Design of Systems for Safe Launch Operations

Session S-12

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Concept of rocket design

- **First focus is performance**
  - **Getting it to go as far as planned and to the desired location**

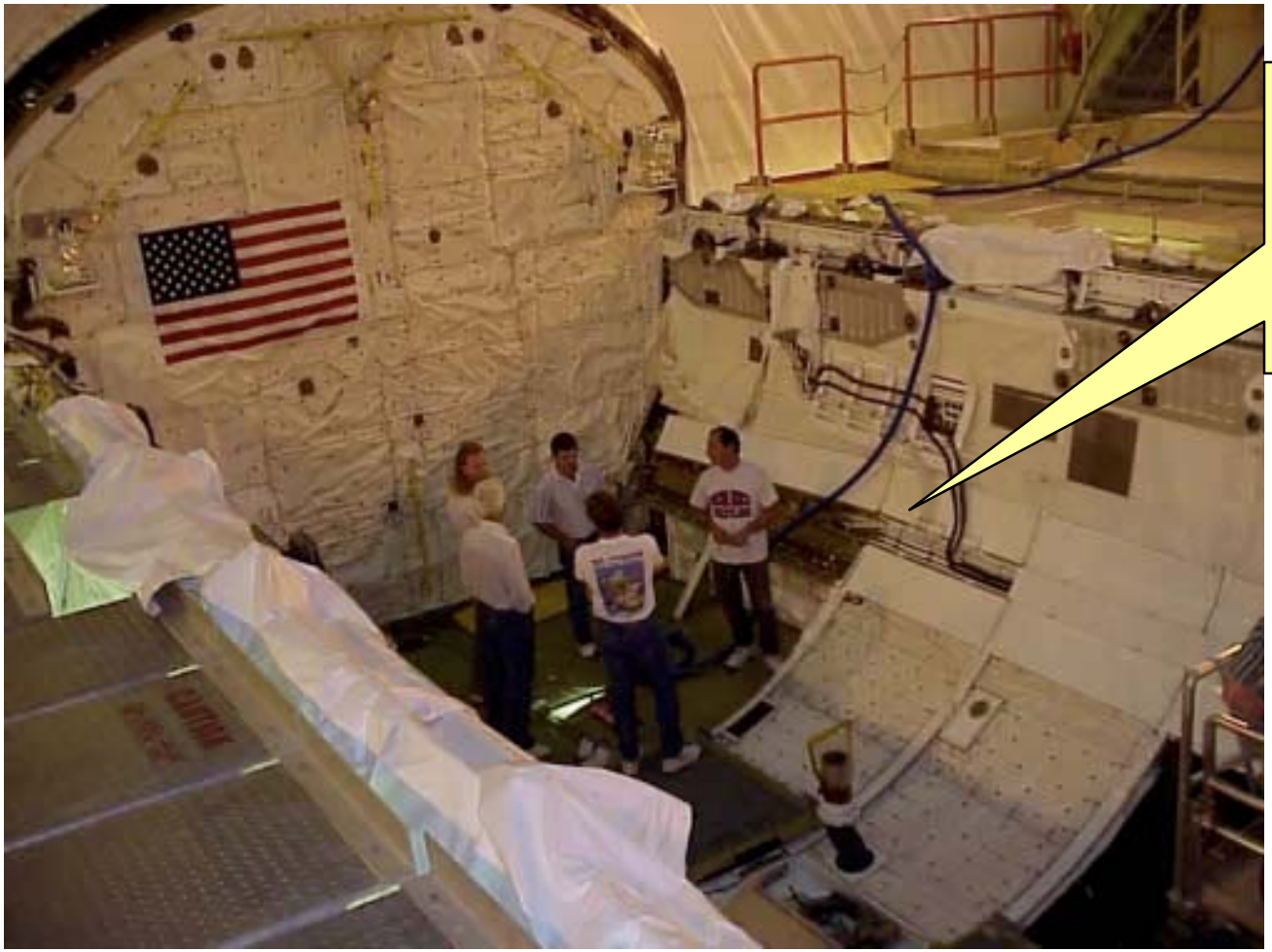
Concept of rocket design

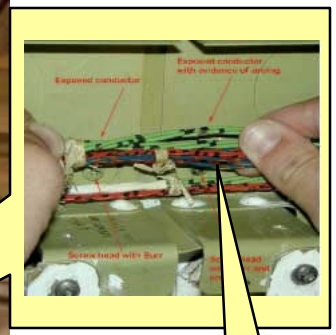
- **First focus is performance**
  - **Getting it to go as far as planned and to the desired location**
  - ***Without blowing up!***
- **So designers worry about**
  - **GN&C**
    - **Avionics**
    - **Electrical power**
    - **Inertial guidance systems**
  - **Fuels**
    - **Types**
    - **Amounts**
  - **Engines**
    - **Turbines**
    - **Combustion chambers**
    - **Nozzles**
  - **Plumbing**
    - **Valves**
    - **Pipes**
  - **Thermal protection**

People in the system

- **Wernher von Braun & the spark**
  - **Cape Canaveral**
  - **Redstone LV**
  - **Champagne**
- **Titan II explosion in silo**
  - **Arkansas, 1980**
  - **Maintenance crew**
  - **Dropped wrench 80’**
  - **Dumped N_2O_4**
- **Saturn V Skylab launch**
  - **Micrometeoroid shield let loose**

