

# *Foreign Material Control for Workers*

# Let's Talk Safety!!



# Why is FME Important



**This problem was traced to a rag left in a brake line (used to stop tire rotation during gear retraction) during the plane's assembly. This caused the wheel to lock up upon landing. One rag caused a several million dollar accident and the near death of the two pilots.**

# Why is FME Important



- The Space Shuttle Columbia was the first space worthy shuttle in NASA's orbital fleet. It was destroyed during re-entry over Texas on February 1, 2003 after a hole was punctured in one of the wings during launch 16 days earlier when struck by insulation debris off of the Solid Rocket Booster.

# Terminal Objective

**Upon successful completion of this course, participants will be able to implement the Nuclear Power Group (NPG) Foreign Material Exclusion [FME] program as detailed in Standard Programs and Process SPP-6.5. In order to demonstrate their knowledge, students must score  $\geq 80\%$  on a written examination.**

# Enabling Objectives

- 1. State the purpose of the FME Program as described in SPP-6.5.**
- 2. Define the term Foreign Material and give examples and affects.**
- 3. Identify the two levels of FME coverage.**

# Enabling Objectives

4. Describe the responsibilities of the following, emphasizing their roles in preventing entry of Foreign Material [FM] into a system or component.
  - Planner
  - Work Supervisor or Designee
  - Worker
  - Foreign Material Exclusion Monitor
  
5. Define the steps to be taken upon suspension of a job within a FME Zone.

# Enabling Objectives

6. Identify steps required for recovery from loss of FME control as stated in SPP-6.5.
7. Describe the proper documentation to include purpose and use of the following procedure attachments.
  - FME Accountability Log
  - Foreign Material Control Requirements Sheet
  - Overhead Crane FME Pre-Operational Inspection
  - Foreign Material Control Exemption
  - FME Plan



# Introduction

Nuclear power is but one of many industries that have been plagued by problems caused by foreign material. We have made great strides forward in its prevention, but still requires further diligence from everyone.

NPG's FME program has been successful in addressing most of these issues, but we are still seeing problems with breaches in fuel cladding.

FME can be summarized as ***“Attention to Detail”*** in the work that you perform.

# Purpose of FME Control

To establish the requirements for maintaining cleanliness by preventing the uncontrolled introduction of foreign material into open systems or components and the recovery from intrusion of foreign material.

Emphasis is Always  
**“FOCUS ON PREVENTION”**

# What is Foreign Material?

Materials that are not part of the systems/component design.



