

**BY ORDER OF THE COMMANDER
45TH SPACE WING**

45TH SPACE WING INSTRUCTION 15-101

26 MARCH 2012



Weather

WEATHER SUPPORT

COMPLIANCE WITH THIS PUBLICATION IS MANDATORY

ACCESSIBILITY: Publications and forms are available on the e-Publishing website at www.e-publishing.af.mil for downloading or ordering.

RELEASABILITY: There are no releasability restrictions on this publication.

OPR: 45 WS/DO

Certified by: 45 WS/CC
(Col Elizabeth B. Borelli)

Supersedes: 45 SWI 15-101,
1 August 2008

Pages: 86

This instruction implements Air Force Policy Directive (AFPD) 15-1, *Atmospheric and Space Environmental Support*; Air Force Instruction (AFI) 10-229, *Responding to Severe Weather Events*; AFI 15-114, *Functional Resource and Weather Technical Performance Evaluation*; AFI 15-128, *Air and Space Weather Operations – Roles and Responsibilities*; Air Force Manual (AFMAN) 15-111, *Surface Weather Observations*; AFMAN 15-124, *Meteorological Codes*; and, AFMAN 15-129, *Air and Space Weather Operations – Processes and Procedures*. It establishes responsibilities and weather support procedures. It provides general information for weather services, including weather observations and forecasts; weather warnings, watches, and advisories; space weather supported services and dissemination of information and reciprocal support. It applies to units assigned to the 45th Space Wing (45 SW) and subordinate units, and units assigned or attached to, or supported by Patrick Air Force Base (PAFB) to include the Kennedy Space Center (KSC) and Cape Canaveral Air Force Station (CCAFS). Refer recommended changes and questions about this publication to the Office of Primary Responsibility (OPR) using the AF Form 847, *Recommendation for Change of Publication*; route AF Form 847s from the field through Major Command (MAJCOM) publications/forms managers. Ensure that all records created as a result of processes prescribed in this publication are maintained in accordance with Air Force Manual (AFMAN) 33-363, *Management of Records*, and disposed of in accordance with (IAW) Air Force Records Information Management Systems (AFRIMS) Records Disposition Schedule (RDS) located at <https://www.myaf.mil/afirms/afirms/afirms/rims.cfm>.

SUMMARY OF CHANGES

This document has been substantially revised and must be completely reviewed. Major changes include the change to automated observing procedures at Patrick AFB, replacing the New Tactical Forecast System (NTFS) with the Joint Environmental Toolkit (JET), adding support to the Customs and Border Protection Department and the deletion of support to Joint Surveillance Target Attack Radar System.

CHAPTER 1—CAPABILITIES	7
1.1. General.	7
1.2. Concept of Operation.	7
1.3. Operational Sensor Suite.	7
1.4. Operational Support Requirements.	8
CHAPTER 2—OBSERVING SERVICES	9
2.1. General.	9
2.2. Surface Observations.	9
Table 2.1. Hourly and Special.	10
2.3. Patrick AFB (KCOF) Surface Observations.	10
Table 2.2. Hourly Observations.	10
Table 2.3. A Ceiling Decreases to Less Than or Increases to Equal or Exceed.	11
Table 2.4. Prevailing Visibility Decreases to Less Than or if Below Increases to Equal or Exceed (in Statute Miles).	11
Table 2.5. Highest Value During the Preceding 10 Minutes from the Designated RVR Runway Decreases to Less Than or if Below Increases to Equal or Exceed.	12
2.4. CCAFS (KXMR) Surface Observations.	12
Table 2.6. Hourly Observations.	13
Table 2.7. Ceiling Decreases to Less Than or Increases to Equal or Exceed.	13
Table 2.8. Prevailing Visibility Decreases to Less Than or if Below Increases to Equal or Exceed.	14
Table 2.9. Highest RVR Value During the Preceding 10 Minutes from the Designated RVR Runway Decreases to Less Than or if Below Increases to Equal or Exceed.	14
2.5. KSC - Shuttle Landing Facility (KTTS).	15
Table 2.10. Space Shuttle Operations, Observations are Taken as Follows.	15
Table 2.11. Hourly Observations Include.	15
Table 2.12. Ceiling Decreases to Less Than or Increases to Equal or Exceed.	16

Table 2.13.	Prevailing SLF Visibility Decreases to Less Than or if Below Increases to Equal or Exceed.	16
2.6.	Cooperative Weather Watch Program (CWW).	18
2.7.	Aircraft Mishaps.	18
2.8.	Upper Air Observations.	18

CHAPTER 3—FORECASTING 19

3.1.	General.	19
3.2.	Terminal Aerodrome Forecasts.	20
Table 3.1.	Ceiling/Visibility Categories.	20
Table 3.2.	Specification Criteria Thresholds for PAFB TAFs.	21
Table 3.3.	Ceiling/Visibility Categories.	21
Table 3.4.	An Increase in Ceiling or Visibility to Equal or Exceed or a Decrease in Ceiling or Visibility to Less Than.	22
3.3.	Planning Forecasts.	22
3.4.	Launch Forecast.	23
3.5.	Aircrew Support.	23
3.6.	Fit-To-Fight Weather.	24
3.7.	Tropical Storm/Hurricane Support.	24
Table 3.5.	HURCON Levels.	24
3.8.	Severe Weather Actions Procedures.	24
3.9.	Staff Meteorological Functions.	24
3.10.	Meteorological Consulting/Advising Services.	25
3.11.	Research Support.	25

CHAPTER 4—METEOROLOGICAL WATCH SUPPORT 26

4.1.	Meteorological Watch (METWATCH) Program.	26
4.2.	Patrick AFB METWATCH Products.	27
Table 4.1.	Patrick AFB METWATCH Criteria and Desired Lead Times.	27
4.3.	CCAFS METWATCH Products.	28
Table 4.2.	CCAFS METWATCH Criteria and Desired Lead Times.	28
4.4.	Port METWATCH Product.	28
Table 4.3.	Port METWATCH Criteria and Desired Lead Times.	29
4.5.	KSC METWATCH Products.	29
Table 4.4.	KSC METWATCH Criteria and Desired Lead Times.	29

	4.6.	Astrotech METWATCH Products.	30
Table	4.5.	Astrotech METWATCH Criteria and Desired Lead Times.	30
	4.7.	Malabar Support.	30
Table	4.6.	Malabar METWATCH Criteria and Desired Lead Times.	30
	4.8.	Astrotech, Cape Canaveral (Spacehab Payload Processing Facility).	30
	4.9.	National Airborne Operation Center (NAOC) Support.	30
Table	4.7.	NAOC METWATCH Criteria and Desired Lead Times.	31
	4.10.	METWATCH Dissemination System.	31

CHAPTER 5—CUSTOMER THRESHOLDS AND REQUIREMENTS 33

	5.1.	General.	33
	5.2.	The 45th Space Wing (45 SW).	33
	5.3.	The 45th Space Wing Safety (45 SW/SE).	33
	5.4.	The 45th Space Wing Inspector General (45 SW/IG).	34
	5.5.	The 45th Space Wing Public Affairs (45 SW/PA).	34
	5.6.	The 45th Space Communications Squadron (45 SCS).	34
Table	5.1.	SCS Critical Weather Thresholds.	34
	5.7.	The 45th Operations Support Squadron (45 OSS).	34
	5.8.	The 45th Contracting Squadron (45 CONS).	35
	5.9.	The 45th Civil Engineering Squadron (45 CES).	35
Table	5.2.	The 45 CES Critical Weather Thresholds.	35
	5.10.	The 45th Force Support Squadron (45 FSS).	35
Table	5.3.	FSS Critical Weather Thresholds.	36
	5.11.	The 39th Rescue Squadron (39 RQS).	36
	5.12.	The 301 Rescue Squadron (301 RQS).	36
Table	5.4.	The 39 RQS Critical Weather Thresholds.	37
	5.13.	Customs and Border Protection (CBP) Department of Homeland Security.	38
Table	5.5.	The 301 RQS Critical Weather Thresholds.	38
Table	5.6.	CBP Critical Weather Thresholds.	39
	5.14.	Department of State.	39
Table	5.7.	Department of State Critical Weather Thresholds.	40
	5.15.	IOMS / Cape Support Duty Office.	40
Table	5.8.	IOMS / Cape Support Duty Office Critical Weather Thresholds.	41
	5.16.	Computer Sciences Raytheon (CSR).	41

Table	5.9.	CSR Critical Weather Thresholds.	42
	5.17.	Space Coast Launch Services (SCLS).	42
Table	5.10.	SCLS Critical Weather Threshold.	42
	5.18.	Astrotech, Cape Canaveral (Spacehab Payload Processing Facility).	43
Table	5.11.	SPACEHAB Critical Weather Thresholds.	43
	5.19.	Office of Space Launch (OSL), Det 1.	43
Table	5.12.	OSL, Det 1 Critical Weather Thresholds.	43
	5.20.	NASA Support.	44
	5.21.	Department of Energy.	46
	5.22.	Human Space Flight Support (HSFS).	46
	5.23.	The 114th Range Operations Squadron, ANG.	47

CHAPTER 6—LAUNCH WEATHER SUPPORT 48

	6.1.	General.	48
	6.2.	Atlas V.	48
	6.3.	Delta II.	48
	6.4.	Falcon 9.	48
	6.5.	Pegasus launch vehicle is launched from a modified L-1011 aircraft.	48
	6.6.	Space Shuttle.	49
	6.7.	Trident II.	49
	6.8.	New Launch Systems.	49
	6.9.	Range Safety Natural and Triggered Lightning Launch Commit Criteria (LCC).	49
	6.10.	Execution.	49

CHAPTER 7—RECIPROCAL SUPPORT 51

	7.1.	General.	51
	7.2.	The 45th Space Wing Commander.	51
	7.3.	The 45th Space Command Post (45 SW/CP).	51
	7.4.	The 1st Range Operations Squadron (1 ROPS).	51
	7.5.	The 45th Operations Support Squadron.	51
	7.6.	The 45th Space Communications Squadron (45 SCS).	52
Table	7.1.	Multiple Observing Outages, the Following Priority Will Be Used for Restoral, Subject to Change Under Unusual Weather Conditions.	52
	7.7.	The 45th Range Management Squadron (45 RMS).	53
	7.8.	The 45th Force Support Squadron.	53

7.9. NASA.	54
7.10. RTSC Responsibilities:	55
Attachment 1—GLOSSARY OF REFERENCES AND SUPPORTING INFORMATION	56
Attachment 2—EXAMPLE PATRICK AFB AND SHUTTLE LANDING FACILITY TAFS	65
Attachment 3—24-HOUR PLANNING FORECAST	66
Attachment 4—SEVEN-DAY PLANNING FORECAST	67
Attachment 5—AVON PARK TRAINING AREA AND DROP ZONES	68
Attachment 6—AVON PARK FLIMSY	69
Attachment 7—DAY-OF-LAUNCH FORECAST	70
Attachment 8—DD FORM 175-1 EXAMPLE	71
Attachment 9—MISSION EXECUTION FORECAST (MEF) EXAMPLE	72
Attachment 10—PATRICK AFB METWATCH AREAS	73
Attachment 11—PATRICK AFB METWATCH PRODUCTS	74
Attachment 12—CCAFS LIGHTNING WATCH AND WARNING LOCATIONS	75
Attachment 13—KSC LIGHTNING WATCH AND WARNING LOCATIONS	76
Attachment 14—PATRICK AFB WEATHER WATCH, WARNING AND ADVISORY DISSEMINATION PYRAMID	77
Attachment 15—CCAFS WEATHER WATCH, WARNING AND ADVISORY DISSEMINATION PYRAMID	79
Attachment 16—KSC WEATHER WATCH, WARNING AND ADVISORY DISSEMINATION PYRAMID	80
Attachment 17—LIGHTNING LAUNCH COMMIT CRITERIA	81

Chapter 1

CAPABILITIES

1.1. General. The purpose of this instruction is to bring together all the services provided by the 45th Weather Squadron (45 WS) to all customers within the Cape Canaveral Spaceport. Basic support concepts and procedures are outlined in this instruction along with Air Force and Air Force Space Command directives, the Range Universal Documentation System (UDS) and the 45 SW Operation Instructions (OI) for Range Support.

1.2. Concept of Operation. The 45 WS provides or arranges weather support to personnel and organizations of the 45 SW, tenant units and all Eastern Range (ER) users. They provide a full spectrum of meteorological products and services to customers including PAFB, CCAFS, National Aeronautics and Space Administration – Kennedy Space Center (NASA-KSC), Human Spaceflight Support (HSFS), Jonathan Dickenson Missile Tracking Annex (JDMTA), Malabar Complex, Detachment 1, 45th Operations Group (OG) Antigua Air Station, Antigua Island, Detachment 2, 45 OG, Ascension Auxiliary Airfield, Ascension Island and Argentina, Newfoundland. General services provided to 45 WS customers include surface observations, upper air observations, forecasts, meteorological watch bulletins, and unique or specialized weather support. Support requirements not covered in this instruction must be coordinated between the user and 45 WS Director of Operations (45 WS/DO) with as much advance notice as possible.

1.2.1. The 45 WS is composed of two divisions focused on different aspects of the mission. The operations division deals with weather support to the customer. The Range Weather Operations Center, (RWOC), provides operational support from the Morrell Operations Center (MOC) at CCAFS. The systems division (SY), located at PAFB, is responsible for weather system requirements, scientific research and resource management. The 45 WS provides airfield weather services for PAFB and the CCAFS Skid Strip. These services include airfield weather observation data PAFB and CCAFS Skid Strip, which is provided by the FMQ-19 Automated Observing Systems.

1.2.2. The Eastern Range Technical Services Contract (ERTSC) provides observation data for selected KSC locations and is responsible for the operations and maintenance of specific meteorological equipment at specified ER and KSC locations, as identified in the ERTSC Statement of Work. In addition, the ERTSC contractor provides airfield weather services for the KSC Shuttle Landing Facility (SLF).

1.2.3. The Applied Meteorology Unit (AMU) is co-located with the RWOC and consists of a NASA-funded team of contractors and NASA atmospheric scientists created to support three participating organizations: National Weather Service (NWS), NASA and the USAF. The AMU's mission is to provide weather support enhancements that safely increase space flight launch and landing opportunities and the productivity of associated ground processing operations, and reduce weather support system life-cycle costs.

1.3. Operational Sensor Suite. To fulfill the weather support mission, the ER operates and maintains an extensive suite of weather sensors and systems to ingest, process, manage, distribute, and archive meteorological information from local sensors, as well as national, international, and satellite sources. Most of the equipment located on the ER is described in the

ER Instrumentation Handbook - Weather Systems. The majority of these systems are operated and maintained by the 45 SW, but the ER also uses data from instrumentation sources operated and maintained by other government agencies, including NASA, NWS, other USAF agencies, and the National Oceanographic and Atmospheric Administration (NOAA). Due to the diversity of specialized systems and number of active sensors, the ER meteorological equipment suite represents one of the largest concentrations of meteorological instrumentation in the world. The density of sensors, combined with state of the art technology and 24-hour data collection, provides a multitude of specialized measurements that help the USAF and its launch customers successfully complete their missions in a variety of weather conditions.

1.4. Operational Support Requirements. Supported agencies will:

- 1.4.1. Coordinate support requirements not covered in this plan with the 45 WS/DO as far in advance as possible.
- 1.4.2. Ensure 45 WS is informed of critical weather elements affecting their operations.
- 1.4.3. Ensure procedures are established within their organization to adequately respond to disseminated weather information.
- 1.4.4. Review this instruction at least annually for any changes in support requirements.

Chapter 2

OBSERVING SERVICES

2.1. General. The 45 WS maintains an automated surface weather observing capability at PAFB and CCAFS Skid Strip. Contract weather observers are employed at the KSC SLF control tower. PAFB and CCAFS have operational FMQ-19 Automated Observing Systems (AOS) which report meteorological conditions 24-hours per day. Contract employees under the ERTSC also provide upper air observations from the CCAFS Balloon Facility (Bldg # 20185). A variety of weather balloons are released to acquire wind, temperature, pressure, and humidity data to support ER operations. Other observational data are generated by an instrumented tower system, wind profilers, and several lightning detection and radar systems located on and around CCAFS, NASA-KSC, and PAFB.

2.1.1. Airfield Weather Sensor Limitations. The FMQ-19 AOS is the primary instrument for measuring atmospheric conditions. The system has the following inherent limitations:

2.1.1.1. Wind gust spread is not reported.

2.1.1.2. Only three cloud layers are reported.

2.1.1.3. Cloud layers above 25,000 ft are not reported.

2.1.1.4. Cloud cover or amount is determined using weighted readings over a 30 minute period. This results in an underestimation of cloud amount when a new layer moves over the system and an overestimation of cloud amount as a cloud layer moves away from the sensor.

2.1.1.5. Visibility is determined by averaging one minute readings over a 10 minute time period.

2.1.1.6. Runway Visual Range (RVR) is determined by averaging one-minute readings over a 10 minute time period.

2.1.1.7. The FMQ-19 is unable to detect hail, volcanic ash and tornadoes.

2.2. Surface Observations. Observing procedures for all locations are accomplished IAW standards established in AFMAN 15-111. Contract weather observers at the SLF maintain a Basic Weather Watch by rechecking weather conditions at intervals not to exceed 20 minutes since the last observation/recheck. This is done to determine the need for a special or local observation.

2.2.1. Examples of Surface Observations. 45 WS provides training to those units with New Tactical Forecast System (N-TFS) or Joint Environmental Toolkit (JET) monitors for explanations and format breakdowns.

2.2.1.1. Hourly and Special.

Table 2.1. Hourly and Special.

METAR KCOF 121355Z AUTO 32015KT 10SM CLR 06/01 A3034 RMK AO2 SLP275 T00570013
SPECI KCOF 120535Z AUTO 36011KT 10SM BKN009 11/10 A3023 RMK AO2 CIG 009V012 BKN V OVC SLP239

2.3. Patrick AFB (KCOF) Surface Observations. The Base Weather Station (BWS) located in building 820, is not manned. The FMQ-19 AOS operates continuously to provide weather observations. The FMQ-19 AOS system is located on Runway 02 at the 1065ft mark and on Runway 20 at the 1024ft mark. In the event of a system or sensor failure, 45 WS personnel will augment observations during the hours the airfield is open. Augmented (manual) observations will also be performed in the event of forecasted severe weather ($\frac{3}{4}$ " hail, tornadoes), which the FMQ-19 cannot detect. The location for taking manual weather observations is about 200 feet west of Building 820. From this point, the observer's view is limited NNE – ESE; however, the weather observing tower located adjacent to the point of observation provides a full view of that segment.

2.3.1. KCOF Observer Duty Priorities. During periods when the FMQ-19 is augmented, the following duty priorities will be followed:

2.3.1.1. Emergency war orders.

2.3.1.2. Execute evacuation.

2.3.1.3. Respond to aircraft/ground emergencies.

2.3.1.4. Provide "Eyes Forward" / Collaborate with RWOC.

2.3.1.5. Disseminate surface observations.

2.3.1.6. Answer operational phone calls and provide other weather information to customers.

2.3.2. Hourly Observations. Hourly observations include:

Table 2.2. Hourly Observations.

Type of observation (Standard Hourly: METAR)
Location Identifier
Date and time of observation in Universal Coordinated Time (UTC)
Automatic Observation Indicator (AUTO)
Wind direction and speed (kt)
Prevailing visibility
Present weather
Ceiling and sky condition (hundreds of feet)
Temperature and dew point (°C)
Altimeter setting (inches)
Plain language and coded remarks

2.3.3. SPECI. Special (SPECI) observations are taken to report significant changes in weather elements and will not necessarily include criteria. SPECIs are taken at PAFB when existing weather conditions change IAW the criteria listed below.

2.3.3.1. A ceiling decreases to less than or increases to equal or exceed:

Table 2.3. A Ceiling Decreases to Less Than or Increases to Equal or Exceed.

3000 feet (AFMAN 15-111)
1500 feet (AFMAN 15-111)
1000 feet (AFMAN 15-111)
800 feet (AFMAN 15-111) (ILS Localizer Critical Area)
700 feet (AFMAN 15-111)
600 feet (Flight Information Publication (FLIP))
500 feet (AFMAN 15-111, FLIP)
400 feet (FLIP)
300 feet (FLIP)
200 feet (Helicopter Ops Min for 301st Rescue Squadron)

2.3.3.2. Sky Condition (AFMAN 15-111): A layer of clouds or obscuring phenomena aloft is detected below 600 feet and no layer was reported below 600 feet on the preceding observation.

2.3.3.3. The prevailing visibility decreases to less than or, if below, increases to equal or exceed (in statute miles):

Table 2.4. Prevailing Visibility Decreases to Less Than or if Below Increases to Equal or Exceed (in Statute Miles).

3 miles (AFMAN 15-111)
2 miles (AFMAN 15-111, FLIP)
1½ miles (FLIP)
1¼ miles (FLIP)
1 mile (AFMAN 15-111, FLIP)
¾ mile (FLIP)
½ mile (Helicopter Ops Min for 301st Rescue Squadron)

2.3.3.4. A tornado, funnel cloud, or waterspout is observed or disappears from sight. Single element specials are authorized for these criteria (AFMAN 15-111).

2.3.3.5. A thunderstorm either begins or ends (AFMAN 15-111). No special is required when a new thunderstorm begins if one is currently being reported.

Note: A thunderstorm is not considered to have ended until 15 minutes after the last occurrence of criteria for a thunderstorm (i.e., thunder and lightning) is detected.

2.3.3.6. Precipitation begins or ends (AFMAN 15-111).

2.3.3.7. Hail begins or ends (AFMAN 15-111).

2.3.3.8. Freezing precipitation or ice pellets begin, end, or change in intensity (AFMAN 15-111).

2.3.3.9. Wind and wind shifts (AFMAN 15-111):

2.3.3.9.1. The wind speed suddenly increases by at least 16 knots and is sustained at 22 knots or more for at least a minute (squall).

2.3.3.9.2. Any wind direction change of 45 degrees or more in less than 15 minutes when the sustained wind speed throughout the shift is 10 knots or more.

2.3.3.10. Within 15 minutes after returning to duty following a break in hourly coverage if a surface aviation routine weather report (METAR) observation was not filed as scheduled during that 15-minute period (AFMAN 15-111).

2.3.3.11. Whenever volcanic ash is observed (AFMAN 15-111).

2.3.3.12. Any other meteorological situation occurs which may be critical to the safety of aircraft operations (AFMAN 15-111).

2.3.3.13. The highest value during the preceding 10 minutes from the designated RVR runway decreases to less than, or if below, increases to equal or exceed:

Table 2.5. Highest Value During the Preceding 10 Minutes from the Designated RVR Runway Decreases to Less Than or if Below Increases to Equal or Exceed.

6000 feet (FLIP)
5000 feet (FLIP)
4000 feet (FLIP)
2400 feet (AFMAN 15-111)
2000 feet AFMAN 15-111)

2.3.4. Dissemination. Observations are disseminated locally and longline over the New Tactical Forecast System (N-TFS), or the Joint Environmental Toolkit (JET) to a number of agencies. In the event of an N-TFS/JET outage, the forecaster located at CCAFS will disseminate weather information to the air traffic control (ATC) tower via telephone.

2.3.5. Patrick AFB Alternate Observing Site. The Alternate Observing Site at PAFB is in Building 629, located northeast of the approximate center point of runway 02/20. From this alternate location, the observer’s view is limited from SE-SW-NW-N. The observer will rely on reports from ATC tower controllers to assist in observing weather approaching from those directions. Pressure and wind data are estimated while the Alternate Observing Site is utilized.

2.4. CCAFS (KXMR) Surface Observations. The FMQ-19 AOS operates continuously to provide weather observations. In the event of a system or sensor failure, 45 WS personnel will augment observations during the hours the airfield is open. Augmented (manual) observations will also be performed in the event of forecasted severe weather (¾” hail, tornadoes) which is undetectable by the automated system. The FMQ-19 system is located on Runway 13 at the 1480ft mark and on Runway 31 at the 1550ft mark.

