Mishap Investigation Board Orientation

Welcome to Your New Job Investigating Mishaps

The explosion of a Titan IVA with a NRO satellite in August 1999 was caused by wiring defects. Titan IV quality defects were linked to the overemphasis on cost cutting and the loss of experienced personnel.

Source: General Tattini, ELV Payload Safety Conference 2004.

Agenda

- NPR 8621.1 Overview
- What's a Mishap?
- Classification of Mishaps
- What Happens After a Mishap Occurs
- Notional Investigation Timeline
- Two Types of Mishap Investigations
- Purpose of Safety Investigation
- Investigating Authority
- Products of Investigation – Report Contents
- Endorsement of Report
- Overview of Investigation Process
- Summary

NPR 8621.1: Mishap Reporting, Investigating and Recordkeeping - Overview

- Describes how to respond to a mishap and close call from discovery through corrective action closure.

- Includes:
  - Descriptions of roles and responsibilities
  - How to classify mishaps (based on dollar loss, injury and visibility)
  - How to establish an investigating authority
  - How to perform an investigations & generate a report
  - How to endorse a report and authorize it for public release
  - How to complete corrective actions and generate lessons learned
  - How to retain records

The purpose of NASA mishap investigation process is to determine cause and develop recommendations to prevent recurrence.

What's A Mishap? What's A Close Call?

NASA Mishap. An unplanned event that results in at least one of the following:

- Injury to non-NASA personnel, caused by NASA operations.
- Damage to public or private property (including foreign property), caused by NASA operations or NASA-funded development or research projects.
- Occupational injury or occupational illness to NASA personnel.
- NASA mission failure before the scheduled completion of the planned primary mission
- Destruction of, or damage to, NASA property.

Definition of Close Call. An event in which there is no injury or only minor injury requiring first aid and/or no equipment/property damage or minor equipment/property damage (less than $20,000), but which possesses a potential to cause a mishap.

ALL MISHAPS and CLOSE CALLS ARE INVESTIGATED

NASA serves as the lead for mishaps investigations of mishaps defined above.

What's Not A Mishap?

- Destruction of, or damage to, any property as a direct result of weather conditions or a natural disaster

- A malfunction or failure of component parts that are normally subject to fair wear and tear and have a fixed useful life that is less than the fixed useful life of the complete system or unit of equipment, provided that all of the following are true:

  a. There was adequate preventative maintenance.

  b. The malfunction or failure was the only damage, and the sole action is to replace or repair that component.
  (This exception does not apply to a malfunction or failure of a component part that results in damage to another component or the facility or injury to personnel.)

What's Not A Mishap?

- A test failure involving damage to equipment or property as a result of testing, provided that all of the following are true:
  a. The test article is not flight hardware.
  b. The testing is part of an authorized research, development, qualification, certification program.
  c. Damage is limited to the test article and test instrumentation.
  d. Risk of damage to the test article and test instrumentation resulting from failure was accepted explicitly (e.g., documented) by program/project management and concurred on by the Center safety office.
  e. The test team performs a test failure analysis and generates a technical report instead of treating it as a mishap and completing a mishap report.

- A failure resulting in damage to flight hardware during the ground Acceptance Test Procedure (ATP) is not a mishap when the following are true:

  a. Failure is a predictable outcome
  b. Only the flight article is damaged
  c. Test equipment functioned properly
  d. There were no anomalies in the facility or test procedures
  e. Test team performs a test failure analysis

Applicability:
RCA Required For Mishaps & Close Calls

Industrial Operations, Processes, and Construction

Cooling Tower Fire

Crane - Pad B

Processing and Test

NOAA N Prime

VAB Foam Fire

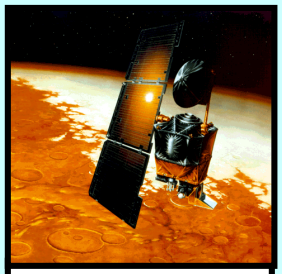
Flight and Space

Lift Off Test Flight

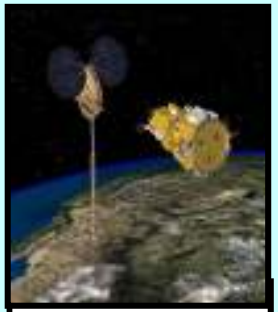
Challenger

Helios

In Space



Mars Climate Orbiter



DART

Landing

Columbia

Genesis

Odds and Ends

CTDs

Slips, Trips, & Falls

Insect & Animal Bites

Automobile

How are Mishaps Classified?

- Classification based on dollar loss and injury.
  (Mission failure based on cost of mission failure).

- Classification determines type of investigation to be conducted.

