

# LESSON 5

## Error Identification

# Study Guide

**Topic:** Error Identification

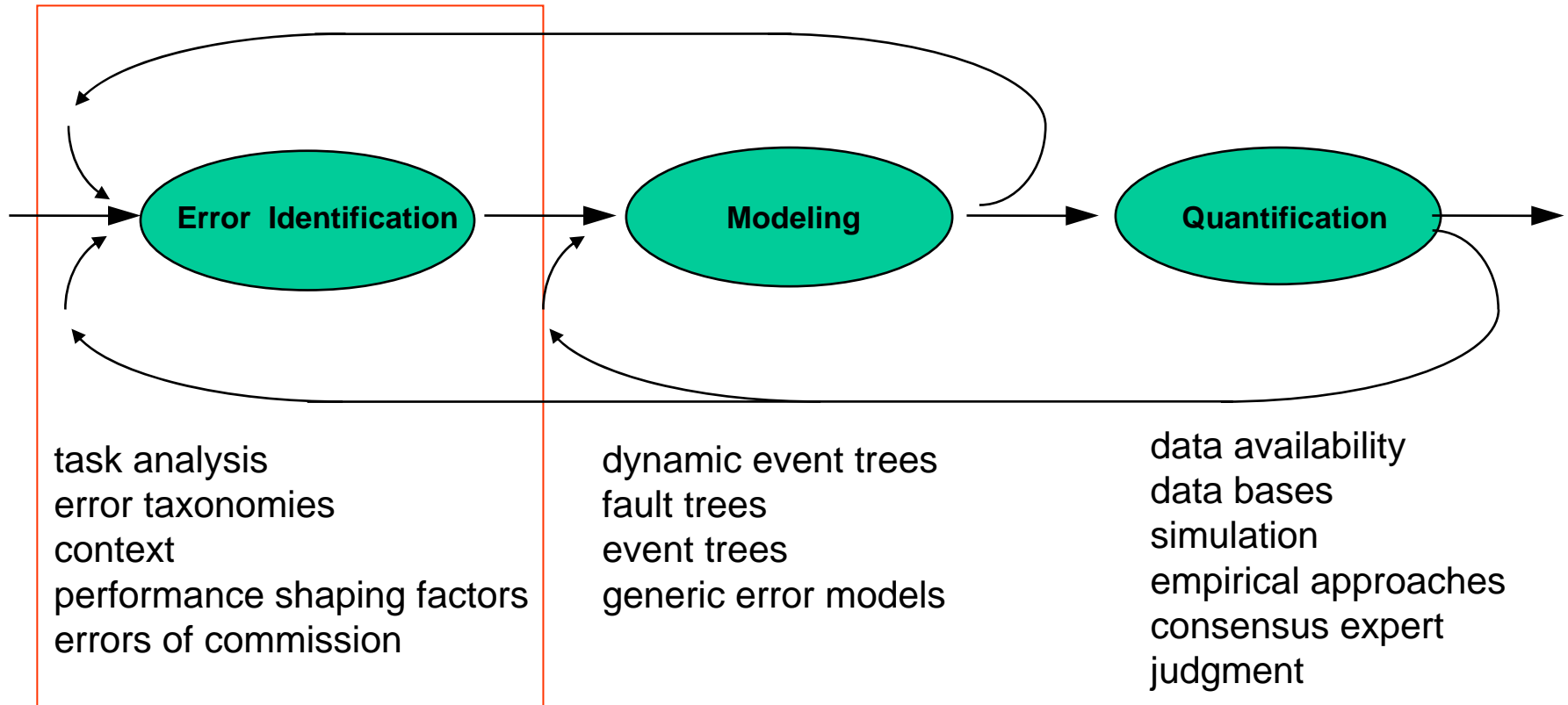
**Purpose:** The first major activity in performing an HRA is to identify the human errors. A good place to start is to look for the initiating errors. Then to analyze the task being performed and the conditions surrounding the performance that either lead to or help prevent errors.

