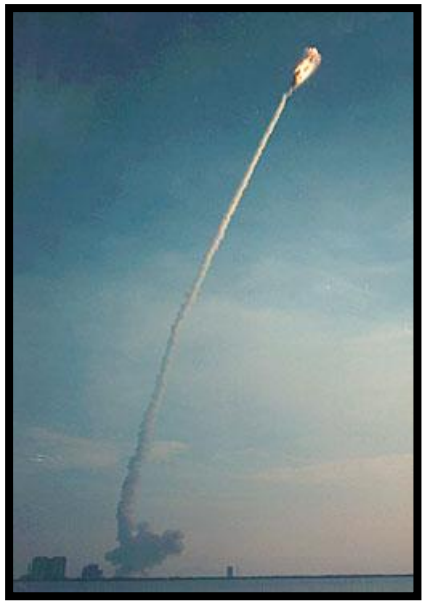
NASA Range Safety Overview





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Agenda

- NPR 8715.5
- Policy highlights
- Day of Launch Requirements
- Failure Videos
  - Bad Day vs Nightmare
- Launch Vehicle Hazards/Mitigations
- Training Courses
- Summary
- Questions

NASA Range Safety Policy

- **NPR 8715.5 "Range Flight Safety Program"**
  - **Implements NPD 8700.1**
    - **"Protect the public, NASA workforce, high-value equipment and property, and the environment…"**
  - **Applies to all NASA centers/test facilities, non-conventionally piloted flight programs/vehicles operating in any location**
    - **NASA ranges**
    - **DoD ranges**
    - **Commercial Spaceports or FAA airspace**
    - **Foreign locations or ranges**
- **NASA developed and approved NPR 8715.5, Range Safety Program policy (July 2005)**
  - **Updated to Revision A in September 2010**
  - **In revision cycle as we speak**

NPR Highlights

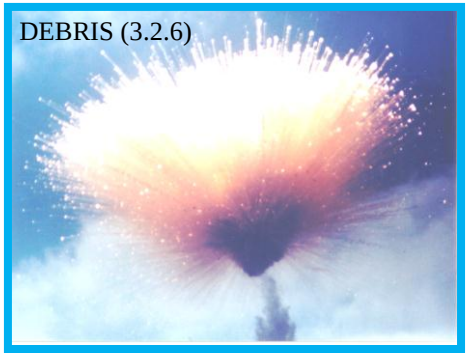
- Requires a Range Safety risk management process
- Requires compliance with minimum launch architecture and associated safety processes/procedures
- Requires compliance with Range Safety System requirements
- Requires assessment of residual risks
- Defines acceptable risk criteria for general public and workforce
- Provides for a Range Safety tailoring process
- Provides a non-compliance process
  - Identifies risk acceptors
  - The vehicle program manager and each Center Director (or NASA designee) responsible for people or property exposed to the associated range operation shall cosign each waiver
- Provides minimum launch/flight commit criteria
- Requirements for entry operations and collision avoidance (COLA)

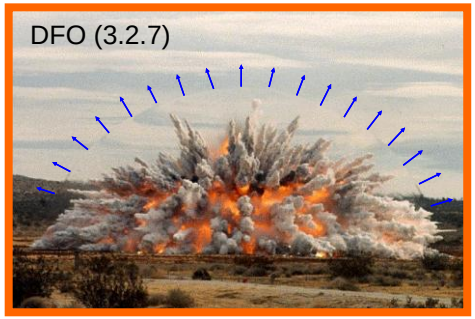
Day of Launch Requirements

Examples:

- Mitigate the risk to members of the public and workforce (3.2.4.3 a)
- Range Safety telemetry validation (3.3.5.1)
- Two independent sources of vehicle tracking data (3.3.4.1a)
- Implement a secure FTS (3.3.1.3)
- Redundant and Independent FTS command paths (3.3.6.1)
- Criteria for activation of FTS (3.3.1.4)
- Launch/Flight Commit Criteria (3.7.1)
- Range Safety Collision Avoidance (COLA) (3.7.3)







NPR 8715.5 AGGREGATE ACCEPTABLE RISK CRITERIA (3.2.4.5)		
	Expected Casualties x 10^{-6}	
Risk	**General Public**	**Center Essential**
Individual (P_c) / mission	1	10
Collective (E_c) / mission	100	300

DELTA II (NAVSTAR GPS IIR-1)
17 January 1997



The "Bad Day"

DELTA II 7925, 17 January 1997

- **Payload: NAVSTAR GPS IIR-1**
- **Propellants:**
  - **Stage 1- LOx/Kerosene main with 9 Graphite Epoxy Motors 40 (GEM 40) solid propellant strap-ons**
  - **Stage 2 – N_2O_4/Aerozine 50**
  - **Stage 3 – Solid propellant**
- **Initiating event: Accident sequence initiated due to structural failure of one of nine GEMs**
- **Vehicle stages exploded and/or destroyed by the Flight Termination System within 23 seconds after launch.**
- **No deaths or injuries**
- **But property damage (including private automobiles): $429,000 (trailers and vehicles)**
- **Root Cause: Investigation inconclusive**