People in the system, II
STS-93





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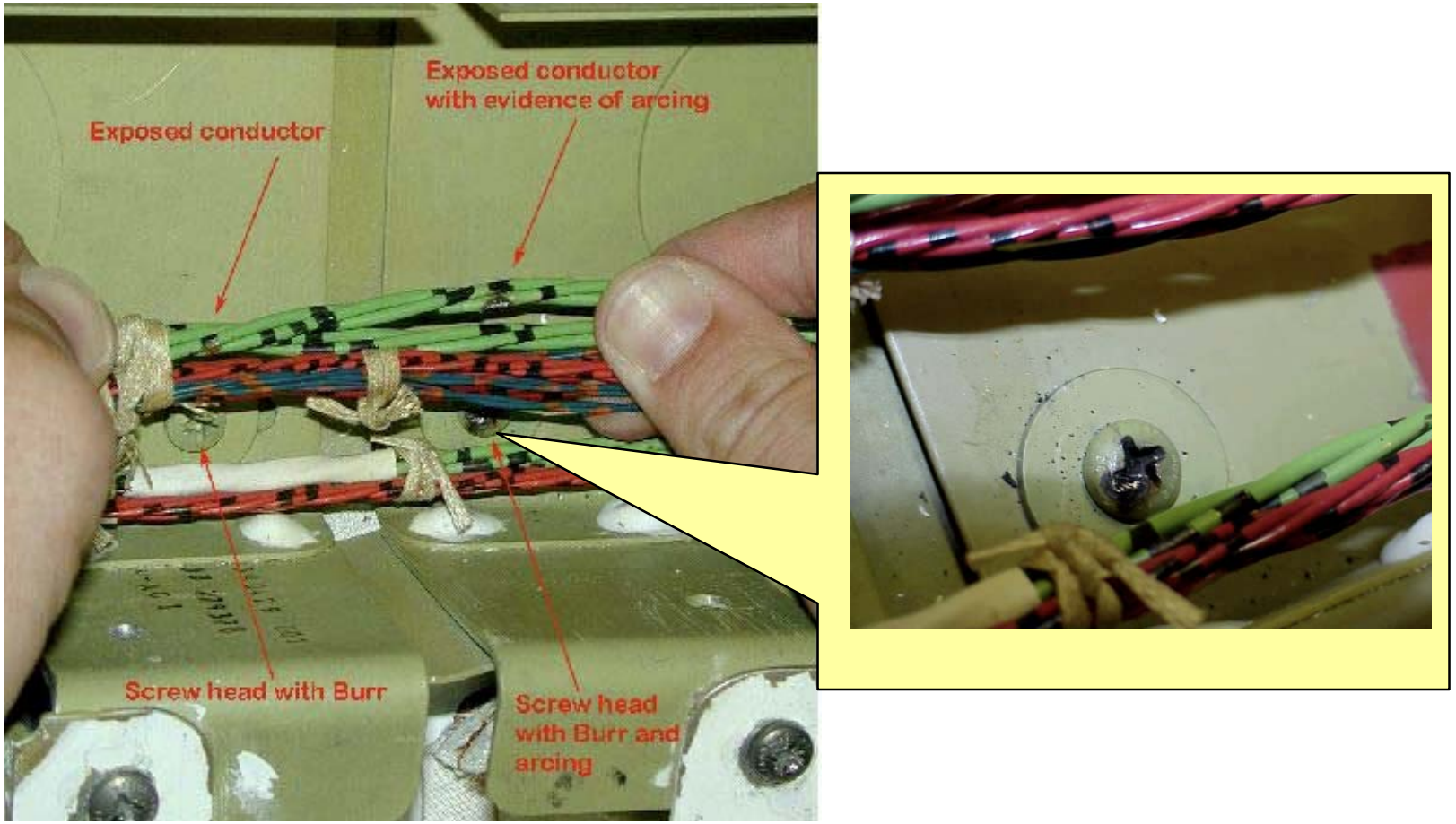
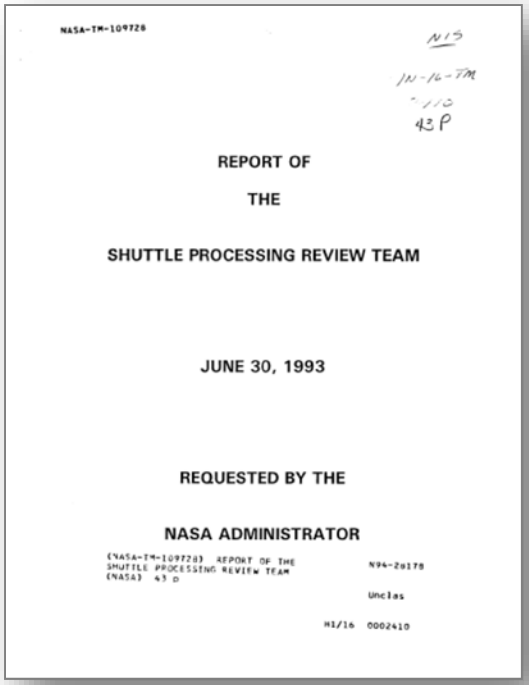


Issue

- Perry Report (1993; KSC) assessed impacts of "human error" on ground processing
- Identified numerous examples of damage to flight hardware by ground crews
  - 58% of mishaps due to human factors
    - (includes procedures)
- Recommended extensive tightening of processes
  - Procedures development and adherence
  - Quality Assurance
  - Communication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REPORT OF

THE

SHUTTLE PROCESSING REVIEW TEAM

JUNE 30, 1993

REQUESTED BY THE

NASA ADMINISTRATOR

(NASA-TM-109728) REPORT OF THE SHUTTLE PROCESSING REVIEW TEAM (NASA) 43 p

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Unclas

H1/16 0002410

- ***They could not change the design of the vehicle***
  - NASA had no human factors requirements imposed on launch vehicles

Development of requirements on flight systems

- Constellation Program (2005-2006)
- Developed requirements on flight systems, *de novo*
- Collaborative effort between Launch Site personnel and Constellation requirements team
  - Requirements are applicable to:
    - "Every-time" assembly tasks
    - "Known" maintenance
      - Preventive
      - Corrective (LRU)
- After Constellation ended (2010)
  - Flight systems (now Space Launch System - LV- and Orion crew vehicle) maintained these requirements
  - Launch Site instituted its own set, applied to design of Ground Support Equipment
- These are being standardized in NASA-STD-3001
  - NASA Space Flight Human System Standards