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## GLOSSARY OF ABBREVIATIONS, ACRONYMS, AND DEFINITIONS

**30 SW/SEO** - 30th Space Wing, Mission Flight Control

**30 SW/SEY** - 30th Space Wing, Flight Analysis

**45 SW/SEOE** - 45th Space Wing, Expendable Launch Vehicle Operations Support and Analysis

**45 SW/SEOO** - 45th Space Wing, Mission Flight Control

**45 SW/SEOS** - 45th Space Wing, Space Transportation System Operations Support and Analysis

**45 SE/SESL** - 45th Space Wing, Missile Systems Division, Large Vehicles Section

**45 and 30 MXS** - 45th and 30th Maintenance Squadrons

**45 and 30 RANS** - 45th and 30th Range Squadrons

**45 and 30 SW/SE** - 45th and 30th Space Wing, Offices of the Chiefs of Safety

**45 and 30 SW/SES** - 45th and 30th Space Wing, Systems Safety

**45 and 30 WS** - 45th and 30th Range Weather Squadrons

**acceptable hazard** - determining the acceptability of any hazard imposed by a missile or orbital vehicle launched from or into the Range is solely the responsibility of the Commander. The acceptability varies with operational requirements and is determined by the Commander on a case-by-case basis.

**ACO** - Area Control Officer, Aerospace Control Officer

**adequate source** - a data source that enables the Mission Flight Control Officer to determine when a launch vehicle violates established in-flight safety criteria

**ARSR** - Air Route Surveillance Radar

**ARTCC** - Miami Air Route Traffic Control Center

**Back Az** - Back Azimuth, a Western Range Forward Observer Ground position

**BDA** - Blast Danger Area

**CCAS** - Cape Canaveral Air Station

**CCC** - Central Computer Complex

**CCP** - Committed Coverage Plan

**CCPS** - Central Control Processing System

**CCS** - Command and Control System

**CCT** - Command Control Transmitter

**CCTV** - closed circuit television

**CDITS** - Command Destruct Independent Test Sets

**CDR AGC** - Command Destruct Receiver Automatic Gain Control (receiver signal strength)

**CDS** - Command Destruct System

**CMEV** - Command Message Encoder/Verifier

**COLA** - Collision Avoidance

**command destruct** - the process in which a command is issued from a ground station or center that, when executed by the flight system, causes the launch vehicle to destroy itself

**Command System** - the portion of the Range Safety System consisting of the airborne flight termination system and the ground flight termination system command transmitter system that sends ARM and DESTRICT commands

**CONDO 8** - the Eastern Range designation for the FURUNO Radar System

**critical-hold scrub point** - the time in the count-down when a hold would normally be expected to result in a scrubbed launch attempt

**CRS** - Command Remoting System

**CSO** - Command Systems Officer

**dB** - decibel; a unit of relative power. The decibel ratio between two power levels, P1 and P2 is defined by the relation  $db=10\log(P1/P2)$

**dBz** - non-dimensional unit of radar reflectivity

**DoD** - Department of Defense

**drag impact points** - debris impact points corrected for atmospheric effect

**ECP** - Estimated Coverage Plan

**ER** - Eastern Range

**Ez** - vertical electric field

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## GLOSSARY OF ABBREVIATIONS, ACRONYMS, AND DEFINITIONS

**FAA** - Federal Aviation Administration

**failure** - the inability of a system or system component to perform a required function within specified limits

**fault** - the manifestation of an error in software that may cause a failure

**FCA** - Flight Caution Area

**FHA** - Flight Hazard Area

**Flight Caution Area** - a hazardous launch area; the controlled surface area outside the Flight Hazard Area where individual risk from a launch vehicle malfunction during the early phase of flight exceeds  $1 \times 10^{-6}$ . When activated, only personnel essential to the launch operation (mission-essential) with adequate breathing protection are permitted in this area.

**Flight Hazard Area** - a hazardous launch area; the controlled surface area and airspace about the launch pad and flight azimuth where individual risk from a malfunction during the early phase of flight exceeds  $1 \times 10^{-5}$ . Because the risk of serious injury or death from blast overpressure or debris is so significant, only mission-essential personnel in approved blast-hardened structures with adequate breathing protection are permitted in this area during launch.

**flight termination action** - the transmission of thrust termination and/or destruct commands to a launched launch vehicle and/or payload

**FMC**- fully mission capable

**FO** - Forward Observer

**FOA** - Forward Observer Airborne

**FOG** - Forward Observer Ground

**FSPO** - a Western Range Flight Safety Project Officer

**FSPOC** - Flight Safety Project Officer Console

**FTS** - Flight Termination System

**FTU** - Flight Termination Unit

**FURUNO** - a marine band radar used for surveillance of the sea danger zone; *see also CONDO 8*

**F minus Time (F-X)** - the time in normal work

days prior to the scheduled launch day

**h** - hour, hours

**hazard, hazardous** - equipment, systems, events, and situations with an existing or potential condition that may result in a mishap

**Hazardous Launch Areas** - Safety Clearance Zones during launch operations with defined mishap probabilities, including the Flight Caution Area, Flight Hazard Area, and Launch Danger Zone

**hangfire** - a condition that exists when the ignition signal is known to have been sent and reached an initiator but ignition of the propulsion system is not achieved

**HLA** - Hazardous Launch Areas

**hold** - a temporary delay in the countdown, test, or practice sequence for any reason

**holdfire** - an interruption of the ignition circuit of a launch vehicle

**independent** - not capable of being influenced by other systems

**IIP** - instantaneous impact point

**ILL** - impact limit line

**IP** - impact prediction

**impact area** - an area surrounding an approved impact point based on the launch vehicle and/or payload dispersion characteristics

**ISP** - Intended Support Plan

**KSC** - Kennedy Space Center

**LA-24** - a large aperture telescope with video capability located at Tranquillon Peak, Vandenberg Air Force Base

**LARA** - Launch Risk Analysis

**launch abort** - termination of a launch sequence in an unplanned manner or the failure of the launch vehicle to liftoff for reasons not immediately known

**launch vehicle** - a vehicle that carries and/or delivers a payload to a desired location; this is a generic term that applies to all vehicles that may be launched from the Eastern and Western Ranges,

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## GLOSSARY OF ABBREVIATIONS, ACRONYMS, AND DEFINITIONS

including but not limited to airplanes; all types of space launch vehicles, manned space vehicles, missiles, and rockets and their stages; probes; aerostats and balloons; drones; remotely piloted vehicles; projectiles; torpedoes and air-dropped bodies

**LCC** - launch commit criteria

**LCU** - launch correlation unit

**LD** - Launch Director

**LDCG** - Launch Disaster Control Group, a team responsible for responding to launch emergencies

**LDZ** - Launch Danger Zone; a combination of the sea surface area and air space measured from the launch point and extending downrange along the intended flight azimuth. The size of the launch danger zone is based on the potential hazard to ships and aircraft.

**L minus Time (L-X)** - the absolute time prior to the scheduled launch time. L-Time may be measured in seconds, minutes, hours, days and includes all scheduled countdown holds. L-Time will always be equal to or greater than T-Time.

**LRR** - Launch Readiness Review

**LWO** - Launch Weather Officer

**LWT** - Launch Weather Team

**MCC** - Mission Control Center

**MFCO - Mission Flight Control Officer** - a United States Air Force Officer or civilian who monitors the performance of launch vehicles in flight and initiates flight termination action when required; the direct representative of the Range Commander during the prelaunch countdown and during launch vehicle powered flight

**min** - minute, minutes

**misfire** - a condition that exists when it is known that the ignition signal has been sent but did not reach an initiator and ignition of the propulsion system was not achieved

**mission-essential personnel** - the minimum number of persons necessary to successfully and safely complete a hazardous or launch operation and whose absence would jeopardize the completion of the operation; this designation also includes people

required to perform emergency actions according to authorized directives, persons specifically authorized by the Wing Commanders to perform scheduled activities, and those personnel in training. The Range Users and Wing Commanders determine, with Range Safety concurrence, the number of mission-essential personnel allowed within Safety Clearance Zones or Hazardous Launch Areas; *see also Safety Clearance Zones and Hazardous Launch Area*

**Mission Rules** - a document of agreements between the Range User and Range Director specifying, in detail, those requirements and procedures not covered by this document

**Mission Scrub** - termination of a launch operation

**MOA** - memoranda of agreement

**MSP** - Mission Support Position

**NASA** - National Aeronautics and Space Administration

**nm** - nautical miles

**NMC** - non-mission capable

**nominal vehicle** - a properly performing launch vehicle whose instantaneous impact point (IIP) does not deviate from the intended IIP locus

**NOTAM** - Notice to Airmen and Mariners

**OD** - Operations Directive

**OPR** - Office of Primary Responsibility

**OpsSup** - Operations Supplement

**OR** - Operations Requirement

**orbital injection (insertion)** - the sequence of events in time and space, whereby a vehicle achieves a combination of velocity and position such that without additional thrust at least one orbit of the earth will be made

**OSC** - Operations Safety console

**OSM** - Operations Safety Manager

**PAFB** - Patrick Air Force Base

**PMC** - partially mission capable

**positive control** - the continuous capability to ensure acceptable risk to the public is not exceeded

## GLOSSARY OF ABBREVIATIONS, ACRONYMS, AND DEFINITIONS

throughout each phase of powered flight or until orbital insertion

**PP** - present position

**PRD** - Program Requirements Document

**Program** - the coordinated group of tasks associated with the concept, design, manufacture, preparation, checkout and launch of a launch vehicle and/or payload to or from, or otherwise supported by the Eastern or Western Ranges and the associated ground support equipment and facilities; a Forward Observer Ground position

**public safety** - safety involving risks to the general public of the United States or foreign countries and/or their property

**Range Contractor** - the Launch Base Support and Range Technical Services contractors and all sub-contracted agencies required for operation and maintenance of the ER and similar contractors at the WR. For the purposes of this regulation, the term Range Contractor also refers to NASA and KSC contractors as applicable.

