Normalization of Deviance

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Learning Objectives and Topics

Learning Objective:

Stretch your Professional Development beyond “pure engineering”

Topics:

- **Normalization of Deviance**
- **Professional Responsibility**
- **Doing the Right Thing**

Main References:

The Challenger Launch Decision
by Diane Vaughan
(Purchase on your own)

Lessons from NASA (And a few others)

- Great engineering organization
- Long and rich history
- A culture of excellence

Why you?

February 1, 2003

What tragic event happened on this date?

Space Shuttle Columbia broke up over Texas during reentry

All seven crew members perished

February 1, 2003

What happened?

Foam hitting the orbiter during launch was the physical reason for the failure happened during launch.

But WHY did this happen?

Normalization of Deviance

NASA

Need to rewind NASA's history to understand

NASA was created in 1958.

Early spectacular rocket failures.

May 5, 1961

What happened this day?

Alan Shepard took the first suborbital flight by an American

May 5, 1961

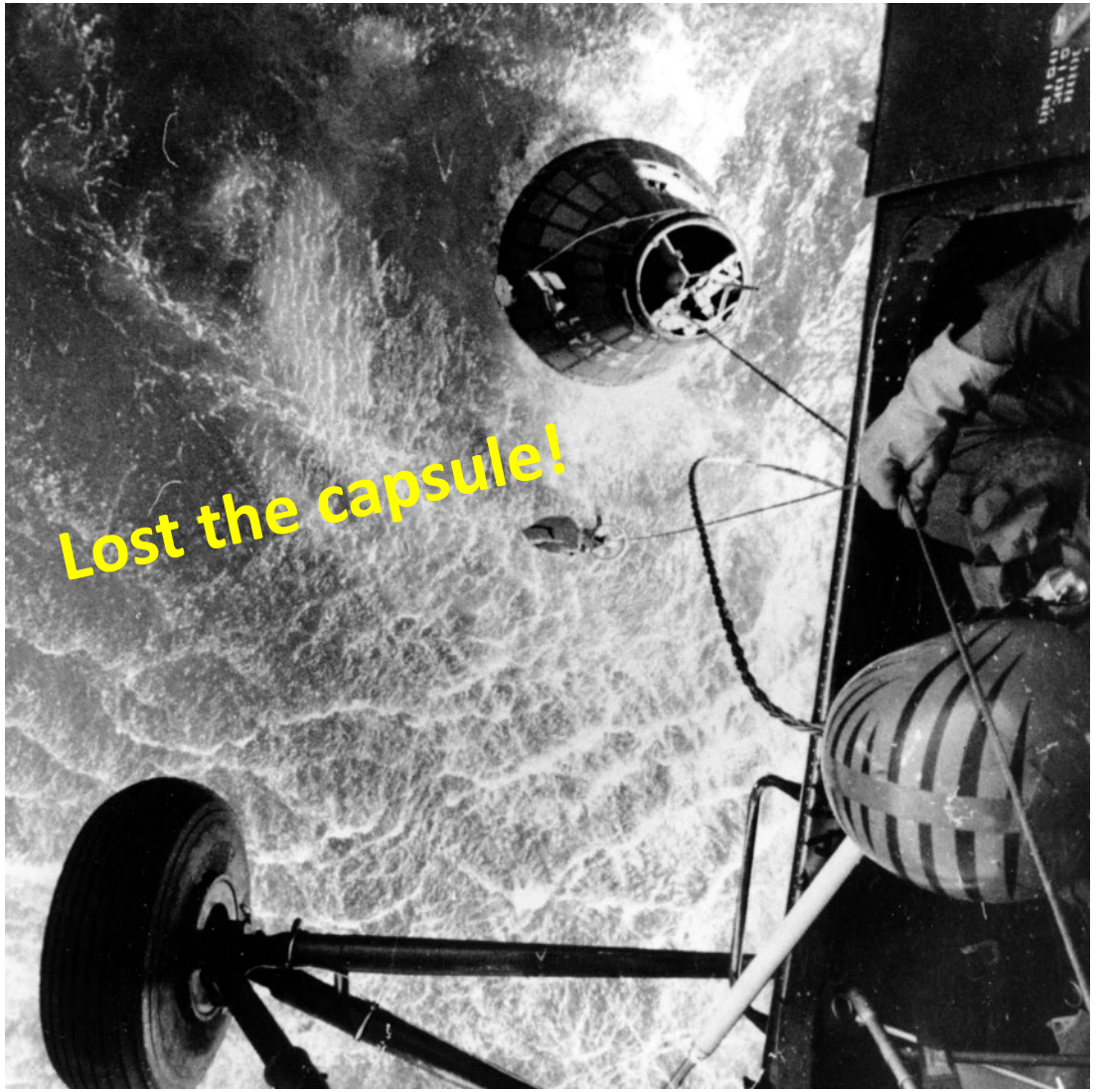
What happened this day?

July 21, 1961

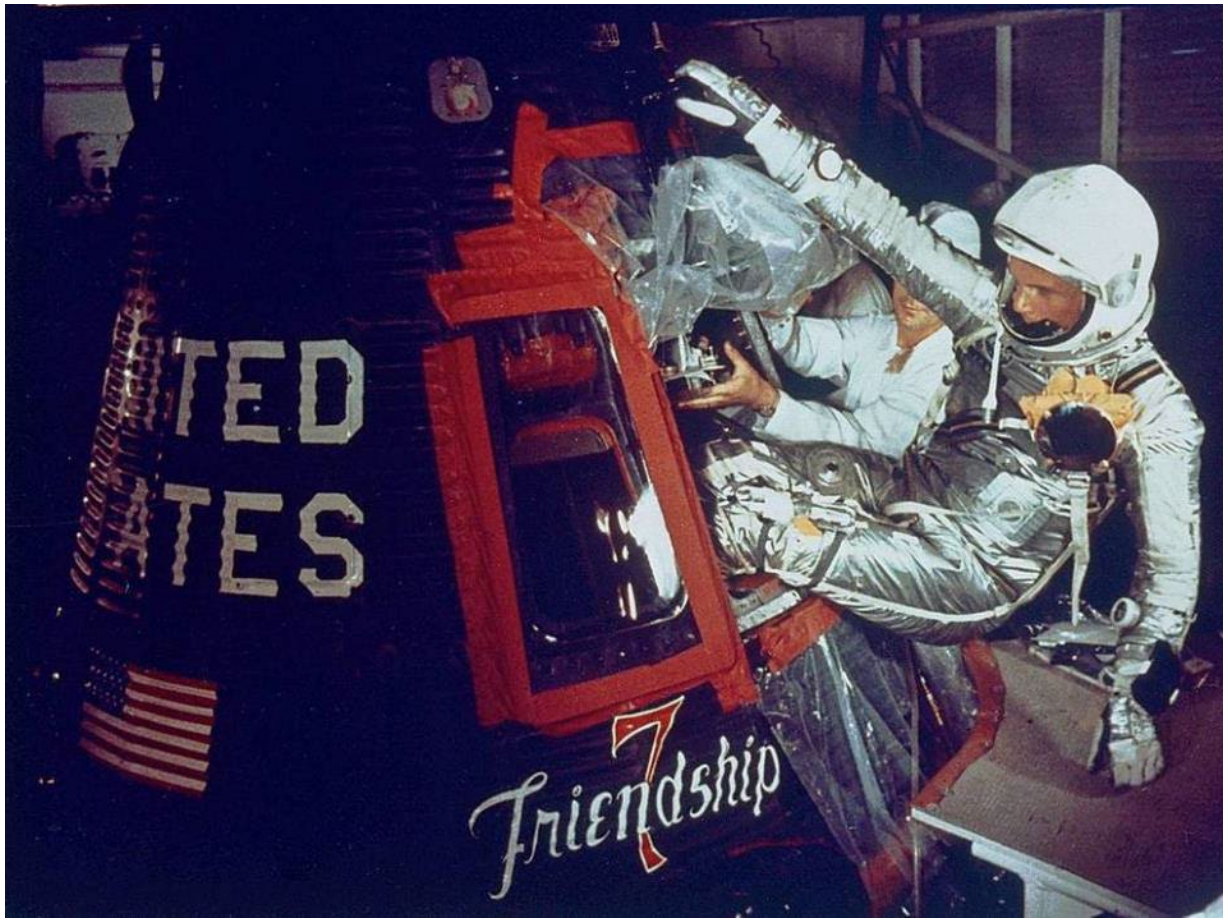
What happened this day?

