A Discussion of the Last Flight of X-31A Aircraft#1

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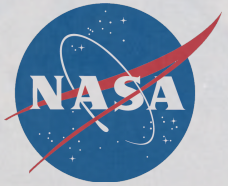
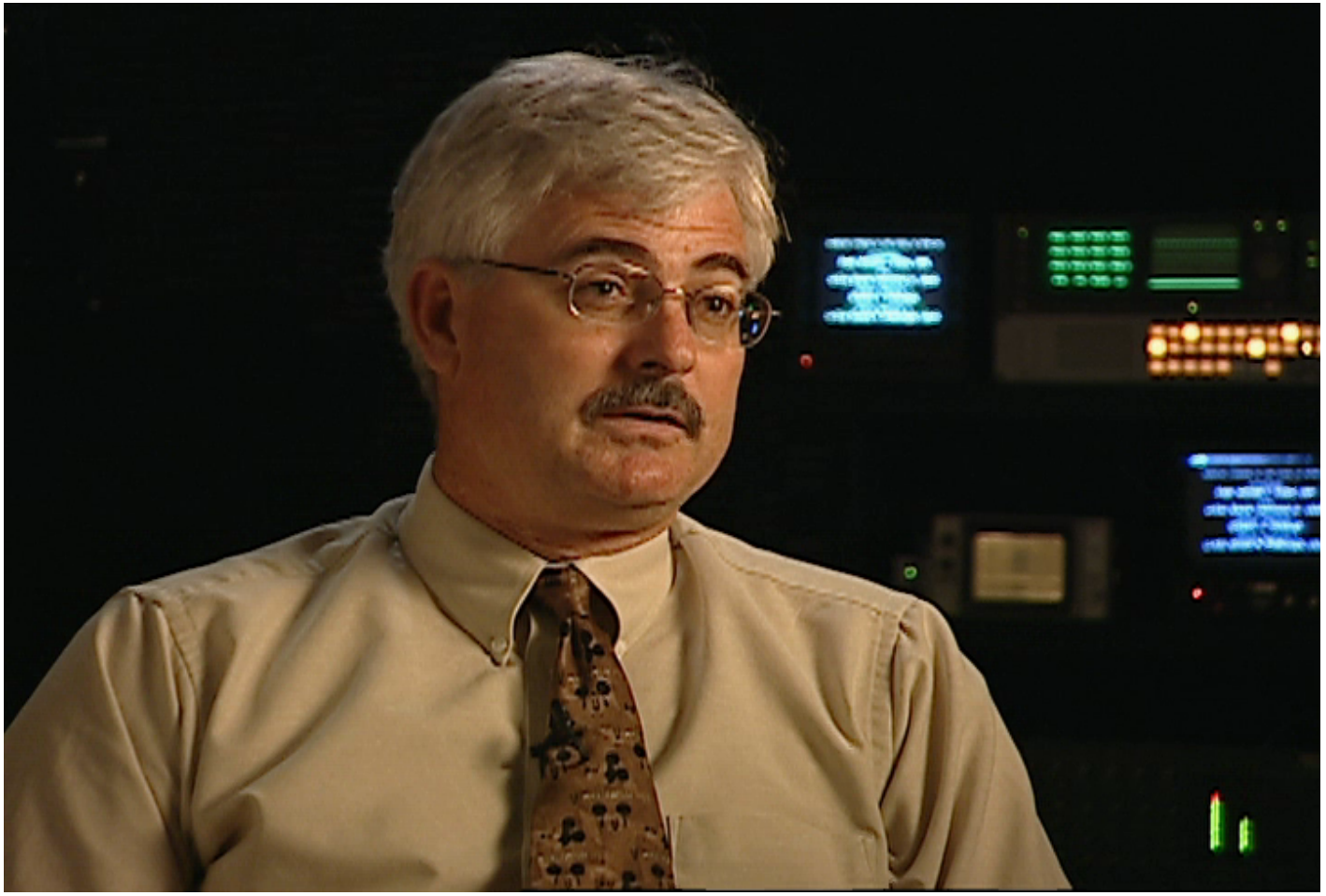


