

A photograph of the Space Shuttle Discovery on the Mobile Launcher Platform (MLP) at night. The MLP is illuminated from below, highlighting the white orbiter and the large orange external tank and white solid rocket boosters. The orbiter has "United States" and "Discovery" written on its side. The MLP is being moved along a crawler-transporter. In the background, the launch complex is visible with various lights and structures under a dark night sky.

Countdown to Safety

www.MikeMullane.com

Riding Rockets, a memoir by Mike Mullane

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070

















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A background image showing a view of Earth from space, with the blue atmosphere and white clouds of the planet visible against the blackness of space. The perspective is from an orbital altitude, looking down at the curved horizon of the Earth.

Safety Fundamentals:

Guard yourself against ‘normalization of deviance’.

Embrace responsibility and accountability.

Normalization of Deviance

Diane Vaughan, 'The Challenger Launch Decision'

**Getting away with short-cutting
safety best-practices until that
'deviance' becomes your 'norm'.**

PRESSURES:

JOB PRESSURES

FAMILY WORRIES

RELATIONSHIP ISSUES

FINANCIAL CONCERNS

HEALTH CONCERNS

FATIGUE

Normalizing deviance leads to...

...your worst nightmare.

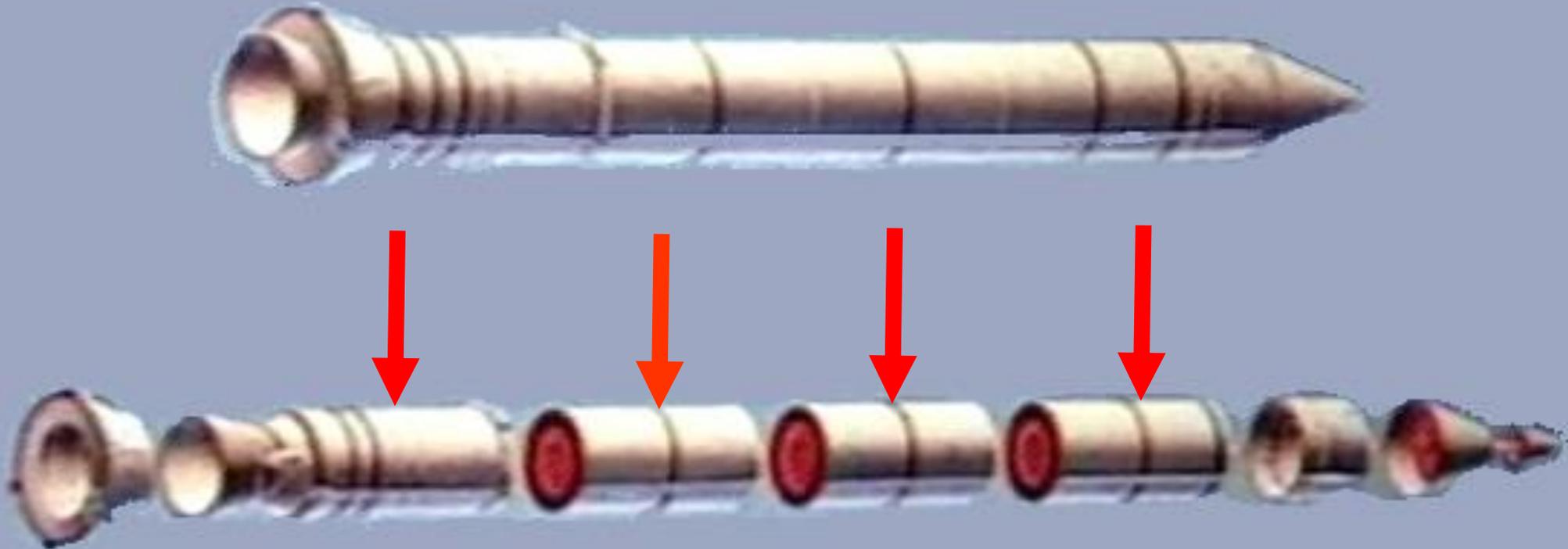
Injuries and Fatalities



**Challenger was a predictable
surprise precipitated by a four
year normalization of deviance.**

Solid Rocket Boosters

46m length; 3.7m diameter; 590 metric tons



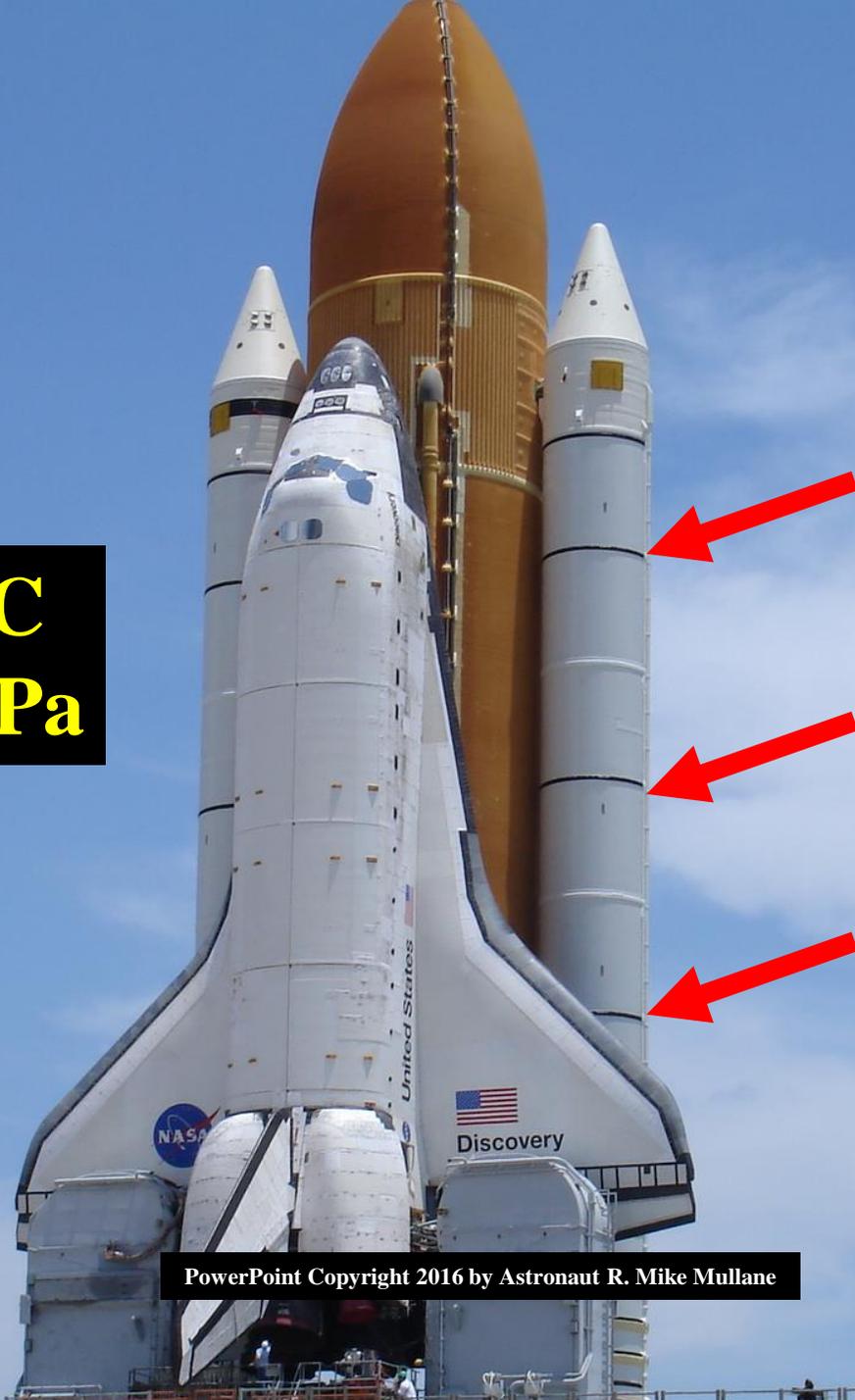


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2700 C
6900 kPa

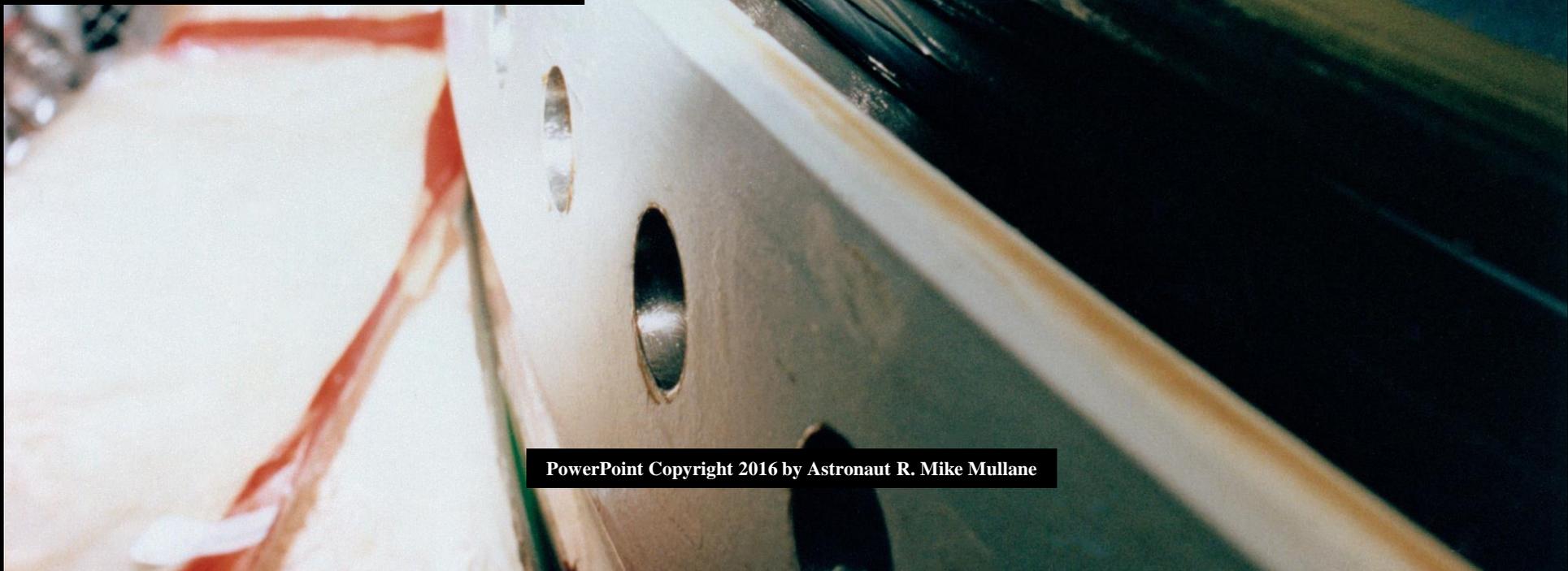




.64cm thick x 3.7m diameter O-ring



Redundant O-rings









A photograph of the Space Shuttle Challenger during launch. The shuttle is ascending vertically against a clear blue sky. A large, billowing plume of white smoke and vapor is trailing from the right Solid Rocket Booster, indicating a significant leak. The orbiter and external tank are visible in the center, surrounded by the exhaust from the main engines.

Predicament: Accident or Surprise

Diane Vaughan, ‘The Challenger Launch Decision’

A background image of the Space Shuttle Challenger being launched, with a large plume of white smoke and fire from the engines. The shuttle is positioned in the center of the frame, ascending vertically against a clear blue sky. The text is overlaid on this image in black boxes with white text.

**Burned O-rings found on 12 of 24
pre-Challenger missions.**

STS-2 Four years prior to Challenger

Thiokol memo dated July 31, 1985
(6 months prior to Challenger)

“It is my honest and very real fear...we stand in jeopardy of losing a flight, (a crew) and all the launch pad facilities.”



Predictable Surprise

Diane Vaughan, “The Challenger Launch Decision”

Hazard Recognition and Mitigation

SRM CRITICAL ITEMS LIST Sheet: 1 of 2

Criticality Category: 1 Criticality Category 1 Reaction Time immediate to Sec.

Item Code 10-01-01 Page A-6A

*Case, P/N (See Retention Rationale) Revision: _____

Item Name (Joint Assys, Factory P/N 1U50147 Field: 1U50747

Failure Effects Summary:
Loss of mission, vehicle, and crew...

NOTE: Leakage of the primary O-ring seal is classified as a single failure point due to possibility of loss of sealing at the secondary O-ring because of joint rotation after star pressurization.

Failure Effect Summary Actual Loss - Loss of mission, vehicle, and crew due to metal erosion, burnthrough, and probable case burst resulting in fire and deflagration.

RATIONALE FOR RETENTION

Case, P/N 1U50129, 1U50131, 1U50130, 1U50185, ~~1U501473~~, 1U50715, 1U50716, 1U50717
1U51473

A. DESIGN

The SRM case joint design is common in the lightweight and regular weight cases having identical dimensions. The SRM joint uses centering clips which are installed in the gap between the tang O.D. and the outside diameter of the case to reduce the loss of concentricity due to gathering and to reduce the total clevis gap.

**Implied best-practice: Any O-ring
damage is a **GROUNDING** deviance.**

LAUNCH SCHEDULE PRESSURE

The Grand Plan for the Shuttle Program



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**Aircraft-like qualities of safety,
maintainability, reliability, etc.**



30,000 kg of payload





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The image shows the Space Shuttle Atlantis in flight, viewed from a side profile. The shuttle is white with black nose and wing leading edges. It has the NASA logo and "United States" with an American flag on the side. The name "Atlantis" is visible on the nose. The shuttle is flying over a body of water with a forested shoreline in the background.

Share Costs with DoD

Sell launch services to:

Communication Satellite Market

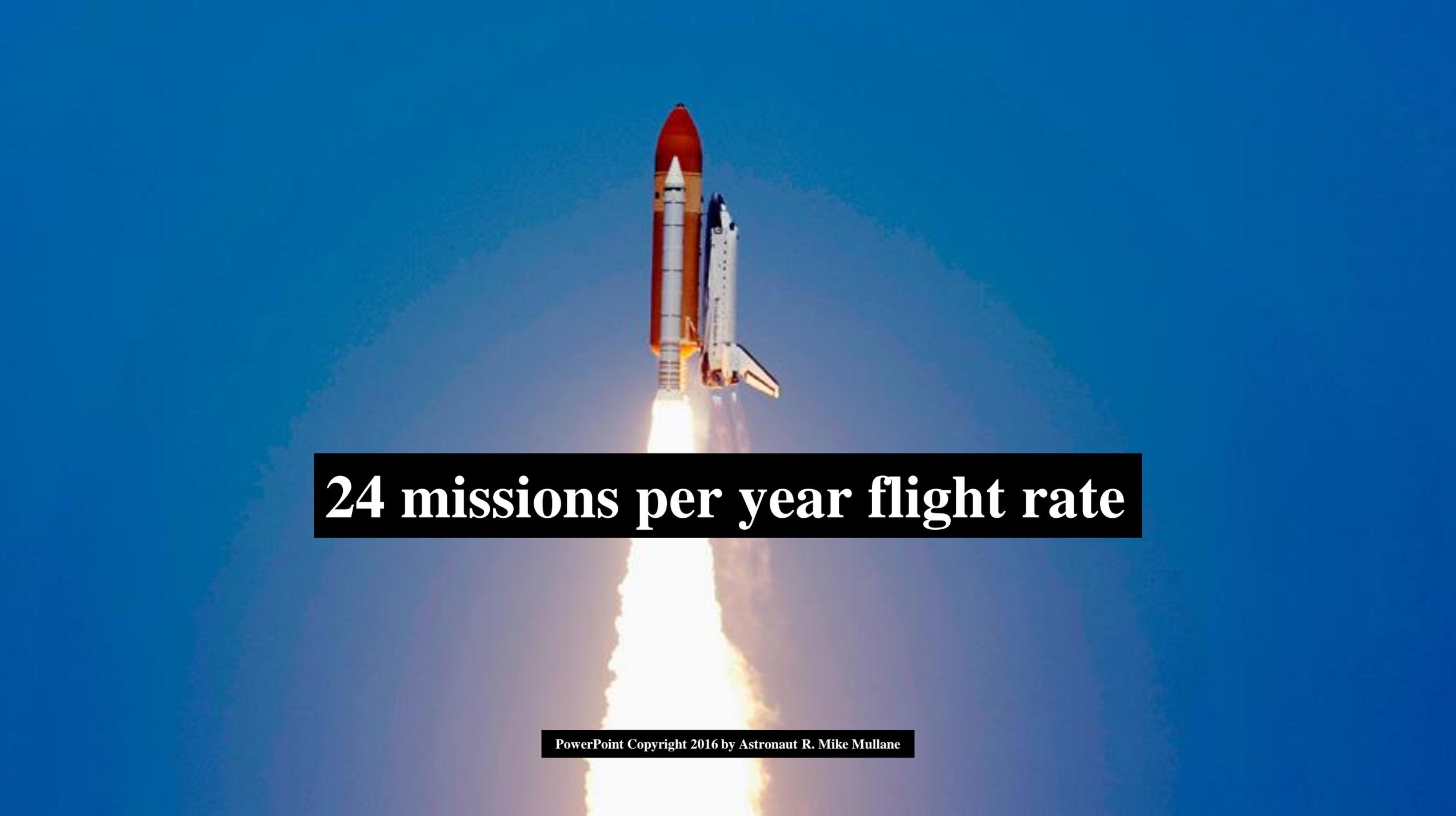
STS-132
5-26-10
Larry Tanner

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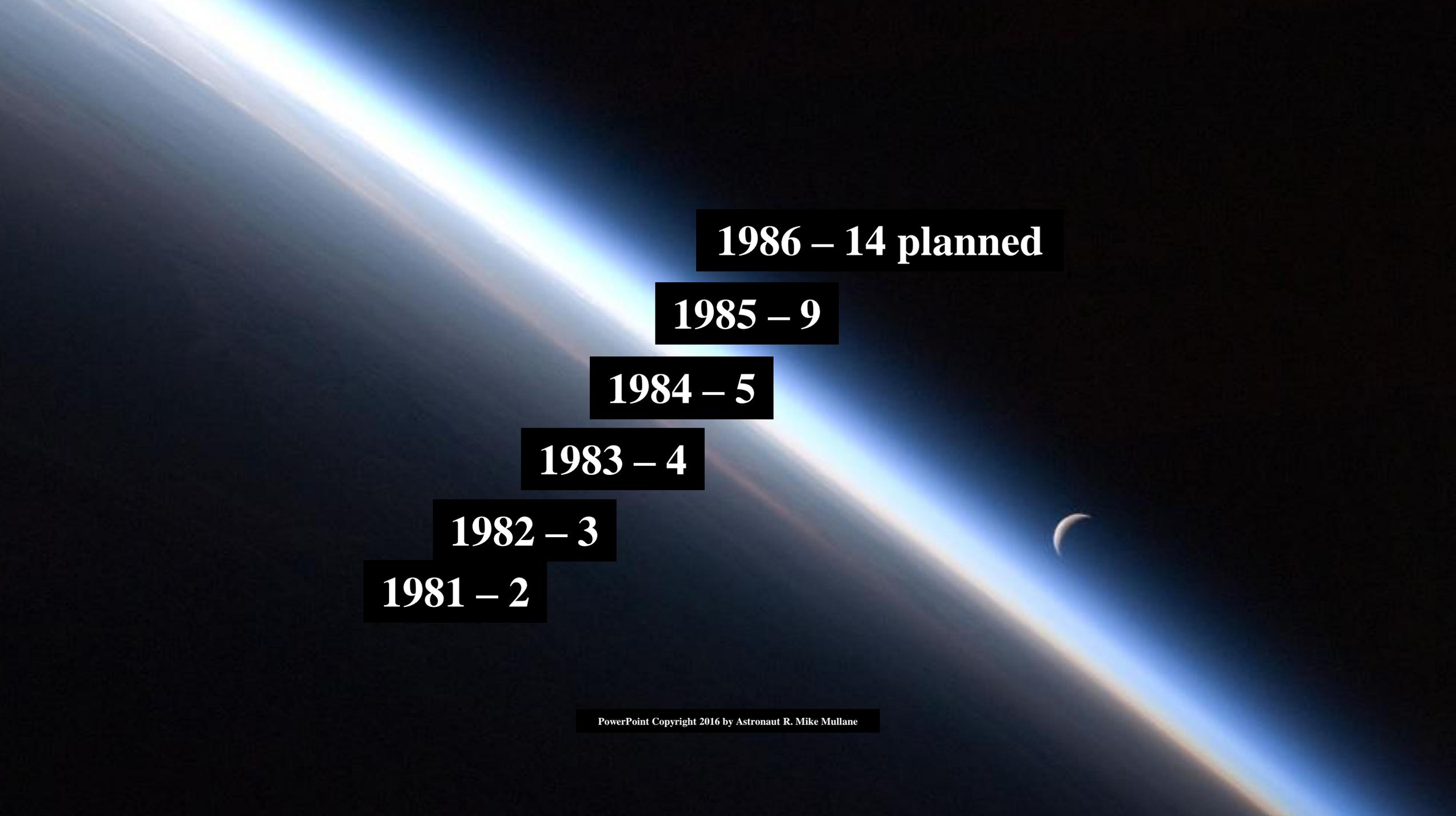
A photograph of a space shuttle launch. The shuttle is ascending vertically, leaving a massive, billowing plume of white and yellow smoke and fire. The launch pad structure is visible at the base, and a tall water tower stands in the background. The sky is a clear, deep blue. Overlaid on the image is a black rectangular box containing the word "BUSINESS" in a bold, yellow, serif font.

BUSINESS



A photograph of the Space Shuttle Columbia during launch, ascending vertically against a clear blue sky. The orbiter is attached to the external tank and solid rocket boosters. A large, bright plume of fire and white smoke trails behind the shuttle, extending from the bottom of the frame towards the orbiter. The shuttle is positioned centrally in the upper half of the image.

24 missions per year flight rate



1986 – 14 planned

1985 – 9

1984 – 5

1983 – 4

1982 – 3

1981 – 2

Roger's Commission Contractor Testimony:

“The problem was the increasing launch rate. We were just getting buried under all this stuff...The system was about to come down under its own weight...”

The background of the slide is a dark space scene. A bright, glowing light source, likely the sun, is positioned in the upper left, creating a lens flare effect that extends across the top and right sides of the frame. In the lower right quadrant, a thin crescent moon is visible against the dark background. The overall color palette is dominated by deep blues, blacks, and bright whites from the light source.

The Apollo era created an exceptional ‘can-do’ culture marked by tenacity in the face of seemingly impossible challenges.



“...NASA’s drive to achieve a launch schedule of 24-flights per year created pressure throughout the agency that directly contributed to unsafe launch operations.”

House Committee on the Challenger Disaster

The background of the slide is a dark space scene. A bright, glowing light source, possibly the sun, is positioned in the upper left, creating a wide, diagonal beam of light that stretches across the frame. In the lower right, a thin crescent moon is visible against the dark sky. The overall color palette is dominated by deep blues, blacks, and the bright white and yellow of the light source.

Schedule Pressure

Creeping Risk Tolerance



.13cm O-ring burn erosion found after STS-2



.25cm intentional cut holds 20,000 kPa pressure



A photograph of a space shuttle launch. The shuttle is ascending vertically, leaving a large, billowing plume of white smoke and steam behind it. The background is a clear, deep blue sky. The smoke plume is dense and textured, with some wispy trails extending upwards and outwards. The shuttle itself is partially visible at the bottom of the frame, with its external tank and boosters. The overall scene captures the power and scale of a major aerospace event.

Test results expanded the acceptable limits of O-ring performance.

The Challenger Launch Decision

“Between 1981 and 1984...Four times, an incident that first was seen as a deviant event, was reinterpreted as non-deviant...”

Normalization of Deviance



What do we learn from the Challenger disaster?