Astronaut Gus Grissom successfully flew a similar suborbital mission

July 21, 1961



February 20, 1962



John Glenn was the First American to Orbit the Earth

A string of 13 successful manned missions after Atlas 6

1962

- Mercury Atlas 6 - **20 February 1962 - Earth Orbiter** (Glenn)
- Mercury Atlas 7 - **24 May 1962 - Earth Orbiter** (Carpenter)
- Mercury Atlas 8 - **3 October 1962 - Earth Orbiter** (Schirra)

1963

- Mercury Atlas 9 - **15 May 1963 - Earth Orbiter** (Cooper)

1964

1965

- Gemini 3 - **23 March 1965 - Earth Orbiter** (Grissom, Young)
- Gemini 4 - **3 June 1965 - Earth Orbiter** (McDivitt, White)
- Gemini 5 - **21 August 1965 - Earth Orbiter** (Cooper, Conrad)
- Gemini 7 - **4 December 1965 - Earth Orbiter** (Borman, Lovell)
- Gemini 6A - **15 December 1965 - Earth Orbiter** (Schirra, Stafford)

1966

- Gemini 8 - **16 March 1966 - Earth Orbiter** (Armstrong, Scott)
- Gemini 9A - **3 June 1966 - Earth Orbiter** (Stafford, Cernan)
- Gemini 10 - **18 July 1966 - Earth Orbiter** (Young, Collins)
- Gemini 11 - **12 September 1966 - Earth Orbiter** (Conrad, Gordon)
- Gemini 12 - **11 November 1966 - Earth Orbiter** (Lovell, Aldrin)

1967

1968

A string of 13 successful manned missions after Atlas 6

- **1966**
- Gemini 8 - **16 March 1966 - Earth Orbiter** (Armstrong, Scott)
- Gemini 9A - **3 June 1966 - Earth Orbiter** (Stafford, Cernan)
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- Gemini 12 - **11 November 1966 - Earth Orbiter** (Lovell, Aldrin)
- **1967**
- **1968**

Gemini 8 redefined “Cool”

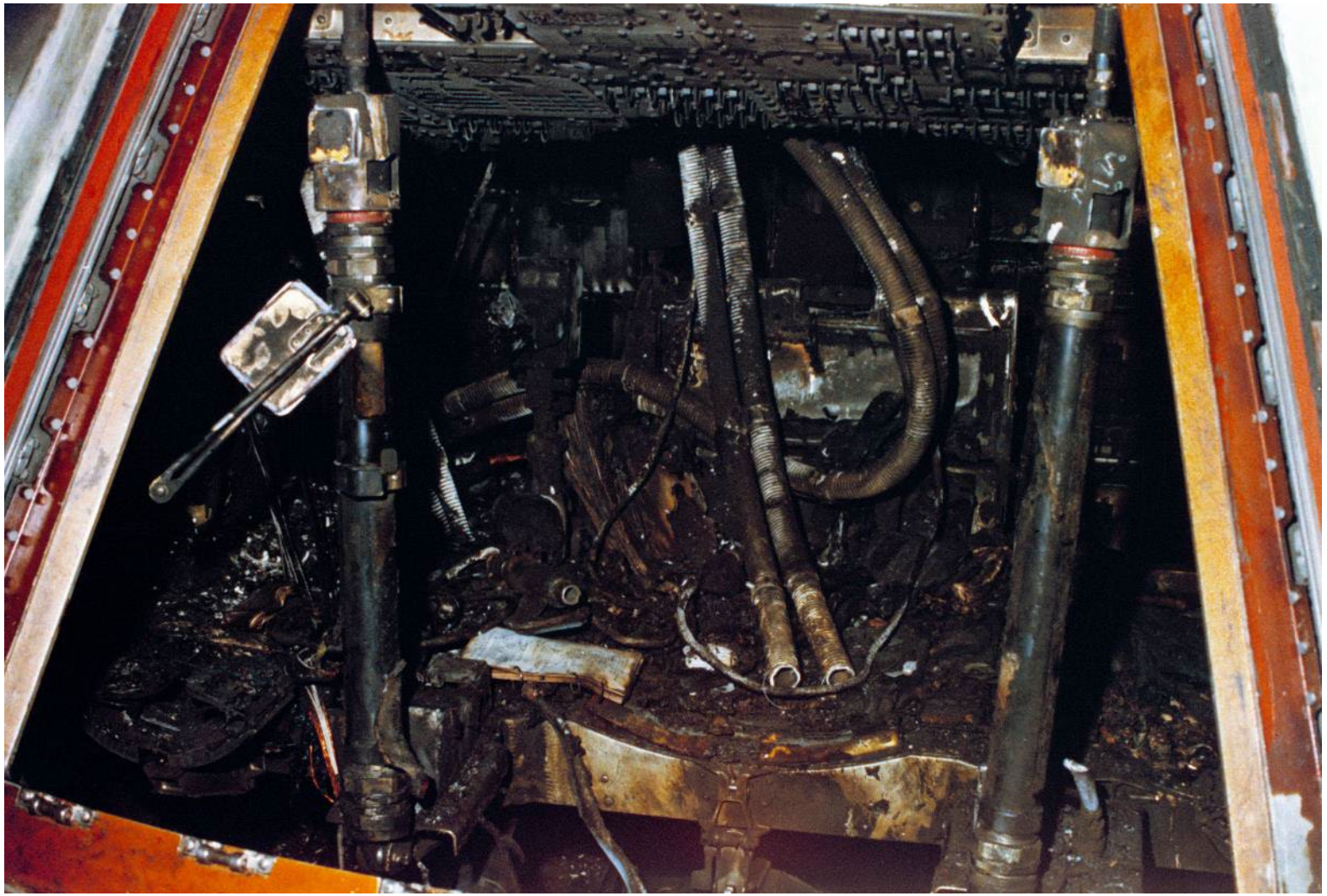
January 27, 1967

What happened this day?