2.4.1. CCAFS Observer Duty Priorities. During periods when the FMQ-19 is augmented, the following duty priorities will be followed:

2.4.1.1. Emergency war orders.

2.4.1.2. Execute evacuation.

2.4.1.3. Respond to aircraft/ground emergencies.

2.4.1.4. Provide “Eyes Forward” / Collaborate with RWO.

2.4.1.5. Disseminate surface observations.

2.4.1.6. Answer operational phone calls and provide other weather information to customers.

2.4.2. Hourly Observations. Hourly observations include:

Table 2.6. Hourly Observations.

Type of observation (Standard Hourly: METAR)
Location Identifier
Date and time of observation in Universal Coordinated Time (UTC)
Automatic Observation Indicator (AUTO)
Wind direction and speed (kt)
Prevailing visibility
Present weather
Ceiling and sky condition (hundreds of feet)
Temperature and dew point (°C)
Altimeter setting (inches)
Plain language and coded remarks

2.4.3. SPECI. SPECIs are taken at the Skid Strip when existing weather conditions change IAW the criteria listed below.

2.4.3.1. Cloud ceiling: Ceiling decreases to less than or increases to equal or exceed:

Table 2.7. Ceiling Decreases to Less Than or Increases to Equal or Exceed.

3000 feet (AFMAN 15-111)
1500 feet (AFMAN 15-111)
1000 feet (AFMAN 15-111)
800 feet (FLIP)
700 feet (AFMAN 15-111)
600 feet (FLIP)
500 feet (AFMAN 15-111)

2.4.3.2. Sky conditions (AFMAN 15-111): Any layer of clouds or obscuring condition aloft is observed below 600 feet and no layer was reported below 600 feet on the preceding observation.

2.4.3.3. Visibility: Prevailing visibility decreases to less than or, if below, increases to equal or exceed:

Table 2.8. Prevailing Visibility Decreases to Less Than or if Below Increases to Equal or Exceed.

3 miles (AFMAN 15-111)
2 ¾ miles (FLIP)
2 ½ miles (FLIP)
2 ¼ miles (FLIP)
2 miles (AFMAN 15-111, FLIP)
1 ¾ miles (FLIP)
1 ½ miles (FLIP)
1 ¼ miles (FLIP)
1 mile (AFMAN 15-111, FLIP)

2.4.3.4. Thunderstorm (AFMAN 15-111).

2.4.3.4.1. Begins.

2.4.3.4.2. Ends.

Note: A Thunderstorm is not considered to have ended until 15 minutes after the last occurrence of criteria for a thunderstorm (i.e., thunder is last detected).

2.4.3.5. Precipitation (AFMAN 15-111):

2.4.3.5.1. Begins.

2.4.3.5.2. Ends.

2.4.3.5.3. Freezing precipitation begins, ends or changes in intensity.

2.4.3.6. Wind and wind shifts (AFMAN 15-111):

2.4.3.6.1. Wind speeds increase to at least 16 kts and are sustained at 22 kts or more for at least 1 minute (squall).

2.4.3.6.2. Any wind direction change of 45° or more in less than 15 minutes when the wind speed or gust is 10 kts or more, throughout the wind shift.

2.4.3.7. The highest RVR value during the preceding 10 minutes from the designated RVR runway decreases to less than, or if below, increases to equal or exceed:

Table 2.9. Highest RVR Value During the Preceding 10 Minutes from the Designated RVR Runway Decreases to Less Than or if Below Increases to Equal or Exceed.

6000 feet (AFMAN 15-111)
5000 feet (AFMAN 15-111)
2400 feet (AFMAN 15-111)

2.4.3.8. Report RVR when prevailing visibility is first observed 1 statute mile or less and again when prevailing visibility goes above 1 statute mile.

2.4.4. Outages. During NTFS/JET outages, the forecaster located at CCAFS RWOC will transmit METAR and SPECI observations to Skid Strip Control Tower.

2.4.5. Launch Observations. During launch operations, ERTS contractor personnel take mission-specific weather observations for CCAFS from Weather Station A, Building 20185 (balloon facility). These observations are taken on an as-needed basis and are only disseminated locally. No viewing obstructions exist at this location.

2.5. KSC - Shuttle Landing Facility (KTTS). The RTSC contractor provides daily surface observing support to KSC from the fourth floor of Building J5-1197 (Air Traffic Control Tower) at the SLF. Weather observers maintain a Continuous Weather Watch, 24-hours per day, 7-days per-week. Weather observations are taken from the facility located approximately 500 feet east of the SLF. The observer's view is generally unobstructed. Weather observations are taken hourly and whenever established special or local criteria are met. During Space Shuttle operations, observations are taken as follows:

Table 2.10. Space Shuttle Operations, Observations are Taken as Follows.

L-3 hour to L-1 hour: Observations are taken every 30 minutes
L-1 hour to Return To Landing Site (RTL): Observations are taken every 15 minutes
RTL until Abort Once Around (AOA): Observations are taken every 30 minutes
L-3 hours to landing: Observations are taken every 15 minutes

2.5.1. Hourly. Hourly observations include:

Table 2.11. Hourly Observations Include.

Type of observation (Standard Hourly: METAR)
Date and time of observation in Universal Coordinated Time (UTC)
Wind direction and speed (kt)
Prevailing visibility
Present weather
Ceiling and sky condition (hundreds of feet)
Temperature and dew point (°C)
Altimeter setting (inches)
Plain language and coded remarks (includes pressure altitude and sea level pressure)
Time and initials of observer

2.5.2. SPECI. IAW AFMAN 15-111 and KSC/Shuttle Specific Criteria for Special Observations. SPECIs are taken at the SLF when existing weather conditions change IAW the criteria listed below.

2.5.2.1. Cloud ceiling: Ceiling decreases to less than or increases to equal or exceed:

Table 2.12. Ceiling Decreases to Less Than or Increases to Equal or Exceed.

10000 feet (L-48 hours through End Of Mission (EOM)) (Space Shuttle Operational Flight Rules)
8000 feet (Program Requirements Document)
5000 feet (L-48 hours through EOM) (Space Shuttle Operational Flight Rules)
3000 feet (AFMAN 15-111)
1500 feet (AFMAN 15-111)
1000 feet (AFMAN 15-111, FLIP)
900 feet (FLIP)
700 feet (AFMAN 15-111, FLIP)
600 feet (FLIP)
500 feet (AFMAN 15-111, FLIP)
400 feet (FLIP)

2.5.2.2. Sky conditions (AFMAN 15-111): Any layer of clouds or obscuring condition aloft is observed below 1000 feet and no layer was reported below 1000 feet on the preceding observation.

2.5.2.3. Visibility: Prevailing SLF visibility decreases to less than or, if below, increases to equal or exceed:

Table 2.13. Prevailing SLF Visibility Decreases to Less Than or if Below Increases to Equal or Exceed.

7 miles (Program Requirements Document)
5 miles (Program Requirements Document)
4 miles (L-48 hours through EOM) (Program Requirements Document)
3 miles (AFMAN 15-111, FLIP)
2 miles (AFMAN 15-111)
1 $\frac{3}{4}$ miles (FLIP)
1 $\frac{1}{2}$ miles (FLIP)
1 $\frac{1}{4}$ miles (FLIP)
1 mile (AFMAN 15-111, FLIP)
$\frac{3}{4}$ mile (FLIP)
$\frac{1}{2}$ mile (FLIP)

2.5.2.4. Tornado, funnel cloud, or waterspout (AFMAN 15-111):

2.5.2.4.1. Is observed.

2.5.2.4.2. Disappears from sight.

2.5.2.4.3. Occurred in the local area within the past hour according to a reliable outside source, and was not observed or recorded at the station.

2.5.2.5. Thunderstorm (AFMAN 15-111):

2.5.2.5.1. Begins.

2.5.2.5.2. Ends.

Note: A Thunderstorm is not considered to have ended until 15 minutes after the last occurrence of criteria for a thunderstorm (i.e., thunder is last heard).

2.5.2.6. Precipitation:

2.5.2.6.1. Begins or ends. (Program Requirements Document).

2.5.2.6.2. Hail begins or ends (AFMAN 15-111).

2.5.2.6.3. Freezing precipitation or ice pellets begin, end, or change in intensity (AFMAN 15-111).

2.5.2.7. Wind and wind shifts (AFMAN 15-111):

2.5.2.7.1. Wind speeds increase to at least 16 kts and are sustained at 22 kts or more for at least 1 minute (squall).

2.5.2.7.2. Any wind direction change of 45° or more in less than 15 minutes when the wind speed or gust is 10 kts or more, throughout the wind shift.

2.5.2.8. Upon receipt of a reportable tower visibility value, when either tower or surface visibility is less than 4 miles (6000 meters) and they differ by a reportable SPECI criteria value. Transmit tower visibility as a SPECI or append remark to a METAR or SPECI observation being taken at the time of notification (AFMAN 15-111).

2.5.2.9. Real-world nuclear accident/release (AFMAN 15-111). When notified of a real-world nuclear accident/release, a SPECI observation will be taken and disseminated both locally and longline. The remark "AEROB" will be appended as the last remark on the longline disseminated observation.

2.5.2.10. When volcanic ash is first observed (AFMAN 15-111).

2.5.2.11. Upon resumption of observing function after the weather observer returns to duty following a break in observing coverage due to evacuation of the weather station.

2.5.2.12. Any other meteorological situation occurs which, in the opinion of the observer, is critical to safety of aircraft/missile operations (AFMAN 15-111).

2.5.2.13. Local. Criteria for LOCAL Observations:

2.5.2.13.1. Aircraft, orbiter, space launch vehicle, or missile mishap (AFMAN 15-111).

2.5.2.13.2. Change in runway (AFMAN 15-111).

2.5.2.13.3. For any other meteorological situation significant to local operations (AFMAN 15-111).

2.5.3. Dissemination. Observations are disseminated via JET or N-TFS. In the event of a JET or N-TFS outage, the observer will pass weather information to the tower via the most efficient means possible (phone, e-mail, etc). Observations will then be disseminated longline via the Air Force Weather Agency's (AFWA) web site. In the event of an JET or N-

TFS outage during a Space Shuttle Operation, surface weather observations can be transmitted to Johnson Space Center (JSC), Houston via Meteorological Interactive Data Display System (MIDDS).

2.6. Cooperative Weather Watch Program (CWW). The CWW program is a mechanism to leverage non-weather personnel in the identification and monitoring of potentially severe weather conditions and enhance the weather squadron's support to local customers. Through an agreement with the weather squadron, ATC personnel at PAFB and CCAFS will advise the 45 WS duty forecaster of changing weather conditions based on a set of predetermined conditions outlined in paragraph 7.5. They will also relay Pilot Reports (PIREPS) and any other significant observation.

2.7. Aircraft Mishaps. Upon notification of an aircraft mishap, the 45 WS will collect and save data related to the mishap IAW AFMAN 15-129 and AFMAN 15-111.

2.8. Upper Air Observations. The 45 WS provides upper air observations via the ERTS contractor at CCAFS.

2.8.1. The ERTS contractor provides upper air observation from Weather Station A, Building 20185. Both high and low-resolution balloons are released to acquire wind, temperature, pressure and humidity data to support range operations. During normal, day-to-day operations, upper air observations are taken twice daily (0615L and 1815L), 7 days-per-week. During the convective season (May – Oct), an additional sounding is taken at 1100L. For launch operations, the schedule for upper air soundings is customer driven and changes with each vehicle launched from the ER and KSC.

2.8.2. High/Low Resolution Launches.

2.8.2.1. High Resolution Radiosondes. High Resolution Automated Meteorological Profiling System (AMPS) radiosondes are connected directly beneath a clear Jimsphere. They measure wind speed and direction only, and have an altitude restriction of 55,000 ft (balloon loses lift and starts to float). They are called 'high resolution' winds because of the Jimsphere's capability to detect small-scale wind features. Jimsphere's are only used for launch support.

2.8.2.2. Low Resolution Radiosondes. Low Resolution AMPS radiosondes are connected 70 feet below a latex balloon. They measure wind direction and speed, temperature and humidity. These balloons reach 100,000 feet on a regular basis. The wind measurements are considered 'low resolution' because the pendulum motion of the 70 ft train is filtered out during derivation of the final winds, eliminating small-scale wind features. The low-resolution radiosondes are used for launch and landing support, as well as daily synoptic weather model runs.

Chapter 3

FORECASTING

3.1. General. The 45 WS provides Terminal Aerodrome Forecasts (TAFs), planning forecasts, and (mission execution forecasts) for activities such as aviation operations, and range ground processing and launch operations. All forecasting services are provided from the RWOC located in the MOC, Building 81900 on CCAFS. Forecasting services are available 24 hours a day, 7 days per week. The RWOC forecaster can be contacted at: Commercial (321) 853-8484/8485, DSN: 467-8484/8485.

3.1.1. RWOC Alternate Operating Location. If the need to evacuate the RWOC occurs and is expected to last more than 60 minutes, one RWOC forecaster will evacuate to the PAFB BWS and provide support until operations in the RWOC have resumed. For evacuations less than 60 minutes, the RWOC forecaster will be available via cell phone at (321) 431-4524.

3.1.2. RWOC Duty Priorities. Since all forecasting tasks cannot be performed simultaneously, priorities are established to ensure tasks are accomplished in proper order. Support agencies should be aware of and respect these priorities. Customers should be aware duty priorities may change during launch operations. Duty priorities (in order of importance) are:

- 3.1.2.1. Emergency war orders.
- 3.1.2.2. Execute 45 WS evacuation.
- 3.1.2.3. Respond to aircraft/ground emergencies.
- 3.1.2.4. Provide Pilot-to-Metro Service (PMSV).
- 3.1.2.5. Disseminate warnings, watches, advisories and other resource protection products.
- 3.1.2.6. Provide weather information to SOF or NASA NTD.
- 3.1.2.7. Prepare and issue mission execution forecasts.
- 3.1.2.8. Provide terminal aerodrome forecasts.
- 3.1.2.9. Disseminate Pilot Reports (PIREPs).
- 3.1.2.10. Provide other aerospace weather products, information, and weather briefings.
- 3.1.2.11. Perform MISSIONWATCH activities.
- 3.1.2.12. Answer operational phone calls.
- 3.1.2.13. Accomplish recurring training.
- 3.1.2.14. Accomplish administrative tasks.

3.2. Terminal Aerodrome Forecasts. The 45 WS will produce TAFs for Patrick AFB (KCOF) and the SLF (KTTS) and issue them IAW AFMAN 15-124. Forecast elements refer to an area within a five nautical mile (NM) radius centered on the midpoint of the runways. The term “VC” (vicinity), referring to the area between 5 and 10 NM from the aerodrome complex, may be used in these forecasts. Forecasts are monitored and amended as required per criteria established by HQ USAF/A3O-W and as agreed upon by local supported organizations.

3.2.1. **Patrick AFB.** The PAFB airfield complex is a limited duty operation. As such, the 45 WS issues TAFs for Patrick AFB (KCOF) at 1100Z, 1900Z, and 0300Z daily except during EDT when they are each issued one Zulu hour earlier. When the airfield is closed, TAFs will not be issued or amended. An example of a Patrick AFB TAF is at attachment 2.

3.2.1.1. Amendment Criteria. 45 WS issues and amends the KCOF TAF when not representative of existing thresholds and conditions and when those conditions are expected to persist for 30 minutes or longer, and if conditions are not covered in a current change group which will become valid by the next cardinal hour. The forecast is issued and amended for the following items.

3.2.1.1.1. The ceiling and/or visibility is, or is expected to be, out of category. Ceiling/visibility categories are determined by the lower of the ceiling or visibility elements. Amendments are not required when either the ceiling or visibility improves to a higher category and the other remains in the lower category. The ceiling/visibility categories are:

Table 3.1. Ceiling/Visibility Categories.

Ceilings (Feet)	Visibility (Statute Miles)
≥3000	≥ 3
≥ 1000, <3000	≥ 2, <3
≥ 300, <1000	≥3/4, <2
< 300 (airfield minimum)	< ¾ (airfield minimum)

3.2.1.1.2. Wind speed error of 10 knots or more (predominant or gust), or a direction error of 30 degrees or more if the predominate wind speed or gusts are, or are expected to be, in excess of 15 knots.

3.2.1.1.3. Anytime in the interest of safety, efficiency of aircraft operations, or flight planning.

3.2.1.1.4. Any locally established criterion for weather warnings/advisories which:

3.2.1.1.4.1. Occurs, or is expected to occur, but is not specified in the original forecast.

3.2.1.1.4.2. Is no longer occurring, or is not expected to recur, but was specified in the original forecast.

3.2.1.1.5. Thunderstorm is no longer expected to occur and is in the TAF. Also, if thunderstorms are not in the TAF and they are now expected or occur.

3.2.1.1.6. The beginning or ending of turbulence or icing from the surface through 10,000 feet above ground level (AGL) which meets, exceeds or decreases below moderate or severe thresholds, and was not specified in the original forecast.

3.2.1.2. Specification Criteria. TAFs will specify time of occurrence to the nearest hour (and/or minute as appropriate), the duration, and intensity of the amendment criteria along with any additional criteria in TAFs based on local customer requirements. The following is the specification criteria thresholds for PAFB TAFs.

Table 3.2. Specification Criteria Thresholds for PAFB TAFs.

Ceilings (Feet)	Visibility (Statute Miles)
700	1
500	½
200	

3.2.1.3. Dissemination. The primary longline and local dissemination system is via JET. The forecast is disseminated using TAF code and valid for a 24-hour period.

3.2.2. **Shuttle Landing Facility.** The 45 WS issues TAFs for KSC's SLF (KTTS). KTTS TAFs are issued at 1100Z and 1900Z daily except during Eastern Daylight Time (EDT) when they are each issued one Zulu hour earlier. An example of a KTTS TAF is at Attachment 2.

3.2.2.1. While the Space Shuttle is on orbit, the 45 WS issues TAFs every 8 hours and continuously monitors them.

3.2.2.2. During Space Shuttle launch and landing operations, the 45 WS discontinues issuing TAFs approximately 8 hours prior to the scheduled operation. JSC Spaceflight Meteorology Group (SMG) produces and issues special forecast bulletins for KTTS during these time periods.

3.2.2.3. Amendment Criteria. 45 WS (or JSC SMG) issues and amends the KTTS TAF when not representative of existing thresholds and conditions and when those conditions are expected to persist for 30 minutes or longer, and if conditions are not covered in a current change group which will become valid by the next cardinal hour. The forecast is issued and amended for the following items.

3.2.2.3.1. The ceiling and/or visibility is, or is expected to be, out of category. Ceiling/visibility categories are determined by the lower value of the ceiling or visibility elements. Amendments are not required when either the ceiling or visibility improves to a higher category and the other remains in the lower category. The ceiling/visibility categories are:

Table 3.3. Ceiling/Visibility Categories.

Ceiling (Feet)	Visibility (Statute Miles)
3000	3
1000	2
400	1/2

3.2.2.3.2. Wind speed error of 10 kts or more, including gusts.

3.2.2.3.3. A direction error of 30 degrees or more if the predominant wind speed or gusts are, or are expected to be, in excess of 15 kts.

3.2.2.3.4. Any locally established criterion (at the surface) for weather warning which occurs, or is expected to occur, but is not specified in the forecast or is no longer occurring, or is not expected to recur, but was specified in the forecast.

3.2.2.3.5. Precipitation, when the beginning or ending causes issuance of a local weather warning or weather advisory for the SLF, or any precipitation the forecaster deems important to operations. Also, when unforecasted freezing precipitation begins or ends.

3.2.2.3.6. An incorrect forecast time of the start or end times of thunderstorms.

3.2.2.3.7. The forecaster does not consider the TAF representative of existing conditions, and those conditions are expected to persist for at least 30 minutes.

3.2.2.3.8. The beginning or ending of turbulence or icing conditions from the surface through 10,000 feet MSL which meet, exceed, or decrease below moderate or severe thresholds (for Category II aircraft) and were not specified in the forecast.

3.2.2.4. Specification Criteria. The TAF specifies time of occurrence to the nearest hour, duration and intensity (if applicable) when one or more of the following elements is expected to occur:

3.2.2.4.1. An increase in ceiling or visibility to equal or exceed, or a decrease in ceiling or visibility to less than:

Table 3.4. An Increase in Ceiling or Visibility to Equal or Exceed or a Decrease in Ceiling or Visibility to Less Than.

Ceiling (Feet)	Visibility (Statute Miles)
10000 (when Shuttle is on orbit)	7 (when Shuttle is on orbit)
9000 (when Shuttle is on orbit)	5 (when Shuttle is on orbit)
8000 (when Shuttle is on orbit)	4 (when Shuttle is on orbit)
7000 (when Shuttle is on orbit)	1 3/4
6000 (when Shuttle is on orbit)	1 1/2
5000 (when Shuttle is on orbit)	1 1/4
1500	3/4

3.2.2.4.2. The beginning or ending of precipitation.

3.2.2.5. Dissemination. The primary longline and local dissemination system is via JET. The forecast is disseminated using TAF code and is valid for a 24-hour period. It consists of valid times, winds, visibility, weather and obstructions to vision, sky conditions, minimum altimeter setting, and turbulence and icing forecasts.

3.3. Planning Forecasts.

3.3.1. The 24-Hour Forecast. The 24-hour planning forecast gives 45 SW and Eastern Range customers an outlook for weather conditions that may impact their operations. The forecast covers CCAFS and KSC complexes and is issued/updated three times per day. Unlike the TAF, the 24-hour forecast is not formally amended. The 24-hour forecast is

divided into three separate time periods and the forecast parameters are sky cover, precipitation probability, lightning probability, 54 foot prevailing wind, temperature range, remarks, and the time period's severe weather potential (slight, moderate, or high). The 24-hour forecast will be posted at <http://www.patrick.af.mil/weather/> by 0800L daily. An example of the 24-hour planning forecast is at Attachment 3.

3.3.2. The 7-Day Forecast. The 45 WS issues a 7-day planning forecast to inform customers of potential weather concerns. The 7-day forecast is less detailed than a TAF and is general in nature. The following criteria will be included in the 7-day planning forecast, with each day broken into 12-hour segments (AM/PM): sky cover, weather, precipitation probability, lightning probability, 54 foot prevailing wind, maximum and minimum temperatures. This product is posted at <http://www.patrick.af.mil/weather/> every morning NLT 0800L and is not amended. An example of the 7-day planning forecast is at Attachment 4.

3.3.3. Mission Planning Forecast. The RWOC issues a Mission Planning Forecast (see drop zone map in Attachment 5) daily, valid 0800-2300L. This forecast is for planning purposes only. In addition, the forecast includes drop zone forecasts valid the same time period. This product is produced once per day and is not amended or METWATCHED. The mission planning forecast is posted at <http://www.patrick.af.mil/weather/> every day at 0800L. Attachment 6 is an example of the Mission Planning Forecast.

3.4. Launch Forecast. The Range Weather Forecaster (RWF) and/or Launch Weather Officer (LWO) provide daily forecasts, as required, in support of ground processing operations. In addition, the LWO prepares pre-launch forecasts 3-4 days prior to a launch and a day-of-launch forecast to include the forecast probability of violating Launch Commit Criteria (LCC). Forecasts are disseminated to applicable agencies and posted at <http://www.patrick.af.mil/weather/>. Attachment 7 is an example of a day-of-launch forecast.

3.5. Aircrew Support. The RWOC provides the following services to aircraft departing PAFB, the SLF, and the Skid Strip:

3.5.1. Weather Briefings. The RWOC provides flight weather briefings for all parent/host unit flights departing PAFB, the SLF and the Skid Strip. The RWOC also provides and/or updates briefings for transient aircraft as time and resources allow. All strategic mobility missions will be directed to contact the 15th Operational Weather Squadron (15 OWS) at Scott AFB, IL. DD Form 175-1 (Attachment 8) and MEF (Attachment 9) are used to document flight briefings. Flight weather briefings are obtained by calling the duty forecaster (853-8484/8485) directly. For aircraft requiring DD Form 175-1 briefings at PAFB, instructions and materials are available at the weather desk in building 820, Base Operations, PAFB. Aircrews should notify the RWOC duty forecaster as soon as possible when support is required and provide take-off time(s), destination(s), estimated time(s) of arrival, flight level(s), and call sign(s) of aircraft. Verbal weather briefings are recorded on a locally generated form.

