No. 3

Western Region Technical Memorandum

WESTERN REGION PRE- AND POST-FP-3 PROGRAM
December 1, 1965 to February 20, 1966

by

Edward D. Diemer

March 1966

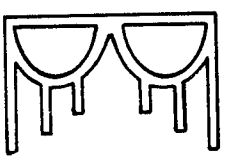
ENVIRONMENTAL SCIENCE SERVICES ADMINISTRATION
U. S. WEATHER BUREAU

Western Region Technical Memoranda:

No. 1 "Some Notes on Probability Forecasting" by Edward D. Diemer

No. 2 "Climatological Precipitation Probabilities" compiled by Lucianne Miller

No. 3 "Western Region Pre- and Post-FP-3 Program" by Edward D. Diemer



A western Indian symbol for rain. It also symbolizes man's dependence on weather and environment in the West.

Western Region Technical Memorandum No. 3, March 1966

WESTERN REGION PRE- AND POST-FP-3 PROGRAM
December 1, 1965 to February 20, 1966

Edward D. Diemer

TABLE OF CONTENTS

LIST OF TABLES

I. DIGEST

Purpose: The purpose of the pre- and post-FP-3 program was to evaluate the influence of the FP-3 guidance on the local forecast.

Method: The pre-FP-3 forecast was made by ten local stations prior to receipt of the FP-3 guidance. The post-FP-3 forecast was made by the ten local stations after receipt of the FP-3 guidance.

Forecasts: The pre-FP-3, post-FP-3, and the FP-3 consisted of precipitation probabilities for three periods which constituted a 36-hour forecast, and maximum or minimum temperature forecast for each period.

Summary of Results: Using FP-3 guidance, local stations were, on the average, able to revise their pre-FP-3 so that their final forecast, the post-FP-3, was better than:

a) Local pre-FP-3
b) FP-3 guidance
c) Climatology

Most of the precipitation forecast improvement occurred in the first 24 hours; whereas, the temperature forecast improvement extended to 36 hours.

II. BACKGROUND INFORMATION

The pre- and post-FP-3 program was initiated in the Western Region on December 1, 1965 for precipitation probabilities. At the request of CO, WXAP, temperature forecasts were included beginning on December 19. The program terminated on February 19, 1966. Between December 19 and February 19, the pre-FP-3 forecasts made by the local stations were transmitted on Service C under the heading FPXX immediately before the FP-3 guidance forecasts from the FP Centers for the 0900 MST and the 1500 MST forecasts only. (For specific instructions given to participating stations, see attachments 1 and 2.)

TABLE I

Participating Stations

Station	Average Grade of Forecasting Personnel	Guidance Center	Average Grade of Forecasting Personnel
Astoria	7.3	Seattle	13
Billings	9.6	Great Falls	12
Boise	9.9	Salt Lake City	12
Fresno	9.3	San Francisco	13
Helena	8.1	Great Falls	12
Medford	9.3	Seattle	13
Sacramento	11.0	San Francisco	13
San Diego	9.4	Los Angeles	13
Spokane	9.3	Seattle	13
Yakima	9.4	Seattle	13

The average GS grade of the meteorologists and meteorological technicians who issued the pre- and post-FP-3 forecasts at the local stations was 9.3. The average GS grade of the meteorologists who issued the FP-3 guidance was 12.6

All local stations had two months' experience with precipitation probability forecasts before beginning this program. The FP Centers at Salt Lake City, San Francisco, and Seattle had several years' or more experience with probability forecasts. The Great Falls and Los Angeles FP Centers had two months' prior experience.

III. FORECASTS

The pre-FP-3 forecast was made by the ten local stations before the receipt of the FP-3 guidance. The post-FP-3 forecast was made by the ten local stations after receipt of the FP-3 guidance.