**Objectives:** At the completion of this session, students will be able to:

- Distinguish between active and latent errors
- Describe the Swiss Cheese model of defenses in depth
- Recall sources used in identifying initiating events
- State the function of a task analysis when performing an HRA
- Define Performance Shaping Factors (PSFs)
- Identify the PSFs present in various accident scenarios
- Recall several taxonomies of error

**Resources:** Reason, Chapters 6 and 8; Gertman and Blackman, Chapters 12 and 2

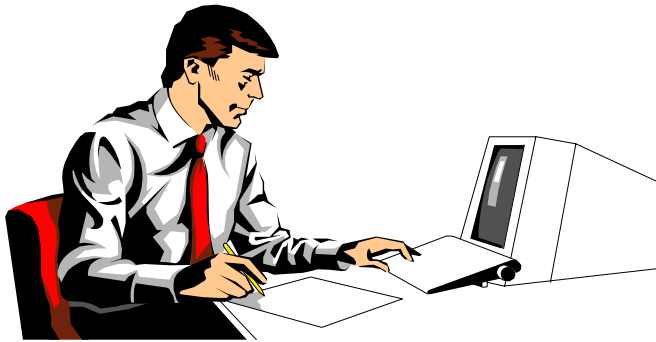
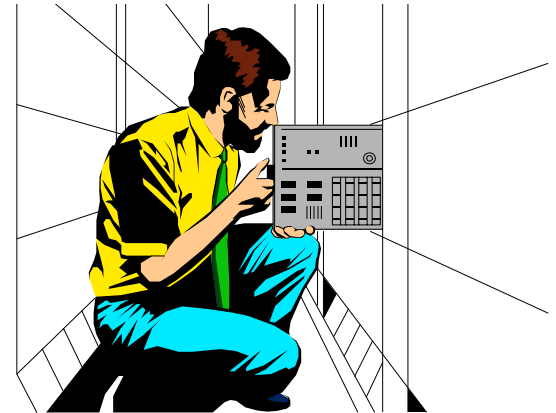
# Requirements for Human Reliability Analysis



# Active Versus Latent Errors

## Active Error ←

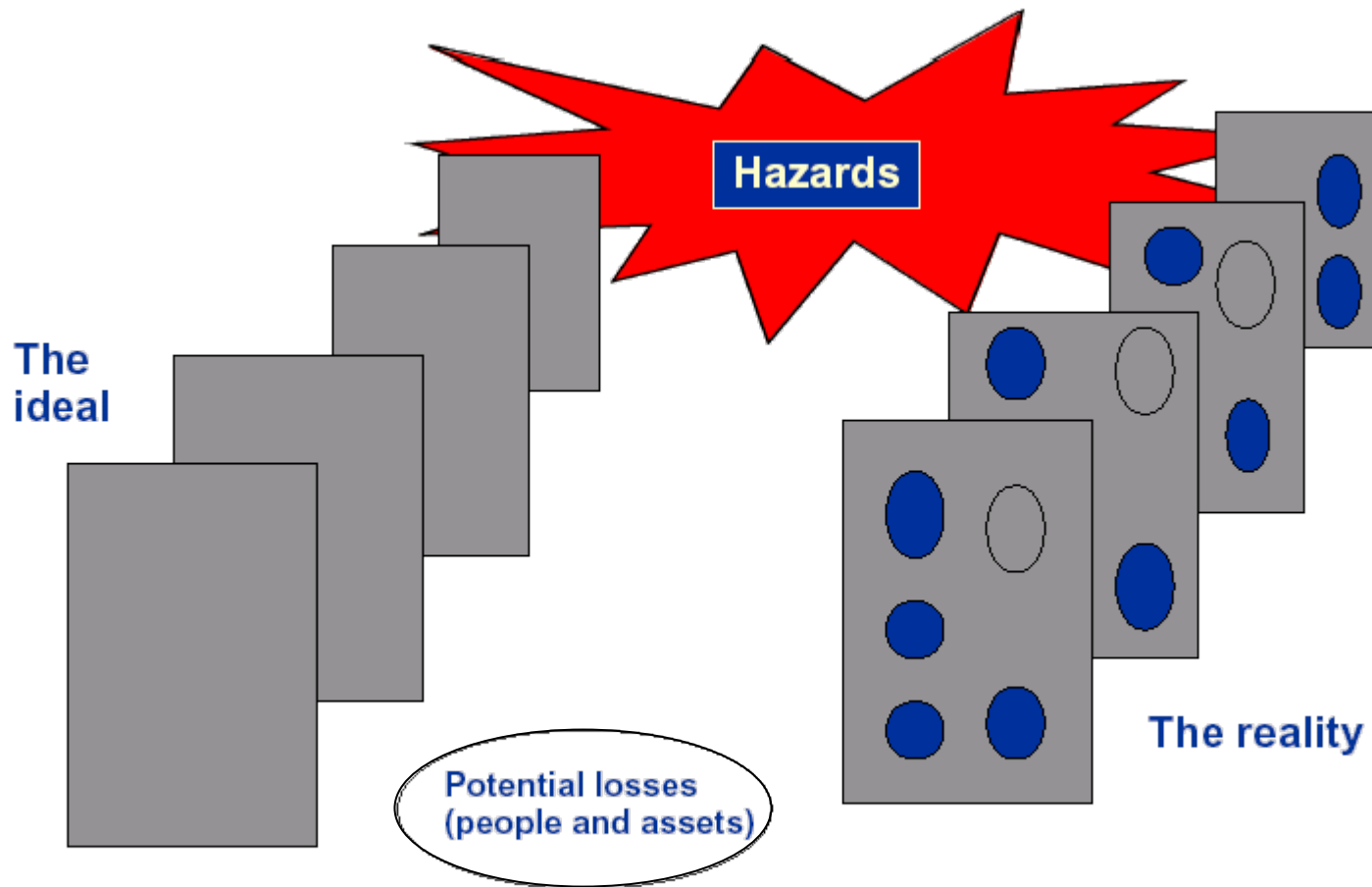
***Active Errors are unsafe acts, failures of technological functions or human actions, which become the local triggering events that afterwards are identified as the immediate causes of an accident.***



