ARLV-351-3

Category: UC-53

WEATHER PREDICTIONS AND SURFACE RADIATION ESTIMATES

for the

MILROW EVENT

Final Report

Robert H. Armstrong

Joseph R. Morrell

Environmental Science Services Administration
Air Resources Laboratory - Las Vegas

Prepared for the
U.S. Atomic Energy Commission
Nevada Operations Office
under Contract No. SF54-351

December 1969

Printed in USA. Price $3.00. Available from the Clearinghouse for Federal Scientific and Technical Information, National Bureau of Standards, U.S. Department of Commerce, Springfield, Virginia 22151.

ARLV-351-3

Category: UC-53

WEATHER PREDICTIONS AND SURFACE RADIATION ESTIMATES

for the

MILROW EVENT

Final Report

Robert H. Armstrong

Joseph R. Morrell

Environmental Science Services Administration
Air Resources Laboratory - Las Vegas
Box 14985
Las Vegas, Nevada, 89114

Prepared for the
U.S. Atomic Energy Commission
Nevada Operations Office
under Contract No. SF54-351

December 1969

TABLE OF CONTENTS

TABLE OF CONTENTS (Cont'd.)

Page

ARLV-351-3

Category: UC-53

February 24, 1970

ERRATA

Weather Predictions and Surface Radiation Estimates for the MILROW Event

Page 7 -- In sub-paragraph 2.32, the first sentence should read: On D-day the normal schedule of upper-air observations was ...

Page 35 -- In paragraph 9.1, the sentence in line 7 should read: It should have the capability of taking vertical soundings of winds and temperatures.

Page 42 -- Delete all data in first column under "RAWIN".

ABSTRACT

For the MILROW event, three surface wind towers were installed and instrumented on Amchitka Island. A 24-hour weather observing station, equipped to take upper-air soundings of wind, temperature, pressure, and humidity along with surface observations, was in operation at the Northwest Camp for two weeks preceding the event. Communications facilities for receiving large-scale meteorological data and forecasts for the North Pacific Ocean area from the major forecast centers were acquired. Weather forecasts for the Amchitka area were issued twice daily.

Event-oriented forecasts of winds, weather, vertical atmospheric stability, and air trajectories were presented to the Test Manager and his Advisory Panel in daily formal and informal briefings beginning at D-9 days. Recognizing the possible, though unlikely, release of radioactivity into the atmosphere, estimates of potential radiation effects were also presented during the briefings.

Intensive surveillance of changing meteorological conditions at the surface and aloft throughout the western Aleutian Islands was maintained on D-Day by means of frequent weather observations at Shemya, Amchitka, and Adak. The Test Manager and his Advisory Panel were kept informed of the meteorological interpretation of data from these observations starting with the final readiness briefing and continuing throughout the day. D-Day meteorological data are included in the report.

PART 1 WEATHER

CHAPTER 1

INTRODUCTION

1.1 BACKGROUND

The Environmental Science Services Administration (ESSA) by agreement with the Atomic Energy Commission's Nevada Operations Office (AEC/NVOO) is responsible for providing all meteorological support required by the Test Manager, NVOO, to conduct nuclear tests safely at the Nevada Test Site (NTS). This ESSA responsibility extends to nuclear tests conducted at off-NTS locations and is met by its Air Resources Laboratory-Las Vegas (ARL-LV) under the Office of the Test Manager, Nevada Operations Office (OTM/NVOO).

ARL-LV is organized and staffed to provide the specialized meteorological services peculiar to the Safety Program associated with nuclear testing as well as to develop, through continuing research, improved methods of weather predictions and radiation estimates. Meteorological data acquisition is a function of the Field Operations Branch. Weather forecasting is performed by the Meteorological Predictions and Research Branch, and the Radiation Estimates and Research Branch has the responsibility for making radiation estimates. Additional services are provided by the Programs and Administration Branch which includes a Computer Services Group, by the Climatology Section within the Meteorological Predictions and Research Branch, and by an Electronics

Maintenance Section within the Field Operations Branch.

1.2 OBJECTIVES

ARL-LV Weather Predictions objectives in support of the MILROW event were to:

1. Provide and interpret climatological data required by the various participants for pre-event planning and preparation.
2. Provide meteorological observations and data essential to the Safety Program.
3. Provide weather and air trajectory forecasts for the Test Manager and his Advisory Panel.
4. Document the state of the atmosphere in the vicinity of Amchitka Island at and subsequent to the time of detonation.
5. Provide weather observing and forecasting service to the Test Manager's representative during any post-shot re-entry program.
6. Provide post-shot analyses, appropriate records, and reports consistent with the experiment.

CHAPTER 2

PROCEDURE

2.1 DATA REQUIREMENTS

2.1.1 Safety Program. Data for the Safety Program were collected to aid in the meteorological predictions and to document the state of the atmosphere at H-Hour. Documentation was continued during a sufficient post-shot period to provide ample detail in time and space for correlation with radiological measurement in the unlikely occurrence of an uncontrolled release of radioactive material.

Data, collected for the purpose of making weather predictions, ranged from teletype weather resumes received from the Alaska Region Weather Bureau Forecast Center to local surface observations. All were subject to selective interpretation by the Weather Briefer in assessing the forecast problem and arriving at a prediction of the various weather elements for shot-time.

Documentation of the state of the atmosphere at and near surface ground zero (SGZ) was accomplished through a close-in network of instruments. Wind information obtained from surface wind towers and upper-wind soundings was used to produce wind flow analyses and air parcel trajectories. Vertical temperature profiles were obtained from radiosonde observations.

Following the final readiness briefing, meteorological data were interpreted by the Weather and Radiation Briefers in order to keep the Test Manager and his Advisory Panel advised concerning meteorological aspects of the Safety Program.

Weather parameters pertinent to the test included:

1. Vertical profile of wind and temperature in the layer through which any released radioactive material might be expected to rise.
2. Time and spatial variation of wind direction and speed at the surface and aloft within the general test area.
3. Air flow patterns (streamlines) and air trajectories at various levels from the surface throughout the layer of concern.
4. Significant cloudiness and precipitation in the general area and downwind.

2.1.2 Technical Program. The Test Director required daily forecasts and surface weather observations for routine site operations. Sea, surf, and swell forecasts were of particular interest to the small ships operating near Amchitka in support of the test.

2.2 DATA SOURCES

2.2.1 International Meteorological Network. The sources of large scale meteorological data available to the weather forecasters included:

1. Weather Facsimile, Intra-Alaska Circuit, by radio from anchorage via Adak.
2. Weather Teletype, Service A, by radio from Anchorage via Adak.
3. Weather Teletype, Service C, by radio from Anchorage via Adak.

4. Weather Teletype, JMG, Tokyo, Japan, by radio receiver in the Weather Forecast Office.

5. Weather Satellite Pictures, by radio from Adak, Alaska.

<u>2.2.2 ARL-LV Instrumentation.</u> Instrumentation established by ARL-LV consisted of surface weather observing instruments, surface wind towers, and an upper-wind and temperature sounding station. Data from these sources were required to augment the large-scale data.

<u>Surface Instrumentation.</u> Maximum and minimum thermometers were housed in a standard instrument shelter at the Control Point (CP) Weather Station.

Hourly humidity data were obtained at the CP Weather Station, using a standard sling psychrometer.

A standard microbarograph was used to record atmospheric pressure and was augmented by a precision aneroid barometer.

Surface wind towers were located near SGZ, in the Main Camp area, and atop a hill near Mile 29.5 of the main highway. The SGZ wind data were telemetered by hardwire to a recorder in the CP Weather Station while data from the other two towers were radio-telemetered to the CP.

<u>Off-Site Upper Wind Network.</u> Arrangements were made for special extra upper-wind soundings to be taken on D-Day by the U.S. Weather Bureau at Shemya, Alaska, and by the U.S. Navy at Adak, Alaska. The data were received at the CP by telephone and teletype.

Rawinsonde Observations. A Ground Meteorological Device (GMD) located at the CP upper air complex was used to track balloon-borne radiosonde instruments in order to measure vertical profiles of temperature, pressure, humidity, and winds.

2.3 OPERATIONS

2.3.1 Pre-Event Operations. Planning for meteorological support of underground events at Amchitka Island began in the fall of 1966. ARL-LV meteorological support plans, cost estimates, and logistic support requirements were submitted to NVOO in March 1967 and were updated periodically to meet changes in program plans and schedules. Communications requirements were identified in September 1967. The procurement of necessary meteorological equipment and instrumentation started in December 1967 and continued through the first half of 1968. A site climatology was prepared and issued in October 1967 using long-term data available from earlier periods when Amchitka had been used by the Department of Defense.

The ARL-LV Project Meteorologist participated in a tour of various Alaska Military Commands with Joint Task Force-8 and AEC officials in April 1968 to coordinate meteorological support of the MILROW event.

Chief, ARL-LV and the Project Meteorologist visited Amchitka and Kiska Islands in September 1968 to select locations for equipment and instruments.

The Project Meteorologist and an ARL-LV electronics technician visited the site in July 1969 to check on the progress of logistic support requirements and to erect a wind tower and ground shelter on Kiska Island.

Two ARL-LV electronics technicians arrived at Amchitka on September 10, 1969, to set up and check out equipment and instrumentation.

ARL-LV operational support was initiated on September 18, 1969, with a 24-hour schedule of surface weather observations, four-a-day upper-air soundings of temperature, pressure, humidity, and wind, and routine twice-daily site weather forecasts.

2.3.2 Event-Oriented Operations. On D-Day, the normal upper-air observations was expanded to provide a complete sounding every three hours. Three-hourly rawinsonde observations were also made at Shemya and Adak, Alaska.

2.3.3 Post-Event Operations. Hourly surface weather observations were continued through D+1 day, after which operational meteorological support was terminated.

CHAPTER 3

RESULTS

3.1 WEATHER OBSERVATIONS

D-Day meteorological data are included as Appendix A.

3.2 WEATHER BRIEFINGS

Forecasts of pertinent meteorological parameters were presented to the Test Manager and his Advisory Panel in formal readiness briefings at the following dates and times:

September 23, 1969	1030 BDT*
September 23, 1969	2000 BDT
September 24, 1969	0700 BDT
September 27, 1969	1530 BDT
September 27, 1969	2000 BDT
September 28, 1969	1400 BDT
September 29, 1969	0700 BDT
October 1, 1969	0700 BDT
October 1, 1969	2000 BDT
October 2, 1969	0700 BDT

The D-1 and D-Day presentations are summarized below:

D-1 October 1, 1969 0700 BDT

The surface weather chart for 0200 BDT today has a low pressure area centered just southwest of Amchitka, which accounts for our present stormy weather. Further to the west, there is a high pressure area, and another storm is brewing in the Sea of Japan (Figure 3.1).

The expected synoptic scale pressure pattern for noon tomorrow is indicated on the surface weather forecast chart (Figure 3.2). We expect the low pressure area centered southwest of

