What does an NTSB aviation engineering investigator do during an investigation?
Before we talk about what an investigator does, let’s start at the beginning of an investigation…the Launch
The NTSB is Responsible for Investigating:

- All U.S. aviation accidents (except those of military and intelligence agencies).
The NTSB also launches to foreign accidents involving a U.S. operator or aircraft/engine.
An NTSB “go-team” is dispatched from Washington headquarters to major transportation accidents.

- A “go-team” is the highly visible group of Safety Board professionals with a wide-range of investigative skills.
A “go-team” typically includes the following:

- A Board Member
- An Investigator-In-Charge (IIC)
- Investigative Specialists
- Public Affairs Officers
- Family Affairs Specialists
Investigative Team

• Investigator in Charge (IIC)
• Group Chairs
  – Operations
  – Human Factors
  – Air Traffic Control
  – Weather
  – Structures
  – Systems
  – Powerplants
  – Maintenance
  – Flight Recorders
  – Survival Factors
  – Airports
  – Aircraft Performance
  – Materials laboratory
Each part of the investigation is led by a Group Chairman – What do they do, exactly?
Role of Systems Group Chairman

- On-scene responsibilities
  - Recorders
  - Cockpit documentation
  - Aircraft system documentation
- Teardown or testing of selected components
- Metalurgical Analysis
- Reporting
  - Factual
  - Analytical
Powerplant Group Chairman

- Locate all Powerplant components
- Was engine making required power?
- Is damage pre or post impact?
- Determine need for follow on work
Uncontained Engine Failures
Uncontained Engine Failures

- Identify and find liberated part(s)
- Map trajectory of liberated part(s)
- Teardown and metallurgy required
- Get history of engine and parts involved
Powerplants - Fires
Engine Fires

- Identify origin of fire
- Teardown of engine usually not required
- Did fire suppression systems work?
- Get maintenance history of engine
Foreign Object Ingestion
Foreign Object Ingestion

• Two types: hard and soft body
• Hard body is caused by rocks and metal
• Soft body is caused by birds and tire rubber
• If birds, collect bird remains
Structures Group Chairman

- Aircraft Recovery
- Documenting Structures Damage
- Two & Three Dimensional Mockups
- Reporting
Aircraft Recovery

- Underwater
- In a Crater
- On Ground
Underwater Recovery
On-Ground Recovery
Documenting Structures Damage

- Walk Around Inspection
- Examination & Documentation
- Wreckage Distribution Diagram
- Analyze individual breaks
- Detailed laboratory analysis?
Examination & Documentation
Wreckage Distribution Diagram

- GPS, Survey, Tape Measures
- Plotting Methods: Grid, Centerline, Map
- Aerial Photographs & Aerial Video
- Develop Numbering & Tagging Methods
Wreckage Distribution Diagrams
Mockups

- Need For a Mockup
- Two Dimensional & Three Dimensional
- Partial or Complete
2-D Mockup
3-D Mockup
So, how is an investigation conducted?

Let’s take an example...
The Accident:
Colgan Air Flight 3407
DHC-8-400
February 12, 2009
History of Flight

- February 12, 2009
- 2217 eastern standard time
- Colgan Air, Inc.
- Bombardier DHC-8-400
- Continental Connection flight 3407
- Buffalo, New York
- 2 pilots, 2 flight attendants, 45 passengers, and 1 resident killed
History of Flight

• Snow and light-to-moderate icing expected en route
• Captain set reference speeds switch to increase (icing conditions)
  – Lowered angle-of-attack reference for stick shaker activation
  – Raised low-speed cue on airspeed displays by 15 knots
  – Improved performance margins
History of Flight

• First officer obtained landing speeds for non-icing conditions
  – Mismatch with position of ref speeds switch resulted in landing speed that was 13 knots lower than stick shaker activation speed
History of Flight

- Stick shaker activated; autopilot disengaged
- Airplane had minimum ice accretion
- Captain pulled back on control column and added power short of rating detent
  - Increased angle-of-attack, pitch, and load factor
  - Airplane entered accelerated stall
History of Flight

- Stick pusher activated three times
- After each activation, captain continued to pull back on control column
  - Exacerbated airplane’s stalled condition
  - Prevented potential recovery
Investigation

• On scene for 8 days
• 3-day public hearing covered
  – Effect of icing on airplane performance
  – Cold weather operations
  – Sterile cockpit rules
  – Flight crew experience
  – Fatigue management
  – Stall recovery training
Investigation

- Flight crew and airplane properly certificated
- No evidence of any preimpact structural, engine, or systems failures
- ATC not factor in accident
- Accident not survivable
Investigation

- Weather was typical for time of year
- Ice accretion did not affect crew’s ability to fly and control airplane
- Need to provide complete and accurate weather documents
- Change in icing definitions needed
Safety Issues

