



**IAASS Space
Launch and Re-entry**

**Safety Academy
Flight Safety Analysis**

**16 -18 October 2008
ESA/ESRIN
Frascati (Rome), Italy**

Presented by:

ACTA Inc

16850 SATURN LANE
SUITE 100
Houston, TX 77058



Course Description 1/2

- *Title of Training:* Launch and Re-entry Flight Safety Analysis

- *History of Course:*

The course is based on material originally presented to:

- U.S. FAA Associate Administrator for Space Transportation (FAA/AST)
- U.S. Air Force Eastern and Western Ranges
- U.S. Navy Pacific Missile Range Facility and Naval Air Warfare Center
- Korean Aerospace Research Institute (KARI)
- IAASS Launch Flight Safety Analysis Course 2007, Chicago, Ill. - USA

- *Length of Course:* Three days.

- *Prerequisites:* Students should be familiar with matrix and vector operations and have a background in physics or mechanical engineering equivalent to a BS.



Why, What, How & Who

Why You Need to Know this:

- To design for launch and re-entry safety
- To understand the significance and procedures of the range safety process
- To identify resources for implementing launch and re-entry safety
- To get safety approval for launch/entry

What you will Learn:

- Risk Concepts
- Mathematical and Statistical Principles
- Computation and Presentation of Risk
- Approaches to Risk Analysis Modeling
- Evaluating Catastrophe Risk
- General Launch Risk Analysis Procedure
- Impact Point Prediction and Impact Dispersions
- Impact Dispersions of Normal and Malfunctioning Vehicles
- Aircraft Probability of Impact and Vulnerability
- Impact Probabilities for Planned Jettisons
- Introduction to Debris List Development
- Failure Rate and Failure Mode Development
- Introduction to Exposure and Vulnerability
- Acceptable Risk
- Planned Re-entry Risk Analysis Methods
- Random Re-entry Risk Analysis Methods

Who leads You Through the Maze
-Leading instructors with long experience in range safety and safety risk management

How You Will Learn It:

- Verbal instruction using Power Point
- Experts Lectures
- Videos and Photographs
- Case studies
- Group exercises & problem solving

What You will Take Away
-Data, model results, and analysis tools
-Binder of comprehensive briefing slides
-Certificate of Course Completion
-Movies and other example results



Course Outline 1/5

- ❖ 1) Introduction
- ❖ 2) Overview of Range Safety
 - ❖ a) Phases of flight
 - ❖ b) Range Safety System
 - ❖ Objectives and Tasks
 - ❖ Elements and Options
 - ❖ Advantages and Disadvantages
 - ❖ c) Range Safety Planning
 - ❖ Locating a launch and abort limits
- ❖ 3) Risk Management Concepts and Definitions
 - ❖ a) Risk Management Process
 - ❖ b) Types of Risks
 - ❖ c) Event Trees
 - ❖ d) Systems Analysis
 - ❖ e) Aerodynamic Properties
- ❖ 4) Basic Mathematical and Statistical Principles
 - ❖ a) Vectors and covariance matrices
 - ❖ b) Probability distributions





Course Outline 2/5

- ❖ 5) Basic Computation and Presentation of Risk
 - ❖ a) Measures of risk (risk metrics)
 - ❖ i) Individual risk
 - ❖ ii) Collective risk
 - ❖ iii) Catastrophic risk
 - ❖ iv) Risk to assets
 - ❖ b) Risk Profile
 - ❖ Uses and properties
 - ❖ Limiting potential for catastrophe
 - ❖ Process to compute
 - ❖ Numerical examples
 - ❖ Decision-making examples
- ❖ 6) Approaches to Risk Analysis Modelling
 - ❖ a) Data requirements
 - ❖ b) Elements of analysis
 - ❖ c) Modelling approaches
 - ❖ d) Statistical modelling techniques





