

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

**45TH SPACE WING INSTRUCTION
15-101**



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Weather

WEATHER SUPPORT

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This instruction implements Air Force Policy Directive (AFPD) 15-1, *Air Force Weather Operations*; AFI 15-114, *Functional Resource and Weather Technical Performance Evaluation*; AFMAN 15-128, *Air Force Weather Roles and Responsibilities*; Air Force Manual (AFMAN) 15-111, *Surface Weather Observations*; AFMAN 15-124, *Meteorological Codes*, AFMAN 15-129 Volume 1, *Air and Space Weather Operations – Characterization*, and AFMAN 15-129 Volume 2, *Air and Space Weather Operations – Exploitation*. 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). 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 Air Force Records Information System (AFRIMS) Records Disposition Schedule (RDS).

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appropriate Tier waiver approval authority, or alternately, to the Publication OPR for non-tiered compliance items.

SUMMARY OF CHANGES

This document has been substantially revised and must be completely reviewed. Major changes include adjustments to unit references and designations, adjustments to source document and reference material, format changes to comply with AFI 33-360, modifications and additions to supported unit requirements, updates to the lightning warning areas used for Phase I and Phase II lightning alerts, and updates to the Lightning Flight-Commit Criteria used for Launch Weather Support.

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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 Space Flight Support (HSFS), Jonathan Dickenson Missile Tracking Annex (JDMTA), Malabar Complex, Detachment 2, 45 OG, Ascension Auxiliary Airfield, and Ascension Island. 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, CCAFS Skid Strip, and KSC Shuttle Landing Facility (SLF). These services include airfield weather observations which are provided by the FMQ-19 Automated Observing Systems, as well as a Terminal Aerodrome Forecast (TAF) for PAFB.

1.2.1.1. Duty Priorities. Table 1.1 lists 45 WS/DOR duty priorities. **(T-3).**

Table 1.1. 45 WS/DOR Duty Priorities.

Order of Priority	Duties
1	Perform Emergency War Order (EWO) Taskings
2	Execute 45 WS Evacuation
3	Respond to Aircraft/Ground Emergencies
4	Respond to Pilot to Metro Service (PMSV)
5	Provide Weather Information to Supervisor of Flying (SOF)/ Provide "Eyes Forward" to RWOC
6	SWAP Operations
7	Disseminate Warnings, Watches, Advisories and Other Resource Protection Products
8	Record and Disseminate Surface Weather Observations / Augment AN/FMQ-19 Observations for Mandatory Elements
9	Provide Terminal Aerodrome Forecasts (TAFs)
10	Provide Mission Weather Products
11	Disseminate PIREPs
12	Perform MISSIONWATCH Activities
13	Provide Other Weather Services and Briefings
14	Answer Operational Phone Calls
15	Weather Functional Training
16	Accomplish Administrative Tasks

1.2.2. The Launch and Test Range System, Integrated Support Contract (LISC) provides upper air data from CCAFS and is responsible for the operations and maintenance of specific meteorological equipment at specified ER and KSC locations, as identified in the LISC Statement of Work.

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. **(T-3).**
- 1.4.4. Review this instruction at least annually for any changes in support requirements. **(T-3).**

Chapter 2

OBSERVING SERVICES

2.1. General. The 45 WS maintains an automated surface weather observing capability at PAFB, CCAFS Skid Strip, and the KSC SLF. Observations are taken by the FMQ-19 Automated Observing Systems (AOS) which report meteorological conditions 24-hours per day. Contract employees 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. Only three cloud layers are reported.

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

2.1.1.3. 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.

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

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

2.1.1.6. 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. Examples of Surface Observations are contained in Table 2.1. 45 WS provides training to those units with Joint Environmental Toolkit (JET) monitors for explanations and format breakdowns.

Table 2.1. Example Surface Observations.

Hourly
METAR KCOF 121355Z AUTO 32015KT 10SM CLR 06/01 A3034 RMK AO2 SLP275 T00570013
Special
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.

2.3.1. General. 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 1,065 ft mark and on Runway 20 at the 1,024 ft mark.

2.3.2. Augmentation. (T-1).

2.3.2.1. In the event of a system or sensor failure, 45 WS personnel will augment observations during the hours the airfield is open.

2.3.2.2. Augmented (manual) observations will also be performed in the event of forecasted severe weather (3/4" hail, tornadoes), which the FMQ-19 cannot detect.

2.3.2.3. 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.

2.3.3. KCOF Observer Duty Priorities. During periods when the FMQ-19 is augmented, the following duty priorities will be followed: (T-3).

2.3.3.1. Emergency war orders.

2.3.3.2. Execute evacuation.

2.3.3.3. Respond to aircraft/ground emergencies.

2.3.3.4. Provide "Eyes Forward" to RWOC.

2.3.3.5. Disseminate surface observations.

2.3.3.6. Provide other weather services and briefings.

2.3.3.7. Answer operational phone calls.

2.3.4. Hourly Observations. Hourly observations include items in Table 2.2. (T-1).

Table 2.2. KCOF Hourly Observation Values.

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

2.3.5. 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. **(T-1)**.

2.3.5.1. A ceiling decreases to less than or increases to equal or exceed the values in Table 2.3.

Table 2.3. KCOF Ceiling SPECI Criteria.

3000 feet (AFMAN 15-111)
2000 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, FLIP)
600 feet (FLIP)
500 feet (AFMAN 15-111, FLIP)
400 feet (FLIP)
300 feet (FLIP)
200 feet (Helicopter Ops Min for 301st Rescue Squadron)

2.3.5.2. Sky Condition (AFMAN 15-111): A layer of clouds or obscuring phenomena aloft is detected below 800 feet and no layer was reported below 800 feet on the preceding observation.

2.3.5.3. The prevailing visibility decreases to less than or, if below, increases to equal or exceed (in statute miles) a value in Table 2.4.

Table 2.4. KCOF Visibility SPECI Criteria.

3 miles (AFMAN 15-111)
2 miles (AFMAN 15-111, FLIP)
1 ¾ miles (FLIP)
15/8 miles (FLIP)
1½ miles (FLIP)
1¼ miles (FLIP)
1⅛ miles (FLIP)
1 mile (AFMAN 15-111, FLIP)
¾ mile (FLIP)
½ mile (Helicopter Ops Min for 301st Rescue Squadron)

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

2.3.5.5. 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.

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

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

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

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

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

2.3.5.9.2. 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.

2.3.5.10. 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).

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

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

2.3.5.13. 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 a value in Table 2.5.

Table 2.5. KCOF RVR SPECI Criteria.

6500 feet (FLIP)
6000 feet (AFMAN 15-111, FLIP)
5500 feet (FLIP)
5000 feet (AFMAN 15-111, FLIP)
4000 feet (FLIP)
2400 feet (AFMAN 15-111)
2000 feet (AFMAN 15-111)

2.3.6. Dissemination. Observations are disseminated locally and longline over the Joint Environmental Toolkit (JET) to a number of agencies. In the event of a JET outage, observations will then be disseminated longline via the Air Force Weather Web Services (AFWWEBS) web site. **(T-1)**.

2.4. CCAFS (KXMR) Surface Observations.

2.4.1. General. The FMQ-19 AOS operates continuously to provide weather observations, and is located on Runway 13 at the 1,480 ft mark and on Runway 31 at the 1,550 ft mark.

2.4.2. Augmentation. **(T-1)**.

2.4.2.1. In the event of a system or sensor failure, 45 WS personnel will augment observations during the hours the airfield is open.

2.4.2.2. Augmented (manual) observations will also be performed in the event of forecasted severe weather ($\frac{3}{4}$ " hail, tornadoes) which is undetectable by the automated system.

2.4.2.3. Pressure and wind data are estimated while the Alternate Observing site is utilized.

2.4.3. CCAFS Observer Duty Priorities. During periods when the FMQ-19 is augmented, the following duty priorities will be followed: **(T-3)**.

2.4.3.1. Emergency war orders.

2.4.3.2. Execute evacuation.

2.4.3.3. Respond to aircraft/ground emergencies.

2.4.3.4. Provide “Eyes Forward” to RWO.

2.4.3.5. Disseminate surface observations.

2.4.3.6. Provide other weather services and briefings.

2.4.3.7. Answer operational phone calls.

2.4.4. Hourly Observations. Hourly observations include items in Table 2.6. **(T-1)**.

Table 2.6. KXMR Hourly Observation Values.

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.

2.4.5. SPECI. Special (SPECI) observations are taken to report significant changes in weather elements and will not necessarily include criteria. SPECIs are taken at the Skid Strip when existing weather conditions change IAW the criteria listed below. **(T-1)**.

2.4.5.1. A ceiling decreases to less than or increases to equal or exceed a value in Table 2.7.

Table 2.7. KXMR Ceiling SPECI Criteria.

3000 feet (AFMAN 15-111)
2000 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)
200 feet (AFMAN 15-111)

2.4.5.2. Sky Condition (AFMAN 15-111): A layer of clouds or obscuring phenomena aloft is detected below 800 feet and no layer was reported below 800 feet on the preceding observation.

2.4.5.3. The prevailing visibility decreases to less than or, if below, increases to equal or exceed (in statute miles) a value in Table 2.8.

Table 2.8. KXMR Visibility SPECI Criteria.

3 miles (AFMAN 15-111)
2 ³ / ₄ miles (FLIP)
2 ¹ / ₂ miles (FLIP)
2 ¹ / ₄ miles (FLIP)
2 miles (AFMAN 15-111, FLIP)
1 ³ / ₄ miles (FLIP)
1 ¹ / ₂ miles (FLIP)
1 ¹ / ₄ miles (FLIP)
1 mile (AFMAN 15-111, FLIP)
¹ / ₂ mile (FLIP)

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

2.4.5.5. 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.

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

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

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

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

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

2.4.5.9.2. 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.

2.4.5.10. 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).

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

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

2.4.5.13. 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 a value in Table 2.9.

Table 2.9. KXMR RVR SPECI Criteria.

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

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

2.4.6. Dissemination. Observations are disseminated locally and longline over the Joint Environmental Toolkit (JET) to a number of agencies. In the event of a JET outage, observations will then be disseminated longline via the AFWWEBS web site. **(T-1)**.

2.5. Weather Station A, Building 20185, Balloon Facility. During launch operations, 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. **(T-3)**.

2.6. KSC - Shuttle Landing Facility (KTTS).

2.6.1. General. The FMQ-19 AOS operates continuously to provide weather observations. Weather observations are taken from the facility located approximately 500 feet east of the SLF.

2.6.2. Augmentation. **(T-1)**.

2.6.2.1. In the event of a system or sensor failure, 45 WS personnel will only augment observations upon request, and with prior coordination to support U.S. Government operations.

2.6.2.2. The observer's view is generally unobstructed.

2.6.2.3. Pressure and wind data are estimated while the Alternate Observing site is utilized.

2.6.3. Hourly. Hourly observations include items in Table 2.10.

Table 2.10. KTTS Hourly Observation Items.

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.

2.6.4. SPECI. Special Observations are taken at the SLF when existing weather conditions change IAW the criteria listed below. **(T-1)**.

2.6.4.1. A ceiling decreases to less than or increases to equal or exceed a value in Table 2.11.

Table 2.11. KTTS Ceiling SPECI Criteria.

3000 feet (AFMAN 15-111)
2000 feet (AFMAN 15-111)
1500 feet (AFMAN 15-111)
1000 feet (AFMAN 15-111, FLIP)
700 feet (AFMAN 15-111,)
600 feet (FLIP)
500 feet (AFMAN 15-111, FLIP)
400 feet (FLIP)
200 feet (AFMAN 15-111)

2.6.4.2. Sky Condition (AFMAN 15-111): A layer of clouds or obscuring phenomena aloft is detected below 1000 feet and no layer was reported below 1000 feet on the preceding observation.

2.6.4.3. The prevailing visibility decreases to less than or, if below, increases to equal or exceed (in statute miles) a value in Table 2.12.

Table 2.12. KTTS Visibility SPECI Criteria.

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

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

2.6.4.5. 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.

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

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

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

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

- 2.6.4.9.1. The wind speed suddenly increases by at least 16 knots and is sustained at 22 knots or more for at least a minute (squall).
- 2.6.4.9.2. 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.
- 2.6.4.10. 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).
- 2.6.4.11. Whenever volcanic ash is observed (AFMAN 15-111).
- 2.6.4.12. Any other meteorological situation occurs which may be critical to the safety of aircraft operations (AFMAN 15-111).
- 2.6.4.13. 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 a value in Table 2.13.

Table 2.13. KTTS RVR SPECI Criteria.

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

2.6.5. Dissemination. Observations are disseminated locally and longline over the Joint Environmental Toolkit (JET) to a number of agencies. In the event of a JET outage, observations will then be disseminated longline via the AFWWEBS web site. **(T-1)**.

2.6.5.1. Local. Criteria for LOCAL Observations:

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

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

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

2.7. 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 7.5.9. They will also relay Pilot Reports (PIREPS) and any other significant observation. **(T-3)**.

2.8. Aircraft Mishap. 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. **(T-1)**.

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

2.9.1. Contractors provide 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 once daily at approximately 0615L and 2000L, 7 days-per-week. During the convective season (May – Oct), an additional sounding is taken at 1100L if requested by the RWOC. For launch operations, the schedule for upper air soundings is customer driven and changes with each vehicle launched from the ER and KSC.

2.9.2. High/Low Resolution Launches.

2.9.2.1. 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.

2.9.2.2. 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.

3.1.1. The 45 WS provides Terminal Aerodrome Forecasts (TAFs), planning forecasts, and mission weather products 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.

3.1.2. 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. **(T-3).**

3.2. Terminal Aerodrome Forecasts. The 45 WS will produce TAFs for Patrick AFB (KCOF) and issue them IAW AFMAN 15-124 and AFMAN 15-129 Volume 1. 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. **(T-1).**

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. **(T-1).**

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. **(T-1).**

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 listed in Table 3.1.

Table 3.1. KCOF Standard Specification and Amendment Criteria.