From December 1, 1965 to February 20, 1966, the pre-FP-3, post-FP-3, and the FP-3 forecast contained precipitation probabilities. From December 19, 1965 to February 20, 1966, these forecasts contained temperature and precipitation forecasts. Temperatures were forecast to the nearest degree. Precipitation probability increments were: 00, 02, 05, 10, . . . , 90, 100. The forecasts were made for three periods: Period I, either 6 or 12 hours; Period II, 12 hours; Period III, 12 hours.

TABLE II

Forecast Periods

Forecast Issued	Period I	Period II	Period III	Temperatures
0300 MST	05-17	17-05	05-17	Hi-Lo-Hi
0900 MST	11-17	17-05	05-17	Hi-Lo-Hi
1500 MST	17-05	05-17	17-05	Lo-Hi-Lo
2300 MST	23-05	05-17	17-05	Lo-Hi-Lo

TABLE III

Times Forecasts Issued for Each Station

	0300 MST	0900 MST	1500 MST	2300 MST
Astoria			*	*
Billings	*	*	*	*
Boise	*	*	*	*
Fresno (1)		*	After 12/19/65	*
Helena (2)		*	*	
Medford			*	*
Sacramento (1)		*	*	*
San Diego		*	*	*
Spokane (1)	*	*	*	*
Yakima	After 12/20/65	*	*	*

(1) Temperatures 0900 and 1500 only
(2) Temperatures at 0300 and 1500 only

IV. DATA SAMPLE

The 60- to 80-day sample of forecasts is not large. Furthermore, since more than one forecast was made by each station on consecutive days, the data sample is not entirely random. Also, stations were not necessarily randomly distributed in the synoptic patterns. The data deal with only winter situations. Each station had potentially different forecast capability. However, the trend of the results of the averages from the ten stations appears reasonable for winter forecasts.

The local forecaster had the previous FP-3 guidance as well as the previous local forecast as input to his pre-FP-3. Thus, the pre-FP-3, although completely independent of the concurrent FP-3, was not made independently of all FP Center guidance. However, this is a normal operating procedure in that previous forecasts are always available. All data were used in the verification.

Of particular interest were the occasions when the local pre-FP-3 was changed based on guidance received in the FP-3. This change was then reflected in the post-FP-3 forecasts. The occasions when the post-FP-3 differed from the pre-FP-3 will be referred to as "Changed Forecasts".

V. TEMPERATURE RESULTS

The temperature verifications for each station are tabulated in appendix 3. The following table gives the results of the temperature forecasts averaged over the ten stations. In general, two months' data are not representative of station performance. It was hoped that by averaging all ten stations, the irregularities would be smoothed and a reasonable trend would result.

TABLE IV

AVERAGES OF THE TEN STATIONS

Pre- and Post-FP-3 Temperature Forecasts

	First Period	Second Period	Third Period
Total Forecasts	1591	1591	1591
Total number of times forecast changed	501	501	619
Percent of times changed	31.5	31.5	38.9
Average error for changed forecasts			
FP-3	3.7	4.4	5.4
Pre	3.7	4.5	5.5
Post	3.1	4.1	5.0
Percent improvement for changed forecasts			
Post over Pre	15.2	9.2	8.1
Post over FP-3	15.1	8.1	7.4

TABLE IV (Continued)

Average Number of Cases of Temperature Errors
By Indicated Class Interval (°F) for Changed Forecasts

	0°-4°	5°-9°	10°-14°	≥15°
Period I				
FP-3*	35.2	13.4	2.4	0.6
Pre	36.4	11.9	2.4	0.9
Post	40.1	9.6	1.5	0.4
Period II				
FP-3*	30.9	14.9	3.9	2.1
Pre	32.1	13.5	4.8	2.2
Post	33.2	14.3	3.6	1.5
Period III				
FP-3**	34.1	17.9	6.4	4.6
Pre	32.0	19.5	7.7	4.4
Post	36.1	18.1	5.5	4.0

* 5 missing reports
**6 missing reports

Note that these data are for changed forecast only. When the pre-FP-3 was not changed, it was not necessarily identical to the FP-3. Therefore, the actual difference between pre- or post-, and the FP-3 forecasts was not determined. What is determined is the actual difference in absolute average error between pre-FP-3 and post-FP-3.