- Mishap Classification Table
  - Type A Mishaps – Type D Mishaps
  - Close Calls

MIB Note

Include the Mishap's Classification, Dollar Loss, and Type of Injury in Your Final Report

Mishap Classification Levels

Classification Level & Investigation Type	Property Damage	Injury
Type A Mishap	Total direct cost of mission failure and property damage equal to or greater than $2,000,000 or more, ***or*** Crewed aircraft hull loss has occurred, ***or*** Unexpected crewed aircraft departure from controlled flight occurred (except high performance jet/test aircraft such as F-15, F-16, F/A-18, T-38, OV-10, and T-34, when engaged in flight test activities).	Occupational injury or illness that resulted in: A fatality, ***or*** A permanent total disability.
Type B Mishap	Total direct cost of mission failure and property damage equal to or greater than $500,000 but less than $2,000,000.	Occupational injury or illness that resulted in a permanent partial disability, ***or*** Hospitalization for inpatient care of three or more people within 30 workdays of the mishap.
Type C Mishap	Total direct cost of mission failure and property damage equal to or greater than $50,000 but less than $500,000.	Nonfatal occupational injury or illness that resulted in: Days away from work, not including the day or shift on which it occurred, or Restricted work, or transfer to another job not including the day or shift on which it occurred, or Hospitalization for inpatient care of one or two people within 30 workdays of the mishap..
Type D Mishap	Total direct cost of mission failure and property damage equal to or greater than $20,000 but less than $50,000.	Any nonfatal OSHA recordable occupational injury or illness that does not meet the definition of a Type C mishap.
Close Call	An event in which there is no equipment or property damage, or minor equipment property damage of less than $20,000, but which possesses a potential to cause a mishap.	No injury or only minor injury requiring first aid, but which possesses a potential to cause a mishap.

What happens when a mishap or close call occurs?

Immediate Notification Process

Within 1 Hour

- **Center Safety Office- Notify Headquarters** by Phone (for Type A, Type B, High Visibility Mishap, or High Visibility Close Call. This includes reporting a human test subject injury/fatality)
  - Duty 202.358.0006
  - Non-duty 866.230.6272
- **Chief, Safety and Mission Assurance - Notify Administrator** (Type A only) (phone and/or mishap lists email)
- Center's Chief of Aircraft Operations- **Notify National Transportation Safety Board** (NTSB) if applicable

Within 8 Hours

- **Notify OSHA** (if applicable)

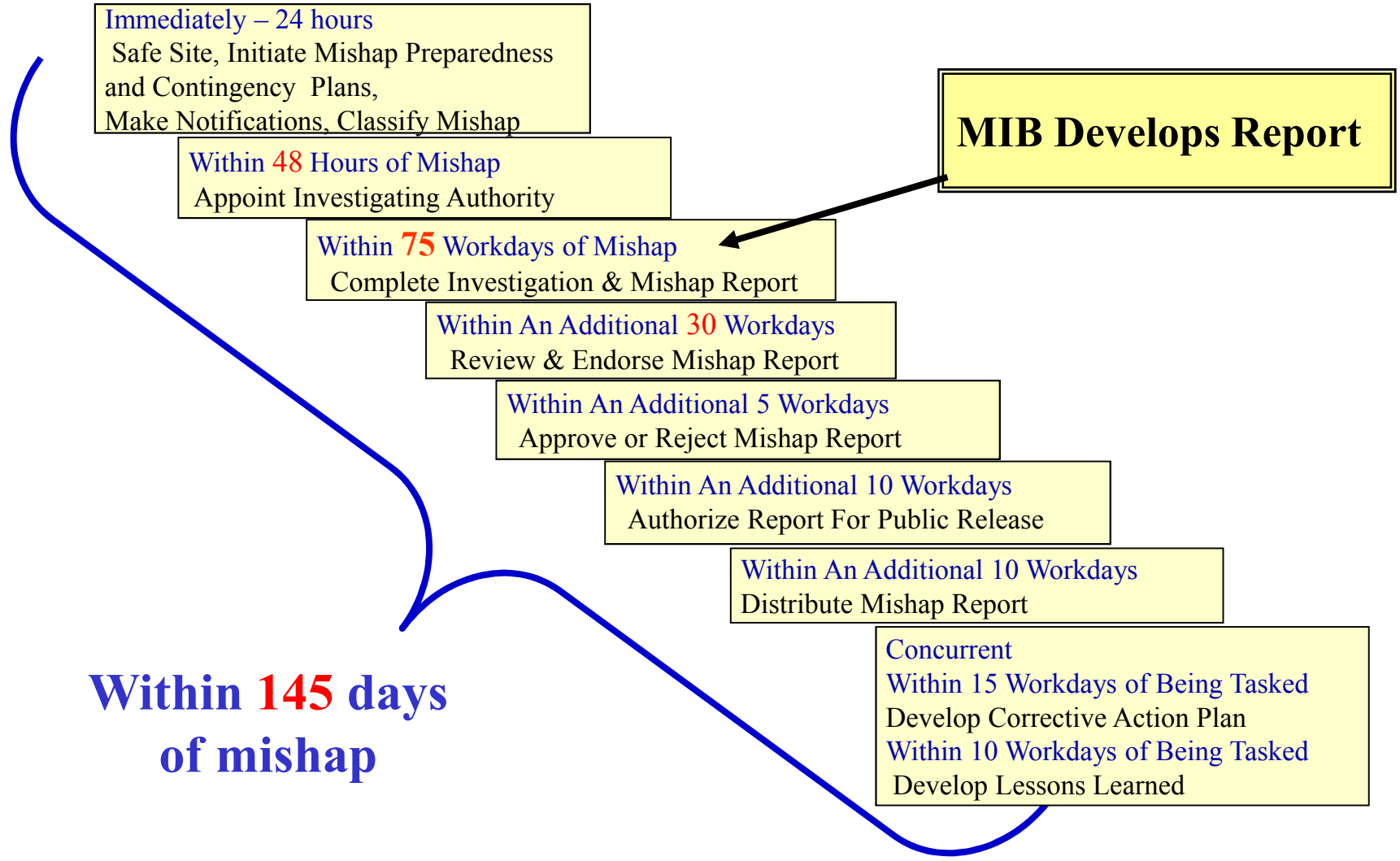
Applicable:
Up to 30 days after mishap when:
- Death of Federal Employee
- Hospitalization 3 or more if 1 is a Federal Employee