CIGS	VIS	Category	Reference
Ceiling or Visibility observed or expected to decrease to less than, or if below, increase to equal or exceed:			
> 2,000 FT	> 3 SM (4800M)	E	AFMAN 15-129V1
< 2,000 FT but > 1000 FT	< 3 SM (4800M) but > 2 (3200M)	D	AFMAN 15-129V1
< 1000 FT but > 800 FT	< 3 SM (4800M) but > 2 (3200M)	C	AFMAN 15-129V1
< 800 FT but > 300 FT	< 2 SM (3200M) but > 3/4 SM (1200M)	B	AFMAN 15-129V1
< 300	<3/4 (1200M)	A	AFMAN 15-129V1

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.

3.3. Planning Forecasts.

3.3.1. 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 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. 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.

3.4. Launch Forecasts. 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. Mission Weather Product. The RWOC issues a Mission Weather Product daily. It is the primary mission execution forecast for all flights around PAFB, CCAFS, and KSC local area. In addition, the forecast includes drop zone forecasts valid for the same time period. This product is produced at 0700 and 1500L each day and is amended as needed. Attachment 6 is an example of the Mission Weather Product. **(T-3).**

3.5.2. 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 leaving the local area. 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. **(T-1).**

3.5.3. 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, Patrick Command Post, SOF, etc.). **(T-3).**

3.5.4. Pilot-to-Metro Service/Phone Patches. PMSV contact is available 24 hours a day on frequencies 225.05 and 123.225 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. **(T-3).**

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. **(T-3).**

3.7. Tropical Storm/Hurricane Support. The RWOC receives hurricane and tropical storm advisories from the National Hurricane Center (NHC) four times daily. 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, or Ascension Island. 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. **(T-3).**

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 contained in Table 3.2. **(T-1).**

Table 3.2. Hurricane Conditions (HURCON) Levels.

V	1 June - 30 November
IV	96 hours prior to arrival of sustained \geq 50 knot winds
III	72 hours prior to arrival of sustained \geq 50 knot winds
II	48 hours prior to arrival of sustained \geq 50 knot winds
I	24 hours prior to arrival of sustained \geq 50 knot winds
1E	\geq 50 knot sustained winds occurring along with other dangerous conditions.
1R	Life-threatening storm hazards have passed but danger from damage may persist. Only emergency responders and damage assessment personnel may move about.

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. **(T-3).**

3.7.3. The RWOC will produce a tailored hurricane forecast for NASA/KSC based on the Hurricane Center's official forecast track and intensity. **(T-3).**

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. **(T-1).**

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 Operating Instruction (OI) 10-2, and Standard 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. (T-1).

3.10. Meteorological Consulting/Advising Services. Technical consultation includes advising 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, or 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), NASA (KSC area) and Astrotech (Titusville, FL).

4.1.1. Weather Warnings (WW).

4.1.1.1. General. 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, followed by the sequence number that begins at 01 (#MM-XX). **Example:** *PAFB number 12-32 is the 32nd WW issued for PAFB in December.*

4.1.1.2. Lightning Warnings (Phase II Lightning Warning). A Phase II Lightning Warning is issued when lightning is imminent or occurring within the specified distance from the center of the specified lightning warning area. The specified distance varies with the specified lightning warning areas, being 5 nautical miles if a single facility is being protected at the center of the lightning warning area, or 6 nautical miles if several facilities are being protected near the center of the lightning warning area. Customers can then take the necessary precautions to protect personnel and resources.

4.1.2. Weather Watches.

4.1.2.1. General. 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, followed by the sequence number for the month that begins at 01 (#MM-XX). **Example:** *PAFB number 1-01 is the 1st watch issued for PAFB in January.*

4.1.2.2. Lightning Watch (Phase I Lightning Watch). A Phase I Lightning Watch is issued when lightning is expected within the specified distance from the center of the specified lightning warning area with a desired lead-time of 30 minutes. The specified distance varies with the specified lightning warning area, being 5 nautical miles if a single facility is being protected at the center of the lightning warning area, or 6 nautical miles if several facilities are being protected near the center of the lightning warning area.

Phase I Lightning Watches alert all agencies to take preliminary actions to protect personnel and resources.

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, followed by the sequence number for the month that begins at 01 (#MM-XX). **Example:** *CCAFS number 3-10 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 and followed up by phone call 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. **(T-1).**

4.2.1. For a tornado or funnel cloud affecting PAFB resources including South Housing, the duty forecaster contacts the Patrick Command Post via hotline and Patrick 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. **(T-3).**

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

Weather Advisories		
Forecast/Observed	Criteria	Desired Lead Time
Observed	Observed Surface Winds ≥ 25 but < 35 kts.	N/A
Observed	Observed Fair Weather Waterspout near Patrick AFB.	N/A
Forecasted	Forecasted Temperatures ≤ 32 F for ≥ 4 hrs.	16 Hours
Weather Watches		
Watch Type	Criteria	Desired Lead Time
Tornado	Potential for Tornadoes exists at Patrick AFB. (SWAP).	As Potential Warrants
Severe Thunderstorm	Potential for Damaging Winds ≥ 50 kts associated with Thunderstorms and/or Damaging Hail $\geq 3/4$ inch (SWAP) at Patrick AFB.	As Potential Warrants
Damaging Winds	Potential for Damaging Winds ≥ 50 kts not associated with Thunderstorms at Patrick AFB.	As Potential Warrants
Lightning	Potential for Lightning within 5 nm exists. This is a Phase I condition.	30 Minutes
Weather Warnings		
Warning Type	Criteria	Desired Lead Time
Tornado	Tornado is imminent or occurring at Patrick AFB. TAKE SHELTER IMMEDIATELY. (SWAP)	5 Minutes
Damaging Winds	Forecasted Damaging Winds ≥ 50 kts for Patrick AFB.	60 Minutes
Strong Winds	Forecasted Strong Winds ≥ 35 but < 50 kts for Patrick AFB.	30 Minutes
Hail	Forecasted Hail $\geq 3/4$ in. for Patrick AFB. (SWAP)	60 Minutes
Observed Weather Warnings		
Observed Lightning	Observed Lightning occurring within 5 nm. This is a Phase 2 condition.	Observed

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 an area around a specific location or complex as indicated in Table 4.2. Attachment 12 graphically displays the 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. **(T-1).**

Table 4.2. CCAFS METWATCH Criteria and Desired Lead Times.

Weather Advisories		
Forecast/Observed	Criteria	Desired Lead Time
Observed	Observed Fair Weather Waterspout near Cape Canaveral AFS.	N/A
Observed	Observed \geq 18 kt Steady-State Winds occurring at Cape Canaveral from SFC to 200 ft.	N/A
Forecasted	Forecasted \geq 22 kt Steady State Winds to occur in the Cape Canaveral Port area from SFC to 54 ft.	30 Minutes
Forecasted	Forecasted Temperatures \leq 32 F for \geq 4 hrs.	16 Hours
Weather Watches		
Watch Type	Criteria	Desired Lead Time
Tornado	Potential for Tornados exists at Cape Canaveral AFS. (SWAP)	As Potential Warrants
Severe Thunderstorm	Potential for Damaging Winds \geq 50 kts associated with Thunderstorms and/or Damaging Hail \geq 3/4 inch (SWAP) at Cape Canaveral AFS.	As Potential Warrants
Damaging Winds	Potential for Damaging Winds \geq 50 kts not associated with Thunderstorms at CCAFS.	As Potential Warrants
Lightning	Potential for Lightning within 5 nm exists for CCAFS Complex 40/41. This is a Phase I condition.	30 Minutes
Lightning	Potential for Lightning within 5 nm exists for CCAFS Complex 37/ITL. This is a Phase I condition.	30 Minutes
Lightning	Potential for Lightning within 6 nm exists for CCAFS Cape Central. This is a Phase I condition.	30 Minutes
Lightning	Potential for Lightning within 5 nm exists for CCAFS Port Area. This is a Phase I condition.	30 Minutes
Weather Warnings		
Warning Type	Criteria	Desired Lead Time
Tornado	Tornado is imminent or occurring at Cape Canaveral AFS. TAKE SHELTER IMMEDIATELY. (SWAP)	5 Minutes

Damaging Winds	Forecasted Damaging Winds \geq 50 kts from SFC to 200 ft for Cape Canaveral AFS.	60 Minutes
Strong Winds	Forecasted Strong Winds \geq 35 but $<$ 50 kts from SFC to 200 ft for Cape Canaveral AFS.	30 Minutes
Hail	Forecasted Hail \geq 3/4 inch for Cape Canaveral AFS. (SWAP)	60 Minutes
Observed Weather Warnings		
Observed Lightning	Observed Lightning occurring within 5 nm of CCAFS Complex 40/41. This is a Phase 2 condition.	Observed
Observed Lightning	Observed Lightning occurring within 5 nm of CCAFS Complex 37/ITL. This is a Phase 2 condition.	Observed
Observed Lightning	Observed Lightning occurring within 6 nm of CCAFS Cape Central. This is a Phase 2 condition.	Observed
Observed Lightning	Observed Lightning occurring within 5 nm of CCAFS Port Area. This is a Phase 2 condition.	Observed

4.4. 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 an area around a specific building, location or complex as indicated in Table 4.3. Attachment 13 graphically displays the 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. The duty forecaster will provide a follow-up phone call to 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 4.3. **(T-1)**.

Table 4.3. KSC METWATCH Criteria and Desired Lead Times.

Weather Advisories		
Forecast/Observed	Criteria	Desired Lead Time
Observed	Observed \geq 18 kt Steady-State Winds occurring at KSC from SFC to 300 ft.	N/A
Forecasted	Forecasted Temperature \leq 35 F.	4 Hours
Observed	Observed Fair Weather Waterspout near KSC.	N/A
Forecasted	Forecasted Temperatures \leq 32 F for \geq 4 hrs.	16 Hours
Forecasted	Forecasted Temperatures \leq 28 F and winds $>$ 10 kts.	16 Hours
Weather Watches		
Watch Type	Criteria	Desired Lead Time
Tornado	Potential for Tornadoes exists at KSC. (SWAP)	As Potential Warrants
Severe Thunderstorm	Potential for Damaging Winds \geq 50 kts associated with Thunderstorms and/or Damaging Hail \geq 3/4 inch (SWAP) at KSC.	As Potential Warrants
Damaging Winds	Potential for Damaging Winds \geq 50 kts not associated with Thunderstorms at KSC.	As Potential Warrants
Lightning	Potential for Lightning within 6 nm exists for KSC SLF. This is a Phase I condition.	30 Minutes
Lightning	Potential for Lightning within 6 nm exists for KSC LC 39. This is a Phase I condition.	30 Minutes
Lightning	Potential for Lightning within 6 nm exists for KSC IA. This is a Phase I condition.	30 Minutes
Lightning	Potential for Lightning within 5 nm	30 Minutes

	exists for Haulover. This is a Phase I condition.	
Weather Warnings		
Warning Type	Criteria	Desired Lead Time
Tornado	Tornado is imminent or occurring at KSC. (SWAP)	5 Minutes
Damaging Winds	Forecasted Damaging Winds \geq 50 kts from SFC to 300 ft for KSC.	60 Minutes
Strong Winds	Forecasted Strong Winds \geq 35 but $<$ 50 kts from SFC to 300 ft for KSC.	30 Minutes
Hail	Forecasted Hail (any size) for KSC.	60 Minutes
Observed Weather Warnings		
Observed Lightning	Observed Lightning occurring within 6 nm of KSC SLF. This is a Phase 2 condition.	Observed
Observed Lightning	Observed Lightning occurring within 6 nm of KSC LC 39. This is a Phase 2 condition.	Observed
Observed Lightning	Observed Lightning occurring within 6 nm of KSC IA. This is a Phase 2 condition.	Observed
Observed Lightning	Observed Lightning occurring within 5 nm of Haulover. This is a Phase 2 condition.	Observed

4.5. 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 telephone to the Astrotech facility. Warning and Watch criteria and desired lead times are in Table 4.4.

Table 4.4. Astrotech METWATCH Criteria and Desired Lead Times.

Weather Watches		
Watch Type	Criteria	Desired Lead Time
Lightning	Potential for Lightning within 5 nm exists for Astrotech. This is a Phase I condition.	30 Minutes
Observed Weather Warnings		
Observed Lightning	Observed Lightning occurring within 5 nm of Astrotech. This is a Phase 2 condition.	Observed

4.6. National Airborne Operations 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 via telephone. NAOC-specific Warning, Watch and Advisory criteria, as well as lead time, are outlined in Table 4.5.

Table 4.5. NAOC METWATCH Criteria and Desired Lead Times.

Weather Advisories		
Forecast/Observed	Criteria	Desired Lead Time
Observed	TS/LTG observed within 50 nm of PAFB.	N/A
Observed	TS/LTG observed within 25 nm of PAFB.	N/A
Observed	Low level wind shear (outside of TS) within 50 nm of PAFB.	N/A
Observed	Visibility < 1 SM.	N/A
Observed	Crosswinds > 20 kts.	N/A
Observed	Moderate or greater icing below 10 kft (outside of TS) within 50 nm of PAFB.	N/A
Observed	Moderate or greater turbulence below 10 kft (outside of TS) within 50 nm of PAFB.	N/A
Weather Watches		
Watch Type	Criteria	Desired Lead Time
Tornado	Potential for Tornados exists w/in 50 nm of Patrick AFB.	As Potential Warrants
Severe Thunderstorm	Potential for Damaging Winds \geq 35 kts associated with Thunderstorms and/or Damaging Hail \geq 1/2 inch.	As Potential Warrants
Hail	Potential for Hail < 1/2 inch exists.	30 Minutes
Weather Warnings		
Warning Type	Criteria	Desired Lead Time
Hail	Forecasted Hail \geq 1/2 inch for Patrick AFB.	60 Minutes

4.7. METWATCH Dissemination System.

4.7.1. The dissemination method used for alerting PAFB Command Post of advisories, watches and warnings is via phone call from the RWF. The Command Post then relays weather alerts via the AtHoc notification system. If the AtHoc system is non-operational for any reason, the backup capability of a unit pyramid notification system will be initiated. The PAFB ATC Tower and Airfield Management Operations (AM Ops) receives alert notification via JET which directly feeds their local Airfield Automation System.

