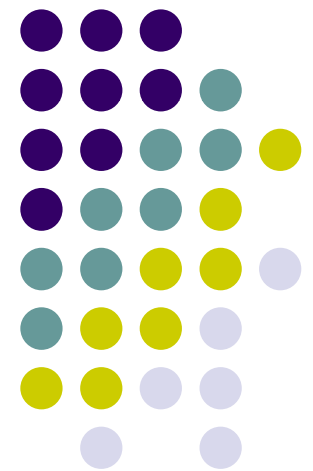
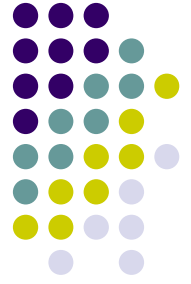


Root Cause Analysis





Root Cause Analysis

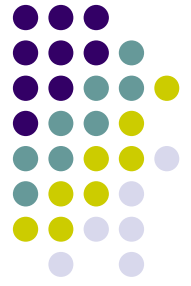
- Systematic safety process
- Series of analytical techniques
- Method for solving problems

Objectives of Root Cause Analysis



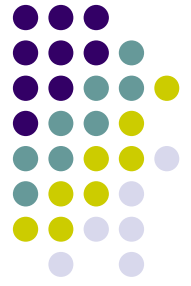
- Determine cause of failure
 - physical
 - operational
 - organizational
- Determine class of failure
 - specific
 - generic
- Take corrective action
 - short term (e.g. replacement, procedure)
 - long term (e.g. stop-use, recall, redesign)

Objectives of Root Cause Analysis (cont'd)



- Response to events
 - timely, objective, systematic
 - technically sound
- Documentation: factual, pertinent
- Identification: facts, conditions, circumstances, operational events
- Follow-up actions: corrective actions, design changes, dissemination of information

Procedures for Conducting Investigations

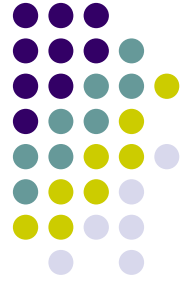


- Unique to each event
- Define the failure to be investigated
- Define individual roles
- Define authority and reporting relationships
- Information gathering needs
- Use of analytical techniques
- Use of relevant procedures



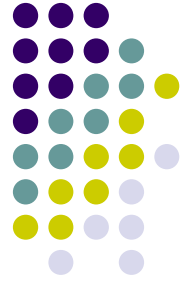
Event Characteristics

- Multiple failures
- Possible adverse generic implication
- Complicated, unique, not understood
- Cause unknown
- Significant system interactions
- Repetitive failures
- Deficiency in design, construction, operation
- Operational or management performance
- Significant overexposure
- Significant release or contamination



Process needs for success:

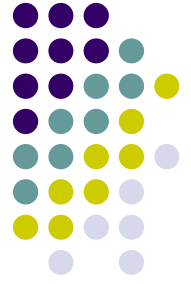
- People
- Procedures
- Plan



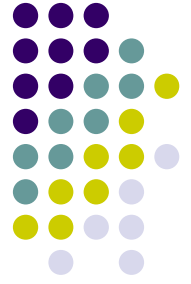
Team Qualification

- Technical experts
- Skills to add potential contributions
- Independent, objective
- Trained in investigative techniques

Program Philosophy

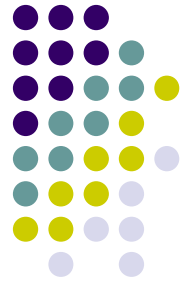


- Thoroughness, fairness, efficiency
- Safety precedence sequence
- Problem solving focus, not blaming
- Overt management support



Procedures

- NRC Augmented Inspection Team (AIT)
(ref. MC 0325)
- NRC Incident Investigation Team
(ref. MC 0513, NRC Course G-600/G-601)
- Special training courses (NRC Root Cause Investigation
Course G-205/G-207)



Techniques (e.g. NRC Course G-205/G-207)

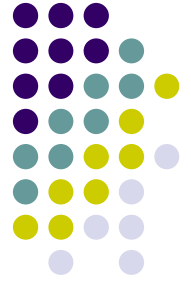
MORT1

Fault Tree Analysis

Hazard-Barrier-Target Analysis

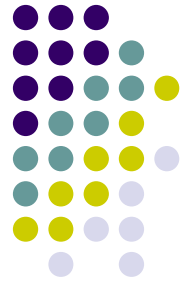
Change Analysis

W.G.Johnson, "MORT - The Management Oversight and Risk Tree," SAN 821-2, February 12, 1973, Sandia National Laboratory, U.S. Dept.of Energy. Current user manual is provided to participants of NRC Course G-205/207.