Within 24 Hours

- Center Safety **Office-Notify Headquarters electronically** with additional details
- Center Safety Office- **Record the occurrence of ALL Mishaps & Close Calls in the NASA Mishap Information System (NMIS)**

• Center Director- Notify Administrator by phone when the following occur:
  - Type A
  - Type B
  - Type C (Lost-time injury only)
  - Onsite non-occupational fatality (e.g. heart attack)
  - Fatalities and serious illness off the job (civil servant & contractor)

Mishap Investigation Notional Timeline



Changes Affecting MIB Formation

NASA must accept investigation by outside authority including:

- **When a Presidential Commission is appointed pursuant to the NASA Authorization Act of 2005 (Public Law 109-155, Section 821) to investigate the loss of a Space Shuttle, the loss of ISS or its operational viability, the loss of any other United States space vehicle carrying humans that is owned by the Federal Government or that is being used pursuant to a contract with the Federal Government, or the loss of a crew member or passenger of any space vehicle described in this subsection.**

Two Types of Mishap Investigations

- **Safety Mishap Investigation**
  (Per NASA Procedural Requirements for Mishap Reporting, Investigating and Recordkeeping - NPR 8621.1)
  - **Describes policy to report, investigate, and document mishaps, close calls, and previously unidentified serious workplace hazards to prevent recurrence of similar accidents.**
- **Collateral Mishap Investigation**
  (Procedures & Requirements being developed by the Office of the General Counsel).
  - **If it is reasonably suspected that a mishap resulted from criminal activity.**
  - **If the Agency wants to access accountability… e.g., determine negligence.**

Purpose of Safety Investigation

- The purpose of NASA mishap investigation process is solely to determine cause and develop recommendations to prevent recurrence.

- This purpose is completely distinct from any proceedings the agency may undertake to determine civil, criminal, or administrative culpability or liability, including those that can be used to support the need for disciplinary action.

MIB NOTE

YOU ARE PERFORMING A SAFETY INVESTIGATION

Collateral Investigation

Collateral Investigation's relationship:

- **The mishap investigating authority shall not distribute witness statements, notes, or transcripts of witness testimony taken during interviews, or medical records to the collateral investigation board, Office of Inspector General, or any other Agency, unless ordered in a court of law.**

- **The investigating authority may provide (at their discretion) the collateral investigation board with access to factual data and physical evidence that will be contained within the mishap investigation report authorized for public release. (All requests for information should go to the chair).**

- **Members and/or Advisors of the investigating authority should not participate in the interviews and/or deliberations of the collateral investigation.**

Investigating Authority for Safety Investigation

- Term "Investigating Authority" refers to individual mishap investigator (MI), mishap investigation team (MIT), or mishap investigation board (MIB) authorized to conduct the safety mishap investigation.