*BDT - Bering Daylight Time

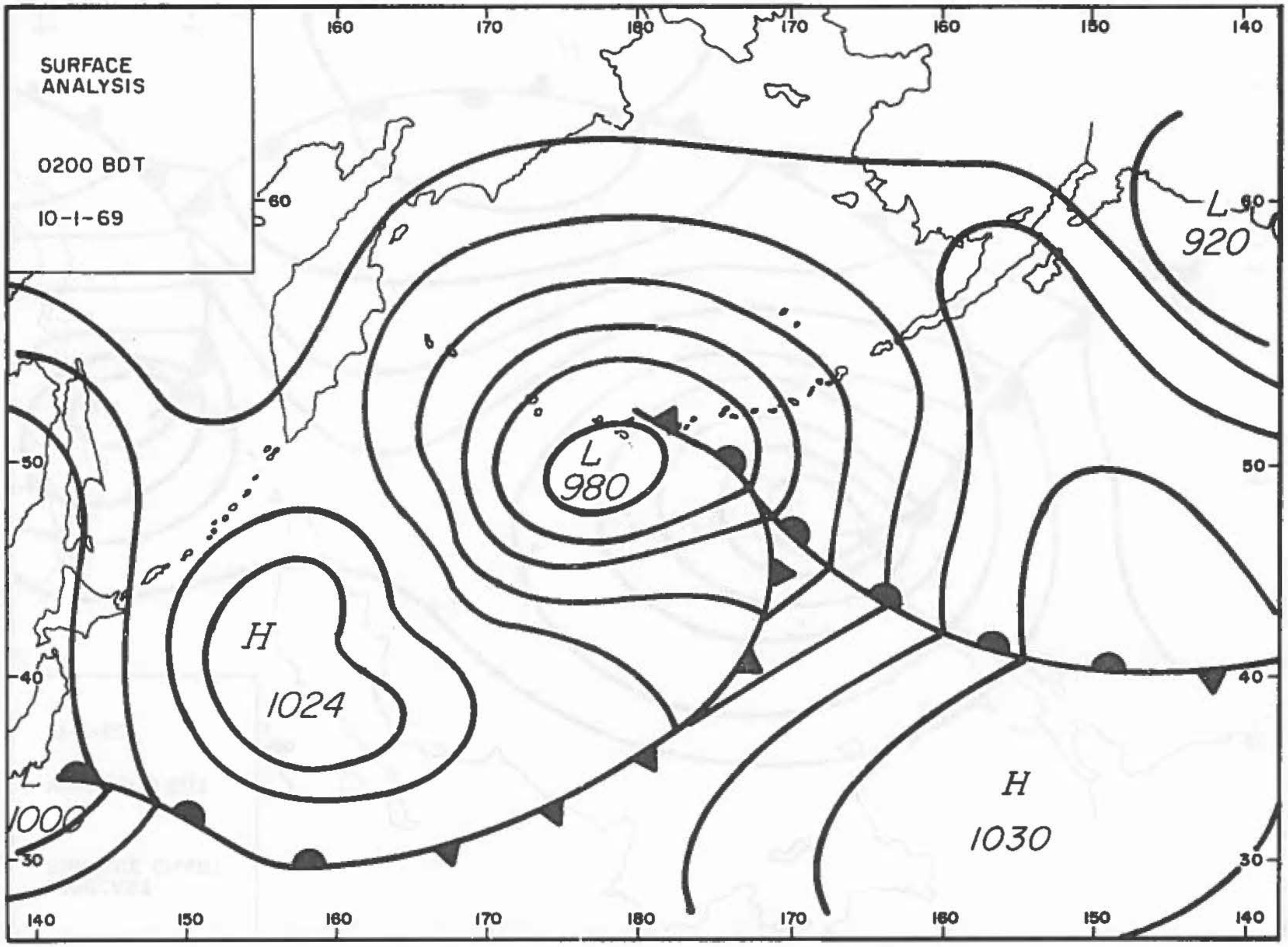


Figure 3.1 North Pacific Surface Weather Analysis, 0200 BDT, October 1, 1969.

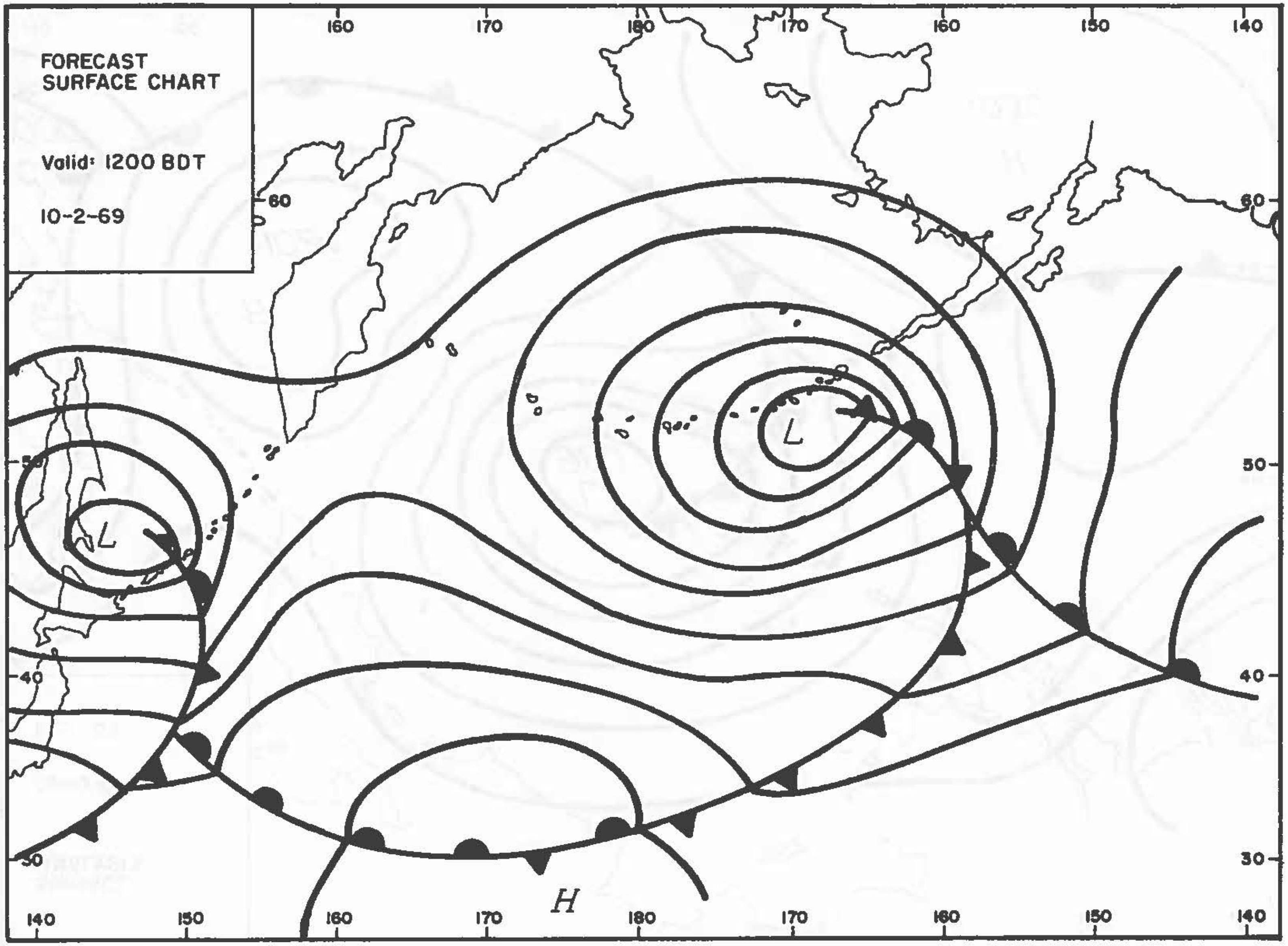


Figure 3.2 North Pacific Surface Weather Forecast Chart, Presented at 0700 BDT, October 1, 1969.

Amchitka to move eastward and to be replaced by the surface high pressure ridge, with resulting north-northwesterly winds at the surface and aloft. Winds will continue backing slowly with time into a more westerly direction at all levels.

We expect scattered to broken cloudiness in the local area tomorrow with broken to overcast skies farther east in the vicinity of the low pressure area.

The predicted vertical temperature profile for tomorrow indicates vertical stability above about three to four thousand feet MSL.

The 5000-ft MSL streamline pattern, forecast for noon tomorrow, has an area of cyclonic inflow above the surface low near 52N 175W and a ridge to the west of the local area.

Air trajectories will be toward the south-southeast, curving more eastward downstream.

(Briefing charts are included as Figures 3.3 and 3.4).

D-1 October 1, 1969 2000 BDT

The surface low pressure system was located just southeast of Adak, Alaska, at 1400 BDT today with a high pressure ridge south of Kamchatka and another low in Northern Japan (Figure 3.5).

The surface low to the east is expected to continue its eastward movement and to be centered in the eastern Aleutians by noon tomorrow. We will be under the influence of north-northwesterly winds and can expect reasonably good weather. The low which is now centered in Japan is predicted to be centered near the southern tip of Kamchatka tomorrow and to continue moving eastward at

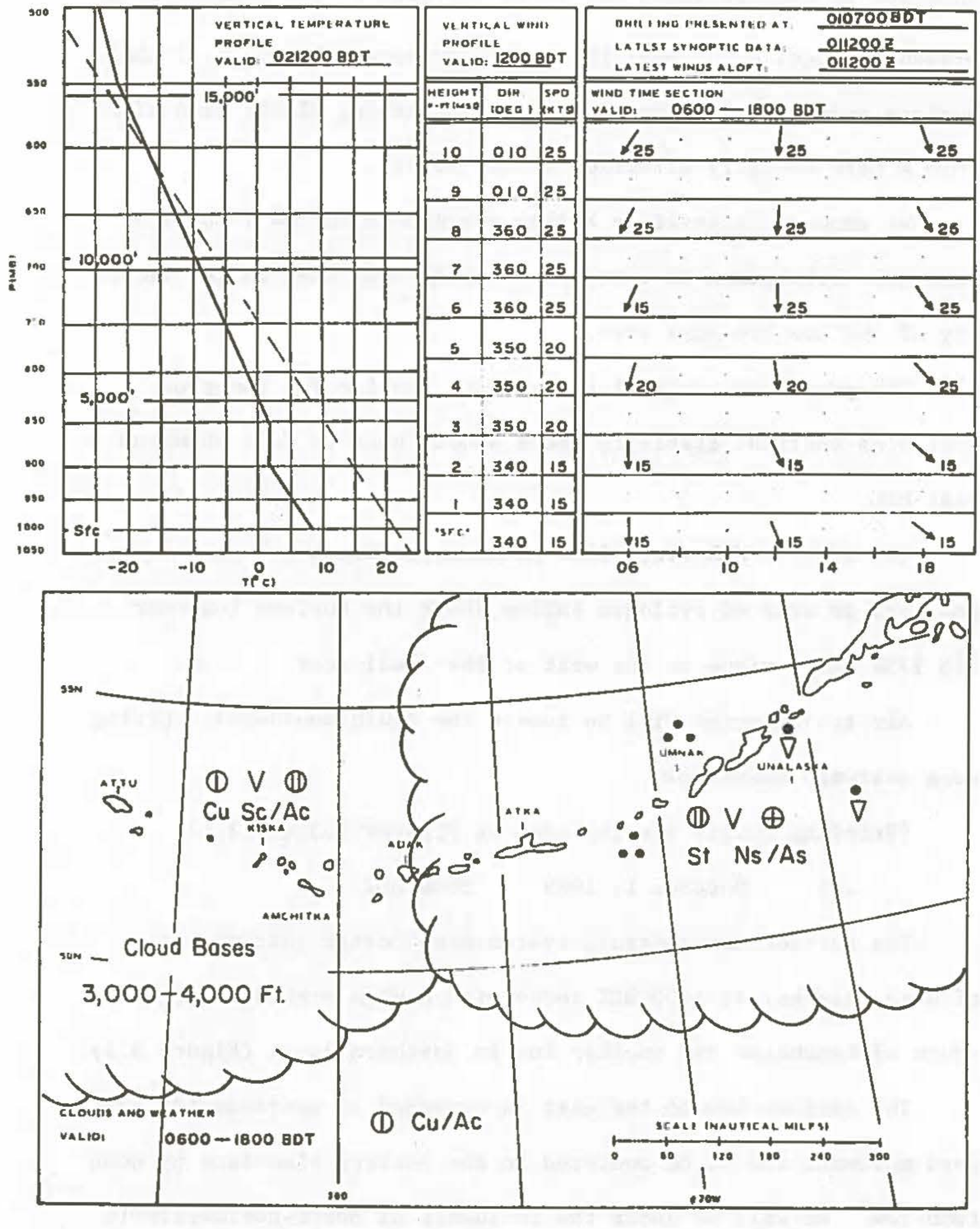


Figure 3.3 Composite Briefing Chart, Presented at 0700 BDT, October 1, 1969.