Gus Grissom, Ed White and Roger Chaffee

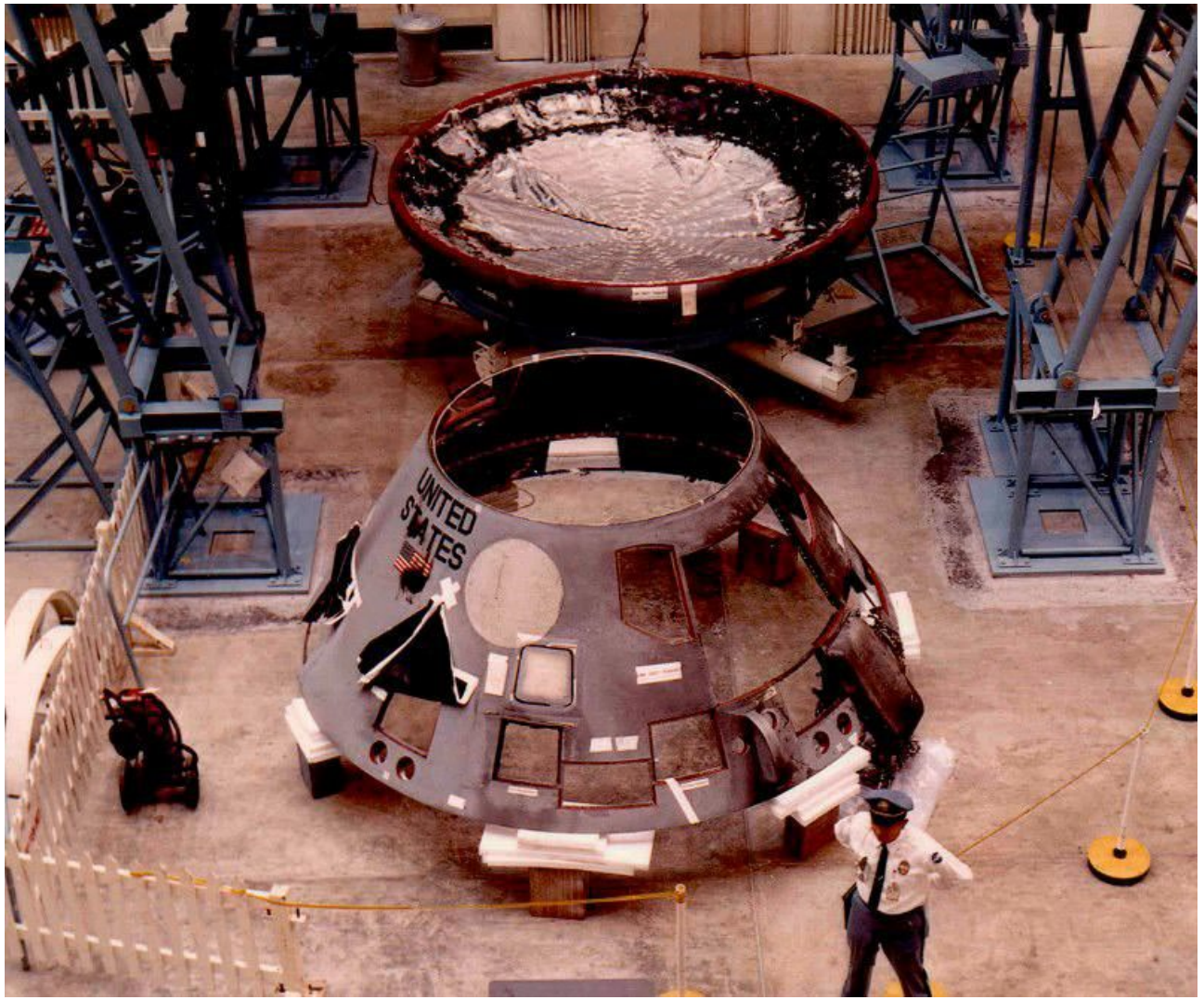
January 27, 1967

Fire!



January 27, 1967

Apollo 1 capsule is still in storage in Langley, Virginia

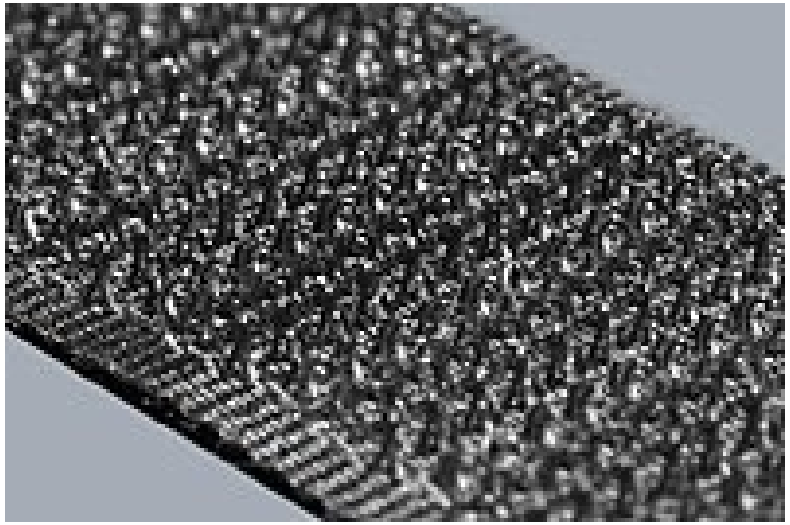


What happened?

Prior missions: If it burns it doesn't fly

Rules were relaxed as more and more successful missions were flown.

"Wall to wall Velcro"



Why was this allowed?

Nothing bad had ever happened.

It became the norm. An informal relaxing of the rules.

“We’ve always done this and it’s ok.”

This is called: Normalization of Deviance

New safety measures were implemented

- No further fatal accidents.
- Apollo 11 safely landed and returned in July of 1969
- Even Apollo 13 made it home
- Apollo was followed by the Shuttle Program

January 28, 1986

January 28, 1986

January 28, 1986

January 28, 1986

Was this the first time this had ever happened, that O-rings had failed during launch?

In 14 of 24 missions prior to Challenger there was evidence that the O-rings had been burned.

O-ring failure was identified after just the second shuttle launch.

Failures occurred regardless of low temperatures at launch.

January 28, 1986

With these known failures why didn't they do something?

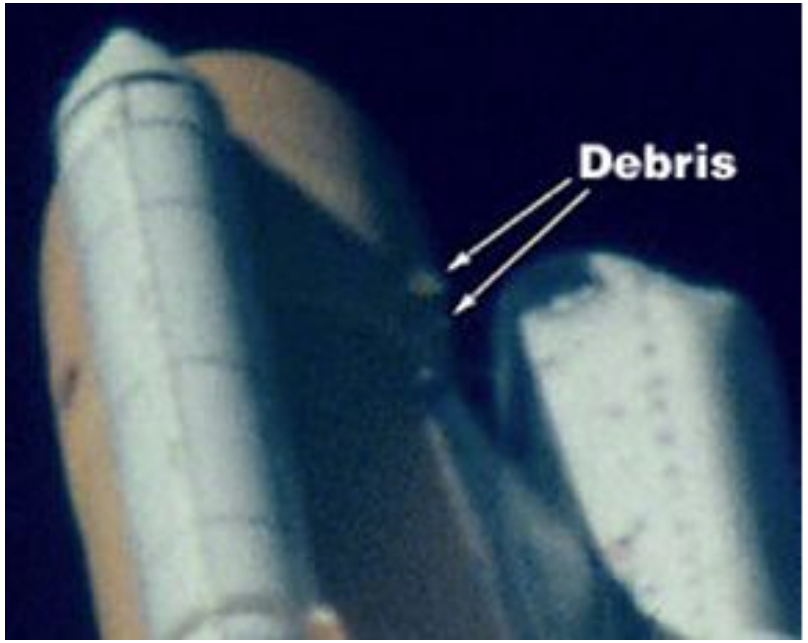
Because nothing bad had ever happened.

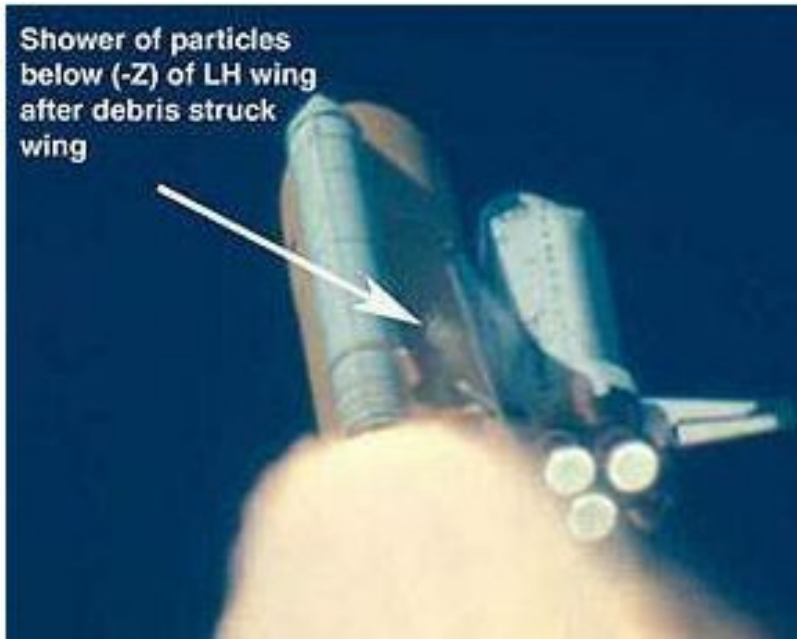
Normalization of Deviance dictated that this became more of an annoyance than a problem.