- Crew response and monitoring failures
- Airspeed selection procedures
- Stall training
- Pilot training records and remedial training programs
Safety Issues

• Pilot professionalism
  – Sterile cockpit
  – Leadership training
  – Use of personal portable electronic devices

• Fatigue and commuting

• FOQA programs, FAA oversight, and SAFO process
Here are the details for how it went for a Group Chairman:

It all starts with a phone call…
The Phone Call

- FAA notifies NTSB comm center
- NTSB comm center gathers decision makers
- Launch/No launch
- Who’s launching
  - Specialties
  - People
  - Timing
- How are they launching
The Launch

- Launch on FAA jet – two trips
  - 1\textsuperscript{st} trip – Board Member, IIC, structures, TDA
  - 2\textsuperscript{nd} trip – other group chairmen
- Direct from DCA to Buffalo
- Police/FBI escort upon arrival
- Recorders returned to DC when FAA jet returned
On-Scene Work – Initial Walk Around

- Initial assessment of wreckage
- Fire still burning – gas leak
- Large variations in wreckage condition
- Aircraft wreckage mixed with ground wreckage
- Photo documentation begins
On-Scene Work – Initial Walk Around
On-Scene Work – Initial Walk Around
On-Scene Work – Organizational Mtg

- First night on-scene
- Led by the IIC
- Create groups based on party availability
  - Parties: FAA, ALPA, Colgan, United Steelworkers Union (F/A’s), NATCA
  - Accredited reps: TSB, AAIB
    - Advisors: Bombardier, P&W Canada, TC, Dowty propellers
On-Scene Work – Organizational Mtg

- 12 groups formed for Colgan accident
  - Systems, structures, powerplants, ops/human performance, survival factors/rescue, weather, pipeline, ATC, performance, FDR, CVR, mx records
  - Not every party placed on every group

Feb 13
On-Scene Work – Documentation

- Majority of work on-scene
- Led by the group chairman
- Document the condition of the aircraft
- Must be done as quickly as possible
  - Things change with time
    - Gauge readings degrade
    - Switches get moved
    - Corrosion
- Priorities vary with each accident

Feb 13-21
On-Scene Work – Documentation

- For Colgan accident (Systems):
  - Flap tracks and jackscrews
  - DDV’s (de-icing system components)
  - Cockpit switches
  - Actuators
  - Avionics boxes (NVM)
  - Deicing bleed lines

Feb 13-21
On-Scene Work – Documentation

- Photos:
  - Absolutely essential
  - Use a good camera
  - Get training
  - Spot metering and macro modes
  - Take pictures of labels/data plates
  - Can never have enough photos
- Field notes
On-Scene Work – Documentation

• Interviews:
  - ATC (conducted by ATC Group)
  - Dispatch/wx briefers (by Wx Group)
  - Crew (if possible) (by Operations Group)

• Progress meetings each night
  - Each group reports

• Press briefing
  - Board Member is lead spokesperson

Feb 13-21
On-Scene Support

- Essential for successful investigation
- Many groups provide support
  - Law enforcement
  - Fire fighters
  - Medical examiner
  - Red Cross
  - Community organizations

Feb 13-21
On-Scene Support
On-Scene Support

- FBI Trailer
On-Scene Support

• Decontamination
  Tents
On-Scene Support

• Fire Fighters
Post On-Scene Work

- Transition from “what happened” to “why did it happen”
- Simulations and performance analysis
- More interviews
  - Training
    - Procedures
  - Review of training records
- Teardowns

Feb 22- Nov 9
Post On-Scene Work

Public Hearing

May 12-14
Post On-Scene Work

- Public hearing - 3 days of testimony
  - Icing certification
  - Stall recovery and cold wx ops
  - Training programs
  - Pilot selection
  - Fatigue management
- 20 witnesses questioned
- Tech panel, parties, & Board of Inquiry
- Get statements on public record

May 12-14
Post On-Scene Work

- Technical Review
  - Formal meeting to finalize all factual reports
  - Starts the countdown on party submissions (60 days)
  - Final opportunity for parties to request additional factual work
• Factual Report (including addenda) – Group Chairman (May 6, Aug 3, Nov 25)
• Analysis Report – Group Chairman (Aug 15)
• Final Report – Dedicated writer
  • Several drafts
    • Staff Draft (Nov 17)
    • Pre - Director’s Draft (Dec 7)
    • Director’s Draft (Dec 10)
    • Notation Draft (Jan 5, 2010)
Board Meeting

- The end of the investigation
- All board members discuss the final report
- Presentations by key group chairmen
- Findings, conclusions, probable cause, and recommendations adopted

Feb 2, 2010