PSAM 12

Probabilistic Safety Assessment and Management
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Use of Corrective Action Programs at Nuclear Plants for Knowledge Management

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Content

- Description (Scope, data, model)
- One tool
- Example
- Database specifications

General Objective

◆ **Develop a tool to reduce human errors**

   ◆ **To increase safety**

   ◆ **To avoid repetition**

   ◆ **To track and trend**

   ◆ **For knowledge management**

◆ **Hypothesis: The Corrective Action Programs are a source of data**

SCOPE

Human Errors



Pre-initiators

Maintenance
- Preventive
- Corrective
- Callibration

Operational
- Surveillance
- Normal
- Abnormal

Post-initiators

After an accident, in control room
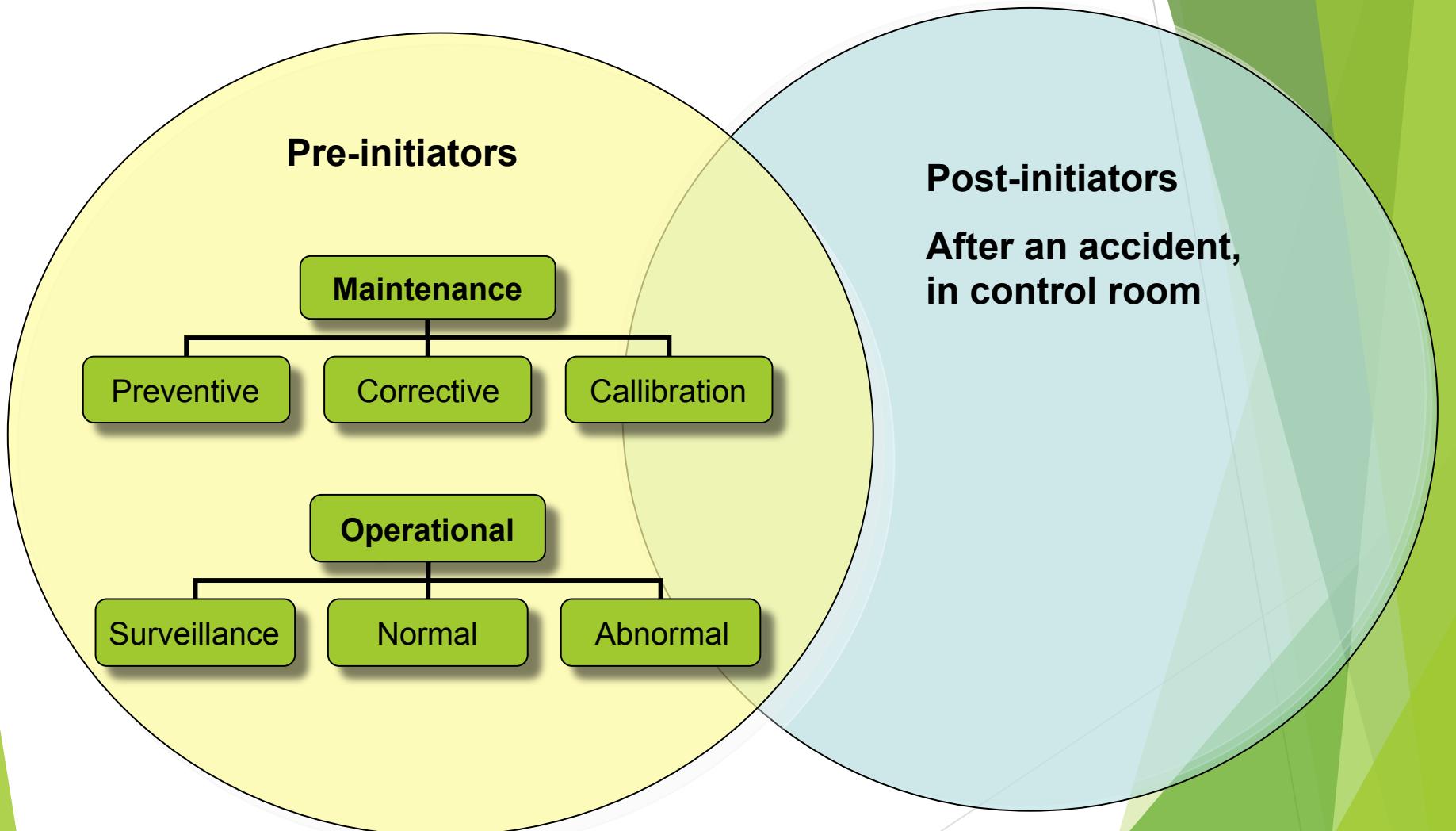
Flow Diagram for Work Order in a Nuclear Power Plant