February 1, 2003

Back to where we started

Space Shuttle Columbia broke up over Texas during reentry



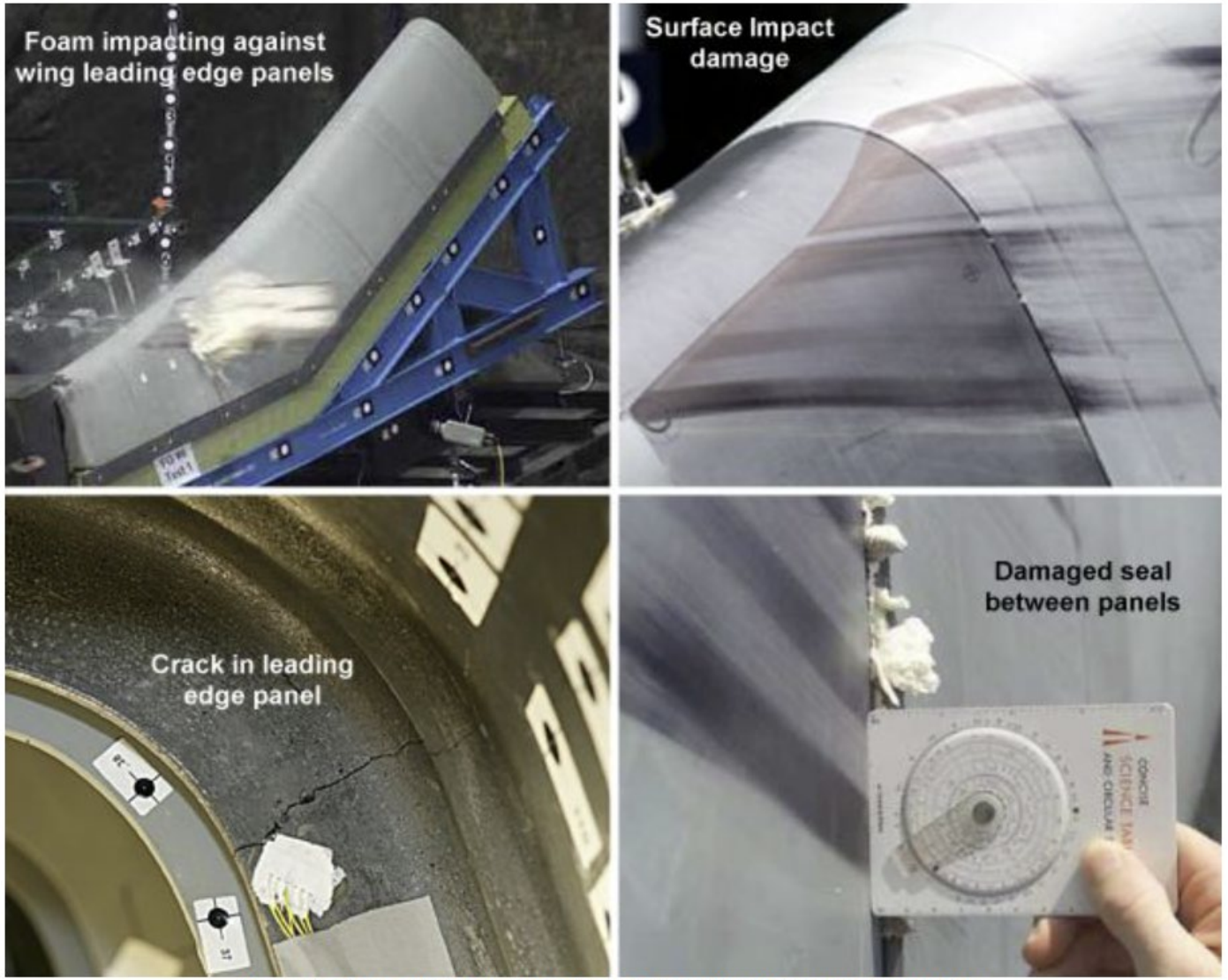


Original Shuttle Design Requirements

3.2.1.2.14 Debris Prevention: The Space Shuttle System, including the ground systems, shall be designed to preclude the shedding of ice and/or other debris from the Shuttle elements during prelaunch and flight operations that would jeopardize the flight crew, vehicle, mission success, or would adversely impact turnaround operations.

3.2.1.1.17 External Tank Debris Limits: No debris shall emanate from the critical zone of the External Tank on the launch pad or during ascent except for such material which may result from normal thermal protection system recession due to ascent heating.

Foam Testing



Damage done to wing RCC panels during foam impact tests

Email to Columbia crew

We have seen this same phenomenon on several other flights and there is absolutely no concern for entry

- *Email from Mission Control to the* Columbia *crew on January 23, 2003.*

Loss of the vehicle

Normalization of Deviance Strikes again!

Normalization of Deviance

"The gradual process through which unacceptable practices and standards become acceptable. As the deviant practice is repeated without catastrophic consequences it becomes the social norm of the organization"

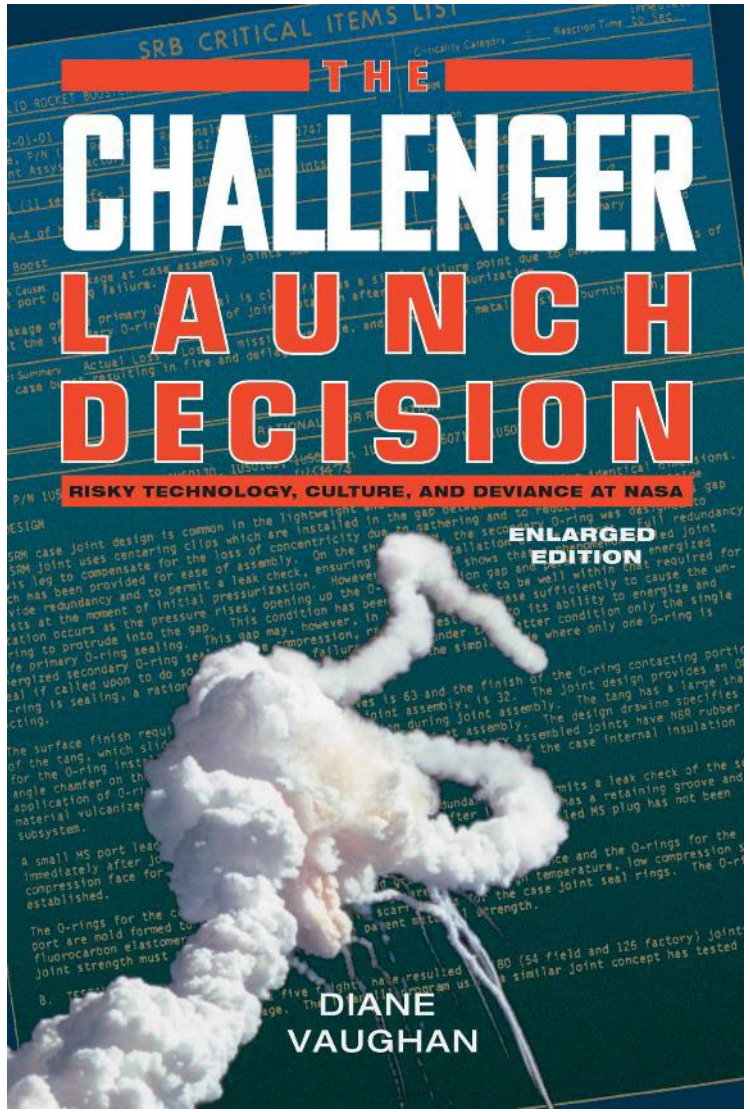
– coined by American sociologist Diane Vaughan

Normalization of Deviance

Further Reading:

The Challenger Launch Decision

by Diane Vaughan



NASA gets it right?

Boeing Starliner

June 5, 2024, astronauts Suni Williams and Butch Wilmore launched from Cape Canaveral in Florida aboard the Boeing Starliner.

Launch was successful however, five thrusters failed during docking due to what was later identified through ground tests as heat build up. However, they could not replicate the problem in space.

Because NASA could not fully understand why the thrusters malfunctioned, they determined returning the craft with astronauts aboard was too risky.

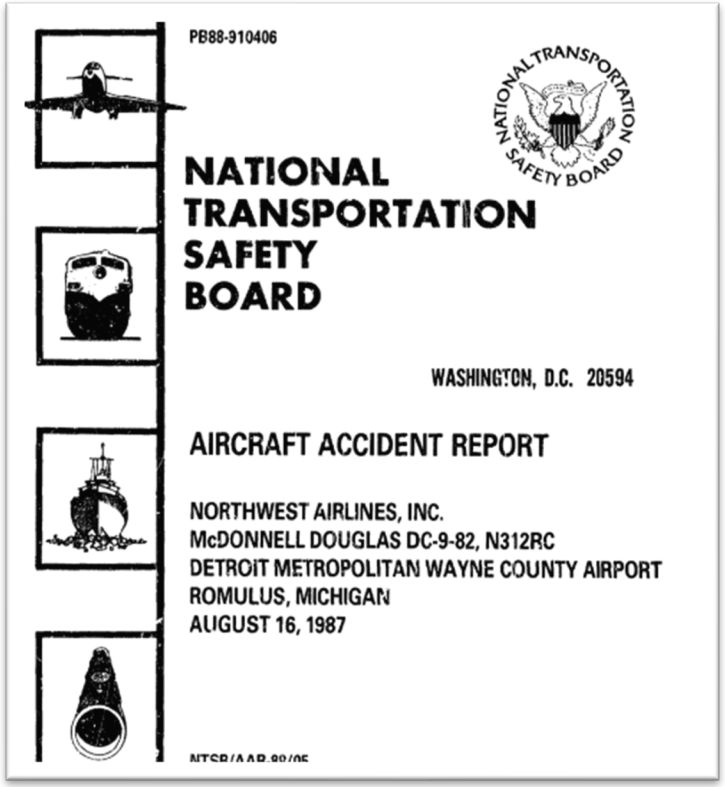
Starliner, returned uncrewed on September 7th without incident.

