

INPO

EPIX Usage Update

May 6, 2004

Glen Masters

INPO

Scope

- Website Usage Levels
- Pattern Analysis Reports
 - Use
 - Description
 - Industry & INPO feedback
 - Ad hoc feedback

INPO

Pattern Analysis Reports

- Industry/Fleet/Unit Analysis
- What are the predominant patterns of equipment failures ?
 - System
 - Component
 - Cause
- What are the adverse trends?

INPO

Industry Pattern Analysis Use

- Input to cost/benefit analysis & business plans
- Identify problems obscured by organizational or other factors
- Validate self identified (top-ten) problem lists

INPO

INPO Industry Performance Analysis

- INPO Analysis Initiatives
 - Has industry performance stalled?
 - What areas are costing the industry the most in trips/transients/lost generation?
- EPIX is preferred tool
 - Only available one that can do pattern analysis without extensive manual review
 - Can be directly cross-checked with ROP & MOR portions of CDE

INPO

Eq. Performance Patterns

- Group of failure occurrences with something in common
- Historically based on AFI
 - Same system/component doesn't work –
Performance Pattern
 - Same system/component/part breaks –
Breakage Pattern
 - Same causal factor

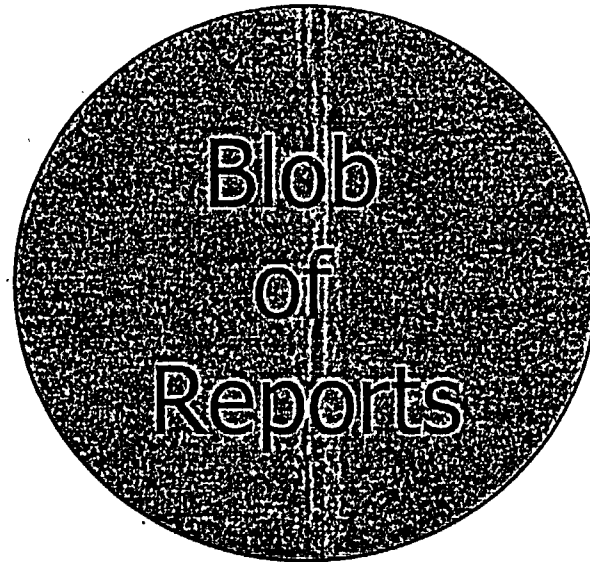
INPO

What Is "Same"?

- Common name (RCP, Feed Pump, etc.)
- Component type (valves)
- Component subtypes (AOV, MOV...)
- Manufacturer/Model/Part
- Cause (general and specific – human performance)
- Combos