Defense in Depth

WORK PACKAGE → Organization → Supervision → Individual Performer → CONSEQUENTIAL EVENT
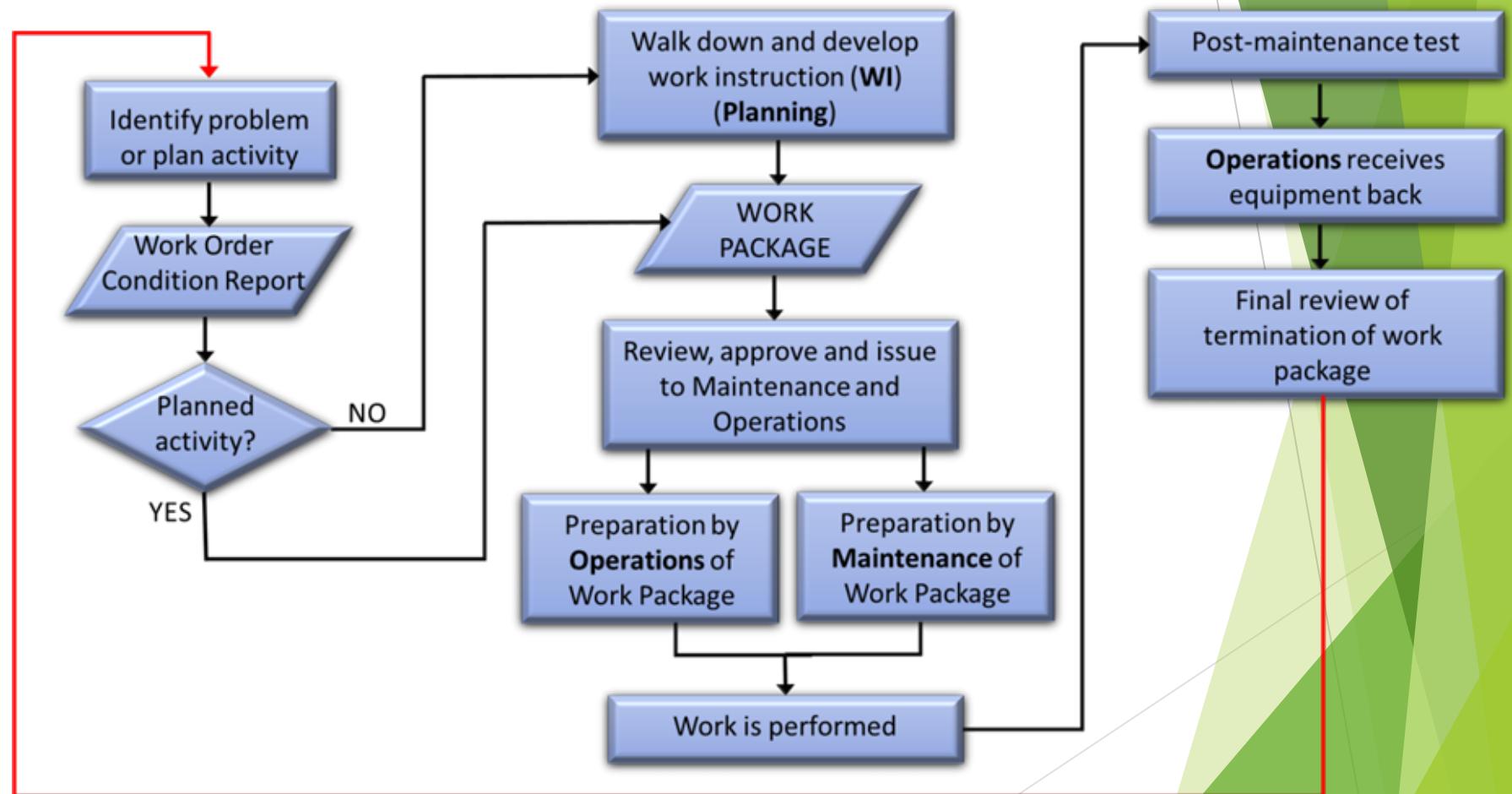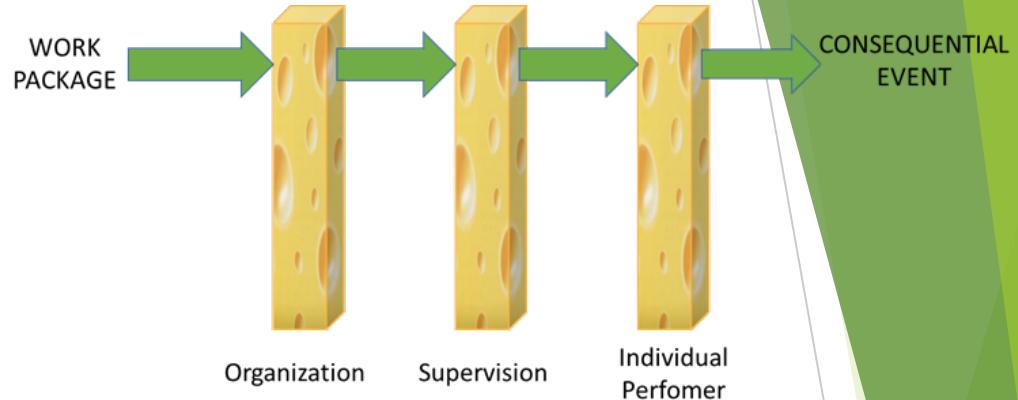
The Latent Failure Model of Complex System Failure