The average error for all forecasts decreased by 0.6 degrees from the pre to the post in Period I, 0.4 degrees in Period II, and 0.5 degrees in Period III. The percent improvements are for the changed forecasts and thus are not indicative of all 1591 forecasts.

Notice that in the cases when the local pre-FP-3 was changed there was not much difference between the average error between the pre-FP-3 and the FP-3, only 0.1 degree at most. The distribution of errors, however, was different. In the nine classes above 5 degrees, the FP-3 had a fewer number of large errors in five classes, a greater number in three classes, and the same number in one class than did the pre-FP-3.

The following table gives the percent reduction (+) or increase (-) of the number of errors by class interval from the pre-FP-3 to the post-FP-3.

TABLE V

Percent Reduction in Temperature Errors by Class Interval
From Pre-FP-3 to Post-FP-3 Forecasts

	5°-9°	10°-14°	≥15°
Period I	+19	+38	+56
Period II	- 6	+25	+32
Period III	+ 7	+29	+ 9

The percent improvement of the post-FP-3 over the pre-FP-3 was 15% for Period I, 9% for Period II, and 8% for Period III.

The data from this program indicate:

1. That the average error between the pre-FP-3 and FP-3 was negligible when the pre-FP-3 was revised.

2. That the temperature forecasts and/or the other contents of the FP-3 influenced the local forecaster so as to result in post-FP-3 forecasts which -

   a) Were better than either the FP-3 or pre-FP-3.
   b) Reduced the number of large temperature errors.

VI. PRECIPITATION RESULTS

The following four tables list data for Brier Scores averaged over the ten stations. Scores for individual stations are listed in appendix 3. The Brier score used here is not averaged over the total number of forecasts and does not include the complementary no-precipitation verification.

Precipitation Data

TABLE VI

Brier Scores Averaged for Ten Stations
For All Forecasts

	FP-3	Pre FP-3	Post FP-3	Climat
Period I	23.6654	22.0162	20.2719	31.6518
Period II	31.0067	31.1267	30.3504	37.3234
Period III	33.4117	34.1902	32.9465	36.8629

TABLE VII

Brier Scores Averaged for Ten Stations
For Changed Forecasts

	FP-3	Pre FP-3	Post FP-3	Climat
Period I	8.1959	8.7285	6.9972	8.8126
Period II	11.9057	11.9546	11.3690	12.4940
Period III	11.2233	12.3705	11.1779	12.4393

TABLE VIII

Percent Improvements for the Averaged Brier Scores
Of the Ten Stations for All Forecasts

	Period I	Period II	Period III
Pre FP-3 over FP-3	+ 6.97	- 0.39	- 2.33
Post FP-3 over FP-3	+14.34	+ 2.12	+ 1.39
Post FP-3 over Pre FP-3	+ 7.92	+ 2.49	+ 3.64
Post FP-3 over Climat	+35.95	+18.68	+10.62

TABLE IX

Percent Improvements for the Averaged Brier Scores
Of the Ten Stations for the Changed Forecasts Only

	Period I	Period II	Period III
Pre FP-3 over FP-3	- 6.5	- 0.4	-10.2
Post FP-3 over FP-3	+14.6	+ 4.5	+ 0.4
Post FP-3 over Pre FP-3	+19.8	+ 4.9	+ 9.6
Post FP-3 over Climat	+20.6	+ 9.0	+10.1

TABLE X

Percent of Forecasts Changed.
Average for Ten Stations

Period I	Period II	Period III
19	26	28

Considering the average for all forecasts, the local pre-FP-3 was more skillful than the FP-3 in Period I, about equivalent to the FP-3 in Period II, and less skillful than the FP-3 in Period III.

After receipt of the FP-3 guidance, the post-FP-3 improved over the FP-3 and the pre-FP-3; however, most of the improvement occurred in the first period. The post-FP-3 made significant improvement over climatology in all three periods.