PPT005.000

Rev. 7

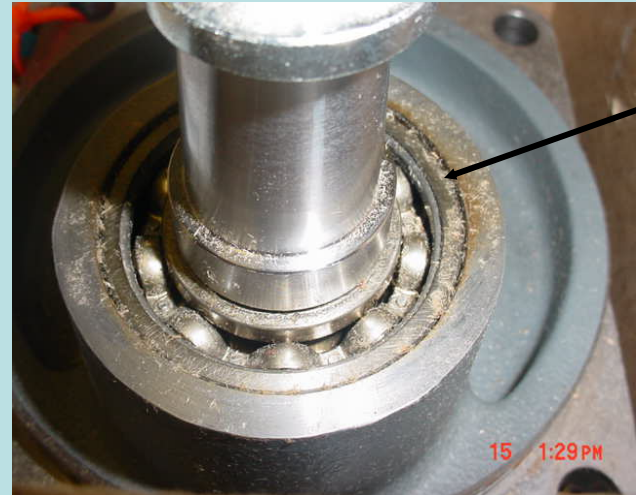


# Types of Foreign Material

**Welding slag**



**Shavings/Grinding dust**



**Bristles from  
Wire Brushes**



# Types of Foreign Material

**Foreign material from protective coverings:**

**Stripped paint & paint chips**

**Wire insulation**



# Types of Foreign Material

Building material &  
Tools

Dirt & debris

Equipment parts

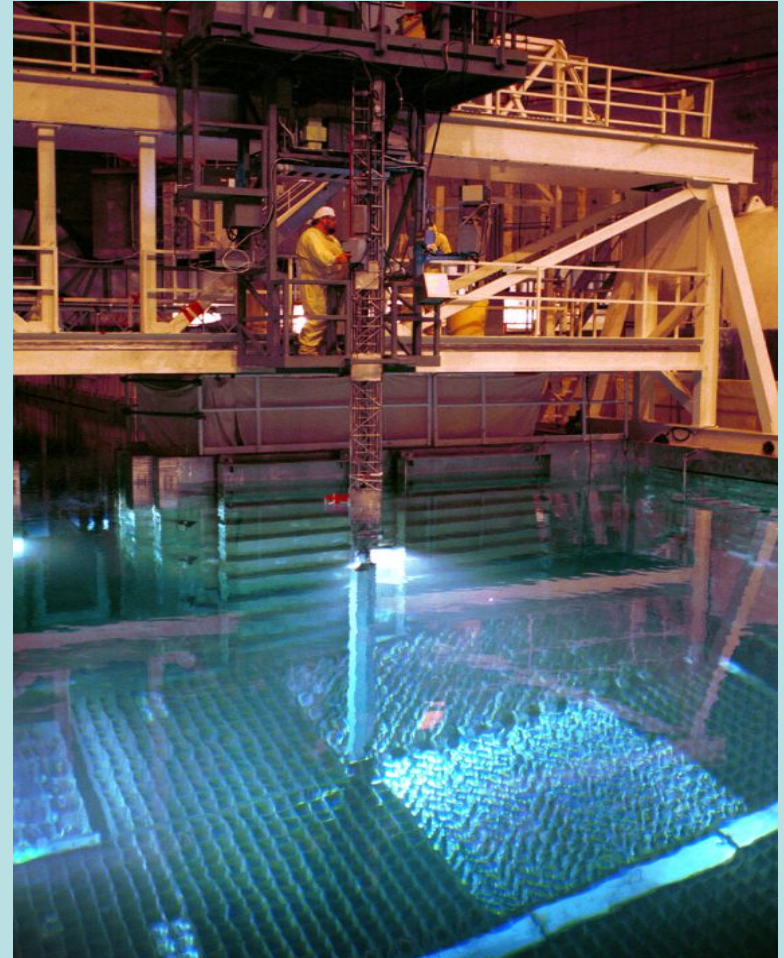


*Does your job  
affect others?*



# Effects on Plant Performance

## Damage to Fuel



# Effects on Plant Performance

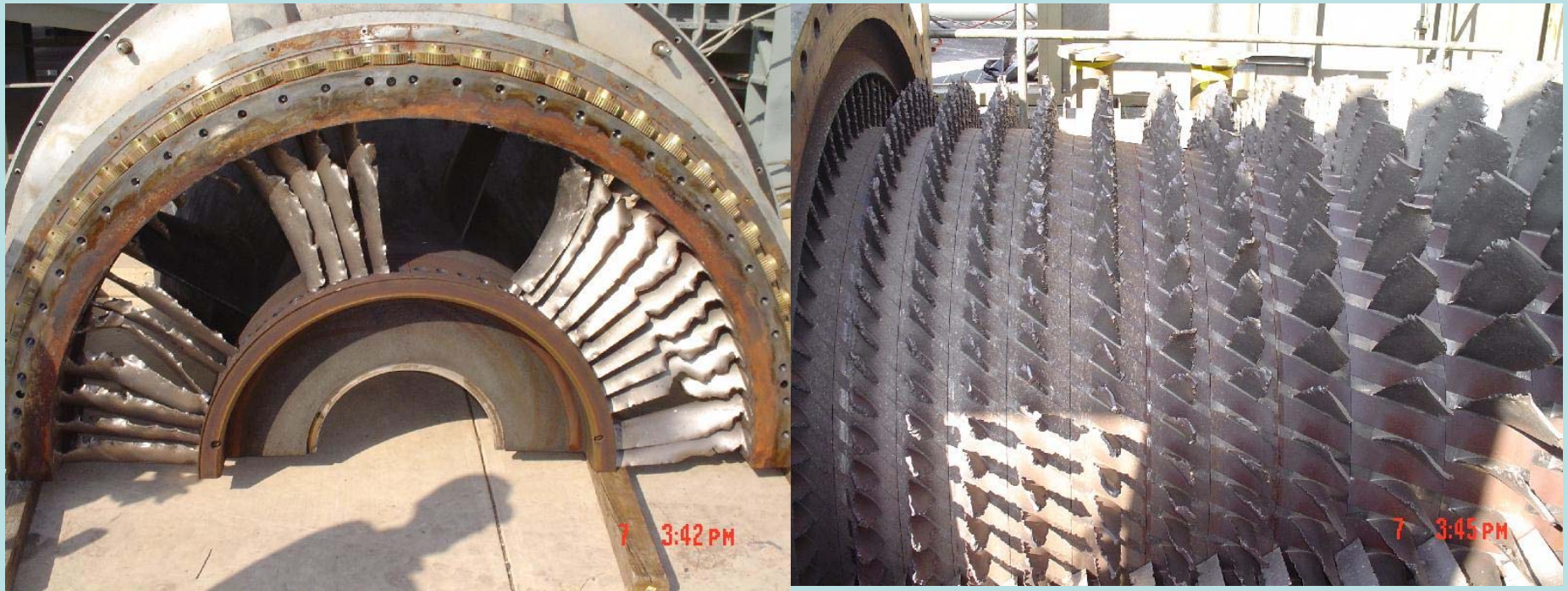
- **Corrosion**
- **Wear of equipment**





# Effects on Plant Performance

**Impact damage caused by roll of paper towels.  
This resulted in 8 million dollars of damage.**



# Effects Plant Performance

## Radiation Hot Spots



PPT005.000

## Radioactive Waste



Rev. 7

# Cobalt Information

**ALARA  
CONCERN !**



**Stellite contains a high percentage of cobalt which is highly radioactive via neutron bombardment**

***1 gram of Cobalt simulated for demonstration purposes***

**1 gram of Co-60 = 17,000 R/hr at contact!**

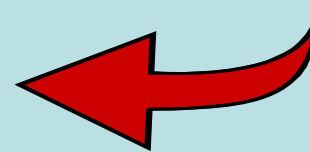
**(1 gram is equal to ~1/28 of an ounce)**