4.7.2. 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.

4.7.3. Weather warnings, watches, and advisories for KSC are disseminated via JET and displayed on the 26 OWS webpage for the ISC DO. The duty forecaster will provide a phone call to the ISC DO alerting of the issuance or cancellation of any watches, warnings or advisories. The ISC DO then disseminates the information via various methods (Aural Warning System, telephone, pager, radio, etc.) to customers.

4.7.4. The dissemination method used for alerting Astrotech of watches and warnings is via phone call from the RWF.

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

- 5.2.1. Provide meteorological consultant and climatological services. **(T-3).**
- 5.2.2. Collect, evaluate, and distribute meteorological data for the ER and worldwide locations to support special projects within resource limitations. **(T-3).**
- 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). **(T-2).**
- 5.2.4. Provide weather services IAW other wing agreements upon request. **(T-3).**
- 5.2.5. Maintain Severe Weather Action Procedures that will be enacted IAW AFMAN 15-129 Volume 1 when severe weather threatens. **(T-1).**
- 5.2.6. Meet requests for meteorological services as required in the Range UDS. **(T-2).**
- 5.2.7. Serve as Weather SME to Chemical, Biological, Radiological, and Nuclear (CBRN) operations IAW AFI 15-128, AFI 10-2501, and AFMAN 10-2503. **(T-1).**
- 5.2.8. Monitor and provide updates on volcanic activity affecting 45 SW assets. **(T-1).**
- 5.2.9. Alert 45 SW leadership of any tsunami effecting 45 SW assets. **(T-3).**

5.3. 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 assess the following hazards: toxic dispersion (both launch day and non-launch day), distant focusing overpressure and debris. **(T-3).**
- 5.3.2. Coordinate with 557th Weather Wing (557 WW) 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 IEMP 10-2 PAFB and IEMP 10-2 CCAFS for further required roles and responsibilities. **(T-3).**
- 5.3.3. Ensure compliance with Range Safety (45 SW/SE) meteorological requirements as detailed in EWR 127-1 and AFSPCMAN 91-710. **(T-2).**
- 5.3.4. Provide 557 WW model recommendation to 45 SW/SEL for ingest into Range Safety models. Recommendation will be conveyed in the body of the email that distributes the

LWO pre-launch forecasts and day-of-launch forecast, see paragraph 3.4 for frequency. (T-3).

5.4. 45th Space Wing Inspector General (45 SW/IG). The 45 WS will provide support to disaster and other training exercises by providing real or simulated weather conditions for specific training purposes within resource limitations the following services. (T-3).

5.5. 45th Space Wing Public Affairs (45 SW/PA). The 45 WS will provide tours of 45 WS facilities upon request. (T-3).

5.6. 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: (T-3).

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

Table 5.1. 45 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/SCOAA 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.

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

5.7. 45th Operations Support Squadron (45 OSS). 45 OSS provides Airfield Managers and Air Traffic Controllers for PAFB and CCAFS airfields. The 45 WS will provide the following services to 45 OSS:

5.7.1. When notified by Patrick AFB or CCAFS Control Towers of any weather observation disparity, provide immediate support to resolve or dismiss the discrepancy. (T-3).

5.7.2. Notify Patrick Control Tower when the Patrick AFB Weather Station is operational. (T-3).

5.7.3. Provide information on the operational status of the PMSV and changes to forecast/observing support hours to the AM Ops Coordinator (AMOC). (T-3).

5.7.4. Train and certify, on request, Control Tower operators on the Cooperative Weather Watch Program (Limited Weather Observation Training) and document that training on AF IMT 3622. **Note:** Training must be completed by certified weather trainers/ examiners. (T-1).

5.7.5. Provide tours of weather facilities as requested. (T-3).

5.7.6. Validate visibility charts annually. (T-1).

5.8. 45th Contracting Squadron (45 CONS). The 45 WS will provide the following services to 45 CONS: (T-3).

5.8.1. Monitor quality of surface observations and maintenance services provided by the LISC contractor in accordance with the latest LISC.

5.8.2. Assist contract development for weather services.

5.9. 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: (T-3).

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

Table 5.2. 45 CES Critical Weather Thresholds.

Weather Threshold	Notification Product	Impact	Customer Action
Tornado	Weather Warning	Hazardous Work Environment	Take Cover
Winds 24 – 34kts	Observed 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 firefighting and for toxic/hazardous spills and exercises.

5.10. 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 45 FSS with weather critical thresholds, notification products, impacts and customer actions for operations as outlined in Table 5.3. (T-3).

Table 5.3. 45 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	Observed 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. 920th Rescue Wing (920 RQW). The 920 RQW mission is to save lives through the combined efforts Combat Search and Rescue and Aeromedical Staging operations. The 920th flies HC-130 aircraft, HH-60 helicopters and possesses Guardian Angel, Aeromedical Staging personnel to prosecute its mission. The 920th RQW is comprised of 5 Groups, 15 Squadrons, and 5 Flights. Weather critical thresholds, notification products, impacts and general customer actions are listed in Table 5.4. **Note:** Customer actions listed in the table are for information. Specific actions are governed in separate operational instructions. **(T-3).**

Table 5.4. 920 RQW Critical Weather Thresholds.

Weather Threshold	Notification Product	Impact	Customer Action
Lightning Forecast w/in 5nm	Weather Watch (Phase I)	Potential Hazardous Work Environment	Prepare to Suspend Outdoor Operations
Lightning Observed w/in 5nm	Weather Warning (Phase II)	Hazardous Work Environment	Suspend Outdoor Operations
Ceiling \leq 200ft Vis \leq 1mi, Vis \leq 2mi	Observation	Below Field Minimums	Cancel/ Divert Aircraft
En Route Ceiling \leq 700ft, Vis \leq 1mi, Vis \leq 2mi	MWP	Cannot Perform Certain Mission Tasks	Change Operations Area
Ceiling \leq 1500ft, Vis \leq 3mi, Vis \leq 1mi	MWP	Cannot Perform Certain Mission Tasks	Change Operations Area
MDT Precip SFC - 500ft	MWP, Observation	Cannot Perform Certain Mission Tasks	Change Operations Area
TURBC \geq MDT SFC - 10,000ft	MWP	No Flight Through	Reroute Flight Path
ICG \geq MDT with Deicing Capability	MWP	Damage to Aircraft	Reroute Flight Path
Land DZ Winds $>$ 13kts	MWP	No Airdrops	Cancel Drops
Water DZ Winds $>$ 18kts	MWP	No Airdrops	Cancel Drops
Thunderstorms	MWP	No Flight Through	Reroute Flight Path
Lunar Data ($<$ 5% Equivalent Mean Illumination)	MWP	Determines Equipment For Mission Use (NVG, FLIR)	Change Mission Plan
Space Weather Constraint GPS error $>$ 50 meters	MWP	Position Error	Evaluate Navigation System
Tornado	Weather Warning	Hazardous Work Environment	Take Cover
SFC Winds \geq 30kts (uses 25kt wind advisory)	Observed Weather Advisory	Hazardous Work Environment	Stops Work on Top of Aircraft
SFC Winds \geq 45kts	Weather Warning	Damage to Aircraft	Moor or Hangar HH-60 Aircraft

Weather Threshold	Notification Product	Impact	Customer Action
SFC Winds \geq 50kts	Weather Warning	Damage to Aircraft	Moor HC-130 Aircraft
SFC Winds \geq 60kts	Weather Warning	Damage to Aircraft	Remove Main Rotor or Hangar HH-60 Aircraft
SFC Winds \geq 75kts	Weather Warning	Damage to Aircraft	Hangar/ Evacuate HH-60/ HC-130 Aircraft
Hail $>$ 3/4"	Weather Warning	Damage to Aircraft	Hanger/ Divert Aircraft
LLWS	MWP	Flight Hazard	Avoid Hazard

5.12. 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 weather critical thresholds, notification products, impacts and customer actions for operations are outlined in Table 5.5. (T-3).

Table 5.5. Department of State Critical Weather Thresholds.

Weather Threshold	Notification Product	Impact	Customer Action
Ceiling < 1500ft, Vis < 3m,	MWP	Below Aircraft Minimums	Cancel Flights, Divert Aircraft
Gust Spread \geq 15kts (use 25kt wind advisory)	MWP	Creates Hazard	Do Not Operate UH- 1 Aircraft
SFC Winds \geq 30kts (uses 25kt observed advisory)	MWP and Weather Advisory	Creates Hazard	Do Not Operate UH- 1 Aircraft
ICG > Trace	MWP	Creates Hazard	Cancel Flights
En route Thunderstorms	MWP	No Flight Through	Reroute Flight Path
TURBC \geq MDT SFC – 10,000ft	MWP	Damage to Aircraft	Change Flight Path
GPS Error > 50 meters	MWP	Position Error	Evaluate Navigation System
Lunar Data	MWP	Creates Hazard	Determine Flight Parameters
Precipitation	MWP	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,

5.13. InDyne / Cape Support Duty Office. Cape Support provides base operations and space launch support services to NASA and 45 SW. The 45 WS will provide weather critical thresholds, notification products, impacts and customer actions for operations are outlined in Table 5.6. (T-3).

Table 5.6. InDyne / Cape Support Duty Office Critical Weather Thresholds.

Weather Threshold	Notification Product	Impact	Customer Action
SFC Winds > 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

5.14. Range Generation Next (RGNext). RGNext provides technical services to NASA and 45 SW in support of launch operations. The 45 WS will provide weather critical thresholds, notification products, impacts and customer actions for operations are outlined in Table 5.7. (T-3).

Table 5.7. RGNNext Critical Weather Thresholds.

Weather Threshold	Notification Product	Impact	Customer Action
SFC Winds > 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

5.15. Space Coast Launch Services (SCLS). SCLS provide operations, maintenance and engineering support to critical launch, spacecraft and ordnance facilities and support systems. The 45 WS will provide weather critical thresholds, notification products, impacts and customer actions for operations are outlined in Table 5.8. (T-3).

Table 5.8. SCLS Critical Weather Thresholds.

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

5.16. 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: **(T-3)**.

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

Table 5.9. 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

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

5.16.3. A 24-hour and weekly planning forecast.

5.16.4. Weather watches, warnings and advisories.

5.16.5. Controlled burn forecasts.

5.16.6. Hurricane forecast information.

5.17. NASA Support. 45 WS is responsible for the following:

5.17.1. Adhering to responsibilities as governed by the following documents.

5.17.1.1. KCA-1645, *Agreement between the DoD and NASA, Regarding Management of the Atlantic Missile Range of DoD and the Merritt Island Launch Area of NASA*, 17 January 1963 (Webb-McNamara Agreement). **(T-0)**.

5.17.1.2. 45 SW No. 15E-2-2, *Joint Operations Support Agreement between the 45th Space Wing and the John F. Kennedy Space Center*, 25 Apr 2013, Appendix E. **(T-3)**.

5.17.1.3. 45 SW No. 15E-3-07, *Joint Operating Procedure (JOP) for Meteorological Support between 45th Space Wing (45 SW) and the National Aeronautics and Space Administration John F. Kennedy Space Center (NASA-KSC)*, 21 Sep 07. **(T-3)**.

5.17.1.4. 45 SW 15E-2-27, *Memorandum of Understanding between the National Aeronautics and Space Administration and the United States Air Force, 45th Space Wing*

and the National Oceanic and Atmospheric Administration National Weather Service on the Operation of the Applied Meteorology Unit, 16 Oct 2008. **(T-3)**.

5.17.1.5. Specific weather thresholds and required actions as outlined in SI Integration checklists and KNPR 8715.3, KSC Safety Procedural Requirements. **(T-3)**.

5.17.2. 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. **(T-1)**.

5.17.3. Satisfying all pre-coordinated weather observing and forecasting requirements. **(T-3)**.

5.17.4. Providing weather forecasts for all NASA launches and processing operations. Forecasts for NASA programs include Complex 39A/B, SLF, various recovery operations and exercises, various ship operations to include government charter missions, and areas of ground activity or work centers at KSC and CCAFS. **(T-0)**.

5.17.5. 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 by 0800L at <http://www.patrick.af.mil/weather>. **(T-3)**.

5.17.6. Providing hurricane/tropical storm support to NASA-KSC: **(T-0)**.

5.17.6.1. 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 Weather Office, 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 (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).

5.17.6.2. Providing support to the NASA-KSC HMT as specified in KSC Hurricane Preparedness Management Plan (NSTS 07700, Volume VIII, Appendix T).

5.17.7. Providing Special Weather Advisory Support and METWATCH support for KSC weather-sensitive ground operations supporting launch programs. **(T-0)**.

5.17.7.1. Quickly notifying the NASA-KSC Ground Processing Integration Office when previously unidentified weather events occur or are expected to occur, and when the weather condition is no longer a threat or danger. **(T-3)**.

5.17.7.2. Notifying the NASA-KSC Weather Office and Director of the Emergency Management Office 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. **(T-3)**.

5.17.8. 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. **(T-0)**.

5.17.9. 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. **(T-0)**.

5.17.10. Collecting, processing, quality controlling and disseminating upper-atmospheric wind and temperature data from the Cape Balloon Facility (Building 20185). **(T-3)**.

5.17.11. 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. **(T-3)**.

5.17.12. Providing full time (24 hours/day, 7 days/week) automated surface weather observations from the SLF. **(T-3)**.

5.17.13. Providing required meteorological data for ingest into the operational toxic model. **(T-0)**.

5.17.14. Providing a Staff Meteorologist assigned to NASA-KSC if resources allow. **(T-3)**.

5.17.15. Providing technical evaluation, as required, of any meteorological proposals under NASA's Small Business Innovative Research program. **(T-3)**.

5.17.16. Providing Cooperative Weather Watch training for the SLF Air Traffic Controllers (ATC). **(T-3)**.

5.17.17. Providing visual displays via CCTV of weather radar, satellite imagery, and other pertinent weather information. **(T-3)**.

5.17.18. Providing operational support for upper-air soundings and predictions, as specified in applicable ODs. **(T-3)**.

5.17.19. 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. **(T-3)**.