Products of the Investigation

Depth & Products of Investigation

- Depth of investigation is determined by the severity of the mishap and potential for reoccurrence. (table next page)
- Clear identification of required products from the investigation (Products become parts of the mishap report).
  - Number and type dependent upon the classification of the mishap.
  - Close calls and incidents require fewer products (elements in the reports) than mishaps.
  - All investigations require root cause analysis.

Classification Level and Required Products

	Classification Level & Investigation Type					
	High Visibility Mishap or Close Call	Type A	Type B	Type C	Type D	Close Call
Investigating Authority	MIB	MIB (at least 5 members)	MIB (at least 3 members)	MIT or MI	MIT or MI	MIT or MI
Required Products	All (a-m) [1]	All (a-m)	All (a-m)	a-e, g, k, l, m	a, b, g, k, l, m	a, b, g, k, l, m

MIB – Mishap Investigation Board
MIT – Mishap Investigation Team
MI – Mishap Investigator

a. **Investigating authority and ex officio signatures.**
b. **Each advisor's signature.**
c. **List of the investigating authority's consultants.**
d. **Executive Summary.**
e. **The OSHA Final Mishap Summary.**
f. **Description of the type of data gathered and evaluated during the investigation.**
g. **Narrative description of the facts including what, when, and where.**
h. **Timeline.**
i. **Description of all structured analysis techniques used and how they contributed to determining the findings.**
j. **Event and causal factor tree or similar graphical representation of the mishap.**
k. **Description explaining why the mishap/close call occurred including all finding(s) such as proximate cause(s), root cause(s), contributing factor(s), failed barrier(s), observation(s), and the evidence upon which the findings are based.**
l. **Conclusions and recommendations.**
m. **Minority report, if there is one**

Report Organization

Organization of Your Report

Section 1: Signature page(s), list of consultants, executive summary, and OSHA summary (when applicable).

Section 2: Narrative description and facts (what, when, where, how).

Section 3: Type of data gathered and data analysis (level of detail and products dependent upon Figure 5 in this NPR).

Section 4: Finding(s).

Section 5: Recommendation(s).

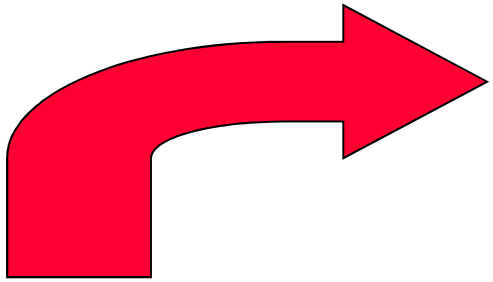
Section 6: Minority Report(s).

After Report is Authorized for Release

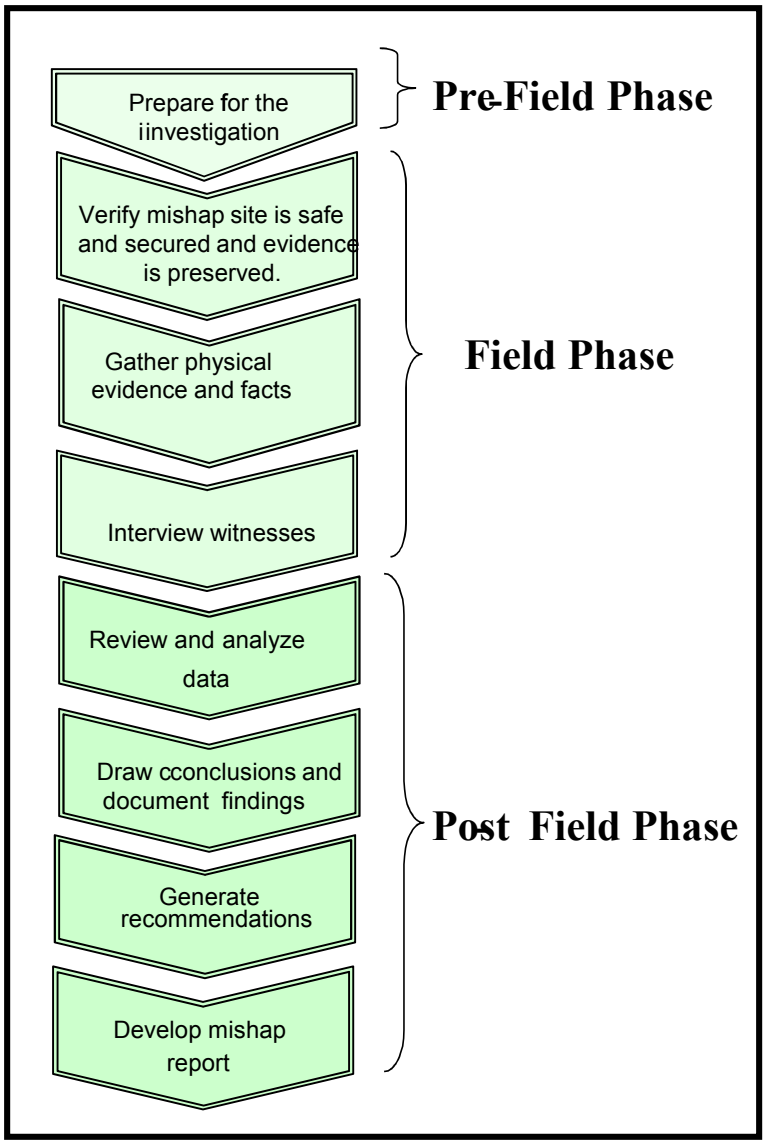
- Corrective Action Plan (CAP)
  - Appointing Official directs responsible organization to develop the CAP.
  - CAP submitted & reviewed
  - CAP implemented
  - Corrective actions tracked to closure in NMIS
- Lessons Learned (LL)
  - Appointing Official directs responsible organization to develop lessons learned
  - LL are reviewed
  - LL entered into Lessons Learned Information System (LLIS) database
- Retain Evidence & Files in Archives