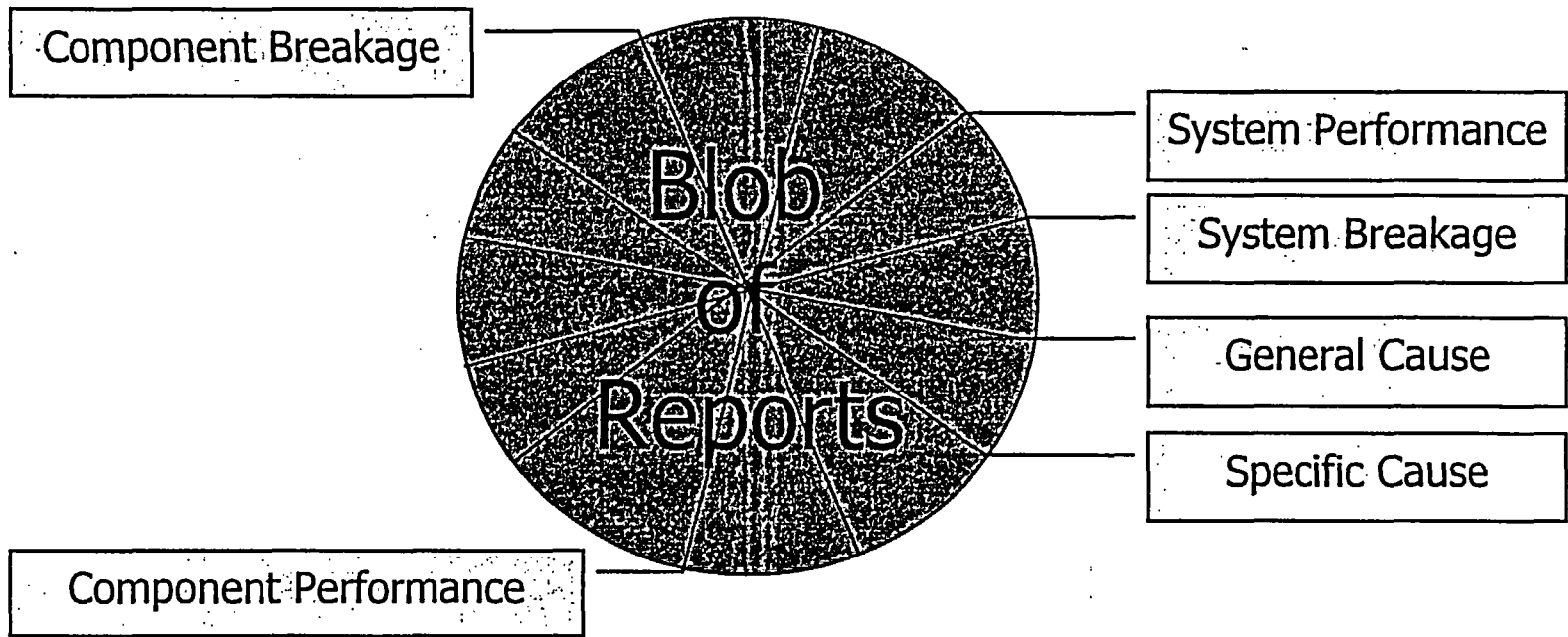
INPO

Most Significant Patterns



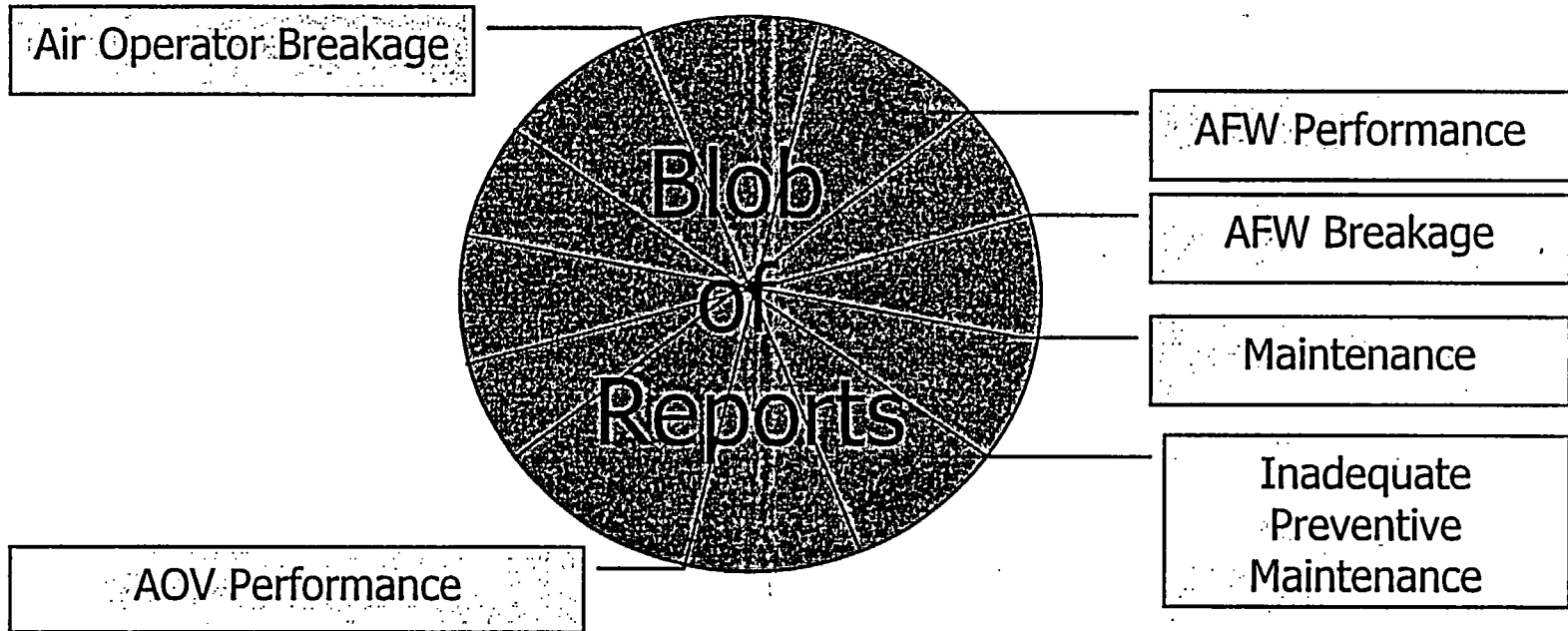
INPO

Cut By Pattern Types (42)



INPO

Yields Thousands of Specific Patterns – For Example



INPO

Specific Pattern Significance – So What?