Other Examples - Northwest flight 255

On August 16, 1987, a McDonnell Douglas MD-82, operating as Northwest Airlines Flight 255, crashed shortly after takeoff from Detroit Metropolitan Airport, about 8:46 pm EDT (00:46 UTC August 17), resulting in the deaths of all six crew members and 148 of the 149 passengers, along with two people on the ground. The sole survivor was a 4-year-old girl who sustained serious injuries.

Other Examples - Northwest flight 255

The National Transportation Safety Board determines that the probable cause of the accident was the flight crew's failure to use the taxi checklist to ensure that the flaps and slats were extended for takeoff. **Contributing to the accident was the absence of electrical power to the airplane takeoff warning system**, which thus did not warn the flightcrew that the airplane was not configured properly for takeoff. The reason for the absence of electrical power could not be determined.



PB88-910406

NATIONAL TRANSPORTATION SAFETY BOARD

WASHINGTON, D.C. 20594

AIRCRAFT ACCIDENT REPORT

NORTHWEST AIRLINES, INC.
McDONNELL DOUGLAS DC-9-82, N312RC
DETROIT METROPOLITAN WAYNE COUNTY AIRPORT
ROMULUS, MICHIGAN
AUGUST 16, 1987

Other Examples - Northwest Flight 255

The investigators spoke with other MD-80 pilots and learned that many of them found it a nuisance to hear a take-off configuration warning ("Slats ... Slats... Slats....") while they were simply taxiing. It was so common for pilots to pull the P-40 circuit breaker that the area around the circuit breaker was smudged from routinely being manipulated. **This circuit breaker also controls some of the stall warning sounds.**

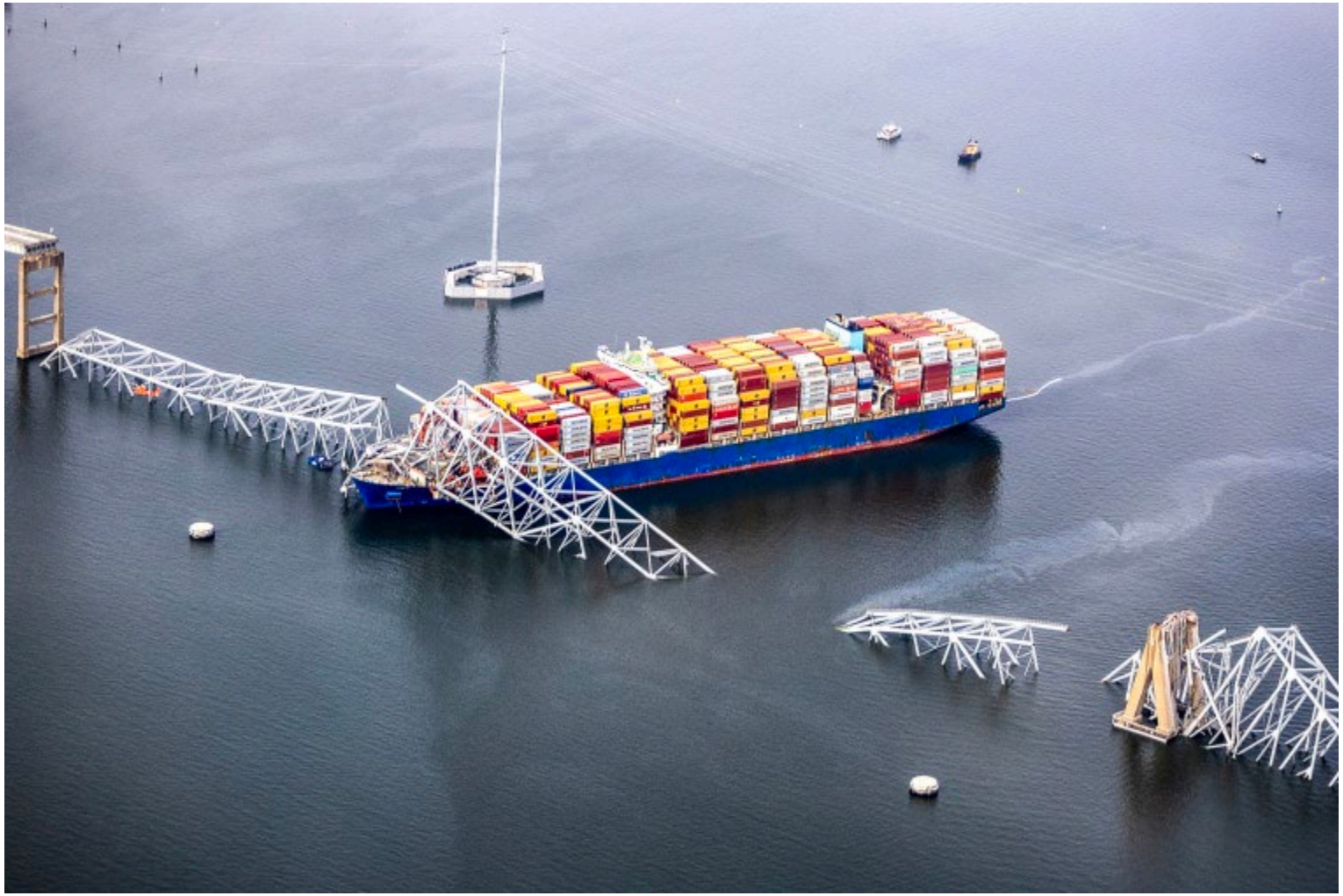
Other Examples – Texas A&M Bonfire Collapse

At approximately 2:42 a.m. on November 18, 1999, the annual Aggie Bonfire at Texas A&M University collapsed during its construction, killing 12 people and injuring 27.

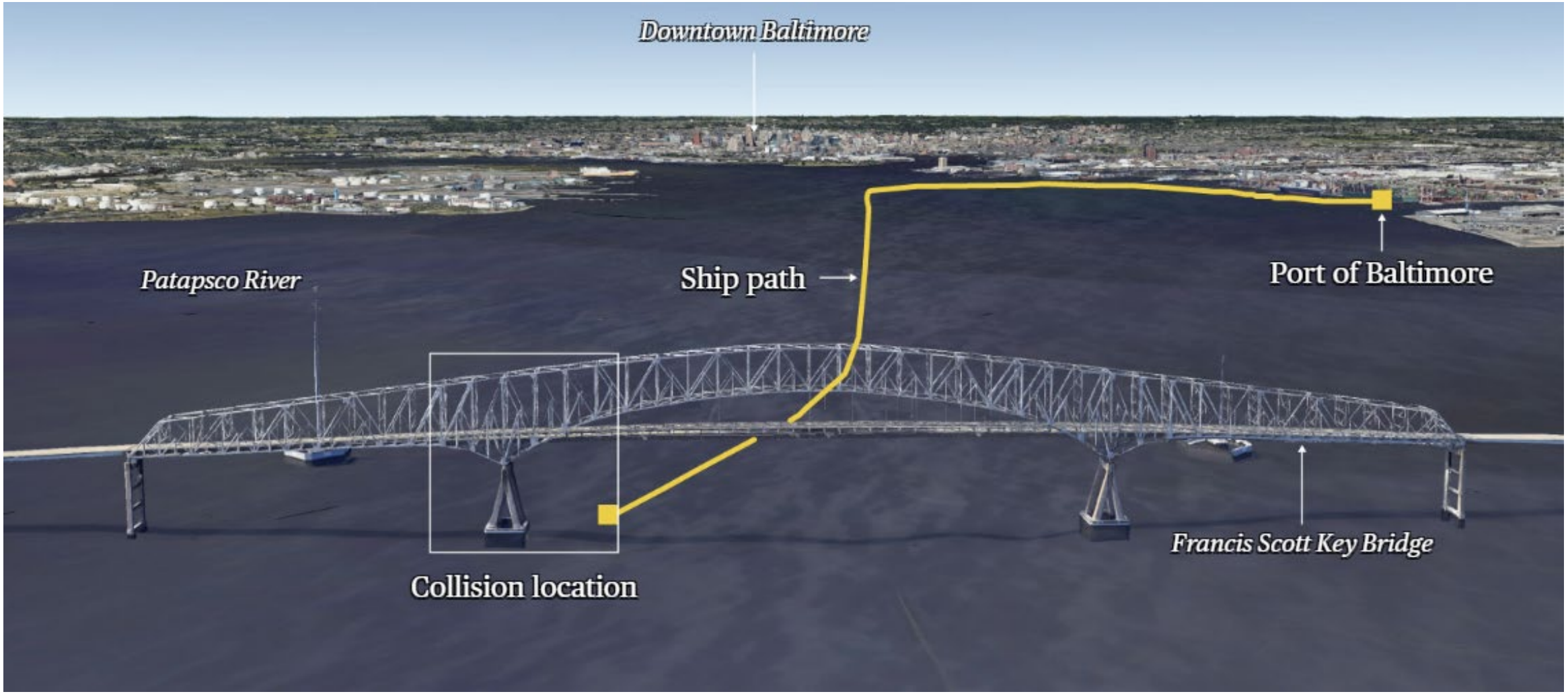
Video clip on next page compliments of @fascinatinghorror. Don’t worry, it’s not graphic.