Investigating the Mishap

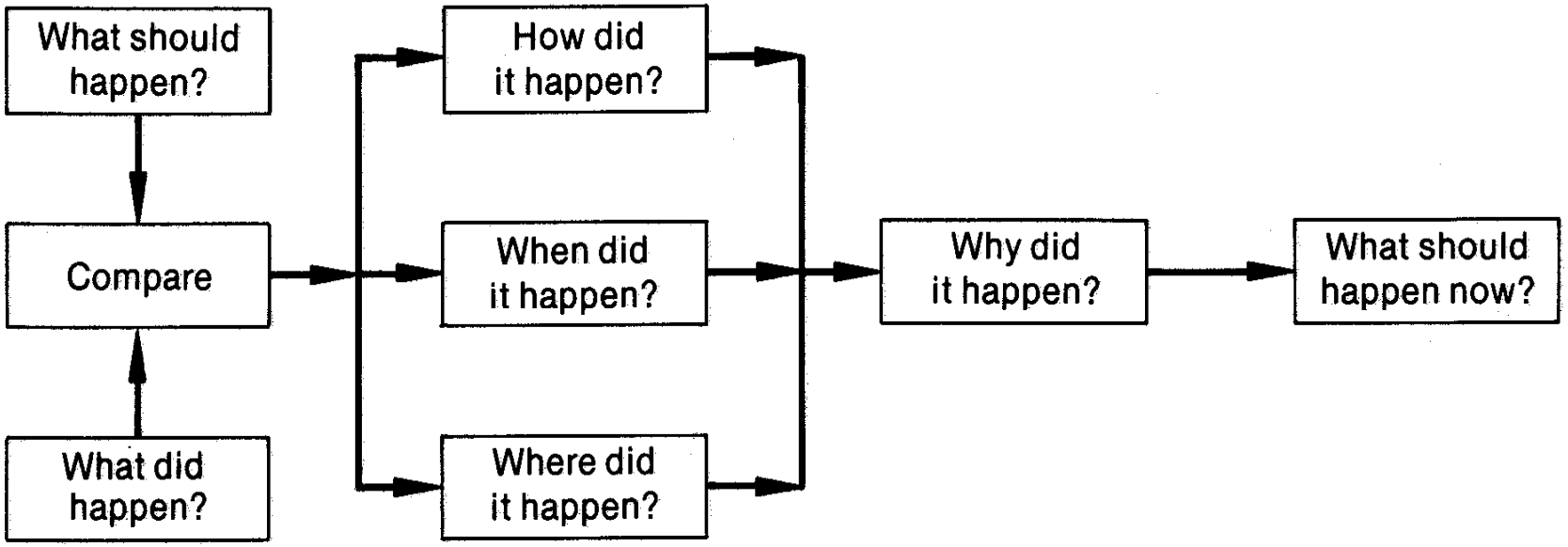
Typical Steps in an Investigation



This is usually where the investigating authority begins



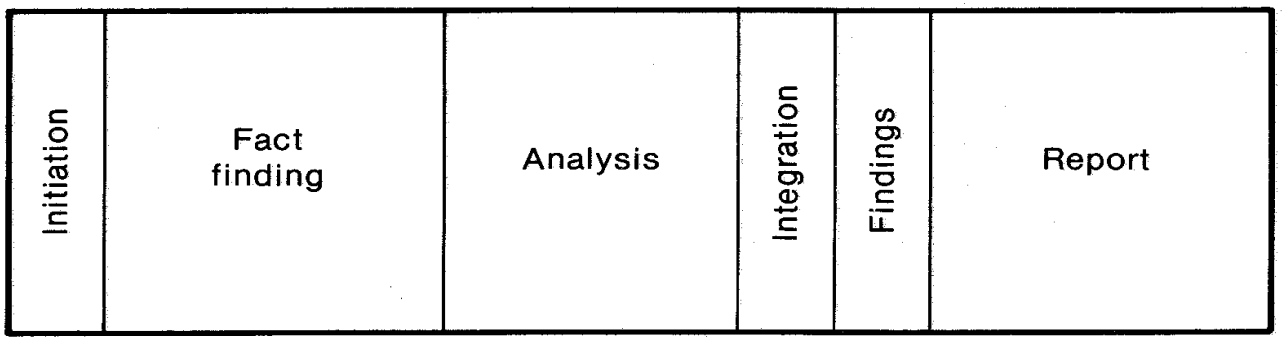
Mishap Process



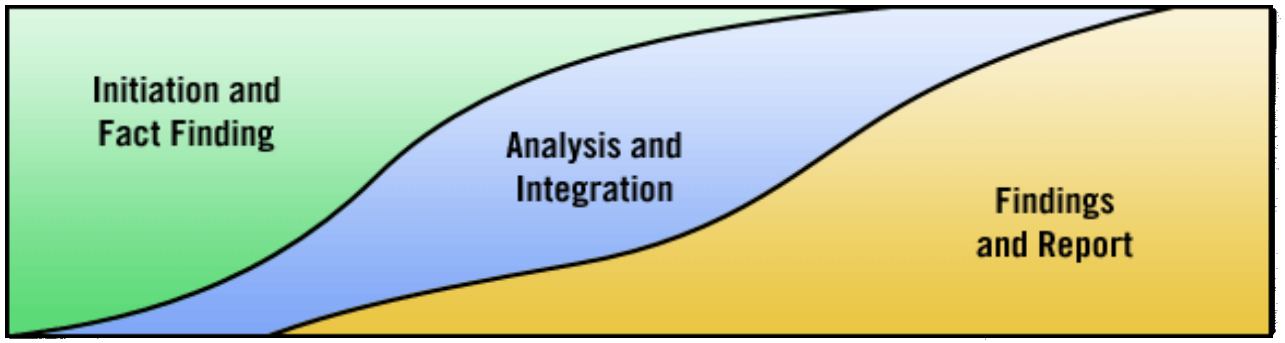
Fact-finding and analysis | Analysis and conclusions | Fact-finding | Judgments of need and recommendations

Implementing the Process

Classic phase sequence (step-by-step)



Real-life phase sequence (overlapping and combined)



Pre-Field Phase

Prepare for the Investigation

a. Mishap investigation overview training (per NPR 8621.1)

b. Acquire resources for the investigation
   - Request executive secretary
   - Request IT support to collect and organize facts & documents as they arrive
   - Photographic services
   - Identification and selection of additional consultants as necessary

c. Ensure that appropriate logistical arrangements are in progress (travel, hotel, office space, and transcription and photographic services)

d. Establish primary site for board to convene and have location furnished (computers, supplies, file cabinets, VCR, shredder, locked room, etc.)

e. Establish a preliminary accident investigation schedule, specifying milestones and deadlines, to include an initial site briefing, tour of the accident scene, and interviews.

Prepare for Investigation
Role of the Chair

Chairperson's first decisions and actions will greatly influence the entire investigation.

The chairperson should be prepared to initially:

- **Establish lines of communication with local authorities.**
- **Establish lines of communication with contractor (s) involved, local unions, and other governmental agencies, if involved.**
- **Assume custody and control of the accident scene and other evidence.**
- **Make assignments and ensure that all board members clearly understand their responsibilities.**