The background of the slide is a dark space scene. A bright, glowing light source, possibly the sun, is positioned in the upper left, creating a wide, diagonal beam of light that stretches across the frame. The light has a blue-white hue and a soft, ethereal glow. In the lower right quadrant, a small, thin crescent moon is visible against the dark background. The overall atmosphere is serene and contemplative.

LESSON 1:

You are vulnerable.



LESSON 2:

**Procedural compliance
should be a religion.**

“It only takes a moment.”

TAKEOFF.

1. Brakes — Release.
2. Throttles — MAX.
3. Instruments — Check.

AFTER TAKEOFF.

1. Landing Gear Lever — LG UP, when definitely airborne.
2. Wing Flap Lever — UP.

CLIMB.

- *1. Zero Delay Lanyard (if applicable) — Disconnect above 2000 feet AGL.
- *2. Oxygen System — Check.
- 3. Cabin Pressure — Check.
- 4. Canopy Defog and Cabin Temp — As Required.

LEVEL-OFF AND CRUISE.

- *1. Oxygen System — Check.
- 2. Cabin Pressure — Check.
- 3. Fuel Quantity — Check.
- *4. Altimeter — Reset as required, check STBY and return to RESET.

DESCENT.

- B*1. Armament Safety Check — Completed.
- B*2. Reticle Intensity Knob — OFF.
- *3. Helmet Visors — As Required.
- 4. Canopy Defog, Cabin Temp — As Required.
- 5. Pitot Heat, Engine Anti-Ice — As Required.
- *6. Altimeter — Reset as required, check STBY, and return to RESET.
- *7. Fuel Balance — Check.
- 8. Crossfeed — OFF.
- 9. Landing and Position Lights — As Required.
- *10. Zero-Delay Lanyard (if applicable) — Attach above 2000 feet AGL.

BEFORE LANDING.

- *1. Pattern Airspeeds — Compute.
- *2. Gear — Down & Check Down.
- *3. Hydraulic Pressures — Check.
- *4. Flaps — As Required.

GO-AROUND.

1. Throttles — MIL (MAX if necessary).
2. Landing Gear Lever — LG UP, when definitely airborne.
3. Wing Flap Lever — UP.

AFTER LANDING.

1. Pitot Heat — OFF.
- *2. Cockpit Loose Items — Check Secured (before opening canopy).
- *3. Seat and Canopy Safety Pins — Install.
- *4. HBU Interim Anchor Hook (if applicable) — Detached.

LESSON 3:

Risk has no memory.

**Risk is not diminished as a function
of your success in taking the risk.**

LESSON 4:

There are no inconsequential shortcuts from safety best practice compliance.

False feedback: The risk isn't 'absolute' as previously learned, but rather it's 'manageable'.

The background of the slide is a dark space scene. A bright, glowing light source, likely the sun, is positioned in the upper left, creating a wide, diagonal beam of light that stretches across the frame. The light has a soft, ethereal quality with some lens flare effects. In the lower right quadrant, a small, thin crescent moon is visible against the dark background. The overall mood is one of vastness and aspiration.

LESSON 5:

Set challenging but attainable goals.



Responsibility & Accountability

STS-132
5-26-10
Larry Tanner

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POSITION

LONGEVITY

LESSON 1:

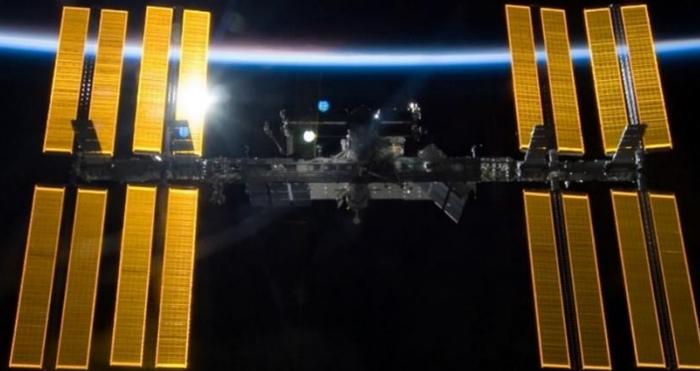
**The responsibilities of your job are non-transferable.
OWN them!**

See something...Say something...Do something.

LESSON 2:

“One person with courage forms a majority.”

author unknown



You count!

LESSON 3:

Value each other.

Take each others' backs.

“It only takes a moment.”



LESSON 4:



Leaders: Empower your teams!



No crew escape system.