Chinese Long March CZ-3B
14 Feb 1996



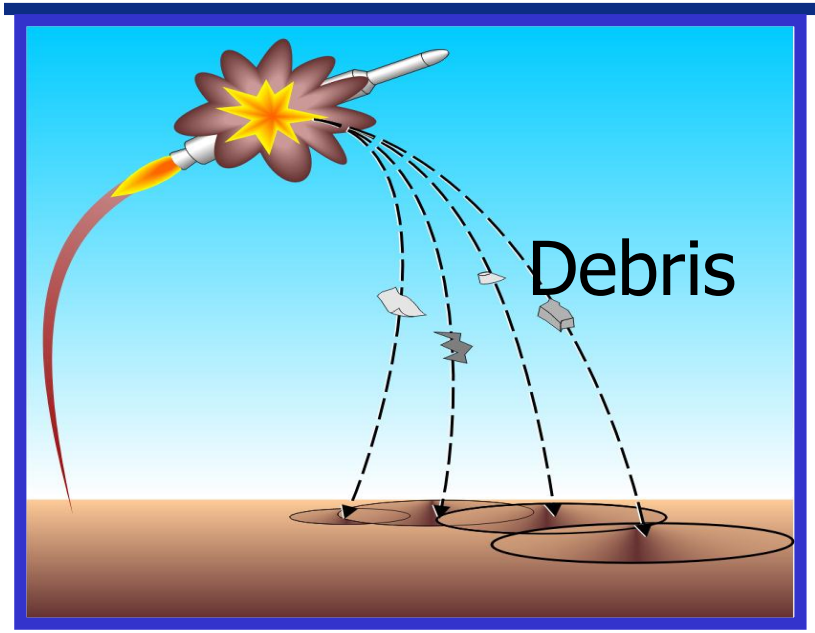
The "Nightmare"

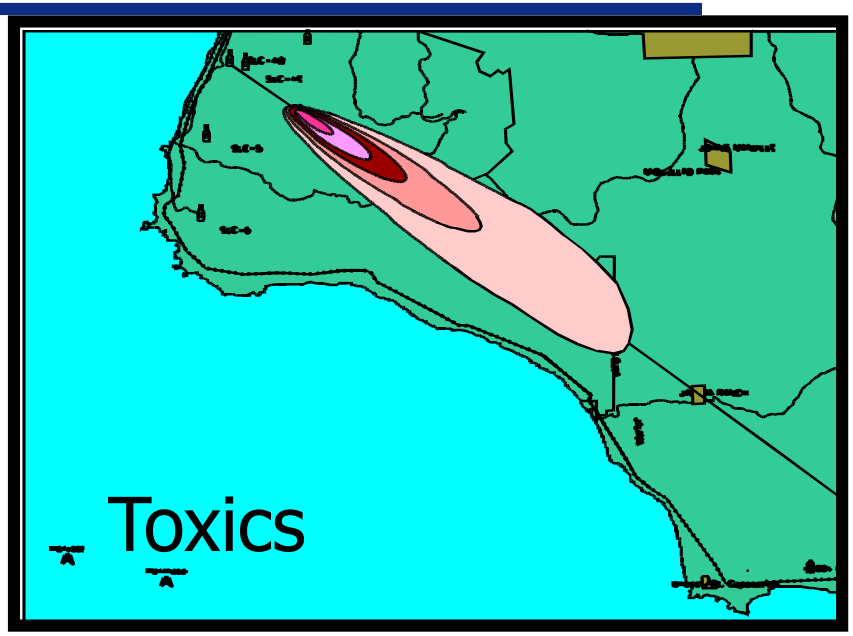
- **Chinese Long March CZ-3B, 14 February 1996**
  - **Payload: Intelsat 708**
  - **Propellants:**
    - **Stage 1, stage 2 and 4 strap-on rocket motors - N_2O_4/UDMH**
    - **Stage 3 – Liquid O_2/H_2**
  - **Failure (3rd in 38 months) attributed to guidance system shortcomings (deterioration of gold/aluminum connections in a power amp for the IMU)**
  - **Vehicle "augured in" nose down at T+22 seconds and exploded violently (20 – 50 tons TNT equivalent)**
  - **Official Report: six killed and 57 injured in nearby village (Personal accounts indicate over 100 people died)**



- **Safety assurance features ???**
  - **Conflicting reports whether the vehicle had a Flight Termination System.**
  - **No analysis of credible failures that would indicate a nearby village in jeopardy.**
  - **No known safety analysis of potential debris, blast or toxic release.**