Goal conflicts and double binds

Incomplete procedures · Mixed messages · Inadequate training · Deferred maintenance

Regulatory Narrowness · Production pressures · Responsibility shifting · Attention distractions · Clumsy Technology

LATENT FAILURES

Triggers — The World

DEFENSES — Institution · Organization · Profession · Team · Individual · Technical → Accident
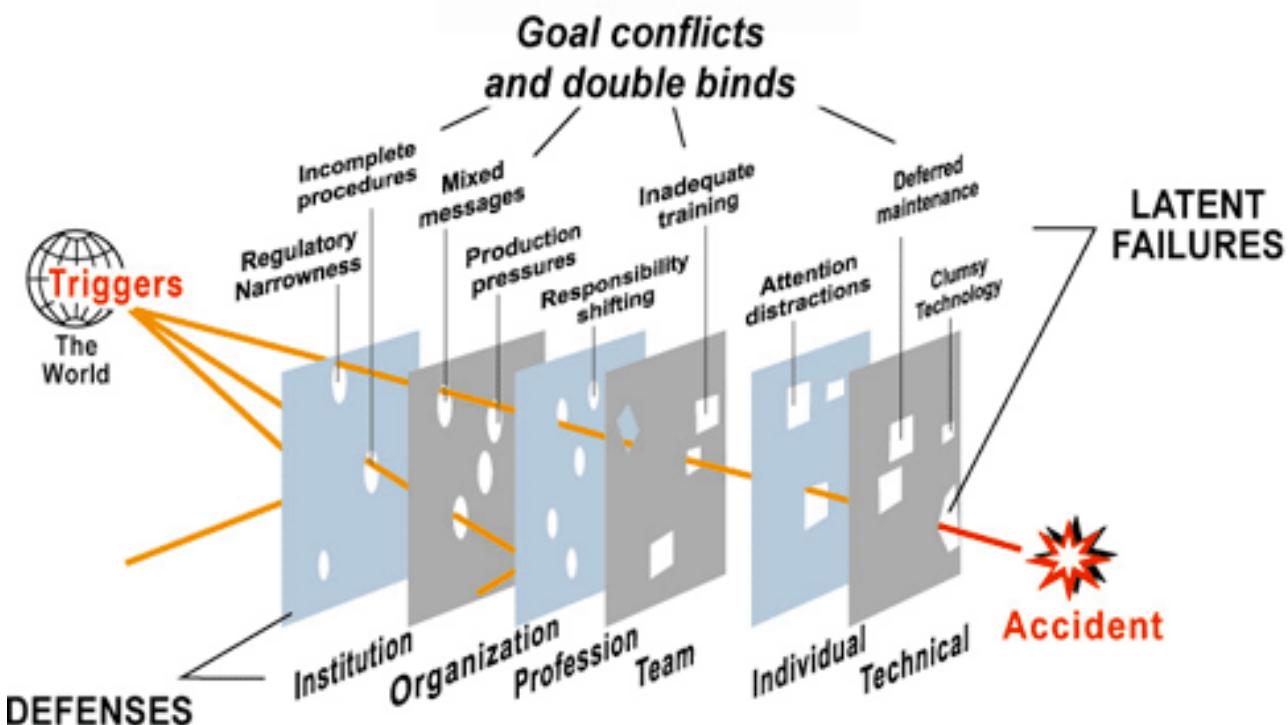
Modified from Reason, 1991
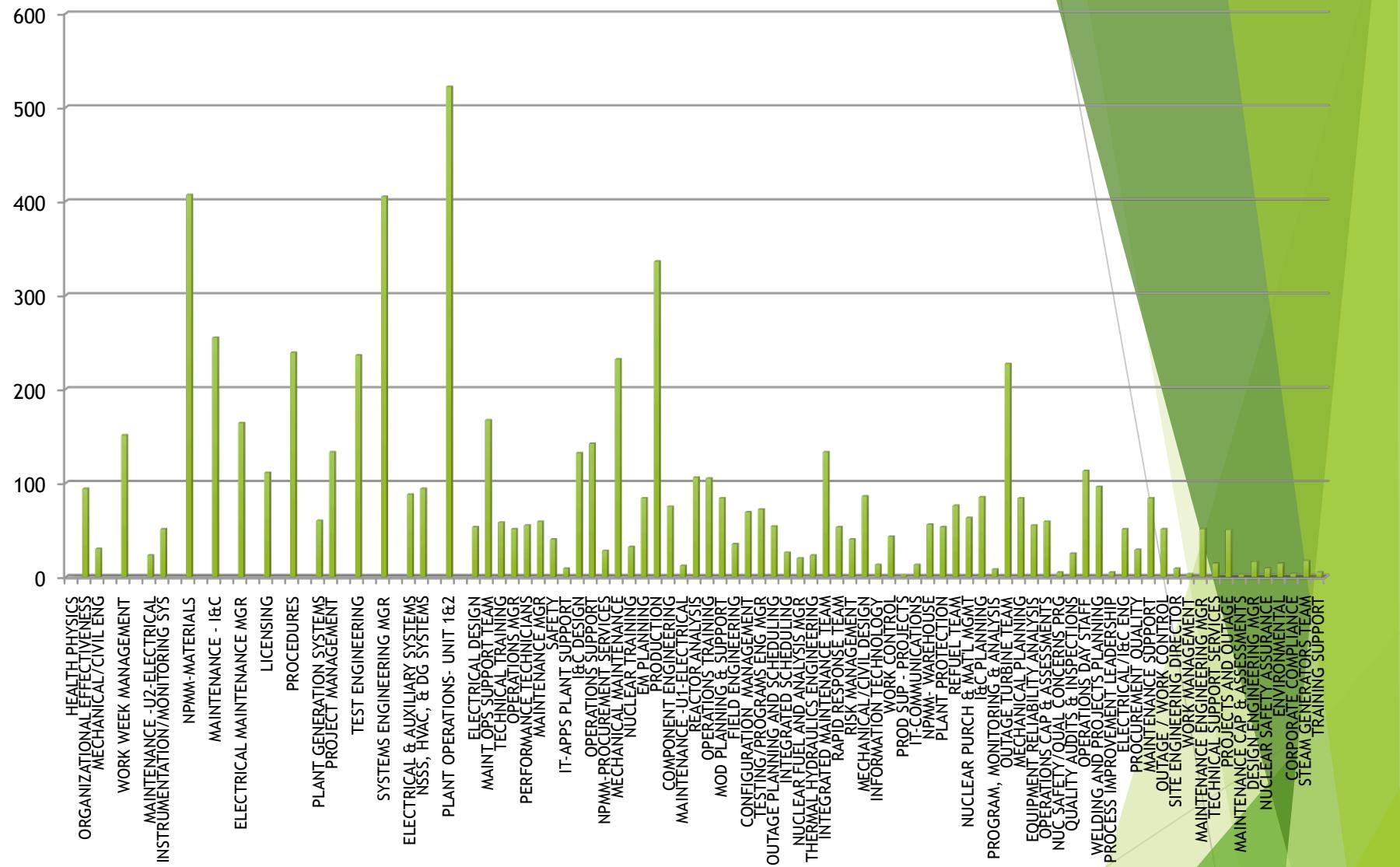
CRs per Department