As most of you know the flight did not end well

The X-31A had flown lots of flights



X-31Enhanced Fighter Maneuverability

- The original goal of the X-31 Aircraft was to demonstrate the feasibility and advantage of post-stall maneuverability using thrust vectoring to provide precise control up to 70° angle-of-attack
- Requirement was for unlimited maneuverability

Envelope Expansion

- Aircraft began operations from Palmdale, conducting initial envelope expansion up to 30° AOA
  - 110 flights conducted between the two aircraft
- The flight envelope was expanded to 70° AOA after moving to Dryden
  - Started with 1g entries
  - Proceeded to elevated g entries, followed by abrupt stick inputs
  - Approximately 171 flights

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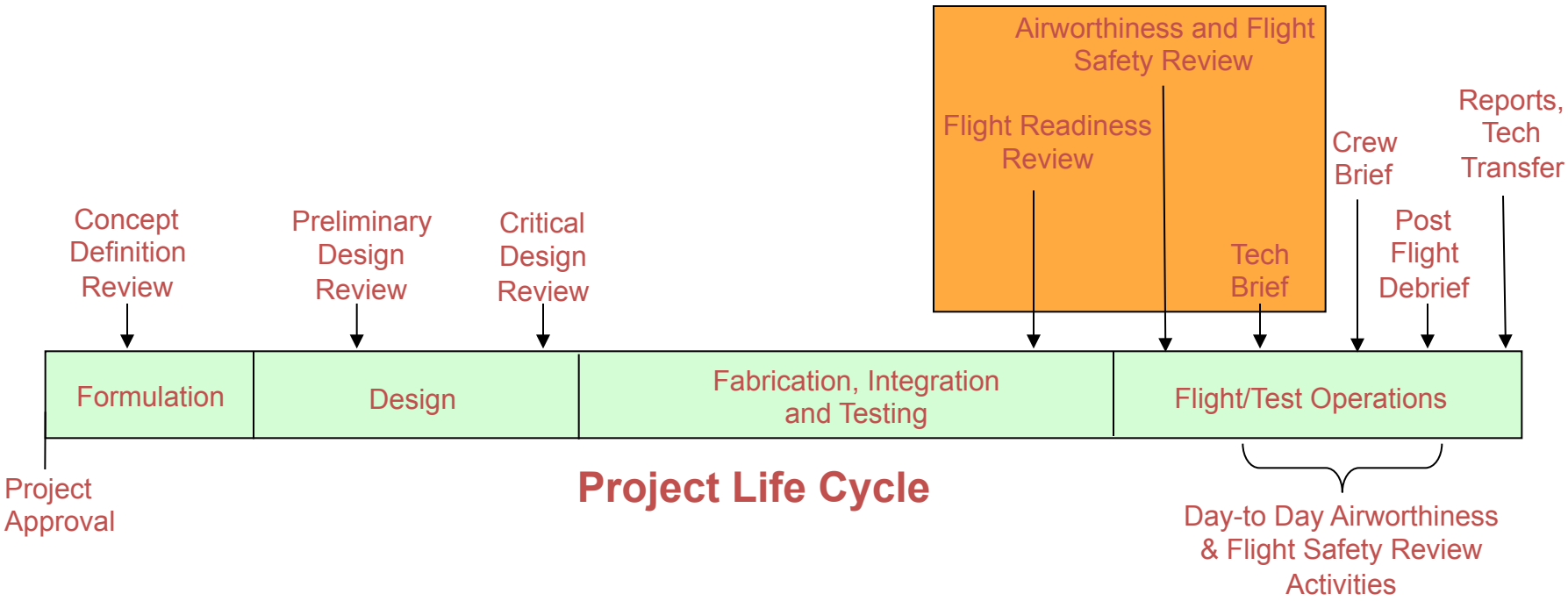
Flight Research Flights

- Aircraft performed approximately 210 flights related to close-in-combat
  - Basic Fighter Maneuvers
  - One versus one with NASA F-18, Navy F-14, Air Force F-15 and F-16 aircraft
  - Helmet mounted display evaluation
  - Standard Evaluation Maneuvers for high angle-of-attack handling qualities
- Approximately 40 Quasi-tailless experiment flights
- A number of flutter-test-box/parameter identifications flights
- 522 flights had been completed by January 19, 1995