5.17.20. Meteorological weather data (e.g., weather tower data, ERDAS grids, etc.) necessary for NASA/KSC MARSS operation. **(T-0)**.

5.17.21. Support to the AMU as specified in the NASA/KSC with USAF/45 SW and NOAA/National Weather Service Memorandum of Understanding (MOU), *The Operation of the Applied Meteorology Unit*, 45 SW No. 15E-2-27. **(T-3)**.

5.17.22. 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. **(T-3)**.

5.18. 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). **(T-3)**.

5.19. 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 astronaut contingency operations. All weather products and services are provided IAW applicable checklists and disseminated via weblink contained in the checklist. **(T-3)**.

5.20. 114th Space Control Squadron, ANG. The 45 WS will provide general forecast information upon request. **(T-3)**.

5.21. Craig Technologies. Craig Technologies is located in Cape Canaveral. They are under contract through NASA and provide technical support to NASA operations. The 45 WS will weather critical thresholds, notification products, impacts and customer actions for operations are outlined in Table 5.10. **(T-3)**.

Table 5.10. Craig Technologies Critical Weather Thresholds.

Weather Threshold	Notification Product	Impact	Customer Action
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, Halt Outside Operations, Power Down Equipment

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, 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 applicable to every vehicle launching from the Range. In addition, the Eastern Range has range safety constraints known as Natural and Triggered Flight Commit Criteria, documented in Attachment 7 of AFSPCMAN 91-710, Vol 6, *Range Safety User Requirements Manual Volume 6 – Ground and Launch Personnel, Equipment, System, and Material Operations Safety Requirements*. These constraints are established by the joint Lightning Advisory Panel and are applicable to every vehicle launching from the Range. Attachment 14 contains the 20 Aug 2014 criteria, current as of this publication. 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 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. 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.

6.6. 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.

6.7. 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 14 and/or AFSPCMAN 91-710, Attachment 7.

6.8. 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 as needed, 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:

6.8.1. 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 NO-GO to GO.

6.8.2. 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 NO-GO to GO when the LWC is not present in the RWOC and initiate and complete all required emergency checklists.

6.8.3. 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 NO-GO/GO status, and has “hold call” responsibility after the final clear to launch authority has been given.

6.8.4. 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.

6.8.5. 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.

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

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. 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. **(T-3).**

7.3. Patrick Command Post. The Patrick Command Post will:

7.3.1. Provide 45 WS with timely notice of alerts, alert messages, changes in Force Protection Conditions (FPCONS), and Battle Staff notification. **(T-3).**

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. **(T-3).**

7.3.3. Disseminate Weather Warnings (WWs), Weather Advisories (WAs), and Watches. **(T-3).**

7.3.4. Disseminate OPREP-3 and BEELINE reports to higher headquarters. 45 WS will provide information listed below for these reports: **(T-1).**

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. 1st Range Operations Squadron (1 ROPS). 1 ROPS will: **(T-3).**

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

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

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

7.5. 45th Operations Support Squadron (45 OSS). 45 OSS will: **(T-3).**

7.5.1. Unless otherwise instructed, complete all weather coordination through the RWF
Note: No weather observer on duty at Patrick AFB.

7.5.2. Report Airfield Automation System (AFAS) outages to the RWF and the AFAS Administrator.

7.5.3. Immediately report any disparity on weather observations to the RWF. Notify pilot and/or F11 if flight safety could be a factor.

- 7.5.4. If Weather reporting capability is rendered unusable coordinate NOTAM action with PAFB or CCAFS Airfield Management as required.
- 7.5.5. Notify the RWF of all in-flight emergencies and aircraft accidents via secondary crash net.
- 7.5.6. Notify the duty forecaster 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.
- 7.5.7. Provide daily radio checks on the PMSV frequencies 225.05 and 123.225 MHz, and when requested.
- 7.5.8. Notify the RWF whenever normal communications are disrupted and advise of alternate method(s) required to relay weather information.
- 7.5.9. Participate in a Cooperative Weather Watch by informing the RWF of any of the following conditions:
- 7.5.9.1. Any observed difference between present weather and the official observation.
 - 7.5.9.2. A tower visibility different from the prevailing surface visibility.
 - 7.5.9.3. Any significant increase or decrease in visibility and/or low cloud ceiling height.
 - 7.5.9.4. The formation of fog, thunderstorms (any observed lightning or thunder), funnel clouds, or tornadoes, hail and volcanic ash.
 - 7.5.9.5. The beginning or ending of precipitation.
 - 7.5.9.6. Any obstruction to vision not previously reported.
- 7.5.10. 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 not later than 5 minutes after receipt.
- 7.5.11. Coordinate with 45 WS for training control tower operators on the Cooperative Weather Watch Program (Limited Weather Observation Training).
- 7.5.12. Report significant weather changes observed on ATC radar to the RWOC.
- 7.5.13. Provide the RWOC with flight and operations schedule.
- 7.5.14. Provide an orientation tour for weather personnel upon request.
- 7.5.15. 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.
- 7.5.16. Notify the range weather forecaster when a runway change is accomplished.
- 7.5.17. Change the FMQ-19 sensor to the appropriate sensor upon implementing a runway change.

7.6. 45th Space Communications Squadron (45 SCS). 45 SCS will: (T-3).

7.6.1. Maintain PAFB, CCAFS, and KTTS airfield weather observing equipment. In the event of multiple observing outages, restoral priority will be IAW *45th Operations Group Operations Letter on Air Traffic Control and Landing Systems (ATCALs) Management and Restoral Priorities*, 18 Jul 2012.

7.6.2. For significant outages, keep maintenance response time to less than one hour after work center is notified unless ATCALs personnel are working to restore higher priority ATC equipment.

7.6.3. Provide local infrastructure communication services at CCAFS via the LISC contractor. 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. 45th Range Management Squadron (45 RMS). 45 RMS will: (T-3).

7.7.1. Provide Range communication and weather instrumentation operations and maintenance via the LISC 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 LISC Statement of Work. The LISC 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 LISC 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 LISC 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. 45th Force Support Squadron (45 FSS). 45 FSS will notify 45 WS/CC of all incidents involving weather personnel and/or resources. **(T-3).**

7.9. NASA. As noted in Section 5.18, NASA has agreed to provide the following: **(T-3).**

7.9.1. Provide a weekly input of the weather-sensitive ground operations to the Range Weather Operations Center (RWOC). Provide the location, duration, and limiting weather parameters (for example: winds, precipitation, lightning, and 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 Duty Officer (DO) and RWOC.

7.9.2. Provide training and informational materials to 45th Weather Squadron (45 WS) when weather launch commit criteria (LCC) are changed to ensure the 45 WS understands the operational reasons and technical basis for the LCC.

7.9.3. Retain property records for engineering support, spares, system configuration, maintenance, and failure analysis documentation for meteorological equipment furnished and used by the KSC.

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 experimental, and 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:** As required, accomplish improvements in accordance with Universal Documentation System procedures, monitored through the 1st Range Operations Squadron (1 ROPS).

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

7.9.8. Through the Shuttle Landing Facility coordinators/Air Traffic Control (when on duty):

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

7.9.8.2. Participate in a CWW by informing the RWOC of any of the following conditions, if not consistent with the FMQ-19 Automated Observing System:

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

7.9.8.2.2. Any significant increase or decrease in visibility.

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

7.9.8.2.4. The beginning or ending of precipitation.

7.9.8.2.5. 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 (Range Safety Office) will provide all toxic modeling support once notified. 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. Complete information on toxic hazard responsibilities is documented in 45 SW No. 15E-2-16, *Memorandum of Agreement (MOA) among the 45th Space Wing (45 SW), the National Aeronautics and Space Administration's John F. Kennedy Space Center (NASA/JFKSC) and the Brevard County Office of Emergency Management (BCOEM) for the Risk Assessment Center (RAC)*, Rev C, 5 Mar 2012.

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

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

7.9.11.5. Operation and management of the Applied Meteorology Unit as indicated in the guidance outlined in Section 5.18.

WAYNE R. MONTEITH, Brigadier General, USAF
Commander

Attachment 1**GLOSSARY OF REFERENCES AND SUPPORTING INFORMATION*****References***

- AFMAN 10-206, Operational Reporting, 11 Jun 2014
- AFI 10-229, *Responding to Severe Weather*, 15 Oct 2003
- AFPD 15-1. *Air Force Weather Operations*, 19 Feb 2010
- AFMAN 15-111, *Surface Weather Observations*, 27 Feb 2013
- AFI 15-114, *Functional Resource and Weather Technical Performance Evaluation*, 07 Dec 2001
- AFMAN 15-124, *Meteorological Codes*, 28 Feb 2013
- AFI 15-128, *Air and Space Weather Operations--Roles and Responsibilities*, 07 Feb 2011
- AFMAN 15-129 Volume 1, *Air and Space Weather Operations – Characterization*, 06 Dec 2011
- AFMAN 15-129 Volume 2, *Air and Space Weather Operations – Exploitation*, 07 Dec 2011
- AFSPCMAN 91-710, Vol 6, *Range Safety User Requirements Manual Volume 6 – Ground and Launch Personnel, Equipment, System, and Material Operations Safety Requirements*, 3 Apr 2014
- KCA-1645, *Agreement between the DoD and NASA, Regarding Management of the Atlantic Missile Range of DoD and the Merritt Island Launch Area of NASA*, 17 Jan 1963 (Webb-McNamara Agreement).
- 45 SW No. 15E-2-2, *Joint Operations Support Agreement between the 45th Space Wing and the John F. Kennedy Space Center, Appendix E*, 25 Apr 2013
- 45 SW No. 15E-3-07, *Joint Operating Procedure (JOP) for Meteorological Support between the 45th Space Wing (45 SW) and the National Aeronautics and Space Administration John F. Kennedy Space Center (NASA-KSC)*, 21 Sep 07
- 45 SW No. 15E-2-27, *Memorandum of Understanding between the National Aeronautics and Space Administration and the United States Air Force, 45th Space Wing and the National Oceanic and Atmospheric Administration National Weather Service on the Operation of the Applied Meteorology Unit*, 16 Oct 2008
- KNPR 8715.3, *KSC Safety Procedural Requirement*, Rev. J-1, 28 Jun 2012
- KNPR 8715.3, Volume 1, *Safety Procedural Requirements for Civil Servants/NASA Contractors*, Rev. Basic-2, 28 Jun 2012
- KNPR 8715.3-2, Volume 2, *Safety Procedural Requirements for Partner Organizations Operating in Joint-Use Facilities*, Rev. Basic-1, 12 Apr 2013
- KNPR 8715.3-3, Volume 3, *Safety Procedural Requirements for Partners Operating in Exclusive-Use Facilities*, Rev. A, 19 May 2014
- 45 SW No. 15E-2-16, *Memorandum of Agreement (MOA) among the 45th Space Wing (45 SW), the National Aeronautics and Space Administration's John F. Kennedy Space Center*

(NASA/JFKSC) and the Brevard County Office of Emergency Management (BCOEM) for the Risk Assessment Center (RAC), Rev C, 05 Mar 2012

45 SW 10-2 IEMP PAFB, *Installation Emergency Management Plan, Patrick Air Force Base*, 19 Mar 2014

45 SW 10-2 IEMP CCAFS, *Installation Emergency Management Plan, Cape Canaveral Air Force Station*, 04 Apr 2014

KNPR 8715.2, *Kennedy NASA Procedural Requirements, Comprehensive Emergency Management Plan (CEMP)*, Rev BASIC-2, 18 May 2009

45th Operations Group Operations Letter on Air Traffic Control and Landing Systems (ATCALs) Management and Restoral Priorities, 18 Jul 2012

Abbreviations and Acronyms

45 SW—45th Space Wing

45 WS—45th Weather Squadron

45 WS/DO—45 WS Director of Operations

557 WW—557th Weather Wing

AFB—Air Force Base

AFI—Air Force Instruction

AFMAN—Air Force Manual

AFPD—Air Force Policy Directive

AFS—Air Force Station

AGL—Above Ground Level

ALSTG—Altimeter Setting

AMPS—Automated Meteorological Profiling System

AOA—Abort Once Around

AOS—Automated Observing System

ATC—Air Traffic Control

ATCALs—Air Traffic Control and Landing Systems

AMU—Applied Meteorological Unit

BWC—Bird Watch Conditions

BWS—Base Weather Station

CC—Commander

CCAFS—Cape Canaveral Air Force Station

CCTV—Closed Circuit Television

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
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

LISC—Launch and Test Range System, Integrated Support Contract

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

METWATCH—Meteorological Watch

MIDDS—Meteorological Interactive Data Display System

MOC—Morrell 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 Oceanic and Atmospheric Administration

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 Assessment Center

RADCC—Radiological Control Center
RAPCON—Radar Approach Control
RECCE—Reconnaissance
ROS—Representative Observation Site
RQS—Rescue Squadron
RSC—Runway Surface Condition
RTLS—Return To Landing Site
RVR—Runway Visual Range
RWF—Range Weather Forecaster
RWOC—Range Weather Operations Center
SAR—Search and Rescue
SCS—Space Communications Squadron
SCLS—Space Coast Launch Services
SFC—Surface
SFS—Security Forces Squadron
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
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)

Attachment 2

EXAMPLE PATRICK AFB TAF

Table A2.1. Example Forecast for Patrick AFB.

