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Richland, Washington 99352

AEC Research and Development Report

THE HANFORD WIND STORM

OF JANUARY 11, 1972

FEBRUARY 1972

BNWL-1640

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THE HANFORD WIND STORM OF JANUARY 11, 1972

By

Staff Members
of the
ATMOSPHERIC SCIENCES DEPARTMENT

February 1972

BATTELLE
PACIFIC NORTHWEST LABORATORIES
RICHLAND, WASHINGTON 99352

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THE HANFORD WIND STORM OF JANUARY 11, 1972

Staff Members
of the
ATMOSPHERIC SCIENCES DEPARTMENT

INTRODUCTION

During the morning hours of January 11, 1972, the AEC's Hanford Reservation in southeast Washington experienced a period of strong gale force winds with gusts exceeding hurricane force.⁽¹⁾ Several wind speed categories were observed which established new records for this location. This report documents these events and includes a discussion of the synoptic conditions prevailing during this period.

DESCRIPTION OF THE HANFORD RESERVATION

The Hanford Reservation includes the major portion of a topographic depression bounded on the north by the Saddle Mountains (elevation 2500 ft MSL), on the east by the White Bluffs (670 to 930 ft MSL), on the south by the Rattlesnake Hills (3500 ft MSL) and on the west by the Yakima and Umtanum Ridges (2000 to 2500 ft MSL). This depression tilts slightly from northwest to southeast which is the general direction of the flow of the Columbia River which enters the Reservation through a gap near the northwest corner and exits through a broad opening near the Tri-Cities to the southeast, (Figure 1).

Figure 1. The Hanford Reservation in Relation to Surrounding Area

HANFORD AREA WIND SENSOR SYSTEMS

The Hanford Meteorology Station and meteorology tower are located near the center of the 600 square mile Hanford Reservation. The Hanford Meteorology Station has been the main observation site for compiling climatological data pertaining to the Hanford Reservation from 1945 to the present time. Table 1 presents in summary form the general climatology of Hanford.

In addition to the 410 ft instrumented tower (Figure 2), nine radio-telemetered automatic weather stations are located on or near the Hanford Reservation at elevations ranging from 400 to 3500 ft MSL (Figure 1). These stations transmit wind information as hourly averages only. Table 2 presents data recorded by the AEC (Battelle) network of wind sensors on January 11, 1972. Other wind measuring equipment within the Hanford Reservation is operated by various AEC contractors and outside the Reservation several private agencies maintain wind measuring instruments. Available wind observations from these locations for January 11 are presented in Appendix I.

Because the 7-ft wind recorder on the Hanford Meteorology Tower is barely above the height of nearby vegetation, the 50-ft wind recorder is considered the most representative surface wind indicator in the station vicinity. Thus, for the majority of plant operations dependent on favorable wind conditions, the meteorologist bases his forecast on the 50-ft wind, unless some other level is specifically requested.

Though the 50-ft peak gust of 80 mph occurred at 0345 PST, January 11, at a time when the average speed was around 40 mph (Figure 3), the highest hourly average for the day was recorded as 51 mph between 0800 and 0900 PST. Gusts during this period frequently reached 70 mph with two to 75 mph (Figure 4). Table 3 summarizes tower wind data for this hour by 10-minute increments for 5 heights on the tower. (Also, see

TABLE 1

AVERAGES AND EXTREMES OF CLIMATIC ELEMENTS AT HANFORD

(BASED ON ALL AVAILABLE RECORDS TO AND INCLUDING THE YEAR 1970)

	TEMPERATURE (°F)												PRECIPITATION (INCHES)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																												
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EXTREME AVERAGES OR TOTALS
AND YEAR OR SEASON OF OCCURRENCE

1912-1970 TEMPERATURE AVERAGES (°F)		
HIGHEST ANNUAL	56.2	1954
LOWEST ANNUAL	30.2	1929
HIGHEST WINTER (10-12-F)	41.1	1933-34
LOWEST WINTER	24.2	1948-49
HIGHEST SPRING (3-5-M)	54.2	1967
LOWEST SPRING	48.0	1955
HIGHEST SUMMER (6-8-J-A)	78.2	1954
LOWEST SUMMER	70.3	1954
HIGHEST FALL (9-11)	54.8	1963
LOWEST FALL	49.6	1946

1912-1970 PRECIPITATION TOTALS (IN.)		
GREATEST ANNUAL	11.45	1950
LOWEST ANNUAL	3.26	1957
HIGHEST SEASONAL	45.8	1915-16
LEAST SEASONAL	0.3	1957-58