3.5.2. Flight and Route Mission Watch (METWATCH). The RWOC forecaster performs a route and flight METWATCH for all flights departing PAFB, the SLF and the Skid Strip for which a flight weather briefing was given by duty forecasters. If weather conditions change from those briefed at departure to affect flight safety, the RWOC forecaster will make every attempt to contact the aircraft in flight by any means available (PMSV, 45 SW/CP, SOF, etc.).

3.5.3. Pilot-to-Metro Service/Phone Patches. PMSV contact is available 24 hours a day on frequency 344.6 MHz. Phone patches can be routed to (321) 853-8484/8485. The RWOC forecaster solicits PIREPS from aircrews and transmits significant reports via JET to other using agencies.

3.6. Fit-To-Fight Weather. The RWOC provides weather information to assess conditions for conducting fitness tests. Information is available by contacting the duty forecaster at 853-8485.

3.7. Tropical Storm/Hurricane Support. The RWOC receives hurricane and tropical storm advisories from the National Hurricane Center (NHC) at approximately 0300Z, 0900Z, 1500Z, and 2100Z. The 45 WS/CC or representative advises the 45 SW/CC, 45 SW Staff and NASA on movement, intensity, weather conditions, and storm surge associated with tropical systems which may affect PAFB, CCAFS, JDMTA, Malabar Annex, Antigua AS, Ascension Island, or Argentina. Although the 45 WS recommends a HURCON level, the 45 SW/CC and NASA-KSC Director, in coordination with each other, have the responsibility of declaring HURCON levels for their specific area of responsibility.

3.7.1. Hurricane Conditions (HURCON). HURCON levels are used to alert personnel to the proximity of the storm to ensure hurricane precautionary and preparatory measures are begun and executed in sufficient time. These categories focus on the forecast time-of-arrival of sustained 50 kt (58 mph) or greater winds associated with a tropical system. The HURCON levels are as follows:

Table 3.5. HURCON Levels.

Condition IV - Within 72 hours
Condition III - Within 48 hours
Condition II - Within 24 hours
Condition I - Within 12 hours

3.7.2. The RWF will plot hurricane advisories received from the NHC and post them to the 45 WS webpage. The NHC forecast intensity and track is the official forecast. The 45 WS will not deviate from this forecast except to apply local effects.

3.7.3. The Space Shuttle LWO will produce a tailored hurricane forecast for NASA/KSC based on the Hurricane Center's official forecast track and intensity.

3.7.4. In the event that 45 WS cannot provide weather support due to evacuation, backup weather support will be provided by 26 OWS per Memorandum of Agreement 15-23.

3.8. Severe Weather Actions Procedures. The RWOC has established procedures ensuring timely, accurate forecast services are provided to customers during severe weather situations. Procedures are defined in 45 WS Standing Operating Procedures (SOPs).

3.9. Staff Meteorological Functions. The 45 WS provides the following staff functions.

3.9.1. Climatological Services. 45 WS will provide or arrange for climatological data or studies as required.

3.9.2. Staff Weather Briefings. 45 WS provides weather briefings to a number of customers, providing commanders, staff and operations and aircrew personnel with valuable weather information for planning and decision making. Wing staff, Battle Staff, flying safety, instrument refresher course, pre-deployment planning and seasonal briefings are provided upon request.

3.9.3. Crisis Action Response/Aircraft or Missile Accident Investigation. 45 WS will provide meteorological support as necessary. In the case of a weather related accident or incident, 45 WS should be notified as soon as possible to allow timely archival of weather data.

3.10. Meteorological Consulting/Advising Services. Technical consultation includes advising the 45 WS operational and support customers on all projects affected by weather from initial project design, through testing, and operational execution. Topics range from simple engineering studies such as adding a new control arm to a launch pad service tower, to emergency parking of a Space Shuttle outside the Vehicle Assembly Building to make room for repair of a hail damaged Space Shuttle, to designing the weather infrastructure at the Kodiak Space Launch Complex in Alaska. Support is also provided to local science field studies. Some of these field studies are done for non-weather research, while some are done specifically to help weather support to the space program. Examples of the latter include the Airborne Field Mill and Balloon-borne Field Mill projects to improve the Lightning LCC. Technical consultation is also provided to 45 WS operations and staff actions, as required.

3.11. Research Support. The 45 WS System Division manages operational research programs to improve weather support to the space program through highly focused research by universities, national laboratories, and contractors. Operational research topics have included nowcasting the start and end of lightning, climatology of Lightning Launch Commit Criteria, convective wind forecasting, forecasting elevated point peak wind in winter and data integration and visualization. External research agencies have included Florida State University the Air Force Institute of Technology, Texas A&M University, National Environmental Satellite Data Information Services, University of Hawaii, National Severe Storms Laboratory, Pennsylvania State University, Air Force Academy and Colorado State University.

Chapter 4

METEOROLOGICAL WATCH SUPPORT

4.1. Meteorological Watch (METWATCH) Program. Certain weather conditions pose a threat to life or create safety hazard for mission operations. Via the METWATCH program, 45 WS monitors for such weather conditions and advises base agencies when these dangerous circumstances are observed or forecast to occur. Weather warnings, watches and advisories are the vehicles through which supported agencies are notified of these critical weather situations. The 45 WS provides METWATCH support to the 45 SW (PAFB, CCAFS, Port, Malabar), NASA (KSC area) and Astrotech (Titusville, FL).

4.1.1. Weather Warnings (WW). A Weather Warning is a special notice to support agencies giving them advanced notification (with sufficient time for protective actions) of weather conditions of sufficient intensity to pose a hazard to life or property. WWs are issued for a designated geographic area such as CCAFS or an area within 5 NM from a designated location such as PAFB. WWs are issued for all 45 SW locations stated in paragraph 4.1. WW numbers are location specific (KSC, CCAFS or PAFB). The format includes the WW number that consists of a two-digit numeric month designator (MM) separated by a dash, then the letter A, followed by the sequence number that begins at 001 (#MM-AXX). *Example: KSC number 12-A32 is the 32nd WW issued for KSC in December.*

4.1.1.1. Lightning Warnings (Phase II Lightning Warning). A Phase II Lightning Warning is issued when lightning occurs or is imminent within 5 NM of a designated location. Customers can then take the necessary precautions to protect personnel and resources.

4.1.2. Weather Watches. Watches are special notices to supported agencies concerning atmospheric conditions that may signal a future potential for weather conditions of intensity to pose a hazard to life or property. It can be used as a “heads up” for agencies to consider making plans to take required protective actions should an actual WW be issued. If weather conditions do favor severe weather or if severe weather is imminent, a WW will be issued. Weather Watches are issued for PAFB, CCAFS and KSC. The Weather Watch number consists of the two-digit numeric month designator (MM) separated by a dash, then the letter A, followed by the sequence number for the month that begins at 01 (#MM-AXX). *Example: PAFB number 1-A01 is the 1st watch issued for PAFB in January.*

4.1.2.1. Lightning Watch (Phase I Lightning Watch). A Phase I Lightning Watch is issued when lightning within 5 NM is expected to occur within the next 30 minutes. Phase I Lightning Watches are issued for PAFB, CCAFS, Astrotech and KSC and alert all agencies to take preliminary actions to protect personnel and resource.

4.1.3. Weather Advisories. The 45 WS issues two types of weather advisories: Observed Weather Advisories and Forecast Weather Advisories. These advisories are issued for PAFB, CCAFS and KSC. The actual number consists of the two-digit numeric month designator (MM) separated by a dash, then the letter A, followed by the sequence number for the month that begins at 01 (#MM-AXX). *Example: CCAFS number 3-A10 is the 10th advisory issued for CCAFS in March .*

4.1.3.1. Observed Weather Advisory (OWA). An OWA is a special notice that non-severe weather conditions, which could affect operations, are occurring within a designated geographic area or within a set nautical miles distance of a designated location. An OWA is issued on the first occurrence of the designated criteria and canceled when the event is no longer occurring. An OWA is used when agencies do not require advanced notification prior to the onset of the weather conditions.

4.1.3.2. Forecast Weather Advisory (FWA). A FWA is a special notice to supported agencies giving them advanced notice (with sufficient time for protective actions) of mission-limiting, non-severe weather conditions expected to directly affect a designated geographic location or an area within a set nautical mile distance of a designated location.

4.2. Patrick AFB METWATCH Products. Warnings, watches and advisories are issued for a 5 NM radius from the center of the runway at PAFB. Attachment 10 graphically displays this area. Products are disseminated via JET to the PAFB command post. Weather warning, watch and advisory criteria and appropriate desired lead times are in Table 4.1. PAFB METWATCH products are issued in the format outlined in Attachment 11.

4.2.1. For a tornado or funnel cloud affecting PAFB resources including South Housing, the duty forecaster contacts 45 SW Command Post via hotline and 45 SW Command Post personnel activate the base siren warning system. The forecaster will issue the tornado or funnel cloud warning on JET after the telephone notification.

Table 4.1. Patrick AFB METWATCH Criteria and Desired Lead Times.

	CRITERIA	Desired Lead Time
Warnings	Tornado/Waterspout	5 minutes
	Strong Winds (surface winds \geq 35 kts)	30 minutes
	Damaging Winds (Surface winds \geq 50 kts)	60 minutes
	Hail \geq 3/4 inch	60 minutes
	Lightning w/in 5 NM (Phase II)	Observed
Watches	Tornado/Waterspout	As Potential Warrants
	Severe Thunderstorm	As Potential Warrants
	Lightning w/in 5 NM (Phase I)	30 minutes
Advisories	Temperature \leq 32 °F for \geq 4 hrs	16 hours
	Surface winds 25-34 kts	30 minutes

4.3. CCAFS METWATCH Products. All non-lightning warnings, watches and advisories are issued for CCAFS for weather events expected to occur within CCAFS boundaries. Lightning watches (Phase I) and warnings (Phase II) are issued for a 5 NM radius around a specific location or complex. Attachment 12 graphically displays the 5 NM areas for lightning watches and warnings for CCAFS. Products are disseminated via JET and displayed on the 26 OWS webpage for Cape Support and ISC DO. The duty forecaster will provide a follow-up phone call to Cape Support and ISC DO alerting of issuance or cancellation of any watches, warnings or advisories. Weather Warning, watch and advisory criteria and appropriate desired lead times are in Table 4.2.

Table 4.2. CCAFS METWATCH Criteria and Desired Lead Times.

	CRITERIA	Desired Lead Time
Warnings	Tornado/Waterspout	5 minutes
	Damaging Winds (Surface-200' winds \geq 35 kts)	30 minutes
	Strong Winds (Surface-200' winds \geq 50 kts)	60 minutes
	Hail \geq 3/4 inch	60 minutes
	Lightning w/in 5 NM (Phase II)	Observed
Watches	Tornado	As Potential Warrants
	Severe Thunderstorm	As Potential Warrants
	Lightning w/in 5 NM (Phase I)	30 minutes
Advisories	Winds Sfc-200' \geq 18 kts steady (5 min average)	Observed
	Temperature \leq 32 °F for \geq 4 hrs	16 hours

4.4. Port METWATCH Product. The RWOC issues one advisory for conditions expected to occur at the Port. This product is disseminated via an automated JET phone call to NASA Shuttle Logistics Depot (NSLD). The product is disseminated via JET and displayed on the 26 OWS webpage for Cape Support and ISC DO. The duty forecaster will provide a follow-up phone call to Cape Support and ISC DO alerting of issuance or cancellation of the advisory. The advisory criteria and desired lead-time is in Table 4.3.

Table 4.3. Port METWATCH Criteria and Desired Lead Times.

	CRITERIA	Desired Lead Time
Advisory	Steady State 5-Minute Wind Average from Sfc – $54' \geq 22$ kts	30 minutes

4.5. KSC METWATCH Products. With the exception of lightning watches and warnings, all warnings, watches and advisories are issued for forecast or observed weather conditions occurring within KSC boundaries. Lightning watches and warnings are issued for a 5 NM radius around a specific building, location or complex. Attachment 13 graphically displays the 5 NM areas for lightning watches and warnings for KSC. Products are disseminated via JET and displayed on the 26 OWS webpage for Cape Support and ISC DO. Products are delivered via the JET Really Simple Syndication (RSS) feed to the KSC DO. The duty forecaster will provide a follow-up phone call to Cape Support, ISC DO and KSC DO alerting of issuance or cancellation of any watches, warnings or advisories. Weather warning, watch, and advisory criteria and appropriate desired lead times are in Table 4.4.

Table 4.4. KSC METWATCH Criteria and Desired Lead Times.

	CRITERIA	Desired Lead Time
Warnings	Tornado/Waterspout	5 minutes
	Damaging Winds (Winds Sfc-300' ≥ 35 kts)	30 minutes
	Strong Winds (Winds Sfc-300' ≥ 50 kts)	60 minutes
	Hail (any size)	60 minutes
	Lightning w/in 5 NM (Phase II)	Observed
Watches	Tornado/Waterspout	As Potential Warrants
	Severe Thunderstorm	As Potential Warrants
	Lightning w/in 5 NM (Phase I)	30 min
Advisories	Fair Weather Waterspout/Funnel Cloud	Observed
	Winds Sfc-300' ≥ 18 kts steady (5 min average)	Observed
	Precipitation Rate of ≥ 1 inch in 1 hour	30 minutes
	Temperature $\leq 45^\circ\text{F}$ for > 4 hrs	4 hours
	Temperature $< 35^\circ\text{F}$ (first occurrence)	4 hours
	Temperature $\leq 32^\circ\text{F}$ for ≥ 4 hrs	16 hours
	Temperature $\leq 28^\circ\text{F}$ and winds > 10 kts	16 hours

4.6. Astrotech METWATCH Products. Lightning warnings and watches are issued for Astrotech in Titusville. Attachment 10 displays the specific location that lightning watches and warnings are issued. Products are disseminated via an automated JET phone call directly to the Astrotech facility. Warning and Watch criteria and desired lead times are in Table 4.5.

Table 4.5. Atrotech METWATCH Criteria and Desired Lead Times.

	CRITERIA	Desired Lead Time
Warning	Lightning w/in 5 NM (Phase II)	Observed
Watch	Lightning w/in 5 NM (Phase I)	30 minutes

4.7. Malabar Support. When 45 SW conducts exercise operations at Malabar, the RWOC issues watches and warnings for this location. METWATCH products are issued for a 5 NM radius around the Malabar complex. Products are disseminated by phone directly to the command organization. Weather warning, watch and advisory criteria and appropriate desired lead times are in Table 4.6.

Table 4.6. Malabar METWATCH Criteria and Desired Lead Times.

	CRITERIA	Desired Lead Time
Warning	Tornado	5 minutes
	Hail $\geq \frac{3}{4}$ inch	30 minutes
	Surface winds ≥ 50 kts	30 minutes
	Surface winds ≥ 35 kts	15 minutes
	Lightning w/in 5 NM (Phase II)	Observed
Watch	Tornado	As potential Warrants
	Hail $\geq \frac{3}{4}$ inch	As potential Warrants
	Surface winds ≥ 50 kts	As potential Warrants
	Lightning w/in 5 NM (Phase I)	30 minutes

4.8. Astrotech, Cape Canaveral (Spacehab Payload Processing Facility). All Phase I and II Lightning Watches/Warnings as well as Cape Severe Thunderstorm and Tornado Watches/Warnings are disseminated to SPPF in support of operations. Products are disseminated via an automated JET phone call.

4.9. National Airborne Operation Center (NAOC) Support. PAFB will occasionally be an operations location for NAOC aircraft from Offutt AFB, NE. Weather support for the aircraft and crew is vital to mission success and national security. NAOC uses PAFB warning, watch and advisory criteria as well as its own set of weather criteria. All PAFB weather alerts, along with specific NAOC alerts, will be relayed from the RWF to the NAOC POC. NAOC-specific Warning, Watch and Advisory criteria, as well as lead time, are outlined in Table 4.7.

Table 4.7. NAOC METWATCH Criteria and Desired Lead Times.

	CRITERIA	Desired Lead Time
Warnings	Convective Sfc winds 35 – 49 kts	60 minutes
	Hail 1/2 inch or greater	60 minutes
Watches	Tornado potential within 50 nm of PAFB	As Potential Warrants
	Hail \geq 1/2 inch and winds \geq 35 kts	As Potential Warrants
	Hail < 1/2 inch	30 min
Advisories	TS/LTG observed within 50 nm of PAFB	Observed
	TS/LTG observed within 25 nm of PAFB	Observed
	Low level wind shear (outside of TS) within 50 nm of PAFB	Observed
	Visibility < 1 sm	Observed
	Crosswinds > 20 kts	Observed
	Moderate or greater turbulence below 10K' (outside of TS) within 50 nm of PAFB	Observed
	Moderate or greater icing below 10K' (outside of TS) within 50 nm of PAFB	Observed

4.10. METWATCH Dissemination System.

4.10.1. The dissemination method used for alerting PAFB Command Post of advisories, watches and warnings is via an automated JET phone call. In addition, JET disseminates a backup e-mail to the Command Post. The Command Post then relays weather alerts via pyramid telephone notifications. The PAFB ATC Tower and Base Operations receive alert notification via JET which directly feeds their local Airfield Automation System. Attachment 14 depicts the notification process for PAFB alerts.

4.10.2. Weather warnings, watches, and advisories for CCAFS are disseminated to Cape Support and ISC DO via JET into a 26 OWS webpage. The RWF will provide a follow-up phone call to Cape Support and ISC DO alerting of the issuance or cancellation of any watches, warnings or advisories. Cape Support and ISC DO then disseminate the information via various methods (Aural Warning System, telephone, pager, radio, etc.) to customers. The CCAFS ATC Tower receives alert notification via JET which directly feeds their local Airfield Automation System. Attachment 15 depicts the notification process for CCAFS alerts.

4.10.3. Weather warnings, watches, and advisories for KSC are disseminated via JET and displayed on the 26 OWS webpage for Cape Support and ISC DO. Products are delivered via the JET Really Simple Syndication (RSS) feed to the KSC DO. The duty forecaster will provide a follow-up phone call to Cape Support, ISC DO and KSC DO alerting of the issuance or cancellation of any watches, warnings or advisories. Cape Support, KSC DO and ISC DO then disseminate the information via various methods (Aural Warning System, telephone, pager, radio, etc.) to customers. Attachment 16 depicts the notification process for KSC alerts.

4.10.4. For Astrotech support, an automated JET phone call is made directly to Astrotech.

Chapter 5

CUSTOMER THRESHOLDS AND REQUIREMENTS

5.1. General. This chapter outlines customer requirements to include mission thresholds, impacts, method or product used to notify the customer and the customer actions when thresholds are met. In addition, the chapter summarizes general and specialized customer weather requirements that the 45 WS provides to various units. All requirements in this chapter are broken out by customers. All support criteria are coordinated between the 45 WS and each customer. Any support requirements not covered here should be coordinated with the 45 WS/DO.

5.2. The 45th Space Wing (45 SW). The 45 WS will provide the following support 45 SW:

- 5.2.1. Provide meteorological consultant and climatological services.
- 5.2.2. Collect, evaluate, and distribute meteorological data for the ER and worldwide locations to support special projects within resource limitations.
- 5.2.3. Support interim/Major Command (MAJCOM) safety investigation boards and Disaster Control Groups, when formed (in accordance with the applicable plans and directives).
- 5.2.4. Provide weather services IAW other wing agreements upon request.
- 5.2.5. Maintain Severe Weather Action Procedures that will be enacted IAW AFMAN 15-129 when severe weather threatens.
- 5.2.6. Meet requests for meteorological services as required in the Range UDS.
- 5.2.7. Monitor and provide updates on volcanic activity affecting 45 SW assets.
- 5.2.8. Alert 45 SW leadership of any tsunami effecting 45 SW assets.

5.3. The 45th Space Wing Safety (45 SW/SE). The 45 WS will provide 45 SW/SE the following services:

- 5.3.1. Meteorological data for input into various Range Safety physics models that determine Impact Limit Lines and assess the following hazards; toxic dispersion, (both launch and non-launch day), distant focusing overpressure and debris.
- 5.3.2. Maintain proficiency on Eastern Range Dispersion Assessment System and the Meteorological and Range Safety Support System in terms of weather capabilities, and provide weather support when requested for non-launch day operations per the KSC/CCAFS Consolidated Comprehensive Emergency Management Plan, JDP-KSC-P-3008, OPlan 32-2, Vol 1 and the numerous operations safety plans.
- 5.3.3. Coordinate with AFWA and the Eastern Range Safety Risk Analysis Section (45 SW/SELR) to generate (toxic dispersion) effective downwind messages for the Civil Engineering Readiness Flight (45 CES/CEX). See CCEMP (KDP-KSC-P-3008), OPlan 32-3, Vol. 1 and 45 SW Full Spectrum Threat Response OPlan 10-2, Vol 1 for further required roles and responsibilities.

5.3.4. Ensure compliance with Range Safety (45 SW/SE) meteorological requirements as detailed in EWR 127-1 and AFSPCMAN 91-710.

5.4. The 45th Space Wing Inspector General (45 SW/IG). The 45 WS will provide the following services to 45SW/IG:

5.4.1. Support disaster and other training exercises by providing real or simulated weather conditions for specific training purposes within resource limitations.

5.5. The 45th Space Wing Public Affairs (45 SW/PA). The 45 WS will provide the following services to 45 SW/PA:

5.5.1. Provide tours of 45 WS facilities upon request.

5.6. The 45th Space Communications Squadron (45 SCS). 45 SCS provides all communications support to wing operations. The 45 WS will provide the following services to 45 SCS:

5.6.1. Weather critical thresholds, notification products, impacts and customer actions for operations are outlined in table 5.1.

Table 5.1. SCS Critical Weather Thresholds.

Weather Threshold	Notification Product	Impact	Customer Action
Tornado	Weather Warning	Hazardous Work Environment	Take Cover
Lightning within 5nm	Weather Watch and Warning (Phase I and II)	Hazardous Work Environment	Stop All Outdoor Work

5.6.2. The 45 WS will notify 45 SCS/SCO Job Control (for 45 SCS controlled weather systems only) of:

5.6.2.1. Any outages to a weather communications system or piece of equipment and of the arrival time of maintenance personnel.

5.6.2.2. Specific maintenance actions performed by contractor personnel to correct equipment problems, if known.

5.7. The 45th Operations Support Squadron (45 OSS). 45 OSS provides airfield operations, and control tower for PAFB and CCAFS airfields. The 45 WS will provide the following services to 45 OSS:

5.7.1. Provide information on the operational status of the PMSV and changes to forecast/observing support hours to the Airfield Operations dispatcher.

5.7.2. Train and certify, on request, Control Tower operators on local weather phenomena to take limited weather observations.

5.7.3. Provide tours of weather facilities as requested.

5.8. The 45th Contracting Squadron (45 CONS). The 45 WS will provide the following services to 45 CONS:

- 5.8.1. Monitor quality of surface observations and maintenance services provided by the RTSC contractor in accordance with the latest RTSC.
- 5.8.2. Assist contract development for weather services.

5.9. The 45th Civil Engineering Squadron (45 CES). 45 CES provides all engineering services to Patrick AFB. The 45 WS will provide the following services to 45 CES:

- 5.9.1. Weather critical thresholds, notification products, impacts and customer actions for operations are outlined in table 5.2.

Table 5.2. The 45 CES Critical Weather Thresholds.

Weather Threshold	Notification Product	Impact	Customer Action
Tornado	Weather Warning	Hazardous Work Environment	Take Cover
Winds 24 – 34kts	Weather Advisory	Hazardous to Equipment	Stop Crane Operations
Winds \geq 35kts	Weather Warning	Hazardous Work Environment	No Bucket Truck or Above Ground Operations
Temperatures \leq 32F for \geq 4hrs	Weather Advisory	Hazardous to Infrastructure	Take Freeze Precautions
Lightning within 5nm	Weather Watch and Warning (Phase I and II)	Hazardous Work Environment	Stop All Outdoor Work

- 5.9.2. Provide wind forecasts for fire fighting and for toxic/hazardous spills and exercises.

5.10. The 45th Force Support Squadron (45 FSS). The 45 FSS operates all Morale, Welfare and Recreation facilities on the base. They are concerned with any weather that may threaten the safety of patrons and possible damage at these facilities. The 45 WS will provide the following services to 45 FSS:

- 5.10.1. Weather critical thresholds, notification products, impacts and customer actions for operations are outlined in table 5.3.