January 19 was an ordinary flying day

Dryden Airworthiness and Flight Safety Review Process



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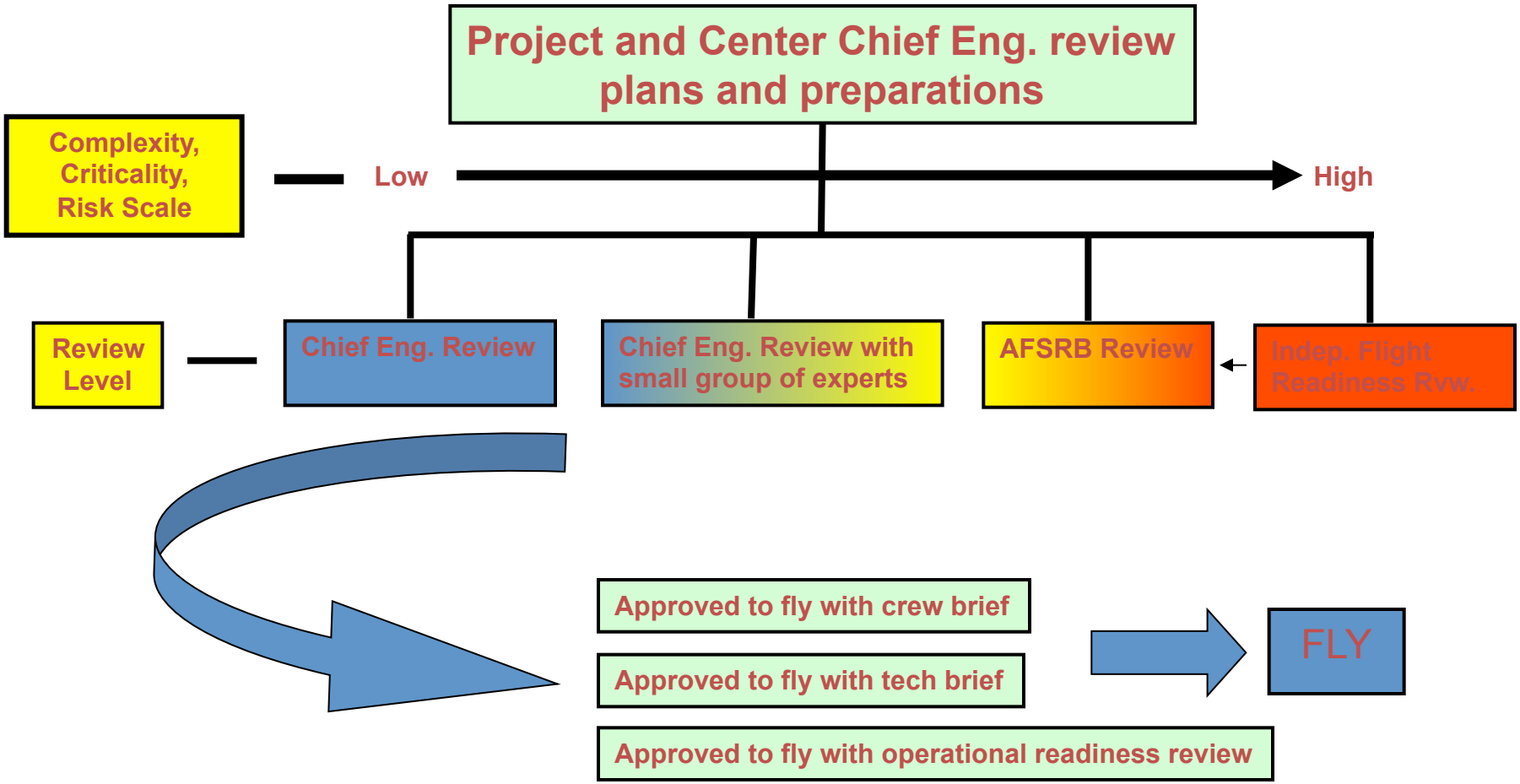
FRR/AFSRB Flexibility