Course Outline 3/5

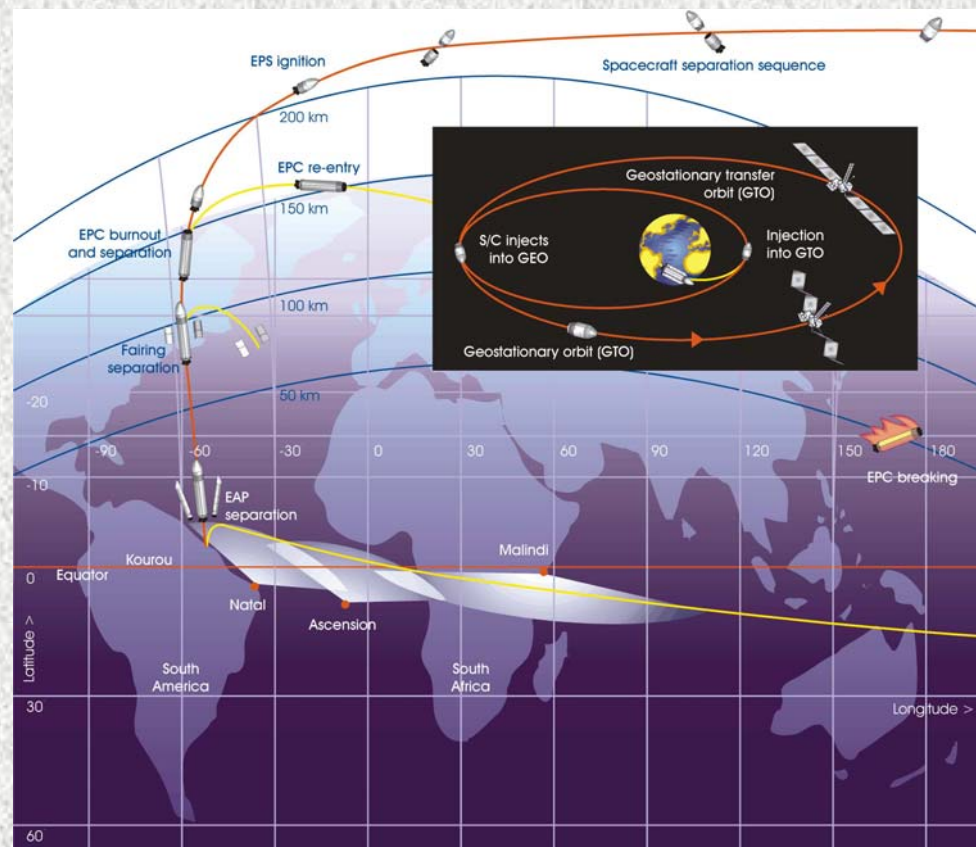
- ❖ 7) General Launch Risk Analysis Procedure
 - ❖ a) Hazard Identification
 - ❖ b) Failure probabilities and missile response
 - ❖ c) Debris generating events
 - ❖ Planned events--Jettisoned hardware /stages
 - ❖ Aerodynamic break-up
 - ❖ Self-destruct
 - ❖ Effect of flight termination actions
 - ❖ Flight termination criteria
 - ❖ System time delays (data latency, decision times)
 - ❖ d) Debris lists
 - ❖ e) Debris propagation
 - ❖ f) Impact probability calculations
 - ❖ g) Compute risk measures
 - ❖ h) Risk accumulation
- ❖ 8) Impact Point Prediction and Impact Dispersions
 - ❖ a) Debris Trajectory Analysis and Requirements
 - ❖ b) Sources of Debris Dispersions
 - ❖ c) Computation of a Debris Footprint





Course Outline 4/5

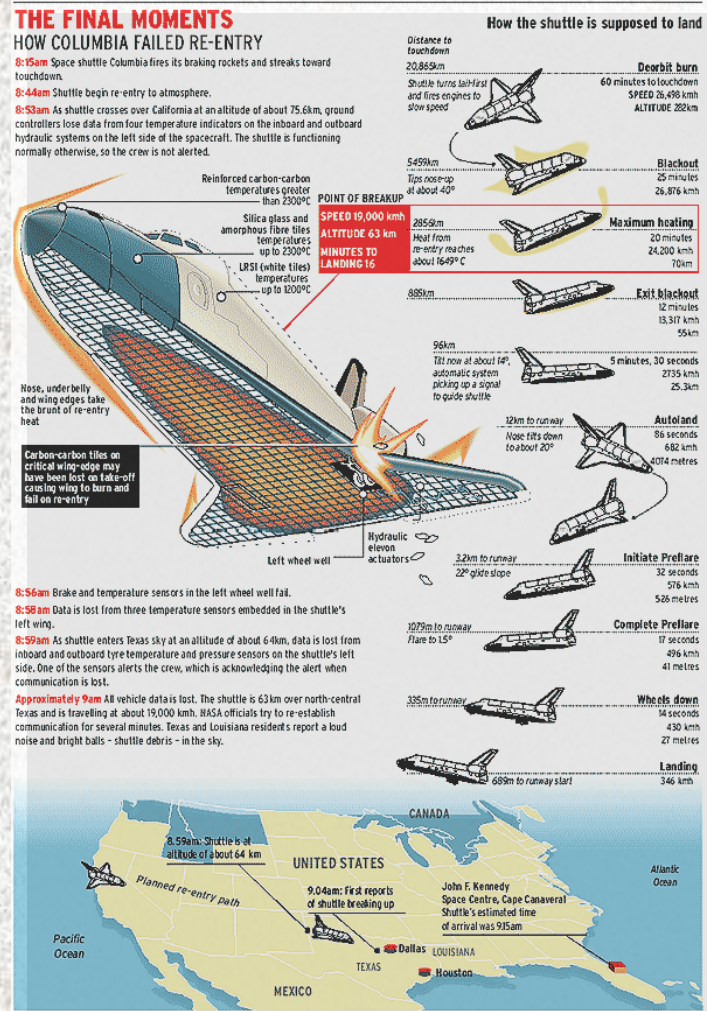
- ❖ 9) Dispersions for Normal and Malfunctioning Vehicles
 - ❖ a) Normal Guidance and Performance
 - ❖ b) Off course malfunctions
 - ❖ c) On course malfunctions
 - ❖ d) Malfunction impact distributions
- ❖ 10) Aircraft Probability of Impact
- ❖ 11) Impact Probabilities for Planned Jettisons
- ❖ 12) Corridor Approach to Risk Analysis
- ❖ 13) Introduction to Debris List Development
 - ❖ a) Break-up sequences
 - ❖ b) Aerodynamic properties of debris
 - ❖ c) Imparted velocities
- ❖ 14) Failure Rate and Mode Development
 - ❖ a) Historical data on failure probabilities
 - ❖ b) Allocation to failure mode and time
 - ❖ Vehicle designer and historical data
 - ❖ c) Accepted methodologies