# Foreign Material Here Can Kill

*A dropped part in  
electrical equipment  
can cause an arc*

- ✓ Do not leave Electrical Components open or uncovered.
- ✓ Do not allow a part or a tool to drop into electrical equipment.
- ✓ If you leave the equipment for a break, lunch or the night

**CLOSE IT OR COVER IT!**



# Foreign Material Effects Everyone

- **Loss of generation**
- **Increases maintenance costs**
- **Increases radiation exposure**
- **Shortens life of parts/equipment**



# **FME Level 1 Zone (High Risk)**

**Established when the most restrictive controls are necessary to prevent the introduction of foreign material into a system or component.**

# FME Level 1 Zone (High Risk) Criteria

- **Loss of FME Integrity could result in:**
  - **Personnel injury**
  - **Nuclear fuel failure**
  - **Reduced safety system or station availability**
  - **Outage extension**
  - **Significant cost for recovery**



# FME Level 1 Zone (High Risk) Criteria

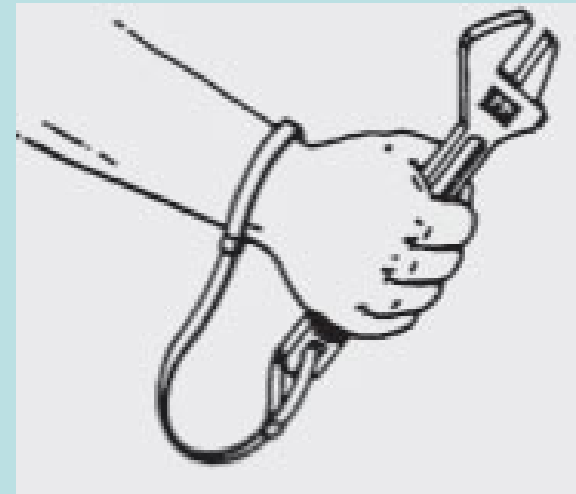
- Final visual inspection of internal cleanliness before system closure is not possible.
- Increased risk to systems, components, or structures.
- Work on systems listed in Appendix B with process stream open.





# FME Level 1(High Risk) Zone Requirements

- **Assign a Monitor**
- **Establish tool and material accountability**
- **Lanyard use**
- **Establish Zone Boundary**
- **Establish Buffer Zone**



# FME Level 1 (High Risk) Zone Requirements

- Record items entering and exiting the FME Zone.
- Personnel entering the zone are accountable for securing their personal objects.



# FME Level 1(High Risk) Zone Requirements

- Any time a crane passes over a FME Zone 1:
  - Preoperational walkdown
  - Remove or secure personal items
  - Secure items inside the cab
  - Post/Control crane as a FME Zone 1

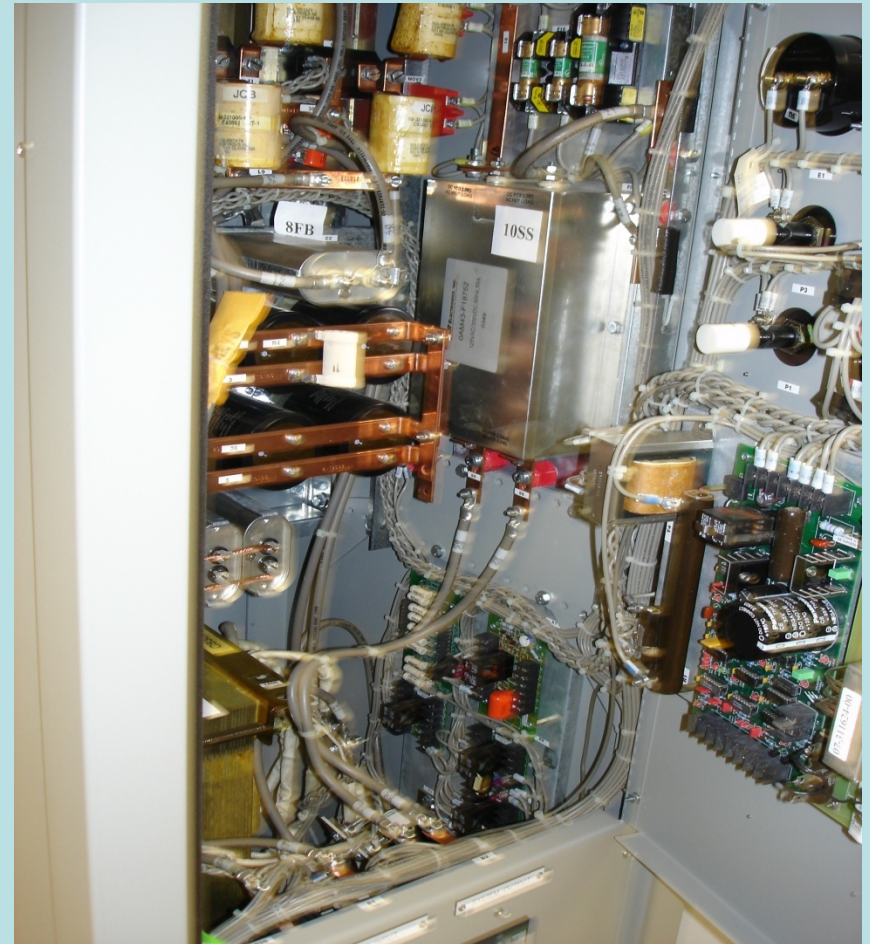


# **FME Level 2 Zone (Moderate Risk)**

**Established for work that  
doesn't meet FME Level 1  
criteria**

# FME Level 2 (Moderate Risk) Criteria

**Work in areas with electrical contacts such as cabinets, panels, racks, boards, breakers, and other components.**



# FME Level 2 Zone (Moderate Risk) Criteria

- Final visual inspection of internal cleanliness before closure.
- Open SSC not meeting Level 1 criteria.



