

Construction Mishap Investigation Orientation

Revised: 01/29/2021



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.



Agenda

- NPR 8621.1 Overview
- What's a Mishap
- What's not a Mishap
- Classification of Mishaps
- What Happens After a Mishap Occurs
- Construction Mishap Investigation
- Notional Investigation Timeline
- Two Types of Mishap Investigations
- Purpose of Safety Investigation
- Investigating Authority
- Products of Investigation Report Contents
- After Report is Authorized for Release
- Overview of Investigation Process
- Pre-Field Phase
- Field Phase
- Data Collection
- Signature Page





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:

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

Close Call:

An unplanned event in which there is no injury or only minor injury requiring first aid, no damage or minor damage (less than \$20,000) to equipment or property or both, but which possesses a potential to cause a mishap.

ALL MISHAPS and CLOSE CALLS ARE INVESTIGATED

NASA reserves the right to be the lead for mishap investigations of mishaps defined above.



What's Not A Mishap?

The following are not considered NASA Mishaps or Close Calls:

- a. Illnesses or fatalities resulting from natural causes or those unrelated to the work environment when disease, not injury, is the cause of lost time (e.g., diabetes and resultant complications, loss of vision).
- b. Intentional self-inflicted injuries or fatality.
- c. Injuries or fatalities resulting from altercations, attack, assault unless incurred in the performance of official duties such as criminal investigations or homicide.
- d. Destruction of or damage to any property (public, private, or Government) onsite at a Center or involving NASA property on grounds outside Center property as a direct result of any of the following:
 - ➤ Weather conditions such as hurricane, lightning, tornado, high winds, dust storm, tidal wave, tsunami, waterspout, or ice or snow loads,
 - ➤ Natural phenomena such as flood, landslide, earthquake, meteoroid landing, or volcanic eruption,
 - > Wild fire,
 - > Vandalism, riot, civil disorder, or felonious act such as arson or, in some cases, theft.



What's Not A Mishap?

The following are not considered NASA Mishaps or Close Calls (continued):

- e. Accidents occurring during the transportation of NASA material by commercial carriers when NASA or NASA contractors had no roles or responsibilities for packing, securing, or transporting the items.
- f. 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 complete system or unit of equipment. This only applies if there was adequate preventative maintenance and the malfunction or failure was the only damage, and the sole action is to replace or repair that component. In addition, there must not have been a malfunction or failure of a component part that resulted in damage to another component, the facility or injury to personnel.
- g. Accidents involving aircraft operated as civil use, owned by civil operators, and accomplishing contract air missions for NASA where there is no NASA property damage or Federal employee injury.



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

NOTE:

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



Mishap Classification Levels

Classification Level	Property Damage	Injury	
	Total direct cost of mission failure and property damage of \$2,000,000 or more, or	Occupational injury or illness resulting in A fatality,	
	Crewed aircraft hull loss,	or	
Type A Mishap	or	A permanent total disability.	
	Unexpected aircraft departure from controlled flight for all aircraft except when departure from controlled flight has been pre-briefed (e.g., upset recovery training, high AOA envelope testing, aerobatics, or OCF for training) or mitigated through the flight test process inherent at each Center.		
	Total direct cost of mission failure and property damage of at least \$500,000, but less than \$2,000,000.	Occupational injury or illness resulting in a permanent partial disability,	
Time D		or	
Type B Mishap		Hospitalization for inpatient care of three or more people within 30 workdays of the mishap.	



Mishap Classification Levels

Classification Level	Property Damage	Injury		
	Total direct cost of mission failure and property damage of at least \$50,000, but less than \$500,000.	Nonfatal OSHA-recordable occupational injury or illness resulting in days away from work, or restricted duty, or transfer to another job beyond the day or shift on which it occurred,		
Type C Mishap		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 of at least \$20,000, but less than \$50,000.	Nonfatal OSHA-recordable occupational injury or illness that does not meet the definition of a Type C mishap.		
Close Call Mishap	Total direct cost of mission failure and property damage of less than \$20,000, but event has the mishap potential using a worst case estimate.	Injury requiring first aid or less, but event has the mishap potential using a worst case estimate.		



What happens when a mishap or close call occurs?



Immediate Notification Process

!!!IMMEDIATELY!!! ALL EMPLOYEES

(who witness or are involved in a workplace injury, illness, or property damage event)
Shall notify emergency services at 228-688-3636 from cell phone, or 911 from a land line while on SSC property, then notify Supervisor, CO or COR, SMA Construction Safety Representative.