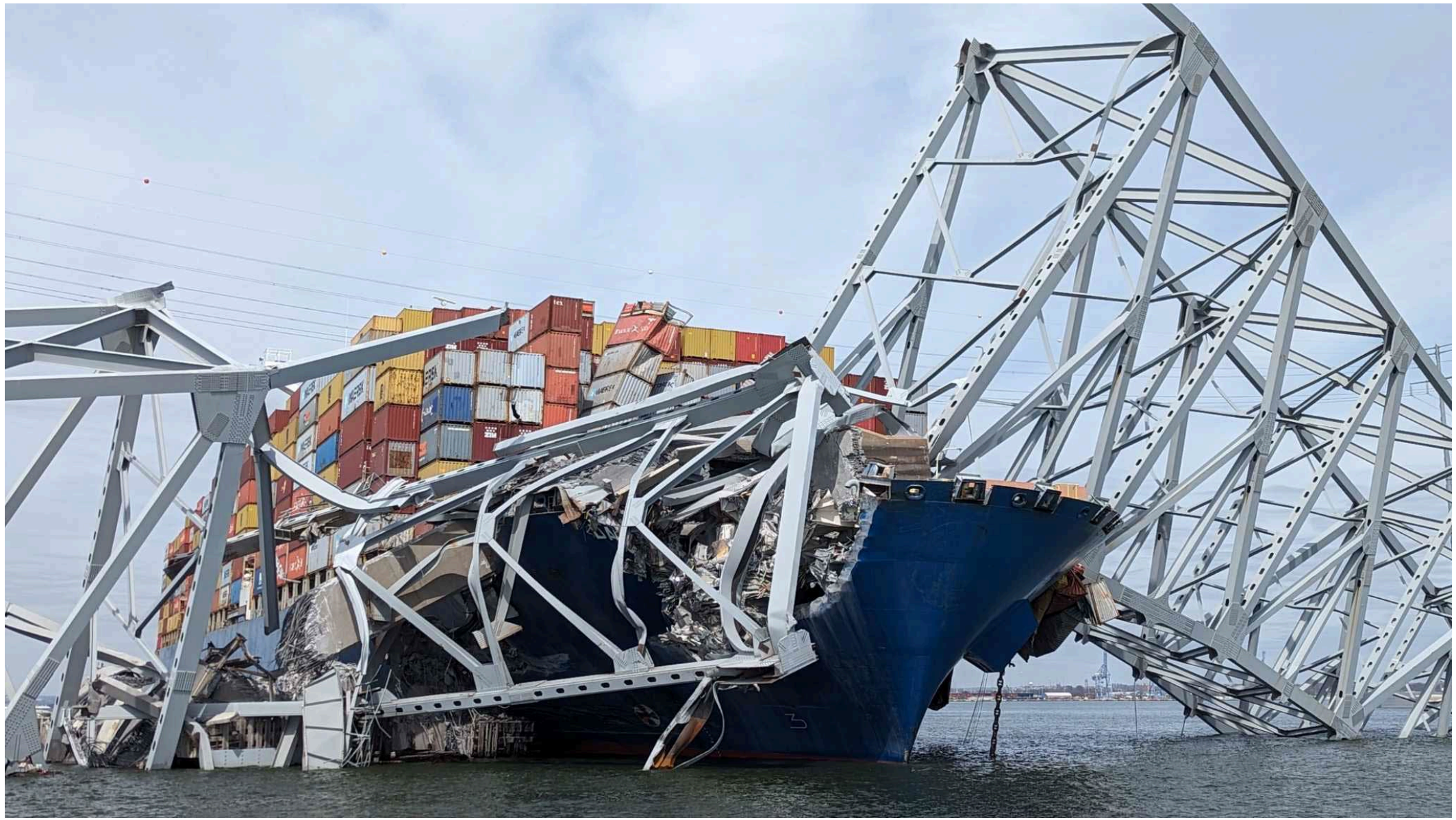

The Aggie Bonfire Collapse | A Short Documentary | Fascinating Horror
to investigate what went wrong.
10:55 / 13:01 • The Aftermath ›
Scroll for details

Francis Scott Key Bridge Collapse



March 26, 2024.



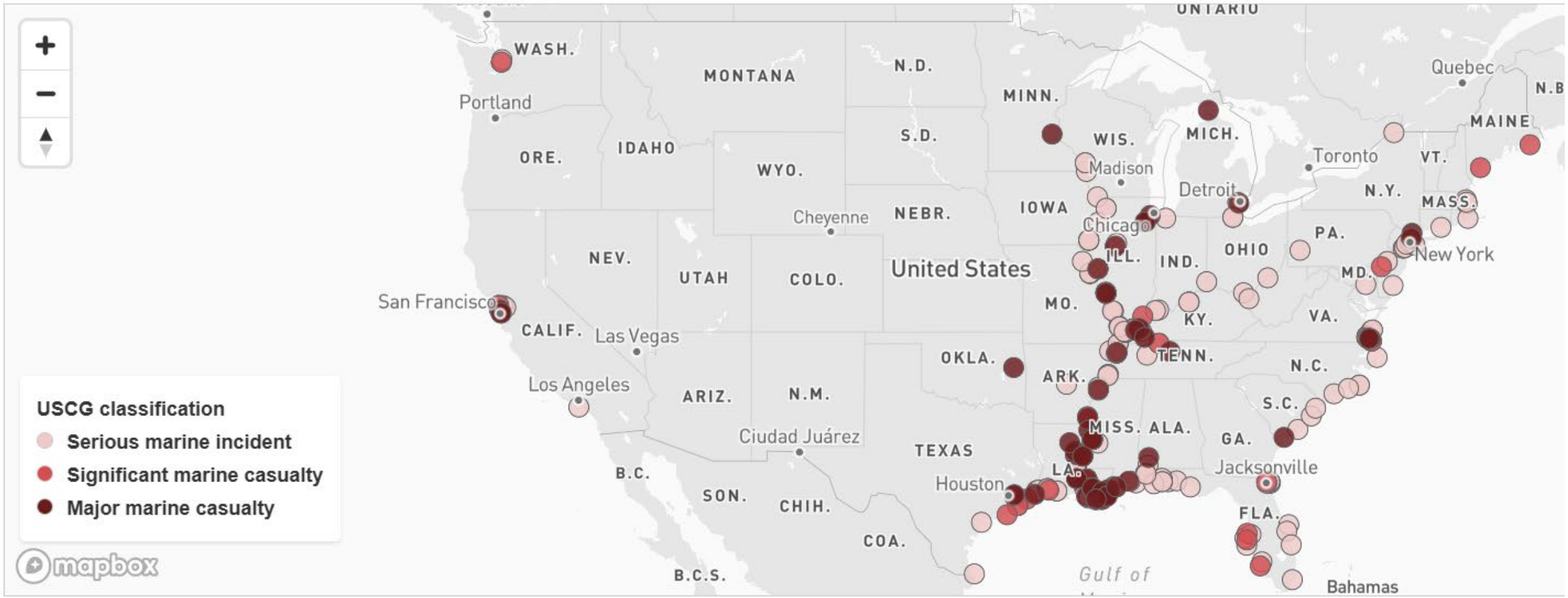


Does this happen often? Ships with no power?