## → Latent Error

***Latent Errors result in latent conditions in the system that may become contributing causes for an accident. They are present within the system as unnoticed conditions well before the onset of a recognizable accident sequence.***

# ***“Swiss Cheese” Model of Defenses in Depth:***



# Initiating Events

## *Event initiators:*

- *Help focus the HRA analysis*
- *Provide sequences and conditions that are generally provided by the Risk Assessment analyst*
- *Are categorized as:*
  - *Human actions (errors)*
  - *Hardware failures*
  - *Software failures*
  - *External events*

# Sources Used to Identify Initiating Events

- *Review of facility experience and procedures*
- *Past operating experience, including similar facilities*
- *Feedback from other risk assessment tasks*
- *Review of other risk assessments*
- *Failure Modes and Effects Analysis (FMEA)*
- *Master logic diagram (special type of fault tree)*

# NMSS Example: Initiating Events for Spent-Fuel Pool Risk Analysis

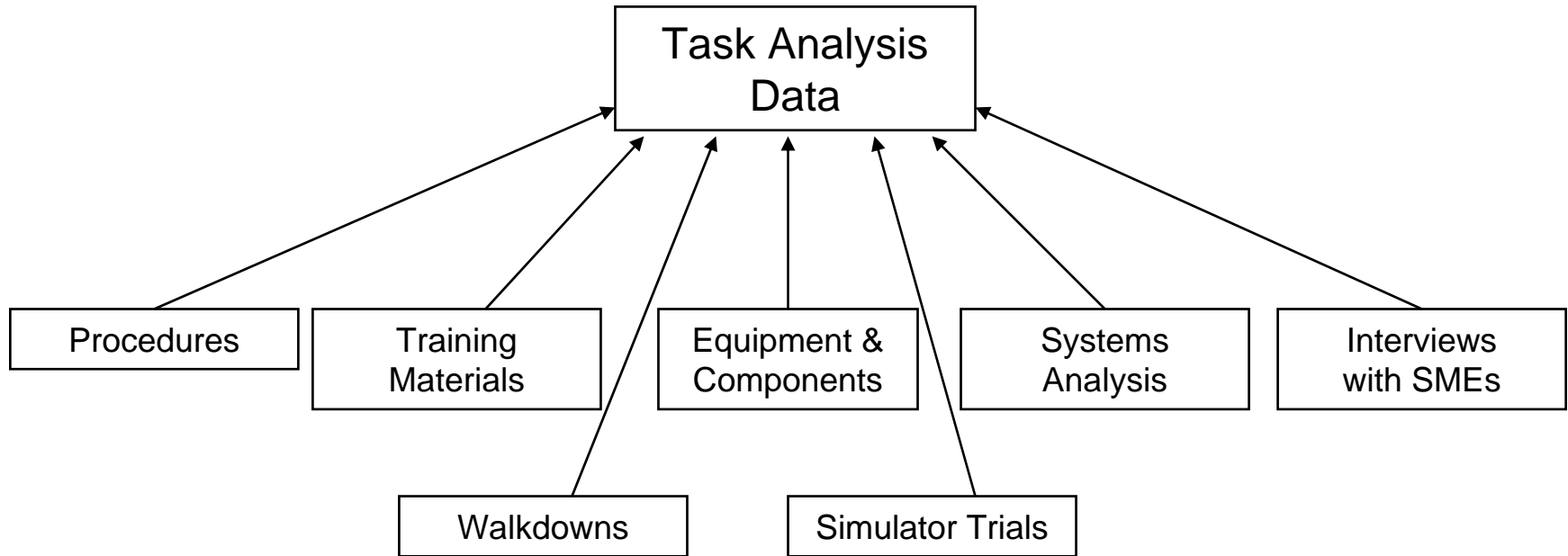
- (i) Loss of offsite power from plant-centered and grid-related events*
- (ii) Loss of offsite power from events initiated by severe weather*
- (iii) Internal fire*
- (iv) Loss of pool cooling*
- (v) Loss of coolant inventory*
- (vi) Seismic event*
- (vii) Cask drop*
- (viii) Aircraft impact*
- (ix) Tornado missile*