Within 1 Hour (ASAP)

For Type A or B Mishap
COR or Supervisor - Notify SMA Director

Within 24 Hours

- Formal Notification
 - > Civil Servants notify supervisors
 - Contractors notify COR
- Supervisors and CORs
 - Notify the SSC SMA Director
- Incident Recorded in NMIS within 24 hours
 - > SMA POC or Mishap Manager
- If applicable Activate Mishap Plan



Immediate Notification Process

For SSC Management and SMA

Within 1 Hour

SMA 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

SMA OFFICE

Notify Administrator (Type A only) (phone and/or mishap lists email)

Chief of Aircraft Operations Notify National Transportation

Safety Board (NTSB)

if applicable

Within 8 Hours

SMA OFFICE

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

SMA OFFICE

Notify Headquarters electronically with additional details

SMA 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)



Immediate Notification Process

For SSC Construction Contractors

Within 1 Hour

- **DISPATCH** (by Phone)
 - > Landline 911
 - > Cell phone 228-288-3636
- NASA SSC Point of Contact
- CO or COR
- SMA Construction Safety

OSHA

Follow company policies for required notifications to OSHA.



Construction Mishap Investigation

SSC Form 1627

- Within 24 hours of incident the <u>initial</u> SSC Form 1627 shall be completed by the contractor and submitted via email or fax to the appropriate configuration coordinator, the CO and the SMA Construction Safety Representative.
- After the contractor completes an investigation of the mishap/close call (NMIS), and has developed a plan of corrective action, the contractor shall complete the remaining portions of the NASA Form 1627 and submit the <u>final</u> SSC Form 1627 to the COR and to NASA SMA Construction Safety.
- Mishap Investigation (Mishap Investigation Document, may also repeat some of the information in the SSC Form 1627)
 - A root cause analysis will be performed using the "Five Whys", or an equivalent technique and ultimately drive the corrective action process.
 - Additionally, the contractor shall complete a written final investigation on company letterhead and sign the report.



Construction Mishap Investigation Notional Timeline

Immediately

Safe Site, Initiate Mishap Preparedness and Contingency

Plans, Make Notifications, Classify Mishap

Within 24 Hours of Mishap

Complete Initial NASA SSC Mishap Report Form SSC 1627

(This report is required to be submitted via email or fax to the appropriate configuration coordinator, the CO and the SMA Construction Safety Representative)

Investigation

A root cause analysis will be performed using the "Five Whys", or an equivalent technique and ultimately drive the corrective action process

Construction Contractors

Ensure at least one (1) employee on the mishap/close call

investigation team is trained in the Mishap Investigation Orientation

Within 75 days of mishap

NOTE

The contractor shall be the default Investigative Authority if the mishap or close call is a contractor onsite injury or illness or the contractor caused property damage classified as a Type C or D mishap or close call, unless specifically directed to do otherwise by NASA. (SPLN-8621-0003, Paragraph 3.3.11)

Investigation Completion

After the contractor completes an investigation of the mishap/close call (NMIS) and has developed a plan of corrective action, the contractor shall complete the remaining portions of NASA Form 1627 and submit it to the COR and to NASA SMA Construction Safety. Additionally, the contractor shall complete a written final investigation on company letterhead and sign the report.

Investigation Board

If an investigation board is convened or will be convened, the supervisor or safety representative of the contractor shall complete the form and forward it to the COR, and to the SMA Construction Safety Representative



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 Requirements being also

(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 <u>determine cause</u> and develop recommendations to <u>prevent</u> <u>recurrence</u>.
- This purpose is completely <u>distinct from</u> any proceedings the agency may undertake to determine <u>civil</u>, <u>criminal</u>, <u>or</u> <u>administrative culpability or liability</u>, 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 <u>shall not distribute witness</u> <u>statements, notes, or transcripts of witness testimony</u> 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 <u>factual data</u> 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 <u>should</u> 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 <u>severity of the</u> <u>mishap and potential for reoccurrence</u>. (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	Туре А	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, I, m	a, b, g, k, l, m	a, b, g, k, l, m

- 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.
- I. Conclusions and recommendations.
- m. Minority report, if there is one