**Range Users** - clients of Cape Canaveral Air Station and Vandenberg Air Force Base; includes DoD, non-DoD government agencies, civilian commercial companies, and foreign government agencies that use the Eastern and Western Range facilities and test equipment to conduct prelaunch, launch, and impact operations or require on-orbit support

**RAPCON** - Radar Approach Control, Patrick Air Force Base

**RASCAD** - Range Safety Control and Display

**RCO** - Range Control Officer

**RF** - Radio Frequency

**ROCC** - Range Operations Control Center

**RSD** - Range Safety Display

**RSOR** - Range Safety Operations Requirement

**RSLCC** - Range Safety Launch Commit Criteria

**RSS** - Range Safety Simulator; Range Safety System; Relative Signal Strength

**RSSR** - Range Safety System Report

**RSWC** - Range Safety Wind Check

**RTP** - real time processing

**RTS** - Range Tracking System

**SCO** - Surveillance Control Officer

**sec** - second, seconds

**shall** - mandatory action

**SMFCO** - Senior Mission Flight Control Officer

**SSBN** - Fleet Ballistic Missile Submarine, Nuclear Powered

**STS** - Space Transportation System (space shuttle)

**SWI** - space wing instruction

**SWR** - space wing regulation

**T minus Time (T-X)** - countdown clock time; T-0 is launch time; time prior to the scheduled launch time not including built-in holds in the countdown; normally measured only in second, minute, and hour

**TACAN** - Tactical Air Control and Navigation

**TDTS** - Telemetry Data Transmitting System

**THC** - Toxic Hazard Corridor (ER)

**THZ** - Toxic Hazard Zone (WR)

**TLCF** - Technical Laboratory Computer Facility

**TM** - telemetry; vehicle systems measurements made available to ground based users via S-band downlinks

**TDMA** - time division multiple access

**TMIG** - telemetry or telemetered inertial guidance data

**TNAR** - Telemetry Doppler Nominal Acceleration; a Kalman filter used for tracking displays at the Western Range

**Toxic Hazard Corridor** - a Hazardous Clear Area; clearance of a sector in which toxic material may reach predetermined concentration levels; called Toxic Hazard Zone on the WR

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## GLOSSARY OF ABBREVIATIONS, ACRONYMS, AND DEFINITIONS

**Toxic Hazard Zone** - *see Toxic Hazard Corridor*

**trilateration** - the use of ranging data from three geographically suitable radar sites to produce high quality tracking data

**TSO** - Telemetry Systems Officer

**TVSS** - television skyscreen

**T-X** - a time late in the minus count after which a holdfire switch will not be activated

**UDS** - Universal Documentation System

**UHF** - ultra high frequency

**USCG** - United States Coast Guard

**VEA** - Vessel Exclusion Area

**Vessel Exclusion Area** - a hazardous launch area; a combination of the sea surface area and airspace measured from the launch point and extending downrange along the intended flight azimuth; the size of the VEA is based on hazard containment or a combination of acceptable impact probability and personnel risk

**VHF** - very high frequency

**VSO** - Video Systems Officer

**VWSS** - Vertical Wire Skyscreen

**WR** - Western Range

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## REFERENCED DOCUMENTS

30 and 45 SW, *Range Safety Operations Requirements (RSOR)*

30 SWI 91-106, *Toxic Hazard Assessments*

45 SWR 80-12, *TDM Data Information Required for 45th Space Wing TLM Support*

45 SWI 99-101, *45th Space Wing Mission Program Documents*

OD-16, *Range Safety Support*

OD-16, Annex A, *Mission Flight Control Training*

OD-16, Annex B, *RSDS Verification Test*

Section R Rules and Agreements, *Johnson Space Center Operational Flight Rules*

WRR 127-9, *Integrated Missile Flight Control Ground Systems*

## **CHAPTER 7 FLIGHT CONTROL DOCUMENTATION, SYSTEMS, AND PROCEDURAL REQUIREMENTS**

### **7.1 INTRODUCTION**

#### **7.1.1 Purpose of the Chapter**

Chapter 7 describes policies, identifies data and systems requirements, and provides procedures required to maintain positive control of launch vehicles and payloads launched on the Eastern Range (ER) and Western Range (WR). The following topics are addressed:

- 7.2 Responsibilities and Authorities
- 7.3 Flight Control Policies
- 7.4 Documentation Requirements
- 7.5 Range Tracking
- 7.6 Real-Time Impact Prediction System
- 7.7 Command and Control System
- 7.8 Timing, Countdown, and Sequencing
- 7.9 Launch Area Surveillance
- 7.10 Range Safety Display System
- 7.11 Flight Control Communication Circuits
- 7.12 Mission Flight Control Training Requirements

#### **7.1.2 Applicability**

The requirements identified in this Chapter are applicable to the flight control functions of the ER and WR. These requirements shall be used to ensure launches do not pose an unnecessary risk.

### **7.2 RESPONSIBILITIES AND AUTHORITIES**

#### **7.2.1 Commanders, 45th Space Wing and 30th Space Wing**

As the Range Directors, the Commanders or their designated representatives are responsible for ap-

proving the Mission Rules and certifying Mission Flight Control Officers.

#### **7.2.2 Chiefs of Safety, 45th Space Wing and 30th Space Wing**

The Chiefs of Safety, 45th Space Wing (45 SW/SE) and 30th Space Wing (30 SW/SE) or their designated representatives are responsible for the following:

- a. The Range Safety Operations Requirement (RSOR)
- b. The Operations Supplement (OpsSup)
- c. Evaluating and issuing safety approval for personnel authorized to remain in hazardous launch areas
- d. Providing Range Users with a Range Safety Launch Operations Approval Letter no later than the Launch Readiness Review (LRR)
- e. Providing the final Range Safety approval to launch

#### **7.2.3 Mission Flight Control Officers, 45th Space Wing and 30th Space Wing**

Mission Flight Control Officers (MFCOs) are directly responsible to the Range Directors for implementation and execution of actions required to comply with applicable public laws and Department of Defense (DoD) directives during a launch.

a. Acting for the Range Directors, MFCOs are responsible for the following:

- 1. From a safety perspective, determining whether a launch operation should be allowed to proceed
- 2. Making Range Safety final launch recom-

mendations

3. Monitoring the progress of a launch vehicle

4. Serving as the sole authority for determining if the flight of a launch vehicle should be allowed to continue or be terminated

5. At the ER monitoring surveillance and control operations within launch surveillance areas to ensure the risks to people, aircraft, and surface vessels are within acceptable limits. At the WR the MFCO is responsible for verifying clearance to ensure safety of defined surveillance areas.

b. MFCO positions include the following:

1. Mission Flight Control Officer (MFCO)

2. Senior Mission Flight Control Officer (SMFCO)

3. Telemetry Systems Officer (TSO)

4. Forward Observer Ground (FOG)

5. ER Surveillance Control Officer (SCO)

6. ER Forward Observer Airborne (FOA)

7. ER Command Systems Officer (CSO)

8. ER Video Systems Officer (VSO)

#### **7.2.4 Offices of the Chiefs of Safety, 45th Space Wing and 30th Space Wing**

The responsibilities and authorities of Mission Flight Control, Flight Analysis, and Systems Safety, all reporting to the Chiefs of Safety, are described below.

##### **7.2.4.1 Mission Flight Control, 45th Space Wing and 30th Space Wing**

Mission Flight Control, 45th Space Wing (45 SW/SEO) and 30th Space Wing (30 SW/SEO) are responsible for the following. **NOTE:** Unless otherwise noted, all references to *Range Safety* in this Chapter refer to Mission Flight Control.

a. Preparing the RSOR

b. Approving Skyscreen sites

c. Publishing and distributing the OpsSup

d. Developing the Mission Rules in conjunction with Flight Analysis and the Range User

e. (WR only) Publishing and distributing the RSOR

##### **7.2.4.2 Operations Support and Analysis, 45th Space Wing and Flight Analysis, 30th Space Wing**

Operations Support and Analysis, 45th Space Wing (45 SW/SEO and SEOS) and Flight Analysis, 30th Space Wing (30 SW/SEY) are responsible for

the following: **NOTE:** For the purposes of this chapter, 45 SW/SEO and SEOS and 30 SW/SEY will be referred to as 'Flight Analysis.'

a. Issuing flight plan approval

b. Computing flight safety criteria

c. Directing the construction of the Range Safety Display (RSD) display backgrounds and independently verifying their accuracy

d. Coordinating with Range Safety and the Range User on mission rules development

e. Performing near real-time risk assessment in support of launch operations

f. Approving mission support positions (MSPs) for supporting Range assets

g. (WR only) Assessing environmental factors during launch operations

##### **7.2.4.3 Systems Safety, 45th Space Wing and 30th Space Wing**

Systems Safety, 45th Space Wing (45 SW/SES) and 30th Space Wing (30 SW/SES) are responsible for the following:

a. Coordinating with Mission Flight Control and Flight Analysis on the review and approval of documents described in this Chapter

b. Approving and certifying the airborne Range Safety System (RSS), including the Flight Termination System (FTS), the Range Tracking System (RTS), and the Telemetry Data Transmitting System (TDTS)

c. Performing prelaunch checkouts of the RSS

d. (ER only) Identifying safety weather constraints for launch

e. (ER only) Assessing environmental factors during launch operations

f. (WR only) Determining the launch countdown FTS status

##### **7.2.4.4 Operations Safety, 45th Space Wing and 30th Space Wing**

Operations Safety, 45th Space Wing (a Range Contractor under the direction of Range Safety) and 30th Space Wing (30 SW/SEGP), including the Launch Disaster Control Group (LDCG) chief, Flight Safety Project Officer (FSPO), the Operations Safety Manager (OSM), and the Area Control Officer (ACO) are responsible for performing and notifying MFCOs of the following:

- a. Verifying the Flight Caution Area (FCA) and flight Hazard Area (FHA) are clear
- b. Verifying that the blockhouse is sealed
- c. Performing HOLDFIRE checks
- d. Determining the launch countdown FTS status

### 7.2.5 Range Squadrons, 45th Space Wing and 30th Space Wing

The Range Squadrons, 45th Space Wing (45 RANS) and 30th Space Wing (30 RANS) are responsible for the following:

- a. (ER only) Printing and distributing the RSOR and ensuring compliance by affected agencies
- b. (ER only) Providing a 12-month forecast of expected support requirements, updated quarterly
- c. (WR only) Providing instrumentation support plans

#### 7.2.5.1 Range Control Officers, 45th Space Wing and 30th Space Wing

The Range Control Officers (RCOs) are responsible for the following:

- a. Providing status of the ground portion of the flight termination system to the MFCO
- b. Providing status of all Range Safety required display systems and associated equipment
- c. Providing status of Range Instrumentation supporting Range Safety
- d. Ensuring that no functions are transmitted without the specific approval of the MFCO after the MFCO has assumed control of the system unless the functions are scheduled countdown items with the MFCO monitoring
- e. (ER only) Advising Miami Air Route Traffic Control Center (ARTCC) to close W-497A for all weather rocket launches from Cape Canaveral Air Station (CCAS)

#### 7.2.5.2 Aerospace Control Officers, 45th Space Wing and 30th Space Wing

The Aerospace Control Officers (ACOs) are responsible for the following:

- a. Verifying supporting Range assets are at their respective Mission Support Positions (MSPs)
- b. Performing as the control authority for restricted air space hazardous areas
- c. Providing air space GO/NO-GO to the MFCO
- d. Managing applicable support aircraft
- e. (ER only) Issuing breakaway instructions for support aircraft in accordance with MFCO and

Flight Analysis instructions

- f. (ER only) Reporting ER launch operation information to the Launch Correlation Unit (LCU)
- g. (WR only) Providing GO/NO-GO to the MFCO for sea, air, and rail traffic

### 7.2.6 Weather Squadrons, 45th Space Wing and 30th Space Wing

The Weather Squadrons, 45th Space Wing (45 WS) and 30th Space Wing (30 WS) are responsible for the following:

- a. Providing all spacelift generation, execution, and recovery weather support services
- b. As members of the Launch Weather Team (LWT), evaluating Range Safety and Range User weather Launch Commit Criteria (LCC) to ensure there are no weather threats to the safe and successful launch of manned, expendable, and ballistic missile launch operations during day-of-launch operations.