Launch Vehicle Hazards





Blast Distant Focusing Overpressure



Debris Harzard Areas

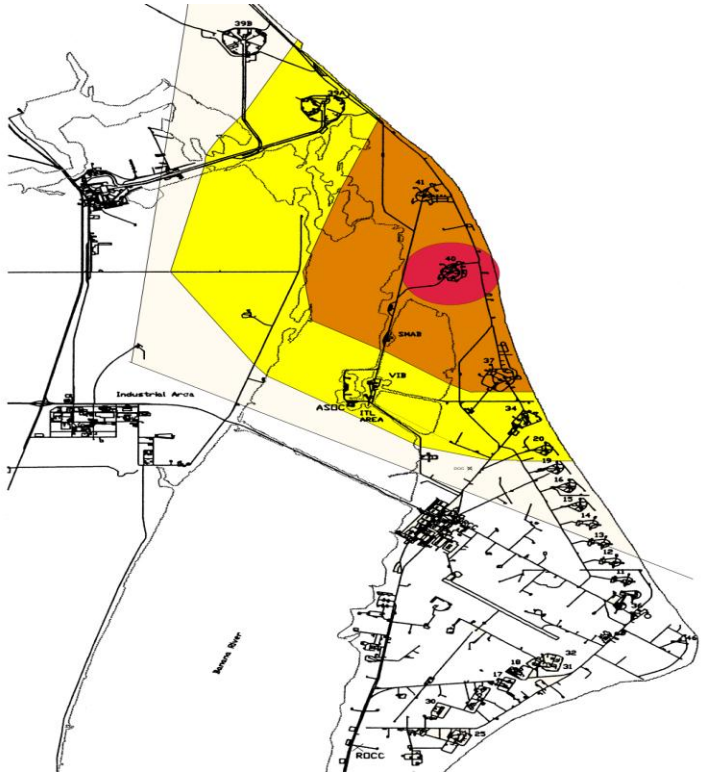
BDA – Blast Danger Area

LHA/FHA – Launch/Flight Hazard Area

FCA – Flight Caution Area or

LDA – Launch Danger Area

ILL – Impact Limit Line



The size of the launch hazard area will be determined by acceptable risk levels

The range is responsible for defining and implementing launch hazard areas (LHAs)

Toxic Hazards

- Defined as Hydrogen Chloride (HCl), Nitrogen Dioxide (NO_2), and various hydrazines
- Cannot be contained within the fence line but is mitigated by Toxic Launch Commit Criteria (LCC)