MIB – Mishap Investigation Board

MIT - Mishap Investigation Team

MI – Mishap Investigator



Report Organization

Organization of a 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



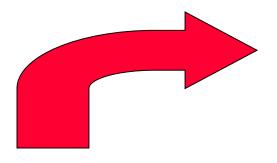
Overview of Investigation Process

Investigating the Mishap

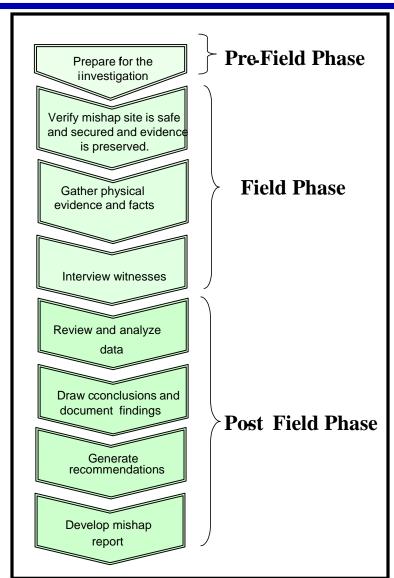




Typical Steps in an Investigation

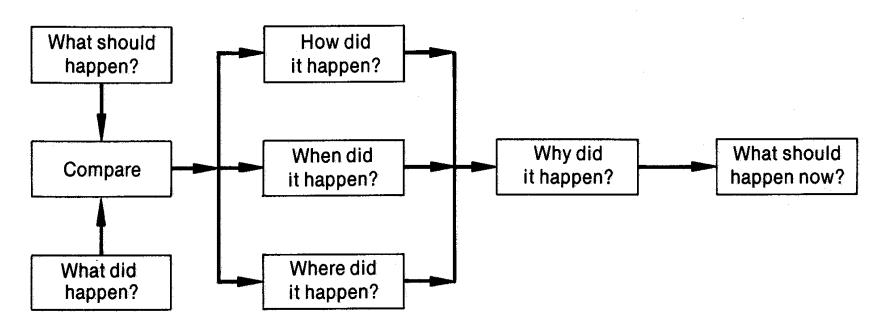


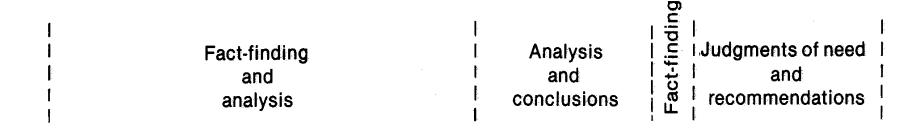
This is usually where the investigating authority begins





Mishap Process





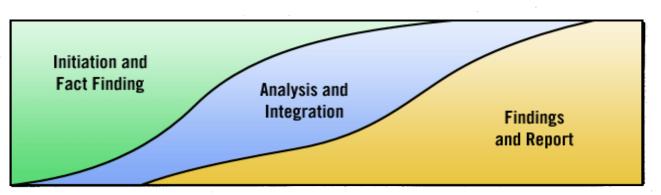


Implementing the Process

Classic phase sequence (step-by-step)

Initiation	Fact finding	Analysis	Integration	Findings	Report
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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 <u>logistical arrangements</u> are in progress (travel, hotel, office space, and transcription and photographic services)
- d. <u>Establish primary site for board to convene</u> and have location furnished (computers, supplies, file cabinets, VCR, shredder, locked room, etc.)
- e. <u>Establish a preliminary accident investigation schedule</u>, 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 <u>communication with local authorities</u>.
- Establish lines of <u>communication with contractor</u> (s) involved, <u>local unions</u>, and other governmental agencies, if involved.
- Assume custody and <u>control of the accident scene and other</u> <u>evidence</u>.
- 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 <u>understand group dynamics to</u> <u>manage the individual personalities of the board members.</u>
- Be aware of the potential for a conflict of interest on the part of board members, advisors, or consultants.
- It is important to <u>designate an individual</u> (i.e., deputy chairperson) to act in the <u>chairperson's place</u> in case of an emergency, and others involved in the investigation should be notified about the temporary delegation.
- <u>Establish a daily routine</u> 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).

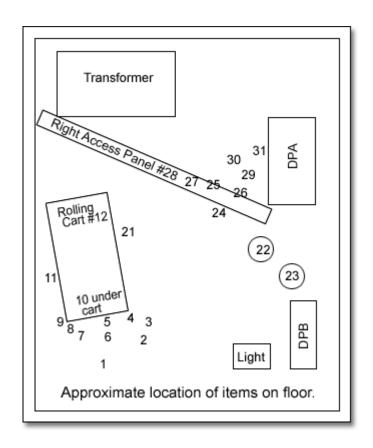


Early Information Releases

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.... <u>Don't release preliminary</u> <u>findings</u>. 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.



Purpose of Witness Interview

- 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

- 1. Privileged Witness Interviews
- 2. Non Privileged Witness 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.



- Interview as soon as possible. (Only 2-3 interviewers in room)
- <u>Prepare for the interview</u> (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.



- 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.



- The witness shall <u>not</u> 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:

Matthew Scott / 228-688-1537 / matthew.r.scott@nasa.gov M. Frank Olinger / 228-688-1766 / milford.f.olinger@nasa.gov

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

Signature	Company	Date