### 7.2.7 Maintenance Squadron, 45th Space Wing

The Maintenance Squadron, 45th Space Wing (45 MXS) is responsible for providing the following information to Range Safety:

- a. Estimated Coverage Plan (ECP) intervals of usable data from each optic, radar, and telemetry (TM) data source used to comply with Flight Control and Range Safety requirements
- b. Committed Coverage Plans (CCPs)
- c. In-count resource commitment status (fully mission capable [FMC], partially mission capable [PMC], non-mission capable [NMC]) and technical evaluation of ER systems required to support Range Safety requirements. **NOTE:** This function is provided by the assigned Range Engineer on all launches.
- d. A preliminary set of ECPs shall be provided to Flight Analysis no later than 10 working days after receipt of a planning or final trajectory tape provided by the Range User; a final set of ECPs and CCPs shall be provided to Flight Analysis no later than 15 working days after the receipt of the final trajectory tape.

### 7.2.8 Range Users

Range Users are responsible for providing the following:

- a. Telemetry measurement lists
- b. Range User countdown checklist

c. Special command requirements and requests

## 7.2.9 Supporting Agencies

### 7.2.9.1 United States Coast Guard

The United States Coast Guard (USCG) provides support for all launches consistent with applicable memoranda of agreement (MOA). **NOTE:** Specific support requirements shall be levied by this document and the RSOR and documented in the Universal Documentation System (UDS).

### 7.2.9.2 ER Operations National Aeronautics and Space Administration Support

The National Aeronautics and Space Administration (NASA) provides support for ER operations from NASA sites at the Wallops Flight Facility at Wallops Island, Virginia; the Bermuda Station; and the United Kingdom consistent with applicable MOA. **NOTE:** Specific requirements shall be levied in the RSOR and documented in the UDS Program Requirement Document (PRD) and Operations Directives (ODs).

## 7.3 FLIGHT CONTROL POLICIES

### 7.3.1 Flight Termination Policy

The following conditions normally result in flight termination action by the MFCO:

a. Valid data shows the launch vehicle has violated established flight safety criteria.

b. The performance of a launch vehicle is obviously erratic and the potential exists for the MFCO to lose positive control. The performance of the launch vehicle may produce a gross flight deviation, and further flight is likely to increase public risk. Termination action may be taken even though the vehicle has not violated flight safety criteria.

c. The performance of the launch vehicle is unknown and the capability exists to violate flight safety criteria. **NOTE:** If the launch vehicle has been nominal for an extended period of flight before the status becomes unknown, the MFCO may allow the flight to continue.

d. At the written request of the Range User, the MFCO may implement special command requirements such as FUEL CUTOFF or SAFE (RF DISABLE).

e. In all instances, the MFCO shall make a decision concerning continued flight or termination based on interpretation of real-time events and

mission rules, all available data sources, and sound judgment.

f. (ER only) The mission rules and flight termination policy for the space transportation system (STS) shall be in accordance with the *Johnson Space Center Operational Flight Rules*, Rules and Agreements, Section R.

### 7.3.2 Command Destruct Receiver Control

After the MFCO assumes control of the ground portion of the Command and Control System (CCS), the command destruct receivers shall not be allowed to be turned on or off without the specific approval of the MFCO unless it is a scheduled countdown item with the MFCO monitoring.

### 7.3.3 Launch Commit Decision

The MFCO is responsible for the launch commit decision from a safety perspective. The launch commit decision shall be based on the ability of range instrumentation to meet minimum Range Safety requirements and a real-time assessment of public safety impacts. The MFCO shall perform final checkout of Range Safety instrumentation (RSD and CCS) prior to accepting the system for launch.

### 7.3.4 Restrictions Applicable to Flight Control Communications and Recordings

a. To avoid unauthorized dissemination of Flight Control communications and recordings, no individual, agency, or organization shall be permitted to monitor the MFCO composite circuits without the expressed written consent of Range Safety. Access to these circuits shall not be allowed at positions other than those specified in the applicable RSOR or OpsSup.

b. Release of recordings of the Flight Control composite circuits to any individual, agency, or organization is prohibited without the expressed written consent of Range Safety.

c. Range Safety shall be advised of all requests to monitor the MFCO composite circuits or requests for access to the circuit recordings.

### 7.3.5 Weather-Related Launch Commit Criteria

**NOTE:** The weather constraints or launch commit criteria (LCC) described below are critical in the launch GO/NO GO decision. If any of the LCCs

are violated, the launch can, and most probably will, be delayed.

### 7.3.5.1 Range Safety Natural/Triggered Lightning Avoidance Weather Launch Commit Criteria

*a.* The Range Safety natural/triggered lightning weather launch commit criteria is a set of rules developed to ensure the avoidance of natural and/or triggered lightning during space/ballistic launch operations. **NOTE:** Navy operations may have a reduced set of weather LCCs due to the location of launch operations.

*b.* Range Safety natural and/or triggered lightning LCC may be waived only under special circumstances by the 45/30 SW Commanders.

### 7.3.5.2 Range User Weather Launch Commit Criteria

*a.* The Range User weather LCC is a set of Range User defined, launch-system unique, weather LCCs applicable to a specific operation and/or launch vehicle. **NOTE:** Typical Range User LCCs may be related to temperature, wind, and/or precipitation; for example, winds greater than 40 knots prohibits launch of X vehicle or movement of the Mobile Service Tower or greater than 10 percent probability of lightning within 5 nm prohibits initiation of Shuttle External Tank fueling operations.

*b.* Range User weather LCCs may be waived by the Range User under special circumstances.

### 7.3.5.3 Range Safety Weather-Related Launch Commit Criteria

*a.* The Range Safety weather-related LCC is a set of LCC that involve meteorological conditions that may affect launch operations; for example, upper level winds (Flight Hazard Area), low level wind and temperature profiles (blast/toxic propagation) and/or ceiling and visibility (optical restrictions).

*b.* Range Safety weather-related LCCs may be waived only, under special situations, by the 45/30 SW Commanders.

## 7.4 DOCUMENTATION REQUIREMENTS

### 7.4.1 Range Safety Operations Requirements

*a.* Range Safety shall develop and publish an RSOR for each applicable PRD or Operations Re-

quirement (OR) prepared by a Range User.

*b.* The RSOR shall be approved by the Chiefs of Safety or their designated representatives and distributed no later than L-60 days. **NOTE 1:** If a systems development effort is required, this time limit is extended to L-180 days. **NOTE 2:** These time limits assume that Range User documentation is on hand no later than 30 days prior to the RSOR due date.

*c.* The RSOR shall document exceptions to the standard provisions of this Chapter.

*d.* The RSOR may also levy additional safety requirements peculiar to a launch vehicle series.

### 7.4.2 Operations Supplement

*a.* Range Safety shall develop and publish an OpsSup containing additional information or requirements particular to a given launch and which are not contained in the RSOR or this document.

*b.* The OpsSup shall be approved by the Chiefs of Safety or their designated representatives and distributed no later than F-5 working days for each ballistic missile or launch vehicle launch operation. **NOTE:** For STS, the time limit is F-10 days.

### 7.4.3 Mission Rules

Mission Rules identify flight control requirements and procedures not covered elsewhere.

*a.* As required, Range Safety, Flight Analysis, and the Range User may develop unique mission rules on a case-by-case basis.

*b.* Mission Rules shall be approved by the Wing Commanders or their designated representatives.

### 7.4.4 Telemetry Measurement List and Tape

*a.* As applicable, the Range User shall develop a Telemetry Measurement List.

*1.* The Telemetry Measurement List shall be furnished to Range Safety no later than L-210 days.

*2.* The Telemetry Measurement List shall be used by Range Safety to develop telemetry analog display requirements contained in the respective RSOR.

*b.* As applicable, Range Users shall develop a Telemetry Tape (preferably populated) to be used to validate Range Safety telemetry systems software modifications.

*c.* The data format and time line requirements for the Telemetry Measurement List and Tape are

contained in 45 SWI 99-101 and 45 SWR 80-12 for the ER and WRR 127-9 and the RSOR for the WR.

#### **7.4.5 ER Range User Countdown Checklist**

A copy of the final Range User Countdown Checklist for each operation shall be provided to Range Safety no later than F-7 days.

#### **7.4.6 ER Committed Coverage Plans**

*a.* The ER CCPs shall include the following information:

*1.* Committed coverage intervals of usable data from each data source used to comply with Flight Control and Range Safety requirements

*2.* The committed radar acquisition mode (optical transfer or beam intercept) for initial coverage in the launch area and tracking modes (optical, skin, beacon)

*3.* Committed coverage for Flight Control command systems

*4.* Committed coverage for telemetry (analog/-telemetry inertial guidance [TMIG])

*b.* A preliminary ECP shall be provided to Flight Analysis no later than 10 working days after receipt of a planning or final trajectory tape provided by the Range User.

*c.* The final CCP, coordinated through 45 RANS, shall be provided to Range Safety no later than 15 working days after receipt of the final trajectory tape.