1945-1970 WIND SPEED AVERAGE (mph)		
HIGHEST ANNUAL	8.3	1968+
LOWEST ANNUAL	6.3	1957

1946-1970 RELATIVE HUMIDITY AVERAGE (%)		
HIGHEST ANNUAL	57.9	1950+
LOWEST ANNUAL	49.4	1957

1946-1970 SKY COVER AVERAGES (SUNRISE TO SUNSET, SCALE 0-10)		
HIGHEST ANNUAL	6.4	1966
LOWEST ANNUAL	5.1	1949

1953-1970 SOLAR RADIATION AVERAGE DAILY TOTAL (LANGLEYS)		
HIGHEST ANNUAL	185	1957
LOWEST ANNUAL	157	1957

NUMBER OF DAYS CLEAR 10.3 TENTHS SKY COVER, SR TO SS1		
GREATEST ANNUAL (1946-70)	141	1951
LEAST ANNUAL (1946-70)	85	1966

CLOUDY 10.3 TENTHS SKY COVER, SR TO SS5		
GREATEST ANNUAL (1946-70)	181	1969
LEAST ANNUAL (1946-70)	84	1949

THUNDERSTORMS		
GREATEST ANNUAL (1945-70)	23	1948
LEAST ANNUAL (1945-70)	3	1949

HEAVY FOG (VIS. 1/4 MI. OR LESS)		
GREATEST SEASONAL (1945-70)	42	1950-51
LEAST SEASONAL (1945-70)	9	1948-49

PRECIPITATION 0.30 INCH OR MORE		
GREATEST ANNUAL (1946-70)	39	1950
LEAST ANNUAL (1946-70)	10	1965

SNOW 1.0 INCH OR MORE		
GREATEST SEASONAL (1946-70)	15	1955-56
LEAST SEASONAL (1946-70)	0	1957-58

3 IN. OR MORE SNOW ON GROUND		
GREATEST SEASONAL (1946-70)	40	1964-65
LEAST SEASONAL (1946-70)	0	1960-61+

PEAK GUST 40 MPH OR GREATER		
GREATEST ANNUAL (1945-70)	41	1941
LEAST ANNUAL (1945-70)	13	1958

MAX. TEMPERATURE 90 OR ABOVE		
GREATEST ANNUAL (1912-70)	85	1940
LEAST ANNUAL (1912-70)	37	1954

MAX. TEMPERATURE 100 OR ABOVE		
GREATEST ANNUAL (1912-70)	32	1962
LEAST ANNUAL (1912-70)	1	1954

MAX. TEMPERATURE 32 OR BELOW		
GREATEST ANNUAL (1912-70)	53	1955-56
LEAST SEASONAL (1912-70)	1	1957-58

MIN. TEMPERATURE 32 OR BELOW		
GREATEST ANNUAL (1912-70)	141	1916-17
LEAST SEASONAL (1912-70)	75	1957-58

MIN. TEMPERATURE 0 OR BELOW		
GREATEST ANNUAL (1912-70)	18	1949-50
LEAST SEASONAL (1912-70)	0	1949-50

	WIND (mph)												RELATIVE HUMIDITY (%)												SKY COVER (SCALE 0-10)						SOLAR RADIATION (LANGLEYS) *																	
	1945-1970 AVERAGES												1946-1970 AVERAGES												1946-1970 AVERAGES (SUNRISE TO SUNSET)						1950-1970 AVG. DAILY TOTALS						1950-1970 EXTREMES DAILY TOTALS											
	PEAK GUST												1946-1970 AVERAGES												1946-1970 EXTREMES						1946-1970 AVERAGES (SUNRISE TO SUNSET)						1950-1970 AVG. DAILY TOTALS						1950-1970 EXTREMES DAILY TOTALS					
	PEAK GUST												1946-1970 AVERAGES												1946-1970 EXTREMES						1946-1970 AVERAGES (SUNRISE TO SUNSET)						1950-1970 AVG. DAILY TOTALS						1950-1970 EXTREMES DAILY TOTALS					
	PRECIPITATION DIRECTION	MEAN MONTHLY INCHES	HIGHEST MONTHLY INCHES	LOWEST MONTHLY INCHES	YEAR	RECORD HIGHEST	RECORD LOWEST	RECORD HIGHEST	RECORD LOWEST	YEAR	RECORD HIGHEST	RECORD LOWEST	MEAN MONTHLY INCHES	MAXIMUM MONTHLY INCHES	MINIMUM MONTHLY INCHES	YEAR	MEAN MONTHLY INCHES	MAXIMUM MONTHLY INCHES	MINIMUM MONTHLY INCHES	YEAR	MEAN MONTHLY INCHES	MAXIMUM MONTHLY INCHES	MINIMUM MONTHLY INCHES	YEAR	MEAN MONTHLY INCHES	MAXIMUM MONTHLY INCHES	MINIMUM MONTHLY INCHES	YEAR	MEAN MONTHLY INCHES	MAXIMUM MONTHLY INCHES	MINIMUM MONTHLY INCHES	YEAR																