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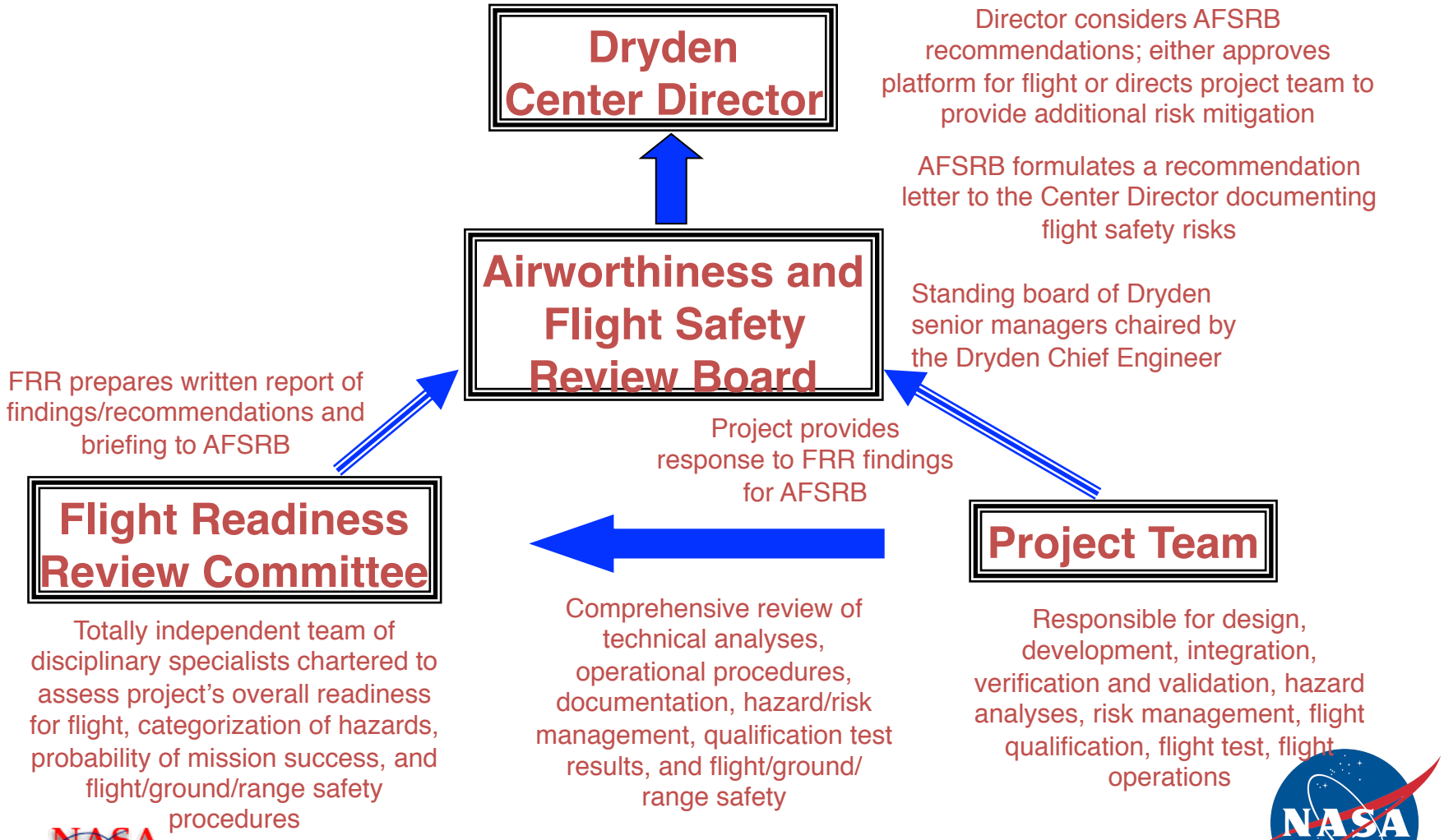
Airworthiness and Flight Safety Review Process



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What gets covered in a Tech Brief?