#### **7.4.7 Launch Operations Approval**

*a.* (WR) A Range Safety Launch Operations Approval Letter to launch from or onto the WR shall be provided to the Range User no later than the scheduled LRR conducted prior to a planned launch operation. Receipt of this letter depends on the Range User having obtained the previously required approvals identified in Chapter 1 of this document.

*b.* (ER) Launch Operations Approval Letters are not normally used on the ER. Wing Safety's GO at the LRR constitutes approval to launch and is contingent on the Range User having obtained the required approvals identified in Chapter 1 of this document. However, a Range Safety Launch Operations Approval Letter can be provided, if requested.

*c.* Lack of Launch Operations Approval may result in the launch being withdrawn from the Range

schedule.

### **7.5 RANGE TRACKING**

*a.* Range tracking instrumentation data is required to provide the MFCO with the following information:

*1.* Real-time information on in-flight vehicle behavior

*2.* Positive knowledge of vehicle position throughout all phases of powered flight

*b.* Tracking data is used to compare actual and nominal flight trajectories, verify performance in conjunction with telemetry, and identify violations of destruct lines.

*c.* The overall tracking systems shall be robust, highly fault tolerant, allow for catastrophic failure in a single system without loss of all tracking data, and provide for graceful degradation of the system under multiple component failures.

#### **7.5.1 Range Tracking Instrumentation System**

*a.* Tracking from at least two adequate and independent Range instrumentation data sources is mandatory and shall be maintained throughout each phase of powered flight from launch to establishment of the final impact point for launch vehicles with suborbital trajectories or to orbital insertion for space launch vehicles.

*b.* Range tracking instrumentation data sources shall be designed to ensure that no hardware or software single point of failure denies the MFCO the capability to directly monitor an in-flight launch vehicle.

#### **7.5.2 Forward Observers**

##### **7.5.2.1 Ground Forward Observers**

*a.* (ER only) A program vertical wire skyscreen (VWSS) manned by an FOG assigned to SEO is required for all pad launches.

*b.* (WR only) Two forward observers, Program and Back Azimuth, are required for all pad launches.

*c.* Locations of FOG sites shall be listed in the appropriate RSOR

##### **7.5.2.2 ER Forward Observer Airborne**

An ER FOA is required for all STS launches.

##### **7.5.2.3 Television Skyscreens**

*a.* Flight line (Back Azimuth) and Program Tele-

vision Skyscreen (TVSS) systems are required for all pad launches and shall be placed in operation no later than L-60 min.

*b.* The flight line (Back Azimuth) camera shall be free to move the azimuth and elevation to permit centering the launch vehicle in the field of view while tracking and shall be located within  $\pm 15^\circ$  of the uprange extension of the flight line.

*c.* (ER only) The Program camera shall be fixed in azimuth, but be free to track in elevation.

*d.* (ER only) A vertical reference line and arrow indicating planned direction of flight shall be superimposed on the TVSS transmission to monitor at the MFCO console positions.

*e.* (WR only) The Program TV camera shall be aligned with the cursor, slightly on the downrange side of the vehicle or tallest structure.

cision authority.

#### **7.5.2.4 Skyscreen Site Location Criteria**

The following criteria shall be used in selecting skyscreen site locations:

*a.* TVSS Flight Line (ER only) and VWSS Program sites shall be located within  $\pm 15^\circ$  of a line extending from the launch point, perpendicular to the flight azimuth.

*b.* (WR only) TVSS flight line (Back Azimuth) sites shall be located within  $\pm 15^\circ$  of the uprange extension of the flight line.

#### **7.5.2.5 Skyscreen Operations**

The Range Technical Services Contractor (RTSC) provided skyscreen operators shall setup and complete a checkout of the skyscreen system prior to T-60 min. All skyscreen systems shall remain operational until released by the MFCO.

### **7.6 REAL-TIME IMPACT PREDICTION SYSTEM**

#### **7.6.1 Real-Time Impact Prediction System General Requirements**

*a.* Present position (PP) and instantaneous impact point (IIP) solutions shall be provided for display on the RSD.

*b.* The data shall be computed from data supplied by the tracking sources identified in the RSOR or OpsSup as applicable.

*c.* PP and IIP computation and display shall be single failure tolerant.

*d.* (ER only) The RSD map switching algorithm shall use the prime tracking source solution for de-

*e.* (ER only) Radar trilateration solutions are required when available.

*f.* (ER only) Launch vehicle TMIG shall be allowed to compete for the alternate source position but shall be excluded from the prime source position.

*g.* (WR only) The RSD map panning algorithm uses the nominal dot for decision authority. The capability shall exist to allow the prime source to be designated as decision authority.

*h.* (WR only) TM Doppler, Nominal Acceleration, and Radar (TNAR) Kalman filter solutions are required when available.

### 7.6.2 System Checks

*a.* In accordance with established procedures, a complete end-to-end system check shall be made during the countdown using taped data inputs and RSD display tapes verified by Flight Analysis. **NOTE:** This functional check does not relieve the Range Contractor of responsibility for proper operation of the system during the launch.

*b.* (ER only) A listing of the sources used during the operation shall be furnished to Range Safety and 45 MXS within two working days after the launch.

*c.* The Central Computer Complex (CCC) shall perform wind-effects calculations for Range Safety on the morning of F-1 work day and again at approximately L-5 h on launch day for all major launches. The following procedure shall be adhered to:

1. By F-8 days, Flight Analysis shall forward a letter to the Range Contractor providing station constants, ballistic coefficients, and trajectory data to compute the effects of wind on the drag impact points.

2. On F-3 days and at L-5 h, Range Weather Operations shall provide forecasts of T-0 files. The wind files shall be used for all prelaunch safety computations.

3. The Range Safety wind check program shall be run by L-4.5 h. The results shall be made available to Flight Analysis on computer disk file.

4. If a HOLD invalidates the predicted wind data or if a later wind prediction is made, it may be necessary to repeat the above calculations as late as L-1 h.

*d.* (WR only) The weather data and associated safety analysis requirements shall be listed in the

RSOR.

## 7.7 COMMAND AND CONTROL SYSTEM

The CCS provides the MFCO with the capability to terminate launch vehicle flight if flight termination criteria are violated or mission rules call for MFCO action.

### 7.7.1 Command and Control System General Requirements

*a.* Ultra high frequency (UHF) transmission capability for flight termination commands is required throughout powered flight or until orbital insertion as dictated by the mission flown.

*b.* Flight control command functions, including the capability to override, shall take precedence over other commands that may be transmitted to or by command transmitter system sites.

*c.* The command control transmitter field intensity along the nominal trajectory shall meet the requirements in Chapter 4 of this document.

*d.* Each command control transmitter supporting a launch shall have a backup transmitter capable of maintaining the proper signal strength.

1. The backup command transmitter shall be activated by an automatic station guardian (failure sensing and failover switching) if the primary transmitter output falls to 50 percent of normal in an unplanned manner.

2. A pair of transmitters at a command control site, each connected to the station guardian, constitute a system.

*e.* When the launch vehicle airborne FTSs are active and ordnance is electrically connected, a command system shall be radiating at the proper frequency to "capture" the receivers.

*f.* During those periods when the FTS receiver is on, no UHF commands shall be radiated in support of another operation unless there is at least a 4 MHz frequency separation.

### 7.7.2 Additional WR Command and Control System Requirements

*a.* The CCP provided by 30 RANS shall contain coverage estimates for each applicable command transmitter site based on the theoretical nominal vehicle trajectory and expected signal attenuation.

*b.* The CCP shall portray site coverage with and without Range Safety decibel (dB) level pads described in 3 dB increments as described in Chapter

4 of this document.

c. The CCP shall provide the optimum command system configuration.

d. The command control system shall meet those requirements listed in WRR 127-9, Chapter 4 or equivalent.

e. The frequency separation shall be at least 3 MHz.

### 7.7.3 ER Command Remoting System

The ER Command Remoting System (CRS) consists of dual command message encoder/verifier (CMEV) units located in the operations control center referred to as the Central CMEVs, the command remoting links, dual site CMEVs located at each of the UHF command transmitter sites, and the Range Safety Control and Display (RASCAD).

a. The CRS monitors the status of the command transmitters located at committed sites. Based on vehicle present position and site bias, the CRS automatically selects the optimum command transmitter site to radiate an adequate carrier signal to the launch vehicle.

b. The CRS is required for the remote control of the command systems transmitters and shall be capable of enabling and disabling remote station command capability.

c. CRS manual control capability is required to back up the automatic system.

d. Indicators located immediately above the Flight Termination Unit switches on the MFCO console shall illuminate when the CRS detects a command transmission such as ARM or FIRE.

e. Command transmission shall also be displayed on the RASCAD monitor screens. CRS status indications on the RASCAD screens shall include the following information:

1. Command site readiness
2. The site transmitting the command carrier
3. Site tracking elevation angles
4. Transmitter fail over
5. System automatic and manual modes
6. MFCO command destruct capability as ACTIVE or LOCKED OUT
7. Command issued
8. Time of transmission
9. Command remoting link health
10. Central CMEV on-line indication

### 7.7.4 WR Central Control Processing System

The WR Central Control Processing System (CCPS) is a multiple microprocessor-based system designed to provide operational support with at least one system failure. Its primary purpose is to communicate with the command control transmitter (CCT) sites.

a. The CCPS provides operator displays to show the status of the CCT sites, its own status, and the status of other systems.

b. The CCPS provides operator controls to allow for remote control of the CCT sites, its own configuration, and other external systems.

c. The CCPS shall meet those requirements listed in WRR 127-9, Chapter 3 or the equivalent.

### 7.7.5 ER Flight Termination Unit

a. An ER Flight Termination Unit (FTU) shall be located at each MFCO console position.

b. The FTU switches shall be programmable for ARM, DESTROY, SAFE, and other, optional commands that may be required for a mission.

1. The switches shall be programmed as specified in the applicable RSOR.

2. Switches having no functions programmed for a launch shall be disabled.

3. Each switch on the FTU shall have a status indicator located immediately above it. When an active switch is thrown, the indicator shall display the command requested and verification of transmission.

### 7.7.6 WR Flight Termination Unit

The WR equivalent of the Flight Termination Unit is an integral part of the CCPS and, as such, shall meet the requirements listed in WRR 127-9, Chapter 3 or the equivalent.

### 7.7.7 Command and Control System Check-out

Proper operation of the CCS shall be verified to and confirmed by the MFCO prior to launch.