# Task Analysis

- *The recording of the simple execution of human skills that includes aspects of planning and coordination required for execution of a task*
- *Typically a task has certain associated requirements that are performed in a specific environment that require a certain degree of skill*
- *One of the main uses has been for training. Task analysis is also called for as a part of HRA*

# What are the Data Sources for a Task Analysis?



# Task Analysis Data

- *Sample task analysis data sheets are included in Gertman and Blackman pages 38-39*
- *Handles approximately 46 data fields*
- *Whether all are really needed for any analysis depends on modeling and quantification methods*
- *This is general task information. Decomposition into sequences of actions is not specifically called out*

# #7 Task Analysis Exercise

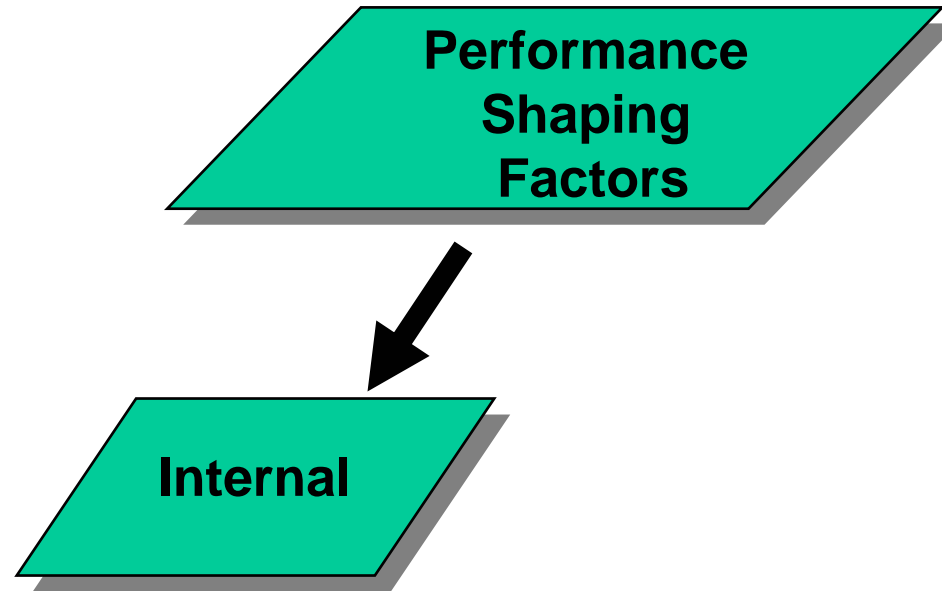
- ***Break into teams***
- ***You are going to the world's largest Harley Davidson motorcycle rally with a group of friends.***  
***Develop a task analysis (i.e., identify the steps/sequence required) for taking a motorcycle trip from Salt Lake City Utah to Sturgis.***
  - ***Hint: think safety, critical functions, performance, etc.***
  - ***Identify major performance shaping factors.***
- ***Document your assumptions.***
- ***Report out and discuss.***

# Performance Shaping Factors (PSFs)

- *Are environmental, personal, or task-oriented factors that influence the probability of human error*
- *Are an integral part of error modeling and characterization*
- *Are evaluated and used during quantification to obtain a human error rate applicable to a particular set of circumstances*

