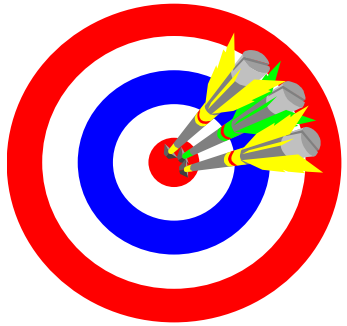
# EFCOG - QA Sub Group
# Atlanta, Georgia
# May 1, 2007


## Quality Management Office
### Roy H. Lebel

# Agenda



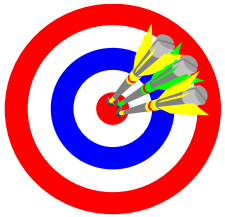
- BNL Overview
- The ARC Flash Event – Type B
  - DOE
  - HPI Team
- BNL's Event & Issues Management
  - Causal Analysis with an HPI twist

Event and Issues Management at BNL

E. Anthony Sierra

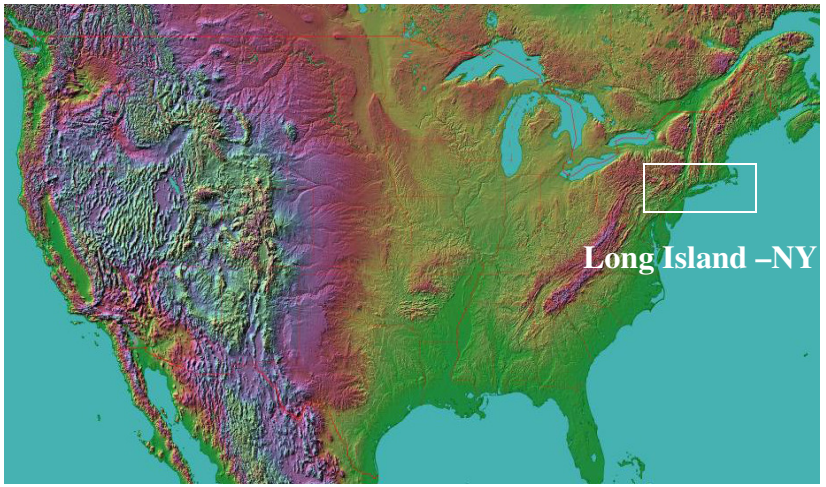
May 2, 2007

10:15AM Tennessee Rm.



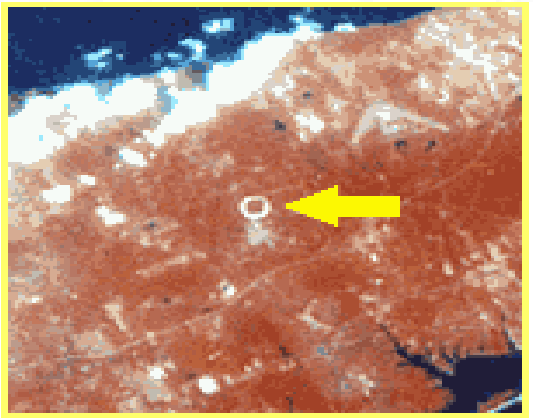
# Brookhaven National Laboratory (BNL)

- **Founded in 1947 by Associated Universities, a coalition of northeastern universities**
- **Operated today by Brookhaven Science Associates for the U.S. Department of Energy**
- **Dedicated to building and operating large experimental facilities, conducting basic and applied research, educating future scientist and engineers**



# Where is Brookhaven National Laboratory?

**Long Island NY**



# Brookhaven National Laboratory

# April 14, 2006
# Arc Flash Incident
# Building 1006A
# Brookhaven National Laboratory


Type B Accident Investigation Board

# Type B Accident Investigation Board

- Accident Investigation Board appointed by BHSO Manager April 17th
- Brookhaven Site Office (BHSO) Manager concern over events surrounding the accident

# Type B Accident Investigation Board

- April 14, 2006 at ~1020
- Building 1006A Mechanical Loft
- Electrical Engineer operates 480 V disconnect switch (3A) for West Pole Tip Trim power supply (Panel PB-1)
- ***Arc Flash causes 1st degree burns to head, face, chest, and hands and 1st and 2nd degree burns to forearms***
- Panel PB-1 destroyed

# Type B Accident Investigation Board

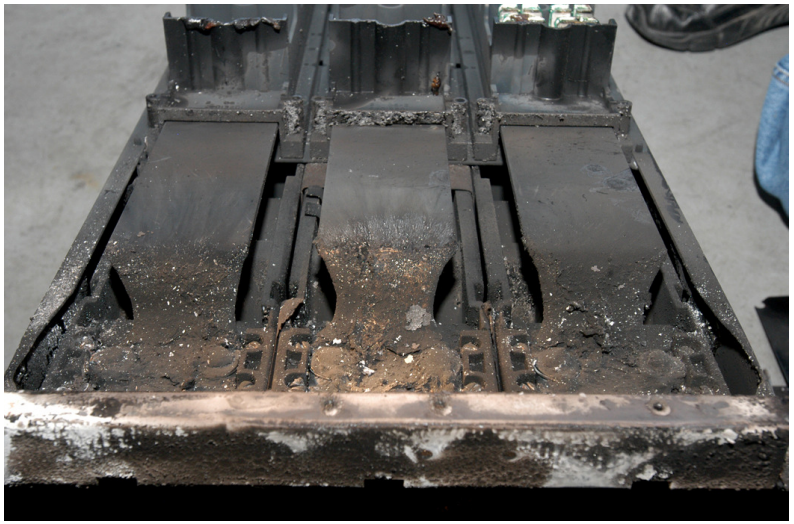
Injured Engineer's cotton short sleeve shirt and cotton undershirt.

# Type B Accident Investigation Board

- NFPA 70-E
  - Personal Protective Equipment requirement for operating switch in accident.
    - Non-melting or untreated natural fiber
      - Long sleeve shirt
      - Long pants
    - Safety glasses

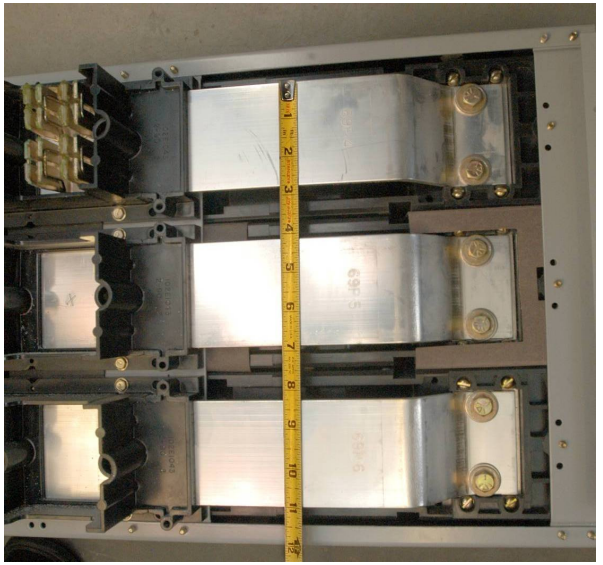
# Type B Accident Investigation Board

Damaged switch



switch

Undamaged



Rear view of switches

# Type B Accident Investigation Board

Back of 480 V switch



Arc flash has blown through the back panel of the switch

# Type B Accident Investigation Board

# Type B Accident Investigation Board

- Possible Causes for Arc Flash
  - High transient voltage caused by arcing ground fault on ungrounded delta system
  - Foreign object
  - Open conduit stub (source of outside foreign object)

# Type B Accident Investigation Board

- Issues
  - Failure to wear PPE properly or at all
  - Supervisor did not ensure engineer had required PPE
  - Lack of urgency for completion of incident energy calculations
  - Divided responsibility for incident energy calculations
  - Inadequate work control