- Review of past flight conduct and results
- Objectives of proposed flight or flight block
- Flight Plan
- Aircraft Status
  - Maintenance Status
  - Instrumentation Status
- Configuration
  - Configuration Changes
  - Open Waivers
- Control Room Operations
- Hazard Review
  - List all Hazards
  - Hazard Action Matrix
- Mandatory Mission Requirements
  - Go/No Go List
  - Mission Rules
  - Weather Constraints
  - Operating Limitation
  - Emergency Procedures
- Dryden range, facility and information technology requirements

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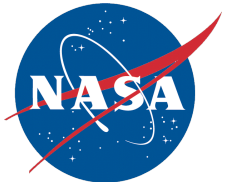
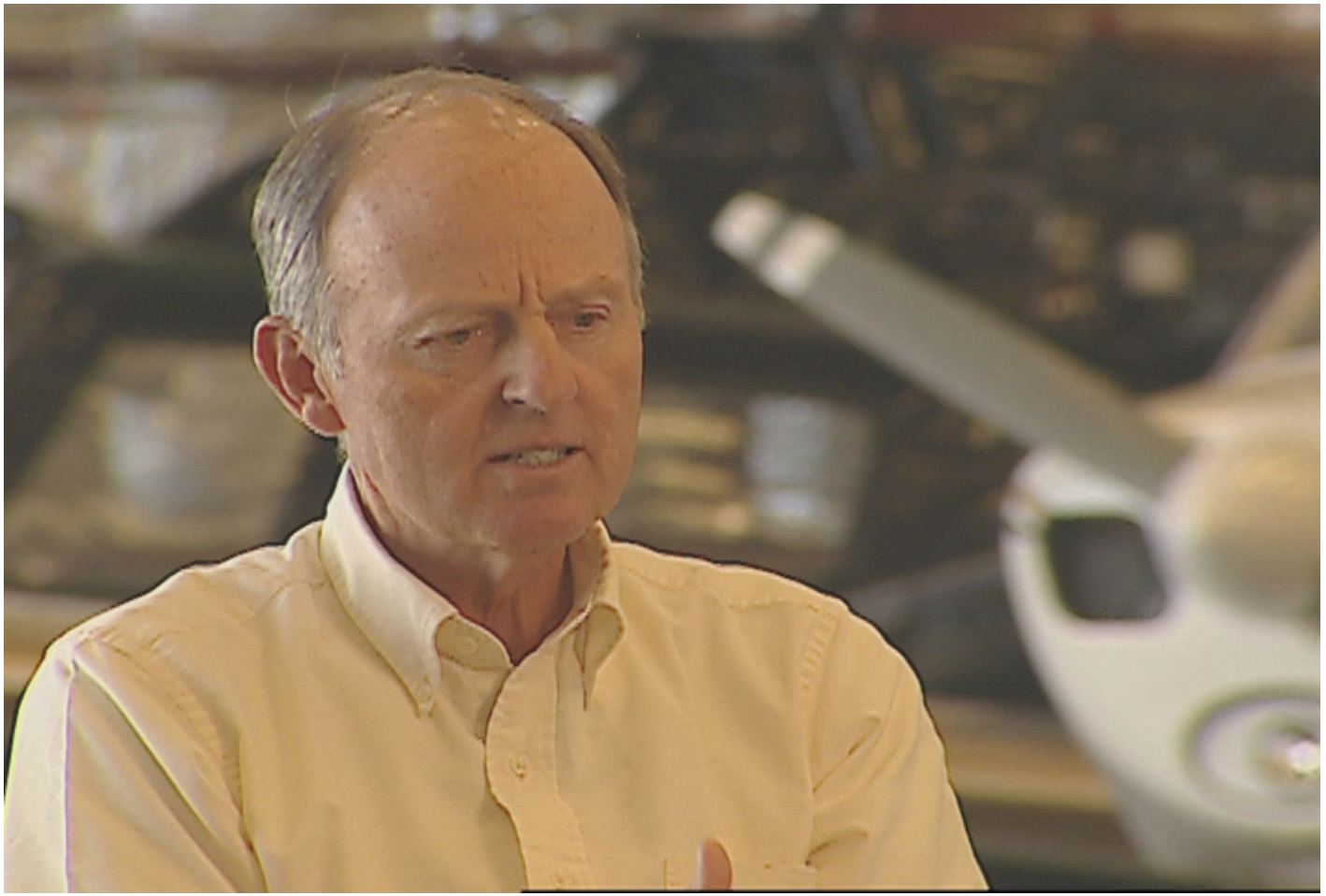
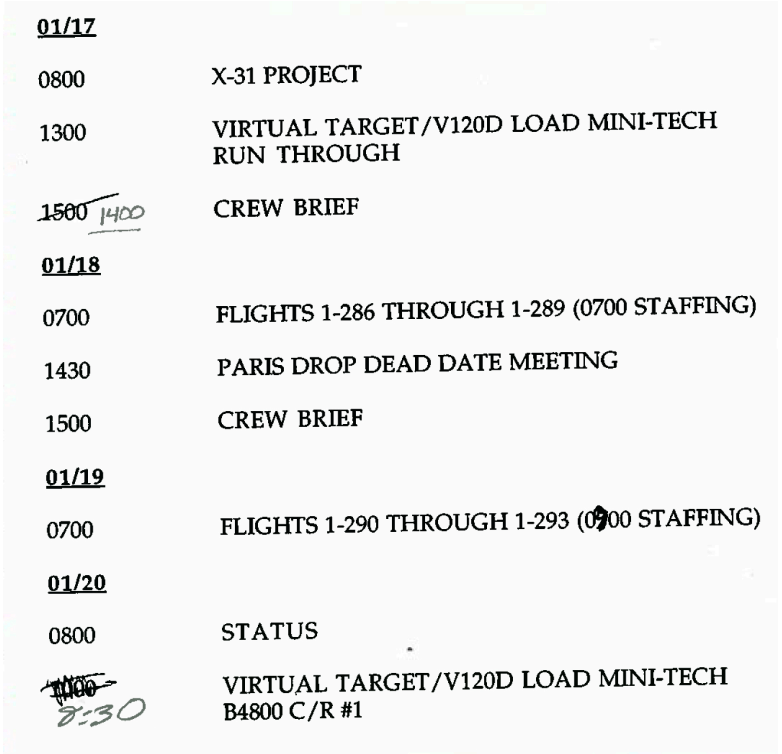