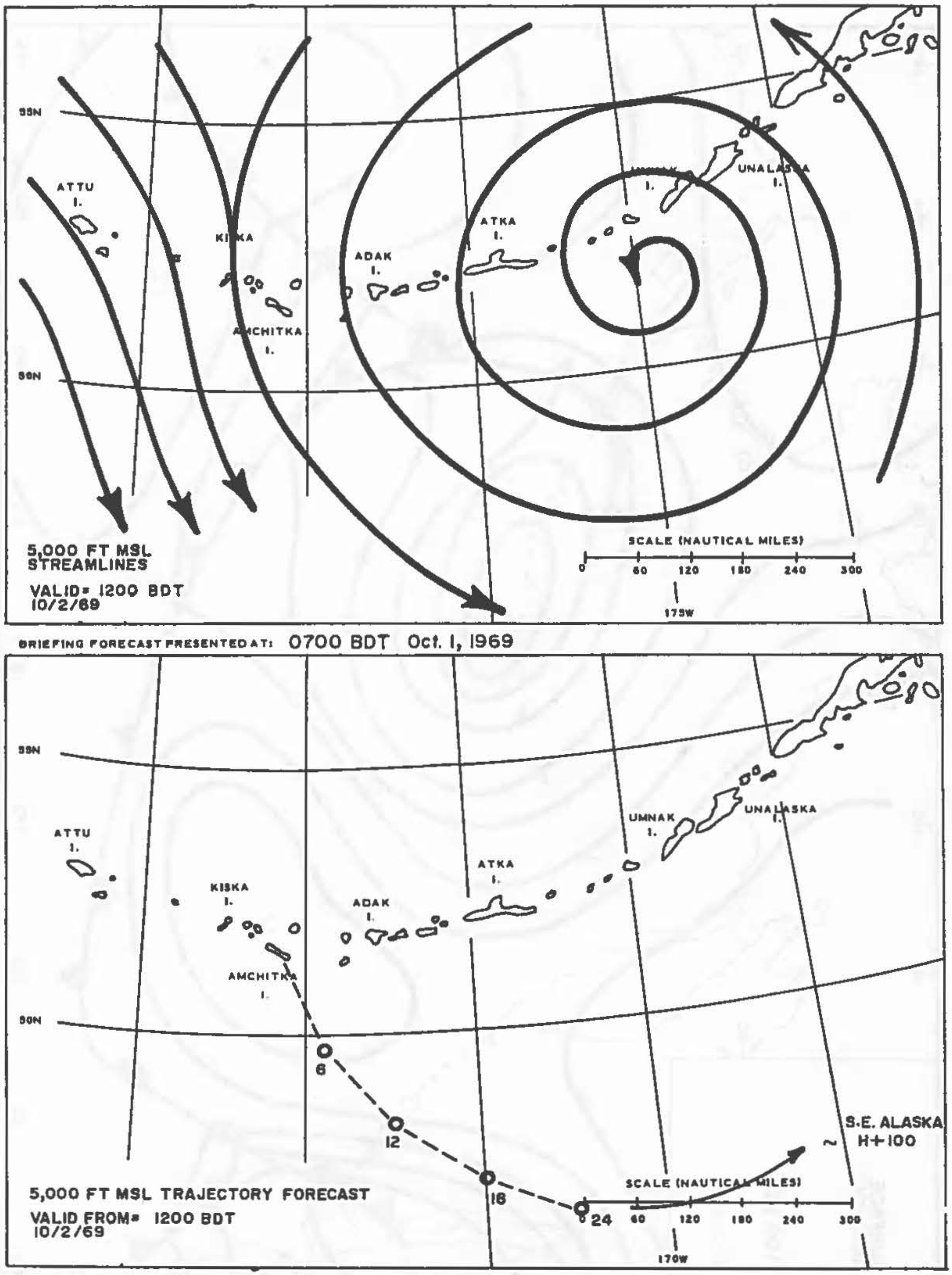


Figure 3.4 Streamlines and Trajectory Forecast Chart, Presented at 0700 BDT, October 1, 1969.

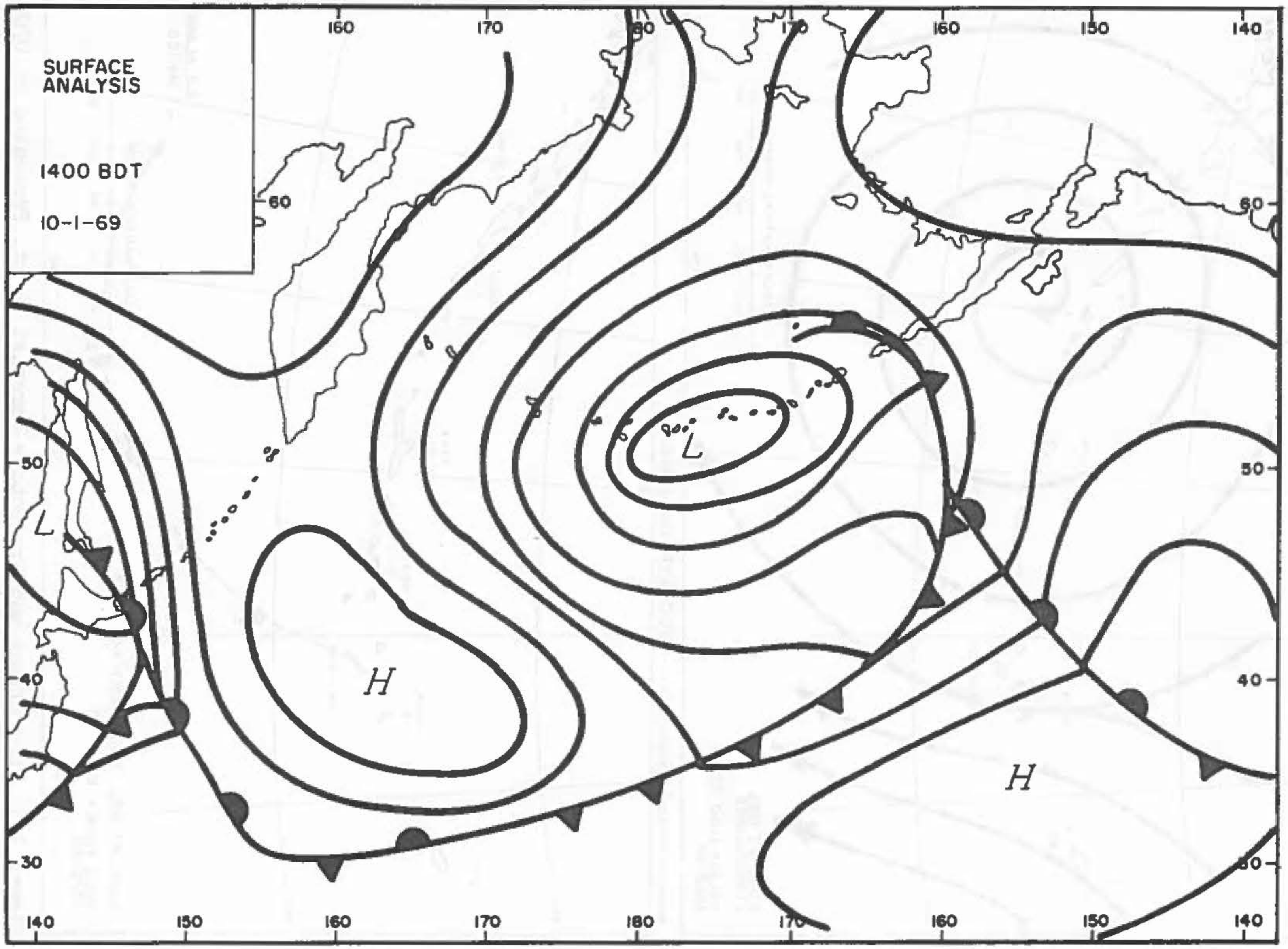


Figure 3.5 North Pacific Surface Weather Analysis, 1400 BDT, October 1, 1969.

about 25 knots (Figure 3.6).

Surface and low level winds aloft will back slowly into the northwest with time.

The predicted vertical stability will permit mixing to only about 4000 ft MSL.

(Briefing charts are included as Figures 3.7 and 3.8).

D-Day October 2, 1969 0700 BDT

There are no significant changes from last night's forecast except that wind speeds are somewhat higher than had been expected.

The low pressure system to the east has continued its eastward progress as anticipated. We expect partly cloudy skies and good horizontal visibility in the local area.

(Briefing charts are included as Figures 3.9 through 3.12).

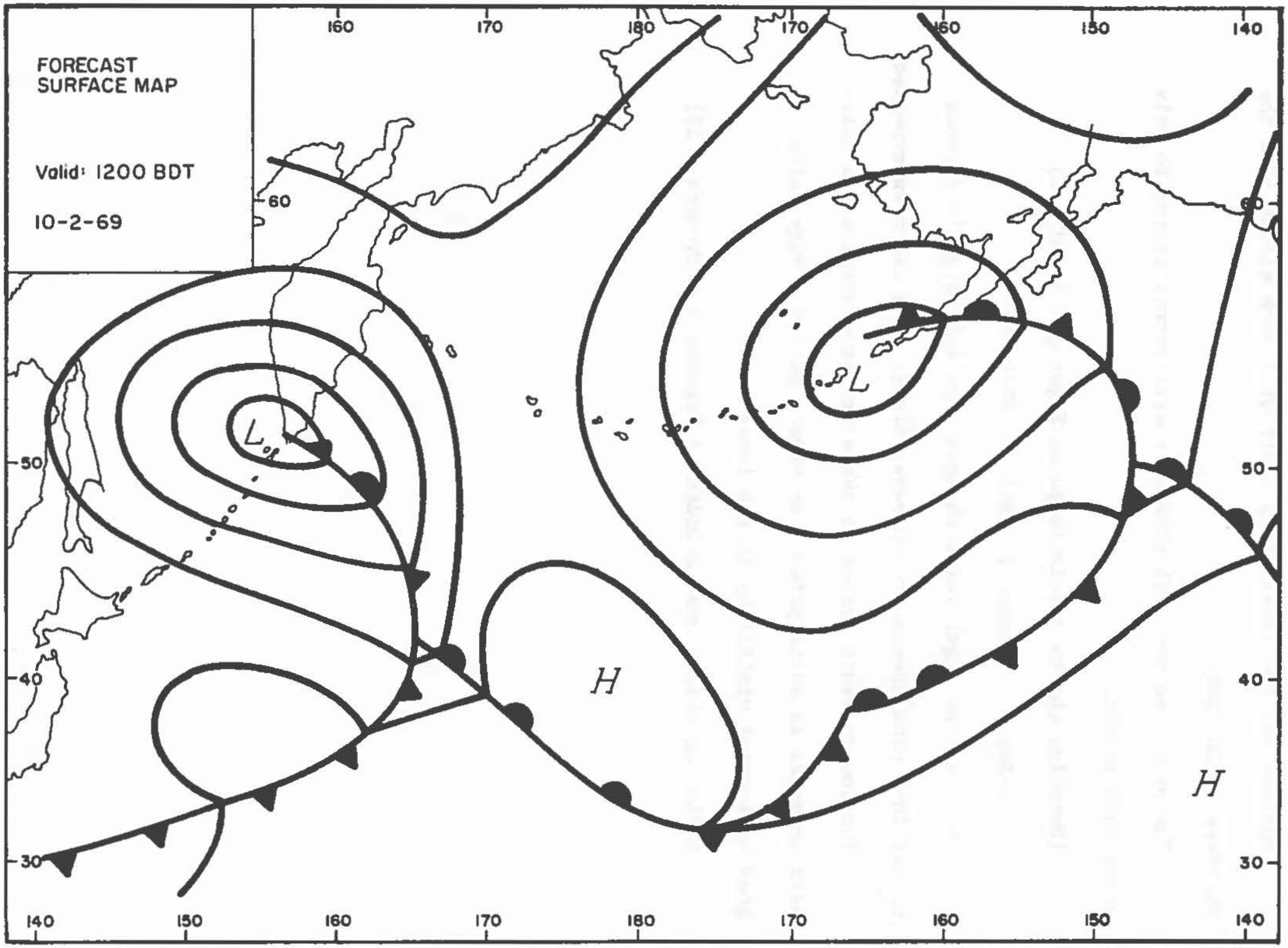


Figure 3.6 North Pacific Surface Weather Forecast Chart, Presented at 2000 BDT, October 1, 1969.