# Human Performance Assessment

# of

# The Arc-Flash Event

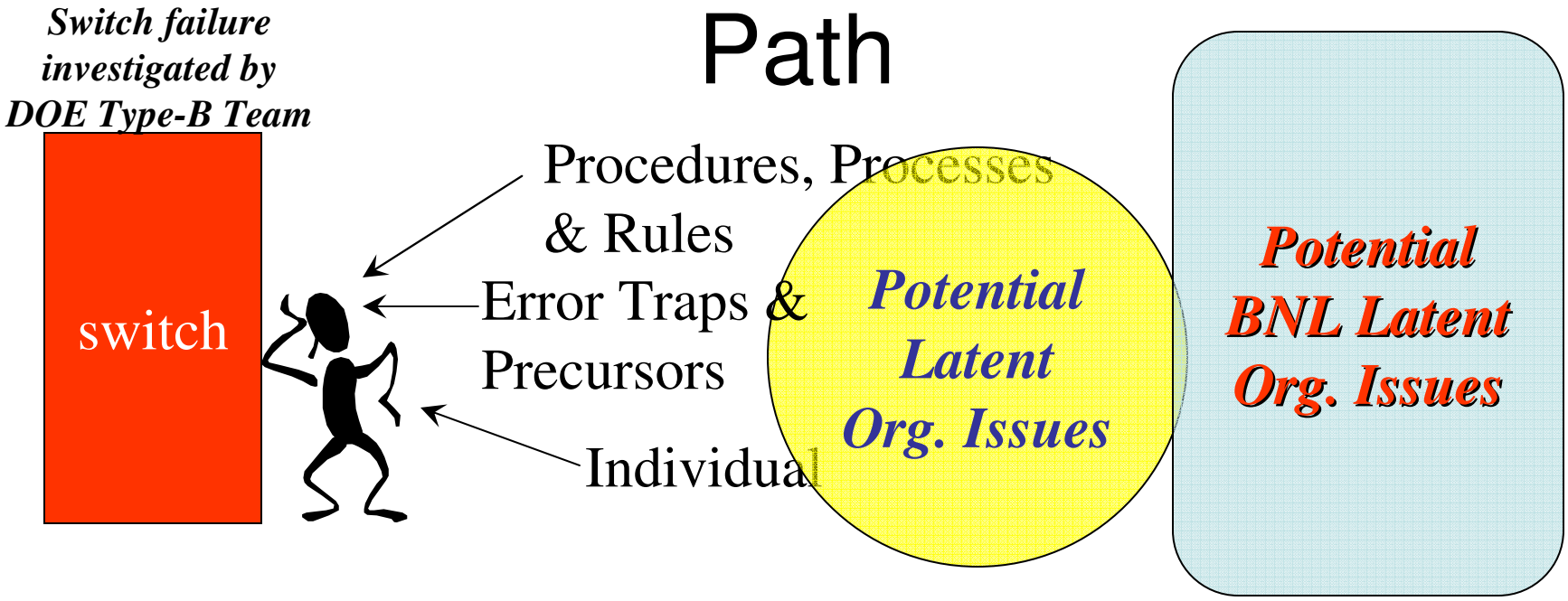
# Abstract and Team

- The team was requested to provide an independent assessment of the human performance related issues that may have existed surrounding the arc-flash event on April 14, 2006. The specific portion of the event being assessed by this team were the injuries received by a BNL employee.
- The team consisted of:
  - Keven Butler, INL Office of Human Performance
  - Bill Brown, BNL EENS
  - Team Lead – Rob Fisher, President, Fisher Improvement Technologies, LLC
- The team used human performance event analysis tools and comparison to human performance best-practices to identify areas where this event may have had human performance related contributors.
- The team conducted interviews, reviewed documents, consulted with the DOE Type-B team, and reviewed issues with management.

# Human Performance Fundamentals

- Three Tenets:
  - The things that cause the small things are the same as the things that cause the big things;
  - 85% - 90% of significant events have their roots in something OTHER than just the individual; and
  - Errors and Events are different things.
- Once these three tenets are understood – assessment begins at what the individual was doing, thinking and feeling at the time of the event – and why they were doing, thinking and feeling those things.
- Human Performance assessment looks at the individuals, environment, situation, barriers, procedures, processes, rules, organizational impacts and other possible contributing or influencing factors.
- If we believe that people come to work to do a good job every day, then we have to also believe that there were reasons individuals did what they did when they did it.

# Human Performance Assessment Path



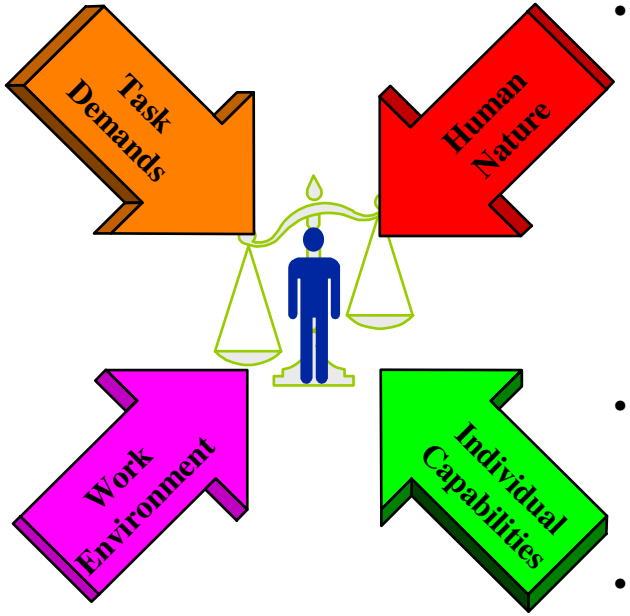

Very quickly, the assessment moved away from the individuals involved, and began identifying potential error-likely situations, error precursors, and latent weaknesses that could have contributed to this or similar events

# Identified Error Traps - or unfavorable conditions at the job site or a characteristic of the task or an individual that increases the **probability for error** during a specific action

- Time Pressure
- Distractive Environment
- High Workload
- First Time Evolution
- First Working Days After Days Off
- One-Half Hour After Wake-up or Meal
- Vague or Incorrect Guidance
- Overconfidence
- Imprecise Communications
- Work Stress
- Fatigue
- Peer Pressure
- Multi-tasking
- Off-normal Conditions

# Identified Error Likely Situations

- The procedure specifically described the required actions however personal protective equipment requirements are not in the procedure
- Individuals are responsible for verifying and obtaining the appropriate personal protective equipment with few pointers as to where this information exists