Causes

| Variable	Description	Examples
DE	Equipment Design/Manufacture/Performance Monitoring	Predictive Maintenance Program Inadequacy, Preventive Maintenance Program Inadequacy
HF	Human Factors/Work Environment	Human Factors Not Properly Addressed in Work Area/Equipment
LS	Job Leader/Supervisory Methods	Pre-job Preparation or Briefing Inadequate, Prioritization of Work Activities Inadequate
MA	Management Assessment/Corrective Action	Organization Not Sufficiently Self-Critical, Cause Analysis for Known Problem Inadequate
MC	Change Management	Need for Change Not Recognized, Change Not Implemented in a Timely Manner
MP	Management Practices	Communication Within an Organization Inadequate/Untimely, Communication Between Organizations Inadequate/Untimely, Management Practices Promote/Allow Unacceptable Behaviors
MR	Management Resources	Prioritization/Scheduling of Activities Inadequate (Management level)
PA	Procedure Adherence	Procedure/Instruction/Step Implemented Incorrectly (Intent Not Met)
TR	Training	Necessary Initial/Refresher Training Not Provided
WI	Work Instructions	Document Contents Incorrect or Missing
WP	Work Practices	Slip or Lapse

Bayesian Networks
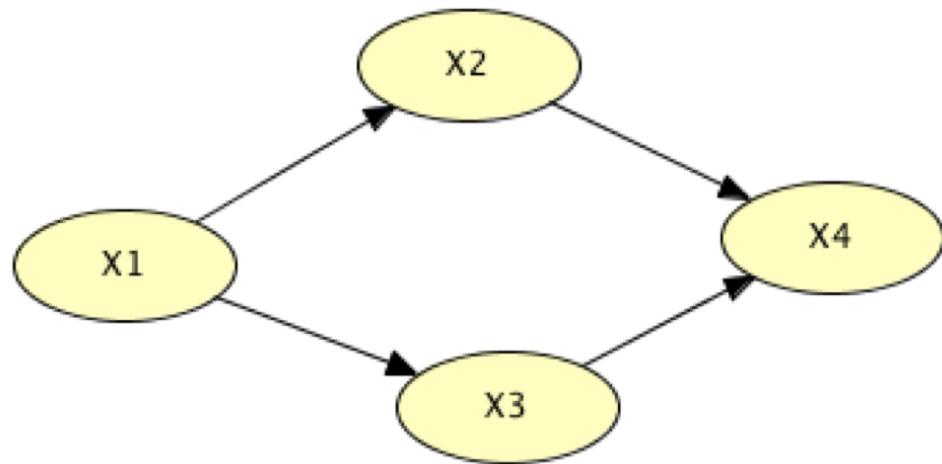
$Pr\ (X1,X2,X3,X4) = Pr\ (X1)\ *\ Pr\ (X2|X1)\ *\ Pr\ (X3|X1)\ *\ Pr\ (X4|X2,X3)$

Data from CAP

Condition Report	DE	HF	LS	MA	MC	MP	MR	PA	WI	WP	TR
1	0	0	1	0	0	1	0	0	0	0	0
2	1	0	0	0	1	0	0	0	0	0	0
3	1	0	0	1	0	0	0	0	1	1	0
4	0	0	0	0	0	0	0	0	1	0	0
5	0	0	0	0	1	0	0	0	1	0	0
6	1	0	0	0	0	0	0	0	0	0	0
7	0	0	1	1	0	1	0	0	0	1	0
8	1	0	0	0	0	0	0	0	0	0	0
9	1	0	1	1	0	1	0	0	1	0	1
10	0	0	1	1	0	1	1	0	0	1	0