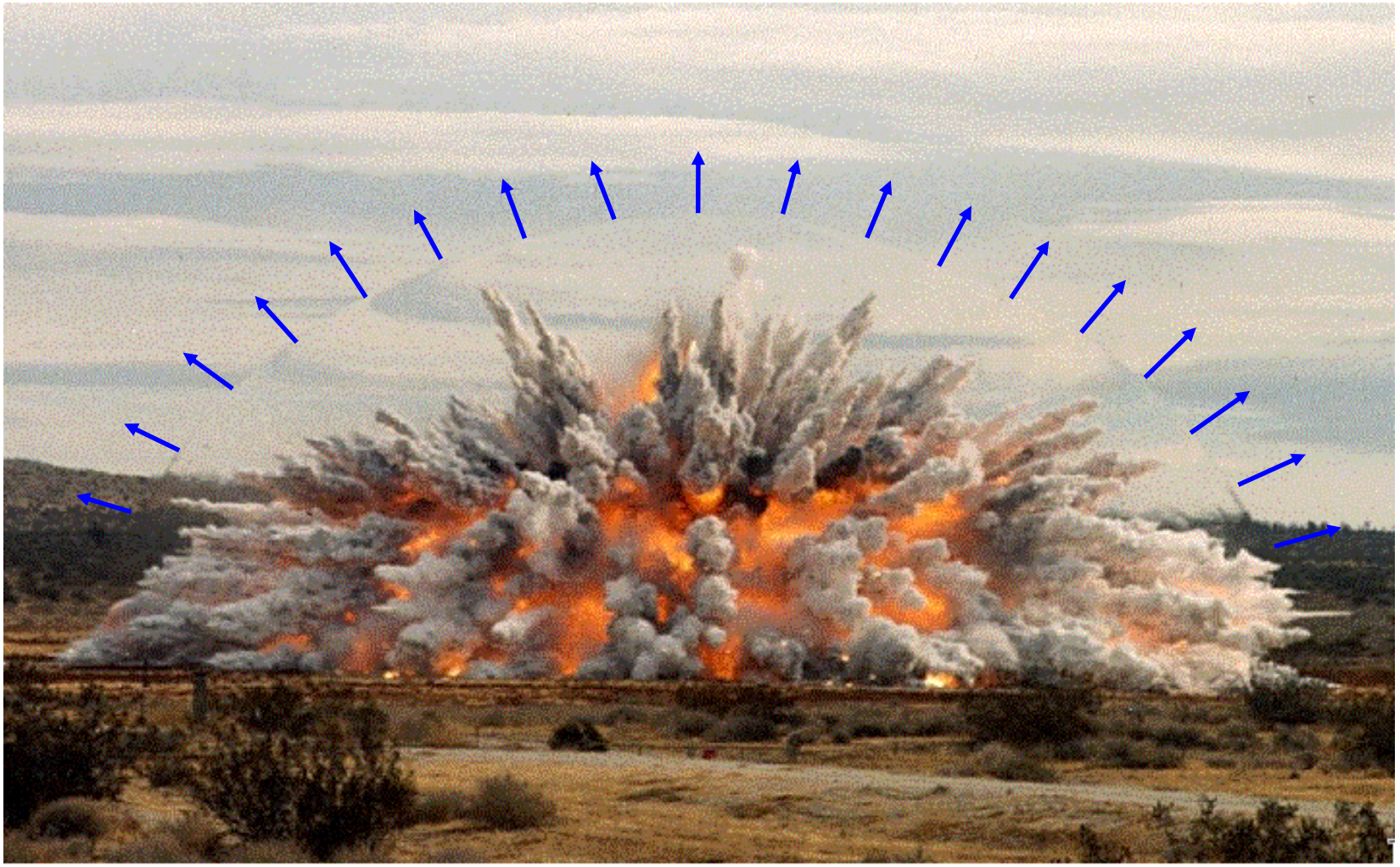




Toxic Emergency Response

- If, after liftoff, launch vehicle catastrophically fails, 45th SW provides real-time dispersion predictions of the toxic cloud over CCTV to
  - Launch Disaster Control Group
  - Brevard Emergency Operation Center Representative in the ROCC
  - Brevard Emergency Operations Center in Rockledge, Florida
  - KSC EOC
  - Florida Marine Patrol
  - USCG-OD
  - SWP
- It is typical to expect minimum time of arrival of the toxic cloud into the closest population center is approximately 20 minutes.
- If low exposure is predicted and a short dwell time (<45 minutes) individuals who are in any type of shelter, regardless of insulation quality, are not expected to be injured, even mildly by toxics
- If high exposure levels are predicted evacuations could be called for

Distant Focusing Overpressure (DFO)



DFO: KSC Mitigation

- **If LCC is exceeded on KSC, KSC EOC will be notified of specific facility risks and KSC will be responsible for taking appropriate mitigation efforts**
  - **It will be recommended that KSC personnel and visitors in affected facilities be required to move to interior rooms away from windows or evacuate**
    - **Availability Study results are provide to KSC via the Launch Risk Notification Letter**
  - **Launch Day DFO GO/NO GO recommendations on KSC based on 100 % of personnel moving away from windows and/or evacuation of affected facilities**

Training Courses

NASA Range Safety offers four courses through the NSTC:

- **Range Safety Orientation (NSTC-074, SMA-AS-WBT-410)**
  - Provides an understanding of the Range Safety mission, associated policies and requirements, and NASA roles and responsibilities; also introduces the students to the major ranges and their capabilities and defines and discusses the major elements of Range Safety (flight analysis, flight termination systems, and range operations).
- **Flight Safety Systems (NSTC-096, SMA-AS-WBT-335)**
  - Describes required safety responsibilities and Flight Termination System (FTS) procedures and plans. It also includes FTS component design, performance, test, and subsystem prelaunch requirements; also includes FTs ground support equipment, FTS analysis, and component test history.
- **NASA Range Safety Analysis (NSTC-086, SMA-AS-WBT-435)**
  - Gives student a good understanding of NASA, FAA, and DoD requirements for flight safety analysis; provides a discussion of range operations hazards, risk criteria, and risk management processes along with and in-depth coverage of the containment and risk management analyses used by NASA ranges.
- **Range Flight Safety Operations (NSTC-097)**
  - Focuses on the roles and responsibilities of the Range Safety Officer for range safety operations as well as real-time support, including pre-launch, launch, flight, landing, and required mitigation actions; also presents launch commit criteria, mission rules, countdown activities, and display techniques.

Summary

Provided an overview of NASA Range Safety Implementation of policy/requirements

- **NPR 8715.5**
- **Policy Highlights**
- **Day of Launch Requirements**
- **Failure Videos**
- **Launch Vehicle Hazards**
- **Training Courses**





QUESTIONS?


45th SPACE WING
SAFETY
OFFICE
Success Per Solidarem


30th SPACE WING
SAFETY