TAF KCOF 091000Z 0910/1016 13010G15KT 9999 FEW250 QNH3013INS BECMG 0917/0918 14012G18KT 9999 FEW030 SCT250 QNH3011INS BECMG 1013/1014 15012G18KT 9999 SCT025 BKN200 QNH3010INS TX29/0918Z TN23/0910Z=
--

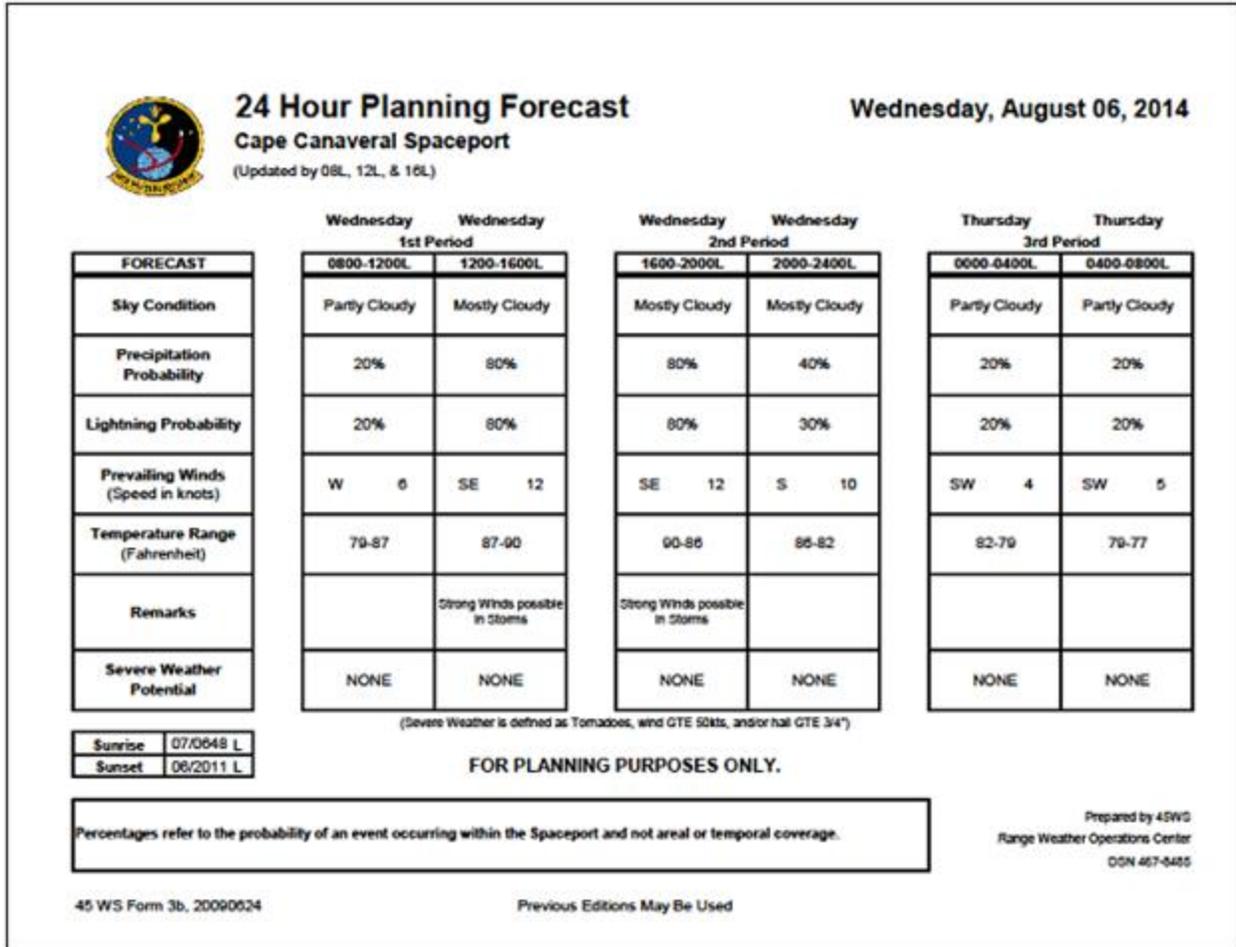
Table A2.2. Example Forecast Amendment/Correction for Patrick AFB.

TAF AMD KCOF 091245Z 0912/1016 13015G25KT 9999 FEW250 QNH3013INS BECMG 0917/0918 14012G18KT 9999 FEW030 SCT250 QNH3011INS BECMG 1013/1014 15012G18KT 9999 SCT025 BKN200 QNH3010INS TX29/0918Z TN23/0910Z AMD 091245=

Attachment 3

24-HOUR PLANNING FORECAST

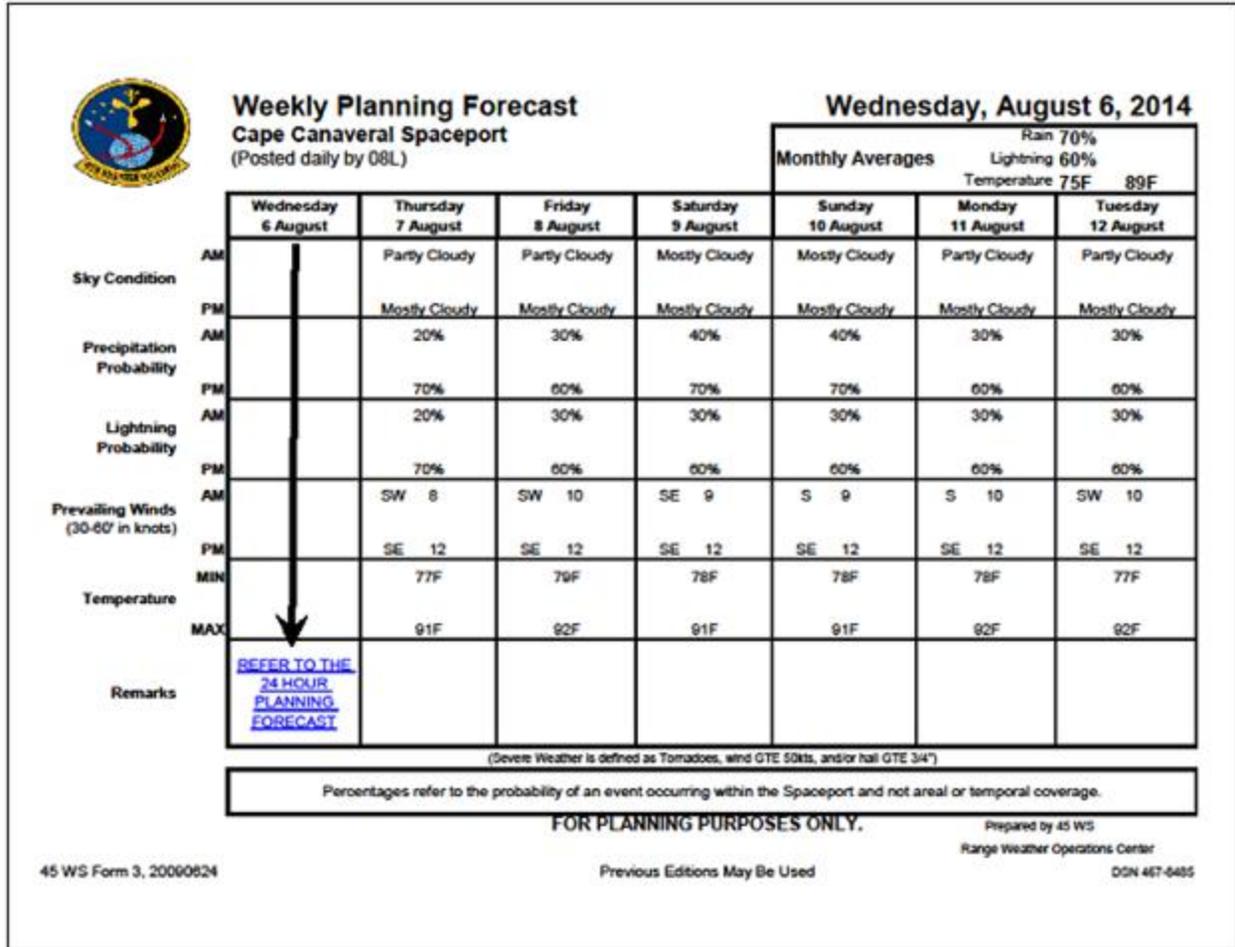
Figure A3.1. Example 24-Hour Planning Forecast.



Attachment 4

SEVEN-DAY PLANNING FORECAST

Figure A4.1. Example 7-Day Planning Forecast.



Attachment 5

AVON PARK TRAINING AREA AND DROP ZONES

Figure A5.1. Avon Park Training Area.

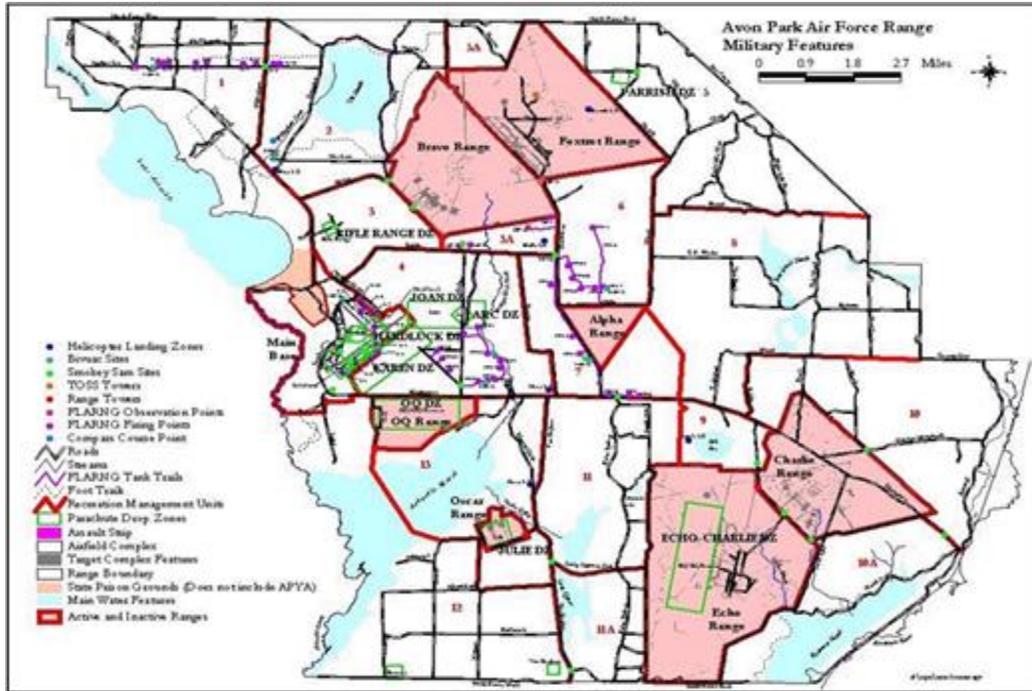


Figure A5.2. Drop Zones.



Attachment 6

45 WS MISSION WEATHER PRODUCT

Figure A6.1. Example Mission Weather Product.

45WS MISSION WEATHER PRODUCT

Date: 6-Aug-14 Local Z-Offset 4 Issue Time: 1100Z

Patrick Air Force Base / Judy DZ / Crown DZ Forecast

TAF 0610/0716 29006KT 9999 SKC
 BECMG 0617/0618 05006KT 9999 FEW035
 BECMG 0620/0621 10009KT 9999 VCTS SCT035CB SCT250
 BECMG 0623/0624 16006KT 9999 NSW FEW035 SCT250

TIME	12Z	13Z	14Z	15Z	16Z	17Z	18Z	19Z	20Z	21Z	22Z	23Z	00Z	01Z	02Z	03Z	04Z
TEMP C	26C	26C	26C	26C	26C	31C	32C	31C	30C	29C	28C	29C	28C	27C	27C	27C	26C
TEMP F	79F	82F	82F	84F	84F	88F	90F	88F	86F	84F	82F	82F	82F	81F	81F	81F	79F
ALSTG	30.00	30.02	30.03	30.04	30.02	30.01	30.00	29.99	29.99	29.98	29.98	29.98	29.98	29.98	29.99	29.99	29.99
PA	-72	-92	-102	-112	-92	-82	-72	-62	-62	-62	-62	-62	-62	-62	-62	-62	-62

Shuttle Landing Facility W497A/B

TAF 0610/0716 29006KT 9999 SKC
 BECMG 0617/0618 05006KT 9999 FEW035
 BECMG 0620/0621 10009KT 9999 VCTS SCT035CB SCT250

TIME	12Z	13Z	14Z	15Z	16Z	17Z	18Z	19Z	20Z
TEMP C	26C	26C	26C	26C	26C	31C	32C	31C	30C
TEMP F	79F	82F	82F	84F	84F	88F	90F	88F	86F
ALSTG	30.00	30.02	30.03	30.04	30.02	30.01	30.00	29.99	29.99
PA	-71	-91	-101	-111	-91	-81	-71	-61	-61

Local Flight Level Winds		
FL400	21015	-51C
FL350	21010	-40C
FL300	26010	-29C
FL250	28010	-17C
FL200	28010	-06C
FL150	26010	01C
FL120	26010	07C
FL100	25010	10C
FL080	24010	13C
FRZ	16,000FT	

LOCAL FLIGHT HAZARDS (Within 50sm of airfield)	
Thunderstorms	Location/Comments
ISOLD MT	480
	FL
Turbulence	Location/Comments
NONE	
Icing	Location/Comments
NONE	

SOLAR/LUNAR DATA (dd/hhhh)			
Sunrise	07/1047Z	Moonrise	06/2020Z
Sunset	06/0052Z	Moonset	07/0720Z
EENT	07/0104Z	Illumination	72%

SEA STATE	
Sea Temp	83 F / 28.3 C
Sea State	2-3 FT

Avon Park Forecast <https://weather.af.mil/aviation/MSIC/REQUEST?script=afdbn/afdbn/AVNO/FD/0203%2000>

* HAIL, SEVERE TURBULENCE, SEVERE ICING, HEAVY PRECIPITATION, LIGHTNING, AND LOW LEVEL WIND SHEAR EXPECTED IN AND NEAR THUNDERSTORMS *

POC: Flight Chief, Range Weather Operations

Reviewed: 23 Jun 14

Call 45WS forecaster for updates (853-8485)

THIS PRODUCT IS ISSUED AT 0700, 1500, AND AMENDED AS NECESSARY

THIS PRODUCT IS ISSUED AT 0700, 1500, AND AMENDED AS NECESSARY

Attachment 8

DD FORM 175-1 EXAMPLE

Figure A8.1. Example DD Form 175-1.