Table 5.3. FSS Critical Weather Thresholds.

Weather Threshold	Notification Product	Impact	Customer Action
Tornado	Weather Warning	Hazardous Work Environment	Take Cover
Wind > 35kts	Weather Warning	Creates Hazard	Outdoor Recreation boat rentals cancelled
Wind > 25kts	Weather Advisory	Creates Hazard	Outdoor Recreation Restricts use of Smaller Vessels
Lightning within 5nm	Weather Watch and Warning (Phase I and II)	Hazardous Work Environment	Clear Swimming Pools, Recall Boats to Marina, Outside Intramurals Canceled, Close Golf Course

5.11. The 39th Rescue Squadron (39 RQS). The 39 RQS has the primary mission of supporting low level Combat Search and Rescue operations (recovery of space crews and downed aircrews), air refueling, airdrop and parachute insertion of rescue personnel. The 39 RQS flies HC-130 type aircraft. The 45 WS will provide the following services to 39 RQS:

5.11.1. Weather critical thresholds, notification products, impacts and customer actions for operations are outlined in table 5.4.

5.12. The 301 Rescue Squadron (301 RQS). The 301 RQS has the primary mission of supporting low level Combat Search and Rescue operations. Missions include the recovery of space crews and downed aircrews along with the insertion of rescue personnel. The 301 RQS flies HH-60 Pave Hawk helicopters. The 45 WS will provide the following services to 310 RQS:

5.12.1. Weather critical thresholds, notification products, impacts and customer actions for operations are outlined in table 5.5.

Table 5.4. The 39 RQS Critical Weather Thresholds.

Weather Threshold	Notification Product	Impact	Customer Action
Ceiling \leq 200ft, Vis \leq 1/2m	Observation	Below Field Minimums	Cancel/Divert Aircraft
Ceiling \leq 1500ft, Vis \leq 3m, Vis \leq 1m	MEF	Cannot Perform Certain Mission Tasks	Change Operations Area
MDT Precip SFC - 500ft	MEF, Observation	Cannot Perform Certain Mission Tasks	Change Operations Area
TURBC \geq MDT SFC – 10,000ft	MEF	No Flight Through	Reroute Flight Path
Land DZ Winds $>$ 13kts	MEF	No Airdrops	Cancel Drops
Water DZ Winds $>$ 18kts	MEF	No Airdrops	Cancel Drops
Thunderstorms	MEF	No Flight Through	Reroute Flight Path
Lunar Data ($<$ 5% Equivalent Mean Illumination)	MEF	Determines Equipment For Mission Use (NVG, FLIR)	Change Mission Plan
Space Weather Constraint GPS error $>$ 50 meters	MEF	Position Error	Evaluate Navigation System
Tornado	Weather Warning	Hazardous Work Environment	Take Cover
SFC Winds \geq 30kts (uses 25kt wind advisory)	Weather Advisory	Hazardous Work Environment	Stops Work on Top of Planes
SFC Winds \geq 35kts	Weather Warning	Hazardous Work Environment	Tie Down Aircraft
SFC Winds \geq 50kts	Weather Warning	Damage to Aircraft	Hangar Aircraft
Hail $>$ 3/4"	Weather Warning	Damage to Aircraft	Hanger Aircraft & Divert Aircraft
LLWS	MEF	Can Not Perform Mission Tasks	Suspend Take-Off, Landing and Approach Training
Lightning within 5nm (Phase I and II)	Weather Watch and Warning	Hazardous Work Environment	Prepare to Suspend Work Suspend Refueling and Outside Operations

5.13. Customs and Border Protection (CBP) Department of Homeland Security. CBP conducts long range counter drug and personnel smuggling operations along the Eastern U.S. border with oversight capabilities to South America. CBP operates the MQ-9 Reaper aircraft from the Skid Strip at CCAFS. Weather support is provided in the form of advisories, warnings and flight weather briefings. Weather critical thresholds for ground and flight operations are outlined in table 5.6.

Table 5.5. The 301 RQS Critical Weather Thresholds.

Weather Threshold	Notification Product	Impact	Customer Action
Ceiling \leq 200ft, Vis \leq 1/2m	Observation	Below Field Minimums	Cancel Flights, Divert Aircraft
En route Ceiling \leq 700ft, Vis \leq 1, Vis \leq 2m	MEF	Cannot Perform Certain Mission Tasks	Change Operations Area
ICG \geq MDT with Deicing Capability	MEF	Damage to Aircraft	Change Flight Path
TURBC \geq MDT SFC – 10,000ft	MEF	Damage to Aircraft	Change Flight Path
Gust Spread \geq 20kts (uses 25kt advisory)	MEF	Damage to Aircraft	Do Not Start Engines
SFC Winds $>$ 40kts (use 35kt advisory)	Weather Warning	Hazardous Work Environment	Hanger Aircraft
MDT Precip SFC - 500ft	MEF	Cannot Perform Certain Mission Tasks	Change Operations Area
Space Weather Constraint GPS error $>$ 50 meters	MEF	Position Error	Evaluate Navigation System
Lunar Data	MEF	Determines Equipment For Mission Use (NVG, FLIR)	Change Mission Plan
En route Thunderstorms	MEF	No Flight Through	Reroute Flight Path
Tornado	Weather Warning	Hazardous Work Environment	Take Cover
SFC Winds \geq 30kts (uses 25kt wind advisory)	Weather Advisory	Hazardous Work Environment	Tie Down Aircraft
SFC Winds \geq 35kts	Weather Warning	Hazardous Work Environment	Hanger Aircraft

Weather Threshold	Notification Product	Impact	Customer Action
Hail > 3/4"	Weather Warning	Damage to Aircraft	Hanger Aircraft, Divert Aircraft
Lightning within 5nm (Phase I and II)	Weather Watch and Warning	Hazardous Work Environment	Prepare to Suspend Work Suspend Refueling and Outside Operations

Table 5.6. CBP Critical Weather Thresholds.

Weather Threshold	Notification Product	Impact	Customer Action
Crosswind \geq 12kts	MEF	Damage to Aircraft	Alter Flight Schedule
Lightning	Weather Watch and Warning (Phase I and II)	Damage to Aircraft	Alter Flight Schedule
Icing	MEF	Damage to Aircraft	Alter Flight Schedule
Heavy Precipitation (in-flight)	MEF	Limit Platform Capability	Alter Flight Schedule
Any Precipitation (Take-off)	MEF	Damage to Aircraft	Cancel Take-off

5.14. Department of State. The State Department maintains a maintenance depot for refurbishment and general maintenance, in addition to AT-802 and UH-1 aircraft. They also provide training for low level aerial spray operations. The 45 WS will provide the following services to the State Department:

5.14.1. Weather critical thresholds, notification products, impacts and customer actions for operations are outlined in table 5.7.

Table 5.7. Department of State Critical Weather Thresholds.

Weather Threshold	Notification Product	Impact	Customer Action
Ceiling \leq 1500ft, Vis \leq 3m,	MEF	Below Aircraft Minimums	Cancel Flights, Divert Aircraft
Gust Spread \geq 15kts (use 25kt wind advisory)	MEF	Creates Hazard	Do Not Operate UH-1 Aircraft
SFC Winds \geq 30kts (uses 25kt wind advisory)	MEF and Weather Advisory	Creates Hazard	Do Not Operate UH-1 Aircraft
ICG $>$ Trace	MEF	Creates Hazard	Cancel Flights
En route Thunderstorms	MEF	No Flight Through	Reroute Flight Path
TURBC \geq MDT SFC – 10,000ft	MEF	Damage to Aircraft	Change Flight Path
GPS Error $>$ 50 meters	MEF	Position Error	Evaluate Navigation System
Lunar Data	MEF	Creates Hazard	Determine Flight Parameters
Precipitation	MEF	Hampers Spray Mission	Cancel Spray Mission
Lightning within 5nm (Phase I and II)	Weather Watch and Warning	Hazardous Work Environment	Prepare to Suspend Work Suspend Refueling and Outside Operations
Lightning within 5nm	Weather Watch and Warning (Phase I and II)	Alerts Personnel of Pending Inclement Weather	Alert Personnel, Prepare to Clear Ramp, Suspend Refueling, Outside Operations Cancelled,
Space Weather Constraint GPS error $>$ 50 meters	MEF	Erroneous Navigation	Use Alternate Navigation System

5.15. IOMS / Cape Support Duty Office. Cape Support provides base operations and space launch support services to NASA and 45 SW. The 45 WS will provide the following services to Cape Support:

5.15.1. Weather critical thresholds, notification products, impacts and customer actions for operations are outlined in table 5.8.

Table 5.8. IOMS / Cape Support Duty Office Critical Weather Thresholds.

Weather Threshold	Notification Product	Impact	Customer Action
SFC Winds \geq 18kts Steady	Weather Advisory	Hazardous Work Environment	Stop Crane Operations Halt Aerial Tree Trimming
Temperature \leq 32F for \geq 4hrs	Weather Advisory	Endangers Assets	Activate Freeze Plan
Tornado	Weather Warning	Hazardous Work Environment	Take Cover
Wind > 35kts SFC- 200ft	Weather Warning	Hazardous Work Environment Endangers Assets	Secure Outdoor Items, Cease Above Ground Electrical, Voltage, HVAC, Mechanical and Communications Operations
Wind > 50kts SFC- 200ft	Weather Warning	Hazardous Work Environment	Pull Security Guards from Towers
Severe Thunderstorm/Tornado Watch	Weather Watch	Alerts Personnel of Pending Inclement Weather	Plan Operations Accordingly
Lightning within 5nm	Weather Watch and Warning (Phase I and II)	Hazardous Work Environment	Halt Outside Operations Bring Visitors Indoors

5.16. Computer Sciences Raytheon (CSR). CSR provides technical services to NASA and 45 SW in support of launch operations. The 45 WS will provide the following services to CSR:

5.16.1. Weather critical thresholds, notification products, impacts and customer actions for operations are outlined in table 5.9.

Table 5.9. CSR Critical Weather Thresholds.

Weather Threshold	Notification Product	Impact	Customer Action
SFC Winds \geq 18kts Steady	Weather Advisory	Hazardous Work Environment	Pull Workers Off Antennas
Tornado	Weather Warning	Hazardous Work Environment	Take Cover
Severe Thunderstorm/Tornado Watch	Weather Warning	Alerts Personnel of Pending Inclement Weather	Plan Operations Accordingly
Lightning within 5nm	Weather Watch and Warning (Phase I and II)	Alerts Personnel of Pending Inclement Weather, Hazardous Work Environment	Alert Personnel, Plan to Stop Work, Revise Work Schedules, Halt Outside Operations

5.17. Space Coast Launch Services (SCLS). SCLS provides provide operations, maintenance and engineering support to critical launch, spacecraft and ordnance facilities and support systems. The 45 WS will provide the following services to SCLS:

5.17.1. Weather critical thresholds, notification products, impacts and customer actions for operations are outlined in table 5.10.

Table 5.10. SCLS Critical Weather Threshold.

Weather Threshold	Notification Product	Impact	Customer Action
Tornado	Weather Warning	Hazardous Work Environment	Take Cover
Wind > 35kts SFC-200ft	Weather Warning	Hazardous Work Environment Endangers Assets	Cease Above Ground Electrical, Voltage, HVAC, Mechanical and Communications Operations
Severe Thunderstorm/Tornado Watch	Weather Watch	Alerts Personnel of Pending Inclement Weather	Plan Operations Accordingly
Lightning within 5nm	Weather Watch and Warning (Phase I and II)	Alerts Personnel of Pending Inclement Weather	Alert Personnel, Plan to Stop Work, Revise Work Schedules, Halt Outside Operations Bring Visitors Indoors Reduce Lanes into CCAFS

5.18. Astrotech, Cape Canaveral (Spacehab Payload Processing Facility). Astrotech, Cape Canaveral is located outside the south gate of CCAFS and provides cargo modules for the Space Shuttle. The 45 WS will provide the following services to the Payload Processing Facility:

5.18.1. Weather critical thresholds, notification products, impacts and customer actions for operations are outlined in table 5.11.

Table 5.11. SPACEHAB Critical Weather Thresholds.

Weather Threshold	Notification Product	Impact	Customer Action
Tornado	Weather Warning	Hazardous Work Environment	Take Cover
Severe Thunderstorm/Tornado Watch	Weather Watch	Alerts Personnel of Pending Inclement Weather	Plan Operations Accordingly
Phase I Lightning Watch (Uses Port Area)	Weather Watch and Warning (Phase I and II)	Alerts Personnel of Pending Inclement Weather	Alert Personnel, Plan to Stop Work, Revise Work Schedules, Halt Outside Operations

5.19. Office of Space Launch (OSL), Det 1. The National Reconnaissance Office, Office of Space Launch is located on CCAFS. The 45 WS will provide the following services to OSL:

5.19.1. Weather critical thresholds, notification products, impacts and customer actions for operations are outlined in table 5.12.

Table 5.12. OSL, Det 1 Critical Weather Thresholds.

Weather Threshold	Notification Product	Impact	Customer Action
Tornado	Weather Warning	Hazardous Work Environment	Take Cover
Severe Thunderstorm/Tornado Watch	Weather Watch	Alerts Personnel of Pending Inclement Weather	Plan Operations Accordingly
SFC Winds \geq 18kts Steady	Weather Advisory	Hazardous Work Environment	Plan Operations Accordingly
Lightning within 5nm	Weather Watch and Warning (Phase I and II)	Alerts Personnel of Pending Inclement Weather, Hazardous Work Environment	Alert Personnel, Plan to Stop Work, Revise Work Schedules, Halt Outside Operations
Temperature \leq 32F for \geq 4hrs	Weather Advisory	Endangers Assets	Activate Freeze Plan

5.19.2. Launch or ground operations support IAW appropriate UDS documents.

5.19.3. A 24-hour and weekly planning forecast.

5.19.4. Weather watches, warnings and advisories.

5.19.5. Controlled burn forecasts.

5.19.6. Hurricane forecast information.

5.20. NASA Support. Responsibilities discussed in this section are identified in Appendix E of the 45 SW/NASA-KSC Joint Operations Support Agreement. (NOTE: See Memorandum of Understanding, 45 SW No. 15E-2-27, for responsibilities regarding operation of the AMU.) Specific weather thresholds and required actions are outlined in S0007, *Launch Countdown Volumes* and S0018, *Adverse Environment and Lightning Monitoring at LC-39* and USA Florida Safety Operating Procedure 6100. 45 WS is responsible for the following:

5.20.1. Responding to all prior-coordinated support requirements contained in the UDS 3200 series, and in all related or affected Program Requirements Documents and Operations Requirement documents for NASA launch programs. All weather support to NASA will be in accordance with Air Force Manual 15-129.

5.20.2. Satisfying all pre-coordinated weather observing and forecasting requirements.

5.20.3. Providing weather forecasts for all NASA launches and Space Shuttle processing operations. Forecasts for NASA programs include the Space Shuttle launch area, SLF, the Solid Rocket Booster recovery area, external tank barge operations, various ship operations to include government charter mission and areas of ground activity or work centers at KSC and CCAFS. Note: JSC/SMG is responsible for all Space Shuttle landing forecasts, including those at the SLF, for RTLS and EOM.

5.20.4. Providing TAF support for SLF during ATC operating hours, PPR flying operations, and when the Space Shuttle is on-orbit.

5.20.5. Providing a 3-day temperature forecast, in 4-hour increments, to KSC/DO each day, during the winter months for conditions when the temperature is expected to fall to or go below 60 °F.

5.20.6. Providing a daily 7-day planning forecast of sky condition, weather, precipitation and lightning probabilities, prevailing wind direction and speed, and maximum and minimum temperature.

5.20.7. Providing hurricane/tropical storm support to NASA-KSC:

5.20.7.1. Disseminating, by electronic mail, telephone or facsimile, all hurricane/tropical storm/tropical depression advisories to NASA-KSC for tropical cyclones that potentially threaten the area. Pass advisories to the Hurricane Management Team (HMT), NASA-KSC DO, and the Emergency Operations Center from the time the hurricane/tropical storm/tropical depression forms, moves to within, or is forecast to move within 1200 NM within the next 72-84 hours, through the all clear. Advisory-related support includes providing the probability of exceeding a critical wind threshold versus time of arrival. The 45 WS coordinates threshold value(s) and required implementation time of the chart with the HMT Chairman or Launch Director (typically, the wind probability chart will be issued when either the 45 WS 120-hour forecast for the probability of winds exceeding the threshold is greater than zero, or the NHC begins issuing wind probabilities for any Florida location).

- 5.20.7.2. Providing support to the NASA-KSC HMT as specified in KSC Space Shuttle Hurricane Preparedness Management Plan (NSTS 07700, Volume VIII, Appendix T).
- 5.20.8. Providing Special Weather Advisory Support and METWATCH support for KSC weather-sensitive ground operations supporting launch programs.
- 5.20.8.1. Quickly notifying the NASA-KSC DO when previously unidentified weather events occur or are expected to occur, and when the weather condition is no longer a threat or danger.
- 5.20.8.2. Notifying the NASA-KSC DO if an unusually strong extratropical storm is possible in the next 72 hours--for example, a storm expected to produce sustained winds or repeated gusts exceeding 40 kts.
- 5.20.9. Providing environmental consultation, to include: current weather monitoring capabilities, climatological information, and meteorological advice. The 45 WS will participate in the coordination and operational implementation of meteorological LCC requirements. (Note: All meteorological LCC changes must be properly coordinated through appropriate NASA and 45 SW channels before implementation).
- 5.20.10. Providing mission support for NASA launch operations, with particular emphasis on items specified in the applicable OD. Support includes weather briefings for the Launch Director, or designated representative, normally via closed circuit television (CCTV). Also, as defined in applicable ODs, 45 WS provides operational weather support to the NASA-KSC Radiological Control Center (RADCC) within resource capabilities.
- 5.20.11. Collecting, processing, quality controlling and disseminating upper-atmospheric wind and temperature data from the Cape Weather Station-A (Facility 20185).
- 5.20.12. Operating and maintaining all meteorological equipment on KSC except on Pads 39-A/B, LDAR, and DRWP. Equipment maintained includes that for measuring wind, temperature, pressure, precipitation, cloud ceilings, and atmospheric electrical fields at the SLF and other locations on KSC. (Note: Operations and Maintenance service normally is not provided for research-type, 45 SW-uncertified meteorological equipment).
- 5.20.13. Providing full time (24 hours/day, 7 days/week) surface weather observations from Weather Station-B.
- 5.20.14. Providing required meteorological data for ingest into the operational toxic model.
- 5.20.15. Providing Space Shuttle operational and METWATCH verification.
- 5.20.16. Providing a Staff Meteorologist assigned to NASA-KSC if resources allow.
- 5.20.17. Providing a forecaster dedicated to Space Shuttle launch support and operations.
- 5.20.18. Providing a spokesperson for Space Shuttle and Constellation Program media weather briefings at KSC.
- 5.20.19. Providing technical evaluation, as required, of any meteorological proposals under NASA's Small Business Innovative Research program.
- 5.20.20. Providing Cooperative Weather Watch training for the SLF Air Traffic Controllers (ATC).

- 5.20.21. Providing visual displays via CCTV of weather radar, satellite imagery, and other pertinent weather information.
- 5.20.22. Providing operational support for upper-air soundings and predictions, as specified in applicable ODs.
- 5.20.23. Access to MIDDs capabilities in the MOC on a non-interference basis, for data acquisition and formatting, for NASA-directed meteorological research, development, and technology transition.
- 5.20.24. Meteorological weather data(e.g., weather tower data, ERDAS grids, etc.) necessary for NASA/KSC MARSS operation.
- 5.20.25. Support to the AMU as specified in the NASA/KSC with USAF/45 SW and NOAA/National Weather Service Memorandum of Understanding (MOU) entitled, "The Operation of the Applied Meteorology Unit" (45 SW No. 15E-2-27).
- 5.20.26. Support requirements and cost management will be processed in accordance with appropriate appendices of the JOSA and the NASA/AF MOA on Reimbursement of Launch and Associated Services for Uses of the Space Shuttle, 1 Feb 83.
- 5.20.27. Provide space, resources and assistance to SMG personnel in support of Emergency Mission Control Center activities in the event a tropical system threatens Johnson Space Center while the Space Shuttle is on orbit.

5.21. Department of Energy. The RWOC provides the Department of Energy weather information during day of launch for missions that involve any type of radiological material. This data is used to compute radiological plume information in case of a mishap. The 45 WS also provides two representatives to serve on the Interagency Nuclear Safety Review Panel (INSRP).

5.22. Human Space Flight Support (HSFS). Per DDMS Pamphlet 1 3610-03, 45 WS/CC serves as the HSFS Assistant for Meteorology (HSFS-W) and manages DoD weather support for Space Shuttle contingency operations. All Space Shuttle weather products and services are provided IAW applicable checklists and disseminated via weblink contained in the checklist.

- 5.22.1. TAL (Trans-Oceanic Abort Landing Site) Support. For every Space Shuttle launch the DDMS-W ensures weather support is provided at each TAL site.
- 5.22.2. Ensures TAL Atmospheric Sounding System (TASS) equipment is operational and supplies are available.
- 5.22.3. Coordinates TAL weather manning.
- 5.22.4. Maintains current written procedures at each TAL site.
- 5.22.5. Ensures weather personnel receive Shuttle unique training services as member of NASA Deployed Operations Team (DOT) and ensures all initial and recurring training is documented.
- 5.22.6. The Officer In Charge of contingency weather support for ground operations if the orbiter lands at either a TAL site or an Emergency Landing Site (ELS).

5.22.7. Ferry Flight. NASA performs Shuttle Ferry Flights (SFF) whenever the orbiter lands somewhere other than at KSC. The 45 WS is the primary weather unit responsible for SFF support. The 45 WS assigns one or two Ferry Weather Officers (FWO) to travel with the ferry team to coordinate both in-flight and on-the-ground support.

5.22.8. At each departure point, the FWO provides a weather briefing for the Shuttle Carrier Aircraft (SCA) and the Pathfinder with the help of the local weather unit and the LWF.

5.22.9. The FWO normally sits in the cockpit of the Pathfinder aircraft to coordinate any route deviations based on changes to initial flight briefing. The FWO may be “patched in” to the LWF via communications devices used by the aircrew.

5.23. The 114th Range Operations Squadron, ANG. The 45 WS will provide general forecast information upon request.

Chapter 6

LAUNCH WEATHER SUPPORT

6.1. General. 45 WS provides comprehensive launch support to the DoD, NASA, and commercial launch vehicles based at CCAFS and KSC 24/7 from the Range Weather operations Center (RWOC) in the Morrell Operations Center (MOC). The specific support requirements are coordinated via the UDS process and documented in the appropriate Operations Directive (OD). The major programs supported are Atlas, Delta, Falcon, Pegasus, Space Shuttle, and Trident. Each system has a lead Launch Weather Officer (LWO) to act as a POC to coordinate weather support for the program. Each system also has specific constraints such as space environment, wind, precipitation, temperature, etc. In addition, the Eastern Range has constraints known as the Range Safety Natural and Triggered Lightning Flight Commit Criteria (attachment 17), which are applicable to every vehicle launching from the Range. See the appropriate UDS Operations Directive and Range Safety Operations Requirements for details concerning these requirements. The following is a brief description of each program.

6.2. Atlas V. The Atlas V family of launch vehicles uses a Common Core Booster and a Centaur upper stage. The vehicle configurations provide a number of flexible mission trajectories for DoD, NASA, and commercial payloads. Multiple trajectory designs are available to place payloads into orbit as well as interplanetary trajectories. Atlas V launches from Complex 41. Specific aerospace weather concerns and constraints are located in appropriate sections of the UDS, Series 5100.

6.3. Delta II. The Delta II is a small to medium expendable launch vehicles are used to lift commercial, civil and DoD payloads into orbit. This vehicle was the primary booster responsible for lifting Air Force Global Positioning System (GPS) block IIR satellites into orbit. Commercial/civil missions range from scientific research to telecommunications satellites. Delta launches occur from Complex 17A/17B on CCAFS. Specific aerospace weather concerns and constraints for the Delta are located in appropriate sections of the UDS, Series 5300, 5400, and 5500.