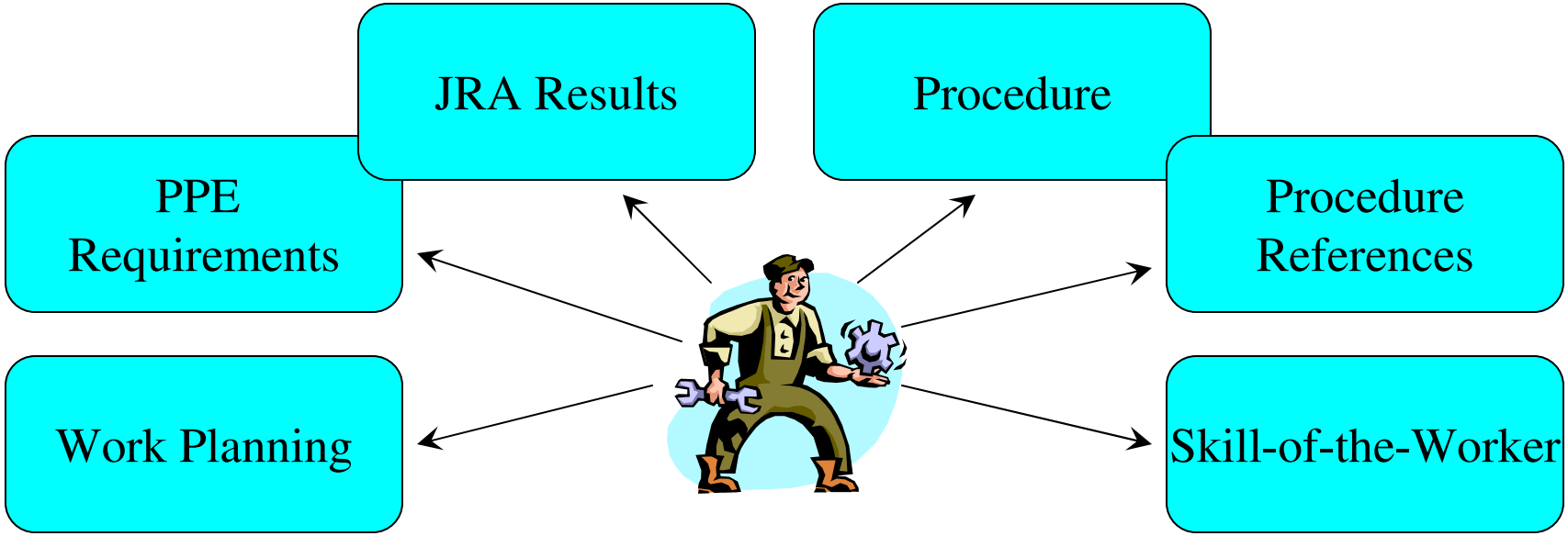

- The Engineer was helping the technicians restore the system
- The Engineer did not recognize when he shifted from troubleshooting to manipulating components that may require personal protective equipment
- Task considered routine for both the technicians and the engineer

•Noisy

•Personal protective equipment requirements for the action only

- Job usually done by the CAS technicians however engineer performed the manipulation this time
- Engineer qualified to perform operations on this equipment by title and by virtue of being the Engineer as opposed to being qualified

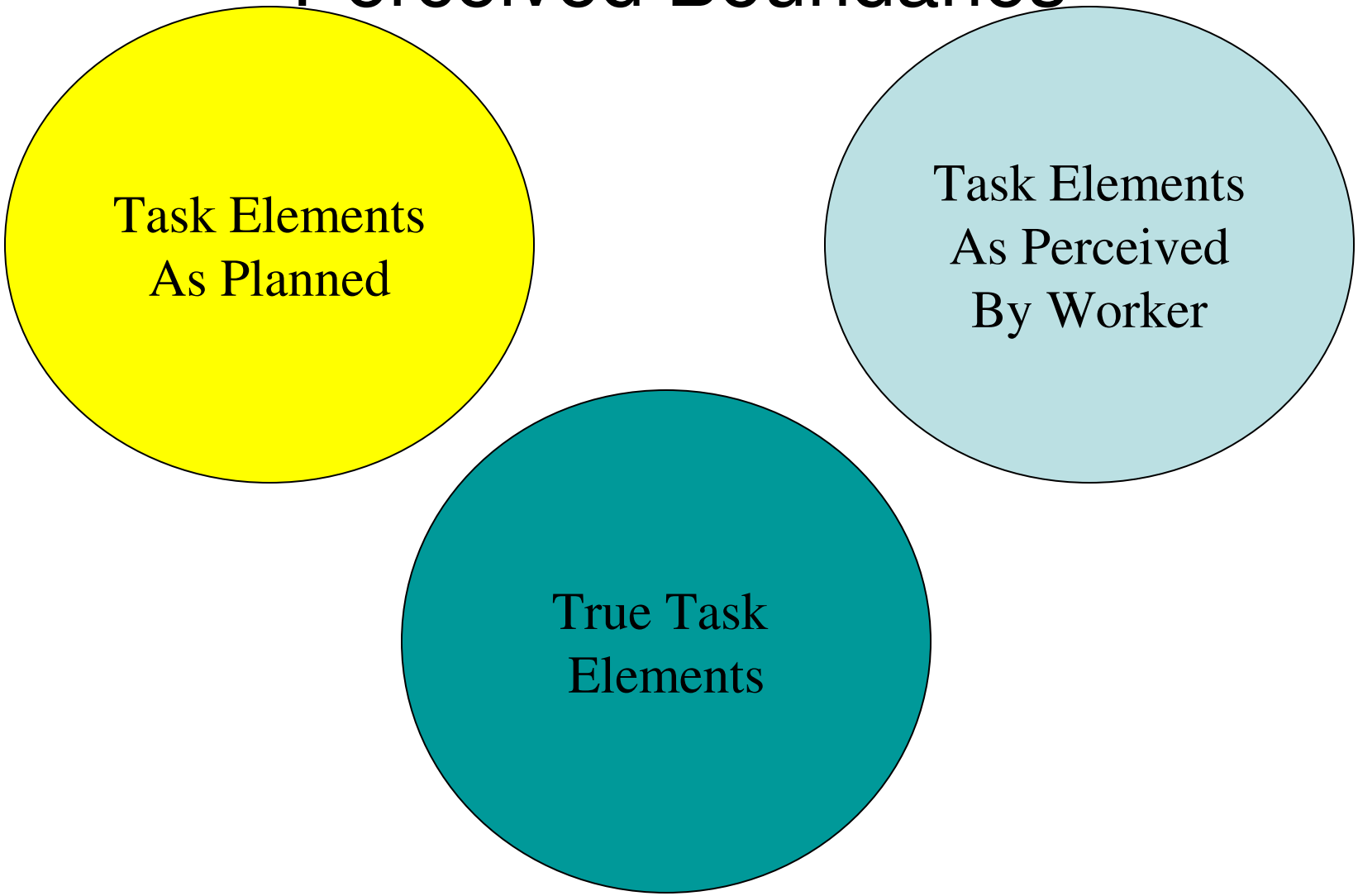
# Identified Potential Organizational Weakness



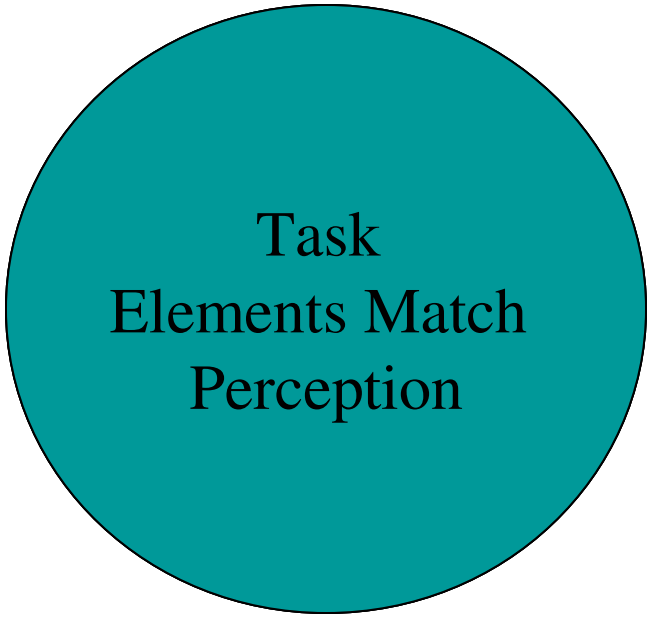

***The worker has to "go get" these things to effectively do the job instead of the organization providing them at the worker's fingertips***

***The organizational weakness is not providing what the worker needs when they need it and relying on the worker's memory for many of the requirements***