Jan.	NW	6.3	9.4	1953	3.1	1955	65	5	1967	75.7	86.8	1960	60.0	1963	100	1970+	13	1963	7.8	8.0	1969	4.3	1949	118	135	1962	8.8	275	267	16	1970																	
Feb.	NW	7.0	9.4	1961	4.6	1963	63	5	1967	69.9	86.9	1963	54.0	1967	100	1970+	14	1962	7.4	8.9	1961	5.9	1964	200	236	1960	164	1974	422	198	16	1970																
Mar.	NW	8.4	10.7	1954	5.9	1958	80	5	1967	59.8	85.9	1950	44.0	1965	100	1970+	12	1955+	6.7	7.9	1959	4.0	1965	340	386	1955	305	161	542	1962	71	1967																
Apr.	NW	9.0	11.1	1954	7.4	1958	80	5	1967	48.7	64.5	1963	36.9	1966	100	1965+	9	1954	6.4	8.1	1953	3.7	1951	470	526	1959	374	693	1968	115	170																	
May	NW	8.8	10.5	1964	5.8	1957	71	5	1967	42.7	62.4	1948	31.2	1966	100	1969+	7	1953	5.8	7.7	1960	4.5	1949	511	634	1960	511	1962	792	89	1965																	
June	NW	9.2	10.7	1949	7.7	1950	72	5	1967	39.4	53.5	1950	30.0	1949	100	1967+	10	1964+	5.2	7.0	1950	2.8	1941	626	698	1953	393	1967	707	86	1965																	
July	NW	8.6	9.6	1963	6.8	1955	53	5	1967	31.8	40.5	1955	21.9	1959	47	1963	6	1951	2.7	4.5	1955	0.9	1953	699	700	1956	588	1969	106	150	1965																	
Aug.	NW	8.0	9.1	1946	6.0	1956	66	5	1967	34.8	43.8	1948	24.5	1967	100	1954	7	1951	3.3	5.9	1964	0.8	1955	551	613	1955	475	1967	72	1957	107	1955																
Sept.	NW	7.5	9.2	1961	5.4	1957	65	5	1967	40.4	55.1	1959	33.9	1952	100	1962+	10	1962+	4.1	6.3	1959	2.5	1950	418	457	1961	354	1999	991	161	61	1955																
Oct.	NW	6.7	9.1	1946	4.4	1952	63	5	1967	57.8	74.2	1962	42.5	1962	100	1969+	10	1962	3.9	7.7	1960	3.9	1952	282	299	1958	227	1966	428	958	38	1960																
Nov.	NW	6.2	7.9	1945	2.9	1954	64	5	1967	72.9	80.5	1956	61.1	1959	100	1970+	16	1959	7.5	9.0	1960	5.2	1957	135	180	1957	47	1964	283	1957	14	1960																
Dec.	NW	6.0	8.3	1960	3.9	1963	71	5	1967	80.4	89.9	1963	60.0	1968	100	1970+	25	1968	8.1	9.2	1962	6.8	1954	11	116	1970	57	1969	185	1962	16	1960																
Year	NW	7.6	11.1	1959	2.9	1956	72	5	1967	54.0	80.9	1963	21.9	1959	100	1970+	6	1951	5.9	9.2	1962	0.6	1955	370	700	1964	57	1949	609	1957	16	1960																

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Figure 2. The Hanford Meteorology Tower

TABLE 2

DATA RECORDED BY THE AEC (BATTELLE) NETWORK OF WIND SENSORS
ON JANUARY 11, 1972

Observation Site	Location ¹	Elevation (MSL - ft)	Height of Sensor Above Ground (ft)	Wind (mph)	Time (PST)
Hanford Met Tower	1	727	7	64	0345
"	"	"	50	80	"
"	"	"	100	79	0835
"	"	"	150	-- ²	-- ²
"	"	"	200	84	0835
"	"	"	250	82	0837
"	"	"	300	84 ³	0835
"	"	"	400	84	0827
Rattlesnake Mt.	11.0 S	3568	10	150+ ⁴	0546-0924
Army Loop Road	7.5 ESE	555	50	60+ ⁵	0900-1700
Central Wahluke Slope ⁶	12.0 NNW	660	23	32	0155
Yakima Barricade ⁶	6.0 WNW	795	23	45	0455
Gable Mountain ⁶	7.0 ENE	1100	23	41	0055
Wye Barricade ⁶	11.5 SE	550	23	43	"
Prosser Barricade ⁶	14.5 SE	450	23	35	"
Richland Barricade ⁶	26.5 SE	390	23	33	0355
Rattlesnake Mt. ⁶	11.0 S	3568	9	-- ⁷	-- ⁷
Eastern Wahluke Slope ⁶	17.5 NE	800	23	34	0455
Ringold ⁶	17.5 E	620	23	30	0355