There are no perfect processes



Preparing for the Final block of Flights

- The aircraft was in a block of routine flights
  - High angle-of-attack flying qualities flights had just been completed
  - A Tech Brief was held prior to Dec 6, 1994 presenting a flight block for a series of Quasi-tailless and parameter identification flights
  - A mini-Tech brief was held Dec 14, 1994 for a minor software revision
  - A crew brief was held January 18



01/17	
0800	X-31 PROJECT
1300	VIRTUAL TARGET/V120D LOAD MINI-TECH RUN THROUGH
~~1500~~ 1400	CREW BRIEF
01/18	
0700	FLIGHTS 1-286 THROUGH 1-289 (0700 STAFFING)
1430	PARIS DROP DEAD DATE MEETING
1500	CREW BRIEF
01/19	
0700	FLIGHTS 1-290 THROUGH 1-293 (0700 STAFFING)
01/20	
0800	STATUS
~~1000~~ 8:30	VIRTUAL TARGET/V120D LOAD MINI-TECH B4800 C/R #1

Crew Brief Contents

- Mission Specific Items
  - Pilot assignments
  - Review of Flight Cards
  - Aircraft Frequencies
  - Weather
- January 18th we briefed three flights
  - Two Quasi-tailless ground attack using the ATLAS light system
  - One parameter Identification Flight
    - Up to 40° AOA, 20kft
  - We discussed the weather and the need to stay out of visible moisture and stay below the clouds

Weather Conditions for the day of Flight

Lesson Learned on Mission Rules

- The X-31A had a Mission rule precluding flight in visible moisture.
- The X-31A SHOULD have had a mission rule precluding flight in visible moisture or icing conditions
- I know of one program that had a mission rule precluding flight below 5000 ft AGL
  - How are you going to land?

- Make sure the mission rules concise and make sense.

January 19th Mission Day

- Flight 1-290 took off at 9:40am, landed at 10:22am
- Flight 1-291 took off at 11:42am, landed at 12:29pm
- Flight 1-292 took off at 1:46pm
  - One parameter identification maneuver at 40°AOA, the remainder of the maneuvers were at 10-20° AOA
  - During the flight, engineers and pilots noted inconsistencies between airspeed and angle of attack
    - They were not adequately discussed on the intercom
  - The pilot reported turning on pitot heat
    - Message that there was no pitot heat did not get transmitted to the pilot promptly
  - Could not complete the last Parameter ID input
  - Aircraft departed controlled flight during Return to Base checklist