# FME Level 2 Zone (Moderate Risk) Requirements

Lanyards used on items smaller than opening (Failsafe)

Maintain zone cleanliness per SPP-10.7

Use temporary Stop signs & covers when unattended



# SELF-MONITORING

- Certain “NON-INTRUSIVE” work applications may be self-monitored, even on SSC work classified as High Risk on Appendix B.
- FME Monitor or Accountability Log is not required.
- Use of lanyards is required if introduction into SSC exists.





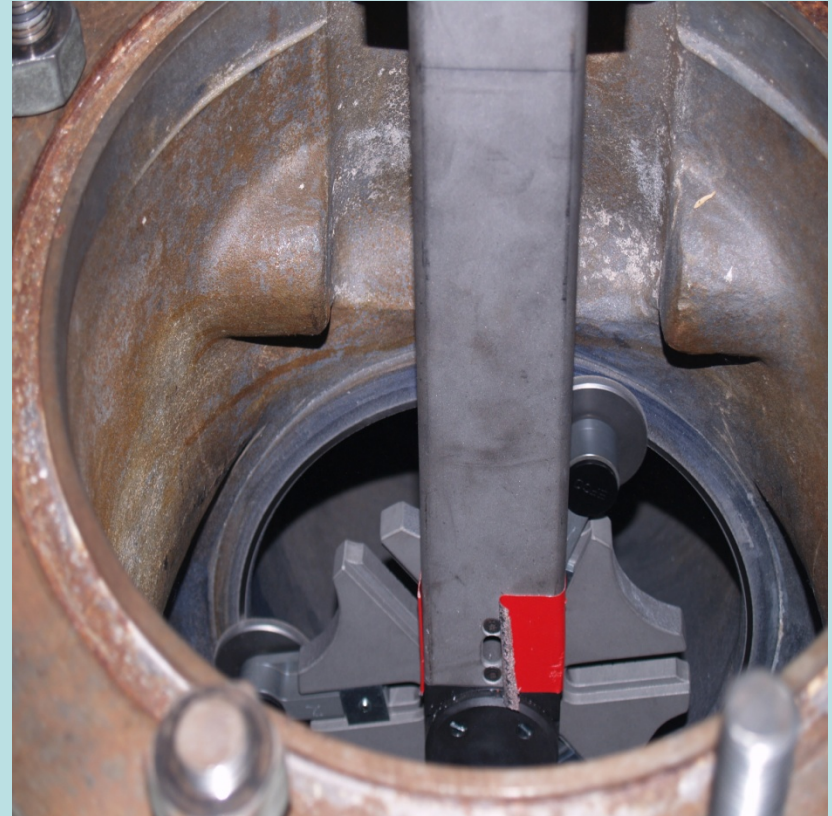
# SELF-MONITORING

- **List of activities:**
  - **Instrument calibrations**
  - **Operation's rounds**
  - **Chemistry activities**
  - **Opening Elec. Cabinets**
  - **Adding oil to components**
  - **Non-intrusive PDM activities**
  - **Crane operation over a FMEZ 2 or with no load over a FMEZ 1**
  - **Other activities authorized by the FME coordinator**



# Work Planner Responsibilities

- **Determines if system is to be opened**
- **Recommends what FME controls to be used**
- **Request evaluation for a reliable replacement gasket for components with a metallic crush style gaskets**



# Work Supervisor

- **Verifies recommended FME control requirements.**
- **May increase controls as necessary.**
- **Verifies that the work to be performed will not affect or be affected by other activities in the area.**



# Work Supervisor

- **Verifies ventilation systems won't inadvertently cause FME issues.**
- **Installation/Removal of protective cover is used (if needed) and documented in WID.**
- **Create FME Plan for all Level 1 Zones.**



# FME Plan Guidelines

- Discuss FME in Pre-job briefs.
- Use FME covers
- Periodic Housekeeping Inspections
- As-Found and As-Left Zone Inspections
- Tooling and/or Material Control



# FME Plan Guidelines

- Tooling pre-use inspections
- Accountability Logs
- Access to Confine Space zones
- Personnel badges and coverall requirements
- Removal of all personal articles



# FME Plan Guidelines

- **Cutting, burning, grinding operations**
- **Control of filler material used in welding**
- **Instructions on how to recover from a loss of FM control**
- **Flushing requirements**