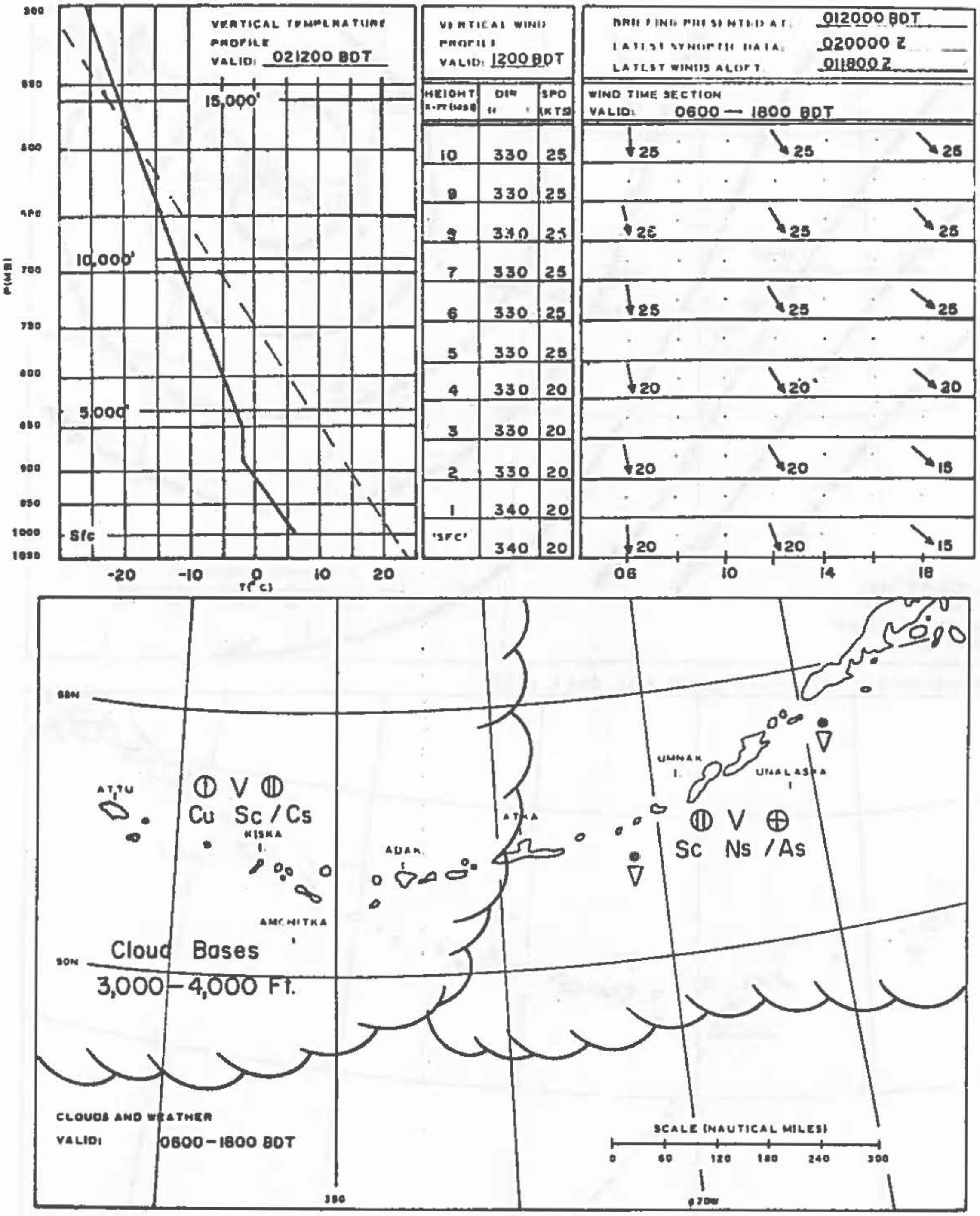


Figure 3.7 Composite Briefing Chart, Presented at 2000 BDT, October 1, 1969.

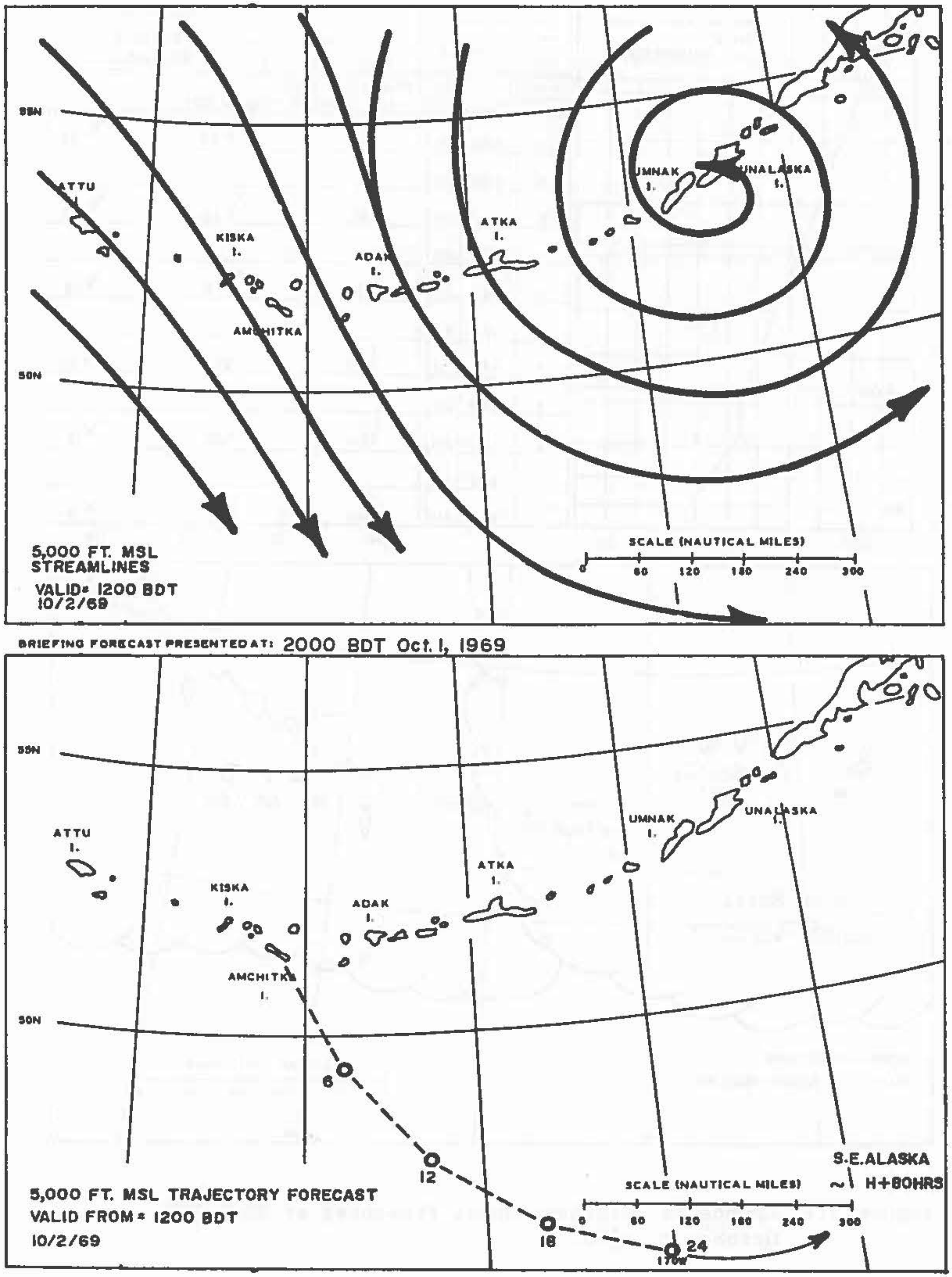


Figure 3.8 Streamlines and Trajectory Forecast Chart, Presented at 2000 BDT, October 1, 1969.

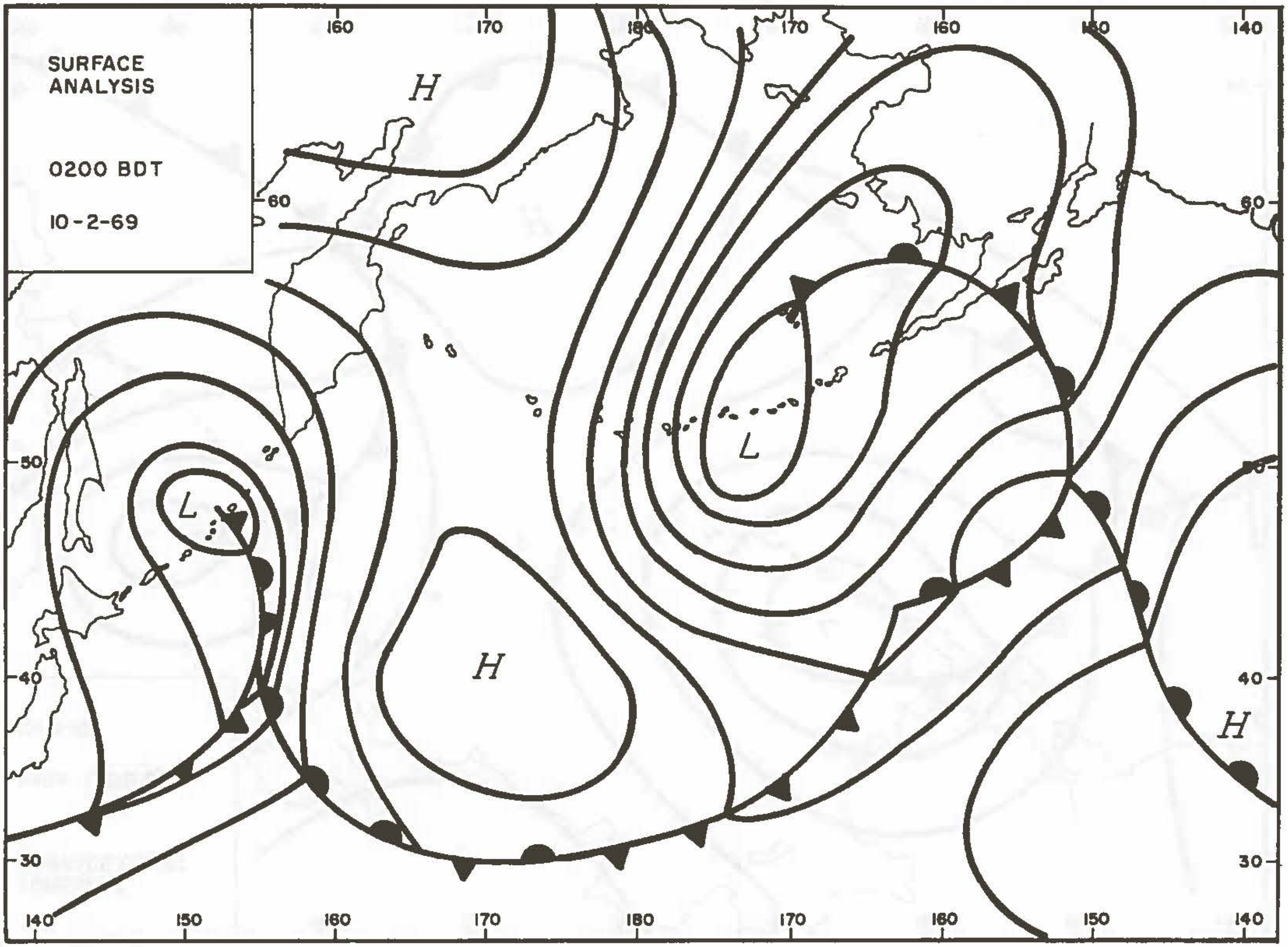


Figure 3.9 North Pacific Surface Weather Analysis, 0200 BDT, October 2, 1969.

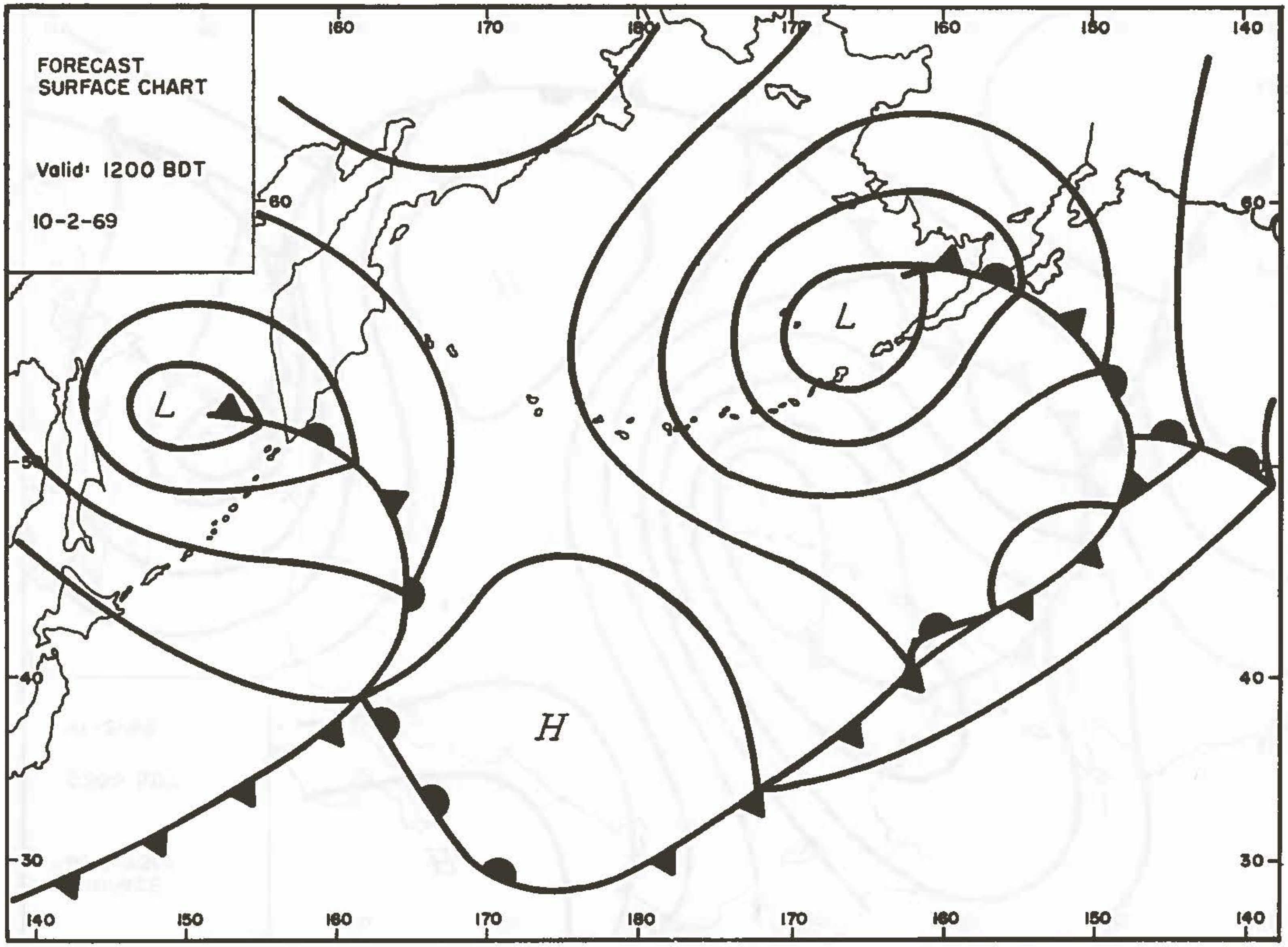


Figure 3.10 North Pacific Surface Weather Forecast Chart, Presented at 0700 BDT, October 2, 1969.