Considering the changed forecasts, the local pre-FP-3 was less skillful than the FP-3 in all periods. The revised forecast, the post-FP-3, improved over the FP-3 and the pre-FP-3; however, most of the improvement over the FP-3 occurred in the first two periods. Thus, on the average, the local stations revised their forecasts in cases where the FP-3 was better than the local pre-FP-3 forecast.

Referring to appendix 4, for all ten stations the post-FP-3 was more skillful than climatology in Period I. However, the guidance FP-3 in one case was about equivalent to climatology and in one other case was less skillful than climatology. In both these cases the pre-FP-3 was better than climatology, and the post-FP-3 improved over the pre-FP-3. Therefore, even though the actual FP-3 specific forecast was not better than climatology in these two cases, the FP-3 contained sufficient information so that the local station could improve the pre-FP-3.

In the second period, there were three cases where guidance FP-3 forecasts fell short of climatology. For these cases the post-FP-3 was less skillful than the pre-FP-3. In two instances, the pre-FP-3 was better than climatology; and the post-FP-3, although less skillful than the pre-FP-3, remained above climatology. In the other case, both the pre- and post-FP-3 forecasts were slightly less than climatology but better than the guidance FP-3.

For the third period, all stations but two improved over climatology with their post-FP-3. In one case, the post-FP-3 was less skillful than the pre-FP-3. In two cases, the FP-3 was below climatology.

For all periods, local stations tended to revise their temperature forecasts a larger percent of the time than they revised their precipitation forecasts. Recall that the average error for the pre-FP-3 and FP-3 was nearly identical for the changed temperature forecasts; however, for the changed precipitation forecasts, the FP-3 was always better than the pre-FP-3.

Most of the local improvement in the post-FP-3 occurred in the first 24 hours for the precipitation forecasts but extended to 36 hours for the temperature forecasts.

The data from this program indicates that in general:

1. The FP-3 guidance was superior to climatology.

2. The post-FP-3 improved over both the pre-FP-3 and the FP-3.

3. Most of this improvement occurred in the first 24 hours of the forecast.

Attachment 1

FP CENTER INSTRUCTIONS FOR THE
COMPARATIVE FORECAST PROGRAM

Beginning with the first forecast (GMT) on December 20, 1965, FP Centers will make temperature forecasts for the official thermometer at the field stations listed below. These forecasts will be included in each FP-3 through and including the last forecast (GMT) on February 19, 1966. The forecast will be the high and the low temperatures as included in the local forecasts. That is, the 0300 MST and 0900 MST forecasts will be the high, low, high; the 1500 MST and 2100 MST will be the low, high, low.

Stations:

SLC for Boise
SFO for Fresno and Sacramento
LAX for San Diego
GTF for Helena and Billings
SEA for Medford, Astoria, Spokane, and Yakima

The temperature forecasts will follow by one space the precipitation probability guidance in the FP-3.

Example:

SAC 32411 415237 FAT 32311 475642

Decode as:

Sacramento: Low 41, high 52, low 37
Fresno: Low 47, high 56, low 42

Attachment 2

LOCAL STATION INSTRUCTIONS FOR THE COMPARATIVE FORECAST PROGRAM

The local stations listed above will continue to make the pre-FP-3 and post-FP-3 precipitation probability forecasts as usual. Although several stations have indicated that it is not practical, it is desirable that every effort be made to make the pre-FP-3 and post-FP-3 forecast at 0900 MST and 1500 MST. Of course, if it is not practical, don't do it. All stations, however, should make as many comparative forecasts per day as possible. This is necessary to obtain as much data as possible in sixty days.

At the same time that the pre-FP-3 and post-FP-3 probabilities are made, a temperature forecast will be made commensurate with that described in attachment No. 1 for the FP-3. Forms to record the temperature forecasts will be supplied. Please complete the entire form legibly. The only record of the local and the FP forecasts for verification is the one kept at the local stations. Please complete all three forecasts (pre-FP-3, FP-3, post-FP-3); all three F-O (forecast minus observed) columns; and the observed temperature (obs. temp.) column every time a comparative forecast is made.