FLIGHT WEATHER BRIEFING											
PART I - TAKEOFF DATA											
1. DATE	2. ACFT TYPE/NO.	3. DEP PT/ETD	4. RWY TEMP	5. DEWPOINT	6. TEMP DEV	7. PRES ALT	8. DENSITY ALT				
9. SFC WIND	M T	10. CLIMB WINDS	Z	°C	°C	N/A	FT	N/A	FT		
13. REMARKS/TAKEOFF ALTN FCST BWC:		11. LOCAL WEATHER WATCH/WARNING/ADVISORY								12. RSC/RCR	
PART II - ENROUTE & MISSION DATA											
14. FLT LEVEL/WINDS/TEMP		SEE ATTACHED		15. SPACE WEATHER			16. SOLAR/LUNAR		LOCATION		
				NO IMPACT MARGINAL SEVERE			B/MNT Z				
				FREQ			SR		MR Z		
				GPS			SS		MS Z		
				RAD			EENT		LLUM %		
17. CLOUDS AT FLT LEVEL					18. OBSCURATIONS AT FLT LEVEL RESTRICTING VISIBILITY						
YES NO IN AND OUT					YES NO TYPE						
19. MINIMUM CEILING - LOCATION					20. MAXIMUM CLOUD TOPS - LOCATION						
FT AGL					FT MSL						
22. THUNDERSTORMS			23. TURBULENCE			24. ICING			25. PRECIPITATION		
CHART			CHART			CHART			CHART		
NONE AREA LNE			NONE IN CLEAR IN CLOUD			NONE RIME MOED CLEAR			NONE DRIZZLE RAIN SNOW PELLET		
ISOLATED 1-2%			LIGHT			TRACE			LIGHT		
FEW3-8%			MODERATE			LIGHT			MODERATE		
SCATTERED 16-45%			SEVERE			MODERATE			HEAVY		
NUMEROUS - MORE THAN 45%			EXTREME			SEVERE			SHOWERS		
HAIL SEVERE THUNDERSTORMS HEAVY PRECIPITATION LIGHTNING & WIND SHEAR EXPECTED IN AND NEAR THUNDERSTORMS.			LEVELS			LEVELS			FREEZING		
LOCATION			LOCATION			LOCATION			LOCATION		
PART III - AERODROME FORECASTS											
26.	27. VALID TIME	28. SFC WIND	29. VSBY/WEA	30. CLOUD LAYERS			31. ALTIMETER	RWY TEMP	PRES ALT		
DEST/ALTN	Z TO Z	M T					INS	°C	FT		
DEST/ALTN	Z TO Z	M T					INS	°C	FT		
DEST/ALTN	Z TO Z	M T					INS	°C	FT		
DEST/ALTN	Z TO Z	M T					INS	°C	FT		
DEST/ALTN	Z TO Z	M T					INS	°C	FT		
DEST/ALTN	Z TO Z	M T					INS	°C	FT		
DEST/ALTN	Z TO Z	M T					INS	°C	FT		
DEST/ALTN	Z TO Z	M T					INS	°C	FT		
DEST/ALTN	Z TO Z	M T					INS	°C	FT		
PART IV - COMMENTS/REMARKS											
32. BRIEFED RSC/RCR	YES	NOT AVAILABLE	33. PM SV 344 6	34. ATTACHMENTS			YES	NO			
35. REMARKS Please call the 45th WS for updates prior to departure and return MEF Brief Form. For updates at your destination, contact the following: 15th OWS - DSN 576-9755/COM (618) 256-9755 25th OWS - DSN 228-6598/COM (877) 451-8367 26th OWS - DSN 781-4775/COM (866) 233-9328 28th OWS - DSN 965-0939/COM (877) 297-4129 45th WS - DSN 467-8485/COM (321) 853-8485											
PART V - BRIEFING RECORD											
36. WX BRIEFED TIME		37. FLIMSY BRIEFING NO.		38. FORECASTER'S INITIALS			39. NAME OF PERSON RECEIVING BRIEFING				
Z											
40. VOID TIME		41. EXTENDED TO/INITIALS		42. WX REBRIEF TIME/INITIALS			43. WX DEBRIEF TIME/INITIALS				
Z		Z		Z			Z				
DD FORM 175-1, OCT 2002 PREVIOUS EDITION MAY BE USED											

Attachment 9

MISSION EXECUTION FORECAST (MEF) EXAMPLE

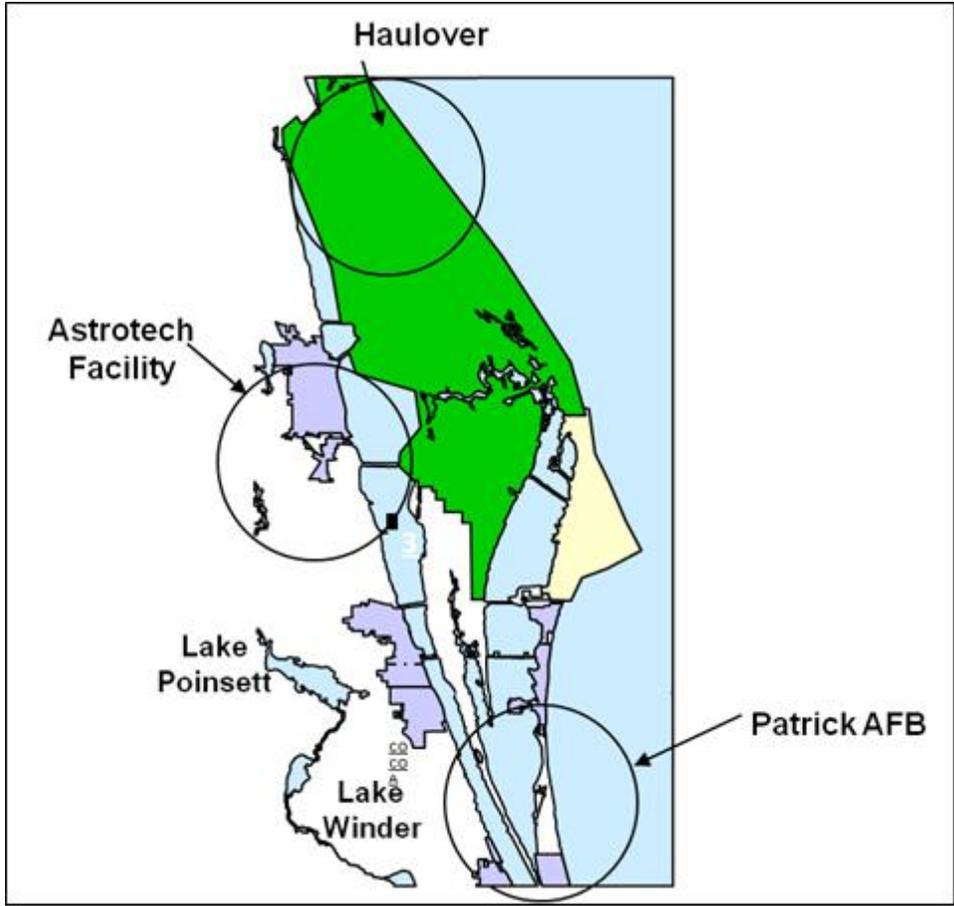
Figure A9.1. Example MEF.

45 WS MISSION EXECUTION FORECAST		DEPARTURE STATION / ETD		DATE		TYPE AIRCRAFT / CALL SIGN			
		KCOF / 2300 Z		5-Aug-14		C130 / KING			
TAKE OFF DATA									
VALID TIME	WIND (M / Z)	VIS	WEATHER	TMP °C	DP °C	SKY CONDITION	ALSTD PA		
2200	26009	7SM	VCTS	+27	+23	BKN035CB BKN100	3002 -83 FT		
2400						X-WIND RWY 0220: 8 1100 5 KTS			
CLIMB WINDS		WATCHES / WARNINGS / ADVISORIES		ICING		BRD WATCH CONDITION			
24010 (SFC-050), 31010 (050-080), 29015 (080-180)		LTG WATCH VALID TIL 22Z		DRY		LOW			
REMARKS (TSMS IMPLY LLWS)									
TEMPO: 26015G25KT 8000 -TSRA BKN035CB									
ENROUTE DATA									
FLIGHT LEVELS WIND / TEMPERATURE °C		SPACE WEATHER		AFW/WRB		LIGHT / NVG DATA			
FL 180		X SEE ATTACHED				SR119			
FREEZING LEVELS / LOCATION		GPS ERROR		NO IMPACT		SR			
148 / TN		X		X		N/A Z			
THUNDERSTORMS		TURBULENCE		ICING		PRECIPITATION			
NONE		NONE		NONE		NONE			
X ISOLATED 1 - 2%		X MT450		X		X			
FEW 3 - 15%		MODERATE		LIGHT		MODERATE			
SCATTERED 16 - 48%		SEVERE		MODERATE		HEAVY			
NUMEROUS - MORE THAN 45%		EXTREME		SEVERE		SHOWERS			
HAZ, SEVERE TURBULENCE, ICING, HEAVY PRECIPITATION, LIGHTNING, WIND SHEAR EXPECTED IN NEAR THUNDERSTORMS		LEVEL(S)		LEVEL(S)		FREEZING			
FL / ATLANTIC		FL / ATLANTIC		160-180		LOCATION(S)			
LOW LEVEL ROUTE FORECAST									
LOCATION / FLIGHT LEVEL	CLOUDS	VIS	WEATHER	WINDS	VALID TIME				
SR119 / 005	040SCT080	3SM IC 7SM OC	NSW	27005	2330 0330 Z				
DROP / LANDING ZONE FORECAST									
DROP ZONE / ALTITUDE	CLOUDS / VISIBILITY / WEATHER	WIND / TEMPERATURE °C		ALSTD	VALID TIME				
		SURFACE							
		DROP ALTITUDE							
HAZARDS / REMARKS:									
WIND (AOL) / TMP °C	040	050	060	070	100	120	150		
	SFC	005	010	015	020	025	030		
RECOVERY / ALTERNATE FORECAST									
STATION	WIND (MT)	VIS	WEATHER	TEMP	SKY CONDITION	PA	ALSTD	VALID TIME	
KAHN	31004	7SM	NSW	-26	FEW250	-726 FT	3001	260030Z	
					X-WIND RWY 0220: 4 0927: 3 KTS			2330 - 0130	
KCHA	VRB06	7SM	NSW	-27	SCT080	-572 FT	3004	060100Z	
					X-WIND RWY 0220: 6 150 4 KTS			0000 - 0200	
KTYS	VRB04	7SM	NSW	-24	SCT080	-871 FT	3004	060130Z	
					X-WIND RWY 0920: 4 KTS			0000 - 0230	
KAVL	VRB04	7SM	NSW	-22	SCT220	-2037 FT	3006	060300Z	
					X-WIND RWY 1904: 4 KTS			0100 - 0300	
KCOF	24006	7SM	NSW	-26	SCT250	-92 FT	3003	060400Z	
					X-WIND RWY 0220: 4 1100 5 KTS			0200 - 0300	
REMARKS (TSMS IMPLY LLWS)				FREQ		PILOT		ATTACHMENT	
For Flight Briefings at stops contact 15th OWS - DSN 570-9755/ COM (618) 250-9755 26th OWS - DSN 781-4775/ COM (866) 223-3328				KCOF		225.05		YES	
BRIEFING DATA									
BRIEF TIME (ZULU)		INITIALS		REDRIEF TIME (ZULU)		INITIALS			
E 052000Z		BWO							

Attachment 10

PATRICK AFB METWATCH AREAS

Figure A10.1. Patrick AFB METWATCH Areas.



Attachment 11

PATRICK AFB METWATCH PRODUCTS

Table A11.1. Example Weather Watch.

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)

Table A11.2. Example Lightning Warning

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.