Prepare for Investigation
Role of the Chair

Some Tips for the Chairperson's

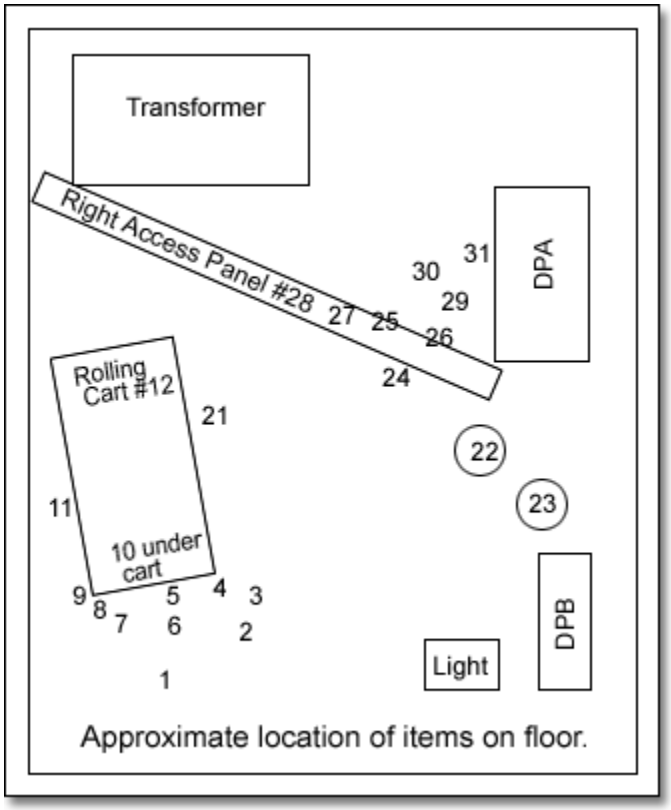
- Be explicit about the board members' level of commitment when first briefing the board. Consider the investigation to be their one and only activity.
- In the stressful situation created by the board's intense schedule and deliberations, it is essential that the chairperson understand group dynamics to manage the individual personalities of the board members.
- Be aware of the potential for a conflict of interest on the part of board members, advisors, or consultants.
- It is important to designate an individual (i.e., deputy chairperson) to act in the chairperson's place in case of an emergency, and others involved in the investigation should be notified about the temporary delegation.
- Establish a daily routine for the board, to include agreed-upon times for beginning and ending each workday. Establish a maximum time duration for the workday (e.g., workday does not exceed 12 hours for safety considerations).

Early Information Releases

Release ONLY Factual Information

What is Factual Information?

- Information that does not require analysis
- Some can be preliminary, but we make that clear
- Quantities like distance person fell, or pipe flew, time before fire put out
- Descriptors like type and color of gas released
- Documentation like system's most recent maintenance check
- Documentation like certification of operator



Security Issues

- Appropriate access to information should be considered during all aspects of the investigation. (e.g.… Don't release preliminary findings. You may release facts).
- It is important to protect sensitive and classified information, the privacy of persons involved in the mishap (e.g., witnesses)
- Keep all pertinent investigation materials in a secured location and make sure that a shredder is available to dispose of unneeded materials.

Field Phase

Visiting the Mishap Scene

- Prepare to Go to the Scene
  - Have appropriate Personnel Protective Equipment (PPE)
  - Have appropriate clothing
  - Bring water and other personal supplies

- Incident Response Team (called out by Program Contingency Plan) has initiated the process to safe site, secure site, and impound evidence. (Upon your request, they will release custody of evidence to your board).

- Verify the site is safe before entering. (Check with site commander to verify site is safe and determine whether PPE is needed)

Prepare for Conditions of the Field Investigation

- Take gear necessary for the environment
- Wear appropriate PPE before approaching the mishap site.

- Genesis spacecraft launch, August 8, 2001
- Collect solar wind samples for two years
- Return to Earth September 8, 2004.
- Most science was recovered.

Visiting the Mishap Scene

- The chairperson shall ensure that all the appropriate perishable evidence has been collected, photographed, documented, and/or impounded.
- Determine what else is needed.
- Make sure that a site map (debris field map) is constructed prior to removal of evidence.
- Protect evidence from the elements.
- Ensure that evidence is impounded.

  (Including all the necessary data, records, and equipment have been impounded and are being stored in a secure site).
- Take good notes and lots of pictures

After Visiting the Scene

MIB Activities in Board Room

- Discuss observations from the accident scene visit.
- Establish a formal chain-of-custody procedure for evidence.
- Discuss the need for laboratory analysis or additional technical experts.
- Determine where physical evidence will be stored… and determine required space and environmental conditions for this storage.
- Determine the need for a telephone "hotline."

Data Collection

Initially Focus on "WHAT HAPPENED"

- **NOT "Why It Happened."**
  Do Not Fixate on Causes.

- **NOT "How Do We Prevent It Again or Solve the Problem."**

Investigating a Mishap and Fixing the Problem are Two Separate Things... Keep Them Separate.

Data Collection

Fact Finding - "What Happened"

Comprehensive Search Should Include:

- ✓ Hardware
- ✓ Software
- ✓ Procedures& Communications
- ✓ Facilities
- ✓ Environment
- ✓ People (technicians, operators, maintainers, supervisors, management, and executives)
- ✓ Company/Organization

Data Collection

Three general types of evidence will be collected:

- **Human evidence** (witness statements and observations).
- **Physical evidence** (matter related to the accident, such as equipment, parts, debris, fluids, etc.).
- **Documentary evidence** (video, photographic, paper and electronic information).