6.3.1. Delta IV. The Delta IV is an expendable medium to heavy lift vehicle for both DoD, civil and commercial payloads. It launches from Complex 37. Delta IV's specific weather aerospace concerns and constraints are located in appropriate sections of the UDS, Series 5000.

6.4. Falcon 9. The Falcon 9 is a LOX and RP-1 two stage, medium to heavy lift, partially reusable vehicle designed for commercial geo-synchronous transfer orbit as well as civil international space station re-supply. Specific weather aerospace concerns and constraints for all aspects of the operation are located in the appropriate sections of the UDS, Series 6000.

6.5. Pegasus launch vehicle is launched from a modified L-1011 aircraft. Pegasus launch operations are rare and require some specialized weather support prior to and during the day-of-launch. Although Pegasus launch support is unique, weather support is less demanding than a standard unmanned launch of a larger vehicle from CCAFS.

6.6. Space Shuttle. The space shuttle is a recoverable manned launch vehicle that launches from Complex 39A. The RWOC provides weather support from pre-launch operations through post-landing operations. Shuttle weather sensitive operations include Rollover, Rollout/Rollback, Segment Moves, Launch, Landing, Ferry Flight, Solid rocket booster recovery operations, Post-landing roll from the SLF to the Orbiter Processing Facility, Payload operations, Terminal Countdown Demonstration Tests and External Tank ocean barge operations. While the RWOC is responsible for weather support for pre-launch activities through launch, from liftoff through landing, the NWS Spaceflight Meteorology Group (SMG) at Johnson Space Center in Houston is the responsible agency for weather support. Specific weather aerospace concerns and constraints for all aspects of the operation are located in the appropriate sections of the UDS, Series 20000.

6.7. Trident II. The Trident II missile is a three-stage solid propellant ballistic missile with a post-boost vehicle for the independent deployment of multiple re-entry bodies. Launched from submarines in the Atlantic, their specific launch location is generally classified. Missile processing is sometimes done in the port area prior to the mission. Specific aerospace weather concerns and constraints are located in appropriate sections of the UDS, Series 900.

6.8. New Launch Systems. Weather support will be identified for all new systems. The specific weather constraints for each new system will be outlined in the appropriate UDS documents.

6.9. Range Safety Natural and Triggered Lightning Launch Commit Criteria (LCC). The Lightning Flight Commit Criteria are a set of rules developed by the Lightning Advisory Panel consisting of leading scientists in atmospheric electricity. These rules were accepted by Range Safety to ensure the avoidance of natural and/or triggered lightning during space/ballistic launch operations. See attachment 17.

6.10. Execution. On launch day personnel in the RWOC use all meteorological sensing equipment located on or near CCAFS and KSC, to include weather reconnaissance aircraft, to assess the current and forecast atmospheric conditions to assure safe access to space. The Launch Weather Team (LWT) must have *clear and convincing* evidence that hazard avoidance criteria are not violated. To ensure these goals are met, a LWT is convened consisting of:

6.10.1. Launch Weather Commander (LWC). This position is normally filled by the 45 WS Commander or Operations Officer. The LWC provides oversight to the LWT during a launch countdown and high-level technical support and advice to the Launch Decision Authority (LDA). The LWC also approves weather commit criteria changes from RED to GREEN.

6.10.2. Launch Weather Director (LWD). This position is normally filled by the Range Weather Operations Flight Commander or Stan-Eval and Training Flight Commander, but may be filled by any certified LWO. The LWD supervises LWT members and orchestrates the operation of the LWT during the launch countdown. The LWD maintains Range Weather Operations Center (RWOC) access control and leads all LWT meetings and the post-mission "Hot Wash". The LWD also approves weather commit criteria changes from RED to GREEN when the LWC is not present in the RWOC and initiate and complete all required emergency checklists.

6.10.3. Launch Weather Officer (LWO). The lead LWO will serve as the single weather point of contact between the LWT, the range launch team, and the range user. The LWO develops and maintains a launch checklist for their vehicle(s) and prepares the Launch Weather Team tasking letter not later than one week prior to launch. The LWO is also responsible for performing system checks on weather and communications equipment and CCTV. Most importantly, the LWO forecasts, monitors, evaluates, and reports weather commit criteria RED/GREEN status, and has “hold call” responsibility after the final clear to launch authority has been given.

6.10.4. Deputy Launch Weather Officer (DLWO) for Radar. The DLWO-Radar is responsible for evaluating weather LCC using weather radar and lightning detection equipment. The DLWO-Radar makes extensive use of vertical launch profiles to ensure proper, three-dimensional stand-off requirements are met per the weather LCC. Any certified LWO may serve as the DLWO-Radar.

6.10.5. DLWO for Reconnaissance (Recce). The DLWO-Recce is responsible for communicating with and directing the weather reconnaissance aircraft to focus on those weather commit criteria and/or observations that are best evaluated in situ. The DLWO-Recce also must convert aircraft pressure-determined altitudes to real-world altitudes based on GPS sounding data and the WMO standard atmosphere. The DLWO-Recce also coordinates possible rapid scan satellite scheduling with NOAA SSD. Any certified LWO may serve as the DLWO-Recce.

6.10.6. Range Weather Forecaster (RWF). The RWF is responsible for providing synoptic discussions, observations, METWATCH, advisories/watches/warnings, and aircrew briefings.

6.10.7. Transoceanic Abort Landing (TAL) Coordinator (Shuttle only). The TAL Coordinator orchestrates search and rescue weather support for the three TAL sites and the 21 OWS in Europe as well as local search and rescue planning/preparation conducted by NORTHCOM Joint Task Force.

6.10.8. Toxic dispersion forecaster. The Toxics forecaster actively modifies weather rawinsonde data to accurately forecast conditions expected at T-0. The forecaster provides this information to the 45 SW/SE Risk Assessment Center (RAC) for inclusion into the toxic dispersion model.

Chapter 7

RECIPROCAL SUPPORT

7.1. General. The 45 WS requires reciprocal support from various base agencies, particularly when the required support is beyond 45 WS capabilities. The support requirements outlined herein are essential to the 45 WS in providing timely, accurate weather support to the Cape Canaveral Spaceport.

7.2. The 45th Space Wing Commander. The 45 SW/CC will chair meetings as required, but not less than annually, reviewing installation severe weather preparedness, capabilities, requirements, and procedures IAW AFI 10-229.

7.3. The 45th Space Command Post (45 SW/CP). The 45 SW/CP will:

7.3.1. Provide 45 WS with timely notice of alerts, alert messages, changes in Force Protection Conditions (FPCONS), and Battle Staff notification.

7.3.2. Notify the 45 WS of all incidents involving weather personnel or resources, severe weather, damage to wing resources due to severe weather or special weather services.

7.3.3. Disseminate Weather Warnings (WWs), Weather Advisories (WAs), and Watches.

7.3.4. Disseminate OPREP-3 and BEELINE reports to higher headquarters. 45 WS will provide information listed below for these reports:

7.3.4.1. Information on the actual severe weather conditions experienced.

7.3.4.2. The weather forecast valid at the time of the occurrence to include any watches and warnings issued.

7.3.4.3. The operational status of meteorological equipment (e.g., radar, wind sensors, etc.) at the time of the event.

7.4. The 1st Range Operations Squadron (1 ROPS). 1 ROPS will:

7.4.1. Coordinate programmed (UDS) weather support requirements and procedures between 45 WS/DO and contractors.

7.4.2. Schedule and notify weather reconnaissance aircraft IAW established procedures and documents.

7.4.3. Update daily spacelift ground processing status, upon request to facilitate weather squadron metwatch of weather hazards associated with these operations.

7.5. The 45th Operations Support Squadron. 45 OSS will:

7.5.1. Notify the RWF of all in-flight emergencies and aircraft accidents via secondary crash net.

7.5.2. Notify the duty forecaster and/or contract observer of scheduled after hours aerodrome observation requirements by 1500L on the day prior to the requirement, time and circumstances permitting (more lead-time is desirable). Exceptions will be made for emergencies, search and rescue missions, and special missions.

7.5.3. Provide daily radio checks on the PMSV frequency (344.6 MHz), and when requested.

7.5.4. Notify the RWF whenever normal communications are disrupted and advise of alternate method(s) required to relay weather information.

7.5.5. Participate in a Cooperative Weather Watch by informing the RWF of any of the following conditions, when the FMQ-19 is not reporting them:

7.5.5.1. Any observed difference between present weather and the official observation.

7.5.5.2. A tower visibility different from the prevailing surface visibility.

7.5.5.3. Any significant increase or decrease in visibility and/or low cloud ceiling height.

7.5.5.4. The formation of fog, thunderstorms (any observed lightning or thunder), funnel clouds, or tornadoes, hail and volcanic ash.

7.5.5.5. The beginning or ending of precipitation.

7.5.5.6. Any obstruction to vision not previously reported.

7.5.6. Assist in obtaining PIREPs/AIREPS, workload permitting. PIREPs/AIREPS will be solicited from the first available aircraft when requested by 45 WS personnel. Pass PIREPs/AIREPS received to the RWOC.

7.5.7. Coordinate with 45 WS for training control tower operators on local weather phenomena and to take limited weather observations.

7.5.8. Report significant weather changes observed on ATC radar to the RWOC.

7.5.9. Notify the range weather forecaster of KXMR (skid strip) flight and operations schedule.

7.5.10. Provide an orientation tour for weather personnel upon request.

7.5.11. When the prevailing visibility is 1 mile or less, or the Runway Visual Range (RVR) is 6,000 feet or less, report changes in the High Intensity Runway Light (HIRL) setting to the weather observer. This ensures the RVR is representative based on the correct HIRL.

7.5.12. Notify the range weather forecaster when a runway change is accomplished.

7.5.13. Change the FMQ-19 sensor to the appropriate sensor upon implementing a runway change.

7.6. The 45th Space Communications Squadron (45 SCS). 45 SCS will:

7.6.1. Maintain PAFB airfield weather observing equipment. In the event of multiple observing outages, the following priority will be used for restoral, subject to change under unusual weather conditions:

Table 7.1. Multiple Observing Outages, the Following Priority Will Be Used for Restoral, Subject to Change Under Unusual Weather Conditions.

Priority 1: FMQ-19
Priority 2: PMSV
Priority 3: N-TFS/JET (Network Connectivity Only)

7.6.2. For significant outages, keep maintenance response time to less than one hour after work center receives notification from 45 SCS Job Control.

NOTE: This response time will not apply if Meteorological and Navigation Equipment (METNAV) personnel are working to restore higher priority navigational aids equipment.

7.6.3. Provide local infrastructure communication services at CCAFS via 45 SCS. Provide telephone services, including Defense Switched Network and Federal Telecommunications System, as prescribed by existing DoD and USAF instructions.

7.6.4. Establish trouble reporting and restoral procedures and priorities for all government furnished weather longline and infrastructure communication facilities terminating at PAFB.

7.6.5. Ensure increased priority for LAN internet access restoral.

7.6.6. Ensure that a chaff countermeasures message is produced and disseminated at the beginning of each month.

7.7. The 45th Range Management Squadron (45 RMS). 45 RMS will:

7.7.1. Provide Range communication and weather instrumentation operations and maintenance via the ERTS contractor. The ER communication network provides transmission and relay of weather data as required by RWOC and Range users.

7.7.2. Ensure priority is given to restoration to weather equipment in a post hurricane/tropical system environment.

7.7.3. Provide oversight of service contract. Surface and upper air weather observing services at ER locations will be maintained by the contractor IAW the current RTSC Statement of Work. The RTSC contractor will also monitor and quality control upper-air data in real-time for launch operations support.

7.7.4. Establish trouble reporting, tracking, and restoral procedures for all government furnished weather instrumentation and Range communication facilities at all ER locations IAW the current RTSC Statement of Work.

7.7.5. Validate ER Instrumentation System sustainment and modification requirements to meet new and changing range meteorological requirements and to allow the RTSC contractor to certify critical range systems and operationally accept non-critical range instrumentation. This is to provide, in association with the Space and Missile Systems Center Program Office (SMC/RNP), ERIS installation, combined development/operational test and evaluation, engineering changes to operational systems/equipment and deactivation or relocation of systems/equipment declared excess to the needs of the ER.

7.7.6. Inform the 45 WS Commander of any significant changes to operational weather support requirements.

7.7.7. Establish, in writing and in coordination with 45 WS, an operational effectiveness metric, for the range contractor's performance, IAW AFI 15-114, AFSPC SUP 1.

7.8. The 45th Force Support Squadron. 45 FSS will notify 45 WS/CC of all incidents involving weather personnel and/or resources.

7.9. NASA. Through a separate agreement, NASA has agreed to provide the following:

7.9.1. Provide a daily input via NASA-KSC Integrated Control Schedule (KICS) of the weather-sensitive ground operations in support of the Space Shuttle Programs to the RWOC. Provide the location, duration, and limiting weather parameters (for example: winds, precipitation, lightning, desired lead-times, etc.) as part of the schedule. Prior coordination is necessary so additional manpower can be scheduled, if available. Verify all schedule inputs changed within 24 hours of the required support by direct verbal communication between the NASA-KSC DO and RWOC.

7.9.2. Provide training and informational materials to 45 WS when weather LCCs are changed to ensure 45 WS understands the operational reasons and technical basis for the LCC.

7.9.3. Retain engineering support, spares, system configuration, maintenance and failure analysis documentation for KSC-furnished/RWOC-used meteorological equipment in KSC property records.

7.9.4. Coordinate engineering development and installation of all Air Force meteorological equipment on KSC for master planning and radio frequency management with NASA-KSC agencies. This equipment will be recorded and tracked on Air Force property records.

7.9.5. Provide operational support and funding for research and development instrumentation required by NASA-KSC.

7.9.6. Coordinate NASA-KSC meteorological support improvements with the 45 WS through the NASA-KSC Weather Office.

Note: Accomplish improvements in accordance with UDS procedures.

7.9.7. Through the NASA-KSC DO, notify the RWOC of any NASA-KSC aircraft, orbiter, missile, or space launch vehicle mishap immediately. Notify RWOC of any KSC weather-related damage incidents as soon as possible.

7.9.8. Through the SLF coordinators/ATC (when on duty):

7.9.8.1. Notify Weather Station-B whenever the control tower is open and operating during other than the normal operating hours (Monday through Friday, 0800L-1600L).

7.9.8.2. Notify Weather Station-B when the runway is in use. Report runway surface conditions and report any subsequent changes.

7.9.8.3. Notify Weather Station-B of any aircraft mishap.

7.9.8.4. Participate in a CWW by informing Weather Station-B, via the hotline, of any of the following conditions:

7.9.8.4.1. Any observed or pilot-reported difference in present weather and the official observation.

7.9.8.4.2. Any significant increase or decrease in visibility.

7.9.8.4.3. The formation of fog, thunderstorms, funnel clouds, or tornadoes.

7.9.8.4.4. The beginning or ending of precipitation.

7.9.8.4.5. Any observed lightning or thunder which was previously unreported.

7.9.9. Operational NASA-KSC MARSS users shall not change, alter, or delete any meteorological data without prior coordination with the RWOC.

7.9.10. The 45 SW/SE (Eastern Range Safety Office) shall be responsible for all non-launch day toxic hazard control for planned/accidental releases of toxic commodities during planned/scheduled system maintenance/vehicle processing, and unplanned releases, e.g., not during a scheduled operation, that occur on CCAFS property, and toxic modeling/product support for unplanned releases, e.g., not during a scheduled operation, on NASA-KSC property, or when releases result in an emergency 911 call during scheduled operations on NASA-KSC property. NASA-KSC notifies the 45 SW during unplanned releases (i.e., not during a scheduled operation) that occur on KSC property, or when a hazardous material release results in an emergency 911 call during a scheduled operation on NASA-KSC property. The 45 SW/SE will provide all toxic modeling support once notified (See 45 SW 15E-2-16 for more complete information on toxic hazard responsibilities.).

7.9.11. NASA-KSC provides to the 45 WS:

7.9.11.1. Office space and furniture, utilities, janitorial and facility maintenance support to Weather Station-B and the NASA-KSC Staff Meteorologist if applicable.

7.9.11.2. Documentation for NASA-KSC equipment furnished to the Air Force to develop training materials.

7.9.11.3. Technology transition services as specified in the NASA/KSC with USAF/45 SW and NOAA/National Weather Service Memorandum of Understanding (MOU) entitled, "The Operation of the Applied Meteorology Unit" (45 SW No. 15E-2-27).

7.9.11.4. Placards and badge overlays to enable authorized personnel access through security checkpoints to instrumentation and facilities during Space Shuttle operations.

7.9.11.5. Coordination of all outages that will affect meteorological instrumentation, systems, or facilities with CCAFS Meteorological Instrumentation personnel.

7.10. RTSC Responsibilities:

7.10.1. Provide initial and annual weather observer training to 45 weather squadron personnel.

7.10.2. Provide weather balloon operator training and WPOC (weather point of contact) training. The RTSC will also provide refresher courses to personnel scheduled to provide upcoming TAL support.

7.10.3. Provide all other support as outlined in the RTSC, 45th Weather Squadron contract.

B. EDWIN WILSON, Brigadier General, USAF
Commander

Attachment 1

GLOSSARY OF REFERENCES AND SUPPORTING INFORMATION

References AFI 10-206, Operational Reporting, 6 September 11

AFI 10-229, Responding to Severe Weather, 15 October 03

AFPD 15-1. Atmospheric and Space Environmental Support, 19 February 10

AFMAN 15-111, Surface Weather Observations, 10 March 09

AFI 15-114, Weather Support Evaluation, 7 December 01

AFMAN 15-124, Meteorological Codes, 28 October 09

AFI 15-128, Air and Space Weather Operations--Roles and Responsibilities, 7 February 11

AFMAN 15-129, Aerospace Weather Operations--Operations and Procedures, 21 June 04

AFI 15-180, Air Force Weather Standardization and Evaluation Program, 23 July 07

45 SW/JOP 15E-3-7, Meteorological Support Between the 45th Space Wing and the John F. Kennedy Space Center, 1 May 07

45 SW Comprehensive Emergency Management Plan 10-2, Volume 1, Cape Canaveral Air Force Station, 29 November 10

45 SW Comprehensive Emergency Management Plan 10-2, Volume 1, Patrick Air Force Base, 29 November 10

Abbreviations and Acronyms

45 SW—45th Space Wing

45 WS—45th Weather Squadron

45 WS/DO—45th WS Director of Operations

AFB—Air Force Base

AFI—Air Force Instruction

AFMAN—Air Force Manual

AFPD—Air Force Policy Directive

AFS—Air Force Station

AFWA—Air Force Weather Agency

AGL—Above Ground Level

ALSTG—Altimeter Setting

AMPS—Automated Meteorological Profiling System

AOA—Abort Once Around

AOS—Automated Observing System

ATC—Air Traffic Control

AMU—Applied Meteorological Unit
BWC—Bird Watch Conditions
BWS—Base Weather Station
CBP—Customs and Border Protection
CC—Commander
CCAFS—Cape Canaveral Air Force Station
CCTV—Closed Circuit Television
CSR—Computer Sciences Raytheon
CWW—Cooperative Weather Watch
DLT—Desired Lead-Time
DLWO—Deputy Launch Weather Officer
DoD—Department of Defense
DoL—Day of Launch
DOT—Deployed Operations Team
DSN—Defense Switched Network
EDT—Eastern Daylight Time
EELV—Evolved Expendable Launch Vehicle
ELS—Emergency Landing Site
EOM—End of Mission
ER—Eastern Range
ERDAS—Eastern Range Dispersion Assessment System
ERTSC—Eastern Range Technical Services Contract
FLIP—Flight Information Publication
FPCONS—Force Protection Conditions
FSS—Force Support Squadron
FWA—Forecast Weather Advisory
FWO—Ferry Weather Officer
HMT—Hurricane Management Team
HSFS—Human Space Flight Support
HURCON—Hurricane Condition
IAW—In Accordance With
ICG—Icing

INSRP—Interagency Nuclear Review Panel
JET—Joint Environmental Toolkit
JSC—Johnson Space Center
JDMTA—Jonathon Dickenson Missile Tracking Annex
JOP—Joint Operating Procedure
JOSA—Joint Operating and Support Agreement
KCOF/COF—International Identifier for Patrick AFB
KICS—KSC Integrated Control Schedule
KSC—Kennedy Space Center
KT(S)—Knot(s)
KTTS—International Identifier for KSC's Shuttle Landing Facility
KXMR—International Identifier for CCAFS's Skid Strip
L—Local weather observation
LCC—Launch Commit Criteria
LLWS—Low Level Wind Shear
LWC—Launch Weather Commander
LWD—Launch Weather Director
LWO—Launch Weather Officer
LWT—Launch Weather Team
MEF—Mission Execution Forecast
METAR—Aviation Routine Weather Report
METNAV—Meteorological and Navigation Equipment
METWATCH—Meteorological Watch
MIDDS—Meteorological Interactive Data Display System
MOC—Murrell Operations Center
MSL—Mean Sea Level
NAOC—National Airborne Operations Center
NASA—National Aeronautics and Space Administration
NHC—National Hurricane Center
NM—Nautical Miles
NOAA—National Oceanographic and Atmospheric Administration
N-TFS—New Tactical Forecast System

NWS—National Weather Service
OBSVD—Observed
OD—Operations Directive
OG—Operations Group
OI—Operations Instruction
OWA—Observed Weather Advisory
OWS—Operational Weather Squadron
PAFB—Patrick Air Force Base
PIREP—Pilot Report
PMSV—Pilot to Metro Service
RAC—Risk Analysis Center
RADCC—Radiological Control Center
RAPCON—Radar Approach Control
RECCE—Reconnaissance
ROS—Representative Observation Site
RQS—Rescue Squadron
RSC—Runway Surface Condition
RSS—Really Simple Syndication
RTLS—Return To Landing Site
RVR—Runway Visual Range
RWF—Range Weather Forecaster
RWOC—Range Weather Operations Center
SAR—Search and Rescue
SCA—Shuttle Aircraft Carrier
SCS—Space Communications Squadron
SCLS—Space Coast Launch Services
SFC—Surface
SFS—Security Forces Squadron
SFF—Shuttle Ferry Flight
SPECI—Special weather observation
SLF—Shuttle Landing Facility
SLS—Space Launch Squadron

SMG—Spaceflight Meteorology Group
SOF—Supervisor of Flying
SOP—Standing Operating Procedures
SW—Space Wing
SY—Systems Division
TAF—Terminal Aerodrome Forecast
TAL—Trans-Oceanic Abort Landing Site
TASS—TAL Atmospheric Sounding System
TURBC—Turbulence
UDS—Universal Documentation System
USAF—United States Air Force
USP—Urgent Special weather observation
UTC—Universal Time Coordinated (GMT, Zulu)
WPOC—Weather Point of Contact
WR—Wet Runway
WS—Weather Squadron
WW—Weather Warning
Z/ZULU—Same as Universal Time Coordinated (UTC)

Terms

Anvil cloud—means a stratiform or fibrous "cloud" produced by the upper outflow or blow-off from "thunderstorms" or convective "clouds" having tops at altitudes where the temperature is colder than or equal to -10 degrees Celsius.

Associated—means that two or more "clouds" are causally related to the same "disturbed weather" system or are physically connected. "Clouds" occurring at the same time are not necessarily "associated." A cumulus "cloud" formed locally and a cirrus layer that is physically separated from that cumulus "cloud" and that is generated by a distant source are not "associated," even if they occur over or near the launch point at the same time.

Average cloud thickness—is the altitude difference (in kilometers, km hereafter) between the average top and the average base of all clouds in the "specified volume." The cloud base to be averaged is the higher of (1) the 0 degree Celsius level and (2) the lowest extent (in altitude) of all "radar reflectivity" measurements of 0 dBZ or greater. Similarly, the cloud top to be averaged is the highest extent (in altitude) of all "radar reflectivity" measurements of 0 dBZ or greater. Given the grid-point representation of a typical radar processor, allowance must be made for the vertical separation of grid points in computing "average cloud thickness": The cloud base at any horizontal position shall be taken as the altitude of the corresponding base grid point minus half of the grid-point vertical separation. Similarly, the cloud top at that horizontal position shall be taken as the altitude of the corresponding top grid point plus half of this vertical

separation. Thus, a cloud represented by only a single grid point having a "radar reflectivity" equal to or greater than 0 dBZ in the "specified volume" would have an "average cloud thickness" equal to the vertical grid-point separation in its vicinity.