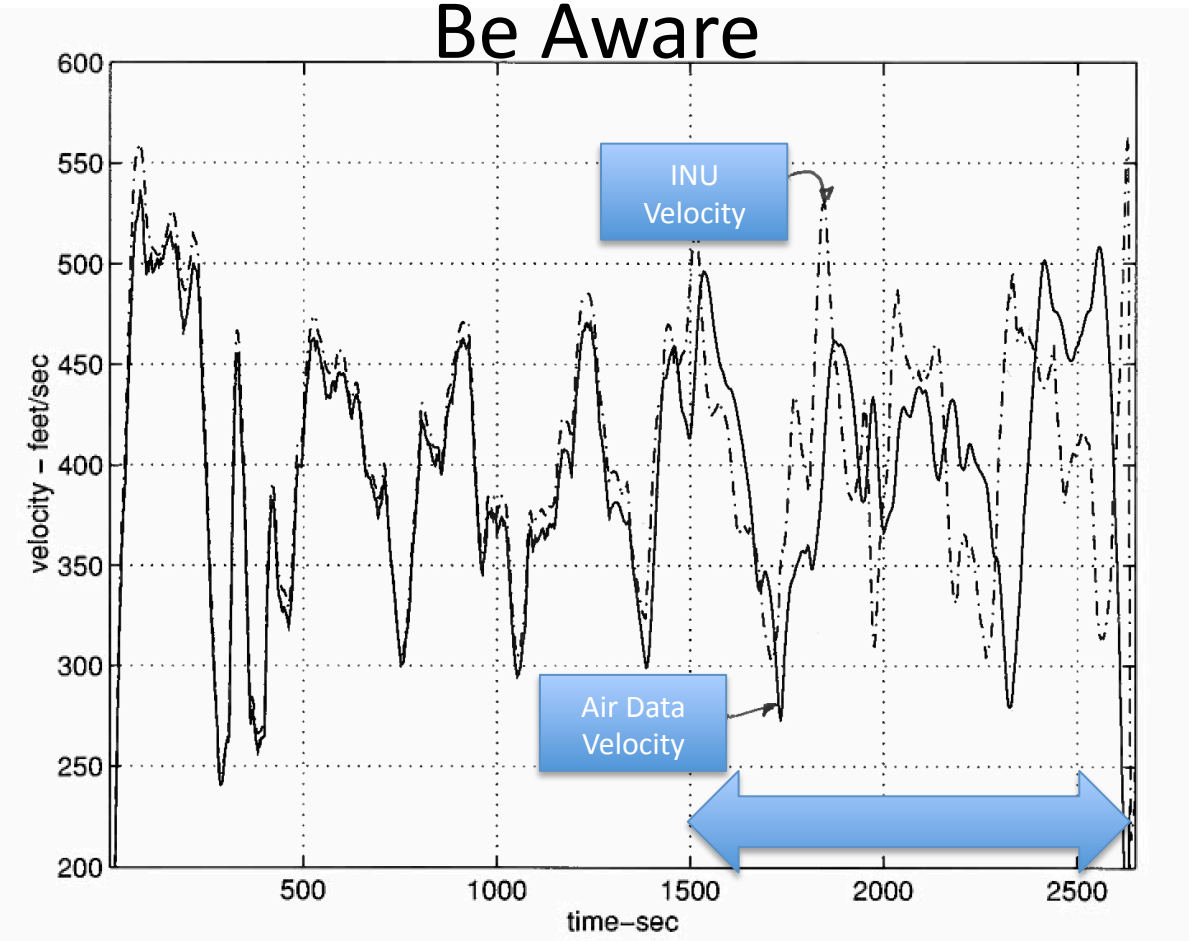
Speak up when something is not right!

Lesson Learned on Vigilance

- You can't treat every flight like a first flight, but you can treat every flight as an important flight.
- Retain control room discipline
  - In terms of monitoring systems until the airplane has landed
  - Identifying anomalies
  - Proper Control room communications on the network
  - And relaying information to the pilot
- Proper cockpit markings
  - Pitot heat should have been marked inoperative
  - Kiel probe had been on the airplane for 300 flights!

Flight Test is about being Prepared

Be Aware



Data plotted on January 24, 1995. Airspeed measurements between the Inertial Navigation System and Air Data began diverging 20 minutes before the mishap!!

Paris Air Show