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Cockpit



Cockpit







ESCAPE ROCKET

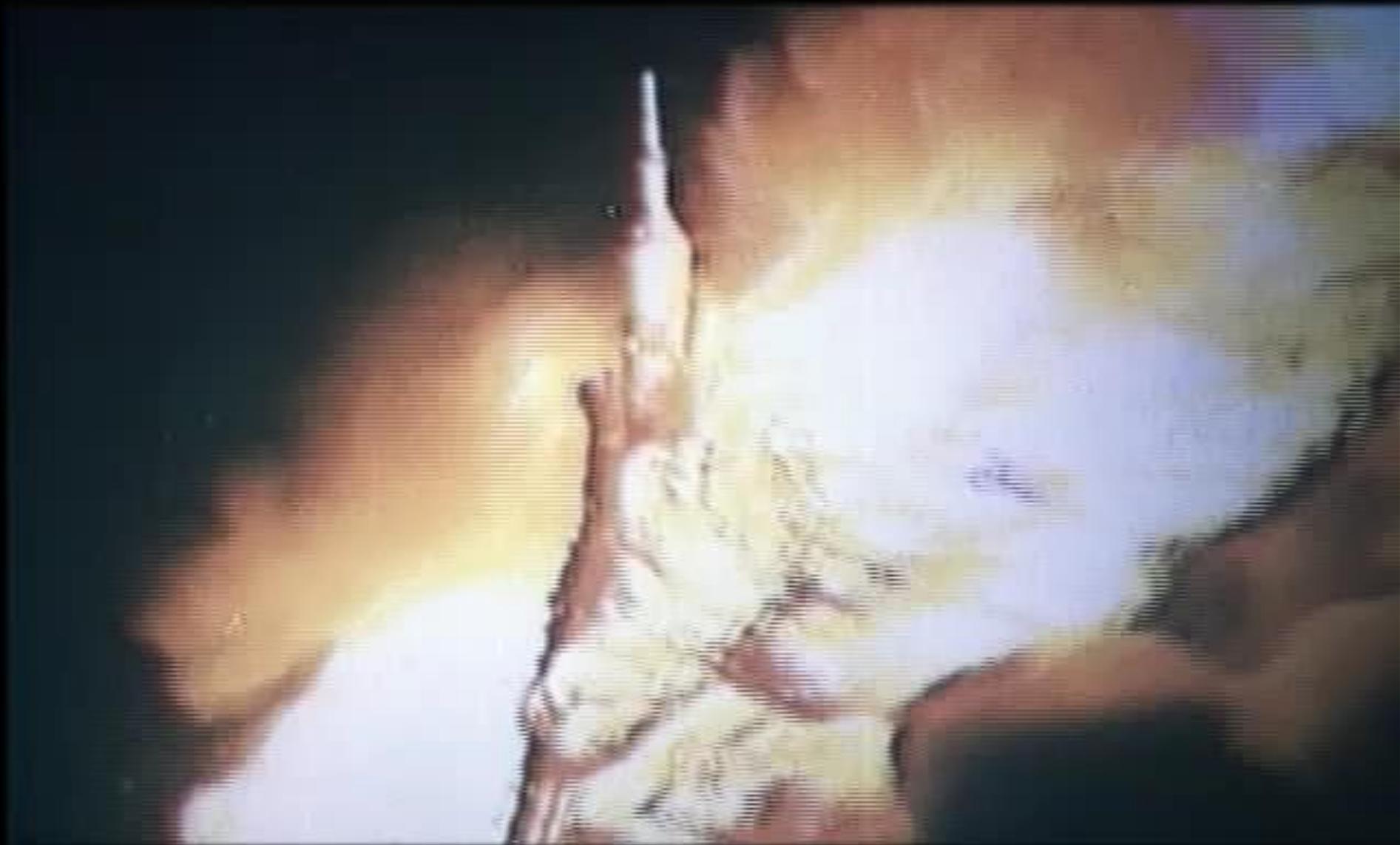






Russian Rocket

ESCAPE ROCKET





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Discovery











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LESSON 5:

Pre-brief hazardous operations.

Maintain situational awareness.

“It only takes a moment.”

LESSON 6:

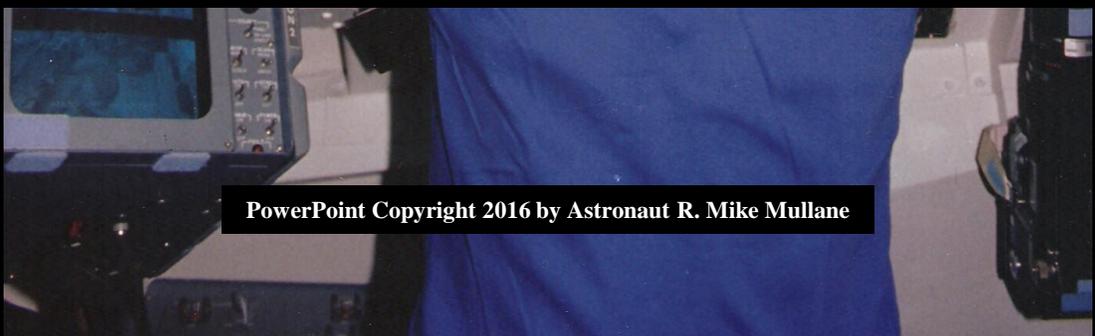
With responsibility comes accountability.

You own it. Own it to the good.

A photograph of astronaut R. Mike Mullane inside a space station module. He is wearing a blue polo shirt and smiling. Behind him is a window and a banner that reads "GO ARMY BEAT NAVY".

Launch Fever

With responsibility comes accountability.

A photograph of astronaut R. Mike Mullane in a space station module, wearing a blue polo shirt. He is standing in front of a control panel with various instruments and screens.

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**In hazardous work environments,
you don't get 'Do-Overs'.**

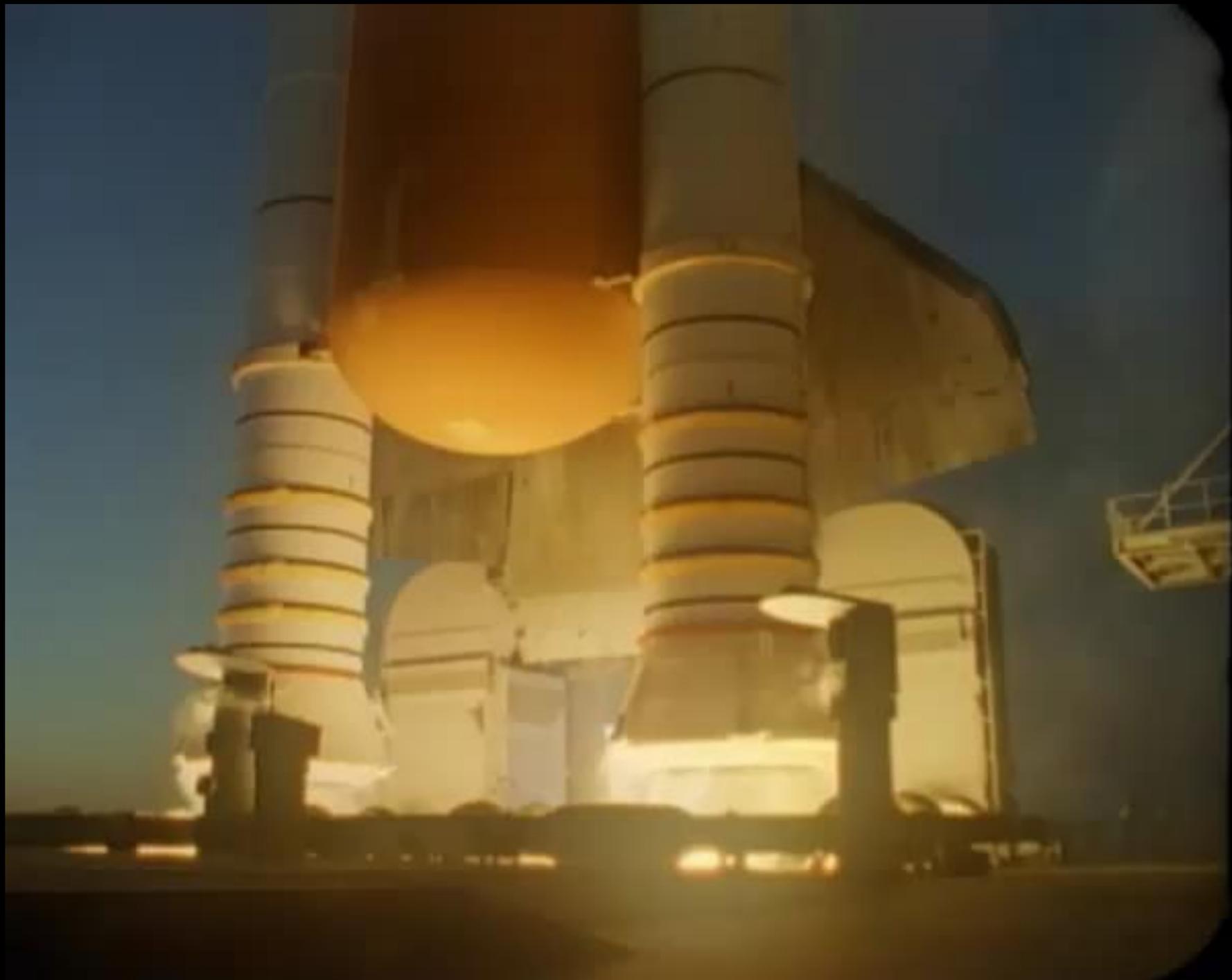
A background image showing a view of Earth from space, with blue oceans, white clouds, and brown landmasses. The perspective is from a high altitude, looking down at the planet.

Safety Fundamentals:

Guard yourself against ‘normalization of deviance’.

Embrace responsibility and accountability.

“It only takes a moment.”