## 7.8 TIMING, COUNTDOWN, AND SEQUENCING

### 7.8.1 MFCO Timers

a. Each MFCO shall have access to the following timers:

1. A universal, coordinated time display in h,

min, and sec

2. Countdown indicators in min and sec for the applicable Range countdown networks
3. (ER only) Two manual interval timers in sec

to be used as stopwatches. **NOTE:** The manual interval timers shall have START, STOP, and RESET push buttons

*b.* All MFCO timers shall be operational for launch.

### 7.8.2 ER MFCO Support Position Timers

*a.* The ER MFCO shall have access to countdown indicators for the two Range countdown networks at each of the MFCO support positions except the FO positions.

*b.* Each telemetry and command systems positions requires two manual interval timers.

### 7.8.3 Holdfire

A holdfire capability is mandatory for all pad launches. This requirement can be met using the Range holdfire system but may also be met by using voice communication to the Test or Launch Director who has launch sequence interrupt capability (See Chapter 3 of this document.)

*a.* At a designated time in the countdown, the HOLDFIRE switches shall be functionally checked.

*b.* The Operations Safety Manager (OSM) (ER only) and the Range User shall verify that the HOLDFIRE switches function properly and report the results to the MFCO.

### 7.8.4 ER T-X Time

#### 7.8.4.1 ER T-X Time for Pad Launches

*a.* The T-X time for pad launches shall be identified by the Range User and coordinated for concurrence with Range Safety.

*b.* No hold shall be initiated after T-X for any Flight Control or Range Safety item.

*c.* The T-X time shall be designated in the OpsSup and the MFCO Countdown Checklist.

#### 7.8.4.2 ER T-X Time for Submarine Launches

*a.* The T-X time for submarine (SSBN) launches is normally 0 seconds.

*b.* Holdfire for these launches is directed verbally and relayed from the Launch Conductor to the SSBN.

*c.* Actual launch times for SSBN launches vary significantly and may occur at any time after the Range has passed a CLEAR-TO-LAUNCH and after the earliest submarine launch time. **NOTE:** For the launch to occur, both conditions must be

met.

the ACO at the WR for ships, aircraft, and

### **7.8.5 Critical Hold or Scrub Point**

*a.* The Range User shall identify critical hold or scrub points for each launch, if they exist, and coordinate these times with the MFCO for the launch.

*b.* (ER only) The MFCO shall assume waiver authority for Range Safety mandatory items when the Range CLEAR-TO-LAUNCH is passed.

### **7.8.6 Launch Aborts**

A launch abort (hangfire/misfire) is the termination of the launch sequence in an unplanned manner or the failure of the vehicle to liftoff for reasons not immediately known. It shall be presumed that the vehicle may liftoff without warning.

*a.* In the event of a launch abort, the RCO shall release no instrumentation until directed to do so by the MFCO.

*b.* (ER only) The OSM shall determine which event (hangfire or misfire) has occurred and report to the MFCO.

*c.* (WR only) The Range User shall determine which event (hangfire or misfire) has occurred and report to the MFCO.

*d.* All other activities shall be conducted in accordance with Chapter 6 of this document.

### **7.8.7 Mission Scrubs**

*a.* In cases where the mission and/or launch operation is terminated under normal circumstances, the RCO shall not release instrumentation until after coordinating with the MFCO.

*b.* The Command Destruct receivers shall remain captured until the FTS is safed in accordance with the Range User provided and Range Safety approved recycle procedures.

## **7.9 LAUNCH AREA SURVEILLANCE**

### **7.9.1 Launch Area Surveillance General Requirements**

*a.* ER launch area surveillance includes those land, air, and sea areas designated as the FCA, FHA, and Launch Danger Zone (LDZ).

*b.* WR launch areas surveillance includes those land, air, and sea areas designated as the FHA and the FCA.

*c.* The determination of a Launch Area Surveillance GO FOR LAUNCH is provided by the Surveillance Control Officer (SCO) at the ER and by

trains to the MFCO who makes the final determination for CLEAR-TO-LAUNCH on the basis of information from the above sources and any other sources available during the final phases of launch countdown.

*d.* Designated clearance areas, warning areas, and restricted airspace areas shall be active and controlled according to this document, Safety Operating Instructions, 45 and 30 SW regulations, and Federal Aviation Administration (FAA) directives and regulations.

## 7.9.2 Hazardous Launch Area Clearance

*a.* Concurrence from the Chief of Safety must be obtained for all personnel required or requesting to be within a Hazardous Launch Area during a launch operation. **NOTE:** Mission-essential personnel may be permitted within the Impact Limit Lines (ILLs) and the FCA, but only within the FHA if located in blast-hardened structures with adequate breathing apparatus.

*b.* Wing-essential personnel located at required work areas and non-essential personnel may be permitted inside the ILLs with Wing Commander approval.

*c.* Requests for personnel to remain in these hazardous launch areas shall be submitted to Range Safety, with justification, in sufficient time to permit approval action prior to L-1 day.

*d.* The OSM shall confirm the on land portions of the FHA and FCA clear and report to the MFCO.

*e.* The FHA and FCA clear report shall occur at a designated time in the launch countdown.

*f.* (ER only) 45 SW/SES shall compile a list of personnel authorized to remain in hazardous launch areas, obtain 45 SW/SE approval, and provide the list to the RCO, MFCO, and OSM no later than L-1 day.

*g.* (WR only) 30th SW/SE shall compile a list of personnel authorized to remain in hazardous launch areas and provide the list to the security police and the LDCG.

## 7.9.3 Hazardous Area Surveillance and Control

### 7.9.3.1 Surveillance Aircraft

Surveillance aircraft support for surveillance control shall be required for all launches.

### 7.9.3.2 Radar Surveillance

The following radars are required to perform air and sea surveillance of the hazardous launch area:

#### 7.9.3.2.1 ER RAPCON Radars and Miami Air Route Traffic Control Center Radar.

*a.* The Radar Approach Control (RAPCON) radars at Patrick Air Force Base (PAFB) and the Miami Air Route Traffic Control Center (ARTCC) radar are required to support pad and offshore launches.

*b.* RAPCON and ARTCC shall survey for intruding aircraft within a 50 nautical mile radius of the launch point beginning no later than L-30 min and continue until released by the SCO.

*c.* Contacts shall be reported using the following criteria:

1. Speed
2. Heading
3. Bearing from a known reference point such as PAFB or Kennedy Space Center (KSC) Tactical Air Control and Navigation (TACAN)
4. Estimated time to clear the warning areas

#### 7.9.3.2.2 WR Air Route Surveillance Radar.

*a.* The Air Route Surveillance Radar (ARSR) shall survey the offshore area from T-90 min until operation completion.

*b.* The ARSR shall survey the restricted airspace from T-15 min until operation completion.

#### 7.9.3.2.3. ER Lighthouse Sea Surveillance Radar.

*a.* The ER lighthouse sea surveillance radar (radar 1.60) is required to survey for surface craft during pad launches.

*b.* Radar 1.60 shall provide coverage from L-120 min; L-180 min for STS.

#### 7.9.3.2.4 ER FURUNO Radar.

*a.* The FURUNO (CONDO 8 radar) is required for sea surveillance during pad launches.

*b.* The FURUNO radar shall be available for SCO use beginning at L-120 min; L-180 min for STS.

### 7.9.3.3 Small, Solid Propellant Rockets and Inert Body Drop Test Impact or Drop Area Surveillance

For small, solid propellant rocket launches or inert body drop tests, the impact or drop area surveil-

lance shall normally be within a few miles of shore. In such cases, surveillance requirements of the impact area shall be specified in the applicable RSOR.

#### 7.9.3.4 ER Launch Danger Zone Warning Requirements

##### 7.9.3.4.1 Warning Signals.

a. Warning signals shall be displayed when the LDZ is closed at L-60 min.

b. The warning signals are large red spheres and red rotating beacons located at the North end, South end, and tip of Cape Canaveral Air Station (CCAS).

c. The spheres shall be raised for daylight launches, and the beacons shall be illuminated for both day and night launches.

**7.9.3.4.2 Warning Signs.** To warn vessels leaving the port, illuminated warning signs shall be posted in the following Port Canaveral areas:

##### a. Channel Leading to the Ocean

1. A 12 x 12 ft warning sign is required along the channel leading to the ocean at Port Canaveral.

2. The sign shall be equipped with strobe lights activated 1 h before the zone is closed.

3. The sign shall have the following or similar wording: *Warning: Flashing Lights Indicate Offshore Launch Danger Zone Closed to all Vessels.*

b. Barrier Gates West of the Canaveral Harbor Locks and Public Boat Ramps at the Port Canaveral Harbor at Jetty Park

1. Two aluminum signs are required on the barrier gates West of the Canaveral Harbor locks, one sign for each set of locks.

2. Three metal signs are required at the public boat ramps at the Port Canaveral Harbor at Jetty Park.

3. The signs described in 1 and 2 above shall have the following or similar wording: *Warning: A sea launch danger zone extending 50 miles from Cape Canaveral is established during launch operations. A US Air Force helicopter shall patrol this area to warn mariners in or approaching the danger zone. All vessels are requested to remain clear of this area. A large red sphere is hoisted and red rotating beacons are activated to indicate danger periods. These signals are located 1/2 mile North of the*

*Southeast corner of Cape Canaveral. Additional white flashing beacons are located atop warning signs on North side of harbor channel. Periodic broadcasts defining specific danger zones are made by the US Coast Guard on VHF channel 16 every hour on the hour beginning 4 hours prior to launch.*

##### 7.9.3.5 Marine Radio Broadcast Warnings

Marine radio broadcast warnings shall be made to inform vessels of the effective closure times for the sea LDZ.

##### 7.9.3.6 Notice to Airmen and Mariners

a. (ER Only) Flight Analysis shall provide 45 RANS with the areas hazardous to ships and aircraft for all normally jettisoned and impacting stages by F-10 days. **NOTE:** 45 RANS is responsible for disseminating the Notice to Airmen and Mariners (NOTAM) to aircraft and shipping interests

b. (WR Only) Flight Analysis shall provide RANS with the areas hazardous to ships and aircraft for all normally jettisoned and impacting stages by F-30 days.

##### 7.9.3.7 Special Designated Control Areas

a. (ER Only) Control of air traffic in FAA designated areas around the ER launch head shall be maintained and coordinated between the SCO, ACO, and Miami ARTCC to ensure that aircraft shall not be endangered by launches, nor launches delayed by the presence of aircraft **NOTE:** Miami ARTCC shall be advised by the RCO to close W-497A for all weather rocket launches from CCAS.

b. (WR Only) Control of air traffic in FAA designated areas around the WR launch head shall be maintained and coordinated between the ACO and FAA to ensure that aircraft shall not be endangered by launches, nor launches delayed by the presence of aircraft.