- Safety
 - Transients
 - Risk-significant equipment affected
- Reliability
 - MWhrs lost
 - Repeat maintenance

INPO

Specific Pattern Significance Index

- Sum of four significance factors
 - Fraction of all failures occurring
 - Fraction of risk-significant equipment failures
 - Fraction of failures causing transients
 - Fraction of all MWhrs lost

INPO

Specific Pattern Trend Detector

- Analysis Period
 - Two year moving window
 - Analyses for the previous 8 quarters at each point
- Adverse Trend (trending up-U)
 - Long term
 - Emerging

INPO

Report Example

| Performance | Significance | | Failures | |
|--------------|--------------|-----|----------|-----|
| Valves | 0.78 | U | 1219 | U |
| Circuit Bkrs | 0.60 | S/D | 435 | S/D |
| Pumps | 0.45 | U | 135 | U |

Trending Up (U) or
Steady/Declining
(S/D)

Pattern Type Ordered by
Significance Index (Max value 4)

INPO

Microsoft Access - [rptMostSignificantPatterns; Report] Type a question for help

Industry Most Significant Failure Patterns for 2 Years Ending (YrMo): 200312

EPIX Analysis Included: 103 Locations, 6722 Failures(Firs.), 2732 Risk-Significant Firs., 699 Transients and, 46711761.1 MWhrs Lost
44 Patterns Types and 108815 Specific Patterns Were Identified

| Pattern Type Specific Patterns | Significance | No. Units | No. Firs. | Specific Pattern's Contribution To: | | | | | |
|---|--------------|-----------|-----------|-------------------------------------|------------------------|-------------|------------|--------|-------|
| | | | | Firs- | Risk Significant Firs- | MW/hr Lost- | Transients | | |
| General & Specific Cause of Breakage | | | | | | | | | |
| erosion / corrosion process - chemical attack | 0.3478 | U | 7 | 9 | S/D | 0.13% | 0.15% | 33.78% | 0.72% |
| management - risks of decisions not completely assessed | 0.3467 | S/D | 8 | 8 | S/D | 0.12% | 0.18% | 33.66% | 0.72% |
| erosion / corrosion process - primary water stress corrosion cracking | 0.3447 | U | 8 | 10 | S/D | 0.15% | 0.37% | 33.38% | 0.57% |
| management - delayed implementation of corrective actions | 0.3435 | S/D | 14 | 32 | S/D | 0.48% | 0.51% | 32.93% | 0.43% |
| management - insufficient interdepartmental communication | 0.3345 | S/D | 8 | 9 | S/D | 0.13% | 0.15% | 32.60% | 0.57% |
| management - needed changes not approved or funded | 0.3287 | S/D | 4 | 5 | S/D | 0.07% | 0.11% | 32.54% | 0.14% |
| mechanical process - leakage | 0.2264 | U | 72 | 206 | S/D | 4.25% | 5.89% | 4.34% | 8.15% |
| electrical process - defective circuit | 0.1570 | S/D | 83 | 406 | S/D | 6.04% | 4.83% | 0.82% | 4.01% |
| electrical process - short/circuit | 0.1560 | U | 77 | 210 | S/D | 3.12% | 3.26% | 5.31% | 4.01% |
| electrical process - open circuit or loss of continuity | 0.1471 | U | 75 | 323 | S/D | 4.81% | 4.80% | 1.28% | 3.72% |
| electrical process - insulation breakdown | 0.1406 | U | 34 | 76 | S/D | 1.13% | 1.32% | 8.75% | 2.86% |
| maintenance - inadequate preventive maintenance | 0.1401 | S/D | 68 | 215 | S/D | 3.20% | 3.37% | 2.72% | 4.72% |
| mechanical process - clogged / blocked | 0.1396 | S/D | 60 | 158 | S/D | 2.35% | 2.86% | 6.33% | 2.43% |
| equipment aging - metallic parts - normal wear | 0.1364 | S/D | 85 | 361 | S/D | 5.37% | 3.40% | 1.72% | 3.15% |
| equipment aging - nonmetallic parts - electrical breakdown | 0.1348 | U | 72 | 219 | S/D | 3.26% | 3.29% | 4.21% | 2.72% |
| mechanical process - sticking or binding | 0.1318 | S/D | 71 | 264 | S/D | 3.93% | 5.05% | 0.48% | 3.72% |
| design - general design inadequacy | 0.1220 | S/D | 63 | 220 | S/D | 3.41% | 3.40% | 2.67% | 2.72% |
| mechanical process - foreign material | 0.1143 | S/D | 59 | 134 | S/D | 1.99% | 2.71% | 3.30% | 3.43% |
| mechanical process - vibration | 0.1076 | S/D | 54 | 103 | S/D | 1.53% | 1.83% | 2.68% | 4.72% |
| maintenance - improper reassembly of component | 0.0926 | S/D | 55 | 122 | S/D | 1.81% | 2.42% | 1.74% | 3.29% |