A photograph of the Space Shuttle Discovery on the Mobile Launcher Platform (MLP) at night. The MLP is illuminated from below, highlighting the white orbiter and the large orange external tank and white solid rocket boosters. The orbiter has "United States" and "Discovery" written on its side. The background shows a dark night sky with some distant lights and a large crowd of people gathered on a grassy field, illuminated by bright spotlights. The overall scene is a dramatic and celebratory moment at a launch site.

Countdown to Safety

www.MikeMullane.com

Riding Rockets, a memoir by Mike Mullane

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A high-angle, wide-field photograph of Earth as seen from space. The image shows a vast expanse of blue oceans, white clouds, and brownish-green landmasses. The perspective is from a high altitude, looking down at the planet's surface. The lighting is bright, highlighting the textures of the clouds and the colors of the land and water.

MY LIFE STORY

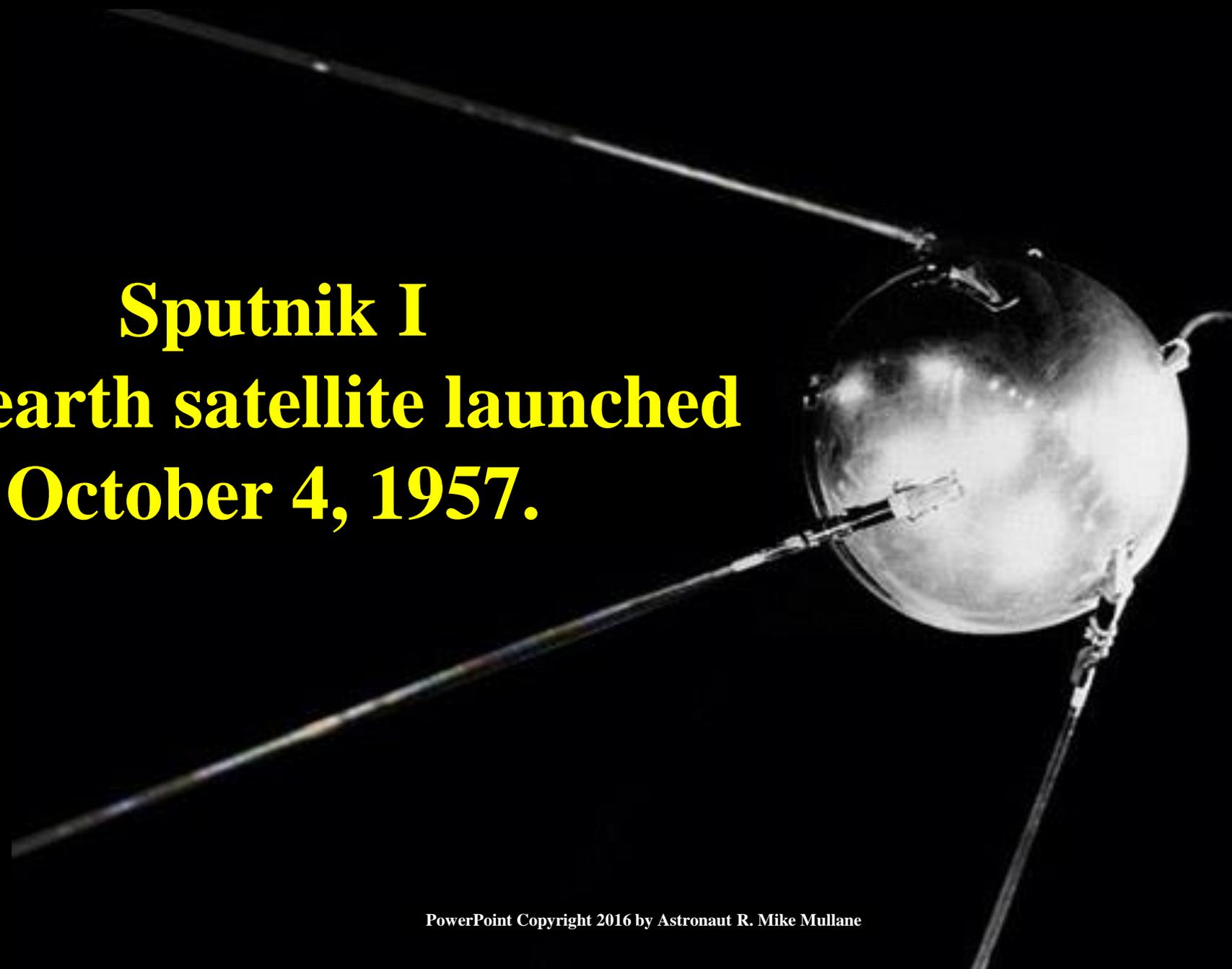
A background image of an astronaut in space, with the Earth's blue and white clouds visible on the left side. The astronaut is wearing a white spacesuit and is positioned in the center-right of the frame. The text is overlaid on this image.

Courageous Self-Leadership

Aggressive goal setting.

Tenacity in the pursuit of goal achievement.

Sputnik I
First earth satellite launched
October 4, 1957.



1960 Science Fair Rocket Project



Preliminary Report
1960 Science Project
Development of Biological Rocketsonde

Michael Mullane
St. Pius X High School

FORWARD

Today, this country and many others throughout the world are steadily working towards the conquest of space. Someday, I also plan to participate in this great undertaking. At present, I am trying to familiarize myself with the basic principles of rocketry and to gain as much knowledge and practical "know-how" in this field as possible. To do this, I have been working on a series of scientific projects. The first of these was the development of a capsule and a reliable recovery system. This project, "Instrument Recovery From High Altitude" was entered in the 1959 Science Fair. With the data collected from this project it is now possible for me to expand my 1960 project into the development of a **PowerPoint Copyright 2016 by Astronaut R. Mike Mullane** a monitoring and telemetry system.

FORWARD

Today (1960), this country and many others throughout the world, are steadily working toward the conquest of space.

Someday, I also plan to participate in this great undertaking.

Mike Mullane, age 14





MICHAEL
MULLANE
Nickname: Mike;
Baseball 2; Science
Fair 1,3; 1st School;
1st Regional; 2nd
State; Physics Club
4; Ambition; Attend
Air Force Academy

Attend Air Force Academy.

REPORT OF UNITED STATES MILITARY ACADEMY ENTRANCE EXAMINATION

FROM: The Adjutant General
Department of the Army
Washington 25, D. C.
Attn: Military Academy Section (AGPB-M)

DATE
22 APRIL 1963

TO: MR RICHARD M MULLANE
8602 LA SALA GRANDE NE
ALBUQUERQUE N M

SOURCE AND TYPE OF NOMINATION
THIRD ALTERNATE
N M AT LARGE
REP MONTOYA

RESULTS OF EXAMINATION WITH RESPECT TO QUALIFICATION		
ACADEMIC	PHYSICAL APTITUDE	MEDICAL
QUALIFIED	QUALIFIED	QUALIFIED

THIRD ALTERNATE

2. DISQUALIFIED FOR ADMISSION, as shown above (See Note 1 on Reverse Side).
3. QUALIFIED - NO VACANCY. You are fully qualified but there is no vacancy for your admission under the terms of your nomination. If your status changes for any reason, **YOU WILL BE NOTIFIED PROMPTLY.**
4. QUALIFIED - STATUS PENDING. You are fully qualified but your right to admission under the terms of your appointment depends upon the outcome of the presently undetermined status of the candidate, or candidates, ahead of you. **YOU WILL BE NOTIFIED AS SOON AS FINAL DETERMINATION IS MADE.**
5. MEDICAL RE-EXAMINATION AUTHORIZED. (Read Note 2 on Reverse Side) Should you desire a medical re-examination you are authorized to report as early as possible, **AND NOT LATER THAN**

Please fill out and return the attached form. Prior to reporting for re-examination, it is suggested you communicate with the hospital for an early appointment. Present indications of medical condition in paragraph 5 above.

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PLEASE EXHIBIT (BUT DO NOT RELINQUISH) THIS FORM WHEN YOU REPORT FOR RE-EXAMINATION

Varsity Club



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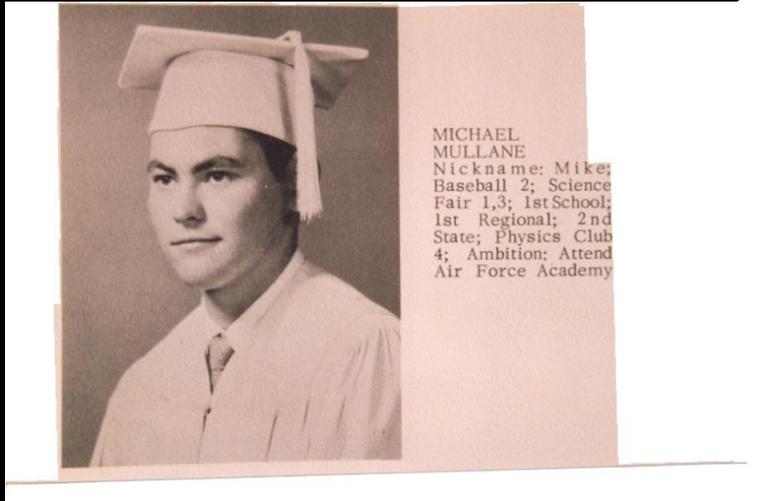
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Autographs