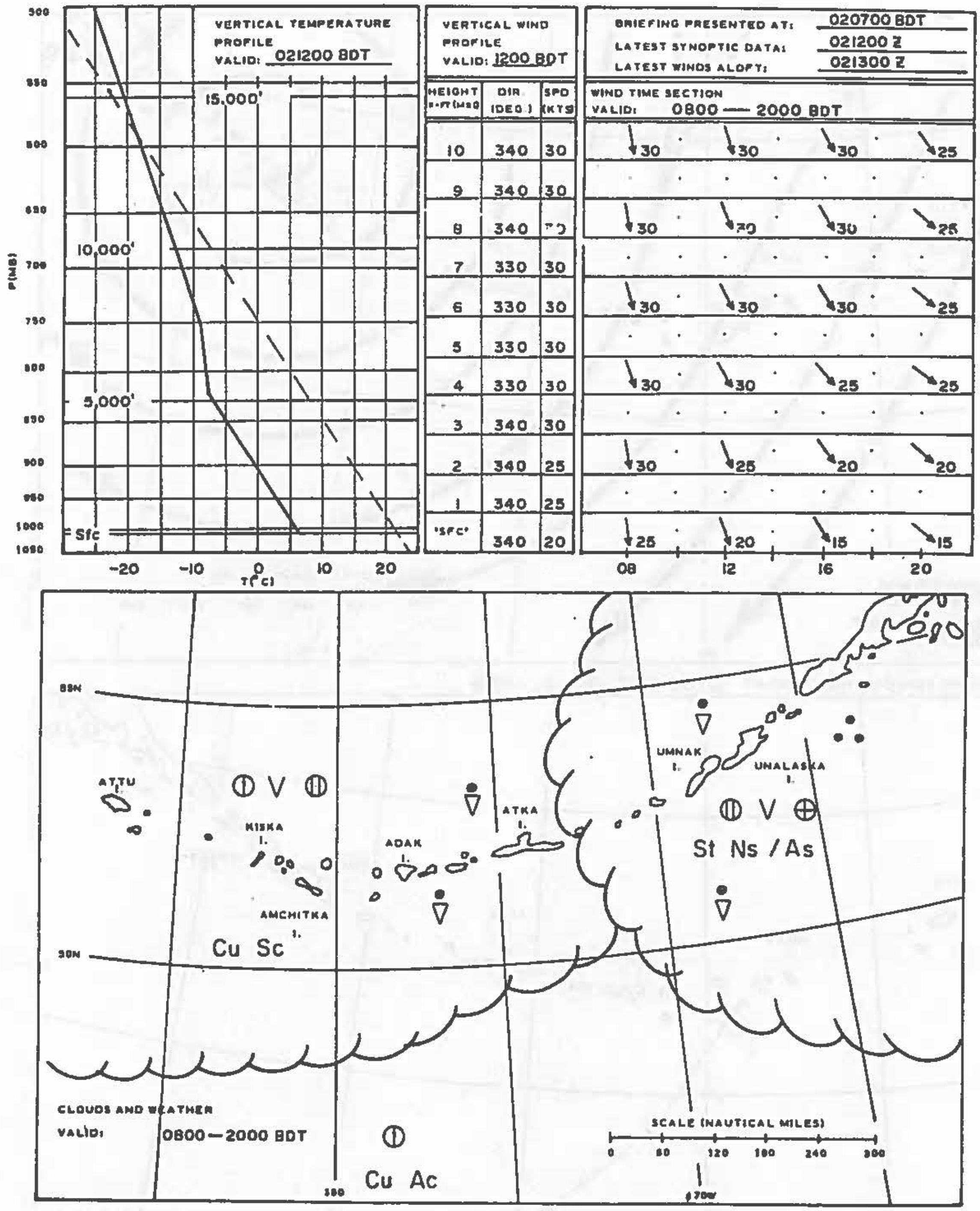


Figure 3.11 Composite Briefing Chart, Presented at 0700 BDT, October 2, 1969.

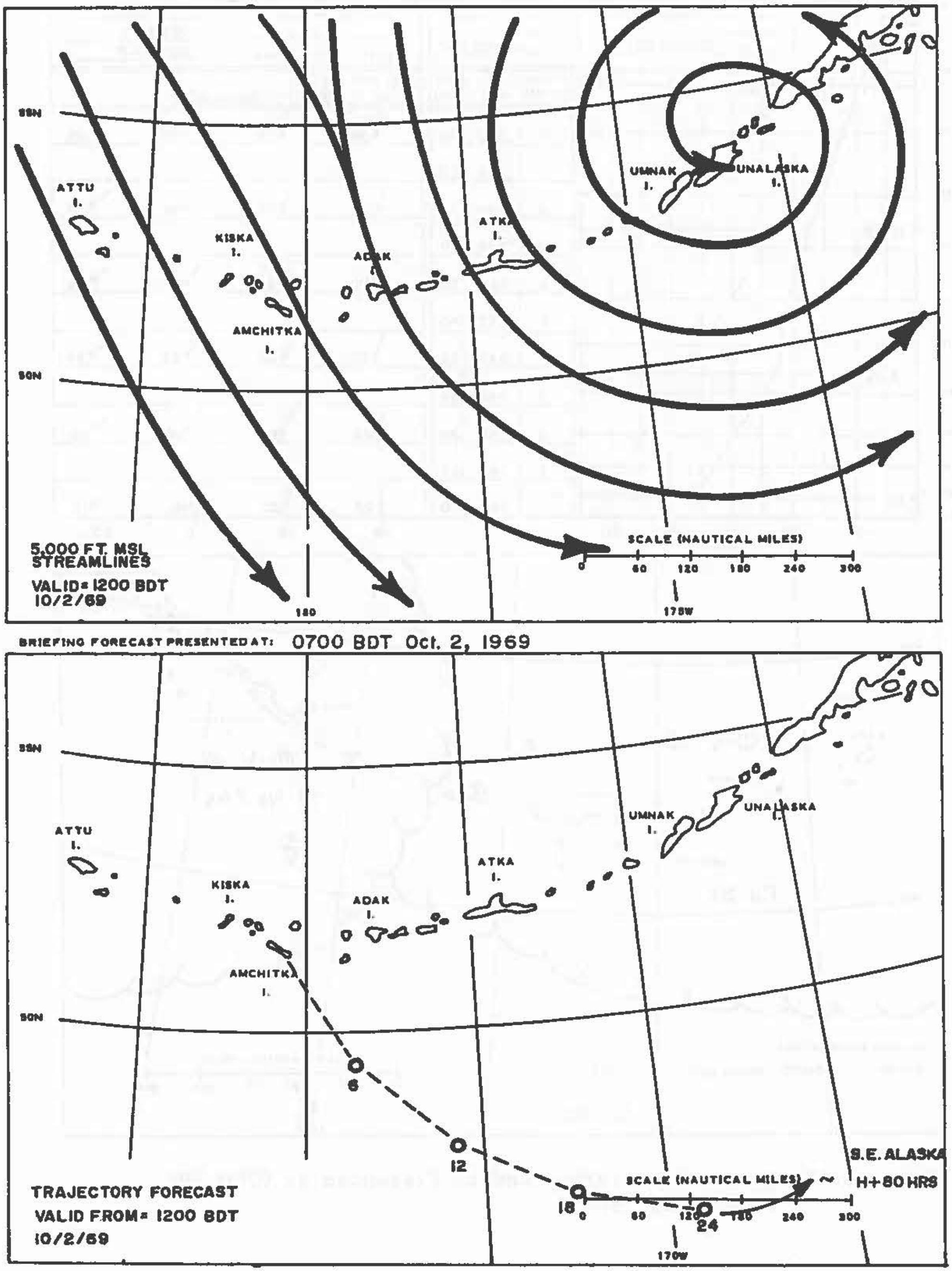


Figure 3.12 Streamlines and Trajectory Forecast Chart Presented at 0700 BDT, October 2, 1969.

CHAPTER 4

DISCUSSION

4.1 WEATHER DESCRIPTION/FORECAST VERIFICATION

Weather in the western Aleutian Islands on D-Day was marked by partly cloudy skies and scattered instability showers. Frequent rain showers of short duration were observed on Amchitka throughout the morning, but they ended by 1300 BDT.

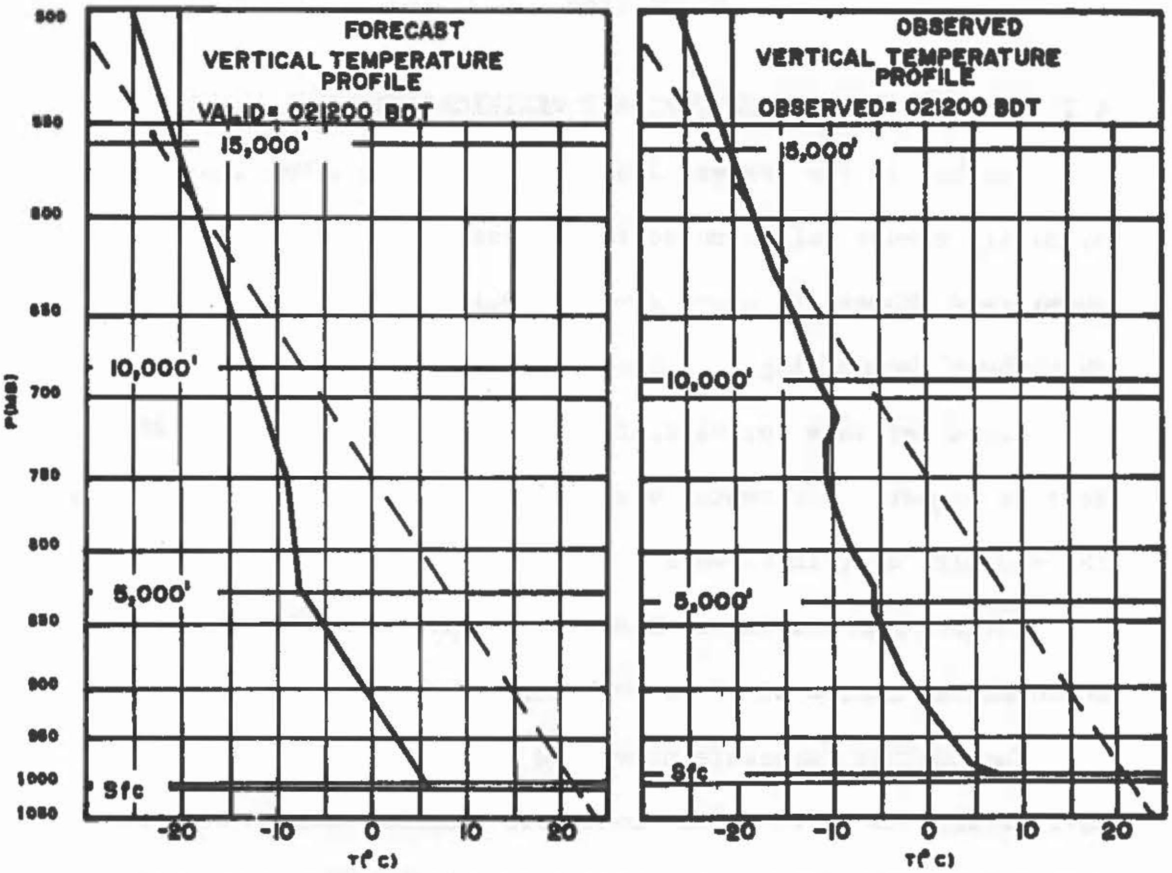
Cloud ceilings for aircraft operations were generally 2000 feet or higher. Horizontal visibility was unrestricted except in the vicinity of rain showers.