Network for Event Types from CAP
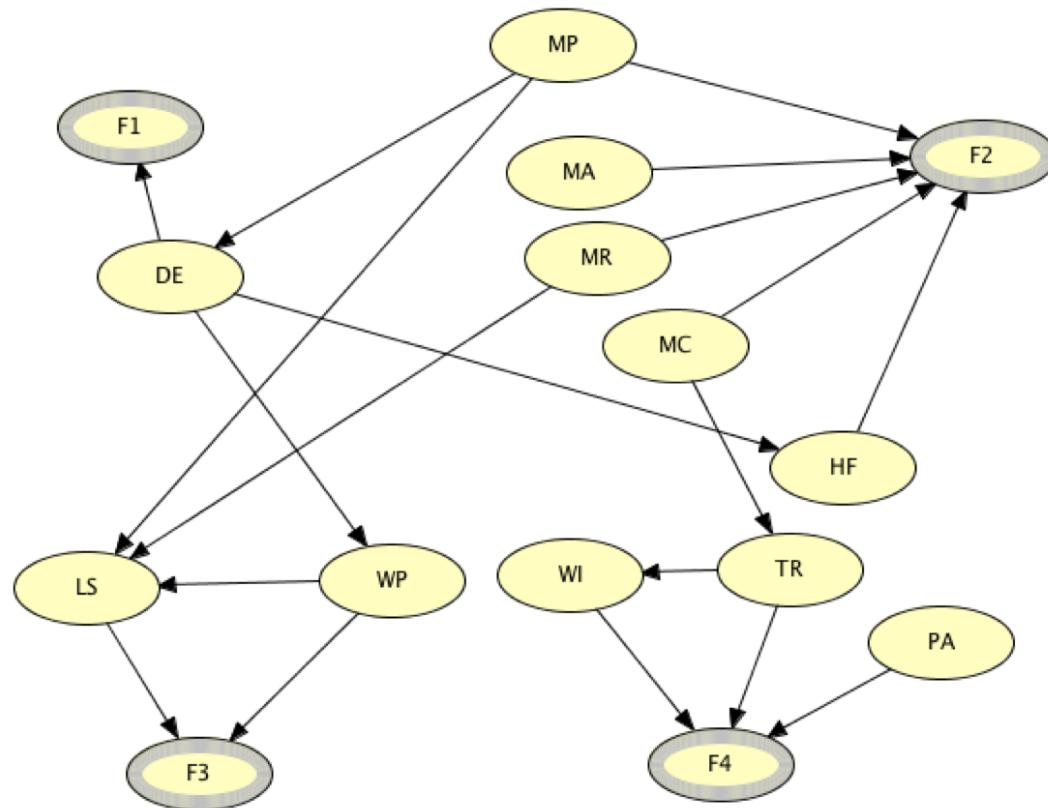
Learned Structure
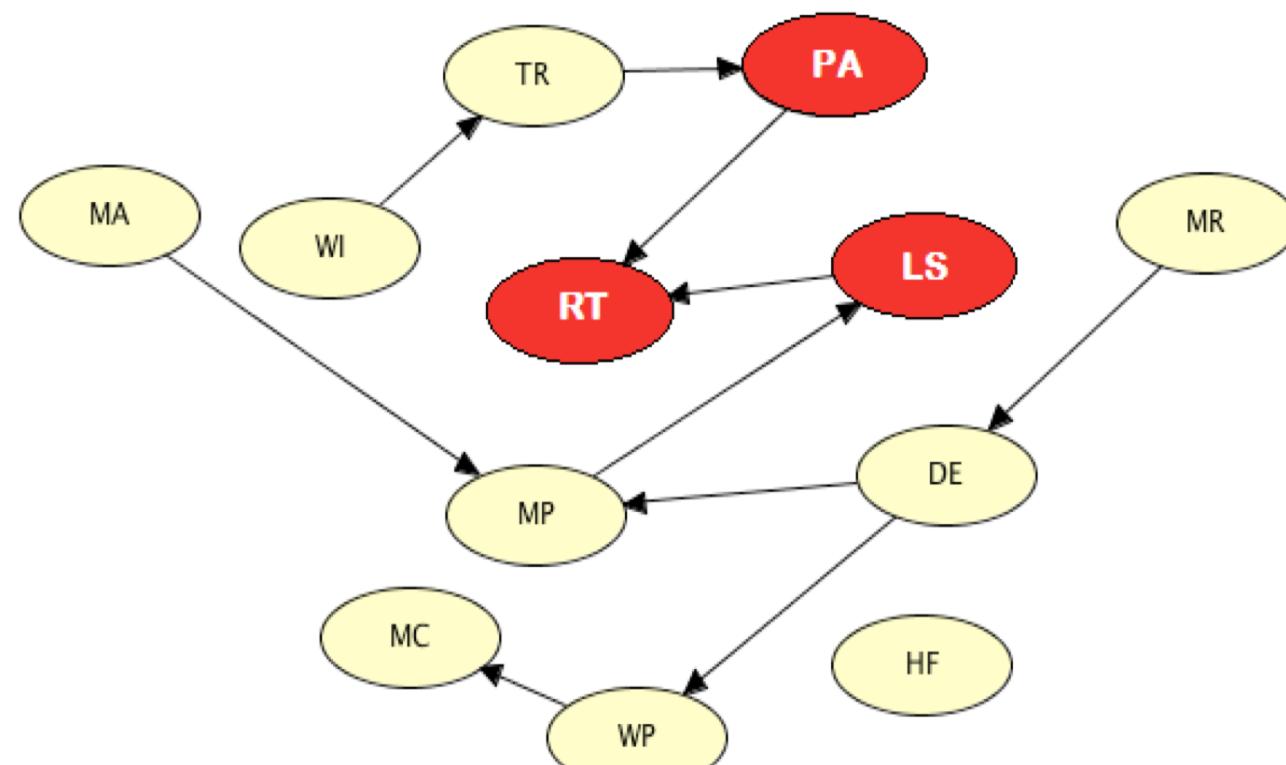