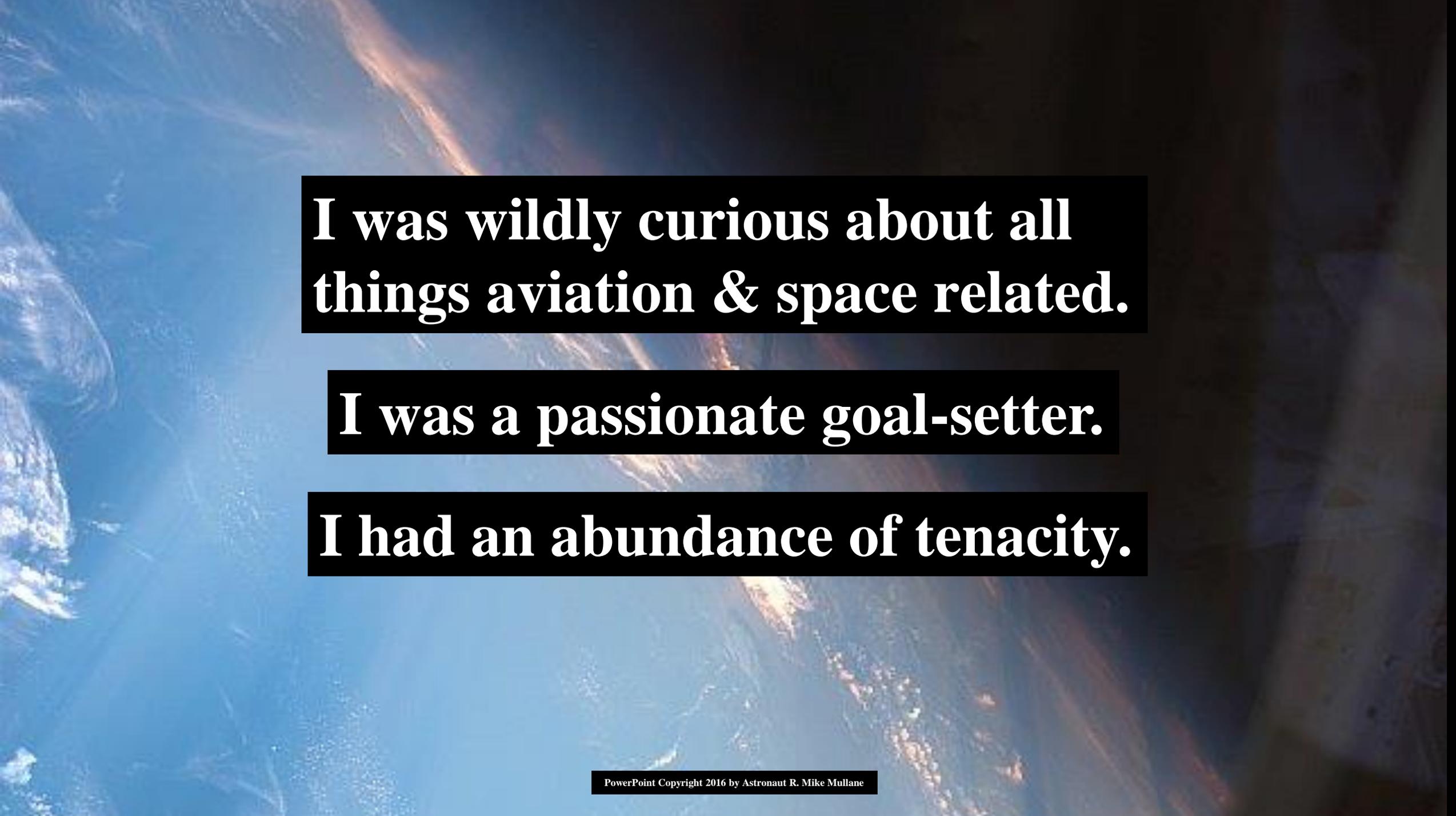
*You missed Korea but
here's hoping you make
Vietnam. Mac*

**You missed Korea, but here's
hoping you make Vietnam.**

?



MICHAEL
MULLANE
Nickname: Mike;
Baseball 2; Science
Fair 1,3; 1st School;
1st Regional; 2nd
State; Physics Club
4; Ambition: Attend
Air Force Academy

Astronaut R. Mike Mullane is shown in a dark space suit, floating in the vastness of space. The background is a deep blue, with a bright, glowing orange and yellow streak of light, possibly a meteor or a satellite, streaking across the upper portion of the frame. The astronaut's helmet and visor are visible, and the overall scene conveys a sense of exploration and adventure.

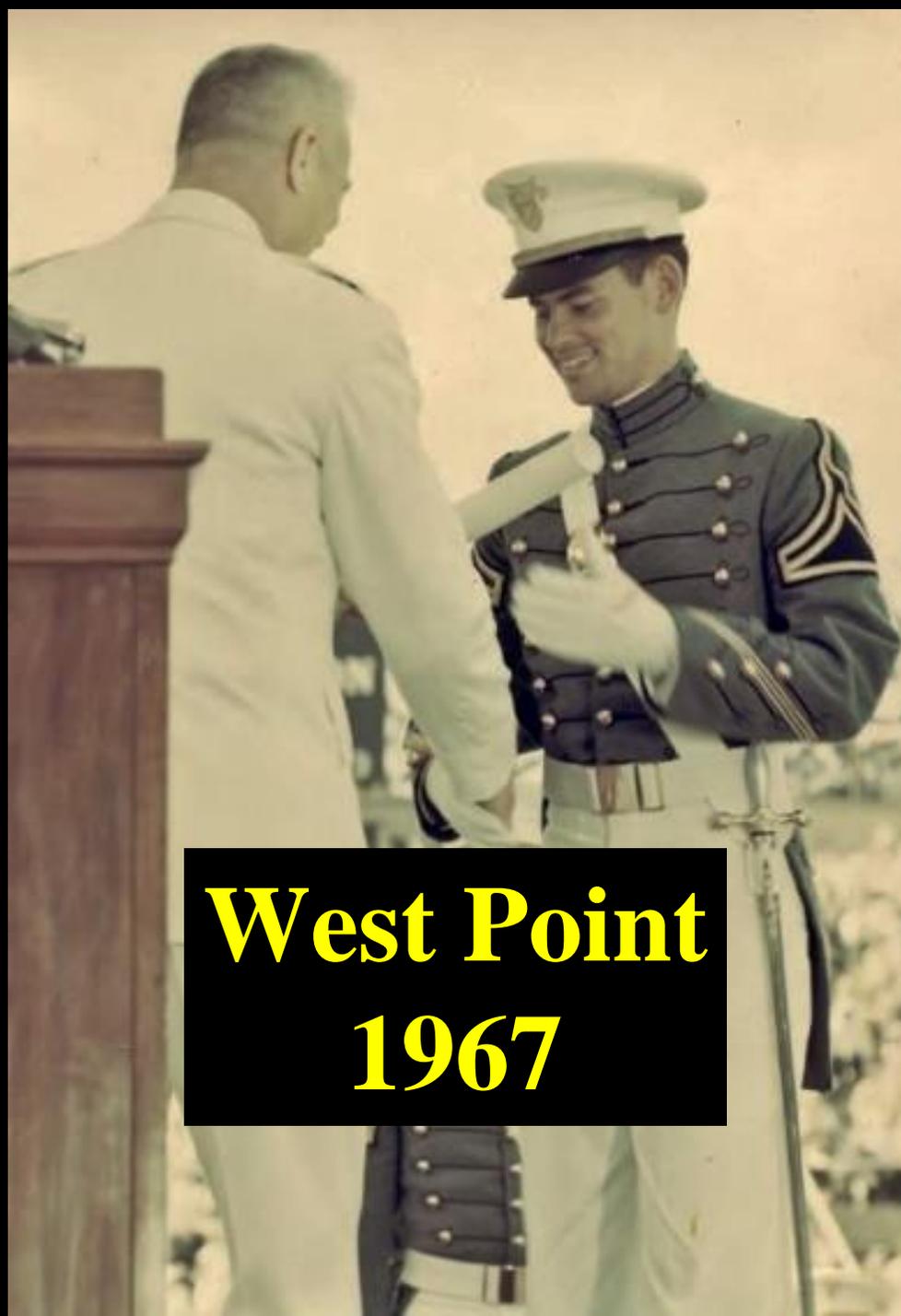
I was wildly curious about all things aviation & space related.

I was a passionate goal-setter.

I had an abundance of tenacity.

Courageous Self-Leader.





