the date and latitude
Battery Voltage	- is less than 11.0 volts direct current
Humidity	- is less than 30% during precipitation events - varies by 30% of the local average for 24 consecutive hours
Precipitation	- is greater than 1.0 inches in one hour - is greater than 3.9 inches in 24 hours - is less than 2.0 inches in three months (possible in dry arid climates)

Notes:

%	Percent
°C	Degree Celsius
m/s	Meter per second

APPENDIX C
UNIT VECTOR AVERAGING METHOD FOR WIND DIRECTIONS

UNIT VECTOR AVERAGING METHOD FOR WIND DIRECTIONS

The unit vector method for averaging wind direction reduces the wind direction for a given period to a “unit vector” and subsequently does not weight the north-south and east-west components of the wind direction by the wind speed. The formula for the components of the wind direction, both in the X-direction and the Y-direction, is as follows:

$$V_x = -(1/N) \sum \sin (A_i)$$
$$V_y = -(1/N) \sum \cos (A_i)$$

Where A_i is the wind direction for a specific period and N is the number of such observations for the hour.

The formula for calculating wind direction is as follows:

$$\text{Vector Wind} = \arctan (V_x/V_y)$$

If the Y-direction component (V_y) is zero and the X-direction component (V_x) is nonzero, the vector wind is set to 90°; however, if V_x, is zero, the vector wind is set to zero.

The unit vector wind is calculated based on the sign of the component winds in the following formula:

Unit Vector Wind = Vector Wind + FLOW

FLOW is determined by examining the signs of both V_x and V_y. If these are both less than or equal to zero, FLOW is set to zero. If V_x is negative, FLOW is set to 360°. If both are positive, FLOW is set to 180°. The following algorithm describes how FLOW is determined:

```
IF (Vy ≤ 0) THEN

    IF (Vx ≤ 0) THEN
        FLOW = 0°
    ELSE
        FLOW = 360°
    ELSE
        FLOW = 180°
```

APPENDIX D
MONITORING STATION
SITE VISIT FORMS

TITAN URANIUM SHEEP MOUNTAIN 10-METER METEOROLOGICAL TOWER
BI-WEEKLY FIELD INSPECTION FORM

11-8-11 8:09AM GG

Date: 10/18/11 Local Time (MDT): 12:42 Inspected By: GG

Observed Weather Conditions: Cool clear breezy

Tower Condition (*Yes/No-Measurement and/or Comment in space provided)*

1. Tower straight; guy wires tight?☐ ☐ Y Y

Instrument Condition – Visual Inspection

1. Horizontal wind speed cups turning? ☐ ☐ Y Y
2. Wind direction vane orienting into wind? ☐ ☐ Y Y
3. Are temperature aspirator fans running? ☐ ☐ Y Y

Data Logger Display – Real Time Data Review

(View values in "Monitor Data" tab)

2011 08:09:49

1. Time☐ ☐ 2011 11:42:31
2. Horizontal wind speed_10M ☐ ☐ (Meters per second) 3.58 5.45
3. Wind direction_10M☐ ☐ (Degrees) 9.5 163.72
4. Temp_2M ☐ ☐ (Degrees Celsius) 6.07 -8.37
5. Temp_10M☐ ☐ (Degrees Celsius) 5.65 -8.77
6. Humidity_10M ☐ ☐ (% rel. humidity) 47.10 76.45
7. Solar radiation_2M ☐ ☐ (watts per m^2) .657 216.45
8. Precipitation ☐☐ (inches) .0 — 0
9. Datalogger battery ☐ ☐ (Volts) 13.55 14.05

Observations/Comments:

NOTE:

- Report any discrepancies immediately to Doug Herlocker at 208-489-2839 Douglas.herlocker@tetratech.com)

Upon completion, this form should be placed in the Titan Uranium Meteorological Tower Site Notebook and kept at the site office for a minimum of two years.