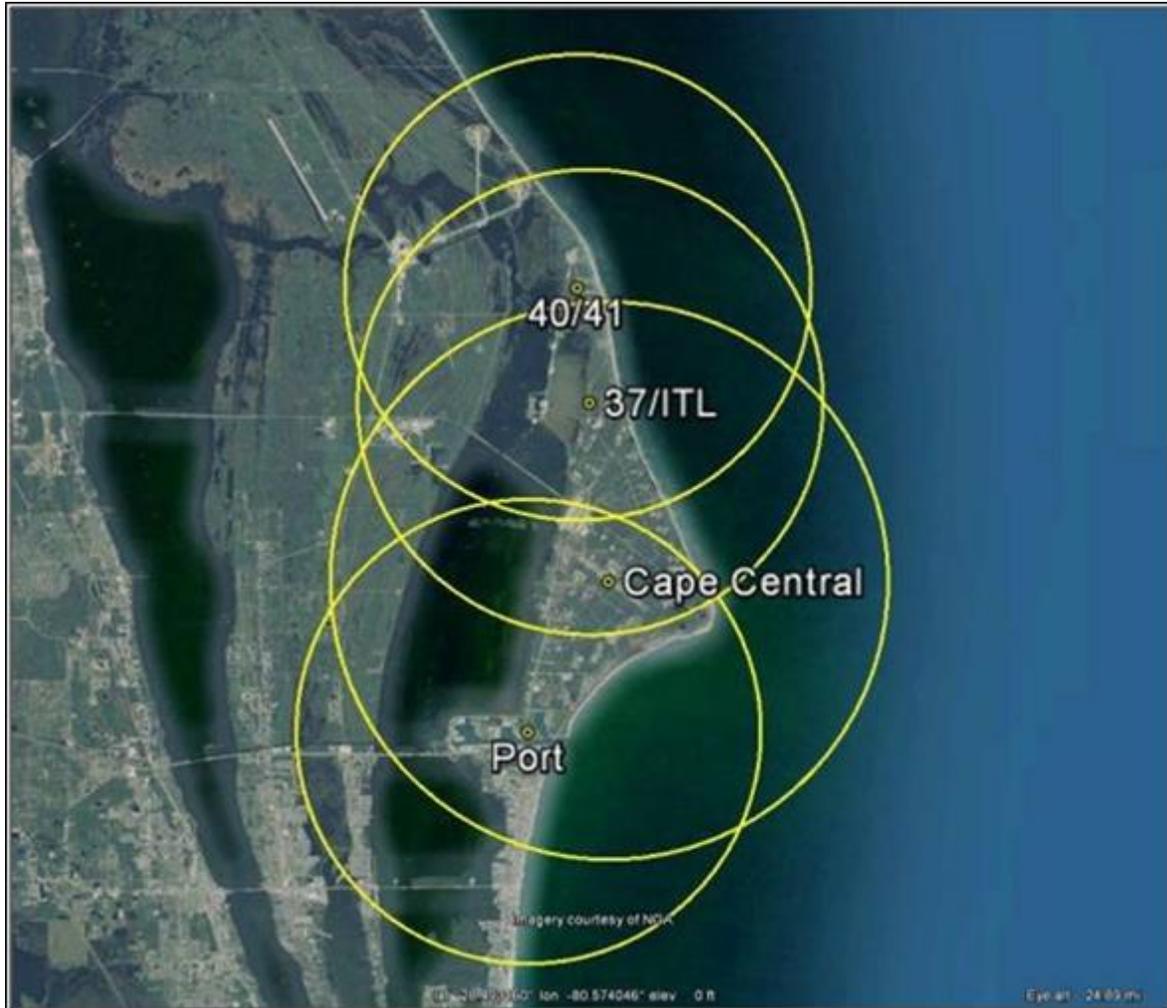
Table A11.3. Example Weather Advisory

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

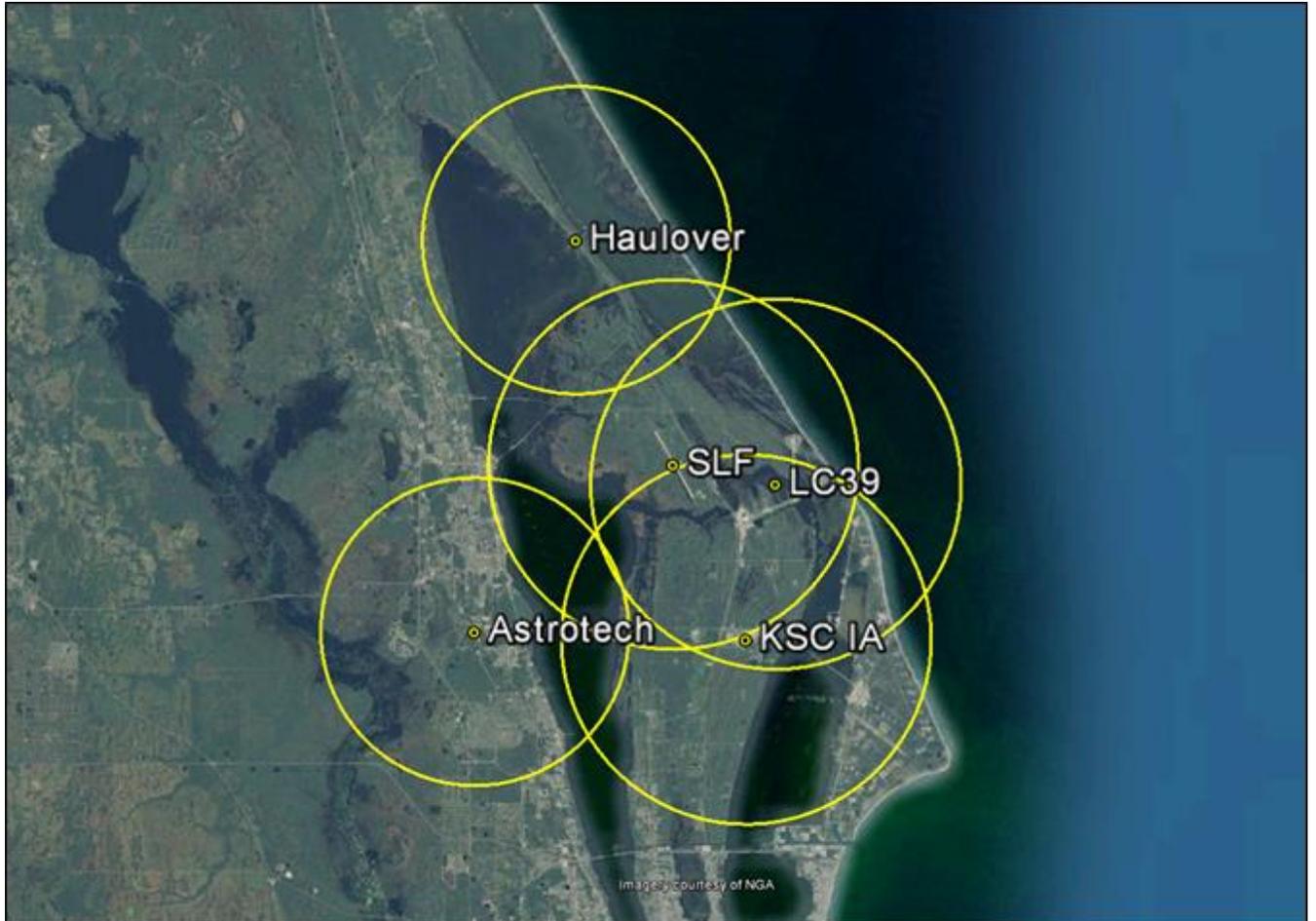
Figure A12.1. CCAFS Lightning Watch/Warning Locations.



Attachment 13

KSC LIGHTNING WATCH AND WARNING LOCATIONS

Figure A13.1. KSC Lightning Watch/Warning Locations.



Attachment 14**LIGHTNING LAUNCH COMMIT CRITERIA, LAP RECOMMENDATION 08/20/14****A14.1. PREAMBLE**

A14.1.1. The launch safety rules include launch-commit criteria that identify each condition that must be met in order to launch. These include criteria for trained weather personnel to monitor the meteorological conditions and implement each launch constraint developed using the following Natural and Triggered Lightning Launch-Commit Criteria. The launch operator must have clear and convincing evidence that none of these criteria is violated at the time of launch. Whenever there is ambiguity about which of several LLCC applies to a particular situation, all potentially applicable LLCC must be applied. If any other hazardous conditions exist, other than those identified below, the launch weather team will report the hazardous condition to the final approval authority for launch, who will determine whether launching would expose the launch vehicle to a lightning hazard and not launch in the presence of the hazard.

A14.1.1.1. NATURAL AND TRIGGERED LIGHTNING LAUNCH-COMMIT CRITERIA

A14.1.1.2. **GENERAL.** These are the launch-commit criteria for mitigating against natural lightning strikes and lightning triggered by the flight of a launch vehicle through or near an electrified environment. A launch operator may not launch unless the weather conditions satisfy all of these Natural and Triggered Lightning Launch-Commit Criteria (LLCC).

A14.1.1.3. In order to meet the LLCC, a launch operator must employ any:

A14.1.1.4. Weather monitoring and measuring equipment needed, and

A14.1.1.5. Procedures needed to verify compliance.

A14.1.2. When equipment or procedures, such as a field mill or calculation of the maximum radar reflectivity (MRR) of clouds, are used with the lightning launch-commit criteria to increase launch opportunities, a launch operator must evaluate all applicable measurements to determine whether the measurements satisfy the criteria. A launch operator may not turn off available instrumentation to create the appearance of meeting a requirement and must use all radar reflectivity measurements within a specified volume for a MRR calculation.

A14.1.3. If a launch operator proposes any alternative lightning launch-commit criteria, the launch operator must clearly and convincingly demonstrate that the alternative provides an equivalent level of safety to that required here.

A14.2. DEFINITIONS. Definitions are provided in Table A14.1 only for technical terms (e.g., "triboelectrification") and for terms that are used in nonstandard ways (e.g., "associated"). For all undefined terms, the Glossary of Meteorology [American Meteorological Society, Boston, MA, 2nd ed., 850 pp., 2000] applies. For the purpose of these LLCC:

Table A14.1. Definitions for LLCC

Anvil cloud means a stratiform or fibrous cloud formed by the upper-level outflow or blow-off from a thunderstorm or convective cloud.
Associated means two or more clouds are caused by the same disturbed weather or are physically connected.
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 collection of suspended water droplets or ice particles, or a combination of water droplets and ice particles. The cloud is the entire volume containing such particles.
Cloud layer means a vertically continuous array of clouds, not necessarily of the same type, whose bases are approximately at the same altitude.
Cone of silence means the volume within which a radar cannot detect any object, and is an inverted circular cone centered on the radar antenna. A cone of silence consists of all elevation angles greater than the maximum elevation angle reached by the radar.
Debris cloud means any cloud, except an anvil cloud, that has become detached from a parent cumulonimbus cloud or thunderstorm, or that results from the decay of a parent cumulonimbus cloud or thunderstorm.
Disturbed weather means a weather system where a dynamical process destabilizes air on a scale larger than the individual clouds or cells. Examples of disturbed weather include fronts, troughs, and squall lines.
Electric field means the rate that the electrostatic potential increases with altitude near the surface of the earth. It is measured in volts per meter (V/m) using the polarity convention that a positive electric field is produced by a positive charge overhead.
Field mill means an 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.
Flight path means the volume defined by the vertical and horizontal uncertainties resulting from all three-sigma guidance and performance deviations about a launch vehicle's planned flight trajectory.
Horizontal distance means a distance that is measured horizontally between a field mill (or electric field measurement point) and the nearest part of the vertical projection of an object or flight path onto the surface of the Earth, or the shortest distance between the vertical projections of any two extended objects onto a common horizontal reference plane.
Lightning means the entire lightning discharge including all of its channels and branches.
Maximum radar reflectivity (MRR) means the largest radar reflectivity within a specified volume that is associated with an evaluation point. [Section 25(b) provides full details on how to calculate MRR.]
Moderate precipitation means a precipitation rate of 0.1 inches/hr or a radar reflectivity of 30 dBZ.

Non-transparent means that one or more of the following conditions apply:

- (1) Objects above, including higher clouds, blue sky, and stars, are blurred, indistinct, or obscured when viewed from below when looking through a cloud at visible wavelengths; or objects below, including terrain, buildings, and lights on the ground, are blurred, indistinct, or obscured when viewed from above when looking through a cloud at visible wavelengths;
- (2) Objects above or below an observer are seen distinctly only through breaks in a cloud layer; or
- (3) The cloud has a radar reflectivity of 0 dBZ or greater. Precipitation means detectable rain, snow, hail, graupel, or sleet at the ground; virga; or a radar reflectivity greater than 18 dBZ.

Radar reflectivity means the radar reflectivity factor due to hydrometeors, in dBZ.

Slant distance means the shortest distance between measurement points and/or objects in three dimensional space. Note that slant distance to a volume, such as a cloud or the flight path, refers to the nearest part of that volume.

Thick cloud layer means one or more cloud layers whose combined vertical extent from the base of the bottom cloud layer to the top of the uppermost cloud layer exceeds 1.4 km (4,500 feet). Cloud layers are combined with neighboring layers for determining total thickness only when they are physically connected by vertically continuous clouds.

Thunderstorm means any convective cloud that produces lightning.

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

A14.3. LIGHTNING.

A14.3.1. A launch operator must wait 30 minutes to launch after any type of lightning occurs at a slant distance of less than or equal to 10 nautical miles from the flight path, unless:

A14.3.1.1. The non-transparent part of the cloud that produced the lightning is at a slant distance of greater than 10 nautical miles from the flight path;

A14.3.1.2. There is at least one working field mill at a horizontal distance of less than or equal to 5 nautical miles from each such lightning discharge; and

A14.3.1.3. The absolute values of all electric field measurements at a horizontal distance of less than or equal to 5 nautical miles from the flight path, and at each field mill specified in paragraph A14.3.1.2 of this section, have been less than 1000 volts/meter for at least 15 minutes.

A14.3.2. A launch operator must wait 30 minutes to launch after any type of lightning occurs within or from a thunderstorm if the flight path will carry the launch vehicle at a slant distance of less than or equal to 10 nautical miles from any nontransparent part of that thunderstorm. This paragraph does not apply to an anvil cloud that is attached to a parent thunderstorm.

A14.4. SURFACE ELECTRIC FIELDS.

A14.4.1. A launch operator must wait 15 minutes to launch after the absolute value of any electric field measurement at a horizontal distance of less than or equal to 5 nautical miles from the flight path has been greater than or equal to 1500 volts/meter.

A14.4.2. A launch operator must wait 15 minutes to launch after the absolute value of any electric field measurement at a horizontal distance of less than or equal to 5 nautical miles from the flight path has been greater than or equal to 1000 volts/meter, unless:

A14.4.2.1. No clouds at a slant distance of less than or equal to 10 nautical miles from the flight path are nontransparent; or

A14.4.2.2. All non-transparent clouds at a slant distance less than or equal to 10 nautical miles from the flight path:

A14.4.2.2.1. Have tops at altitudes where the temperature is warmer than or equal to +5 degrees Celsius, and

A14.4.2.2.2. Have not been part of convective clouds with cloud tops at altitudes where the temperature was colder than or equal to -10 degrees Celsius for 3 hours.

A14.5. CUMULUS CLOUDS.

A14.5.1. This section applies to non-transparent cumulus clouds, except for cirrocumulus, altocumulus, or stratocumulus clouds. This section does not apply to an anvil cloud that is attached to a parent cumulus cloud.

A14.5.2. Flight path through the cloud: A launch operator may not launch if the flight path will carry the launch vehicle through any cumulus cloud if either of the following conditions applies:

A14.5.2.1. The cloud has a top at an altitude where the temperature is colder than or equal to +5, and warmer than -5, degrees Celsius unless:

A14.5.2.1.1. The cloud is not producing precipitation;

A14.5.2.1.2. The horizontal distance from the center of the cloud top to at least one working field mill is less than 2 nautical miles; and

A14.5.2.1.3. All electric field measurements at a horizontal distance of less than or equal to 5 nautical miles from the flight path, and at each field mill specified in paragraph A14.5.2.1.2, have been between -100 volts/meter and +500 volts/meter for at least 15 minutes.

A14.5.2.2. The cloud has a top at an altitude where the temperature is colder than or equal to -5 degrees Celsius.

A14.5.3. Flight path between 0 and 5 nautical miles from the cloud: A launch operator may not launch if the slant distance to the flight path is greater than zero and less than or equal to 5 nautical miles from any cumulus cloud that has a top at an altitude where the temperature is colder than or equal to -10 degrees Celsius.