Bright band—means an enhancement of "radar reflectivity" caused by frozen hydrometeors falling and beginning to melt at any altitude where the temperature is 0 degrees Celsius or warmer.

Cloud—means a visible mass of suspended water droplets or ice crystals. The "cloud" is considered to be the entire volume enclosed by the visible, "nontransparent cloud" boundary as seen by an observer, or, in the absence of a visual observation, by the 0 dBZ "radar reflectivity" boundary. A visual evaluation of transparency is preferred whenever possible. Distance from the "cloud" to a point in question refers to the separation between the point and the nearest part of that "cloud." Specifically, the wording, "less than or equal to 10 nautical miles from any cumulus 'cloud'" means that the "flight path" must not penetrate either the *interior* of the "cloud" itself or the volume between 0 and 10 nautical miles, inclusive, *outside* the "cloud" boundary [for example, see E. G417.9(a), Cumulus "Clouds"]. On the other hand, "between 0 and 3 nautical miles, inclusive, from" refers *only* to the volume at a distance that is greater than or equal to 0, but less than or equal to 3, nautical miles *outside* the "cloud" boundary, specifically omitting the interior of the "cloud" itself [for example, see H. G417.15(a), "Debris Clouds"].

Cloud layer—means a vertically continuous array of "clouds," not necessarily of the same type, whose bases are approximately at the same level.

Cloud top—means the visible top of the cloud, or, in the absence of a visual observation, the 0 dBZ radar top. A visual evaluation of "cloud top" is preferred whenever possible.

Cone of silence—means the volume in an inverted circular cone centered on the radar that is generated by all elevation angles greater than the maximum elevation angle used in the radar scan strategy. For the purpose of "VAHIRR" calculation this volume is capped by the observed maximum "cloud top" height, the observed tropopause height, or an altitude of 20 km (66 kft), whichever is lowest.

Cumulonimbus cloud—means any convective "cloud" with any part at an altitude where the temperature is colder than -20 degrees Celsius.

Debris cloud—means any "cloud," except an "anvil cloud," that has become detached from a parent "cumulonimbus cloud" or "thunderstorm," or that result from the decay of a parent "cumulonimbus cloud" or "thunderstorm."

Disturbed weather—means a weather system where dynamical processes destabilize the air on a scale larger than individual "clouds" or cells. Examples of "disturbed weather" include fronts, troughs, and squall lines.

Electric field measurement—means the 1-minute arithmetic average of the vertical electric field (E_z) at the surface of Earth, measured by a ground-based "field mill." The polarity of the electric field is the same as that of the potential gradient; that is, the polarity of the field at Earth's surface is the same as the dominant charge overhead. Do not use interpolated electric field contours for purposes of this appendix. An "'electric field measurement' less than or equal to 5 nautical miles from the 'flight path'" [e.g., C. G417.5(a) Surface Electric Fields] is not applicable if the altitude of the flight path everywhere above the 5 nautical mile circle around the "field mill" in question is greater than 20 km (66 kft).

Field mill—is a specific class of electric-field sensor that uses a moving, grounded conductor to induce a time-varying electric charge on one or more sensing elements in proportion to the ambient electrostatic field. **Note:** For the purpose of this publication, distance from an electric "field mill" is measured differently than distance from any other object or measurement point: Distance between a "radar reflectivity" or "Volume Averaged Height Integrated Radar Reflectivity" ("VAHIRR") measurement point and any object or the "flight path" is the *shortest separation* (horizontal, vertical, or slant range) between that point and the *nearest part* of the object or "flight path." Similarly, distance between the "flight path" and any object is the *shortest separation* between any point on the "flight path" the *nearest part* of that object. For example, "every point less than or equal to 1 nautical mile from the 'flight path'" [see F. G417.11(c)(2) Attached "Anvil Clouds"] means that the "VAHIRR" threshold must be satisfied at every point throughout the entire volume defined by a 1 nautical mile radius from every point on the "flight path." (See also the additional explanation beneath the definition of "cloud.") In contrast, distance between a "field mill" or an "electric field measurement" and any object or the "flight path" is always measured *horizontally* between that mill or measurement point and the nearest part of the *vertical projection* of the object or "flight path" onto the surface of Earth. For example, "from the center of the 'cloud top' to at least one working 'field mill'" [see E. G417.9(d)(2) Cumulus "Clouds"] means that the *horizontal* distance between the "field mill" and a point on the surface directly beneath the center of the "cloud top" must be less than 2 nautical miles. The following bold-face terms are defined here and appear in quotes wherever they are used in accordance with these definitions elsewhere in this appendix.

Flight path—means the planned nominal flight trajectory, including its vertical and horizontal uncertainties specified by the three-sigma guidance and performance deviations.

Moderate precipitation—means a "precipitation" rate of 0.1 inches/hr or a "radar reflectivity" factor of 30 dBZ.

Nontransparent—"Cloud" cover is "nontransparent" if one or more of the following conditions is present: (a) Objects above, including higher "clouds," blue sky, and stars, are blurred, indistinct, or obscured as viewed from below; or objects below, including terrain, buildings, and lights on the ground, are blurred, indistinct, or obscured as viewed from above; when looking through the "cloud" cover at visible wavelengths (the sun and moon may not be used to evaluate transparency); (b) Such objects are seen distinctly only through breaks in the "cloud" cover; or; (c) The "cloud" cover has a "radar reflectivity" factor of 0 dBZ or greater.

Precipitation—means detectable rain, snow, hail, graupel, or sleet at the ground; virga; or a "radar reflectivity" factor greater than 18 dBZ at any altitude above the ground.

Radar reflectivity—means the radar return from hydrometeors, in dBZ, measured by a meteorological radar operating at a wavelength greater than or equal to 5 cm. A "radar reflectivity" measurement is valid only in the absence of significant attenuation by intervening "precipitation" or by water or ice on the radome.

Specified volume—The volume bounded in the horizontal by vertical planes with perpendicular sides located 5.5 km (3 nautical miles) north, east, south, and west of the point at which "VAHIRR" is being computed. The volume is bounded on the bottom at the altitude where the temperature is 0 degrees Celsius, and on the top by a fixed altitude of 20 km (66 kft).

Thick cloud layer—means one or more "cloud layers" whose combined vertical extent from the base of the bottom layer to the "cloud top" of the uppermost layer exceeds a thickness of 4,500 feet. "Cloud layers" are combined with neighboring layers for determining total thickness only when they are physically connected by vertically continuous "clouds," as, for example, when towering "clouds" in one layer contact or merge with "clouds" in a layer (or layers) above.

Thunderstorm—means any convective "cloud" that produces lightning.

Transparent—Any "cloud" that is not "nontransparent" is "transparent."

Treated—means that a launch vehicle satisfies both of the following conditions: (a) All surfaces of the launch vehicle susceptible to ice particle impact are such that the surface resistivity is less than 10^9 "Ohms per square;" and; (b) All conductors on surfaces (including dielectric surfaces that have been coated with conductive materials) are bonded to the launch vehicle by a resistance that is less than 10^5 ohms.

Triboelectrification—means the transfer of electrical charge between ice particles and the launch vehicle when the ice particles collide with the vehicle during flight.

Volume-Averaged, Height-Integrated Radar Reflectivity (VAHIRR)—is the product of the "volume-averaged radar reflectivity" and the "average cloud thickness" in a "specified volume" surrounding any point at which "VAHIRR" is being computed (units of dBZ-km). The "specified volume" must not contain any portion of the "cone of silence" above the radar, nor any portion of any sectors that may have been blocked out for payload-safety reasons.

VAHIRR application criteria—The individual grid-point reflectivity measurements used to determine either the "volume-averaged radar reflectivity" or the "average cloud thickness" must be meteorological "radar reflectivity" measurements. For "VAHIRR"-evaluation points along the "flight path" itself (*not* those at a prescribed distance away from the "flight path"), the "volume-averaged, height-integrated radar reflectivity" is not applicable at any point that is less than or equal to 10 nautical miles from any "radar reflectivity" of 35 dBZ or greater at altitudes of 4 km (13 kft) or greater above mean sea level, nor is it applicable at any point that is less than or equal to 10 nautical miles from any type of lightning that has occurred in the previous 5 minutes.

Volume-averaged radar reflectivity—is the arithmetic average (in dBZ) of the "radar reflectivity" in the "specified volume." Normally, a radar processor will report reflectivity values interpolated onto a regular, three-dimensional array of grid points. Any such grid point in the "specified volume" is included in the average if and only if it has a "radar reflectivity" equal to or greater than 0 dBZ. If fewer than 10% of the grid points in the "specified volume" have "radar reflectivity" measurements equal to or greater than 0 dBZ, then the "volume-averaged radar reflectivity" is either the maximum "radar reflectivity" (in dBZ) in the "specified volume," or 0 dBZ, whichever is greater.

Attachment 2**EXAMPLE PATRICK AFB AND SHUTTLE LANDING FACILITY TAFS****FORECASTS**

KCOF FCST 17-17 13009KT 7 VCSHRA SCT020 SCT060 BKN090 ALSTG30.05INS
FM 02 VRB05KT 3 BR FEW010 SCT025 ALSTG30.00INS
BECMG 11-12 19007KT 7 NSW SCT025 SCT210 ALSTG30.05INS 12/JA

KTTS FCST 18-18 21008KT 7 SCT030 SCT060 BKN120 ALSTG30.08INS WND
180V260 VCSHRA TIL 22 AND AFT 04
BECMG 12-13 23010G15KT 7 SCT030 BKN060 OVC120 ALSTG30.00INS
LAST NO AMDS AFT 0521 NEXT 0612 10/JB

AMENDMENTS/CORRECTIONS

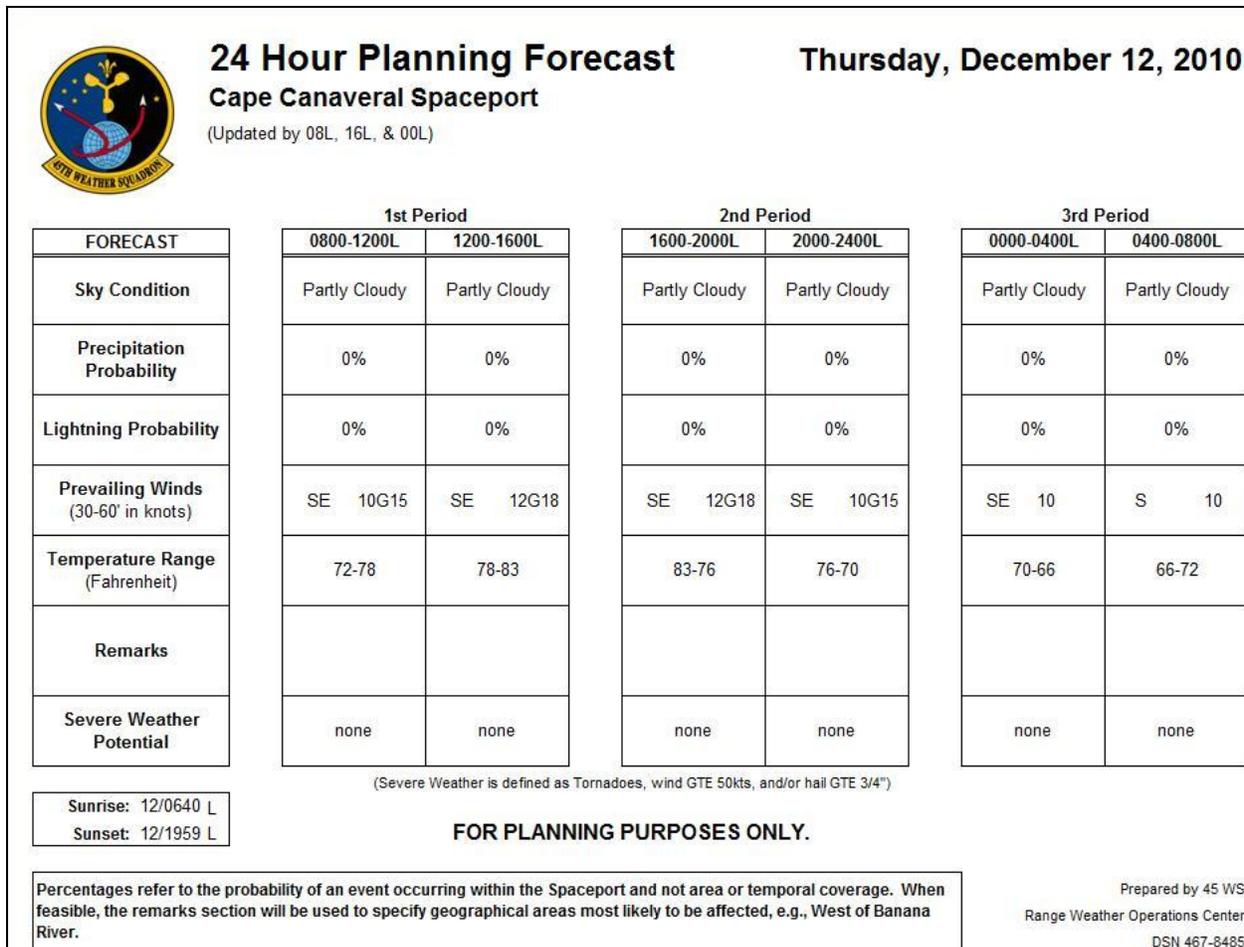
KCOF FCST AMD 19-17 23010KT 5 -RA BKN020 BKN060 OVC100 .ALSTG30.05INS
BECMG 21-22 19007KT 7 NSW SCT025 SCT060 BKN100 ALSTG30.05INS
AMD 1934 38/JA

KTTS FCST COR 18-18 21008KT 7 SCT030 SCT060 BKN120 ALSTG30.08INS WND
180V260 VCSHRA TIL 22 AND AFT 04
BECMG 12-13 23010G15KT 7 SCT030 BKN060 OVC120 ALSTG30.00INS
COR 1845 LAST NO AMDS AFT 0521 NEXT 0612 49/JB

Attachment 3

24-HOUR PLANNING FORECAST

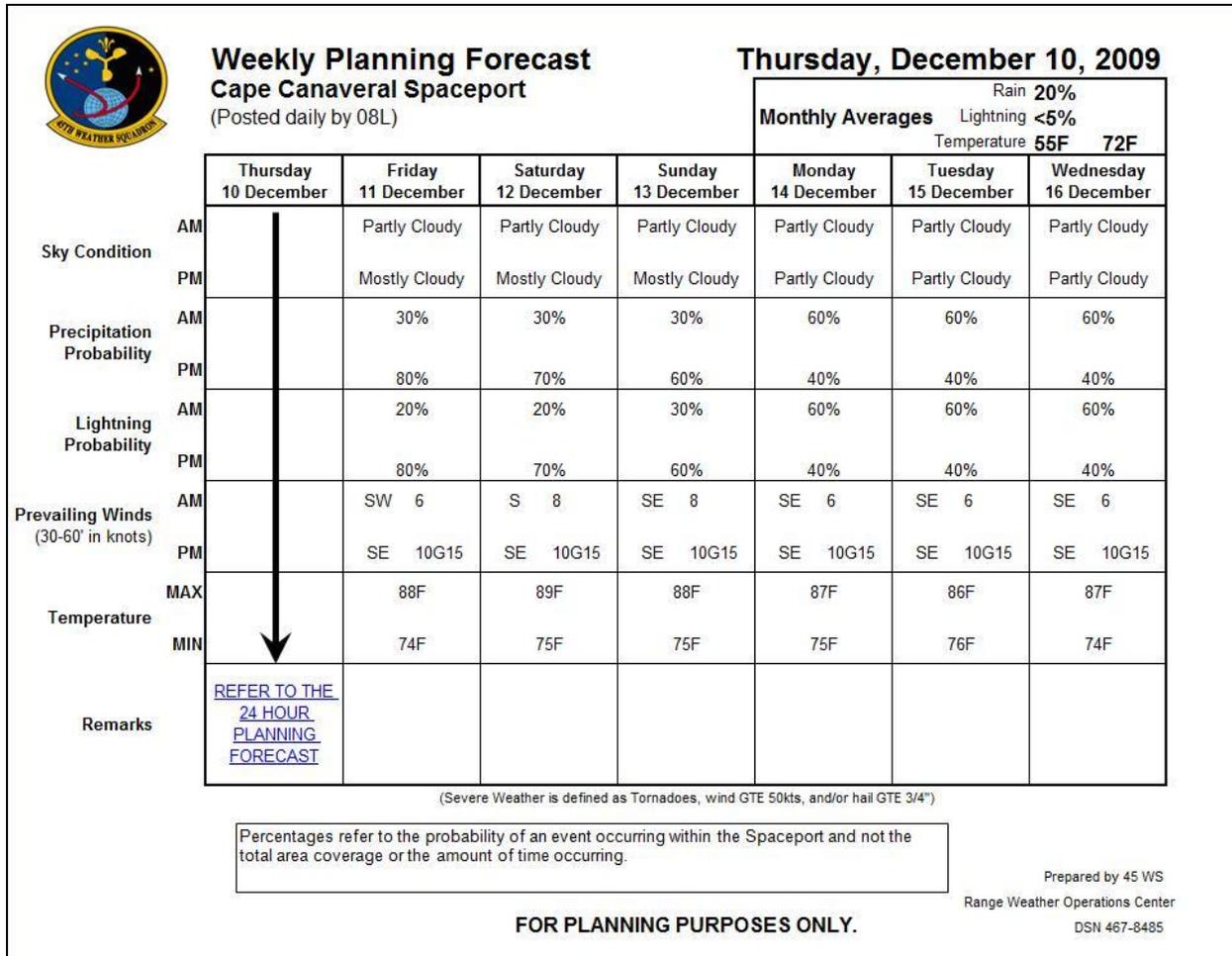
Figure A3.1. 24-HOUR PLANNING FORECAST.



Attachment 4

SEVEN-DAY PLANNING FORECAST

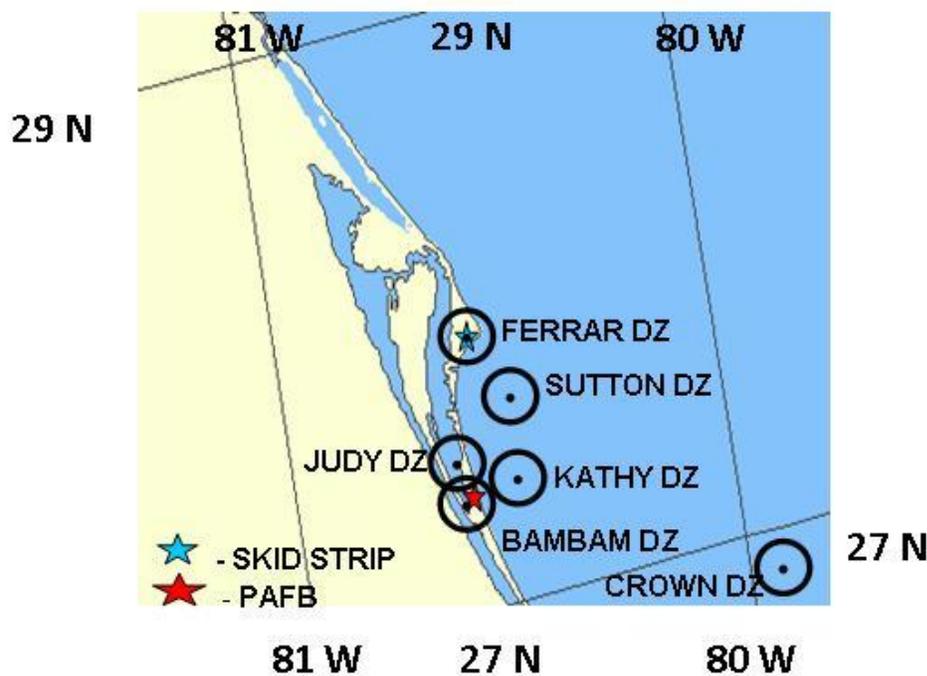
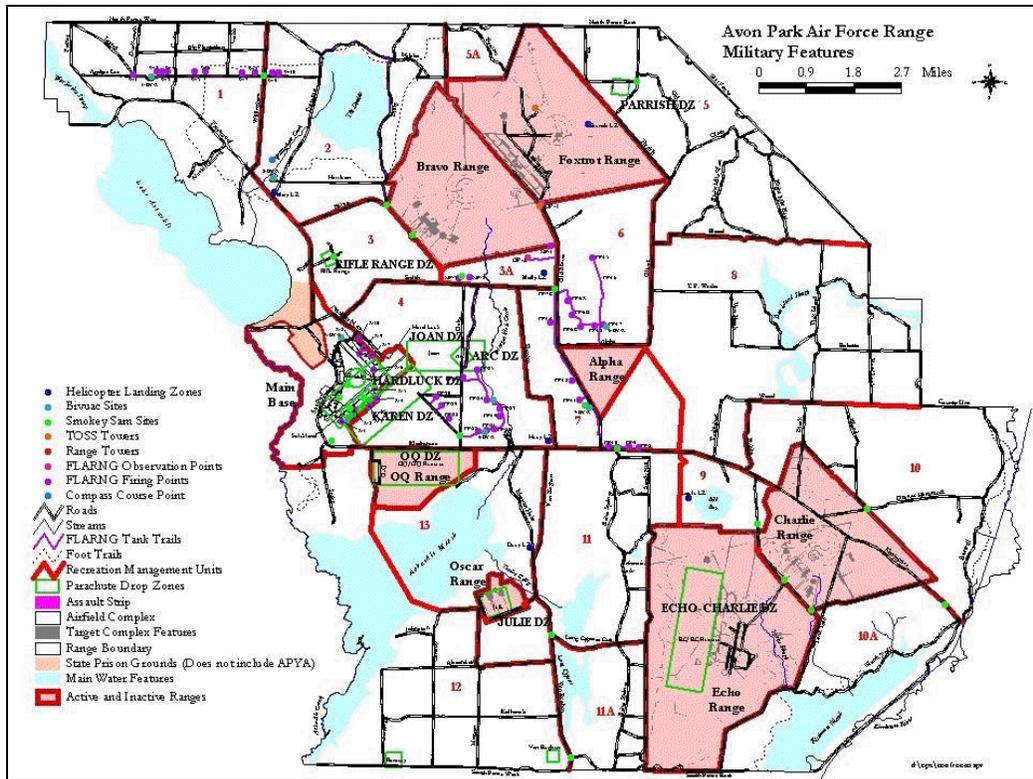
Figure A4.1. SEVEN-DAY PLANNING FORECAST.



Attachment 5

AVON PARK TRAINING AREA AND DROP ZONES

Figure A5.1. AVON PARK TRAINING AREA AND DROP ZONES.



Attachment 6
AVON PARK FLIMSY

Figure A6.1. AVON PARK FLIMSY.

