

STONE & WEBSTER ENGINEERING CORPORATION
CALCULATION TITLE PAGE

CLIENT & PROJECT: PFSLLC/Private Fuel Storage Facility				PAGE 1 of 8 Total Pages: 9 w/attachments pages 1	
CALCULATION TITLE: Summary of On-Site Meteorological Data				QA CATEGORY (✓) <div style="display: flex; justify-content: space-around;"> <input type="checkbox"/> I <input checked="" type="checkbox"/> II <input type="checkbox"/> III </div>	
<div style="display: flex; justify-content: space-between;"> <div> CALCULATION IDENTIFICATION NUMBER JOB ORDER NO. <u>05996.0102</u> DISCIPLINE <u>E(B)</u> CURRENT CALC NO <u>02</u> OPTIONAL TASK CODE _____ </div> <div> OPTIONAL WORK PACKAGE NO. </div> </div>					
APPROVALS - SIGNATURE & DATE				REVISION NO. OR NEW CALCULATION NO. 	
PREPARES(S) / DATE(S)	REVIEWER(S) / DATES(S)	INDEPENDENT REVIEWER(S) / DATE(S)	SUPERSEDES CALCULATION NO. OR REVISION NO.		CONFIRMATION REQUIRED (✓) <div style="display: flex; justify-content: space-between;"> YES NO </div>
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CHANGE HISTORY PAGE

REVISION NO.	DESCRIPTION OF CHANGES	PAGES REVISED	PAGES ADDED	PAGES REPLACED
1	Revise the meteorological data summary to include the entire period of record from 12/19/96 to 12/29/98. Also include soil temperature and the method of calculating average wind direction.	1 - 5	6 - 8, A-1	N/A

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OBJECTIVE

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The purpose of this calculation is to summarize the hourly-average on-site meteorological data collected at the PFSF facility in Skull Valley, Utah during the period from December 19, 1996 to December 29, 1998, which is included in Table 6.1-2 of the Environmental Report.

METHODOLOGY

The hourly-average on-site meteorological data collected by an instrumented meteorological tower specified in accordance with Ref. 1 are summarized using the statistical functions available in an Excel spreadsheet in which the data are stored (Ref. 2). The statistics computed include the average, maximum, and minimum values of each parameter using the Excel functions "AVERAGE", "MAX", and "MIN". The parameters monitored include: wind speed, wind direction, sigma theta, dry bulb temperature, relative humidity, barometric pressure, solar radiation, soil temperature, and precipitation.

The meteorological database was created in accordance with the criteria identified in Ref. 3 and was validated using criteria in Ref. 4. The validation process did not identify any parameter values that were unreasonable or out of range.

ASSUMPTIONS

1. The average wind direction is represented by the scalar mean wind direction ($\bar{\theta}_s$) as approximated by the unit vector wind direction (Ref. 5). This direction is the arctangent of the mean sine and cosine of the hourly average wind direction as follows:

$$\overline{\sin \theta} = (1/N) \sum_{i=1}^N \sin \theta_i; \quad \overline{\cos \theta} = (1/N) \sum_{i=1}^N \cos \theta_i$$

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The magnitudes and signs of $\sin \theta$ and $\cos \theta$ must be taken into account to determine $\bar{\theta}_s$ as follows:

if $\overline{\sin \theta} = 0$ and $\overline{\cos \theta} > 0$	$\bar{\theta}_s = 0^\circ$
if $\overline{\sin \theta} > 0$ and $\overline{\cos \theta} > 0$	$\bar{\theta}_s = \tan^{-1}(\sin \theta / \cos \theta)$
if $\overline{\sin \theta} > 0$ and $\overline{\cos \theta} = 0$	$\bar{\theta}_s = 90^\circ$
if $\overline{\sin \theta} > 0$ and $\overline{\cos \theta} < 0$	$\bar{\theta}_s = \tan^{-1}(\sin \theta / \cos \theta) + 180^\circ$
if $\overline{\sin \theta} = 0$ and $\overline{\cos \theta} < 0$	$\bar{\theta}_s = 180^\circ$
if $\overline{\sin \theta} < 0$ and $\overline{\cos \theta} < 0$	$\bar{\theta}_s = \tan^{-1}(\sin \theta / \cos \theta) + 180^\circ$
if $\overline{\sin \theta} < 0$ and $\overline{\cos \theta} = 0$	$\bar{\theta}_s = 270^\circ$
if $\overline{\sin \theta} < 0$ and $\overline{\cos \theta} > 0$	$\bar{\theta}_s = \tan^{-1}(\sin \theta / \cos \theta) + 360^\circ$

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2. Monitoring did not take place for the entire months of December 1996 and December 1998. The statistics for the parameters monitored during December, 1996 are for the period December 19 through December 31 and those for December, 1998 are for the period December 1 through December 29, 1998.