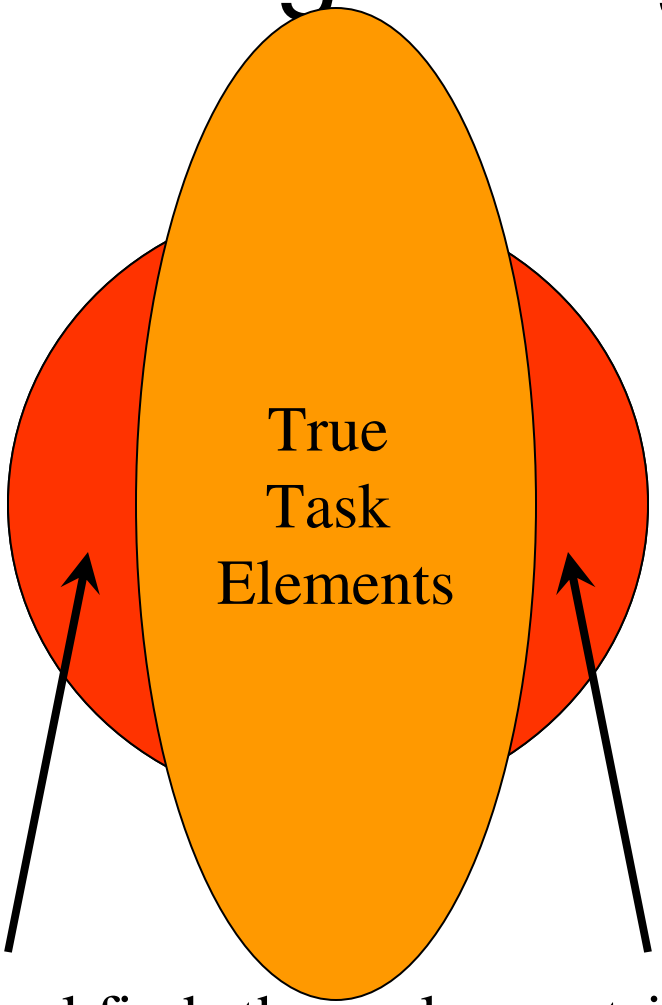
# Changing Circumstances & Perceived Boundaries



# Start of Task



# Something Changes




Individual finds themselves outside of the Plan, Process, Procedure, or anticipated situation **without recognizing it.**

# The HPI Team Observations

## Observations fell into several general categories:

- "Just-in-time" PPE requirements
- Too many external references left to the workers to decipher
- Fuzzy lines of demarcation as to roles and responsibilities regarding work among multiple groups
- Workers knowing a rule cannot be followed, but management doesn't know this
- Unclear lines between troubleshooting and work

# HPI-Team Observations

- **The injured was hurt because of the switch failure and resultant arc-flash, NOT because of a human error.**
  - The only human error identified was the failure of the Engineer to be wearing the prescribed PPE at the time of switch operation, and this error had little or no impact on his injuries.
  - There were no visual ‘triggers’ for the individual to follow to remind him during this routine task that he may need to stop and put on PPE.
  - Had this individual not operated the switch, and someone in the prescribed PPE operated the switch, they would have been injured as well.
  - The other individuals in the room could not have reasonably prevented the error from occurring because:
    - There were no PPE requirements for the task, and none in the procedure.
    - The first time in several hours that PPE would be required is at the instant the switch was operated.
    - The switch was operated while the other personnel were engaged in a different task and did not know switch manipulation was occurring.

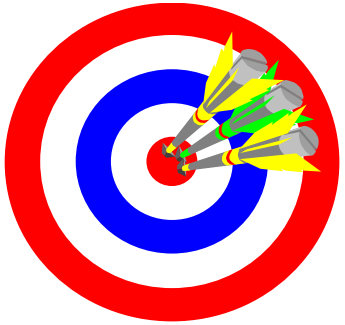
# HPI-Team Observations

There was little recognition of the shift between performing troubleshooting and performing *"WORK"*

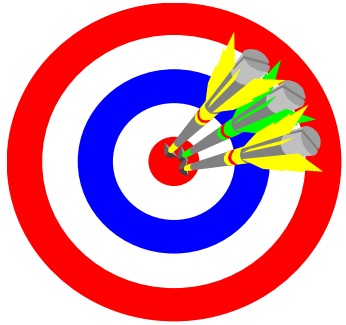
- **Troubleshooting does not appear to be well documented**
  - Engineering performed operations instead of remaining in an oversight or troubleshooting role
- Understanding of the level to which PPE protects people is not consistently understood across the facility.
- BNL Engineers are not required to have or wear PPE when responding to the field, but expected to put on the right gear at the instant it is needed.
- Technicians were provided PPE but Engineers were only provided PPE upon their request

T

# Event/Issues Management



## Causal Analysis



# BNL's Objective

- We needed to move beyond responding to the problems of the day and actually get into a true prevention mode by learning what we can from appropriate issues or events