Course Outline 5/5

- ❖ 15) Introduction to Hazard Areas and Casualty Areas
- ❖ 16) Human Vulnerability Modelling
 - ❖ Blunt Trauma
 - ❖ Penetration
 - ❖ Crushing
- ❖ 17) Modelling Explosive Impacts
- ❖ 18) Modelling Casualty Areas for Inert Debris Impacts
 - ❖ People indoors and outdoors
- ❖ 19) Modelling Casualty Areas for Explosive Debris
 - ❖ People indoors and outdoors
- ❖ 20) Modelling Population Exposure-Sheltering
- ❖ 21) Modelling Ship and Aircraft Vulnerabilities
- ❖ 22) Acceptable Risk Criteria
- ❖ 23) Planned Re-entry Risk Analysis
- ❖ 24) Random Re-entry Risk Analysis
 - ❖ Risk versus orbital inclination per casualty area





Instructors Biographies

Jerry Haber: ACTA Inc. Operations Manager and Program Manager for Flight Safety operations for two U.S. Navy Ranges and Air Force Access to Space Office

Mr. Haber's career in Flight Safety and Risk Analysis spans more than three decades. During this time he has (1) developed new models for assessing risks from launch and reentry operations, (2) performed risk analyses for a wide variety of space-lift vehicles and missile launches, and (3) provided technical management and leadership for the development of standards for risk acceptability and flight safety criteria to implement these standards.

He has been a leader in improving the modeling of the vulnerability of unsheltered and sheltered people. He has been a leader of U.S. efforts to develop nationwide common risk acceptability standards. He successfully introduced the concept of risk profiles at these workshops as a tool for managing catastrophic risk. He led the formulation of the acceptable risk criteria and rationale and risk assessment paradigm for the first U.S. National Flight Safety risk acceptability standard (RCC 321).

Mr. Haber is an Associate Fellow of the IAASS, a Senior Member of the AIAA, and a member of the U.S. National Research Honorary, Sigma Xi. He is listed in *Who's Who in Risk Management*.



Jerry Haber



Paul Wilde

Paul Wilde: ACTA Inc Manager of Texas operations for ACTA Inc, and licensed Professional Engineer

He has 18 years of aerospace engineering experience in Flight Safety and Risk Analysis including launch and reentry safety evaluations, trajectory analysis, explosive safety, operational support, and standards development.

He has performed leading roles for multi-organization projects in high-profile situations, such as (1) developing the Columbia Accident Investigation Board (CAIB) report section on public safety, (2) performing as the principal technical representative at the CAIB for the foam impact tests, (3) writing five chapters of the national standard on risk acceptability for launch and reentry hazards (RCC 321), (4) leading the development of national safety requirements for space launches as the co-chair of the Common Standard Working Group (FAA, NASA, USAF), (4) performing flight safety evaluations for the maiden launches of the Atlas V, Delta IV, Spaceship 1, Titan IVB and other innovative space flight operations, (5) developing the glass breakage consequence models used in many flight safety and explosive safety tools.

Dr. Wilde is a Fellow and serves on the executive board of IAASS



Instructor Contact Information

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Registration

- **Course Date:** 16-18 October 2008
 - **Time:** Starting 8.30 hrs, Thursday 16 October; ending 17.30 hrs, Saturday 18 October
 - **Location:** ESA/ESRIN
 - **Address:** Via Galileo Galilei, Frascati (Roma), Italy
 - **Registration on-line:** www.congrex.nl/08a11
 - **Registration Fee:** Euro 1350 (before 1 October 2008; afterwards Euro 1450)
 - 10% discount for IAASS individual members
 - Registration fee due upon registration
 - Participants number limited to 30 students (early registration recommended)
- If less than 15 students enroll the course may be cancelled*
- **Contacts:** ESA Conference Bureau
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