RESULTS

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The summarized hourly-average on-site meteorological data are provided on pages 5 – 8.

REFERENCES

Rev. 1

1. Specification for Meteorological Monitoring System, Purchase Specification No. 05996.01-W012G-Rev.0, October 17, 1996.
2. Hourly On-Site Meteorological Data Collected at the Skull Valley Goshute Indian Reservation in Skull Valley, Utah from December 19, 1997 to December 29, 1998. Data are stored in Excel spreadsheet named "PFSFMET.XLS" dated 1/20/99. See Attachment A.

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3. Procedure for Meteorological Data-Base Management, Procedure Number 05996.01-MET-003, 12/13/96.

4. Procedure for Routine Meteorological Data-Base Validation, Procedure Number 05996.01-MET-001, 12/13/96.

5. ANSI/ANS-3.11 (draft), "American National Standard for Meteorological Data at Nuclear Facilities", Appendix E, January 22, 1999.

SUMMARY OF ON-SITE METEOROLOGICAL DATA

<u>Parameter</u>	<u>Month/Year</u>						
	<u>12/96</u> (19-31)	<u>01/97</u>	<u>02/97</u>	<u>03/97</u>	<u>04/97</u>	<u>05/97</u>	<u>06/97</u>
Wind Speed (mph)							
- avg	12.1	8.9	8.4	9.4	9.7	7.9	10.1
- max	26.9	32.8	28.9	32.0	32.9	23.5	32.8
Wind Direction (deg)							
- scalar avg	142.8	139.9	103.2	144.0	64.1	122.0	145.5
Temperature (°F)							
- avg	36.7	27.6	29.8	40.1	42.9	58.4	67.2
- max	59.4	57.1	55.8	74.9	76.2	94.5	93.4
- min	10.9	-7.0	6.7	6.4	10.6	21.2	36.5
Relative Humidity (%)							
- avg	62.3	77.4	2.7	55.7	59.3	50.1	45.9
- max	95.5	98.4	97.5	96.9	96.8	94.0	97.6
- min	25.8	38.4	25.0	8.3	12.4	6.9	5.2
Solar Radiation (W/m ²)							
- avg	55.5	78.3	134.8	196.6	228.6	279.7	278.1
- max	533.2	536.1	717.0	823.0	897.0	977.0	988.0
Barometric Pressure (mb)							
- avg	857.1	861.5	862.2	861.9	858.0	860.0	856.4
- max	870.5	875.6	872.5	874.9	866.3	866.2	865.3
- min	844.9	846.4	839.7	849.7	845.1	851.9	848.3
Soil Temperature (°F)							
- avg	41.7	40.4	38.4	41.4	47.5	55.7	61.7
- max	42.5	42.6	38.9	46.4	50.9	59.6	65.0
- min	40.9	38.5	37.8	37.5	45.4	50.4	56.9
Precipitation (inches)							
- total	0.20	0.60	0.44	0.06	1.06	0.60	2.80

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<u>Parameter</u>	<u>07/97</u>	<u>08/97</u>	<u>09/97</u>	<u>10/97</u>	<u>11/97</u>	<u>12/97</u>	<u>1997</u>
Month/Year							
Wind Speed (mph)							
- avg	8.5	9.9	8.9	9.8	6.7	7.6	8.8
- max	30.0	25.5	28.5	32.5	28.4	29.4	32.9
Wind Direction (deg)							
- scalar avg	160.3	154.9	157.1	153.0	144.9	138.0	145.3
Temperature (°F)							
- avg	71.7	75.3	63.5	47.9	36.7	21.0	48.6
- max	99.3	96.6	91.4	84.6	66.6	49.0	99.3
- min	36.5	49.2	30.3	18.6	9.2	-4.7	-7.0
Relative Humidity (%)							
- avg	39.5	39.6	56.6	55.3	72.6	80.8	58.7
- max	96.5	98.1	98.4	96.5	97.8	98.0	98.4
- min	3.9	8.9	10.5	11.1	18.1	33.3	3.9
Solar Radiation (W/m ²)							
- avg	287.9	256.5	193.4	153.4	97.8	83.4	189.4
- max	958.0	914.0	817.0	756.0	556.2	481.7	988.0
Barometric Pressure (mb)							
- avg ²	860.9	861.1	861.5	860.8	861.2	864.7	860.9
- max	866.4	868.5	870.1	874.4	873.2	881.8	881.1
- min	851.5	850.1	850.2	844.4	841.4	845.3	839.7
Soil Temperature (°F)							
- avg	67.8	69.8	68.0	59.1	49.9	42.7	53.6
- max	70.2	71.1	71.2	63.7	53.7	46.7	71.2
- min	65.0	65.1	62.3	53.7	46.7	38.9	37.5
Precipitation (inches)							
- total	0.53	0.78	1.12	0.44	0.34	0.72	9.49