# Work Supervisor/Designee

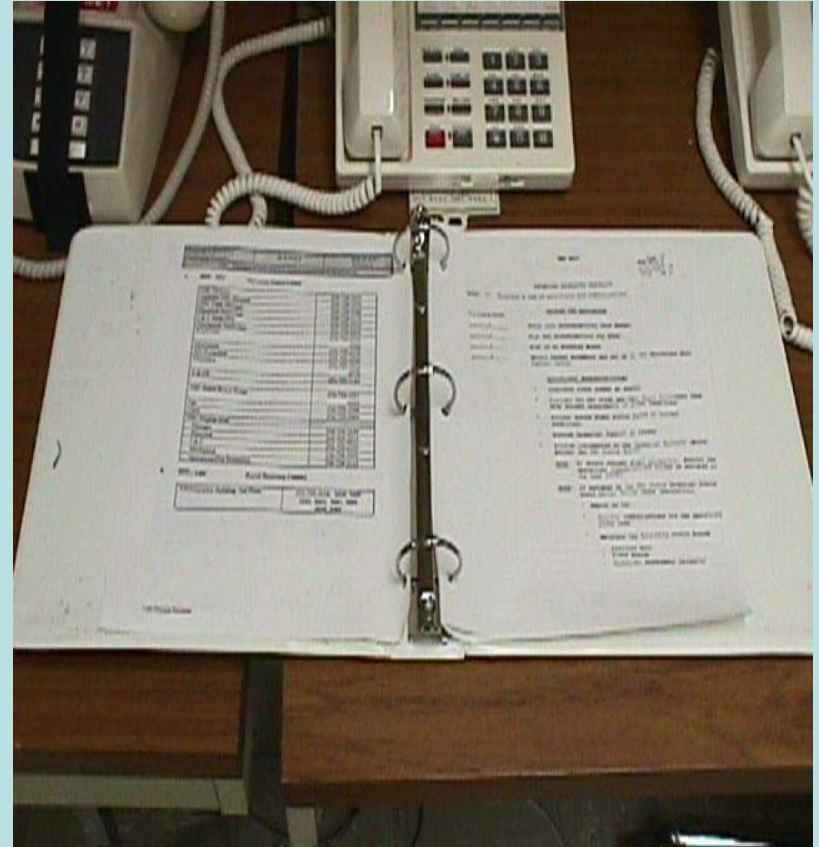
- Provide pre-job briefings
- Obtain qualified monitor
- Defines FME Zone boundaries
- Ensures Attach. 2 is in WID
- Ensures all prereq's have been met prior to opening a SSC
- Initial inventory and accountability log is maintained





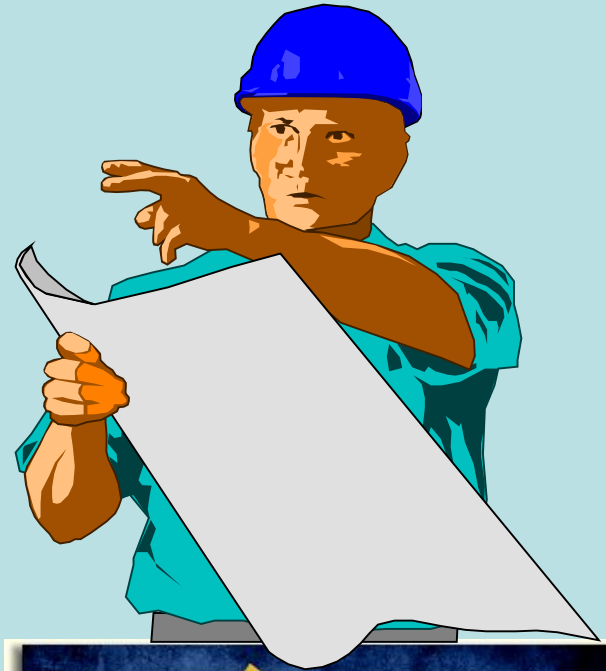
# Work Supervisor/Designee

- Ensures workers meet training requirements
- Ensures FME and cleanliness criteria have been met
- Witness closure
- Daily field observations



# Worker Responsibilities

- Establishes FMEZ 1 boundaries using FME tape
- Cleans zone and surrounding area including overhead
- Removes non-essential material from FMEZ