Influence Diagram
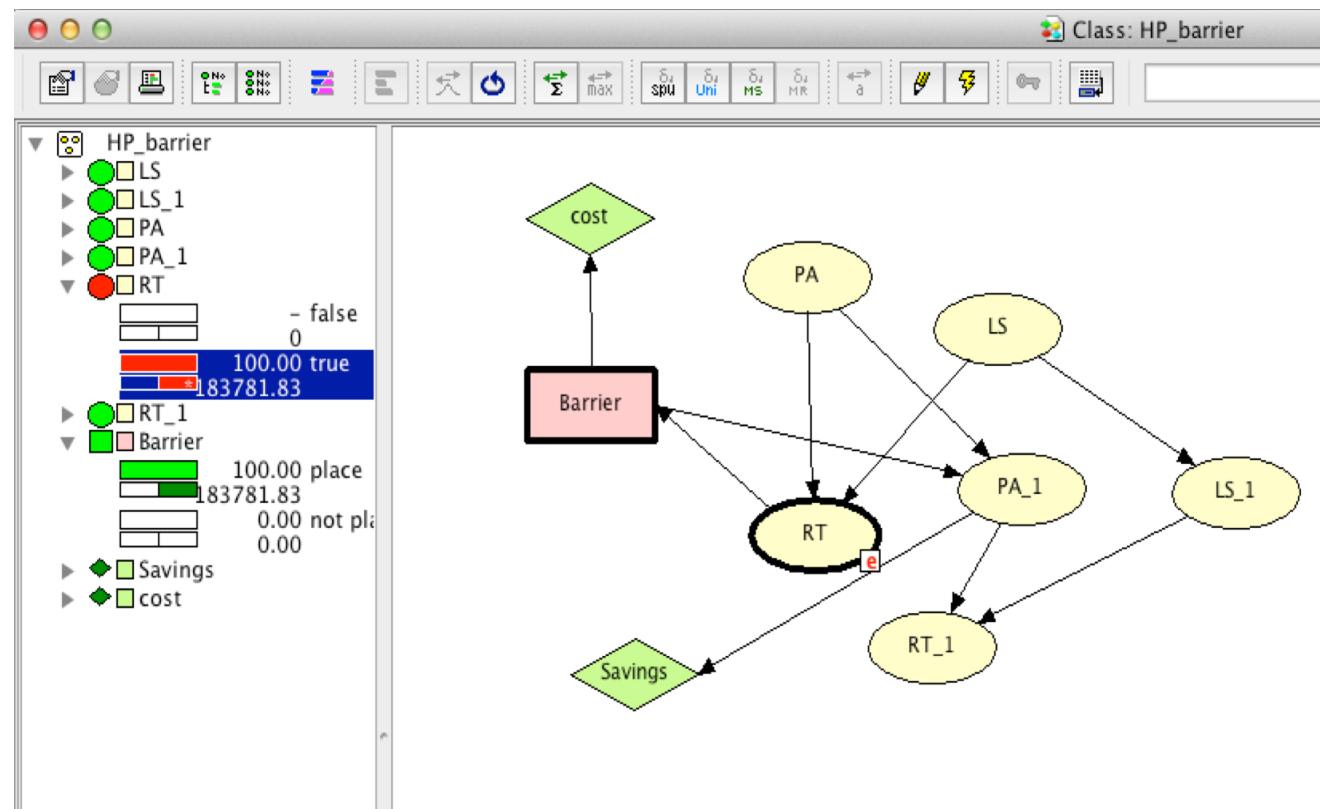
Process to Risk Inform Procedures