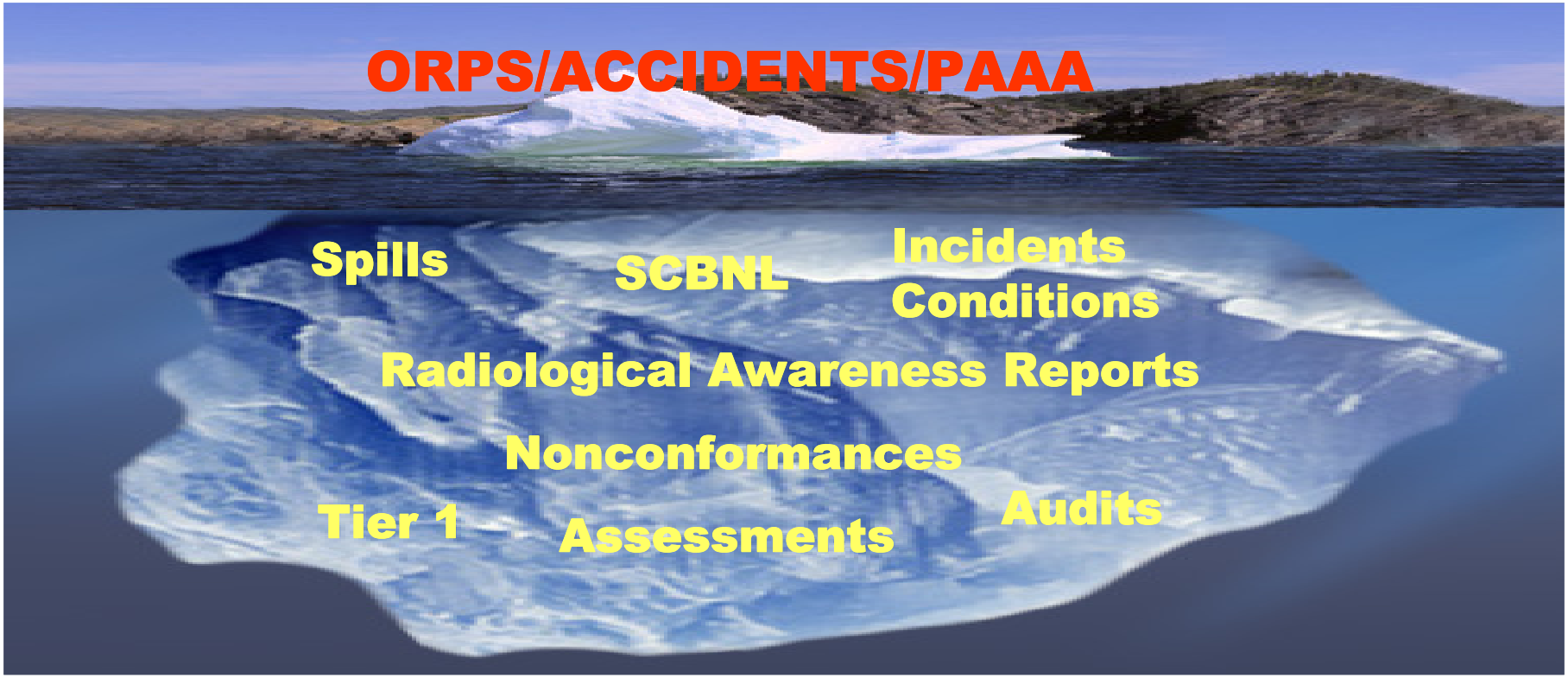
- Creation of a learning organization

**A Key HPI Tenet** ,

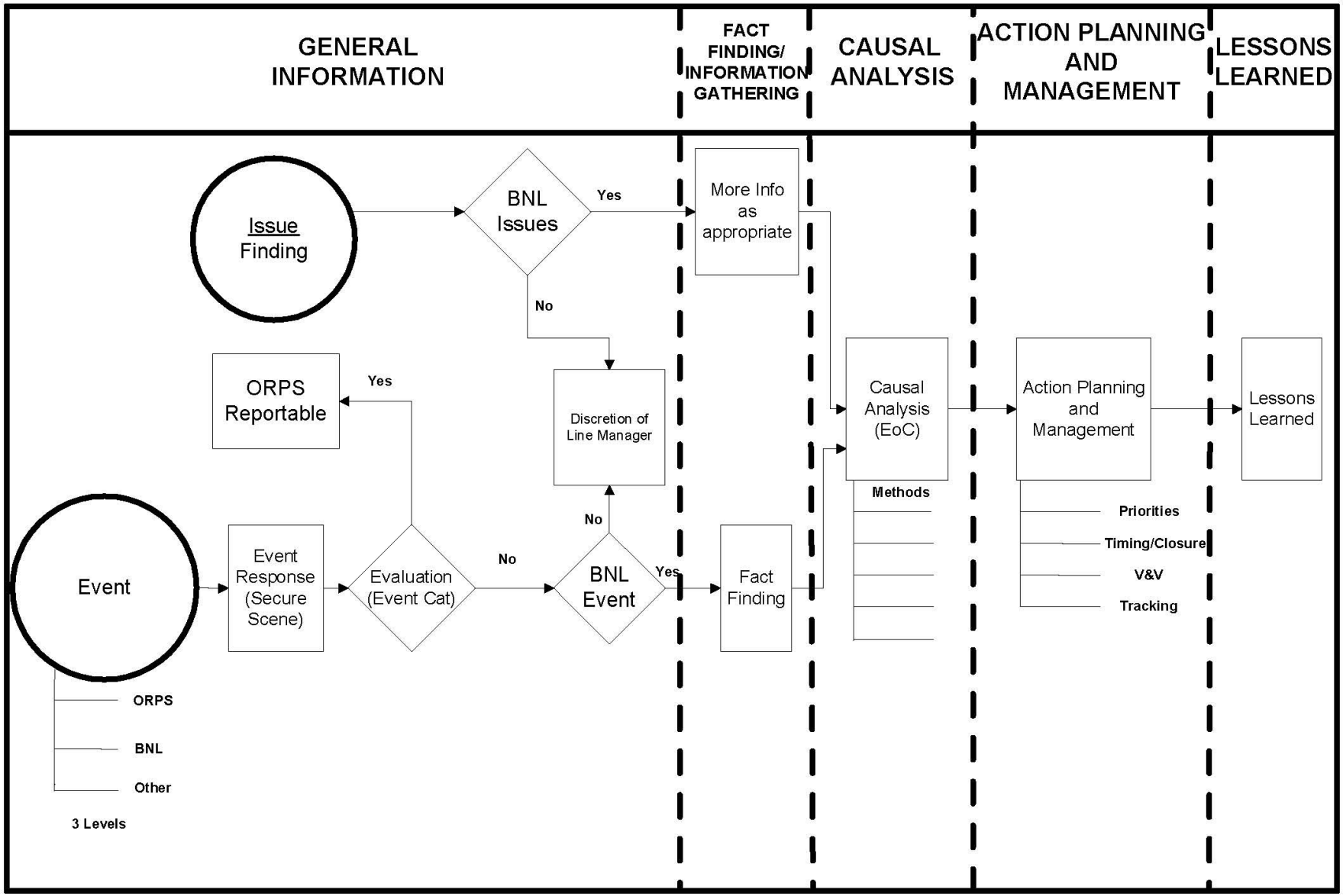
The things that cause the small things are the same as the things that cause the big things

# Why?

✓Prevent More Serious Events from Occurring by Focusing on Review and Analysis of Low Significance (**low-level**) Events



# EVENTS/ISSUES MANAGEMENT



# Key Improvements

- Defined “lower level issue” for the line
  - SCBNL
- Critiques –Now Fact finding with trained facilitators
- Institutionalized electronic reporting
- Analysis of Events/Issues
  - Causal analysis training for the line
  - Training done by recognized experts
  - Simple but concise
  - Approx – 60 trained
- Better defined Corrective action management
  - Not all Corrective actions are equal
    - Prioritization of actions

# Capitalizing on


**"Primary" - Notification System**

- Ensure Prompt Notification of Significant Events to Senior DOE Management

**"Secondary" - Data Collection System**

- Management Tool for Improvement

# Event Significance Categories

**ORPS:**

Operational Emergency
Significance Category 1 (SC1)
Recurring (SCR)
SC2
SC3
SC4

**BNL Internal Reporting:**

Significance Category BNL (SCBNL)

What is a reasonable beginning, where do I start???

# Event Reportability Criteria

1. **Operational Emergencies**
2. **Personnel Safety (SCBNL added)**
3. **Nuclear Safety Basis**
4. **Facility Status (SCBNL added)**
5. **Environmental**
6. **Cont/Rad Control (SCBNL added)**
7. **Nuclear Explosive Safety**
8. **Transportation**
9. **Noncompliance Notifications**
10. **Management Concerns/Issues**