**West Point
1967**



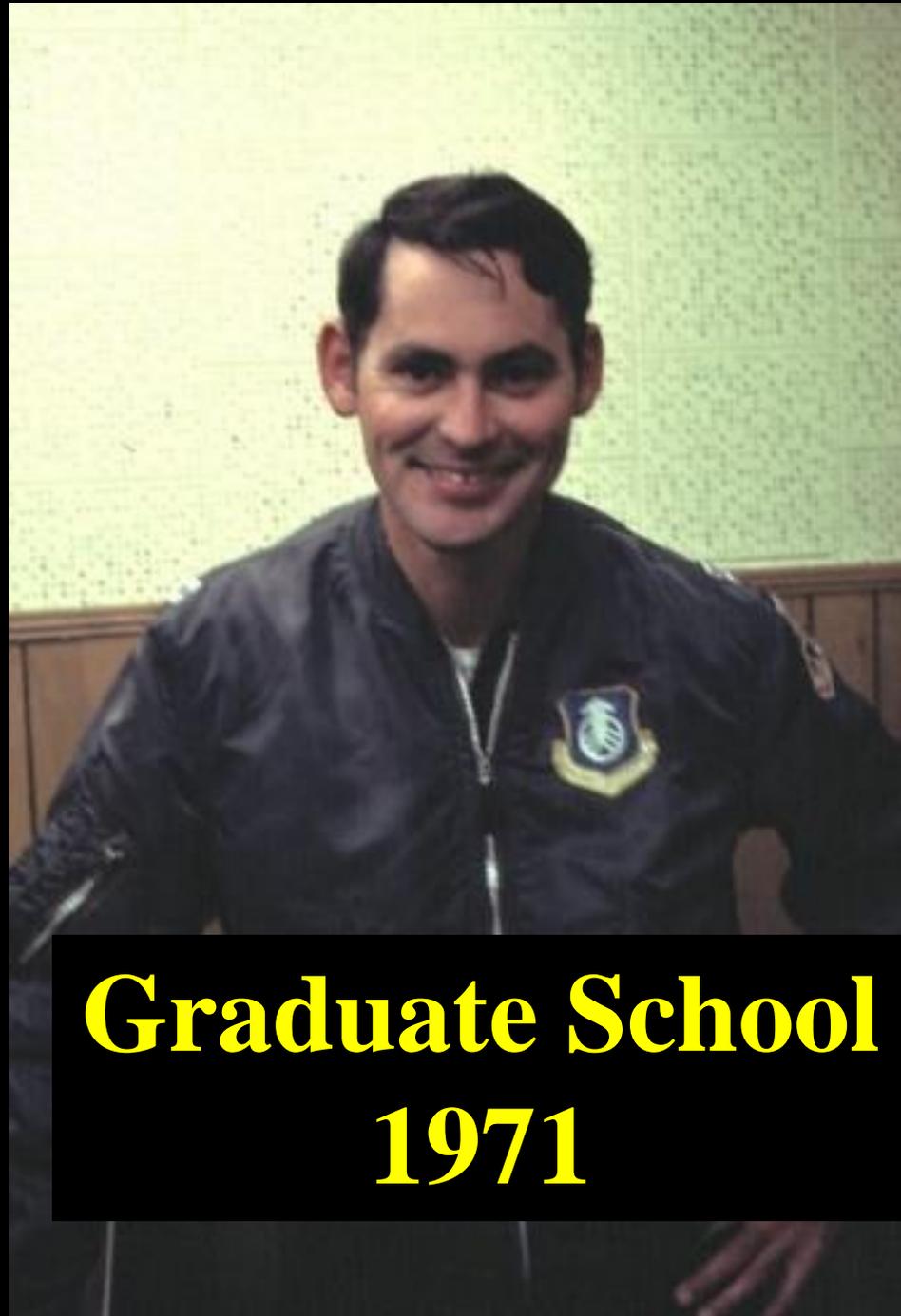
**Flight Training
1968**



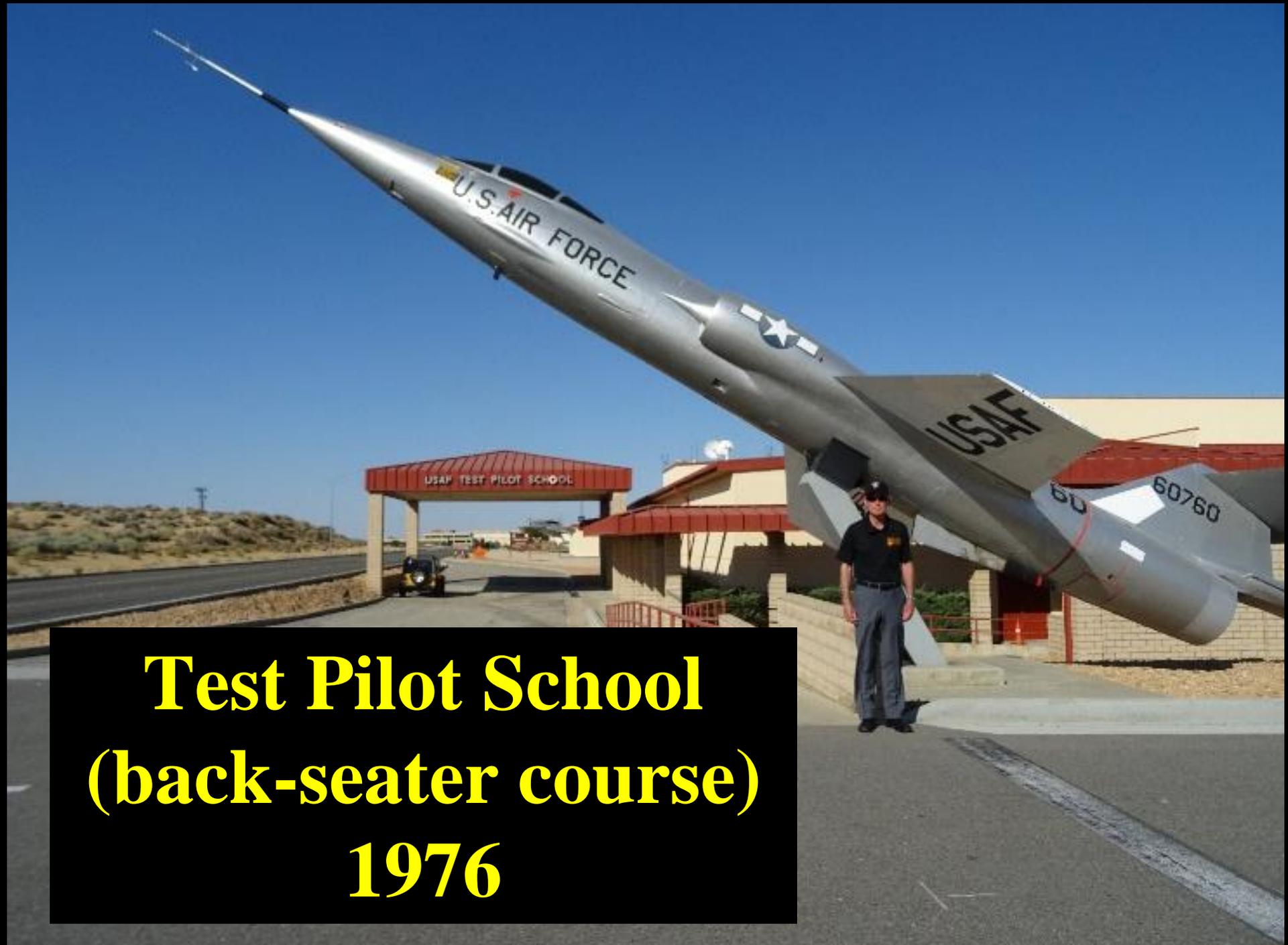
Me



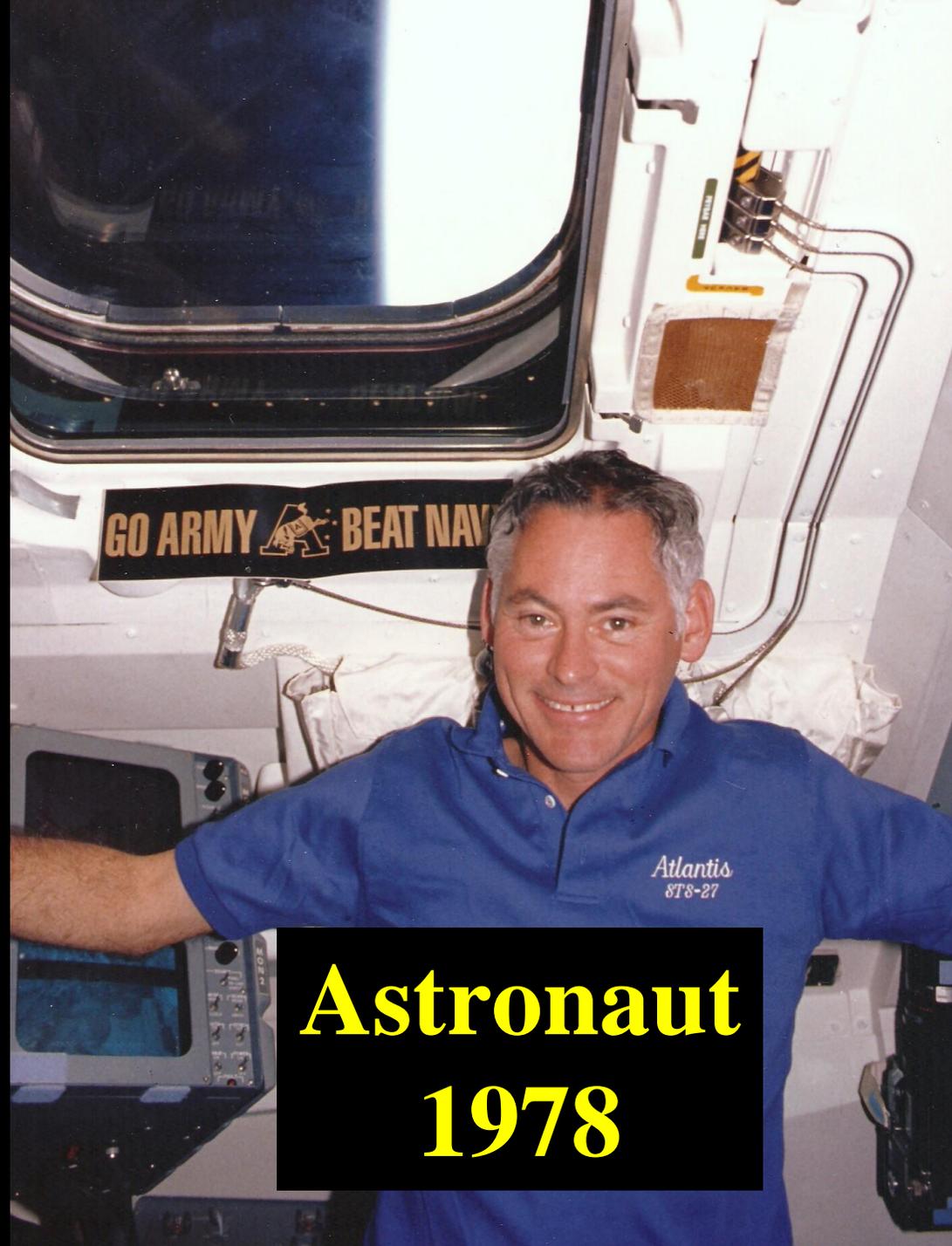
**Vietnam
1969**



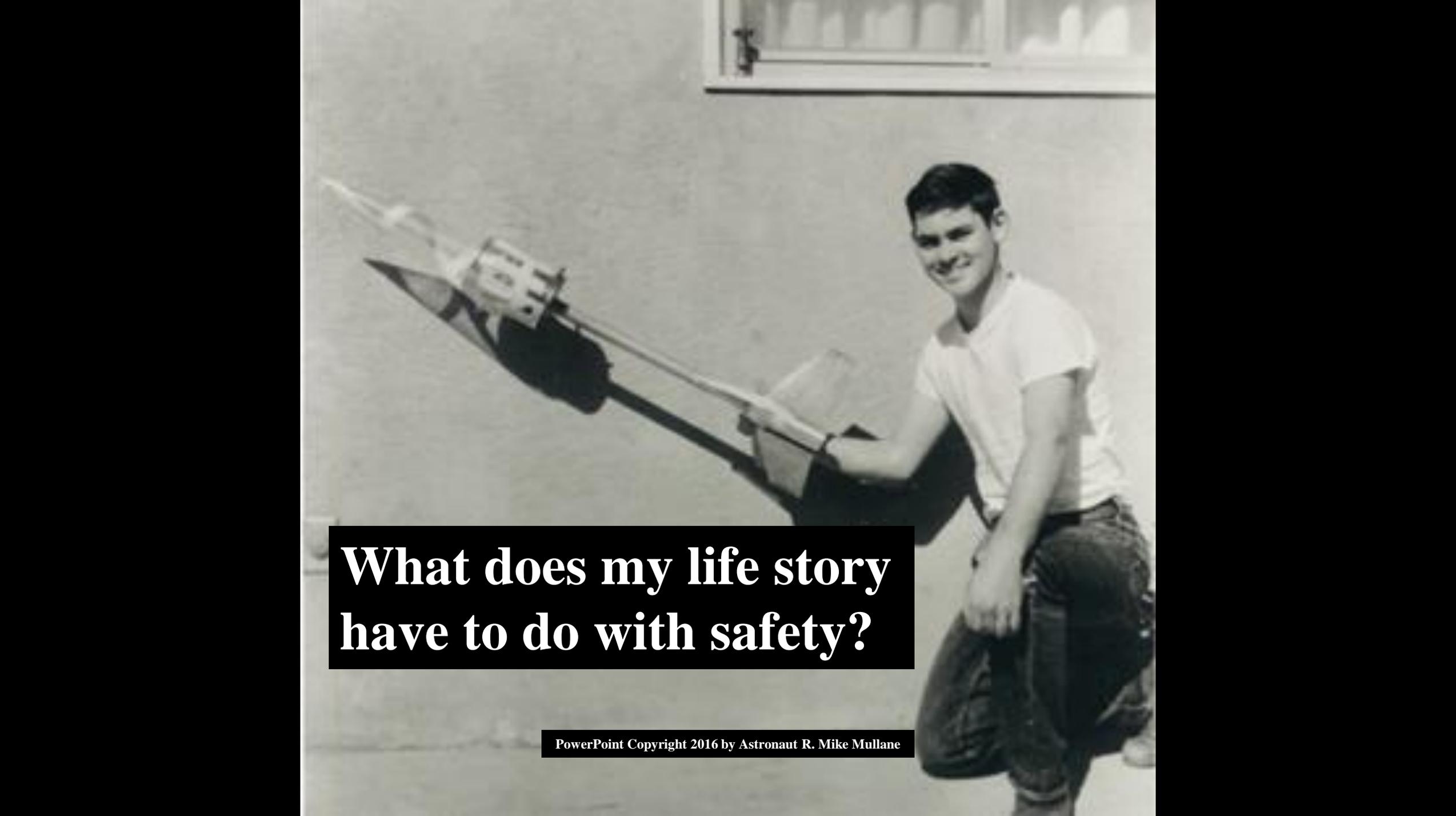
**Graduate School
1971**



**Test Pilot School
(back-seater course)
1976**



**Astronaut
1978**



**What does my life story
have to do with safety?**

LESSON 1:

Within each of us exist great reserves of courageous self-leadership.

It takes courageous self-leadership to achieve and sustain great safety performance.

LESSON 2:

We're more capable than we think.

And so are our team members.

LESSON 3:

Genius is overrated.

Tenacity counts BIG!



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A scenic mountain landscape featuring a dirt trail in the foreground, patches of snow on the slopes, and a clear blue sky. The mountains in the background are rugged and partially covered in snow.

LESSON 4:

Envision Mission Success