¹Distance (miles) and direction from the Hanford Meteorology Tower located at 46° 34'N latitude, 119° 36'W longitude, approximately 25 miles NW of Richland, Washington.

²Equipment malfunction.

³Interpolated value.

⁴Limit of recorder 150 mph, also visually observed by (2).

⁵Temporary research equipment - limit of recorder 60 mph.

⁶Radio-Telemetered Automatic Weather Station - highest hourly integrated wind speed, not equipped with gust recorder.

⁷Power outage for telemetering equipment during periods of peak winds.

Figure 3. Hanford Meteorology Station 50-ft Wind Recorder Chart for 0730-1000 PST, January 11, 1972

Appendix II.)

TABLE 3

HANFORD METEOROLOGY TOWER AVERAGE WIND SPEEDS AND PEAK GUSTS
FOR JANUARY 11, 1972

Time	10-Minute Intervals During Highest Hourly Average											
	7 ft		50 ft		100 ft		200 ft		300 ft		400 ft	
	Peak		Peak		Peak		Peak		Peak		Peak	
	Avg	Gust	Avg	Gust	Avg	Gust	Avg	Gust	Avg	Gust	Avg	Gust
	(mph)		(mph)		(mph)		(mph)		(mph)		(mph)	
0800-0810	36	55	48	66	56	67	60	76			63	74
0810-0820	37	57	49	69	56	73	60	74			64	73
0820-0830	38	54	51	67	59	73	65	81			68	84
0830-0840	40	53	51	62	59	68	67	84			69	81
0840-0850	38	54	52	70	59	68	64	79			69	80
0850-0900	36	56	52	68	59	72	64	78			69	80
Avg Hourly Speed	38		51		58		63				67	

NEW RECORD WIND SPEEDS

The wind storm of January 11, 1972 established three 50-ft wind speed records at the Hanford Meteorology Station as indicated below:

1. A peak gust of 80 mph was recorded at 0345 PST. This was 8 mph higher than the previous record of 72 mph recorded on June 5, 1957. (Observational period of record, 27 years.)
2. An hourly average wind speed of 51 mph from 0800-0900 PST was recorded. This exceeded the previous record of 48 mph recorded on March 28, 1963. (Observational period of record, 26 years.)

3. The 24-hour average wind speed for January 11, 1972 was 33.7 mph. This exceeded the previous record of 27 mph recorded on December 3, 1968. (Observational period of record, 27 years.)

The 1957 peak wind gust records for the 200 and 400-ft tower levels, however, remained intact, (Table 4).

TABLE 4

TOWER PEAK GUST COMPARISONS

<u>Tower Level</u> (ft)	<u>January 11, 1972</u> (mph)	<u>June 5, 1957</u> (mph)
50	80	72
200	84	89
400	84	93

Several peak gusts of over 150 mph (limit of recording equipment) were recorded during the period 0546-0924 PST on Rattlesnake Mountain (elevation 3568 ft MSL), located 11 miles south of the Hanford Meteorology Station. (See Appendix II.) The previous record for the same observational site was 142 mph recorded on March 22, 1969.

EXTREME VALUE ANALYSIS

Applying statistical analysis techniques⁽³⁾ to the 27 years of record for peak wind speeds at the Hanford Meteorology Tower, average return periods for highest peak gusts observed to date are as follows:

<u>Level</u> (ft)	<u>Speed</u> (mph)	<u>Date</u>	<u>Return Period</u> (years)
50	80	January 11, 1972	35
200	89	June 5, 1957	28
400	93	June 5, 1957	28

For the peak speeds occurring on January 11, 1972, corresponding return periods are as follows:

<u>Level</u> (ft)	<u>Speed</u> (mph)	<u>Return Period</u> (years)
50	80	35
200	84	20
400	84	7

Figure 5 depicts the curves from which the above data are derived.

SYNOPTIC DISCUSSION

The surface pressure pattern associated with the Hanford wind storm of January 11, 1972 was not unique. It is a classical pattern with winter wind storms in this area — a low pressure center moving inland over southern British Columbia while a relatively stationary high pressure area holds to the southwest of Hanford.