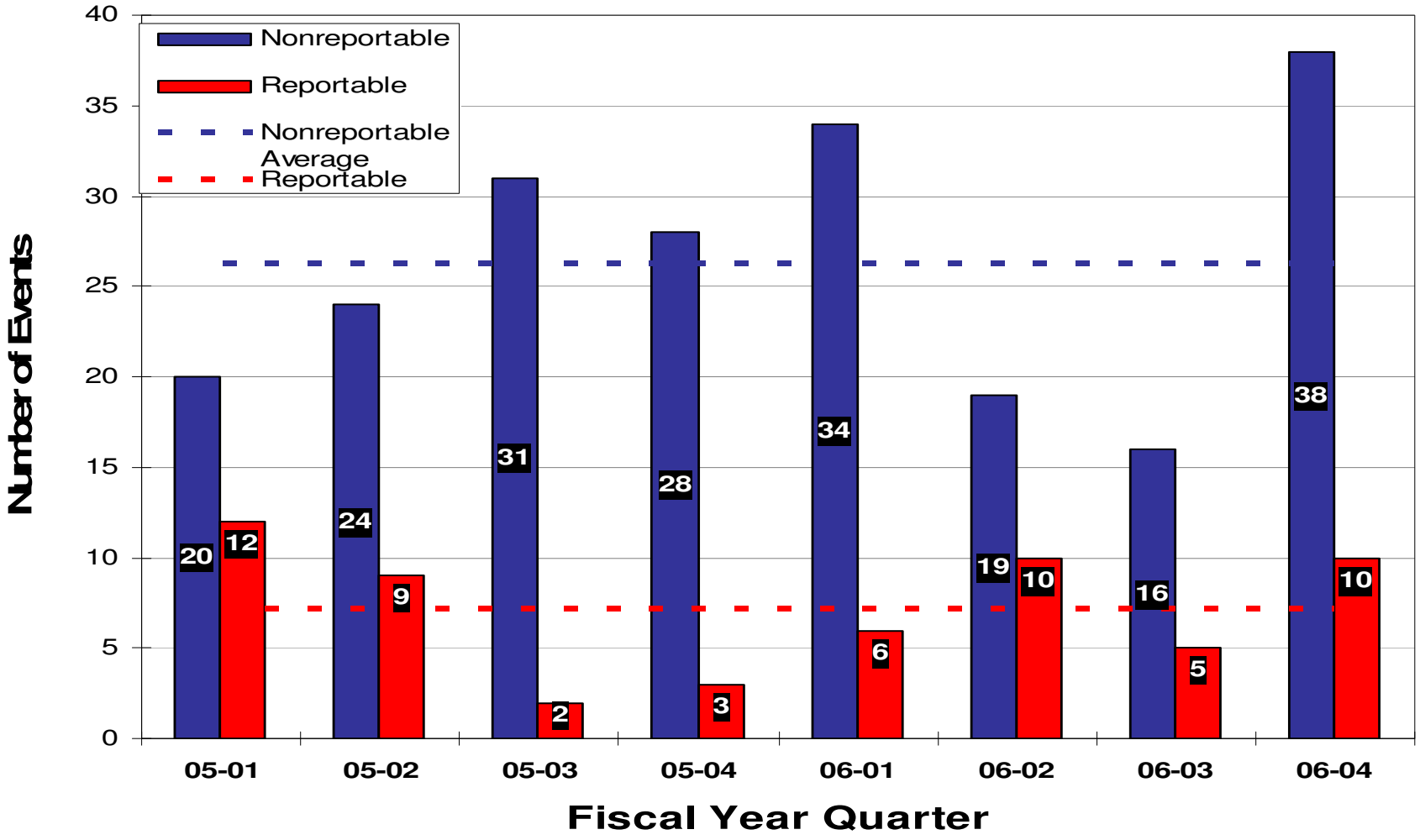
# SCBNL Criteria

## Group 2 - Personnel Safety and Health

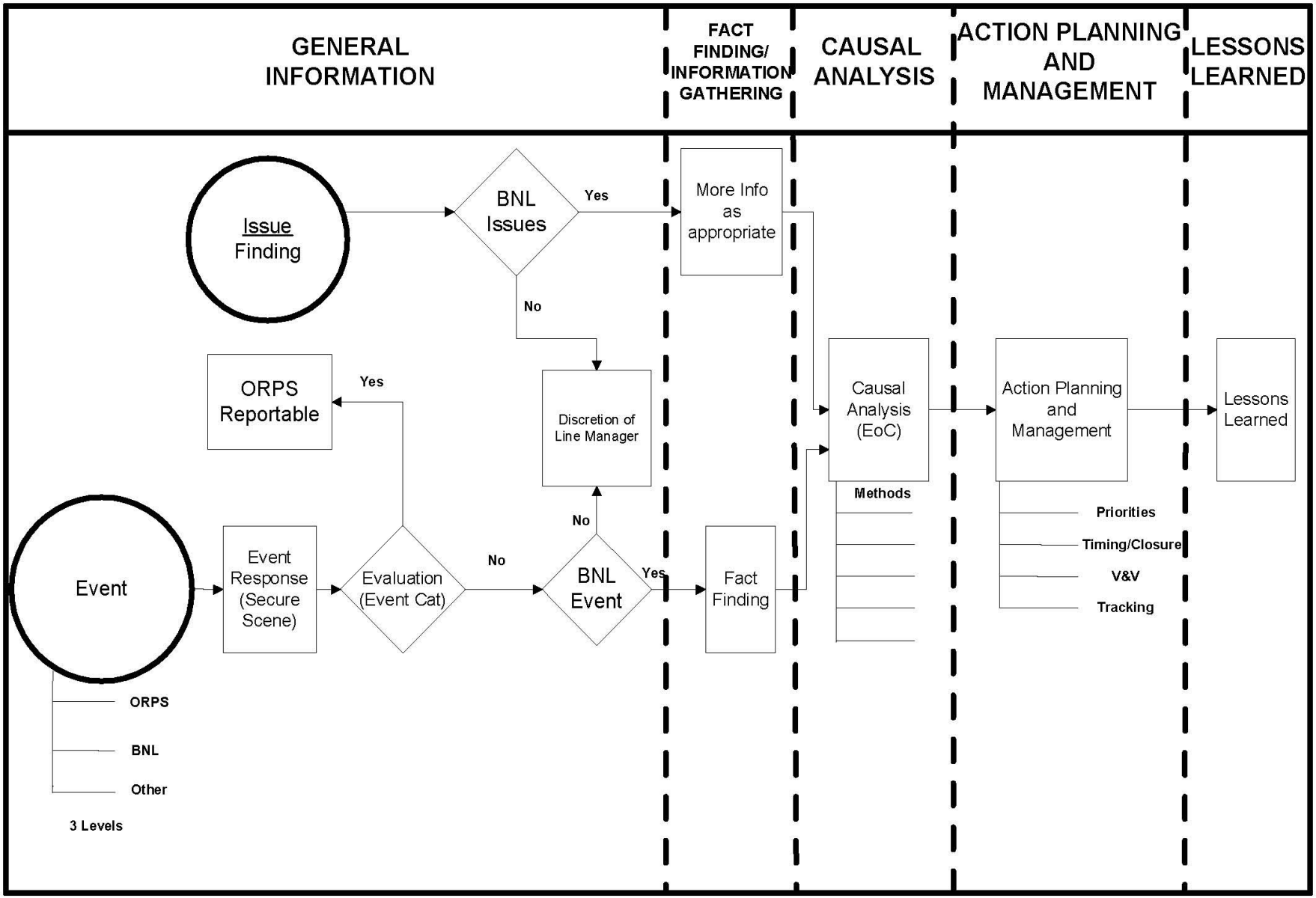
A. An occupational injury that
- Requires hospitalization
- Results in simple fractures of fingers, toes, or nose, or a minor chipped tooth
- Causes damage to nerves, muscles, tendons, and/or ligaments as determined by a physician
- Causes third-degree burns
- Causes second degree burns with the exception of burns to extremities

B. Any fire on the BNL site

# ORPS Reportable and Nonreportable Cat Entries



# EVENTS/ISSUES MANAGEMENT



# *Effectively Facilitating Fact-Finding Meetings*

**Prepared for:**
Jessie Wilke
November 13, 2006

**Prepared by:**
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*Proposal*

# *TRAINING SEMINAR*

# *Practical Approaches to Causal Analysis Processes: Barrier Analysis and Five Whys*

**Conducted for**
**Brookhaven National Laboratory**

**Bob Crowley, Department of Energy Office of Environment, Safety & Health**
**Bob McCallum, McCallum-Turner, Inc.**

**Week of July 31, 2006**




# *TRAINING SEMINAR*

# *Practical Approaches to Causal Analysis Processes: Events and Causal Factor Analysis and Human Performance Improvement*