Staple the daily temperature verification sheet to the daily probability sheet and mail to Scientific Services Division each week.

The Central Office has requested that a hard copy of the pre-FP-3 be recorded. This will be done by a Service C transmission immediately prior to the FP-3 transmission. Notification from the Central Office by GENOT will state the exact time and particulars of transmission.

The code for transmission of the pre-FP-3 by the local stations will be the same as described above for the FP-3. For example:

SAC 32411 415237

The 32411 are the precipitation probabilities, the 41, 52, and 37 are the temperatures. The headings will be FPXX, date, time, etc.

Hard copies of the FPXX and corresponding FP-3 transmissions (4 per day) for the Western Region during the dates of this program will be collected by Boise and by Sacramento and forwarded to Scientific Services Division weekly. These will provide back-up copies for the Service C teletype in the Regional Headquarters.

Appendix 3

TEMPERATURE VERIFICATION BY STATION

(Station skill cannot be compared among all stations since forecasting difficulties are not everywhere equal.)

ASTORIA

Pre- and Post-FP-3 Temperature Forecasts

	First Period	Second Period	Third Period
Total Forecasts	125	125	125
Total number of times forecast changed	41	34	48
Percent of times changed	32.8	27.2	38.4
Average error for changed forecasts			
FP-3	3.5	2.8	4.3
Pre	3.9	2.7	4.5
Post	2.9	2.3	3.6
Percent improvement for changed forecasts			
Post over Pre	25.6	14.8	20.0
Post over FP-3	17.1	17.8	16.2

Temperature-Error Distribution by Indicated Class Interval (°F)
For Changed Forecasts

	0°-4°	5°-9°	10°-14°	≥15°
Period I				
FP-3	29	11	1	0
Pre	27	12	2	0
Post	32	8	1	0
Period II				
FP-3	26	7	1	0
Pre	29	3	2	0
Post	30	4	0	0
Period III				
FP-3	29	15	4	0
Pre	27	17	4	0
Post	34	11	3	0

BILLINGS

Pre- and Post-FP-3 Temperature Forecasts

	First Period	Second Period	Third Period
Total Forecasts	245	245	245
Total number of times forecast changed	102	118	138
Percent of times changed	41.6	48.2	56.3
Average error for changed forecasts			
FP-3	5.3	7.0	8.9
Pre	5.5	7.4	10.2
Post	4.2	6.3	8.9
Percent improvement for changed forecasts			
Post over Pre	23.6	14.9	12.7
Post over FP-3	20.8	10.0	0

Temperature-Error Distribution by Indicated Class Interval (°F)
For Changed Forecasts

	0°-4°	5°-9°	10°-14°	≥15°
Period I				
FP-3	56	29	13	4
Pre	57	31	8	6
Post	67	29	5	1
Period II				
FP-3	57	34	11	16
Pre	48	38	19	13
Post	53	40	15	10
Period III				
FP-3	54	32	24	28
Pre	33	43	30	32
Post	47	45	19	27

BOISE

Pre- and Post-FP-3 Temperature Forecasts

	First Period	Second Period	Third Period
Total Forecasts	220	220	220
Total number of times forecast changed	75	76	79
Percent of times changed	34.1	34.5	35.9
Average error for changed forecasts			
FP-3	3.0	4.1	5.5
Pre	3.2	4.6	5.3
Post	2.8	4.2	5.0
Percent improvement for changed forecasts			
Post over Pre	12.5	8.7	5.7
Post over FP-3	6.7	-2.4	9.1

Temperature-Error Distribution by Indicated Class Interval (°F)
For Changed Forecasts

	0°-4°	5°-9°	10°-14°	≥15°
Period I				
FP-3*	56	16	2	0
Pre	52	21	1	1
Post	60	14	1	0
Period II				
FP-3*	44	25	5	1
Pre	45	25	4	2
Post	52	17	6	1
Period III				
FP-3**	47	12	12	5
Pre	43	21	12	3
Post	52	12	11	4