Data Collection – Some Sources of Data

- Audio (during accident, of meetings e.g., PAR, COFR)
- Video & photographs
- Computer aided design, 3-D simulation, flight simulation
- Telemetry & radar
- Hardware design drawings, as-built configuration & debris
- Quality records on materials & processes (manufacturers, suppliers, operations, engineering)
- Maintenance & inspection records
- Info. on chemical, radiation, thermal, structural, mechanical, electrical and biological changes in system or processes

- Existing fault trees & FMEAs
- Hazard analysis & safety analysis
- Risk assessment and PRA
- Policies and procedures (including stamped job cards/procedures)
- Problem reports, corrective action reports, anomaly reports and/or mishap reports
- Interviews & initial witness statements
- Time cards, training records, certification records
- Medical evidence
- Company records (budget, layoffs, past reports, hiring practices)
- Weather data

Data Collection - Tips

- Never discard anything — even items that appear trivial at first may prove useful later in the investigation.
- Carefully document evidence at the time it is obtained or identified.
- Enlist the aid of technical experts when making decisions about handling or altering physical evidence.
- Intact and complete evidence is the foundation of a successful accident investigation.
- Fluids emanating from equipment or vehicles may quickly evaporate or be absorbed by surrounding materials. Therefore, fluid samples should be taken quickly.

Data Collection: Interviews

Purpose of Witness Interview

1. To find out what the witness observed or did.
2. To learn the witness's opinion of potential cause(s) of the mishap.

Two Types of Interviews

- Privileged Witness Interviews
- Non Privileged Witness Interviews

Data Collection: Interviews

- All written witness statements obtained within the first 24 hours of the occurrence of a mishap or close call shall be considered privileged and protected.

- All verbal witness statements and written statements given after 24 hours as part of a NASA mishap investigation, where the witness was explicitly informed that his/her account will not be released, shall be considered privileged and protected.

- NASA shall make every effort to keep witness testimony (both written and verbal) confidential and privileged to the greatest extent permitted by law. This privileged information will be strictly limited to only the information provided directly by the witness for the safety investigation.

Data Collection: Interviews

- Interview as soon as possible. (Only 2-3 interviewers in room)
- Prepare for the interview (prepared questions, recording devices, comfortable room).
- Obtain witness permission before taking notes or recording.
- Explain interview purpose (written statement)
- Establish rapport with the interviewee.
- Get facts (name, company, witness location, duty, etc.).
- Begin with open ended statement: "Can you tell me in your own words what you know about the accident?"
- Use neutral questions "Then what did he do?"
- Request suggestions on prevention strategies.
- Listen, Listen, Listen....
- Get interviewee's agreement on content of statement.
- Provide call back information.
- Thank them.

Data Collection: Interviews

- His/her oral statement (taken during interview) and/or written statement will be retained as part of the investigation report background files but will not be released as part of the mishap report.

- When a verbal statement is taken or interview conducted the witness interview shall be confidential, and the interviewer shall read the statement on the following slide:

Statement to Witnesses

The purpose of this safety investigation is to determine the proximate cause(s) and root cause(s) of the mishap that occurred on _____ and to develop recommendations toward the prevention of similar mishaps. It is not our purpose to place blame or to determine legal liability. Your testimony is entirely voluntary, but we hope that you will assist the investigating authority to the maximum extent of your knowledge in this matter.

Your testimony will be documented and retained as part of the mishap report background files but will not be released with your name as part of the mishap report.

The investigating authority will make every effort to keep your testimony confidential and privileged to the greatest extent permitted by law.

For the record, please state your full name, title, address, employer, and place of employment.

Data Collection: Interviews

- The witness shall not be given a copy of the written statement or transcripts of verbal witness statements given in the course of a NASA mishap investigation.

- WHY? If witness statements or transcripts of witness testimony are provided to a witness, NASA cannot ensure that it remains privileged and confidential.

Signature Page

You have completed:

Mishap Investigation Board Orientation

If you have any questions about this presentation or Stennis Space Center procedures for mishap investigations, you may contact the persons listed below:

Mike Rewis / 228-688-2663 / mike.j.rewis@nasa.gov
Daryl Kosturock / 228-688-3641 / daryl.kosturock-1@nasa.gov

Print this slide, sign and date and submit to NASA SMA with your completed mishap investigation report

_____	_____	_____
Signature	**Company**	**Date**