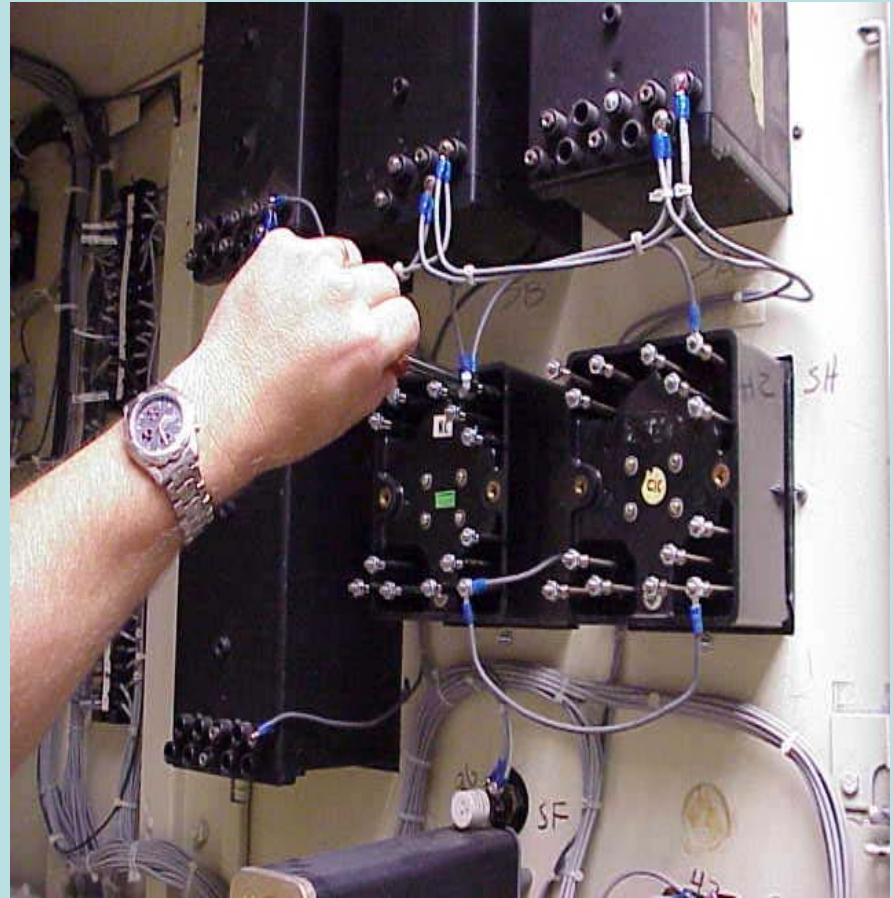
# Worker Responsibilities

- Erect a clean enclosure around the zone (if req'd)
- Verify ventilation system won't introduce debris into zone
- Examines all items for loose or missing parts
- Ensures all items are made fail-safe
- Clean all old/new components & parts of protective coatings.



# Good Work Practices

- **Notify Monitor upon entering & exiting the zone**
- **Ensure external surfaces are clean**
- **Removes all personal items**
  - **Watches**
  - **Rings**
  - **Necklaces / Bracelets**



**What's wrong with this picture?**

# Good Work Practices

- **Ensure areas around and below the zone are protected from items being dropped**
- **Examine all items going in for loose or missing parts**
- **Caution should be taken when opening systems with metallic crush style gaskets**
- **Use only approved chemicals**



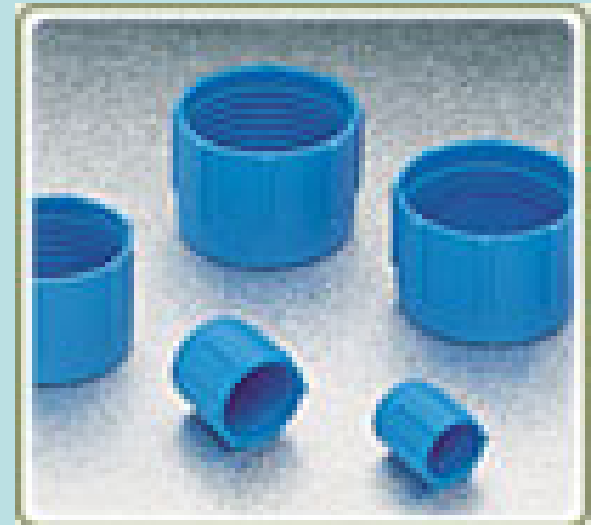
# Good Work Practices

- **Visually inspect system internals for FM immediately after breaching**
- **Inspect internals that will not be accessible as work progresses.**
- **Ensure system cleanliness before final closure**



# Good Work Practices

- In FME Zone 1
  - Log work gloves and paper
- For FME Zone 1 & 2
  - Log installation/removal of placing any temporary material in the SSC
    - Pipe plugs
    - Dams
    - barriers



# Good Work Practices

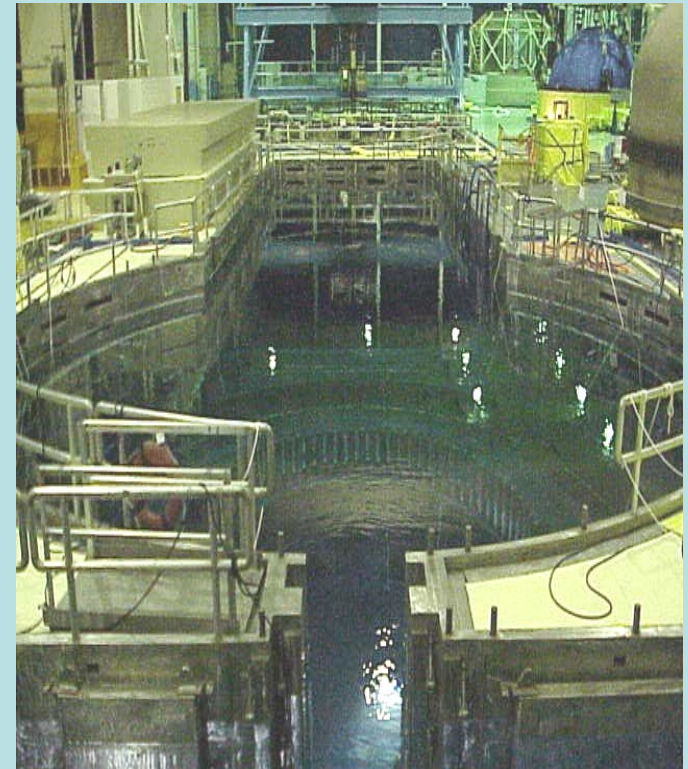
- **Cleans immediately following system breaches and as work progresses**
- **Stop all work if FME control is lost**
- **Uses fail safe containers for small parts & items that can not be made fail safe**