A14.5.4. Flight path between 5 and 10 nautical miles from the cloud: A launch operator may not launch if the slant distance to the flight path is greater than 5 and less than or equal to 10 nautical miles from any cumulus cloud that has a top at an altitude where the temperature is colder than or equal to -20 degrees Celsius.

A14.6. ATTACHED ANVIL CLOUDS.

A14.6.1. This section applies to any non-transparent anvil cloud formed from a parent cloud that has, or had at any time, a top at an altitude where the temperature is colder than or equal to -10 degrees Celsius.

A14.6.2. Flight path through or within 3 nautical miles of cloud: If a flight path will carry a launch vehicle less than or equal to 3 nautical miles from any attached anvil cloud, the launch operator may not launch unless:

A14.6.2.1. The portion of the attached anvil cloud at a slant distance of 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; and

A14.6.2.2. The MRR is less than +7.5 dBZ at every point at a slant distance of less than or equal to 1 nautical mile from the flight path.

A14.6.3. Flight path between 3 and 5 nautical miles from cloud: If a flight path will carry a launch vehicle at a slant distance of greater than 3 and less than or equal to 5 nautical miles from any attached anvil cloud, a launch operator must wait 3 hours to launch after every lightning discharge within or from the parent cloud or anvil cloud, unless the portion of the attached anvil cloud at a slant distance of 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.

A14.6.4. Flight path between 5 and 10 nautical miles from cloud: If the flight path will carry the launch vehicle at a slant distance of greater than 5 and less than or equal to 10 nautical miles from any attached anvil cloud, the launch operator must wait to launch for 30 minutes after every lightning discharge within or from the parent cloud or anvil cloud, unless the portion of the attached anvil cloud that is at a slant distance of 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.

A14.7. DETACHED ANVIL CLOUDS.

A14.7.1. This section applies to any non-transparent anvil cloud formed from a parent cloud that had, at or before detachment, a top at an altitude where the temperature was colder than or equal to -10 degrees Celsius.

A14.7.2. Flight path through cloud: If the flight path will carry the launch vehicle through a detached anvil cloud, the launch operator may not launch unless:

A14.7.2.1. The launch operator waits 4 hours after every lightning discharge within or from the detached anvil cloud; and observation shows that 3 hours have passed since the anvil cloud detached from the parent cloud; or

A14.7.2.2. Each of the following conditions exists:

A14.7.2.2.1. Any portion of the detached anvil cloud at a slant distance of 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; and

A14.7.2.2.2. The MRR is less than +7.5 dBZ everywhere within the flight path.

A14.7.3. Flight path between 0 and 3 nautical miles from cloud: If a flight path will carry a launch vehicle at a slant distance of greater than 0 and less than or equal to 3 nautical miles from a detached anvil cloud, the launch operator must accomplish both of the following:

A14.7.3.1. Wait 30 minutes to launch after every lightning discharge within or from the parent cloud or anvil cloud before detachment of the anvil cloud, and after every lightning discharge within or from the detached anvil cloud after detachment, unless:

A14.7.3.1.1. 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; and

A14.7.3.1.2. The MRR is less than +7.5 dBZ at every point at a slant distance of less than or equal to 1 nautical mile from the flight path; and

A14.7.3.2. If a launch operator is unable to launch in the first 30 minutes under paragraph A14.7.3.1, the launch operator must wait to launch for 3 hours after every lightning discharge within or from the parent cloud or anvil cloud before detachment of the anvil cloud, and after every lightning discharge within or from the detached anvil cloud after detachment, unless:

A14.7.3.2.1. All of the following are true:

A14.7.3.2.1.1. There is at least one working field mill at a horizontal distance of less than or equal to 5 nautical miles from the detached anvil cloud;

A14.7.3.2.1.2. The absolute values of all electric field measurements at a horizontal distance of less than or equal to 5 nautical miles from the flight path, and at each field mill specified in paragraph A14.7.3.2.1.1, have been less than 1000 V/m for at least 15 minutes; and

A14.7.3.2.1.3. The largest radar reflectivity from any part of the detached anvil cloud at a slant distance of less than or equal to 5 nautical miles from the flight path has been less than +10 dBZ for at least 15 minutes; or

A14.7.3.2.2. Both of the following are true:

A14.7.3.2.2.1. The portion of the detached anvil cloud at a slant distance of 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; and

A14.7.3.2.2.2. The MRR is less than +7.5 dBZ at every point at a slant distance of less than or equal to 1 nautical mile from the flight path.

A14.7.4. Flight path between 3 and 10 nautical miles from cloud: If a flight path will carry a launch vehicle at a slant distance of greater than 3 and less than or equal to 10 nautical miles from a detached anvil cloud, the launch operator must wait 30 minutes to launch after every lightning discharge within or from the parent cloud or anvil cloud before detachment, and after every lightning discharge within or from the detached anvil cloud after detachment, unless the portion of the detached anvil cloud at a slant distance of 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.

A14.8. DEBRIS CLOUDS.

A14.8.1. This section applies to any non-transparent debris cloud whose parent cumuliform cloud had any part at an altitude where the temperature was colder than -20 degrees Celsius or to any debris cloud formed by a thunderstorm. This section does not apply to either an attached or a detached anvil cloud.

A14.8.2. A launch operator must calculate a "3-hour period" as starting at the latest of the following times:

A14.8.2.1. The debris cloud is observed to be detached from the parent cloud;

A14.8.2.2. 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; or

A14.8.2.3. Any lightning discharge occurs within or from the debris cloud.

A14.8.3. Flight path through cloud: If a flight path will carry a launch vehicle through a debris cloud, the launch operator may not launch during the "3-hour period," of paragraph A14.8.2, unless:

A14.8.3.1. The portion of the debris cloud at a slant distance of 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; and

A14.8.3.2. The MRR is less than +7.5 dBZ everywhere within the flight path.

A14.8.4. Flight path between 0 and 3 nautical miles from cloud: If the flight path will carry the launch vehicle at a slant distance of greater than 0 and less than or equal to 3 nautical miles from the debris cloud, the launch operator may not launch during the "3-hour period," unless one of the following applies:

A14.8.4.1. A launch operator may launch during the "3-hour period," of paragraph A14.8.2 if:

A14.8.4.1.1. There is at least one working field mill at a horizontal distance of less than or equal to 5 nautical miles from the debris cloud;

A14.8.4.1.2. The absolute values of all electric field measurements at a horizontal distance of less than or equal to 5 nautical miles from the flight path, and at each field mill specified in paragraph A14.8.4.1.1, have been less than 1000 volts/meter for at least 15 minutes; and

A14.8.4.1.3. The largest radar reflectivity from any part of the debris cloud less than or equal to a slant distance of 5 nautical miles from the flight path has been less than +10 dBZ for at least 15 minutes; or

A14.8.4.2. A launch operator may launch during the "3-hour period," of paragraph A14.8.2 if:

A14.8.4.2.1. The portion of the debris cloud at a slant distance of 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; and

A14.8.4.2.2. The MRR is less than +7.5 dBZ at every point at a slant distance of less than or equal to 1 nautical mile from the flight path.

A14.9. DISTURBED WEATHER. A launch operator may not launch if the flight path will carry the launch vehicle through a non-transparent cloud associated with disturbed weather that includes clouds with tops at altitudes where the temperature is colder than 0 degrees Celsius and that contains, at a slant distance of less than or equal to 5 nautical miles from the flight path, either:

A14.9.1. Moderate or greater precipitation; or

A14.9.2. Evidence of melting precipitation such as a radar bright band.

A14.10. THICK CLOUD LAYERS.

A14.10.1. This section does not apply to either attached or detached anvil clouds. Two or more cloud layers must be combined if they are physically connected by towering cumuliform clouds, but a cumulus cloud is never combined with cloud layers to increase the total thickness beyond the combined thickness of the layered clouds.

A14.10.2. A launch operator may not launch if the flight path will carry the launch vehicle through a non-transparent cloud layer that is:

A14.10.2.1. Greater than or equal to 1.4 km (4,500 feet) thick and any part of the cloud layer within the flight path is located at an altitude where the temperature is between 0 degrees Celsius and -20 degrees Celsius, inclusive; or

A14.10.2.2. Connected to a thick cloud layer that, at a slant distance of less than or equal to 5 nautical miles from the flight path, is greater than or equal to 1.4 km (4,500 feet) thick and has any part located at any altitude where the temperature is between 0 degrees Celsius and -20 degrees Celsius, inclusive.

A14.10.3. A launch operator may launch despite paragraphs A14.10.2.1 and A14.10.2.2 if the thick cloud layer:

A14.10.3.1. Is a cirriform cloud layer that has never been associated with convective clouds,

A14.10.3.2. Is located entirely at altitudes where the temperature is colder than or equal to -15 degrees Celsius, and

A14.10.3.3. Shows no evidence of containing liquid water.

A14.10.4. A launch operator need not apply the lightning launch-commit criteria in paragraphs A14.10.2.1 and A14.10.2.2 if the cloud layer does not contain a radar reflectivity of 0 dBZ or greater at any location that is less than or equal to 5 nautical miles from the flight path.

A14.11. SMOKE PLUMES. A launch operator may not launch if the flight path will carry the launch vehicle through any non-transparent 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.

A14.12. TRIBOELECTRIFICATION.

A14.12.1. A launch operator may not launch if the flight path will carry the launch vehicle through any part of a cloud at any altitude where:

A14.12.1.1. The temperature is colder than or equal to -10 degrees Celsius; and

A14.12.1.2. The launch vehicle's velocity is less than or equal to 910 m/s (3000 feet/second),

A14.12.2. Paragraph A14.12.1 does not apply if either:

A14.12.2.1. The launch vehicle is treated for surface electrification so that:

A14.12.2.1.1. All surfaces of the launch vehicle susceptible to ice particle impact are such that the surface resistivity is less than 109 Ohms per square; and

A14.12.2.1.2. 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 105 ohms; or

A14.12.2.2. A launch operator demonstrates 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.

A14.13. MEASUREMENT OF CLOUD RADAR REFLECTIVITY, COMPUTATION OF MRR, MEASUREMENT OF ELECTRIC FIELD, DETERMINATION OF NONTRANSPARENT CLOUD BOUNDARIES, AND DETERMINATION OF SLANT DISTANCE FROM LIGHTNING.

A14.13.1. **(Removed)** This section from the LAP recommendation does not apply to the 45WS radar system.

A14.13.2. Computation of MRR. A launch operator who measures MRR to comply with these LLCC must ensure that—

A14.13.2.1. The specified volume is the volume bounded in the horizontal by vertical, plane, perpendicular sides located 5.5 kilometers (3 nautical miles) north, east, south, and west of the point where MRR is to be evaluated; on the bottom by the 0 degree Celsius level; and on the top by an altitude of 20 kilometers above mean sea level;

A14.13.2.2. MRR is the largest radar reflectivity measurement within the specified volume;

A14.13.2.3. If the MRR defined in paragraph A14.13.2.2 cannot be accurately determined, then the MRR is the largest composite reflectivity at a horizontal distance of less than or equal to 7.5 km (4 nautical miles) from the point where MRR is to be evaluated;

A14.13.2.4. All MRR-evaluation points within the flight path are:

A14.13.2.4.1. Greater than a slant distance of 10 nautical miles from any radar reflectivity of 35 dBZ or greater at altitudes of 4 kilometers or greater above mean sea level;

A14.13.2.4.2. Greater than a slant distance of 10 nautical miles from any type of lightning that has occurred in the previous 5 minutes; and

A14.13.2.4.3. A launch operator need not apply paragraph A14.13.2.4 to additional MRR-evaluation points outside the flight path that are required in certain rule exceptions; and

A14.13.3. Electric field measurement. A launch operator who measures an electric field to comply with these LLCC must—

A14.13.3.1. Employ a ground-based field mill;

A14.13.3.2. Ensure that all field mills are calibrated such that the polarity of the electric field measurement is the same as the polarity of the voltage placed on a test plate above the sensor;

A14.13.3.3. Use only the one-minute arithmetic average of the instantaneous readings from that field mill;

A14.13.3.4. Ensure that the altitude of the flight path of the launch vehicle is less than or equal to 20 kilometers (66 thousand feet) everywhere above a horizontal circle of 5 nautical miles centered on the field mill being used;

A14.13.3.5. Use only direct measurements from a field mill and never interpolate between mills.

A14.13.4. Non-transparent-cloud or precipitation boundaries. A launch operator who locates non-transparent cloud boundaries or precipitation regions to comply with these LLCC must ensure that—

A14.13.4.1. If more than one of the three conditions specified in the definition of non-transparent apply, then the condition that most restricts launch availability is used;

A14.13.4.2. The Sun or the Moon is not used to evaluate non-transparency;

A14.13.4.3. If radar is used, then allowance is made for the vertical and horizontal spatial resolution of the radar in computing any cloud or precipitation boundary;

A14.13.4.4. If radar is used, the radar-display threshold is set sufficiently lower than the boundary threshold (0 dBZ for cloud, 18 dBZ for precipitation, etc.), at least intermittently, so that the next lower radar reflectivity display bin would be shown if that lower radar reflectivity were present in the atmosphere at similar range;

A14.13.4.5. The thickness of a cloud that is not observed visually but that contains a radar reflectivity of 0 dBZ or greater is evaluated according to its radar-observed dimensions; and

A14.13.4.6. If a cloud layer has a visible base but no visual observation of its top is available and it does not contain a radar reflectivity of 0 dBZ or greater, then the thickness of that cloud is taken as zero.

A14.13.5. Slant distance from lightning. A launch operator who locates lightning to comply with these LLCC must ensure that—

A14.13.5.1. The three-dimensional nature of lightning is taken into account;

A14.13.5.2. If a two-dimensional lightning-locating system locates channels and branches but provides no altitude information, then the slant distance between the lightning and the flight path is taken as the horizontal distance between the vertical projections of both the flight path and the lightning onto a common, two-dimensional reference surface such as the surface of the earth.

A14.13.5.3. A launch operator need not apply the standoff requirement in A14.3.1 to any portion of the flight path at an altitude greater than 37 km (20 nautical miles).