##### 7.9.3.8 Surveillance Control

a. Specific surveillance control requirements shall be specified in the appropriate RSOR.

b. (WR only) The ACO shall ensure that a plot of all surface contacts is maintained and provided to the MFCO via closed circuit television (CCTV).

### 7.9.3.9 United States Coast Guard Support

In accordance with applicable MOAs, the USCG shall assist in clearing the hazardous areas for launches.

## 7.10 RANGE SAFETY DISPLAY SYSTEM

### 7.10.1 Range Safety Display System General Requirements

*a.* The RSD is required as the primary information display system used by the MFCO to evaluate launch vehicle flight.

*b.* Flight Analysis shall provide RSD requirements, instructions, and data necessary for display generation to RANS or the Range Technical Services Contractor.

### 7.10.2 Additional ER RSD Display System Requirements

*a.* Prior to L-2 h, the "A" background tape shall be displayed.

*b.* No later than L-2 h, Flight Analysis shall notify the RCO of the applicable autoloading tape to be used in support of the mission.

*c.* A final RSD verification using theoretical data shall be completed by the MFCO no later than L-90 min in the countdown.

*d.* Recordings of the launch displays shall be made for post-operation review. **NOTE:** The capability to print color hard copies of selected displays during operations and for post-operations analysis is required.

### 7.10.3 Video Display Systems

#### 7.10.3.1 Video Display Systems General Requirements

*a.* Video monitors with channel switching capability are required at the MFCO and SMFCO positions.

*b.* Specific video coverage requirements peculiar to a mission shall be identified in the RSOR for the vehicle or OpsSup for the mission.

#### 7.10.3.2 Flight Line and Program Cameras

*a.* Videotape recordings of flight line (Back Azimuth) and Program camera presentations are required for all launches.

*b.* When used to support a launch, flight line (Back Azimuth) and Program cameras shall be operated in accordance with requirements identified in this Chapter.

*c.* Flight line (Back Azimuth) and Program cameras shall be located according to the **Skyscreen Site Locations** section of this Chapter.

*d.* Videotapes shall be retained for 45 days unless directed otherwise by Range Safety.

*e.* (WR only) Video recordings of Program, Back Azimuth, LA-24, Santa Ynez, and pad view (when scheduled by the Range User) with the safety net audio recorded from the MFCO consoles and 30 SW public address net are required from T-90 seconds until loss of signal.

*f.* The IRIG-B timing signal display will be located in the upper right corner of the video frame.

#### 7.10.3.3 ER Surveillance Radar 1.60 Camera

*a.* A camera shall be located at Surveillance Radar 1.60 for display of the radar scope to the MFCO and SCO.

*b.* A separate monitor is required in the SCO area for presentation of the radar scope display.

#### 7.10.3.4 ER Weather Forecast Monitor

The ability to monitor range weather forecasts shall be provided at the MFCO consoles by L-60 min and the SCO area by L-60 min.

#### 7.10.3.5 Telemetry Display

Specific telemetry display requirements shall be listed in the RSOR.

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## **7.11 FLIGHT CONTROL COMMUNICATION CIRCUITS**

### **7.11.1 Flight Control Communication Circuit General Requirements**

The Flight Control communication circuits shall be specified in the applicable RSOR.

### **7.11.2 Checkout and Operation of Communication Networks**

All communication networks required in an RSOR or OpsSup shall be checked out and operational prior to the scheduled time for FTS destruct checks or L-2 h, whichever is earliest in the countdown.

*a.* MFCO communications shall be recorded for all launches.

*b.* A voice operated relay may be used for recording voice data between the time the circuit checkout is completed and L-10 min.

*c.* A continuous recording shall be made from L-10 min to the termination of Flight Control operations.

*d.* Recordings shall be filed for a minimum of 45 days unless directed otherwise by Range Safety.

*e.* The appropriate security classification guide shall be followed prior to the release of information.

## **7.12 MISSION FLIGHT CONTROL TRAINING REQUIREMENTS**

*a.* In accordance with applicable ER and WR directives, Mission Flight Control Training shall be conducted.

*b.* All displays used for training shall operate at full speed.

## APPENDIX 7A RANGE SAFETY LAUNCH COMMIT CRITERIA

### 7A.1 INTRODUCTION

Range Safety launch commit criteria (RSLCC) are those criteria associated with launch day parameters that must be met prior to final SE approval for launch. These criteria ensure public, launch site, and launch complex safety. They include launch vehicle, range, and environmental factors.

#### 7A.1.1 Purpose

This appendix provides Range Users with general, and, where possible, specific information regarding RSLCC. Knowledge of this criteria may help Range Users to better understand and plan for potential Range Safety holds or scrubs as a result of related violations during the launch countdown.

#### 7A.1.2 Content

Descriptions of each RSLCC are included in this appendix. Where possible, the exact criteria used during the countdown is provided. General criteria is provided for cases in which the criteria is too complex to address in this document and/or where the criteria is in a state of flux. Range Safety offices of primary responsibility (OPR) and referenced documents are provided as sources of additional information.

#### 7A.1.3 Applicability

All RSLCC are not applicable to all launch vehicles. The applicability of each RSLCC is identified in the individual descriptions. Additional specific RSLCC may be provided as part of the RSOR for each individual mission.

### 7A.2 RANGE SAFETY LAUNCH COMMIT CRITERIA

#### 7A.2.1 Range Safety Systems

Range Safety Systems are those ground and airborne systems required to monitor, track, aid decision making, and, if necessary, destroy errant launch vehicles in flight.

##### 7A.2.1.1 Ground Range Safety Systems

**7A.2.1.1.1 General Description.** Ground Range Safety Systems include such systems as the command destruct system (CDS), RTS, TDTS, RSD, real time processing (RTP) system, and all other

associated ground-based systems necessary to monitor, track, aid decision making, and destroy an errant launch vehicle.

**7A.2.1.1.2 Applicability.** All launch vehicle missions using a command FTS require certain ground range safety system assets to be operational prior to launch. The launch vehicle configuration, flight azimuth, and other factors drive the selection of necessary ground safety system assets.

**7A.2.1.1.3 Ground Range Safety System Launch Commit Criteria.**

*a.* Range tracking systems include radar, optics, telemetry inertial guidance downlink, S-Band tracking, and global positioning system based downlinks.

*1.* Two adequate and independent tracking sources shall be available throughout powered flight.

*(a) Adequate* is defined by error statistics for each source.

*(b) Independent* is defined as having no common components or systems between the vehicle and the front-end computers in the Range Operations Control Center (ROCC).

*2.* Tracking sources shall be tested prior to launch to ensure requirements for accuracy and data integrity such as good communication with the ROCC.

*b.* The CDS has dual transmitter sites connected to central command in the ROCC. The system is capable of operation in both secure and non-secure modes.

*1.* A dual command site (two transmitters connected by an automatic failover control system) and two command data links shall be available throughout powered flight.

*2.* Using test codes, closed loop testing shall be performed between command central and each site prior to launch to ensure proper performance of the system.

*3.* Using flight codes, closed loop testing shall be performed between command central and the Launch Area command site prior to launch to ensure code integrity.

*4.* Using test codes, open loop testing shall

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### RANGE SAFETY LAUNCH COMMIT CRITERIA

be performed between command central, via the Launch Area command site, to the launch vehicle performed prior to launch to ensure total system integrity.

5. System testing shall include the use of both the FTU and the Range Safety control and display (RASCAD) console.

6. Using test codes, open loop testing shall be performed between command central, via each command site, to the command destruct independent test sets (CDITS) prior to launch to quantitatively verify proper message, code, and radio frequency parameters.

c. Computer and data communications systems, including RTP and RSD, collect and process data from the tracking sources. They calculate vehicle state vector information and predict the vacuum impact point of a vehicle in real time. In addition, these systems are used to point command destruct antennas at the vehicle and provide the MFCO with graphic displays of vehicle position, velocity, and impact point overlaid on a geographic representation of the flight.

1. Using end-to-end playback of theoretical data, the proper function of all computer and data communication systems shall be verified prior to launch.

2. The data processing and display (RTP and RSD) systems and their associated peripheral support equipment are configured in two independent strings connected with an automatic failover system. Both strings shall function correctly prior to allowing a vehicle to launch.

**7A.2.1.1.4 Offices of Primary Responsibility.** 30 SW/SEO and 45 SW/SEO are the OPRs for determining ground safety systems launch commit criteria.

**7A.2.1.1.5 Reference Documents.** Vehicle specific ground safety systems launch commit criteria shall be documented in the RSOR. Mission specific modifications to the RSOR are published for each operation in the OpsSup.

#### 7A.2.1.2 Airborne Range Safety Systems

**7A.2.1.2.1 General Description.** Airborne Range Safety Systems include the FTS and the airborne RTS.

**7A.2.1.2.2 Applicability.** An airborne FTS is required for all powered flight stages of a launch vehicle in accordance with Chapter 2 of this document. The need for an airborne FTS for all upper stages, payloads, and/or spacecraft capable of powered flight is determined as part of the flight plan approval process addressed in Chapter 2. An RTS is required for all launch vehicles per Chapter 2.

#### 7A.2.1.2.3 Airborne Range Safety System Launch Commit Criteria.

a. The Operations Safety Console (OSC) (ER) and the Flight Safety Project Officer Console (FSPOC) (WR) shall be used to monitor the status of the airborne FTS prior to launch.

1. Final open-loop testing of the airborne FTS just prior to launch shall be satisfactory.

2. All components of the airborne FTS shall be operating within expected limits prior to launch.

3. The FTS shall be armed prior to launch.

b. The frequency control and analysis van and radar installations are used to monitor the status of the airborne RTS. The airborne RTS shall be operating within expected limits prior to launch.

c. A launch hold or launch scrub shall be implemented if the above criteria are not met.

#### 7A.2.1.2.4 Offices of Primary Responsibility.

a. 30 SW/SES and 45 SW/SES are the OPRs for airborne FTS launch commit criteria.

b. 30 SW/SEO and 45 SW/SEO are the OPRs for airborne RTS launch commit criteria.

#### 7A.2.1.2.5 Reference Documents.

a. Operating characteristics of the OSC and FSPOC are required as part of airborne Range Safety System Report (RSSR) in accordance with Appendix 4A of this document.

b. Vehicle specific airborne RTS launch commit criteria shall be documented in the RSOR. Mission-specific modifications to the RSOR shall be published in the OpsSup for each operation.