Surface and low-level winds aloft were from the north-northwest at speeds of 20 to 30 knots.

The weather forecasts proved to be quite accurate although surface and low level winds aloft were slightly more northerly than had been expected, and the morning instability showers had not been predicted. Figure 4.1 presents a comparison of predicted and observed vertical profiles of temperature and wind.

4.2 GENERAL

The marine influence of the Pacific Ocean and Bering Sea and the absence of significant terrain effects resulted in a simplification of weather forecasting problems for the MILROW event. The Polar Front Theory, particularly applicable in the upper middle latitude ocean areas, made it possible for the Weather Briefer to prepare accurate weather forecasts by charting positions of the large scale pressure systems and, with the aid of the forecast



HEIGHT K-FT(MSL)	DIR. (DEG.)	SPD (KTS)
10	340	30
9	340	30
8	340	30
7	330	30
6	330	30
5	330	30
4	330	30
3	340	30
2	340	25
1	340	25
'SFC'	340	20

HEIGHT K-FT(MSL)	DIR. (DEG.)	SPD (KTS)
10	335	17
9	335	16
8	345	16
7	355	22
6	355	26
5	350	26
4	355	25
3	355	24
2	355	23
1	355	21
'SFC'	350	21

Figure 4.1 Forecast and Observed Vertical Temperature and Wind Profiles.

centers, predicting their movement. Fortunately, during the MILROW event, the progression of storms was regular and without significant instances of retardation or acceleration. Had their progression been less regular, the forecast problem would have been much greater, since minor perturbations are difficult to detect due to the sparsity of weather observations in the North Pacific Ocean.

PART 2 RADIATION ESTIMATES

CHAPTER 5

INTRODUCTION

Estimates of potential downwind radiation intensity were required as an integral part of the Test Manager's Operational Safety Program for the MILROW event. The Radiation Estimates and Research Branch (RERB), ARL-LV, was responsible for the preparation of these estimates during the pre-event, event, and post-event phases of the project.

Specific program objectives in support of each project phase were:

1. Pre-event.

   Provide preliminary estimates of potential radiation levels requested by various participants for the preparation of technical and safety plans.

2. Event.

   Provide operational radiation estimates to the Test Manager and his Advisory Panel.

3. Post-event.

   Analyze observed meteorological data and any radiological data in order to document the radiation pattern, compare the observed radiation levels with those estimated, and examine the applicability of the ARL-LV radiation estimation technique used for the MILROW event.

CHAPTER 6

PROCEDURE

6.1 RADIATION ESTIMATES

6.1.1 Pre-Event Planning. Estimates of potential radiation exposures were initially provided to the Radiological Safety Branch, NVOO, the AEC Event and Event Evaluation Officers, NVOO, and the Effects Evaluation Scientist, Sandia Corporation, in August 1969. During September 1969, estimates of potential radiation exposures from specific nuclides were also submitted to the Los Alamos Scientific Laboratory (LASL). The preliminary calculations were prepared for a range of meteorological conditions using an analog scaling radiation estimation technique. Device-related data, required for the estimation of potential radiation exposure levels, were provided by LASL. Final selection of the technique best suited for the estimation of potential levels was coordinated with the laboratory.

6.1.2 Event Support. Estimates of potential radiation exposure levels were made using the analog scaling technique. The PIKE event was selected as the scaling analog. The meteorological parameters required as input to this method are:

1. The height above the terrain to which the potential effluent cloud will rise.
2. The angular shear in the wind hodograph through the cloud layer.
3. The mean wind speed in the cloud layer.

Prior to a scheduled readiness briefing, the weather forecast prepared by the Weather Briefer was utilized by the Radiation Briefer to estimate the above parameters and their temporal and spatial variability.

At the readiness briefings, the Radiation Briefer presented the following information:

1. The estimated fallout sector, hot-line orientation, and arrival times of the major portion of the potential debris cloud.
2. The potential external gamma cloud passage exposure and infinite deposition exposure along the hot-line as a function of distance from SGZ.

6.2 RADIATION ANALYSIS

Post-event responsibilities assigned to RERB include the evaluation and analysis of radiological data to:

1. Document the observed radiation pattern so that a better empirical background for improvement of radiation estimates may be established.
2. Provide additional analogs for future events.

CHAPTER 7

RESULTS

7.1 RADIATION ESTIMATES

7.1.1 Event Support. At the D-9 readiness briefing for a scheduled D-8 event rehearsal, the fundamental assumptions adopted for deriving radiation estimates for the MILROW event were presented. In essence, these were:

1. Radioactive gases and particulates would be released to the atmosphere through a prompt, dynamic venting mechanism analogous to that of the PIKE event.
2. The analog scaling technique would be the most applicable technique by which radiation estimates could be derived.
3. Since examination of potential exposures from tritium and the five isotopes of iodine revealed that they would not produce significant radiological effects, it was agreed that only estimates of potential external gamma exposures during cloud passage and from fallout would be presented at subsequent briefings.

At the final readiness briefing on event day, the predicted atmospheric stability and wind structure were discussed and interpreted as the basis for predicting the vertical mixing of the potential nuclear cloud, the mean cloud transport speed, and the delineation of the fallout sector. Any dynamically vented effluent was expected to mix upward to about 5000 feet above the surface by H+1 hour and to approach a maximum of about 6000 feet during the afternoon. The potential effluent cloud was predicted to move essentially south-southeastward at a mean speed of about 30 mph through H+6, then slow down to about 25 mph. Shear in the wind hodograph through the cloud layer was to remain near 10° throughout the day.

The estimated fallout sector, hot-line orientation, and hourly positions of the main debris cloud through H+5 hours are shown in Figures 7.1 and 7.2.

The estimated variation of external gamma exposure levels with distance along the hot-line is shown in Figure 7.3.

7.1.2 Post-Event Support. The Radiation Briefer remained on-site to provide support, if required. He was released by direction of the Test Manager on D+3 days.

7.2 RADIATION ANALYSIS

The MILROW detonation was wholly contained as expected. All post-event radiological data that were acquired indicate that no radiation was released to the atmosphere as a result of this test.

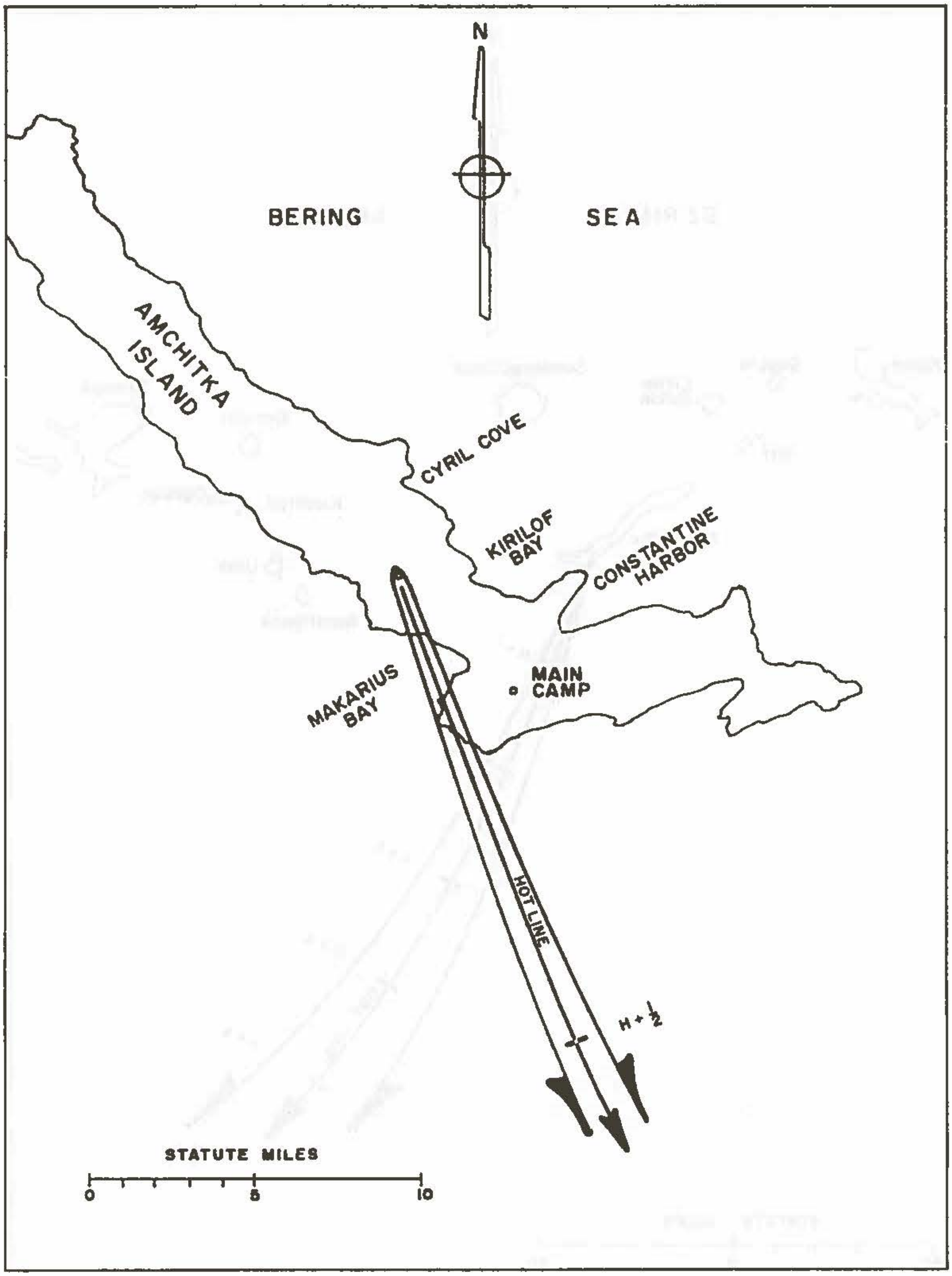


Figure 7.1 Fallout Sector Estimate (H-5).

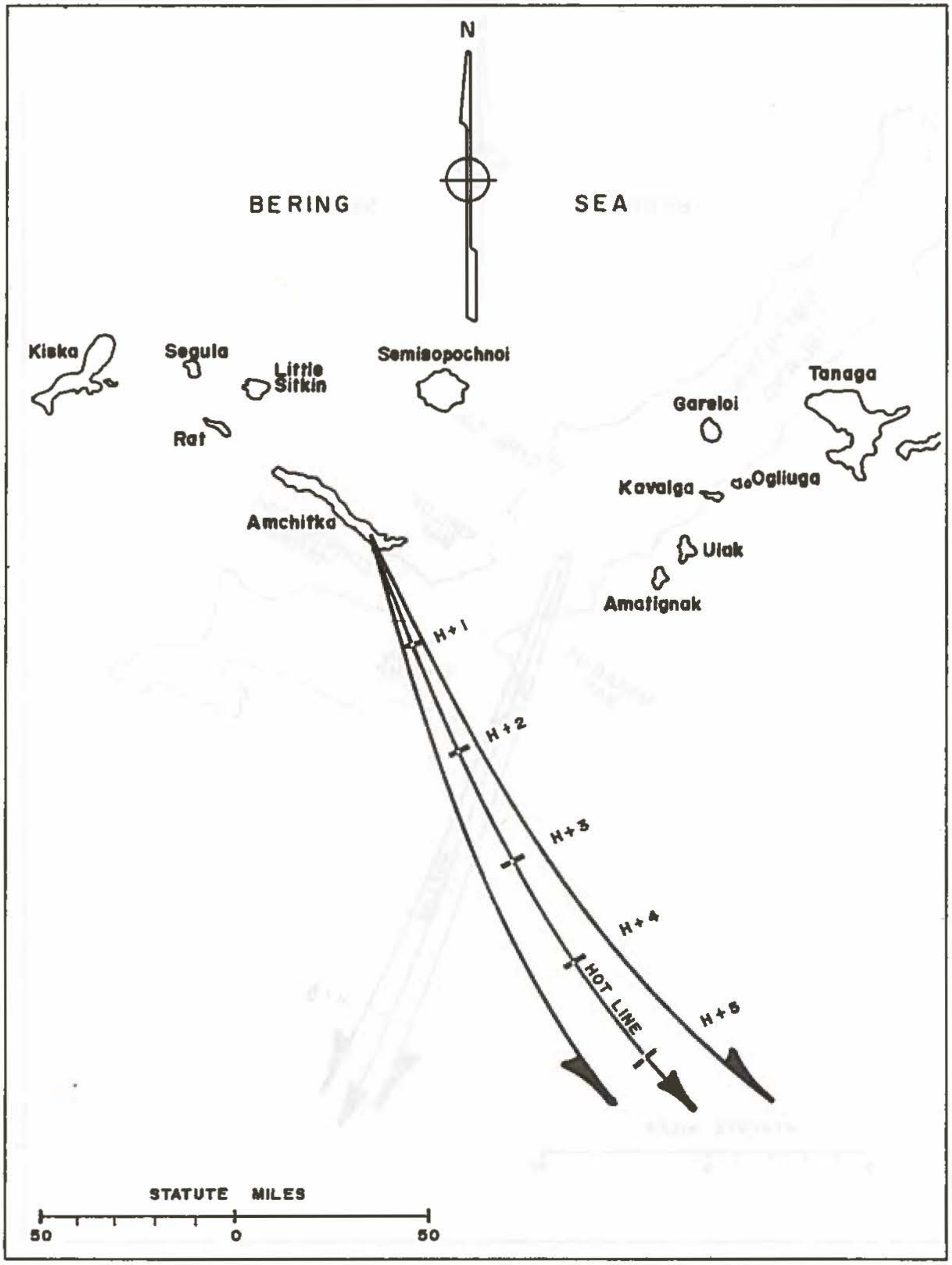


Figure 7.2 Extended Fallout Sector Estimate (H-5).