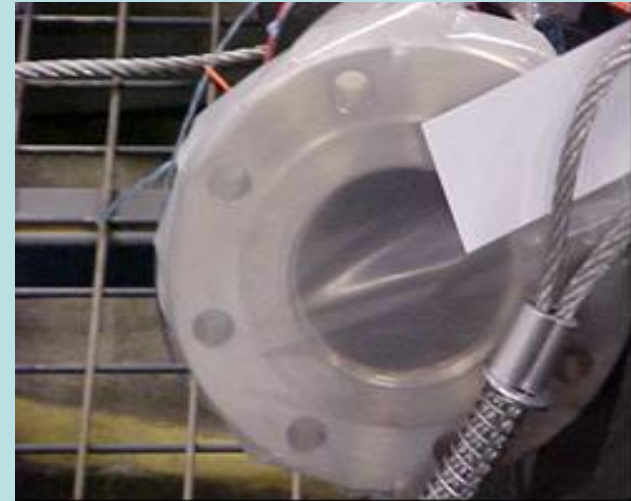
# Good Work Practices

- Tie wraps should be bright in color, non-metallic, and float if possible.
- **Prohibit** the use of metal tie wraps (plastic tie wraps containing metal tabs) in and adjacent to FMEZ around the Fuel pool, Reactor cavity, and other designated areas



# Good Work Practices

- **Prohibit the use of clear plastic material in FMEZs or adjacent areas.**
- **Prohibit the use of wire brushes on systems that come in contact with the RCS, without proper consent and approval from the FME Coordinator.**
- **Plastic bags or duct tape should not be used for FME covers.**
- **Red duct tape may be used for other purposes**



# FME Monitor (FMEM)

- Perform and document initial inventory and obtains concurrence from supervisor
- Maintains a copy of SPP-6.5 at the control point
- Maintains access control and accountability log for the FMEZ 1



# FME Monitor

- Ensures only authorized workers enter zone
- Checks items entering FMEZ for loose or missing parts
- Inspect boxes and containers for loose debris
- Logs all tools, material, and equipment entering zone



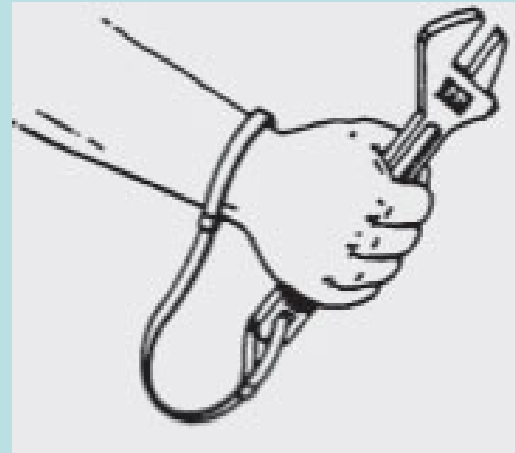
# FME Monitor

- Ensures log entries are accurate and legible
- Ensures items are secured (fail-safe)
- Stops all work in zone 1 if control is lost and notifies the supervisor
- Reconcile the accountability log each shift for active FME Zones. and quarterly for long duration FME Zones
  - such as the spent fuel pool, where no entries into the FME Zone have occurred since the last reconciliation.