**Conducted for**
**Brookhaven National Laboratory**

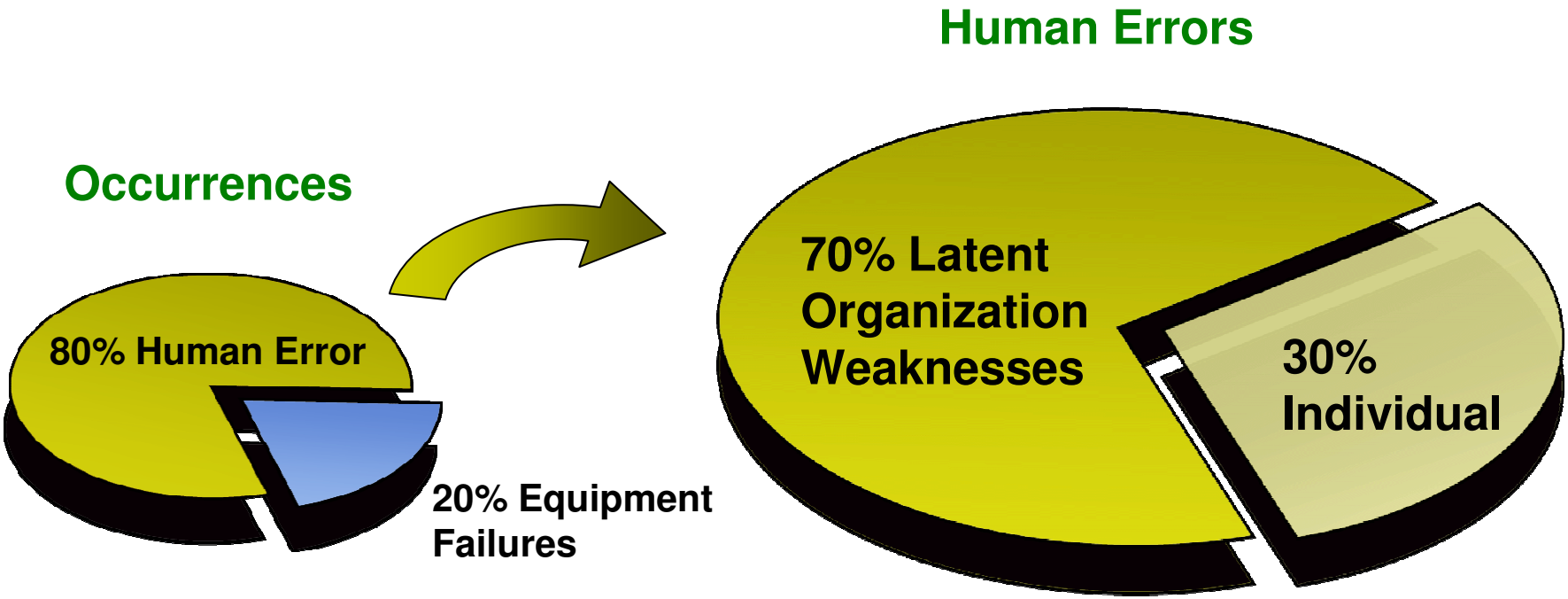
**Bob Crowley, Department of Energy Office of Health, Safety & Security**
**Bob McCallum, McCallum-Turner, Inc.**

**Week of December 11, 2006**

# HPI Training Objectives

- Discuss the significance of human performance in events and accidents
- Discuss work environment or task related factors that contribute to human error
- Describe how latent organizational weaknesses can set someone up to commit a consequential error
- Identify Error Precursors for Analysis

# Why a Human Performance Approach?



# Principles of Human Performance

1. People are fallible, even the best make mistakes.

2. Error-likely situations are predictable, manageable and preventable.

3. Individual behavior is influenced by organizational processes and values.

4. People achieve high levels of performance based largely on the encouragement and reinforcement received from leaders, peers, and subordinates.

5. Events can be avoided by understanding the reasons mistakes occur and applying the lessons learned from past events.

# What is Human Error?

An error is an unintentional departure from an expected behavior


It is a behavior without malice or forethought

# What is a Violation?

**Deliberate, intentional acts to evade a known policy or procedure requirement for personal advantage.**

**It is usually adopted for**

- **Fun**
- **Comfort**
- **Expedience, or**
- **Convenience**

# Who Commits Human Errors?

## ***Everyone does*** **– Humans are fallible**

- An airline pilot takes off on the wrong runway
- A doctor amputates the wrong leg
- A driver crosses in front of oncoming train
- An electrician locks out the wrong breaker

# Where Do Human Errors Occur?

## ***Throughout the Entire Organization***

## At the Work Level

- Moving waste containers
- Doing radiological surveys
- Operating heavy equipment
- Calibrating equipment

## In Management Systems

- Engineering calculations
- Management policy
- Internal or External Feedback Mechanisms

# Factors That Impact Human Error – Limitations in Human Nature

- Stress
- Avoidance of mental strain
- Inaccurate mental models
- Limited working memory
- Limited attention resources

- Mind set
- Limited perspective
- Susceptible to emotion
- Focus on goal
- Difficulty seeing own errors

# Factors That Impact Human Error – Limitations In Human Nature

***"No matter how well work is organized, how good procedures are, how well equipment is designed, how good the teamwork, people will never perform better than what the organization will allow."***

Maurino, Reason, Johnston & Lee. Beyond Aviation Human Factors. 1995

# Factors That Impact Human Error – Organizational Weaknesses in Processes & Values

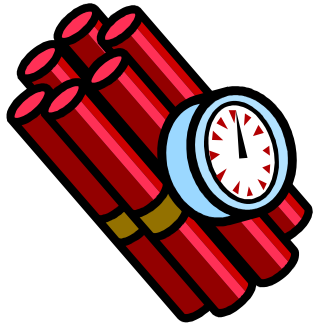
## Processes
(structure)

- Poor Work Control
- Inadequate Training
- Weak Accountability Mechanisms
- Shoddy Reviews/ Approvals
- Inadequate Equipment Design
- Human Resource Issues

## Values
(relationships)

- Priorities - Weak Safety Culture
- Measures/Controls - Production-centered
- Respect for Workers - Lacking
- Coaching & Teamwork - Lacking
- Rewards & Sanctions - Unbalanced
- Promotions & Terminations - Reinforce Wrong Values

# Factors That Impact Human Error – Work Environment & Task Related Items



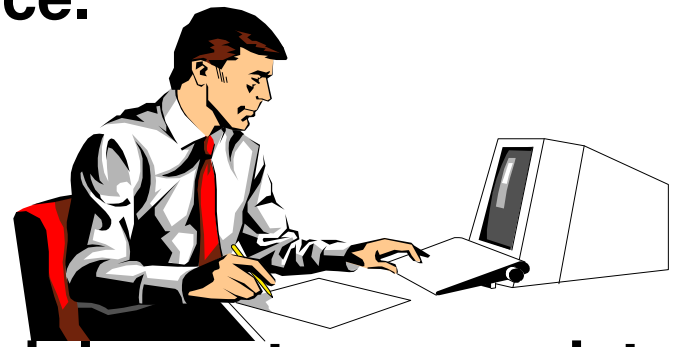
***"Events are not so much the result of error-prone workers as they are the outcome of error-prone tasks and error-prone work environments, which are controlled by the Organization."***