Quality / Safety Related Procedures → Procedure 1

Identify procedures in CAP data → Identify safety functions

Procedure 1 → Identify safety functions → Rank procedure → Rank procedure steps → Evaluate failure modes → Identify barrier to the risk significant step → Estimate worth of barrier for risk reduction → Utility >0?

Utility >0? — No → Identify barrier to the risk significant step

Utility >0? — Yes → Implement barrier

Example

▶ Procedure to test SLC pumps

▶ Safety Functions: shut down plant in ATWS

▶ Failure Mode: deviate flow

▶ Procedure Steps: close v10 and v21

▶ Barrier Options:

  ▶ Holding Point, Warning,

  ▶ Required Photo (cost of camara, software, admin. controls),

  ▶ Contract additional supervisor

▶ Evaluate Barriers
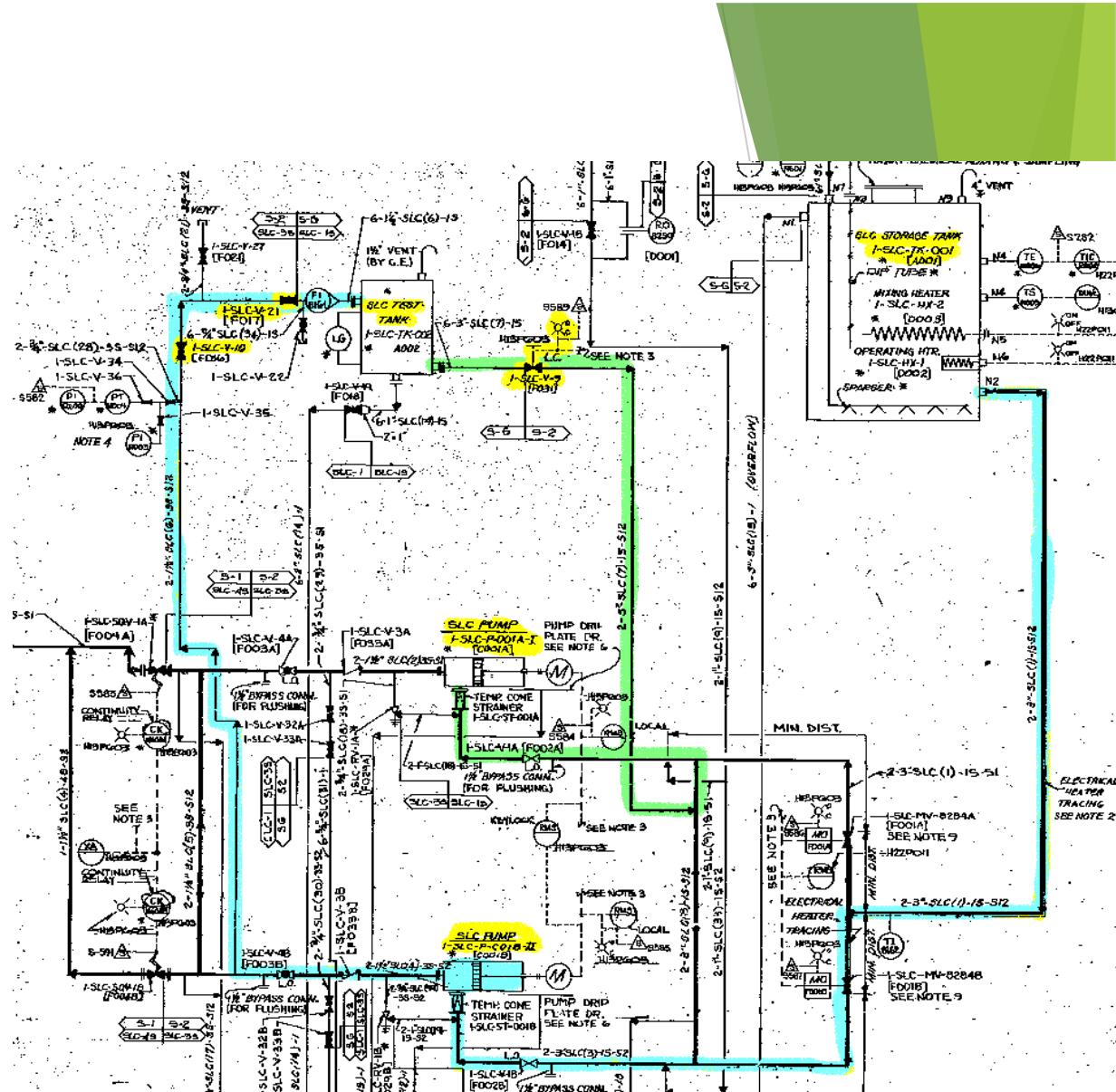
Database: New Structure

- Date
- CR number
- Organization
- Equipment
- Tag #
- Error
- Document
- Plant state
- Activity when detected
- Factor
- Final State
- Causes
- PRA