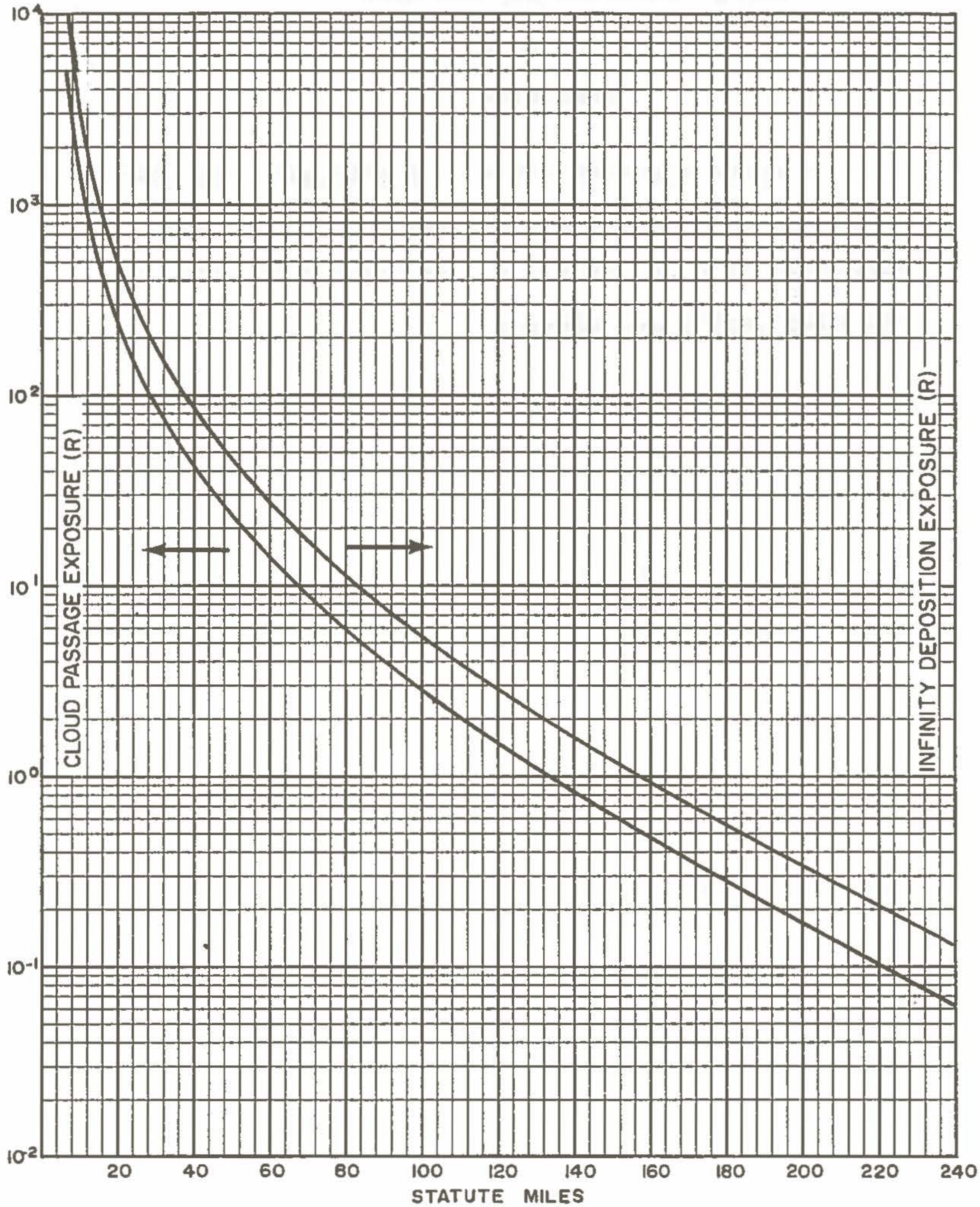


Figure 7.3 External Gamma Exposure Estimate (H-5) on the Hotline.

PART 3 CONCLUSIONS AND RECOMMENDATIONS

CHAPTER 8

CONCLUSIONS

All ARL-LV objectives were met. Climatological data provided were sufficient for pre-shot planning and preparation. Meteorological observations, data, and forecasts in support of the Safety Program were adequate.

CHAPTER 9

RECOMMENDATIONS

9.1 WEATHER DEPENDENCE

Every effort should be exerted to make future events at Amchitka less weather dependent. This implies less use of aircraft, including helicopters, requiring VFR flying weather, and suggests a shipboard CP.

A large ship, capable of housing the number of people necessary in the final preparations for an event and with adequate communications facilities, would be required. It would provide the capability of taking vertical soundings of winds and temperatures. Such a mobile CP need not be downwind, regardless of the wind direction. Also, if personnel could be embarked by surface vessel there would be less need for personnel lifts by helicopter.

Radio telemetry of wind data to the ship from island wind towers would present no insurmountable problems. We assume that radio telemetry of seismic, RAMS, and other data would also be possible.

The end of the old air airstrip near Constantine Harbor is about 200 feet lower than the main airstrip. Use of the lower strip for a helicopter terminal would increase the frequency with which ship-to-shore helicopter flights might occur in bad weather. Similar near-sea-level pads on nearby islands would facilitate travel to them from shipboard. This would permit helicopter operations during numerous periods when cloud ceilings were below operational minimums at the air terminal height. No statistics are available to indicate the resulting increase in frequency of flights. Installation of automatic ceiling and visibility measuring devices at the old airstrip, with readout at the present terminal, would be necessary to make use of the lower facility.

We suggest a comparison be made of the additional cost which would result from lengthy weather delays with the cost of reducing or eliminating weather dependence.

9.2 EVENT SCHEDULES

If VFR aircraft operations continue to be a requirement, we strongly recommend that events at Amchitka be scheduled only during periods of a high statistical probability of favorable weather. These periods are from mid-March to mid-May and mid-September to mid-November. The entire period from mid-September to mid-May has a relatively high frequency of VFR flying weather; however, low temperatures, strong winds, and snow accumulation would cause other problems during the winter months. A high frequency of fog during the summer months would surely result in extensive delays during that season.

9.3 AUXILIARY WEATHER STATIONS

Even with the regular movement and "typical" progression of storms during MILROW, the weather forecaster was handicapped by the complete absence of data within a 160-mile radius of Amchitka. The question often asked was, "Is the storm slowing down or accelerating?". This question can seldom be answered satisfactorily when using aircraft reports because the times and sequence of changes are not recorded at a single point in space. Ideally, meteorologists would require a network of stationary measurement stations in the upwind sector. Instrumentation of Kiska and other neighboring islands, with real-time data radio-telemetered to Amchitka, would be a reasonably low-cost substitute for such a grid.

Reports from transient surface ships are very useful if received, but most ships take no observations at night and transmission of their weather reports is somewhat erratic because of low priority, even when radio facilities are operating.

9.4 NEAR-ISLAND OPERATIONS

Our experience during preparations for MILROW indicates that efficient utilization of the islands near Amchitka requires the continuing presence of an AEC-controlled ship with a helicopter platform and a helicopter capable of lifting a Snow-Trac vehicle and necessary equipment ashore on the neighboring islands. This ship-helicopter combination would insure accessibility to the islands on a continuing basis which is necessary to support instrument installations on these islands.

APPENDIX A

MILROW METEOROLOGICAL DATA

SURFACE OBSERVATION AT	:	AMCHITKA ISLAND, ALASKA; Elevation 590 ft MSL 1145 BDT, October 2, 1969
Sky Condition and Weather	:	Estimated 2500 Broken
Cloud Amount and Type	:	7 Tenths Stratocumulus
Visibility	:	10 Miles
Atmospheric Pressure	:	988.5 Millibars
Temperature	:	6.4°C
Dew Point Temperature	:	3.6°C
Relative Humidity	:	82%
UPPER AIR DATA AT	:	NORTHWEST CAMP CP, AMCHITKA ISLAND, ALASKA 1145 BDT, October 2, 1969

HEIGHT (Ft MSL)	WIND (Deg/Kts)	PRESSURE (mb)	TEMPERATURE (°C)	DEW POINT (°C)	RELATIVE HUMIDITY (%)
SFC 590	350/21	989	6.4	3.6	82
800	350/21	979	3.6	-1.2	71
1000	355/21	972	3.3	-1.5	71
2000	355/23	937	1.2	-3.5	71
2090	355/23	934	1.0	-3.7	71
3000	355/24	903	-1.6	-4.4	81
3500	355/25	885	-3.0	-4.7	88
4000	355/25	869	-4.0	-6.0	86
4790	350/26	843	-5.8	-10.0	72
5000	350/26	836	-5.8	-12.6	59
5390	355/26	824	-5.8	-19.3	34
6000	355/26	805	-7.3	-13.2	63
6680	355/25	783	-8.3	-20.3	37
7000	355/22	773	-9.1	-20.8	38
7550	350/19	756	-10.3	-21.6	39
8000	345/16	744	-10.3	-27.5	23
8240	340/16	736	-10.3	-32.7	14
8750	340/16	722	-9.7	-33.0	13
9000	335/16	715	-10.0	-33.3	13
10000	335/17	688	-11.9	-34.1	14
11000	335/20	660	-13.0	-34.3	15
11430	335/22	649	-13.3	-34.5	15
12000	335/25	634	-14.8	-35.1	16
12250	335/25	628	-15.4	-34.4	18
13000	330/23	610	-16.6	-34.9	19
14000	320/25	585	-18.3	-34.8	22

HEIGHT (Ft MSL)	WIND (Deg/Kts)	PRESSURE (mb)	TEMPERATURE (°C)	DEW POINT (°C)	RELATIVE HUMIDITY (%)
15000	320/24	562	-20.0	-35.5	24
15120	320/24	559	-20.2	-35.2	25
16000	295/21	539	-22.0	-38.0	22
17000	280/20	517	-24.0	-41.6	18
18000	290/23	443	-26.6	-46.2	14
18300	295/24	487	-27.1	-47.3	13
19000	310/36	473	-26.5	-46.7	13
20000	320/55	454	-25.6	-46.0	13
20230	320/59	450	-25.3	-48.5	13
21000	320/68	436	-27.0	-46.5	14
22000	320/70	418	-29.1	-48.3	14
23000	320/69	403	-31.3	-49.4	15
23100	320/68	400	-31.6	-49.8	15
25000	315/73	357	-37.0	-53.7	16
26050	315/73	350	-40.0	-56.3	16
30000	310/82	292	-50.0	--	--
30720	310/84	282	-51.8	--	--
32050	310/86	265	-53.6	--	--
32800	310/86	256	-52.1	--	--
33890	310/73	243	-53.8	--	--
35000	310/69	231	-51.5	--	--
35400	310/62	226	-50.7	--	--
37380	305/65	206	-52.7	--	--
38650	300/65	194	-48.6	--	--
40000	290/64	183	-51.7	--	--
40270	290/63	180	-52.1	--	--
43200	290/52	157	-52.1	--	--
45000	290/53	145	-50.5	--	--
45830	290/52	139	-49.5	--	--
50000	295/54	114	-50.3	--	--
52950	295/60	100	-50.8	--	--
55000	300/54	91	-50.7	--	--
60000	285/31	72	-50.4	--	--
65000	270/24	57	-50.2	--	--
70000	245/18	45	-50.0	--	--
70440	245/19	44	-50.0	--	--
74140	255/20	37	-47.6	--	--
75000	260/22	36	-47.4	--	--
80000	280/33	28	-46.7	--	--
80970	280/30	27	-46.5	--	--
85000	265/22	22	-48.0	--	--
87400	255/23	20	-48.6	--	--