At least 6,000 times in the past 22 years – an average of more than five times a week – crews on board massive cargo ships, oil tankers, container barges and even cruise vessels have reported what befell the Dali: a loss of power, loss of propulsion, loss of steering, or some combination of the three – *USA Today*

At least 900 of them occurred near bridges identified by the U.S. Department of Transportation as spanning navigable waters. The vast majority were classified as routine but a dozen were labeled major or significant. – *USA Today*

The Frequency of incidents is alarming

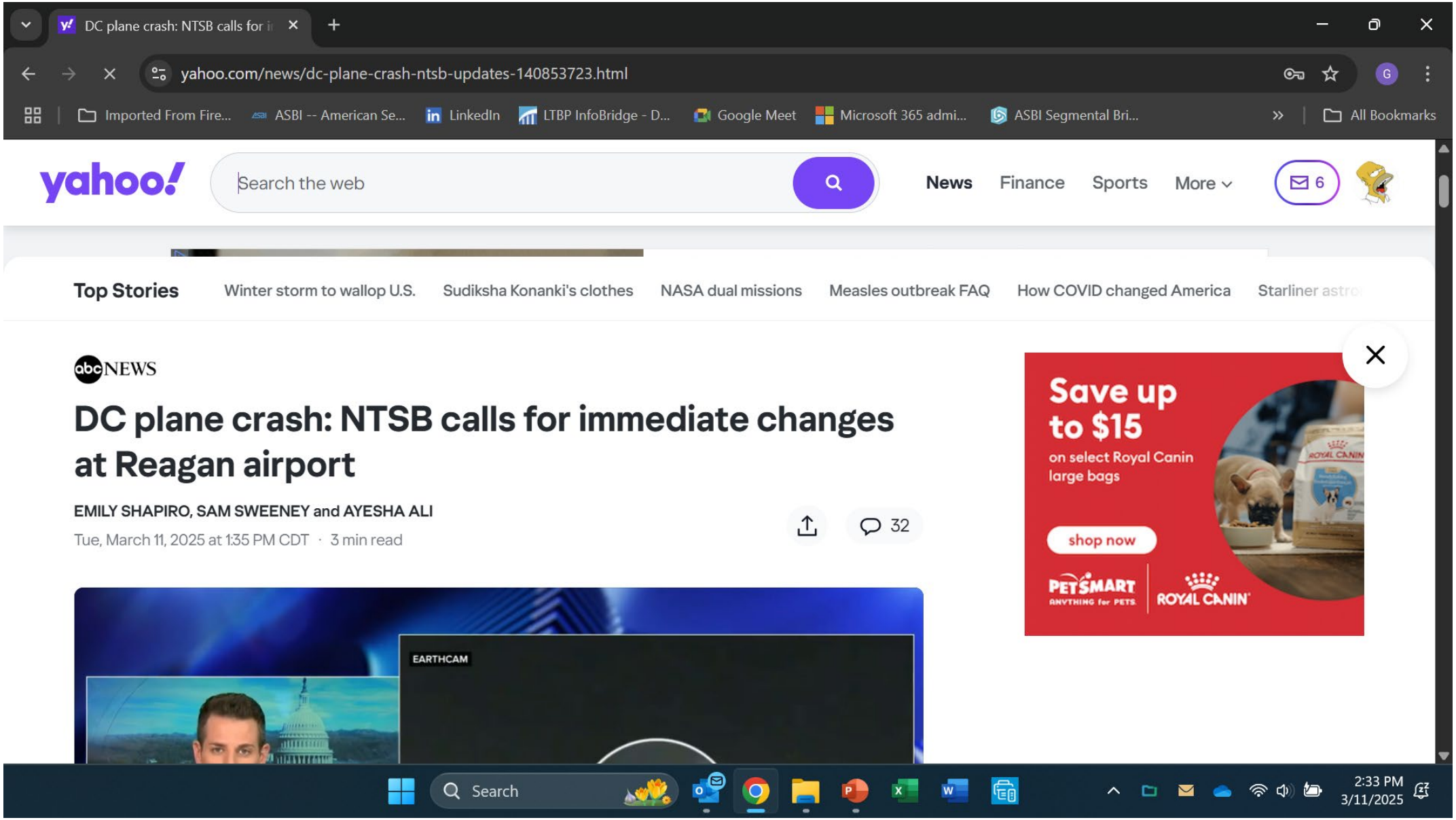


Source: USA TODAY analysis of U.S. Coast Guard incident investigation reports

But nothing bad ever happens

That’s Normalization of Deviance!

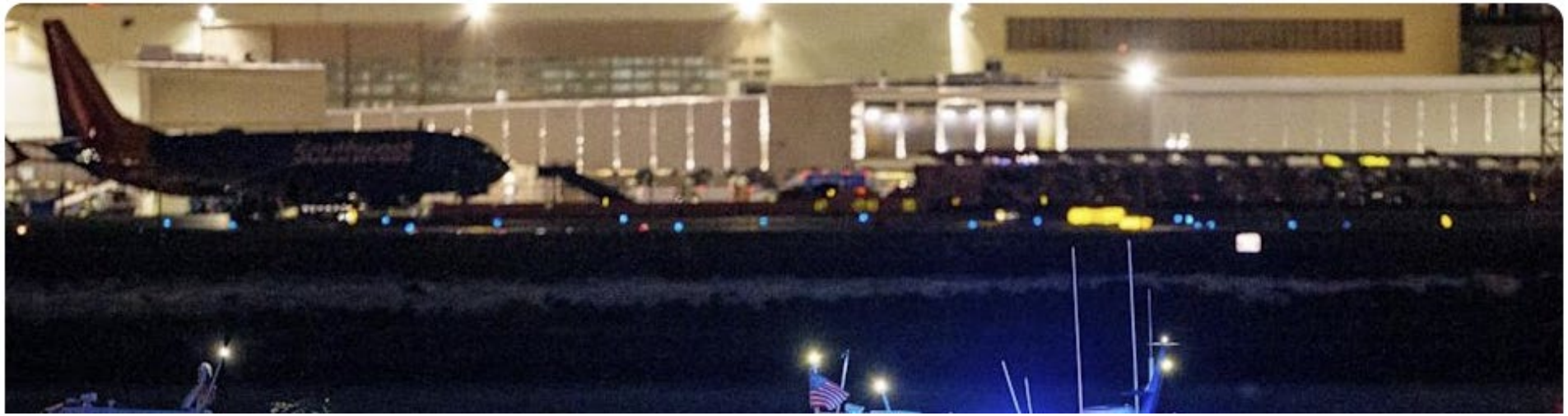
And as I was preparing this presentation…



NTSB Investigation

Between October 2021 and December 2024, there were 944,179 commercial operations at Reagan, Homendy said. During that time, there were 15,214 close proximity events between commercial airplanes and helicopters, she said.

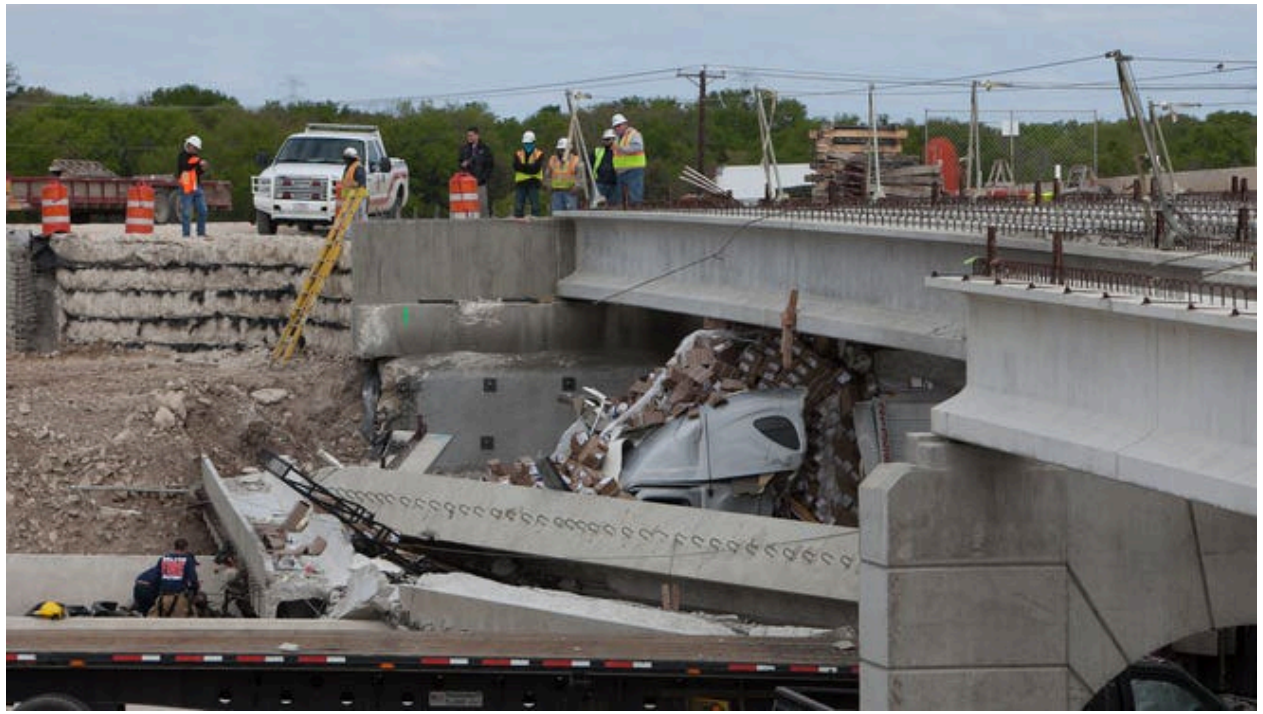
Encounters between helicopters and commercial aircraft near Reagan show that, from 2011 through 2024, a vast majority of reported events occurred on approach to landing, she said.