TITAN
URANIUM USA INC

WIND DIRECTION MONITORING

These are to be filled in ~~on the same~~ day the MET tower data is downloaded.

Date: 10/18/11 11-8-11 Field Personnel: GG

Location 1- McIntosh Pit	Wind Direction	N80°E N5°W	Apparent Speed	2 mph 2 mph
	Time	12:35PM 7:59AM		
Location 2- Main Gate	Wind Direction	— N 50°E	Apparent Speed	0 7 mph
	Time	7:53AM		
Location 3 - West Congo Pit	Wind Direction	S30°E N 85°E	Apparent Speed	5 mph 1 MPH
	Time	2:01 PM 8:30 AM		
Location 4 - East Congo Pit on ridge	Wind Direction	S70°W N5°E	Apparent Speed	3 mph 3 mph
	Time	1:50 PM 8:35 AM		

Comments

TITAN URANIUM SHEEP MOUNTAIN 10-METER METEOROLOGICAL TOWER
BI-WEEKLY FIELD INSPECTION FORM

Date: [redacted] 12/2/11 Local Time (MDT): [redacted] 10:47 am Inspected By: [redacted] GG

Observed Weather Conditions: [redacted] windy Cold Clr.

Tower Condition (*Yes/No-Measurement and/or Comment in space provided)*

1. Tower straight; guy wires tight?☐ ☐ [redacted] Y

Instrument Condition – Visual Inspection

1. Horizontal wind speed cups turning? ☐ ☐ [redacted] Y
2. Wind direction vane orienting into wind? ☐ ☐ [redacted] Y
3. Are temperature aspirator fans running? ☐ ☐ [redacted] Y

Data Logger Display – Real Time Data Review

(View values in "Monitor Data" tab)

1. Time☐ ☐ [redacted] 10:47:53
2. Horizontal wind speed_10M ☐ ☐ (Meters per second) [redacted] 11.07
3. Wind direction_10M☐ ☐ (Degrees) [redacted] 148.10
4. Temp_2M ☐ ☐ (Degrees Celsius) [redacted] -7.41
5. Temp_10M☐ ☐ (Degrees Celsius) [redacted] -7.49
6. Humidity_10M ☐ ☐ (% rel. humidity) [redacted] 62.55
7. Solar radiation_2M ☐ ☐ (watts per m^2) [redacted] 424.63
8. Precipitation ☐☐ (inches) [redacted] 0
9. Datalogger battery ☐ ☐ (Volts) [redacted] 14.01

Observations/Comments:

NOTE:

- Report any discrepancies immediately to Doug Herlocker at 208-489-2839 Douglas.herlocker@tetratech.com)

Upon completion, this form should be placed in the Titan Uranium Meteorological Tower Site Notebook and kept at the site office for a minimum of two years.

TITAN
URANIUM USA INC

WIND DIRECTION MONITORING

These are to be filled in on the same day the MET tower data is downloaded.

Date: [redacted] 12/2/11 Field Personnel: [redacted] GG, HA

Location 1- McIntosh Pit — Wind Direction N40E [redacted] Apparent Speed [redacted] 6mph
Time 10:33AM [redacted]

Location 2- Main Gate — Wind Direction [redacted] N10°W Apparent Speed [redacted] 9mph
Time [redacted] 10:23

Location 3 - West Congo Pit — Wind Direction [redacted] Apparent Speed [redacted]
Time [redacted]

Location 4 - East Congo Pit on ridge — Wind Direction [redacted] Apparent Speed [redacted]
Time _____

Comments _____

TITAN URANIUM SHEEP MOUNTAIN 10-METER METEOROLOGICAL TOWER
BI-WEEKLY FIELD INSPECTION FORM

Date: 12/31/11 Local Time (MDT): 11:00AM Inspected By: J. W.