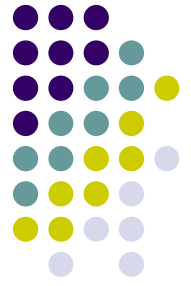
Key Program Considerations

- Event definition
- Assigning the investigation
- Procedures for conducting the investigation
- Define post-investigation responsibilities
- Training



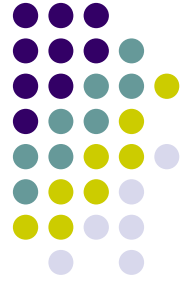
Probabilities

- Frequent - to occur often during life
- Probable - several times during life
- Occasional - sometime in life
- Remote - unlikely, but possible sometime
- Improbable - unlikely in one particular unit, assumed in large number



Consequences

- Catastrophic - death, loss of system or plant
- Critical - severe injury, major system damage
- Marginal - minor injury, minor system damage
- Negligible - less than the above

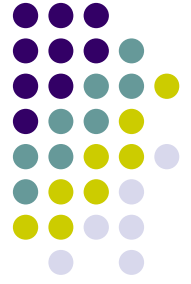


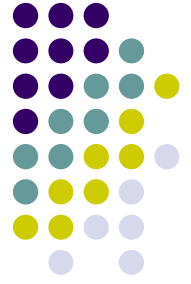
Analysis of Hardware Failure

- Initial familiarization
- Consideration of consultants
- Preservation of physical evidence
- Hardware analysis
- Analysis of Equipment Use

First Actions to Take

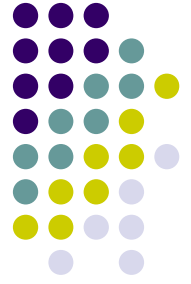
- Preservation of evidence
 - scene/object observation
 - testimony of personnel
- Initial documentation
 - field notes
 - photography
 - sketches
 - drawings
- Familiarization with facility, operation





Hardware Analysis

- Hardware tear down
- Consideration of failure modes
 - structural integrity
 - chemical
 - embrittlement
 - radiation
 - corrosion
 - functional integrity
 - unanticipated energy transfer
- Consideration of failure sequence



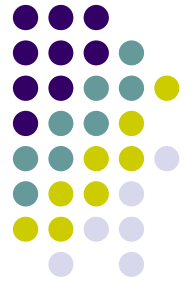
Analysis of Equipment Use

- Operating parameters (temp., pressure, etc.)
 - logs, charts, tapes
 - entire system
 - individual components
- Correlation with design/ operating limits
 - adequacy of limits
 - adherence to limits

Analysis of Equipment Use (cont'd)



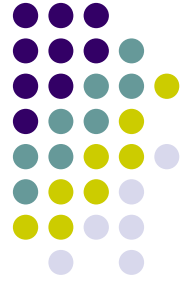
- Equipment history
 - failure history
 - mis-use history
 - maintenance history
 - QA records



Presentation of Findings

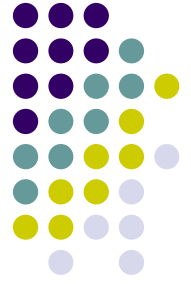
- Main Line Events
 - central to the action
 - delineation of who did what when and where

- Off the Main Line Issues
 - secondary events (responses, less important happenings)
 - conditions
 - background
 - delineation of how and why things happened



Presentation Style

- Precisely and concisely worded
- Contain a single main idea
- Connected logically and chronologically
- Based on valid information



Define Post-Investigation Responsibilities

- Review of results
- Implementation of corrective actions
- Response to comments
- Feedback to those involved
- Verification of completions of corrective actions
- Trending of causes



Examples

“Source Disconnects Resulting from Radiography Drive Cable Failures,” NUREG-1631, May 1998

“Loss of an Iridium-192 Source and Therapy Misadministration at Indiana Regional Cancer Center, Indiana, Pennsylvania, on November 16, 1992,” NUREG-1480, February 1993

“Inadvertent Shipment of a Radiographic Source from Korea to Amersham Corporation, Burlington, Massachusetts,” NUREG-1405, May 1990