* 1 missing report
**3 missing reports

FRESNO

Pre- and Post-FP-3 Temperature Forecasts

	First Period	Second Period	Third Period
Total Forecasts	115	115	115
Total number of times forecast changed	25	30	43
Percent of times changed	21.7	26.1	37.4
Average error for changed forecasts			
FP-3	4.8	3.8	4.6
Pre	2.9	3.7	4.3
Post	2.7	3.7	4.1
Percent improvement for changed forecasts			
Post over Pre	6.8	0	4.7
Post over FP-3	43.8	2.6	10.9

Temperature-Error Distribution by Indicated Class Interval (°F)
For Changed Forecasts

	0°-4°	5°-9°	10°-14°	≥15°
Period I				
FP-3	18	5	1	1
Pre	20	4	1	0
Post	21	3	0	1
Period II				
FP-3	23	3	3	1
Pre	20	8	2	0
Post	20	9	0	1
Period III				
FP-3	25	15	2	1
Pre	28	15	0	1
Post	27	15	0	1

HELENA

Pre- and Post-FP-3 Temperature Forecasts

	First Period	Second Period	Third Period
Total Forecasts	106	106	106
Total number of times forecast changed	15	19	22
Percent of times changed	14.2	17.9	20.8
Average error for changed forecasts			
FP-3	3.5	6.3	9.0
Pre	4.9	6.5	8.7
Post	3.4	5.4	8.4
Percent improvement for changed forecasts			
Post over Pre	30.6	16.9	3.4
Post over FP-3	2.9	14.3	6.7

Temperature-Error Distribution by Indicated Class Interval (°F)
For Changed Forecasts

	0°-4°	5°-9°	10°-14°	≥15°
Period I				
FP-3	12	3	0	0
Pre	9	4	2	0
Post	11	4	0	0
Period II				
FP-3	10	6	2	1
Pre	9	5	3	2
Post	9	7	1	2
Period III				
FP-3	8	5	3	6
Pre	9	4	4	5
Post	8	7	1	6

MEDFORD

Pre- and Post-FP-3 Temperature Forecasts

	First Period	Second Period	Third Period
Total Forecasts	114	114	114
Total number of times forecast changed	60	51	60
Percent of times changed	52.6	44.7	52.6
Average error for changed forecasts			
FP-3	3.6	4.6	4.7
Pre	2.7	4.1	4.2
Post	2.8	4.2	4.3
Percent improvement for changed forecasts			
Post over Pre	-3.7	-2.4	-2.4
Post over FP-3	22.2	8.7	8.5

Temperature-Error Distribution by Indicated Class Interval (°F)
For Changed Forecasts

	0°-4°	5°-9°	10°-14°	≥15°
Period I				
FP-3*	36	23	0	0
Pre	52	6	2	0
Post	52	6	2	0
Period II				
FP-3	27	21	2	1
Pre	31	17	2	1
Post	35	13	2	1
Period III				
FP-3	29	24	5	2
Pre	35	22	3	0
Post	34	22	4	0

* 1 missing report

SACRAMENTO

Pre- and Post-FP-3 Temperature Forecasts

	First Period	Second Period	Third Period
Total Forecasts	123	123	123
Total number of times forecast changed	39	34	44
Percent of times changed	31.7	27.6	35.8
Average error for changed forecast			
FP-3	3.2	3.8	3.5
Pre	3.3	3.2	4.5
Post	3.0	2.7	3.8
Percent improvement for changed forecasts			
Post over Pre	9.1	15.6	15.6
Post over FP-3	6.3	28.9	-8.6

Temperature-Error Distribution by Indicated Class Interval (°F)
For Changed Forecast

	0°-4°	5°-9°	10°-14°	≥15°
Period I				
FP-3*	26	12	0	0
Pre	28	10	1	0
Post	33	5	1	0
Period II				
FP-3**	18	13	1	0
Pre	27	5	2	0
Post	26	8	0	0
Period III				
FP-3*	29	14	0	0
Pre	26	15	3	0
Post	29	13	2	0