### 7A.2.2 Blast

#### 7A.2.2.1 General Description

The Blast Damage Assessment model addresses intermediate hazardous range effects of a shock

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### RANGE SAFETY LAUNCH COMMIT CRITERIA

wave from an inadvertent detonation, such as from a launch vehicle malfunction, impact, or destruction. Near-in areas of overpressure above one pound per psi are evacuated of personnel and are not considered in the assessment. At far-out distances, with overpressures of less than 0.1 psi, there are relatively small hazards. It is the intermediate distance with overpressures of 0.1 to 0.5 psi that are of concern. The area encompassing overpressures in this range varies considerably with local meteorological conditions.

#### 7A.2.2.2 Applicability

This launch commit criteria is generally applicable to large launch vehicles with large amounts of propellants, solid rocket motor launch vehicles with high energy propellants, and launch vehicles using launch complexes near the borders of general population.

#### 7A.2.2.3 Blast Launch Commit Criteria

If the expected casualties of a potential blast overpressure exceed those limits defined in Chapter 1 of this document, a launch hold or launch scrub shall be implemented.

#### 7A.2.2.4 Offices of Primary Responsibility

30 SW/SEY and 45 SW/SESE are the OPRs for launch commit criteria associated with the BlastC model; 45 SW/SESE is the OPR for launch commit criteria associated with the BlastX (tailored version of BlastC) model.

#### 7A.2.2.5 Reference Documents

Mission-specific blast launch commit criteria shall be addressed in the RSOR.

### 7A.2.3 Collision Avoidance

#### 7A.2.3.1 General Description

A collision avoidance (COLA) analysis is used in the minus count to protect manned orbiting objects from collision with a launch vehicle or its jettisoned components.

#### 7A.2.3.2 Applicability

All launch vehicles with the potential to collide with manned orbiting objects shall meet the following criteria:

#### 7A.2.3.3 Collision Avoidance Launch Commit Criteria

*a.* The COLA program computes the closest approach between the launch vehicle and an orbiting object based on a miss distance screening criteria of 200 km for manned objects.

*b.* A COLA (no launch) closure time period is calculated for the defined miss distance for any object approaching within distances less than the above criteria.

*c.* A COLA closure time period shall result in a launch hold for that time period. A launch scrub occurs only if the closure time period conflicts with any remaining T-0 for the mission launch window.

#### 7A.2.3.4 Offices of Primary Responsibility

30 SW/SEY and 45 SW/SEO are the OPRs for determining COLA launch commit criteria.

#### 7A.2.3.5 Reference Documents

*a.* Chapter 2 of this document provides more insight into the COLA process.

*b.* Mission-specific COLA criteria shall be documented in the COLA Requirements letter by 45 SW/SEO and 30 SW/SEY.

### 7A.2.4 Launch Winds and Debris Hazard

#### 7A.2.4.1 Launch Winds (ER Only)

A Range Safety wind check (RSWC) program is used to compare forecasted T-0 winds and actual winds with statistical wind data and their effects on potential launch vehicle debris impacts.

**7A.2.4.1.1 Applicability.** All launch vehicles with potentially hazardous launch vehicle debris are subject to this launch commit criteria.

**7A.2.4.1.2 Day of Launch Winds Commit Criteria.** If forecasted T-0 winds cause potential launch vehicle debris dispersions to exceed acceptable statistical wind dispersion limits, a launch hold or launch scrub shall be implemented.

**7A.2.4.1.3 Offices of Primary Responsibility.** 30 SW/SEY and 45 SW/SEO are OPR for day of launch wind commit criteria.

#### 7A.2.4.1.4 Reference Documents.

*a.* At the ER, the requirements shall be listed in the Range Safety Wind letter in accordance with

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Chapter 2, of this document.

*b.* At the WR, weather requirements and associated safety analyses shall be listed in the RSOR.

#### 7A.2.4.2 Debris Hazard (WR Only)

At the WR, the Launch Risk Analysis (LARA) program is used to compute the estimate of casualty to personnel supporting the operation and to the general public due to debris from a vehicle destroyed during flight. The LARA program incorporates the latest available atmospheric data as well as vehicle breakup, malfunction turn, trajectory, and failure rate data.

**7A.2.4.2.1 Applicability.** In general, the launch commit criteria is applicable to all launch vehicles using an FTS and/or active guidance systems. Some larger rail-launched or unguided vehicles may also be affected.

**7A.2.4.2.2 Debris Hazard Launch Commit Criteria.** If the expected casualties exceed those limits defined in Chapter 1 of this document, a launch hold or launch scrub shall be implemented.

**7A.2.4.2.3 Office of Primary Responsibility.** 30 SW/SEY is OPR for debris hazard commit criteria.

#### 7A.2.4.2.4 Reference Documents.

*a.* Data requirements are specified in Chapter 2 of this document.

*b.* Weather requirements are specified in the RSOR.

### 7A.2.5 Natural and Triggered Lightning

#### 7A.2.5.1 General Description

Both natural and triggered lightning can cause launch vehicle malfunction and/or destruction. Triggered lightning is the phenomena associated with launch vehicles affecting the atmosphere during flight so that, under certain meteorological conditions, lightning is triggered and attracted to the launch vehicle.

#### 7A.2.5.2 Definitions and Explanations

**anvil** - stratiform or fibrous cloud produced by the upper level outflow or blow-off from thunderstorms or convective clouds

**cloud edge** - the visible cloud edge is preferred. If this is not possible, then the 10 dBz radar cloud

edge is acceptable.

**cloud layer** - an array of clouds, not necessarily all of the same type, whose bases are approximately at the same level. Also, multiple arrays of clouds at different altitudes that are connected vertically by cloud elements; for example, turrets from one cloud array to another. Convective clouds (those clouds falling under **7A.2.5.4 b**) are excluded from this definition unless they are embedded with other cloud types.

**cloud top** - the visible cloud top is preferred. If this is not possible, then the 13 dBz radar cloud top is acceptable.

**cumulonimbus cloud** - any convective cloud with any part above the  $-20.0^{\circ}$  temperature level.

**debris cloud** - any non-transparent cloud that has become detached from a parent cumulonimbus cloud or thunderstorm or results from the decay of a parent cumulonimbus cloud or thunderstorm.

**documented** - with respect to *EXCEPTION (2)* in paragraph **7A.2.5.4 c**, *documented* means sufficient data has been gathered on the benign phenomena to both understand it and to develop procedures to evaluate it; and the supporting data and evaluation have been reported in a technical report or equivalent publication. For launches at the ER, copies of documentation shall be maintained by the 45th Weather Squadron and the KSC Weather Projects Office. The procedures used to assess the phenomena during launch countdowns shall be documented and implemented by the 45th Weather Squadron.

**electric fields** (for surface-based electric field mill measurements) - the one minute arithmetic average of the vertical electric field ( $E_z$ ) at the ground, such as measured by a ground-based field mill. The polarity of the electric field is the same as that of the charge overhead; that is, the polarity of the field at the ground is the same as that of the charge overhead.

**flight path** - the planned flight trajectory including its uncertainties (error bounds).

**precipitating cloud** - any cloud containing precipitation, producing virga, or having radar reflec-

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tivity greater than 13 dBz.

**thunderstorm** - any cloud that produces lightning.

**transparent** - synonymous with *visually transparent*. Sky cover through which higher clouds, blue sky, stars, and other items may be clearly observed from below. Also, sky cover through which terrain, buildings, and other items may be clearly observed from above. Sky cover through which forms are blurred, indistinct, or obscured is not transparent.

#### 7A.2.5.3 Applicability

All launch vehicles are subject to this launch commit criteria, with exceptions as noted.

#### 7A.2.5.4 Natural and Triggered Lightning Launch Commit Criteria

The constraints listed below are for the avoidance of natural or triggered lightning, based on known cloud types that can produce discharges and the distances to the charge regions. Even when constraints are not violated, if any other hazardous conditions exist, the Launch Weather Officer (LWO) will report the threat to the Launch Director (LD). The LD may initiate a launch hold at any time based on the instability of the weather. The LWO must have clear and convincing evidence the following constraints are not violated:

*a.* A launch shall not occur if any type of lightning is detected within 10 nautical miles (nm) of the flight path within 30 min prior to launch, unless the meteorological condition that produced the lightning has moved more than 10 nm away from the flight path.

*b.* A launch shall not occur if the flight path will carry the launch vehicle:

*1.* Through a cumulus cloud with its top between the  $+5.0^{\circ}\text{C}$  and  $-5^{\circ}\text{C}$  levels. **EXCEPTION:**

*(a) The cloud is not producing precipitation and*

*(b) the horizontal distance from the furthest edge of the cloud top to at least one working field mill is less than the altitude of the  $-5.0^{\circ}\text{C}$  level or 3 nm whichever is smaller;*

*and*

*(c) all field mill readings within 5 nm of the flight path are between -100 volts (V) per meter (m) and +1000V/m for the preceding 15 min.*

*2.* Through cumulus clouds with tops higher than the  $-5.0^{\circ}\text{C}$  level.

*3.* Through or within 5 nm (horizontal or vertical) of the nearest edge of cumulus clouds with tops higher than the  $-10.0^{\circ}\text{C}$  level.

*4.* Through or within 10 nm (horizontal or vertical) of the nearest edge of any cumulonimbus or thunderstorm cloud, including non-transparent parts of its anvil.

*5.* Through or within 10 nm (horizontal or vertical) of the nearest edge of a non-transparent detached anvil for the first hour after detachment from the parent thunderstorm or cumulonimbus cloud. **NOTE:** Cumulus does not include altocumulus or stratocumulus.

*c.* A launch shall not occur if, for Ranges equipped with a working surface electric field mill network, at any time during the 15 min prior to launch time the one-minute average of the absolute electric field intensity at the ground is greater than 1000 V/m within 5 nm of the flight path. **EXCEPTION:** *(1) There are no clouds with-in 10 nm of the flight path except transparent clouds OR clouds with tops below the  $+5.0^{\circ}\text{C}$  level that have not been associated with convective clouds with tops above the  $-10.0^{\circ}\text{C}$  level within the last three hours;*

*and*

*(2) a known source of electric field, such as ground fog, smoke, or sunrise effect that is occurring near the sensor, and that has been previously determined and documented to be benign, is clearly causing the elevated readings. NOTE: For confirmed failure of the surface field mill system, the countdown and launch may continue since other lightning launch commit criteria completely describe unsafe meteorological conditions.*

*d.* A launch shall not occur if the flight path is through a vertically continuous layer of clouds with an overall depth of 4,500 ft or greater where any part of the clouds is located between the  $0.0^{\circ}\text{C}$  and  $-20^{\circ}\text{C}$  levels.