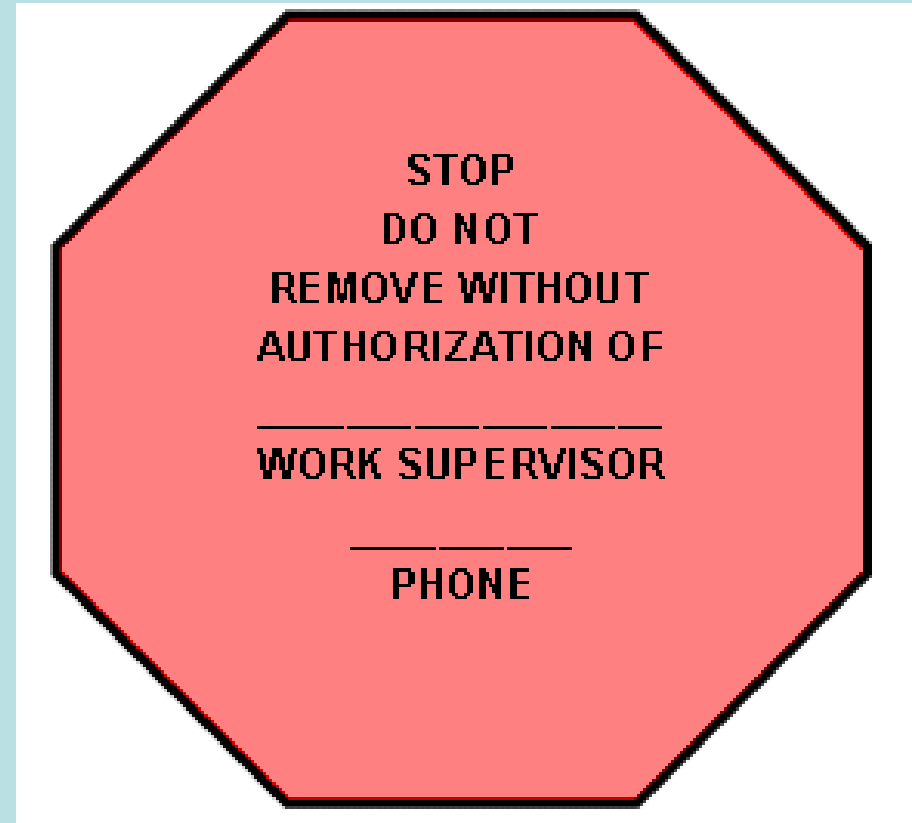
# FME Zone 1 Controls

- **Tape placed over all pocket openings**
- **Loose objects & dosimetry made fail-safe**
- **Jewelry removed**
- **Paper, pens, and pencils shall be secured and logged**
- **PPE made fail-safe**
- **No clear plastic permitted**



# Suspension of Work

- Work location is secured with covers, plugs
- All debris, tools, etc.. removed
- FME Level 1 (High Risk) sign posted
  - Boundary may be removed if sign is placed on the component
  - Stop signs with supv/contact info may be used as postings



# Loss of FME Control

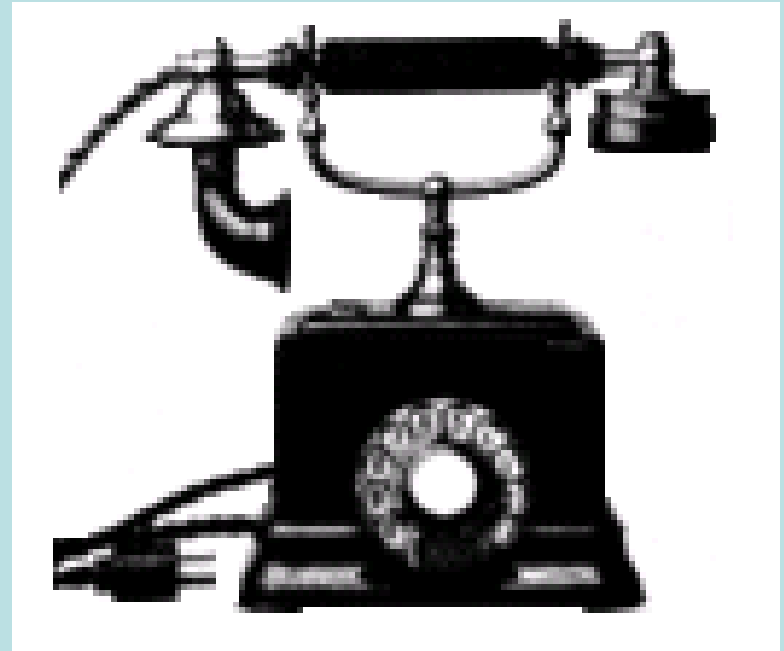
- **Foreign Material introduced into components/systems.**
- **Material logged in that can't be accounted for.**
- **Material found in the zone that wasn't logged.**
- **Internal barriers fail or covers become damaged or missing.**
- **Missing parts.**
- **FME found in an open-air system.**





# Notifications

- **Notify Monitor and Supervisor and possibly RFF SRO.**
- **Notify FME Coordinator**
- **Notify the group's Dept. Manager**
- **During outages notify the OCC.**



# Retrieval

- If easily retrieved, with approval, remove object.
- If not easily retrieved, after notifications, develop retrieval plan.
- **Always/Always Write a PER**



# If Items Can't Be Accounted For

- **Supervisor to determine when to do search and retrieval**
- **SE to evaluate the effects if not retrieved**
- **Technical Evaluation for items that fall into Rx vessel, Rx internals, Spent Fuel pool/transfer canal or systems with a direct path to Rx vessel**



# Completing the Job Closeout

- All FME PER's must be evaluated and system acceptable for closure
- Supervisor/Designee shall perform final inspection prior to closure and witness the closure of the system/component and sign-off Attachment 1
- Prior to closure, reconcile the FME Log



# Completing the Job Closeout

- All FME concerns that could affect plant operation must be resolved prior to return to service
- Housekeeping shall be completed
- Supervisor shall initiate corrective actions if FME controls inadequate



# Completing the Job Closeout

- **Workers remove all materials, debris, tools, and equipment**
- **If determined FME controls were inadequate, initiate a PER as necessary**
- **Participants review for Lessons Learned and provide feedback to Planner on problems or good practices**









# Summary

This course has equipped you with knowledge of our FME Program as it pertains to you're responsibilities. We have discussed the following in detail:

- FME levels,
- Documentation of FME forms
- PER's, Industry events, OE's, and Good FME Work Practices.

If everyone will actively practice FME control by these 3 simple words- **FOCUS ON PREVENTION** , we WILL minimize and/or eliminate the possibility of foreign material problems and in turn have a Safer Work Environment and more reliable equipment and operating systems.