MILROW METEOROLOGICAL DATA

SUPPLEMENTARY WINDS ALOFT
DATA (Degrees and Knots) : October 1, 2, 1969

Observational Point : AMCHITKA ISLAND, ALASKA (NORTHWEST CAMP)

		10/1	10/2			
Time of Ob. (BDT)		2000	0200	0400	0500	0600
Type of Measurement		RAWIN	RAWIN	PIBAL	PIBAL	PIBAL
H	Surface	360/28	360/30	350/30	360/25	350/20
E	1000	360/28	360/33	350/31	360/25	350/23
I	2000	360/34	360/40	300/43	350/30	350/32
G	3000	010/36	360/39	300/46	350/35	350/29
H	4000	010/32	360/32	310/35	350/41	350/29
T	5000	010/33	020/33	310/35	350/49	350/28
	6000	010/36	360/33	310/37	--	350/28
	7000	010/34	350/34	310/35		350/32
(Ft MSL)	8000	010/32	350/33	310/35		350/34
	9000	010/33	340/31	310/31		--
	10000	010/35	340/32	320/25		

MILROW METEOROLOGICAL DATA

SUPPLEMENTARY WINDS ALOFT
DATA (Degrees and Knots) : October 2, 1969

Observational Point : AMCHITKA ISLAND, ALASKA (NORTHWEST CAMP)

HEIGHT (Ft MSL)	0700	0800	0900	1000	1110
Type of Measurement	PIBAL	RAWIN	PIBAL	PIBAL	PIBAL
Surface	350/20	340/20	340/20	330/18	350/21
1000	350/20	340/23	340/23	340/23	350/32
2000	350/25	350/25	350/36	350/30	350/26
3000	350/33	350/26	350/29	350/32	350/31
4000	350/35	350/29	350/31	350/30	360/27
5000	350/33	350/31	350/31	350/23	350/24
6000	350/29	350/30	350/31	350/19	350/20
7000	330/29	350/32	340/31	340/18	350/18
8000	350/30	350/31	340/31	340/21	--
9000	--	350/27	340/29	--	
10000		350/29	340/26		
11000		340/29	--		
12000		340/25			
13000		340/23			
14000		330/21			
15000		330/24			
16000		340/26			
17000		330/28			
18000		330/28			
19000		330/25			
20000		320/24			
21000		320/23			
22000		320/22			
23000		310/22			

MILROW METEOROLOGICAL DATA

SUPPLEMENTARY WINDS ALOFT
DATA (Degrees and Knots) : October 2, 3, 1969

Observational Point : AMCHITKA ISLAND, ALASKA (NORTHWEST CAMP)

Time of Ob. (BDT)	:	1145	1300	1400	1710
Type of Measurement	:	RAWIN	PIBAL	PIBAL	PIBAL
H	Surface	350/21	010/20	340/20	360/15
E	1000	360/21	360/24	340/21	360/16
I	2000	360/23	360/31	360/26	360/13
G	3000	350/24	360/30	350/24	360/12
H	4000	350/25	360/27	350/21	360/11
T	5000	350/26	360/23	350/21	360/11
	6000	350/25	360/22	350/21	360/11
	7000	--	--	--	360/11
	8000				--
	9000				
	10000				
	11000				
(Ft MSL)	12000				
	13000				
	14000				
	15000				
	16000				
	17000				
	18000				
	19000				
	20000				

MILROW METEOROLOGICAL DATA

SUPPLEMENTARY WINDS ALOFT
DATA (Degrees and Knots) : October 2, 3, 1969

Observational Point : AMCHITKA ISLAND, ALASKA (NORTHWEST CAMP) (CONTINUED)

Time of Ob. (BDT)		:	2000	10/3 0200
Type of Measurement		:	RAWIN	RAWIN
H	Surface		020/08	120/06
E	1000		020/09	135/08
I	2000		015/11	155/15
G	3000		010/10	160/15
H	4000		360/08	155/10
T	5000		020/12	140/08
	6000		030/18	135/09
	7000		030/18	150/10
	8000		030/17	180/09
	9000		020/15	210/10
	10000		010/19	210/12
	11000		340/12	230/15
(Ft MSL)	12000		310/14	250/22
	13000		300/18	250/27
	14000		300/24	250/28
	15000		300/29	250/28
	16000		280/32	250/29
	17000		270/30	250/31
	18000		270/25	250/34
	19000		260/22	250/35
	20000		260/23	250/36

MILROW METEOROLOGICAL DATA

SUPPLEMENTARY WINDS ALOFT
DATA (Degrees and Knots) : October 1, 2, 1969

Observational Point : ADAK, ALASKA

		10/1	10/2		
Time of Ob. (BDT)	:	1400	0200	0500	0800
Type of Measurement	:	RAWIN	RAWIN	RAWIN	RAWIN
H	Surface	045/10	010/16	350/22	340/23
E	1000	050/24	010/37	350/43	345/48
I	2000	050/39	015/37	355/41	350/55
G	3000	060/33	015/39	360/37	350/52
H	4000	070/25	020/37	355/37	350/42
T	5000	075/28	020/37	355/37	350/41
	6000	105/12	025/39	355/37	360/41
	7000	080/10	025/49	360/17	360/44
(Ft MSL)	8000	040/07	025/52	360/33	360/45
	9000	040/09	020/39	355/43	355/47
	10000	040/10	020/35	355/43	355/47

Time of Ob. (BDT)	:	1100	1400
Type of Measurement	:	RAWIN	RAWIN
H	Surface	340/23	360/20
E	1000	345/48	355/35
I	2000	340/55	355/39
G	3000	350/52	360/37
H	4000	010/29	010/34
T	5000	350/42	010/35
	6000	360/41	010/37
	7000	360/44	010/37
(Ft MSL)	8000	360/45	010/40
	9000	355/47	010/42
	10000	355/48	010/41

MILROW METEOROLOGICAL DATA

SUPPLEMENTARY WINDS ALOFT
DATA (Degrees and Knots) : October 1, 2, 1969

Observational Point : SHEMYA, ALASKA

		10/1	10/2		
Time of Ob. (BDT)		1400	0200	0500	0800
Time of Measurement		RAWIN	RAWIN	RAWIN	RAWIN
H	Surface	360/25	350/18	350/16	350/12
E	1000	010/25	360/26	350/21	350/15
I	2000	010/33	360/26	350/21	360/18
G	3000	020/35	360/29	350/26	360/17
H	4000	020/35	350/28	350/23	350/17
T	5000	020/31	350/26	355/22	355/19
	6000	030/25	350/24	360/24	355/17
	7000	020/31	350/23	005/20	360/18
	8000	030/28	350/22	005/19	360/16
	9000	030/29	360/28	005/21	360/20
	10000	030/31	005/31	355/23	005/22
	11000	--	--	--	--
(Ft MSL)	12000				
	13000				
	14000				
	15000				

Time of Ob. (BDT)		1100	1400
Type of Measurement		RAWIN	RAWIN
H	Surface	020/08	CALM
E	1000	020/08	045/04
I	2000	015/11	060/04
G	3000	015/12	015/03
H	4000	020/09	095/03
T	5000	020/10	165/02
	6000	010/10	330/01
	7000	010/12	005/01
	8000	005/12	015/02
	9000	360/13	350/05
	10000	350/15	345/04
	11000	335/11	330/06
(Ft MSL)	12000	330/15	320/10
	13000	330/21	310/16
	14000	310/20	305/25
	15000	305/23	300/34

MILROW METEOROLOGICAL DATA

SUPPLEMENTARY WIND DATA
(Degrees/Knots) : October 2, 1969

TOWER		: GZ	MAIN CAMP TOWER #2	MILE 29.5 TOWER #3
TOWER Ht. (Ft.Abv.Sfc.) :		6'	88'	88'
T	0000	350/18	230/24	330/36
	0100	360/18	280/24	320/34
I	0200	350/17	340/24	330/39
	0300	350/19	340/24	330/40
M	0400	350/19	280/23	330/39
	0500	350/19	340/20	330/34
E	0600	350/21	350/26	320/37
	0700	340/18	340/21	310/35
	0800	340/19	340/21	320/29
	0900	340/18	340/21	320/34
	1000	340/17	340/25	330/32
	1100	340/19	340/24	320/28
	1115	340/17	340/22	320/25
	1130	340/17	340/22	320/27
	1145	350/17	330/21	320/29
(BDT)	1200	350/20	340/22	330/31
	1215	350/19	340/24	330/33
	1230	350/19	340/23	330/30
	1245	350/18	340/23	330/31
	1300	350/18	340/24	330/30
	1400	350/19	340/20	330/24
	1500	340/17	340/21	320/19
	1600	340/16	340/19	320/13
	1700	350/15	330/13	320/13
	1800	350/12	340/13	330/10
	1900	350/08	340/10	330/09
	2000	340/04	340/07	340/09
	2100	320/24	340/05	340/07
	2200	280/03	350/04	340/04
	2300	280/04	340/02	360/05

HOURLY WEATHER AMCHITKA, ALASKA (NW CAMP)
October 2, 1969

TIME (BDT)	Sky Condition*	Visi-bility (mi)	Weather and Obstructions to Vision	Sea Level Pressure (mb)	Temp. (°F)	Dew Point Temp (°F)	Wind Dir. (deg)	Wind Spd. (kt)
0800	Estimated 2500' Broken	10		**1004.8	40	36	340	22
0900	1000' Scattered Estimated 2500' Broken	10		**1005.1	40	36	340	20
1000	2500' Scattered	10		**1005.5	41	36	340	21
1100	2500' Scattered	10	Very light Rain Showers	**1005.8	43	38	340	25
1200	Estimated 2500' Broken	10		**1006.2	44	38	340	21
1300	2500' Scattered	10		**1005.8	44	40	340	22
1400	2500' Scattered High Scattered	10		**1006.2	46	40	350	23
1500	1500' Scattered 2500' Scattered High Thin Broken	10		**1006.4	45	39	330	19

*Scattered -- 1/10-5/10 Sky Cover
Broken -- 6/10-9/10 Sky Cover
Overcast -- 10/10 Sky Cover
**Estimated From Station Pressure

HOURLY WEATHER ADAK, ALASKA
October 2, 1969

TIME (BDT)	Sky Condition*	Visibility (mi)	Weather and Obstructions to Vision	Sea Level Pressure (mb)	Temp. (°F)	Dew Point Temp. (°F)	Wind Dir. (deg)	Wind Spd. (kt)
0900	Estimated 2000' Broken 8000' Broken	7		999.4	44	38	350	20 Gusts to 30
1000	1000' Scattered Estimated 2200' Broken 8000' Broken	7		999.9	46	38	350	20 Gusts to 27
1100	1500' Scattered Estimated 2500' Broken 8000' Broken	7		1000.6	47	39	350	20 Gusts to 29
1200	1500' Scattered Estimated 2500' Broken	10		1000.9	48	40	360	22 Gusts to 29
1300	Estimated 2500' Broken High Broken	10		1001.3	50	38	360	22 Gusts to 31
1400	2500' Scattered Unknown Broken	10		1001.5	50	38	360	20 Gusts to 32
1500	Estimated 2500' Broken High Broken	10		1002.1	50	37	350	20 Gusts to 34

*Scattered -- 1/10-5/10 Sky Cover
Broken -- 6/10-9/10 Sky Cover
Overcast -- 10/10 Sky Cover

HOURLY WEATHER SHEMYA, ALASKA
October 2, 1969

TIME (BDT)	Sky Condition*	Visibility (mi)	Weather and Obstructions to Vision	Sea Level Pressure (mb)	Temp. (°F)	Dew Point Temp. (°F)	Wind Dir. (deg)	Wind Spd. (kt)
0900	1500' Scattered	40		1014.9	44	37	360	14
1000	2500' Scattered 10,000' Scattered	40		1014.6	46	38	010	13
1100	Estimated 2500' Broken High Broken	35		1014.6	46	37	020	08
1200	Measured 3000' Broken High Broken	50		1014.2	47	37	020	09
1300	Estimated 3000' Broken High Broken	50		1013.5	47	35	050	05
1400	Estimated 3000' Broken High Overcast	50		1013.5	48	37	CALM	CALM
1500	2700' Scattered Unknown Overcast	50		1012.9	47	35	160	07

*Scattered -- 1/10-5/10 Sky Cover
Broken -- 6/10-9/10 Sky Cover
Overcast -- 10/10 Sky Cover

DISTRIBUTION LIST

No. Copies	
50	Technical Information Branch, AEC, NVOO.
9	Technical Support Division, AEC, NVOO.
2	Test Manager, AEC, NVOO.