For planning purposes only - call 45 WS for official forecast (DSN 467-8485)



45 WS MISSION PLANNING FORECAST

Date: 9-Dec-10 Local-Z Offset: 5
Valid Time: 1300Z - 0400Z

Patrick Air Force Base / Judy DZ / Crown DZ Forecast:



32010KT 7 SCT040 BKN120 BKN250
AFT 17Z 35010G15KT 7 SCT040 BKN120
AFT 01Z 01008KT 7 SCT040

	13Z	14Z	15Z	16Z	17Z	18Z	19Z	20Z	21Z	22Z	23Z	24Z	01Z	02Z	03Z	04Z
TEMP C	14C	16C	18C	20C	21C	22C	22C	22C	21C	21C	20C	20C	19C	18C	17C	17C
	57F	61F	64F	68F	70F	72F	72F	72F	70F	70F	68F	68F	67F	64F	63F	62F
ALSTG	30.09	30.08	30.07	30.06	30.06	30.05	30.05	30.05	30.06	30.06	30.06	30.06	30.07	30.07	30.08	30.09
PA	-161	-151	-141	-131	-131	-121	-121	-121	-131	-131	-131	-141	-141	-151	-161	-161

Avon Park Gunnery Range Local Forecast:

32008KT 7 SCT040 BKN120 BKN250
AFT 17Z 35010G15KT 7 SCT040 BKN120
AFT 01Z 01008KT 7 SCT040

	13Z	14Z	15Z	16Z	17Z	18Z	19Z	20Z	21Z	22Z	23Z	24Z	01Z	02Z	03Z	04Z
TEMP C	13C	14C	16C	18C	20C	21C	21C	21C	20C	20C	19C	19C	18C	17C	17C	17C
	55F	57F	61F	64F	68F	70F	70F	70F	68F	68F	67F	66F	64F	62F	63F	63F
ALSTG	30.11	30.11	30.10	30.09	30.09	30.08	30.07	30.04	30.01	30.00	30.01	30.01	30.02	30.04	30.04	30.05
PA	-124	-124	-114	-104	-104	-94	-84	-54	-24	-14	-24	-24	-34	-54	-54	-64

Cape Canaveral Air Station / Ferrar DZ Forecast:

33008KT 7 FEW085 FEW140 OVC200
AFT 17Z 35010G15KT 7 SCT040 BKN120
AFT 01Z 01008KT 7 SCT040

	13Z	14Z	15Z	16Z	17Z	18Z	19Z	20Z	21Z	22Z	23Z	24Z	01Z	02Z	03Z	04Z
TEMP C	14C	16C	18C	20C	21C	22C	22C	22C	21C	21C	20C	20C	19C	18C	17C	17C
	57F	61F	64F	68F	70F	72F	72F	72F	70F	70F	68F	68F	66F	64F	63F	63F
ALSTG	30.09	30.08	30.07	30.06	30.06	30.05	30.05	30.05	30.06	30.06	30.06	30.07	30.08	30.08	30.08	30.09
PA	-160	-150	-140	-130	-130	-120	-120	-120	-130	-130	-130	-140	-150	-150	-150	-160

DROP ZONE WINDS/TEMPERATURES

FL	DIR	SPL	TEMP
FL100	21015	-04	
FL080	19015	-01	
FL060	16010	+02	
FL040	06010	+04	
FL030	05010	+07	
FL020	04010	+09	
FL010	03010	+12	
FL005	02015	+14	

LOCAL FLIGHT HAZARDS

Thunderstorms
NONE

Turbulence
LGT-MOD 180/350

Icing
LGT RIME 180/210

VIS/CIG
Min Vis: 7
Min Cig: 120

SEAS
Sea Temp: 75 F
Sea State: 2-4 FT

SOLAR/LUNAR DATA (dd/hhhh)

Sunrise	09/0703 L	Sunset	09/1726 L	EENT	09/1821 L
Moonrise	09/1009 L	Moonset	09/2119 L	Illumination	13 %

FORECASTER COMMENTS/ADDITIONAL INFORMATION

For planning purposes only - call 45 WS for official forecast (DSN 467-8485)

SOP F-03-4 Attachment 1

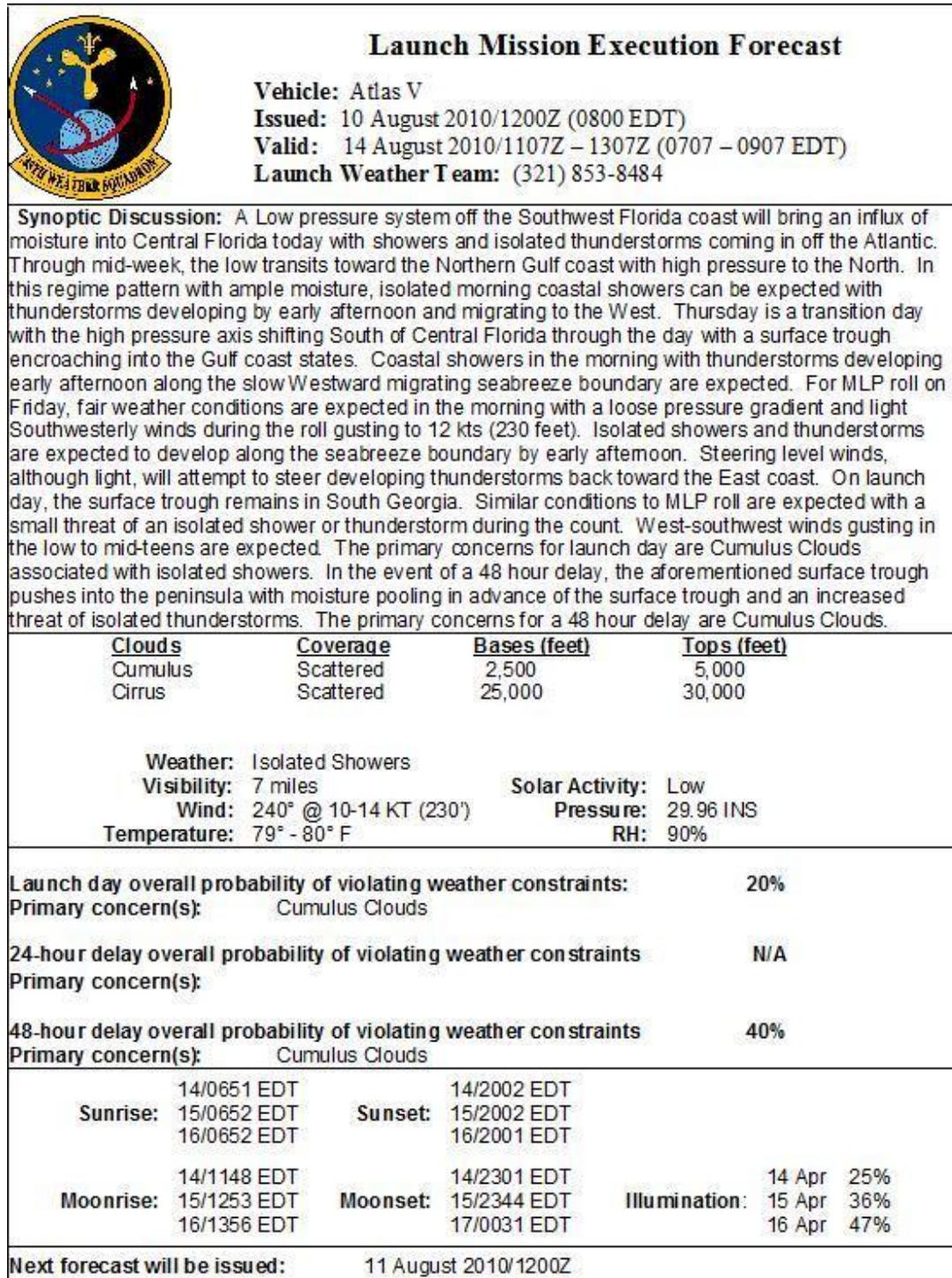
PLANNING WEATHER ONLY - ISSUED AT 8AM WITH NO UPDATES AFTERWARD - CALL 45 WS FOR OFFICIAL BRIEFING

PLANNING WEATHER ONLY - ISSUED AT 8AM WITH NO UPDATES AFTERWARD - CALL 45 WS FOR OFFICIAL BRIEFING

Attachment 7

DAY-OF-LAUNCH FORECAST

Figure A7.1. DAY-OF-LAUNCH FORECAST.



Attachment 9

MISSION EXECUTION FORECAST (MEF) EXAMPLE

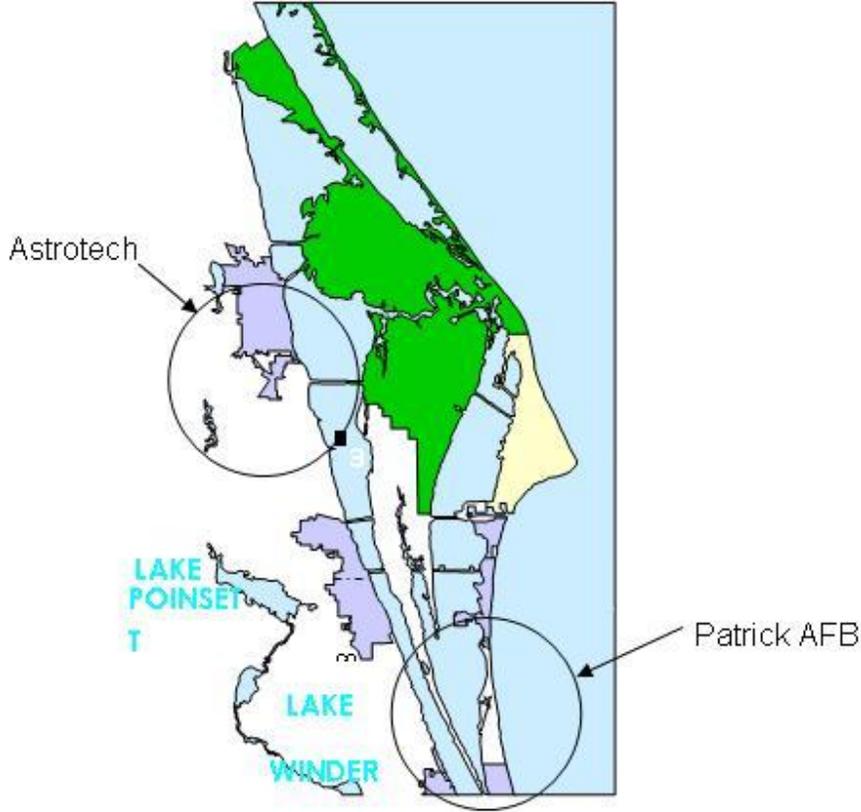
Figure A9.1. Mission Execution Forecast (MEF) Example.

45 WS MISSION EXECUTION FORECAST		DEPARTURE STATION / ETD		DATE		TYPE AIRCRAFT / CALL SIGN	
		KCOF /		Z		/	
TAKE OFF DATA							
VALID TIME	WIND (M /)	VIS	WEATHER	TMP °C	DP °C	SKY CONDITION	ALSTG PA
-	Z						FT
CLIMB WINDS:			WARNINGS / ADVISORIES			RCR / RSC	BIRD WATCH CONDITION
REMARKS (TSTMS IMPLY LLWS)							
ENROUTE DATA							
FLIGHT LEVELS WIND / TEMPERATURE				<input type="checkbox"/> SEE ATTACHED		SPACE WEATHER	
						LIGHT / NVG DATA	
						NO IMPACT	MARGINAL
						SVR	BMNT
						SR	Z MR
						SS	Z MS
						EENT	Z ILLUM
FREEZING LEVELS / LOCATION				GPS ERROR			
THUNDERSTORMS		TURBULENCE		ICING		PRECIPITATION	
MWA / WW NO.		CAT ADVISORY		NONE		NONE	
X	NONE	AREA	LINE	X	NONE	IN CLEAR	IN CLOUD
ISOLATED 1 - 2%		LIGHT		TRACE		LIGHT	
FEW 3 - 15%		MODERATE		LIGHT		MODERATE	
SCATTERED 16 - 45%		SEVERE		MODERATE		HEAVY	
NUMEROUS - MORE THAN 45%		EXTREME		SEVERE		SHOWERS	
HAIL, SEVERE TURBULENCE & ICING, HEAVY PRECIPITATION, LIGHTNING & WIND SHEAR EXPECTED IN AND NEAR THUNDERSTORMS.		LEVELS		LEVELS		FREEZING LOCATION	
LOCATION		LOCATION		LOCATION			
AIR REFUELING / ORBIT / LOW LEVEL ROUTE FORECAST							
LOCATION / FLIGHT LEVEL	CLOUDS	VIS	WEATHER	WINDS	VALID TIME		
							Z
							Z
DROP / LANDING ZONE FORECAST							
DROP ZONE / ALTITUDE	CLOUDS / VISIBILITY / WEATHER			WIND / TEMPERATURE °C		ALSTG	VALID TIME
				SURFACE	DROP ALTITUDE		
							Z
							Z
HAZARDS / REMARKS:							
WIND (AGL) / TMP °C		040	050	060	080	100	120
		SFC	005	010	015	020	025
							030
RECOVERY / ALTERNATE FORECAST							
STATION	WIND (MT)	VIS	WEATHER	TEMP	SKY CONDITION	PA	ALSTG
	M						Z
	M						Z
	M						Z
	M						Z
	M						Z
REMARKS (TSTMS IMPLY LLWS)				PMSV LOCATION		ATTACHMENT	
For Flight Briefings at stops contact				KCOF		344.6	
45th WS - DSN 467-8485/ COM (321) 853-8485				BRIEFING DATA			
28th OWS - DSN 965-0939/ COM (877) 297-4129				BRIEFED TIME (ZULLU)		REBRIEFED TIME (ZULLU)	
				E			

Attachment 10

PATRICK AFB METWATCH AREAS

Figure A10.1. PATRICK AFB METWATCH AREAS.



Attachment 11**PATRICK AFB METWATCH PRODUCTS**Weather Watch Example:

Weather Watch 11-A01 for Patrick AFB (KCOF) Valid 22/1700Z (22/1200L) to 22/2000Z
Potential for Severe Thunderstorms is forecast for Patrick AFB. (Winds GTE 50kts and/or Hail
GTE 3/4in)

Lightning Warning Example:

Weather Warning 11-A01 for Patrick AFB (KCOF) Valid 22/1700Z (22/1200L) UFN
Observed Lightning is occurring within 5 nm. This is a Phase II lightning condition.

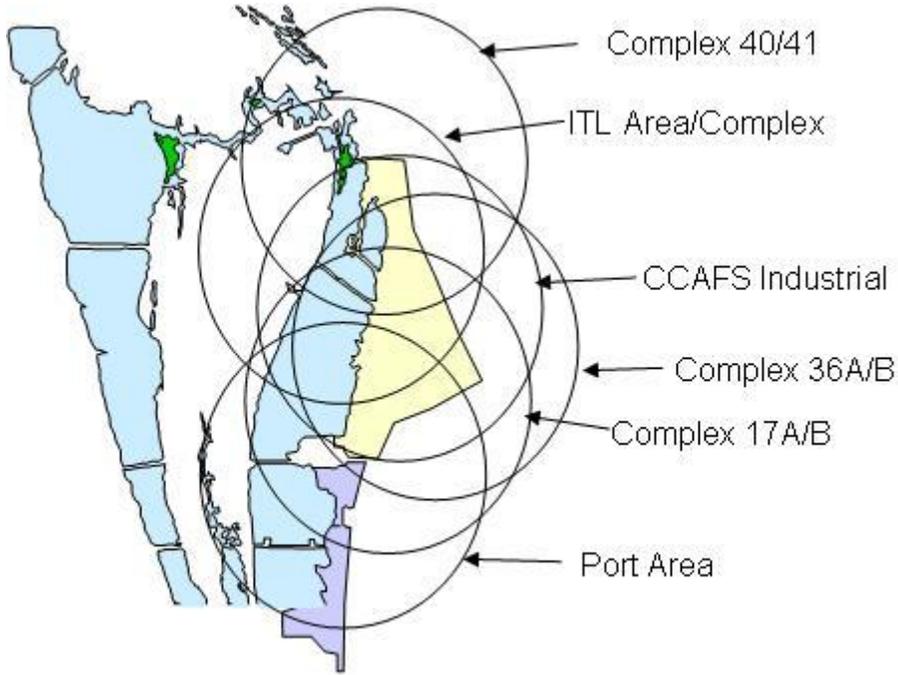
Weather Advisory Example:

Weather Advisory 11-A01 for Patrick AFB (KCOF) Valid 22/1700Z (22/1200L) to 22/2000Z
Forecast Winds greater than or equal to 25 but less than 35 kts. Maximum expected 25 kts.
Winds expected 12015G25Kts

Attachment 12

CCAFS LIGHTNING WATCH AND WARNING LOCATIONS

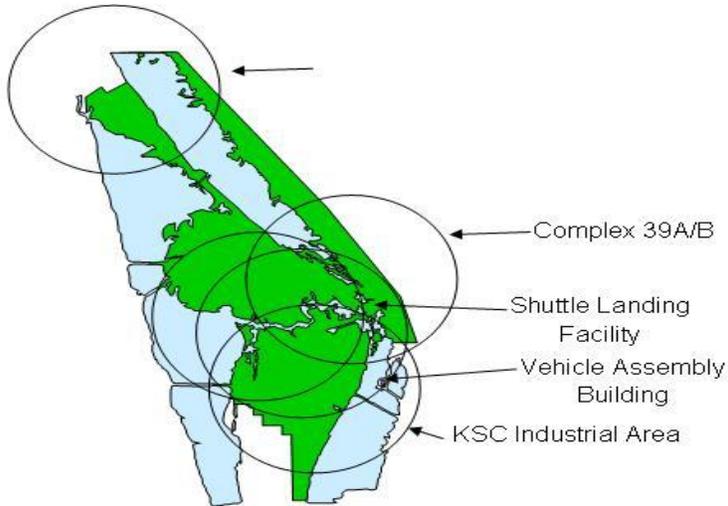
Figure A12.1. CCAFS LIGHTNING WATCH AND WARNING LOCATIONS.



Attachment 13

KSC LIGHTNING WATCH AND WARNING LOCATIONS

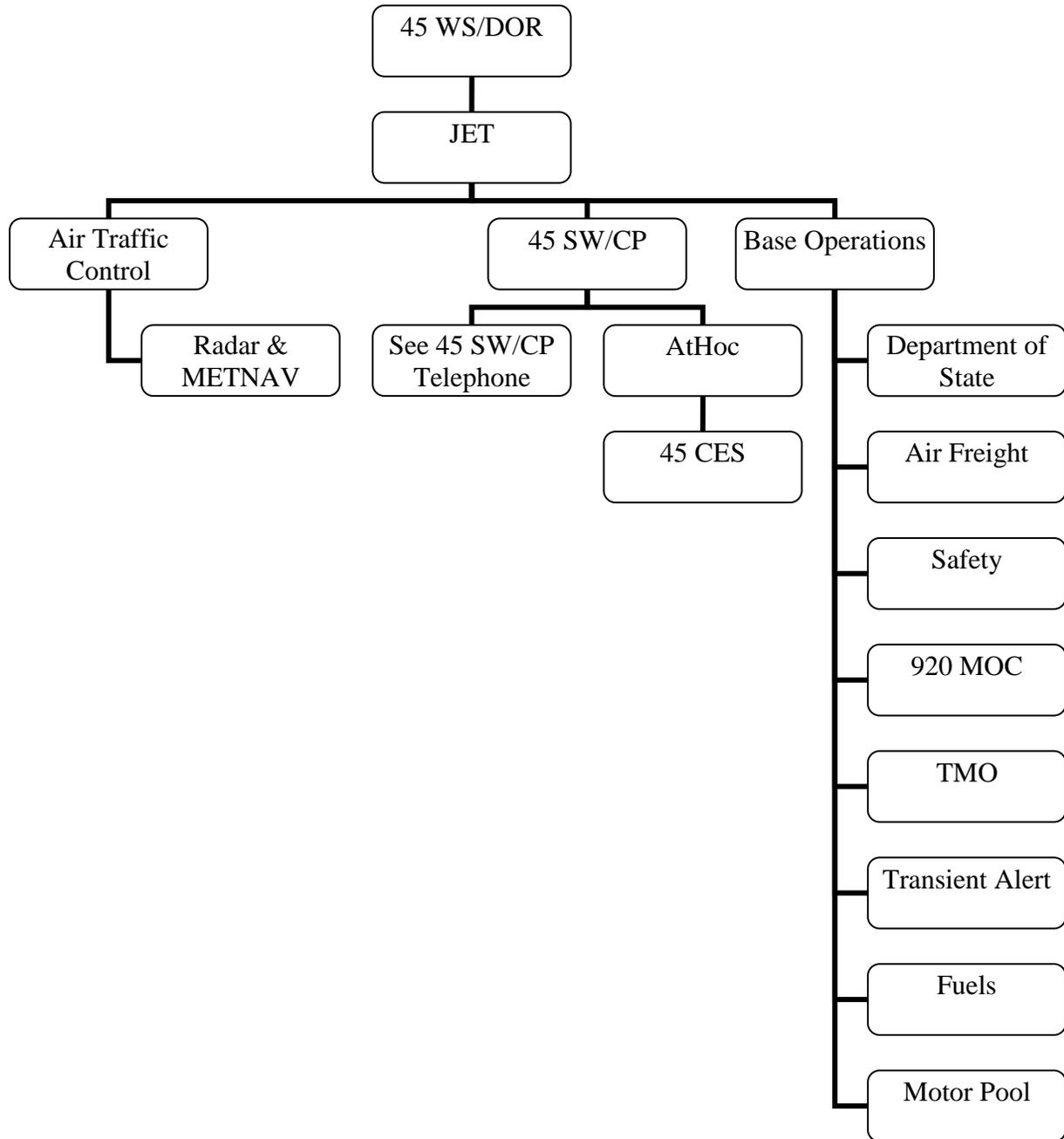
Figure A13.1. KSC LIGHTNING WATCH AND WARNING LOCATIONS.



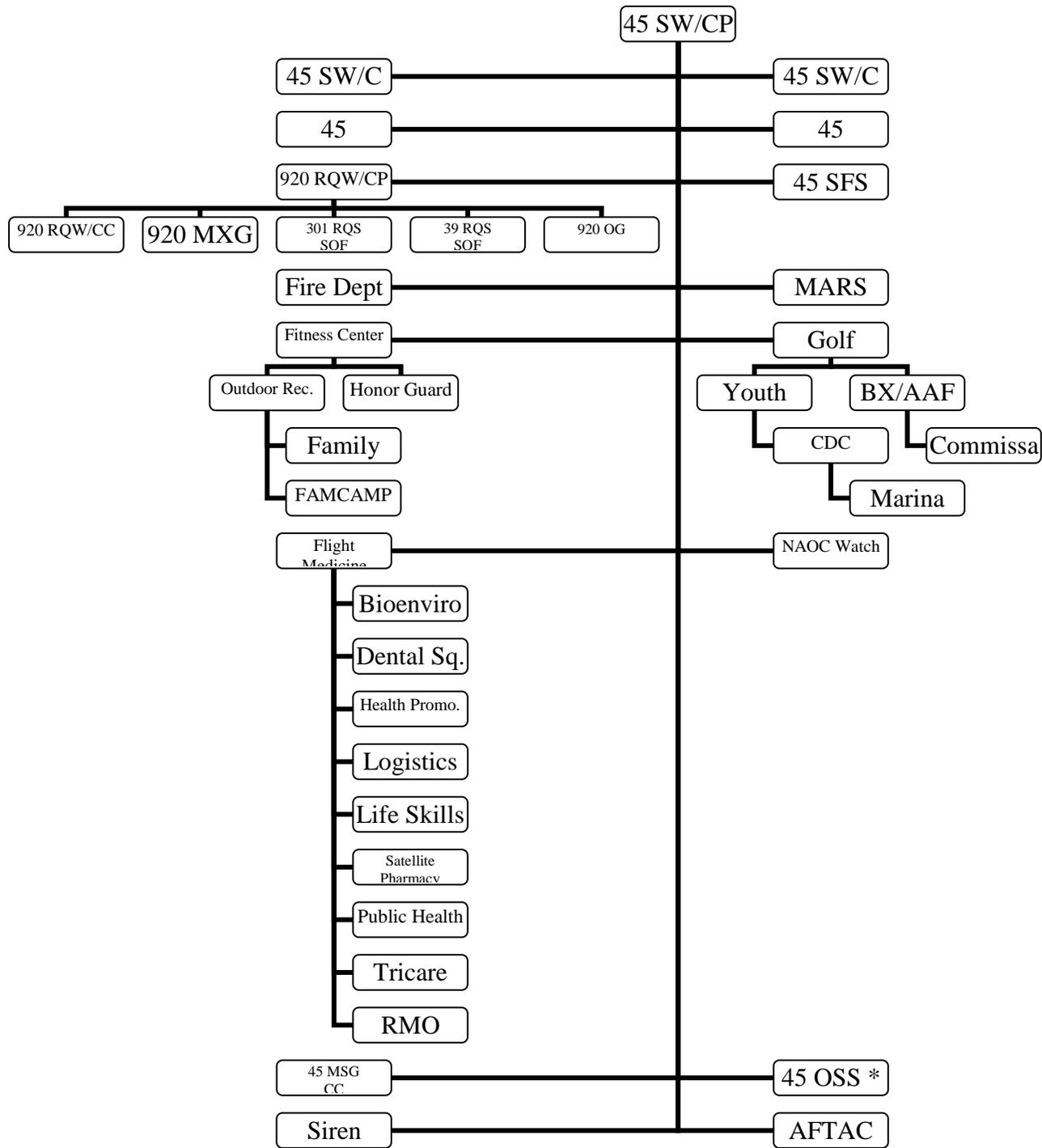
Attachment 14

PATRICK AFB WEATHER WATCH, WARNING AND ADVISORY DISSEMINATION PYRAMID

Figure A14.1. PATRICK AFB WEATHER WATCH, WARNING AND ADVISORY DISSEMINATION PYRAMID.