The surface pressure started to fall at the Hanford Meteorology Station about 1300 PST on January 10, 1972. This pressure fall was in advance of a low frontal system moving southeastward from the Gulf of Alaska. Jet stream winds, northwest to southeast, at the 500 millibar (17,000 ft) level steered the surface low center rapidly (63 knots) southeastward to the British Columbia-Washington border by 0700 PST, January 11. The occluded front associated with the system passed the Hanford Meteorology Station about 0900 PST, probably during the time of the highest mean wind.

This rapid fall of surface barometric pressure over southern British Columbia, Washington, and northern Idaho during January 10 and 11, coupled with the relatively unchanging high pressure pattern over Oregon resulted in an unusually strong and increasing pressure gradient. A strong south

Figure 5. Peak Wind Gust Return Period Probability Diagram

to north pressure gradient of this type is the most likely weather situation to produce high winds over the Hanford area in winter. Appendix III presents surface and upper air weather charts applicable to the period of highest winds.

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APPENDIX I

WIND OBSERVATIONS ON OR NEAR THE HANFORD RESERVATION

FOR JANUARY 11, 1972

WIND OBSERVATIONS ON OR NEAR THE HANFORD RESERVATION FOR JANUARY 11, 1972

<u>Observation Site</u>	<u>Location*</u>	<u>Height of Sensor Above Ground (ft)</u>	<u>Type of Data Readout</u>	<u>Peak Wind (mph)</u>	<u>Time (PST)</u>	<u>Operating Agency</u>	<u>Remarks</u>
FFTF	15.0 SE	13	Analog Tape	--	--	AEC (HEDL)	Recorder limit, 60 mph Equipment malfunction ⁽⁴⁾
FFTF	15.0 SE	25	Dial	65	A.M.	AEC(Bechtel)	Visual observation ⁽⁵⁾
N-Reactor	8.0 NNE	200	Analog Tape	42	0830-0900	AEC(DUN)	Recorder not activated; visual observation ⁽⁶⁾
Richland Airport	22.0 SE	30	Strip Chart	74	0245	AEC(Battelle)	
Priest Rapids Dam	18.0 NW	30	Dial	100+	0700+	Grant County PUD	Visual observation; dial limit - 100 mph ⁽⁷⁾
Richland By-Pass Highway	24.0 SE	35	Dial	100+	A.M.	Teleprompter Cable TV Co.	Visual observation; dial limit - 100 mph ⁽⁸⁾
Tri-Cities Airport (Pasco)	30.0 SE	16	Dial	63	A.M.	Hughes Air-west	Visual observation ⁽⁹⁾
KONA Radio (Pasco)	32.0 SE	30	Manometer	78	1000	KONA Radio	Visual observation ⁽¹⁰⁾
Columbia TV (Kennewick)	35.0 SE	40	Dial	100+	1200-1300	Columbia TV	Visual observation; dial limit - 100 mph ⁽¹¹⁾

* Miles from Hanford Meteorology Station.

BNWL-1640

APPENDIX II

HANFORD METEOROLOGY TOWER, RICHLAND AIRPORT AND
RATTLESNAKE MOUNTAIN WIND RECORDER CHARTS
FOR JANUARY 11, 1972

Figure 6A. Hanford Meteorology Station 7-ft Wind Record, January 11, 1972

Figure 6B. Hanford Meteorology Station 7-ft Wind Record, January 11, 1972

Figure 7A. Hanford Meteorology Station 100-ft Wind Record, January 11, 1972

Figure 7B. Hanford Meteorology Station 100-ft Wind Record, January 11, 1972

Figure 8A. Hanford Meteorology Station 200-ft Wind Record, January 11, 1972

Figure 8B. Hanford Meteorology Station 200-ft Wind Record, January 11, 1972

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Figure 9B. Hanford Meteorology Station 300-ft Wind Record, January 11, 1972

Figure 10A. Hanford Meteorology Station 400-ft Wind Record, January 11, 1972

Figure 10B. Hanford Meteorology Station 400-ft Wind Record, January 11, 1972

Figure 11A. Richland Airport Wind Record, January 11, 1972

Figure 11B. Richland Airport Wind Record, January 11, 1972

Figure 12. Rattlesnake Mountain Wind Record, January 11, 1972

APPENDIX III

WEATHER CHARTS FOR JANUARY 11, 1972

Figure 13. 500 mb (~17,000 ft) Weather Chart for 0400 PST January 11, 1972

Figure 14. Surface Weather Chart for 0400 PST January 11, 1972

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