*e.* A launch shall not occur if the flight path is through any clouds that extend to altitudes at or above the  $0.0^{\circ}\text{C}$  level and are associated with disturbed weather that is producing moderate (29 dBz) or greater precipitation within 5 nm of the flight path.

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f. A launch shall not occur if the flight path will carry the vehicle:

1. Through any non-transparent thunderstorm or cumulonimbus debris cloud during the first three hours after the debris cloud formed from the parent cloud.

2. Within 5 nm (horizontal or vertical) of the nearest edge of a non-transparent thunderstorm or cumulonimbus debris cloud during the first three hours after the debris cloud formed from a parent cloud. *EXCEPTION: (a) There is at least one working field mill within 5 nm of the debris cloud and*

*(b) all electric field intensity measurements at the ground are between +1000 V/m and -1000 V/m within 5 nm of the flight path during 15 min preceding the launch time;*

*and*

*(c) the maximum radar return from the entire debris cloud is less than 10 dBz during the 15 min preceding launch time.*

3. The start of the three-hour period is determined as follows:

a) *Detachment.* If the cloud detaches from the parent cloud, the three-hour period begins at the time when cloud detachment is observed or at any time of the last detected lightning discharge (if any) from the detached debris cloud, whichever is later.

b) *Decay Or Detachment Uncertain.* If it is not known whether the cloud is detached or the debris cloud forms from the decay of the parent cloud, the three-hour period begins at the time when the parent cloud top decays to below the altitude of the -10.0°C level, or at the time of the last detected lightning discharge (if any) from the parent cloud or debris cloud, whichever is later.

g. A launch vehicle that has not been treated for surface electrification shall not be launched if the planned flight path will go through clouds from the -10.0°C level, upward to the altitude at which the launch vehicle velocity exceeds 3000 ft/sec. **NOTE 1:** A launch vehicle is considered *treated* for surface electrification if all surfaces of the launch vehicle susceptible to precipitation particle

impact have been treated to ensure the surface resistivity is less than 10<sup>9</sup> ohms/square AND all conductors on surfaces, including dielectric surfaces that have been treated with conductive coatings, are bonded to the vehicle structure by a resistance that is less than 10<sup>5</sup> ohms. **NOTE 2:** The correct unit for surface resistivity is ohms/square. This means that any square area of any size measured in any units has the same resistance in ohms when the measurement is made from an electrode extending the length of one side of the square to an electrode extending the length of the opposite side of the square. The area-independence is literally valid only for squares; it is not true for other shapes such as rectangles and circles.

#### 7A.2.5.5 Electrical Charge Regions

Electrical charge regions can occur in clouds with altitudes at or above the 0°C isotherm. These regions can produce lightning discharges triggered by the proximity of long electrical conductors (launch vehicle plus conductive port on the plume)

#### 7A.2.5.6 Offices of Primary Responsibility

30 SW/SEY and 45 SW/SESE along with 30 WS and 45 WS are the OPRs for natural and triggered lightning launch commit criteria.

#### 7A.2.5.7 Reference Documents

Additional or different mission specific natural and triggered lightning launch commit criteria shall be documented in the RSOR.

### 7A.2.6 Toxics

#### 7A.2.6.1 General Description

A variety of predictive models and analytical techniques are used to ensure that the public and launch area personnel are not exposed to toxic chemicals in concentrations that exceed applicable threshold limits. Key considerations include, but are not limited to, the specific commodities loaded and their quantity; potential agents resulting from mixing and/or reactions; nature or mechanism of release; and weather parameters such as wind speed, wind direction, temperature, temperature gradient, inversion layer, surface re-

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flection coefficient, exposure response functions, and cloud cover as well as the uncertainty of these parameters.

#### 7A.2.6.2 Applicability

All launch vehicles, including payloads, with potentially hazardous chemicals are subject to this toxic launch commit criteria.

#### 7A.2.6.3 Toxic Launch Commit Criteria

The acceptable limits for various commodities are governed by a number of standards, statutes, and specifications. These standards, statutes, and specifications are subject to frequent revision based on controlled studies, real-world events, and other discoveries. Additionally, commodity loads also vary among launch vehicle classes and there are differences between variants within the same class. For these reasons and because of the evolving nature of predictive models used, a general toxic launch commit criteria cannot be stated. For guidance about a specific commodity or set of commodities in the case of a particular launch vehicle, contact the 45 SW Office of Safety, Missile Systems Division, Large Vehicles Section (45 SW/SESL). At the WR, the 30 SWI 91-106 defines the exposure criteria, unit support requirements, actions required for cold spill potential Hazard Zones as well as other requirements.

#### 7A.2.6.4 Offices of Primary Responsibility

30 SW/SEY and 45 SW/SESL are the OPRs for toxic launch commit criteria.

#### 7A.2.6.5 Reference Documents

Mission-specific toxic launch commit criteria shall be addressed in the RSOR.

#### 7A.2.7 Safety Clearance Zones

Safety Clearance Zones are restricted areas designated for day-to-day prelaunch processing and launch operations to protect the public, launch area, and launch complex personnel. These zones are established for each launch vehicle and/or payload at specific processing facilities to include launch complexes. Safety Clearance Zones include Hazardous Clear Areas and Hazardous Launch Areas.

#### 7A.2.7.1 Hazardous Clear Areas

**7A.2.7.1.1 General Description.** Hazardous Clear Areas are Safety Clearance Zones for ground processing that are defined in the Operations Safety Plan for each operating facility. Hazardous Clear Areas include Blast Danger Areas (BDA), Control Area Clears, and Toxic Hazard Corridor (THC) (ER) and Toxic Hazard Zone (WR).

**7A.2.7.1.2 Applicability.** All launch vehicles and, if necessary, associated payloads shall be evaluated and hazardous clear areas determined.

#### 7A.2.7.1.3 Hazardous Clear Areas Launch Commit Criteria.

*a. Blast Danger Area:* Clearance prior to establishment of a major explosive hazard such as vehicle fuel/oxidizer load and pressurization. This is the area subject to fragment and direct overpressure resulting from the explosion of the booster/payload.

*b. Control Area Clears:* Clearance of defined areas to protect personnel from hazardous operations

*c. Toxic Hazard Corridor/Zone:* Clearance area of a sector in which toxic material may exceed predetermined concentration levels

#### 7A.2.7.2 Hazardous Launch Areas

**7A.2.7.2.1 General Description.** Hazardous Launch Areas are Safety Clearance Zones used during launch operations and include the FCA, FHA, the Vessel Exclusion Area (VEA) and the Impact Limit Lines (ILLs).

**7A.2.7.2.2 Applicability.** All launch vehicles and, if necessary, associated payloads, shall be evaluated and hazardous launch areas determined.

#### 7A.2.7.2.3 Hazardous Launch Area Launch Commit Criteria.

*a. FHA.* Only mission-essential personnel in approved blast-hardened structures with adequate breathing protection are permitted in this area during a launch.

*b. FCA.* Only mission-essential personnel

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with adequate breathing protection are permitted in this area during launch.

*c.* VEA. Ships and aircraft shall remain outside this area during launch.

*d.* ILL. Mission-essential and Wing-essential personnel are permitted within ILLs during a launch. Non-essential personnel, with Wing Commander approval, may be permitted in this area during a launch; however, the collective risk shall not exceed acceptable standards for non-essential personnel.

#### 7A.2.8 LAUNCH AREA AIR AND SEA SURVEILLANCE

##### 7A.2.8 Launch Area Air and Sea Surveillance

###### 7A.2.8.1 General Description

Areas to be cleared of boats and ships are defined by Flight Analysis and based on probability contours and/or Toxic Hazard Zones, including known impact areas of jettisoned stages/bodies and destruct debris resulting from malfunction scenarios plus the areas and altitudes in which Toxic Hazards will exist. Areas defined by NOTAM are surveilled on launch day for intruder aircraft and are analyzed as a potential for risk to the launch vehicle or the aircraft.

###### 7A.2.8.2 Applicability

These criteria are applicable to all CCAS/KSC pad launch vehicles and select offshore Navy launches and all 30 SW launch operations.

###### 7A.2.8.3 Launch Area Air and Sea Surveillance Launch Commit Criteria

###### 7A.2.8.3.1 Boat and Ship Traffic.

*a.* At the ER, if the sum total of the individual hit probabilities of all targets plotted within, or predicted to be within, the established probability contours exceed  $10^{-5}$ , a launch hold or scrub may be initiated.

*b.* At the WR, if an individual vessel is exposed to a probability of impact greater than  $10^{-5}$ , the vessel shall be moved or a launch hold or scrub may be initiated.

**7A.2.8.3.2 Aircraft.** For an aircraft posing a threat to itself or the launch vehicle by its expected position being within predetermined hazard corridors, launch hold or scrub may result until the aircraft clears the hazard corridor.

###### 7A.2.8.4 Offices of Primary Responsibility

At the ER, 45 SW/SEO is the OPR for launch area air and sea surveillance. At the WR, the ACO is the OPR for launch area air and sea surveillance; however, 30 SW/SEY performs the analysis for the hazard areas and the boat box.

##### 7A.2.9 JETTISONED BODIES IMPACTING LAND IN LAUNCH AREA

###### 7A.2.9.1 General Description

EWR 127-1 prohibits the impact of jettisoned components on any land mass. For certain launch vehicles, the possibility exists for jettisoned bodies such as nozzle closures to impact in the launch area near occupied facilities or resources requiring protection. This is allowed in these cases when the risks associated are mitigated or minimized. Hit probability contours are created and used in conjunction with launch day impact prediction runs to determine possible threat near the predicted impact location.

###### 7A.2.9.2 Applicability

All vehicles jettisoning components in the launch area with the potential to impact land.

###### 7A.2.9.3 Jettisoned Bodies Launch Commit Criteria

Launch day impact prediction runs are made and the associated probability contours or impact dispersions are overlaid with the launch areas. A launch hazard may result in a launch hold or scrub condition.

###### 7A.2.9.4 Offices of Primary Responsibility

30 SW/SEY and 45 SW/SEO are the OPRs for jettisoned bodies impacting land.