PATRICK AFB WEATHER WATCH, WARNING AND ADVISORY DISSEMINATION PYRAMID CONTINUED

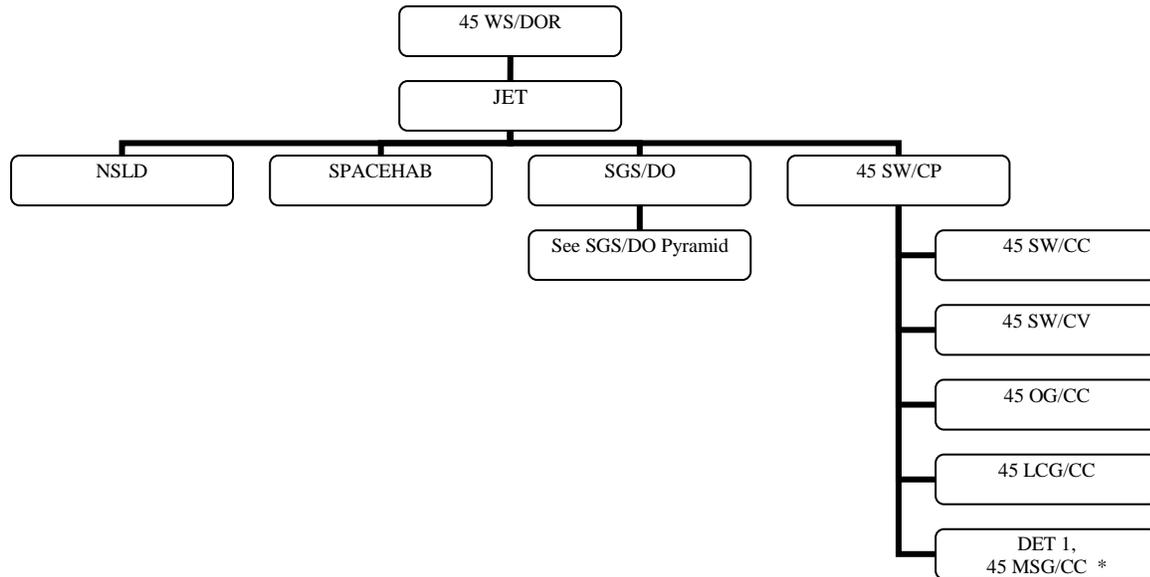


* - After duty hours only

Attachment 15

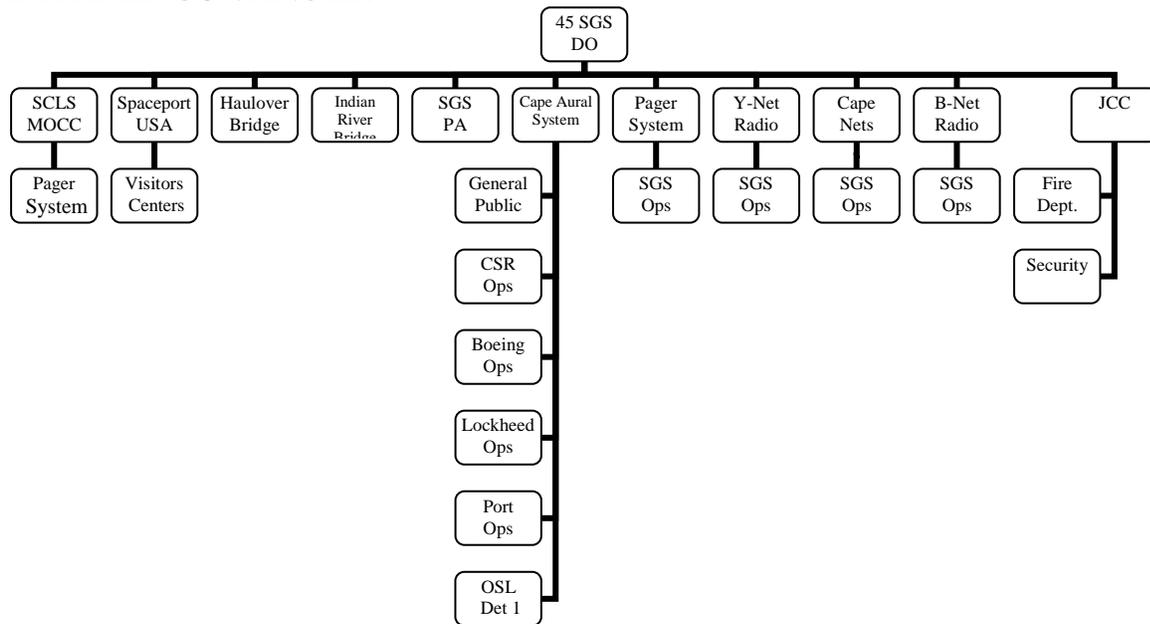
CCAFS WEATHER WATCH, WARNING AND ADVISORY DISSEMINATION PYRAMID

Figure A15.1. CCAFS WEATHER WATCH, WARNING AND ADVISORY DISSEMINATION PYRAMID.



* - After duty hours only

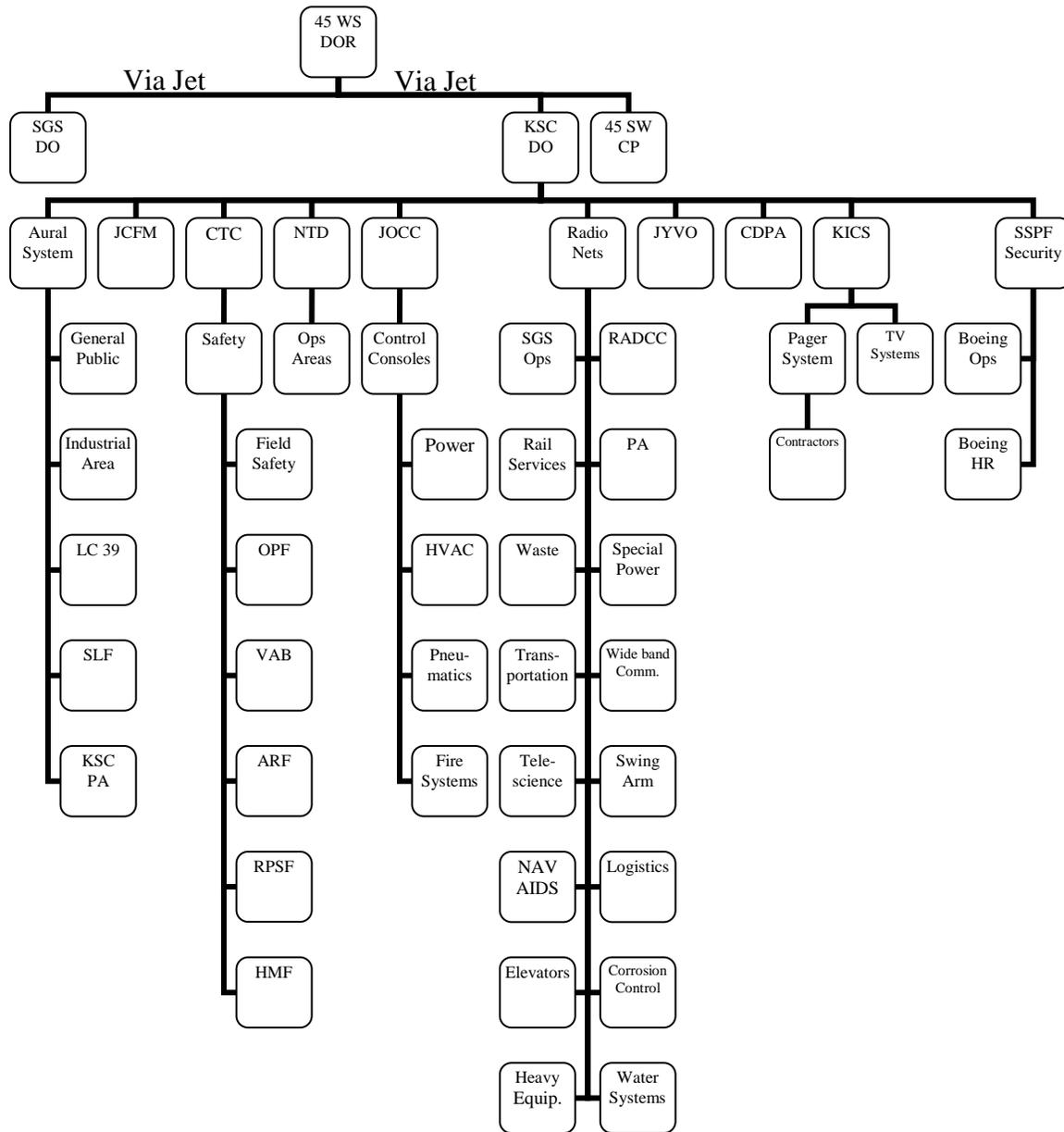
CCAFS WEATHER WATCH, WARNING AND ADVISORY DISSEMINATION PYRAMID CONTINUED.



Attachment 16

KSC WEATHER WATCH, WARNING AND ADVISORY DISSEMINATION PYRAMID

Figure A16.1. KSC WEATHER WATCH, WARNING AND ADVISORY DISSEMINATION PYRAMID.



Attachment 17**LIGHTNING LAUNCH COMMIT CRITERIA**

The Launch Weather Team must have clear and convincing evidence that the following hazard avoidance criteria are not violated.

Even when these criteria are not violated, if any other hazardous condition exists, the Launch Weather Team will report the threat to the Launch Director. The Launch Director may HOLD at any time based on the instability of the weather.

1. Surface Electric Fields.

(a) A launch operator must not initiate flight for 15 minutes after the absolute value of any "electric field measurement" less than or equal to 5 nautical miles from the "flight path" has been greater than or equal to 1500 volts/meter.

(b) A launch operator must not initiate flight for 15 minutes after the absolute value of any "electric field measurement" less than or equal to 5 nautical miles from the "flight path" has been greater than or equal to 1000 volts/meter unless either Section (1) or Section (2) is satisfied:

(1) All clouds less than or equal to 10 nautical miles from the "flight path" are "*transparent*;" or;

(2) All "clouds" less than or equal to 10 nautical miles from the "flight path" have "cloud tops" at altitudes where the temperature is warmer than +5 degrees Celsius and have not been part of convective "clouds" with "cloud tops" at altitudes where the temperature is colder than or equal to -10 degrees Celsius during the last 3 hours.

2. Lightning.

(a) A launch operator must not initiate flight for 30 minutes after any type of lightning occurs in a "thunderstorm" if the "flight path" will carry the launch vehicle less than or equal to 10 nautical miles from that "thunderstorm." An attached "anvil cloud" is not considered part of its parent "thunderstorm," but is covered instead by paragraph 4, Attached "Anvil Clouds."

(b) A launch operator must not initiate flight for 30 minutes after any type of lightning occurs less than or equal to 10 nautical miles from the "flight path" unless all three of the following conditions are satisfied:

(1) The "cloud" that produced the lightning is greater than 10 nautical miles from the "flight path;"

(2) There is at least one working "field mill" less than 5 nautical miles from each such lightning discharge; and;

(3) The absolute values of all "electric field measurements" less than or equal to 5 nautical miles from the "flight path," and at each "field mill" specified in paragraph (b)(2) of this section, have been less than 1000 volts/meter for 15 minutes or longer.

3. Cumulus Clouds.

For the purposes of this section, "cumulus 'clouds'" do not include cirrocumulus, altocumulus, or stratocumulus "clouds." An attached "anvil cloud" is never considered part of its parent cumulus "cloud," but is covered instead by paragraph 4, Attached "Anvil Clouds." Paragraph 5, Detached "Anvil Clouds," applies to any detached "anvil cloud." Paragraph 6, "Debris Clouds," applies to "debris clouds."

(a) A launch operator must not initiate flight if the "flight path" will carry the launch vehicle less than or equal to 10 nautical miles from any cumulus "cloud" that has a "cloud top" at an altitude where the temperature is colder than or equal to -20 degrees Celsius.

(b) A launch operator must not initiate flight if the "flight path" will carry the launch vehicle less than or equal to 5 nautical miles from any cumulus "cloud" that has a "cloud top" at an altitude where the temperature is colder than or equal to -10 degrees Celsius.

(c) A launch operator must not initiate flight if the "flight path" will carry the launch vehicle through any cumulus "cloud" with its "cloud top" at an altitude where the temperature is colder than or equal to -5 degrees Celsius.

(d) A launch operator must not initiate flight if the "flight path" will carry the launch vehicle through any cumulus "cloud" that has a "cloud top" at an altitude where the temperature lies in the range from warmer than -5 degrees Celsius to colder than or equal to +5 degrees Celsius unless all three of the following conditions are satisfied:

(1) The "cloud" is not producing "precipitation;"

(2) The distance from the center of the "cloud top" to at least one working "field mill" is less than 2 nautical miles; and;

(3) All "electric field measurements" less than or equal to 5 nautical miles from the "flight path," and at each "field mill" specified in paragraph (d)(2) of this section, have been greater than -100 volts/meter, but less than +500 volts/meter, for 15 minutes or longer.

4. Attached "Anvil Clouds".

For the purposes of this section, if there has never been lightning in or from the parent "cloud" or "anvil cloud," sub-sections (a) and (b) shall be considered satisfied, but sub-section (c) shall still apply.

(a) A launch operator must not initiate flight if the "flight path" will carry the launch vehicle less than or equal to 10, but greater than 5, nautical miles from any attached "anvil cloud" for the first 30 minutes after the last lightning discharge in or from the parent "cloud" or "anvil cloud" unless the portion of the attached "anvil cloud" less than or equal to 10 nautical miles from the "flight path" is located entirely at altitudes where the temperature is colder than 0 degrees Celsius.

(b) A launch operator must not initiate flight if the "flight path" will carry the launch vehicle less than or equal to 5, but greater than 3, nautical miles from any attached "anvil cloud" for the first three hours after the last lightning discharge in or from the parent "cloud" or "anvil cloud" unless the portion of the attached "anvil cloud" less than or equal to 5 nautical miles from the "flight path" is located entirely at altitudes where the temperature is colder than 0 degrees Celsius.

(c) A launch operator must not initiate flight if the "flight path" will carry the launch vehicle less than or equal to 3 nautical miles from any attached "anvil cloud" unless all three of the following conditions are satisfied:

- (1) The portion of the attached "anvil cloud" less than or equal to 5 nautical miles from the "flight path" is located entirely at altitudes where the temperature is colder than 0 degrees Celsius;
- (2) The "volume-averaged, height-integrated radar reflectivity" is less than +10 dBZ-km (+33 dBZ-kft) at every point less than or equal to 1 nautical mile from the "flight path;" and;
- (3) All of the "VAHIRR application criteria" are satisfied.

5. Detached "Anvil Clouds".

For the purposes of this section, detached "anvil clouds" are never considered "debris clouds."

For the purposes of this section, if there has never been lightning in or from the parent "cloud" or "anvil cloud," sub-sections (a), (b), (c), and (d)(1)(i) shall be considered satisfied, but sub-sections (d)(1)(ii), and (d)(2), shall still apply.

(a) A launch operator must not initiate flight if the "flight path" will carry the launch vehicle less than or equal to 10, but greater than 3, nautical miles from a detached "anvil cloud" for the first 30 minutes after the last lightning discharge in or from the parent "cloud" or "anvil cloud" before detachment or after the last lightning discharge in or from the detached "anvil cloud" after detachment unless the portion of the detached "anvil cloud" less than or equal to 10 nautical miles from the "flight path" is located entirely at altitudes where the temperature is colder than 0 degrees Celsius.

(b) A launch operator must not initiate flight if the "flight path" will carry the launch vehicle between 0 (zero) and 3 nautical miles, inclusive, from a detached "anvil cloud" for the first 30 minutes after the time of the last lightning discharge in or from the parent "cloud" or "anvil cloud" before detachment or after the last lightning discharge in or from the detached "anvil cloud" after detachment unless all three of the following conditions are met:

- (1) The portion of the detached "anvil cloud" less than or equal to 5 nautical miles from the "flight path" is located entirely at altitudes where the temperature is colder than 0 degrees Celsius;
- (2) The "volume-averaged, height-integrated radar reflectivity" is less than +10 dBZ-km (+33 dBZ-kft) at every point less than or equal to 1 nautical mile from the "flight path;" and;
- (3) All of the "VAHIRR application criteria" are satisfied.

(c) A launch operator must not initiate flight if the "flight path" will carry the launch vehicle between 0 (zero) and 3 nautical miles, inclusive, from a detached "anvil cloud" less than or equal to 3 hours, but greater than 30 minutes, after the time of the last lightning discharge in or from the parent "cloud" or "anvil cloud" before detachment or after the last lightning discharge in or from the detached "anvil cloud" after detachment unless Section (1) or Section (2) is satisfied:

- (1) This section is satisfied if all three of the following conditions are met:

- (i) There is at least one working "field mill" less than 5 nautical miles from the detached "anvil cloud";
 - (ii) The absolute values of all "electric field measurements" less than or equal to 5 nautical miles from the "flight path," and at each "field mill" specified in paragraph (c)(1)(i) of this section, have been less than 1000 V/m for 15 minutes; and;
 - (iii) The maximum radar reflectivity from any part of the detached "anvil cloud" less than or equal to 5 nautical miles from the "flight path" has been less than +10 dBZ for 15 minutes.
- (2) This section is satisfied if all three of the following conditions are met:
- (i) The portion of the detached "anvil cloud" less than or equal to 5 nautical miles from the "flight path" is located entirely at altitudes where the temperature is colder than 0 degrees Celsius;
 - (ii) The "volume-averaged, height-integrated radar reflectivity" is less than +10 dBZ-km (+33 dBZ-kft) at every point less than or equal to 1 nautical mile from the "flight path;" and;
 - (iii) All of the "VAHIRR application criteria" are satisfied.
- (d) A launch operator must not initiate flight if the "flight path" will carry the launch vehicle through a detached "anvil cloud" unless Section (1) or Section (2) is satisfied
- (1) This section is satisfied if both of the following conditions are met.
- (i) At least 4 hours have passed since the last lightning discharge in or from the detached "anvil cloud;" and;
 - (ii) At least 3 hours have passed since the time that the "anvil cloud" is observed to be detached from the parent "cloud."
- (2) This section is satisfied if all three of the following conditions are met.
- (i) The portion of the detached "anvil cloud" less than or equal to 5 nautical miles from the "flight path" is located entirely at altitudes where the temperature is colder than 0 degrees Celsius;
 - (ii) The "volume-averaged, height-integrated radar reflectivity" is less than +10 dBZ-km (+33 dBZ-kft) everywhere along the "flight path;" and;
 - (iii) All of the "VAHIRR application criteria" are satisfied.

6. "Debris Clouds".

The 3-hour time period defined in this section must begin again at the time of any lightning discharge in or from the "debris cloud."

- (a) A launch operator must not initiate flight if the "flight path" will carry the launch vehicle between 0 and 3 nautical miles, inclusive, from a "debris cloud" for 3 hours after the "debris cloud" is observed to be detached from the parent "cloud," or after the "debris cloud" is observed to have formed by the collapse of the parent "cloud top" to an altitude where the temperature is warmer than -10 degrees Celsius unless Section (1) or Section (2) is satisfied:

(1) This section is satisfied if all three of the following conditions are met:

- (i) There is at least one working "field mill" less than 5 nautical miles from the "debris cloud";
- (ii) The absolute values of all "electric field measurements" less than or equal to 5 nautical miles from the "flight path" and at each "field mill" employed by paragraph (a)(1)(i) of this section has been less than 1000 volts/meter for 15 minutes or longer; and;
- (iii) The maximum radar reflectivity from any part of the "debris cloud" less than or equal to 5 nautical miles from the "flight path" has been less than +10 dBZ for 15 minutes or longer.

(2) This section is satisfied if all three of the following conditions are met:

- (i) The portion of the "debris cloud" less than or equal to 5 nautical miles from the "flight path" is located entirely at altitudes where the temperature is colder than 0 degrees Celsius;
- (ii) The "volume-averaged, height-integrated radar reflectivity" is less than +10 dBZ-km (+33 dBZ-kft) at every point less than or equal to 1 nautical mile from the "flight path;" and;
- (iii) All of the "VAHIRR application criteria" are satisfied.

(b) A launch operator must not initiate flight if the "flight path" will carry the launch vehicle through any "debris cloud" during the 3-hour period defined in paragraph (a) of this section, unless all three of the following conditions are met:

- (1) The portion of the "debris cloud" less than or equal to 5 nautical miles from the "flight path" is located entirely at altitudes where the temperature is colder than 0 degrees Celsius;
- (2) The "volume-averaged, height-integrated radar reflectivity" is less than +10 dBZ-km (+33 dBZ-kft) everywhere along the "flight path;" and;
- (3) All of the "VAHIRR application criteria" are satisfied.

7. "Disturbed Weather".

A launch operator must not initiate flight if the "flight path" will carry the launch vehicle through a "cloud" "associated" with "disturbed weather" that has "clouds" with "cloud tops" at altitudes where the temperature is colder than or equal to 0 degrees Celsius and that contains, less than or equal to 5-nautical miles from the "flight path," either:

- (1) "Moderate precipitation" or greater; or;
- (2) Evidence of melting "precipitation" such as a radar "bright band."

8. "Thick Cloud Layers".

For the purposes of this section neither attached nor detached "anvil clouds" are considered "thick cloud layers."

- (a) A launch operator must not initiate flight if the "flight path" will carry the launch vehicle through a "cloud layer" that is either:

- (1) Greater than or equal to 4,500 feet thick and any part of the "cloud layer" along the "flight path" is located at an altitude where the temperature is between 0 degrees Celsius and -20 degrees Celsius, inclusive; or;
 - (2) Connected to a "thick cloud layer" that, less than or equal to 5 nautical miles from the "flight path," is greater than or equal to 4,500 feet thick and has any part located at an altitude where the temperature is between 0 degrees Celsius and -20 degrees Celsius, inclusive.
- (b) A launch operator need not apply the lightning commit criteria in paragraphs (a)(1) and (a)(2) of this section if the "thick cloud layer" is a cirriform "cloud layer" that has never been "associated" with convective "clouds," is located entirely at altitudes where the temperature is colder than or equal to -15 degrees Celsius, and shows no evidence of containing liquid water.

9. Smoke Plumes.

- (a) A launch operator must not initiate flight if the "flight path" will carry the launch vehicle through any cumulus "cloud" that has developed from a smoke plume while the "cloud" is attached to the smoke plume, or for the first 60 minutes after the cumulus "cloud" is observed to be detached from the smoke plume.
- (b) Paragraph 3, Cumulus "Clouds," applies to cumulus "clouds" that have formed above a fire but have been detached from the smoke plume for more than 60 minutes.

10. "Triboelectrification".

A launch operator must not initiate flight if the "flight path" will carry the launch vehicle through any part of a cloud, *specifically including all "transparent" parts*, at any altitude where both Section (a) and Section (b) are satisfied:

- (a) The temperature is colder than or equal to -10 degrees Celsius; and;
- (b) The launch vehicle's velocity is less than or equal to 3000 feet/second; unless Section (1) or Section (2) is satisfied:
 - (1) The launch vehicle is "treated" for surface electrification; or;
 - (2) A launch operator has previously demonstrated by test or analysis that electrostatic discharges on the surface of the launch vehicle caused by "triboelectrification" will not be hazardous to the launch vehicle or the spacecraft.