James Reason, Managing the Risks of Organizational Accidents

# Types of Human Errors

## Active Error

**An error that changes equipment, systems, or plant state that triggers an immediate undesired consequence.**



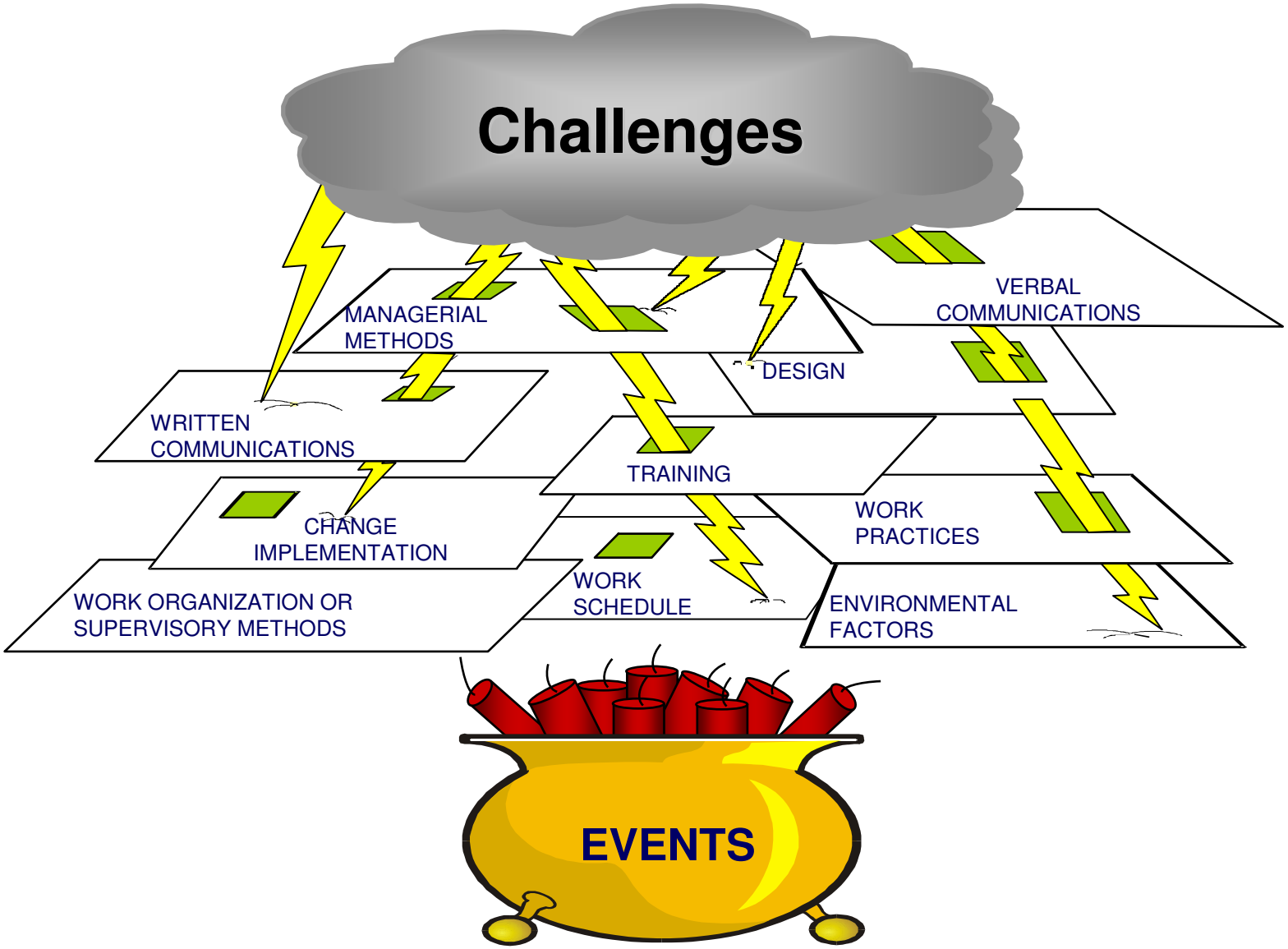
## Latent Error

**An error which creates an undetected equipment or organization-related weakness or condition that later causes an undesired consequence.**

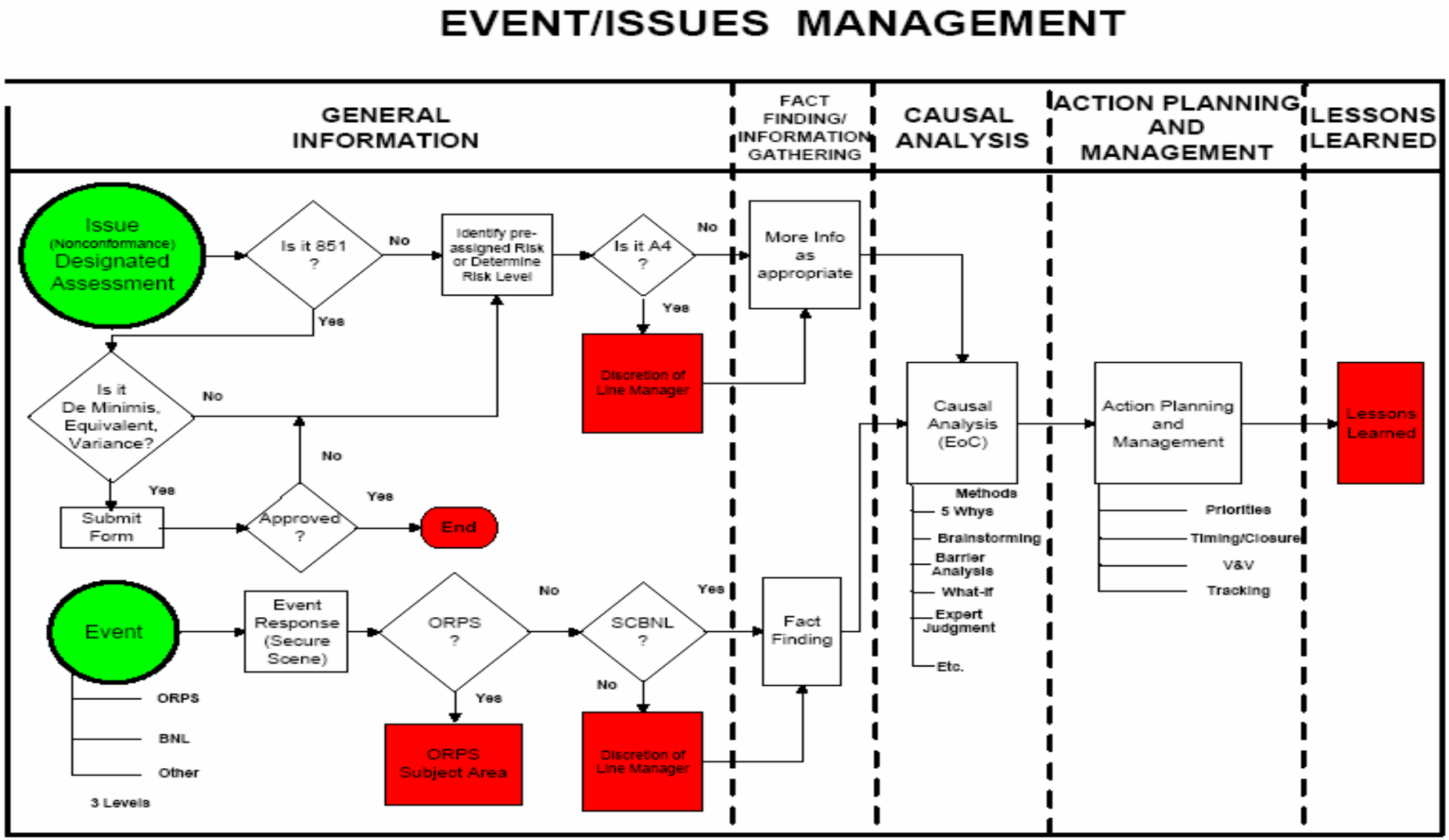
# Summary of Human Error

- **It abounds in every industry**
- **It is a major contributor to accidents, events, and occurrences**
- **It is adverse to safety goals and objectives**
- **It is impacted by limitations in human nature, the job site and task factors and individual capabilities**
- **The greatest cause of human error is *weaknesses in the organization* not lack of skill or knowledge**

# Defense In Depth



# Path Forward



# *Summary Message*

- **The Current BNL HPI Initiative is one with DOE Headquarters**
  &
  Private Consultants (The Implementers)

- Fixing the causes of low level events/issues clearly reduces the likelihood of future significant events/issues

- **Events/issues do not speak for themselves**
  - Analysis is essential

- **Organizational response is essential**
  - Encouraging open, honest reporting is the crucial first step

# CONSISTENCY REDUCES VULNERABILITY