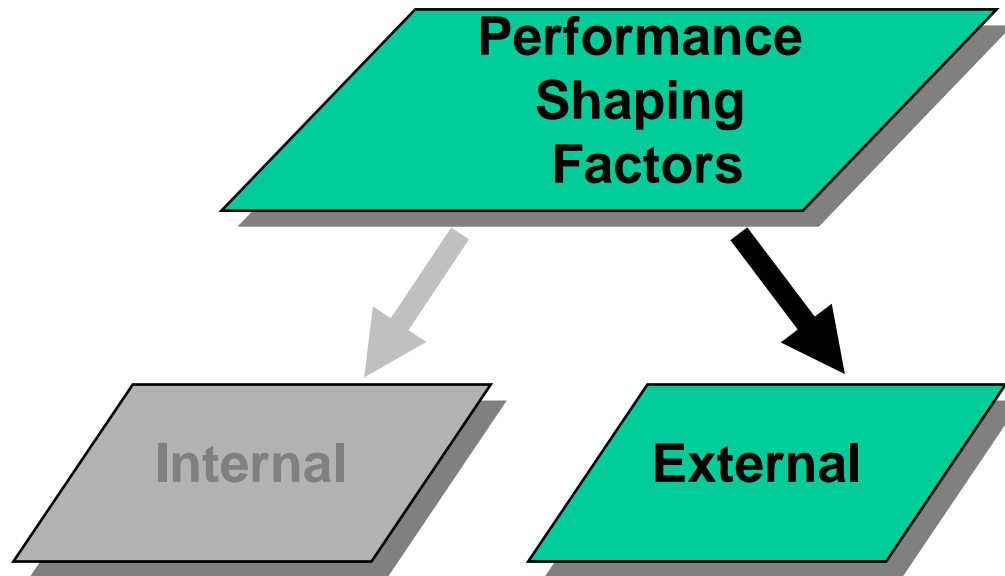
*Specifically, the basic human error probabilities obtained for generic circumstances are modified (adjusted) per the specific situation*

# Internal Performance Shaping Factors



***Internal PSFs are human attributes, such as skills, abilities, and attitudes, which operate within the individual, and which are brought to the job by the individual.***

# External Performance Shaping Factors



***External PSFs are aspects of situations, tasks, and equipment characteristics which influence performance.***

# What's Wrong with This Picture?





# PSFs Are Present Across HRA Methods

- *THERP contains many PSFs embedded in failure rates present in Chapter 20 tables. The following are represented: HMI (alarm response, labeling, tagging, color coding, similarity, chart type, functional grouping, population stereotypes, rotary controls), procedures (short, long, written notes versus formalized), stress (skill, novice, dynamics)*
- *ASEP (outside control room, stress, SRK, time and procedures)*
- *SPAR-H (time, stress, complexity, HMI, experience, procedures, fitness for duty, work processes)*
- *FRANCIE (procedures, design, tools/equipment, personnel, environment, organizational, work group, task-related)*
- *CAHR (task prep, complexity, pressure, task order, person, action, feedback, system)*
- *HCR (procedures, experience, stress)*
- *CREAM (organization, working conditions, MMI, procedures and plans, goals, time available, time of day, training, crew collaboration factor)*
- *HEART*
- *ATHEANA (procedures, training, stress, supervision, environment, and HMI as suggestions)*

# Name the PSFs Potentially Involved in this Event:



**BREAK**



# Taxonomies of Human Error

- *A taxonomy is a systematic grouping according to laws and/or principles*
- *Different approaches to human error have different principles and therefore have different systematic groupings*
- *The benefit of the taxonomy is the understanding it may provide and the insights into the underlying reasons for the error and the identification of error*
- *This course presents three taxonomies*

# Swain and Guttman's Taxonomy

- ***Errors of omission***
- ***Errors of commission***
- ***Sequence errors***
- ***Timing errors***