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A man wearing a green beanie, sunglasses, and a grey jacket is sitting on a large, grey rock formation on a mountain peak. He is looking towards the camera. The background shows a vast, rugged mountain landscape with patches of snow and a clear blue sky. The overall scene is bright and clear, suggesting a high-altitude environment.

Envision Mission Success

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Safety Fundamentals:

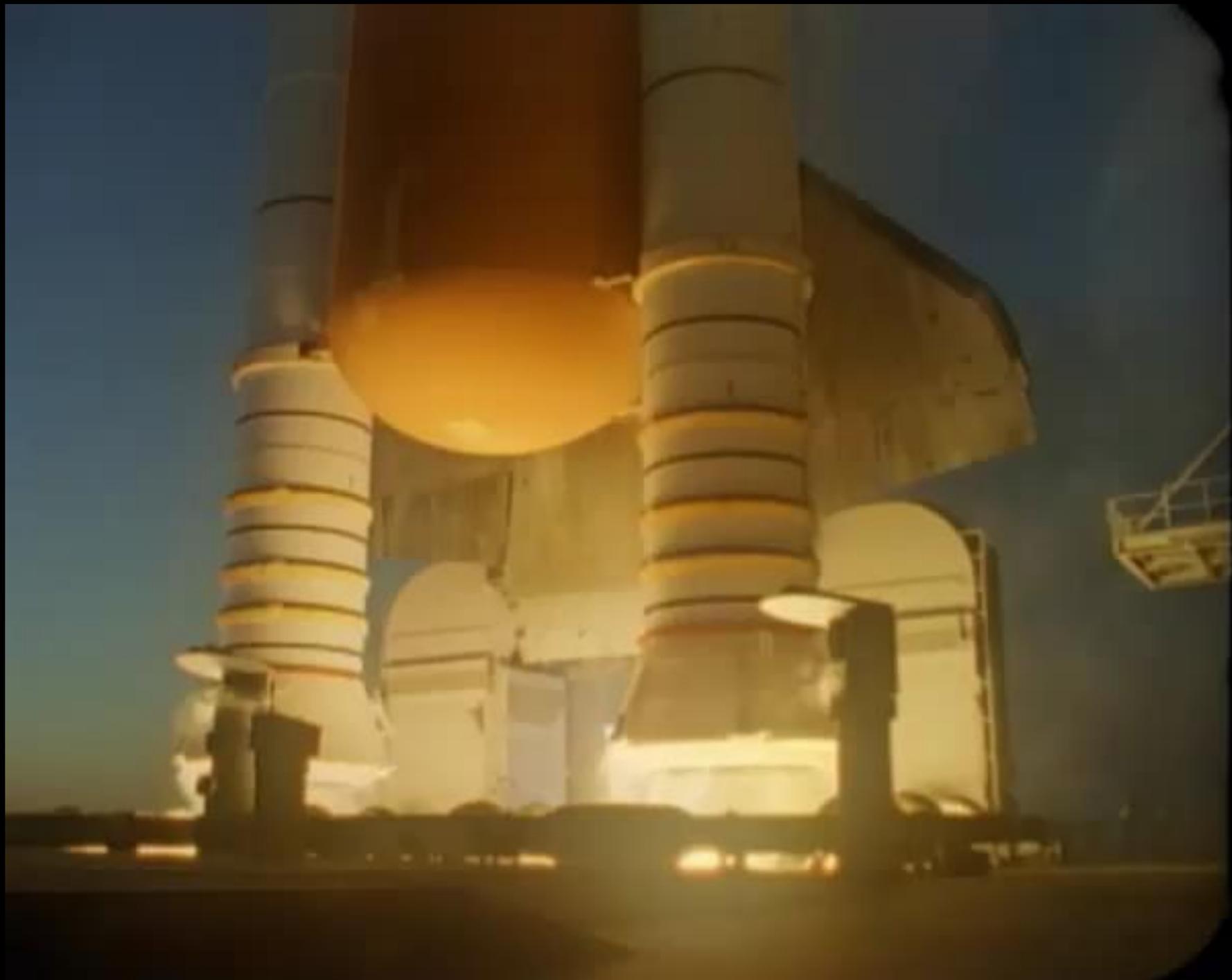
A shared vision of ‘Zero Harm’ operations.

Guard yourself against ‘normalization of deviance’.

Embrace responsibility and accountability.

Maintain yourself as a courageous self-leader.

“It only takes a moment.”



A photograph of the Space Shuttle Discovery on the Mobile Launcher Platform (MLP) at night. The MLP is illuminated from below, highlighting the white orbiter and the large orange external tank and white solid rocket boosters. The orbiter has "United States" and "Discovery" written on its side. The background shows a dark night sky with some distant lights and a large crowd of people gathered in the distance, illuminated by bright spotlights.

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