* 1 missing report
**2 missing report

SAN DIEGO

Pre- and Post-FP-3 Temperature Forecasts

	First Period	Second Period	Third Period
Total Forecasts	161	161	161
Total number of times forecast changed	46	49	63
Percent of times changed	28.6	30.4	39.1
Average error for changed forecasts			
FP-3	2.7	2.8	4.5
Pre	2.8	3.2	3.0
Post	2.5	2.7	2.9
Percent improvement for changed forecasts			
Post over Pre	10.7	15.6	0.3
Post over FP-3	7.4	3.6	3.4

Temperature-Error Distribution by Indicated Class Interval (°F)
For Changed Forecasts

	0°-4°	5°-9°	10°-14°	≥15°
Period I				
FP-3	38	8	0	0
Pre	38	7	1	0
Post	39	7	0	0
Period II				
FP-3	40	9	0	0
Pre	36	12	1	0
Post	41	8	0	0
Period III				
FP-3	45	16	1	1
Pre	47	15	1	0
Post	49	13	1	0

SPOKANE

Pre- and Post-FP-3 Temperature Forecasts

	First Period	Second Period	Third Period
Total Forecasts	164	164	164
Total number of times forecast changed	38	38	59
Percent of times changed	23.2	23.2	35.9
Average error for changed forecasts			
FP-3	3.6	4.5	4.3
Pre	4.3	5.4	5.8
Post	3.4	4.6	4.7
Percent improvement for changed forecasts			
Post over Pre	20.9	14.8	19.0
Post over FP-3	5.6	-2.2	-9.3

Temperature-Error Distribution by Indicated Class Interval (°F)
For Changed Forecasts

	0°-4°	5°-9°	10°-14°	≥15°
Period I				
FP-3*	26	8	1	1
Pre	25	11	1	1
Post	29	6	2	1
Period II				
FP-3**	18	9	6	0
Pre	22	7	8	1
Post	22	10	6	0
Period III				
FP-3***	29	20	8	0
Pre	25	23	9	2
Post	31	20	9	0

* 2 missing reports
** 5 missing reports
***3 missing reports

YAKIMA

Pre- and Post-FP-3 Temperature Forecasts

	First Period	Second Period	Third Period
Total Forecasts	218	218	218
Total number of times forecast changed	75	77	80
Percent of times changed	34.4	35.3	36.7
Average error for changed forecasts			
FP-3	3.8	4.4	4.8
Pre	3.7	4.1	4.7
Post	3.1	4.4	4.6
Percent improvement for changed forecasts			
Post over Pre	16.2	-7.3	2.1
Post over FP-3	18.4	0	4.2

Temperature-Error Distribution by Indicated Class Interval (°F)
For Changed Forecasts

	0°-4°	5°-9°	10°-14°	≥15°
Period I				
FP-3*	55	19	6	0
Pre	56	13	5	1
Post	57	14	3	1
Period II				
FP-3	46	22	8	1
Pre	54	15	5	3
Post	44	27	6	0
Period III				
FP-3	46	26	5	3
Pre	48	20	11	1
Post	50	23	5	2