# Rasmussen's Cognitive Taxonomy

Knowledge-based behavior

Rule-based behavior

Skill-based behavior

Behavioral Continuum

# Reason's Error Taxonomy

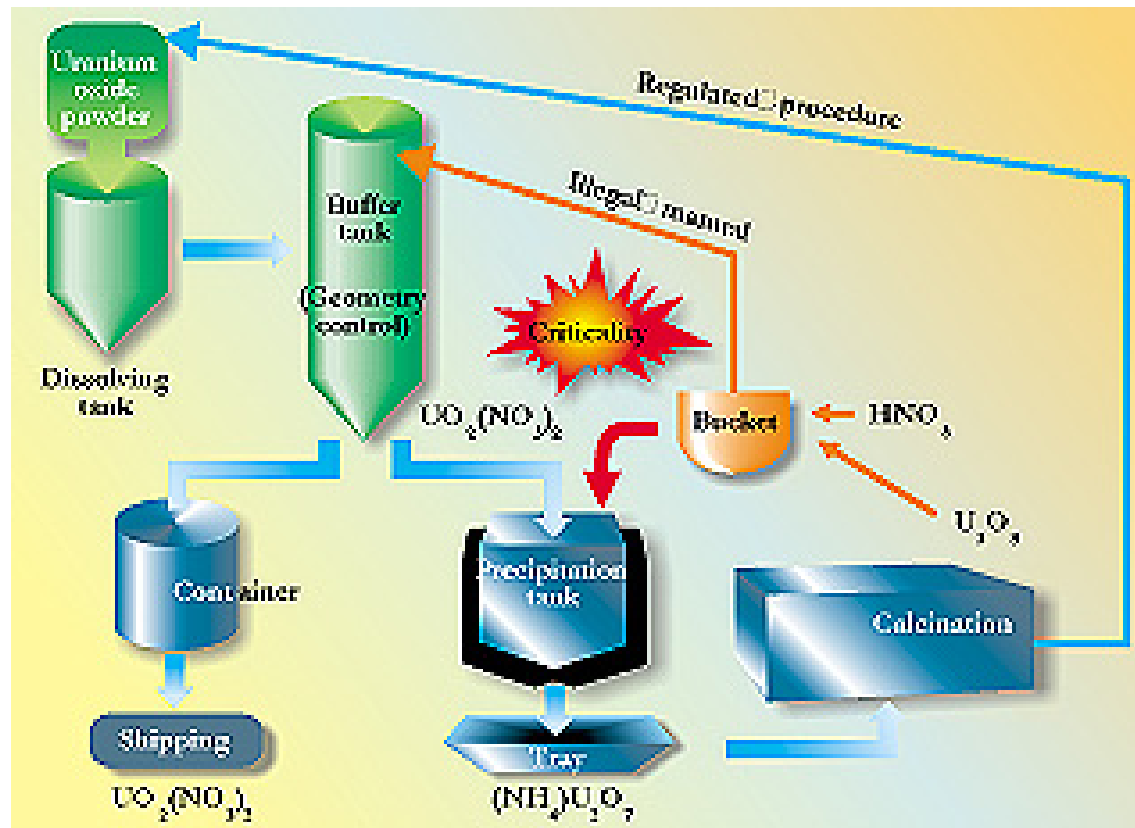
- *Slips*
- *Lapses*
- *Mistakes*
- *Violation (willful circumvention)*

## **#8 Group Exercise: Identifying Human errors**

- *Divide the class into groups*
- *Read and discuss the event from NUREG/CR-6088 on misadministration (Appendix A)*
  - *Develop overall description*
  - *Perform top level task analysis*
  - *Describe the human errors*
  - *Identify the important PSFs*
  - *Classify those errors according to one of the taxonomies discussed*
- *Team presentation*



# Case Study: What Happened at Tokai-mura?



Process flow for the conversion facility at the JCO plant. Blue lines indicate the procedure approved by Japan's Science and Technology Agency. Uranium oxide and nitric acid are fed through a dissolving tank into a buffer tank. Orange lines indicate a company-initiated procedure not approved by STA, in which uranium oxide and nitric acid are added by bucket directly to the buffer tank. The red line indicates buckets dumped directly into a precipitation tank—a further deviation from licensed procedure.

## **#9 In Class Exercise: Identify errors and PSFs that influenced the Tokai-mura Accident**

- *Assemble in groups*
- *Accident details are contained in Appendix B of your handout*
- *Formulate a table of errors and PSFs you discovered*
- *In-class presentations*

# Lesson Summary

## ***Key Points:***

***There are a number of useful taxonomies of error***

***Active errors are those that initiate an event***

***Latent errors are those hidden errors such as inaccurate procedures or documentation***

***HRAs depend on task analysis to provide a task description***

***There are a large number of performance shaping factors (PSFs), both internal and external***

***All HRA methods use PSFs to some extent to model and quantify***