Observed Weather Conditions: cold, clear

Tower Condition (*Yes/No-Measurement and/or Comment in space provided)*

1. Tower straight; guy wires tight? ☑ ☐ Yes

Instrument Condition – Visual Inspection

1. Horizontal wind speed cups turning? ☑ ☐ yes
2. Wind direction vane orienting into wind? ☑ ☐ yes
3. Are temperature aspirator fans running? ☑ ☐ yes

Data Logger Display – Real Time Data Review

(View values in "Monitor Data" tab)

1. Time☐ ☐ 2011 13 21 16 17 19 132130
2. Horizontal wind speed_10M ☐ ☐ (Meters per second) 3.58
3. Wind direction_10M☐ ☐ (Degrees) 303
4. Temp_2M ☐ ☐ (Degrees Celsius) -3.09
5. Temp_10M☐ ☐ (Degrees Celsius)
6. Humidity_10M ☐ ☐ (% rel. humidity)
7. Solar radiation_2M ☐ ☐ (watts per m²) (49.92), 421.77
8. Precipitation ☐☐ (inches) Ø
9. Datalogger battery ☐ ☐ (Volts) 13.87

Observations/Comments:

SLR/KJ .84
RTD 2m -3.72
" 10m -3.7
RVA Ø

(* precip cup bottom was leaking when tried to winterize)

NOTE:

- Report any discrepancies immediately to Doug Herlocker at 208-489-2839 Douglas.herlocker@tetratech.com)

Upon completion, this form should be placed in the Titan Uranium Meteorological Tower Site Notebook and kept at the site office for a minimum of two years.

TITAN
URANIUM USA INC

WIND DIRECTION MONITORING

These are to be filled in on the same day the MET tower data is downloaded.

Date: 12/31/11 Field Personnel: J. Wilson

Location 1- McIntosh Pit	Wind Direction		Apparent Speed	
	Time			
Location 2- Main Gate	Wind Direction		Apparent Speed	
	Time			
Location 3 - West Congo Pit	Wind Direction		Apparent Speed	
	Time			
Location 4 - East Congo Pit on ridge	Wind Direction		Apparent Speed	
	Time			

Comments Not performed on this visit
snow was blocking roads

TITAN URANIUM SHEEP MOUNTAIN 10-METER METEOROLOGICAL TOWER
BI-WEEKLY FIELD INSPECTION FORM

Date: 1/18/12 Local Time (MDT): 10:57AM Inspected By: GG

Observed Weather Conditions: Windy - cloudy

Tower Condition (*Yes/No-Measurement and/or Comment in space provided)*

1. Tower straight; guy wires tight?☐ ☐ Y

Instrument Condition – Visual Inspection

1. Horizontal wind speed cups turning? ☐ ☐ ✓
2. Wind direction vane orienting into wind? ☐ ☐ ✓
3. Are temperature aspirator fans running? ☐ ☐ ✓

Data Logger Display – Real Time Data Review

(View values in "Monitor Data" tab)

1. Time☐ ☐ 10:57:04
2. Horizontal wind speed_10M ☐ ☐ (Meters per second) 8.8
3. Wind direction_10M☐ ☐ (Degrees) 203.1
4. Temp_2M ☐ ☐ (Degrees Celsius) -5.86
5. Temp_10M☐ ☐ (Degrees Celsius) -5.55
6. Humidity_10M ☐ ☐ (% rel. humidity) 58.9
7. Solar radiation_2M ☐ ☐ (watts per m^2) 0.38
8. Precipitation ☐☐ (inches) 0
9. Datalogger battery ☐ ☐ (Volts) 13.95

Observations/Comments:

No Cold Weather gear installed

NOTE:

- Report any discrepancies immediately to Doug Herlocker at 208-489-2839 Douglas.herlocker@tetratech.com)

Upon completion, this form should be placed in the Titan Uranium Meteorological Tower Site Notebook and kept at the site office for a minimum of two years.

APPENDIX E
METEOROLOGICAL DATA AND PDF COPY OF ENTIRE REPORT

Available upon request