* 1 missing report

Appendix 4

PRECIPITATION VERIFICATION BY STATION

BRIER SCORES FOR ALL FORECASTS

	Period I				Period II				Period III			
	FP-3	Pre	Post	Climat	FP-3	Pre	Post	Climat	FP-3	Pre	Post	Climat
Astoria	23.9525	22.4400	21.0900	38.3633	32.1300	29.6100	29.9000	38.3900	31.9300	35.0200	32.6390	37.6650
Billings	25.5329	21.8316	21.2316	31.7786	32.4629	29.4841	28.8020	34.5599	33.0779	35.0487	32.2212	37.2226
Boise	42.6262	34.6011	31.7832	42.2857	50.6303	46.1511	47.5531	49.6595	56.9654	52.3186	51.7835	50.2143
Fresno	8.7591	8.3575	7.6529	17.6457	14.5008	16.3700	14.7400	24.9488	15.0791	18.0904	16.6754	22.6652
Helena	17.8133	13.2654	12.3854	14.3545	21.9587	21.7100	21.7275	20.6421	19.1254	21.6850	21.5950	20.5579
Medford	17.7729	17.3700	13.2925	22.1279	24.9904	25.6625	24.1575	31.0020	27.1229	27.6110	28.7400	30.5002
Sacramento	13.4500	11.7025	11.8079	31.4462	19.4675	24.6425	23.5254	37.2624	26.6137	27.1193	25.8847	36.1933
San Diego	19.6761	23.5375	20.6229	31.8324	20.7387	26.9529	24.6075	36.9441	26.1258	29.0300	27.8775	35.5098
Spokane	38.9099	41.5862	40.0462	53.0587	54.9812	56.9312	54.5862	61.9010	55.8150	59.8704	56.4054	61.2155
Yakima	28.1612	25.4704	22.8066	33.6250	38.2062	33.7529	33.9054	37.9244	42.2616	36.1083	35.6429	36.8854
AVERAGE	23.6654	22.0162	20.2719	31.6518	31.0067	31.1267	30.3504	37.3234	33.4117	34.1902	32.9465	36.8629

BRIER SCORES FOR CHANGED FORECASTS ONLY

	Period I				Period II				Period III			
	FP-3	Pre	Post	Climat	FP-3	Pre	Post	Climat	FP-3	Pre	Post	Climat
Astoria	8.9200	8.4100	7.0600	10.9163	13.3800	11.8800	12.1700	14.7008	12.9000	16.5300	14.1490	15.2434
Billings	9.1700	7.9029	7.6729	9.5695	17.4525	16.5825	15.8704	18.3131	17.3005	19.0608	16.0937	20.1812
Boise	16.4425	15.4487	12.8708	13.1794	23.9062	21.9908	23.6095	19.1409	20.8075	19.5250	18.9874	17.5071
Fresno	3.8129	2.9075	2.2029	5.0346	2.8033	4.4125	2.7825	4.5956	2.5683	4.5229	3.1079	4.2867
Helena	1.0300	2.0400	1.1600	2.2338	5.1925	6.3725	6.3900	5.3698	4.9600	5.3300	5.2400	5.4966
Medford	7.3700	10.2800	5.7725	9.2537	14.9704	13.3900	12.8450	14.8064	13.0200	13.0205	13.9300	12.2936
Sacramento	1.6200	1.7750	1.8804	3.2769	6.1575	7.0250	5.9079	7.1841	6.1379	8.1904	6.9558	7.8020
San Diego	5.0729	7.9250	5.0104	8.7428	6.3025	9.3829	7.0375	13.0833	9.6625	10.8300	9.6775	12.9979
Spokane	15.4260	18.0825	16.4925	14.3182	16.4300	17.6975	16.1125	17.6697	14.8150	17.2350	14.6425	18.7586
Yakima	13.1004	12.5129	9.8491	11.6006	12.4625	10.8125	10.9650	10.0768	10.0608	9.4604	8.9950	9.8261
AVFRAGF	8.1959	8.7285	6.9972	8.8126	11.9057	11.9546	11.3690	12.4940	11.2233	12.3705	11.1779	12.4393

PERCENT OF FORECASTS CHANGED BY STATION

Station	Number Changed	Total Forecasts	Percent Changed		
			Period I	Period II	Period III
Astoria	44	170	25.9	37.1	41.8
Billings	61	244	25.0	42.2	48.8
Boise	68	324	21.0	28.7	31.8
Fresno	21	223	9.4	10.3	10.3
Helena	9	162	5.6	14.8	15.4
Medford	57	160	35.6	43.8	40.6
Sacramento	16	241	6.6	14.5	14.5
San Diego	28	243	11.5	14.8	18.5
Spokane	72	318	22.6	27.1	29.3
Yakima	68	288	23.6	29.1	26.8