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Parameter	Month/Year					
	01/98	02/98	03/98	04/98	05/98	06/98
Wind Speed (mph)						
- avg	8.7	9.7	8.4	9.4	10.5	8.5
- max	28.6	32.0	29.7	32.5	33.1	27.7
Wind Direction (deg)						
- scalar avg	143.1	141.4	132.4	145.8	154.0	135.0
Temperature (°F)						
- avg	33.8	33.7	37.9	43.9	54.1	59.4
- max	55.8	54.1	75.3	78.1	79.4	95.9
- min	4.3	4.7	1.3	21.5	26.0	36.0
Relative Humidity (%)						
- avg	71.0	75.8	66.9	63.7	54.7	57.5
- max	97.5	97.9	97.2	96.7	96.7	96.9
- min	20.4	32.8	17.8	15.2	10.9	7.2
Solar Radiation (W/m ²)						
- avg	86.4	104.4	175.4	223.5	251.3	268.2
- max	539.3	707.0	799.0	930.0	1025.0	987.0
Barometric Pressure (mb)						
- avg ²	859.0	856.0	857.7	858.6	856.7	858.4
- max	867.9	867.7	870.4	869.6	865.0	865.7
- min	845.8	841.5	839.4	842.2	846.1	848.6
Soil Temperature (°F)						
- avg	37.3	39.7	40.2	45.5	52.5	57.1
- max	38.9	40.2	43.9	49.3	55.2	60.9
- min	35.4	38.3	38.4	43.6	49.3	55.2
Precipitation (inches)						
- total	0.23	0.52	0.67	0.80	0.83	3.52

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Parameter	Month/Year						
	07/98	08/98	09/98	10/98	11/98	12/98 (1-29)	1998
Wind Speed (mph)							
- avg	8.5	8.3	7.5	7.3	8.1	7.2	8.5
- max	27.5	25.9	22.7	24.6	28.2	27.1	33.1
Wind Direction (deg)							
- scalar avg	155.0	143.8	145.7	135.5	146.4	146.2	144.8
Temperature (°F)							
- avg	75.7	74.0	63.3	46.1	39.3	24.3	49.0
- max	103.4	97.6	92.6	77.4	64.9	62.0	103.4
- min	47.1	41.0	32.9	18.0	15.4	-13.1	-13.1
Relative Humidity (%)							
- avg	40.4	39.4	56.7	64.9	62.3	70.2	60.1
- max	100.0	96.3	98.9	99.5	98.2	96.9	100.0
- min	5.8	8.0	8.3	8.2	15.5	25.9	5.8
Solar Radiation (W/m ²)							
- avg	287.1	260.7	183.3	141.9	98.4	90.7	182.1
- max	993.0	935.0	803.0	714.0	656.8	548.3	1025.0
Barometric Pressure (mb)							
- avg ²	861.2	863.1	859.9	861.9	861.3	866.3	860.0
- max	867.5	869.8	864.3	869.5	873.0	879.4	879.4
- min	854.3	855.6	853.4	850.4	848.9	848.2	839.4
Soil Temperature (°F)							
- avg	66.8	69.5	67.6	59.1	50.4	44.6	52.6
- max	70.0	70.2	69.2	64.1	55.3	48.3	70.2
- min	60.9	68.4	64.1	55.3	47.8	40.1	35.4
Precipitation (inches)							
- total	1.92	0.42	0.79	1.04	0.05	0.03	10.82

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