Source:
CBS News

What are some practices you have perhaps relaxed or just accepted?

- Design review and checking?
- QC/QA during construction?
- Safety procedures?



If we have time

Opportunities from the American Segmental Bridge Institute.

Information from the National Concrete Bridge Council.

American Segmental Bridge Institute

ASBI Opportunities

Monthly Webinars

- Last Wednesday of Each Month
- Recordings of All Past Webinars are Available Under the 'Learn'->'Monthly Webinars on the ASBI Website
- We will resume in February of 2025
- To pre-register for ALL ASBI webinars in 2025, use this QR code:

You will receive an email notice one month prior to each webinar. The email will include an option to create a calendar appointment.

https://www.surveymonkey.com/r/5QMBDT5

2025 Grouting Certification Training

ASBI will host Grouting Training in
Austin, TX on April 7, 2025

Please see the website for registration.

www.asbi-assoc.org

National Concrete Bridge Council

National Concrete Bridge Council

… a council of allied industry organizations dedicated to:

- Promote quality in concrete bridge construction
- Gather and disseminate information on design, construction, and condition of concrete bridges
- Establish communication with federal and state departments of transportation, city and county public works departments, and consulting engineers
- Provide information on behalf of the concrete industries to codes and standards groups

NCBC website: www.nationalconcretebridge.org

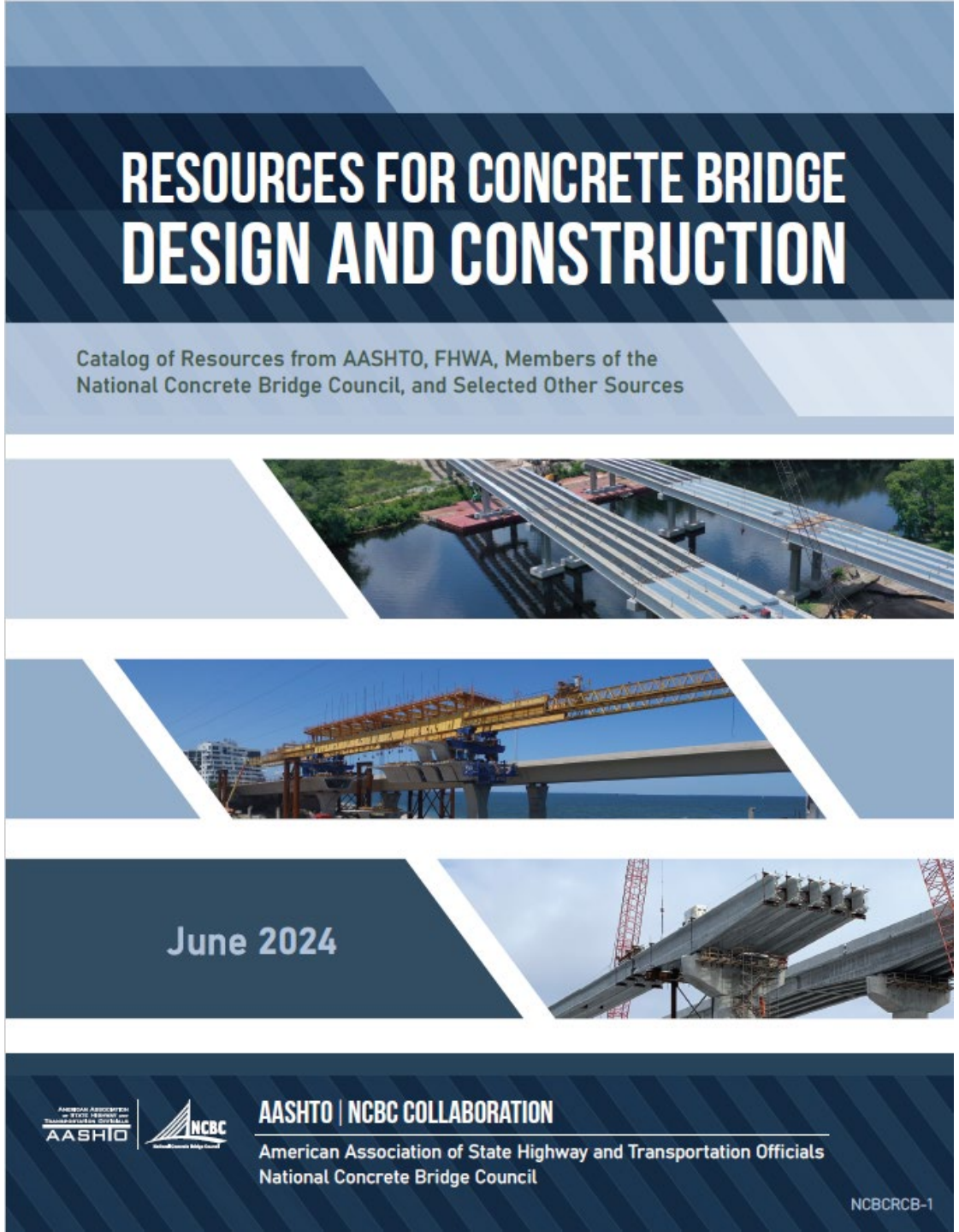
Current NCBC Members

Principal Members

- American Segmental Bridge Institute (ASBI)
- Concrete Reinforcing Steel Institute (CRSI)
- Epoxy Interest Group of CRSI (EIG)
- National Ready Mixed Concrete Association (NRMCA)
- Precast/Prestressed Concrete Institute (PCI)
- Post-Tensioning Institute (PTI)
- Silica Fume Association (SFA)

Associate Members

- American Concrete Institute (ACI)
- Expanded Shale, Clay, and Slate Institute (ESCSI)
- International Concrete Repair Institute (ICRI)
- Wire Reinforcement Institute (WRI)



- Developed from the AASHTO/NCBC Collaboration Agreement, this document compiles essential resources from AASHTO, FHWA, and NCBC members.
- This vital catalog will aid concrete bridge practitioners in their design and construction endeavors.

Webinars

Save the Dates!

Whether you are involved in bridge design, maintenance, construction, or asset management we will continue to bring valuable insights regarding the concrete bridge industry to you in 2025. Certificates of attendance are available for these free webinars. **Each webinar starts at 1 p.m. ET.**

Dates:

February 19
March 19
April 23
May 22
June 18
July 23
August 20
September 10
October 22
November 19

April 15 -16, 2025
Columbus, Ohio
Attendance will be limited to the first 100 registrants.

- Intensive two-day seminar
- From basic to advanced concepts.

ASPIRE Magazine

- *ASPIRE*, the concrete bridge magazine
  - About all types of concrete bridges
  - First issue was Winter 2007
  - All issues are available online
    - www.aspirebridge.org
    - Can search an issue or across all issues
  - Free subscription
  - Supported by several members of NCBC

- Need ideas for:
  - Project articles
  - State features

Look for my article in the next issue, due for publication at the end of March, on Normalization of Deviance!

Thank You!

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