Notes: Report is ordered from most significant to least significant. Significance is fraction of risk-significant equipment failures + fraction of MWhrs lost + fraction of transients induced + fraction of all failures. U is an upward (adverse) trend. S/D is a stable or decreasing trend. Trend detection is based on a moving two year window stated at eight quarterly points. U indicates 5/8 point trending up by 30%, or 2/3 most recent point trending up by 30%. If 3/3 most recent point are trending down by 30%, trend is S/D.

Page: 14 3

Ready

Microsoft Access - [rptMostSignificantPatterns; Report] Microsoft PowerPoint - [Industry SP 2003-EP] [rptMostSignificantPa...

INPO

Engineering Supervisors Professional Development Seminars(6) Feedback

- Provides a unique and valuable analysis capability not available at many member plants
- Data reporting not complete enough at a some of sites to yield credible results
- Need to express factor fractions as percents
- Needs a "drill down" capability

INPO

INPO Equipment Performance and Analysis Department Feedback

- Needs a “drill down” analysis capability
- Some major events are mischaracterized
- Some major events are not reported
- May have too rich a set of pattern types (some are redundant)
- Significance factors may need to be changed

INPO

Other Management Feedback

- Needs to identify improving as well as adverse trends
- Format looks too complexed, needs a summary or rollup

INPO

Drill Down Capability

- Requested by INPO Analysis Dept.
- Requested by ESPDS
- ACCESS® prototype in testing
- Demonstration

INPO

Questions for Ad hoc Feedback


INPO

Is Two Years the Right Window?

- Two years includes at least one refueling
- Corresponds with Plant Information Center
- WANO/ROP use 3 years for equipment performance

INPO

Are the Significance Factors Correct?

- Currently
 - Fraction of all failures occurring
 - Fraction of risk-significant eq. failures
 - Fraction of failures causing transients
 - Fraction of all MWhrs lost
- Possibly
 - Fraction of automatic/manual/all scrams
 - Fraction of unplanned/planned MWhrs lost
 - Fraction of unavailable hours
 - Fraction of units affected 
 - other

INPO

Are the Pattern Types Correct?

- Which can be dropped
- Should we add?
 - System-component
 - System-component-general cause
 - System-component-general & specific cause
 - System-component subtype-cause
 - System-component-general & specific cause
 - Other

INPO

Redundant Specific Patterns

- Multiple specific patterns may consist of the same n reports
- Should we
 - Ignore it and present all specific patterns?
 - Filter out more detailed specific patterns that are covered by more general specific patterns?

INPO

Unit Common Failures

- Currently
 - Counted against all units at station
 - Small number of events (32 in last 2 years)
- Other alternatives?

INPO

Single Event Saturation of Results

- Single large events saturate results for a window before & after
- What do we need to do?
 - Ignore it, it reflects reality
 - Cap MWhrs from any one event
 - Exclude selected events
 - Other

INPO

MWhrs For Continuing Events

- Currently not accounted for
- Possibilities
 - If failure end date is blank, use plant rating x hours since discovery for trips/shutdowns
 - If MWHrs is blank, use plant rating x hours between discovery and failure end for trips/shutdowns

INPO

Format Improvements?

- How do we improve readability?
- How make it look less complexed?
- Do we apply a significance cutoff?
- Do we apply a number of failures cutoff?
- How do we make a summary?

INPO

Should We Include?

- Improving as well as adverse trend identification
- Significance outlier information (this is a worst problem here than at peer plants)
- Failure probability outlier information (CFAR replacement)

INPO

Performance Analysis Problems

- There is an increasing demand for this type of analysis with short lead times
- High stakes analysis requires high quality, reasonably complete data
- A single misreported/omitted large event can skew the results
- Examine details in the Data Update



UPDATE ON NRC USAGE OF EPIX DATA

**BENNETT M. BRADY (301-415-6363, bmb1@nrc.gov)
OPERATING EXPERIENCE RISK ANALYSIS BRANCH
OFFICE OF NUCLEAR REGULATORY RESEARCH
U.S. NUCLEAR REGULATORY COMMISSION**

Presentation for EPIX Ad hoc Working Group

MAY 6, 2004



CONTINUED USE OF EPIX DATA IN REGULATORY PROGRAMS

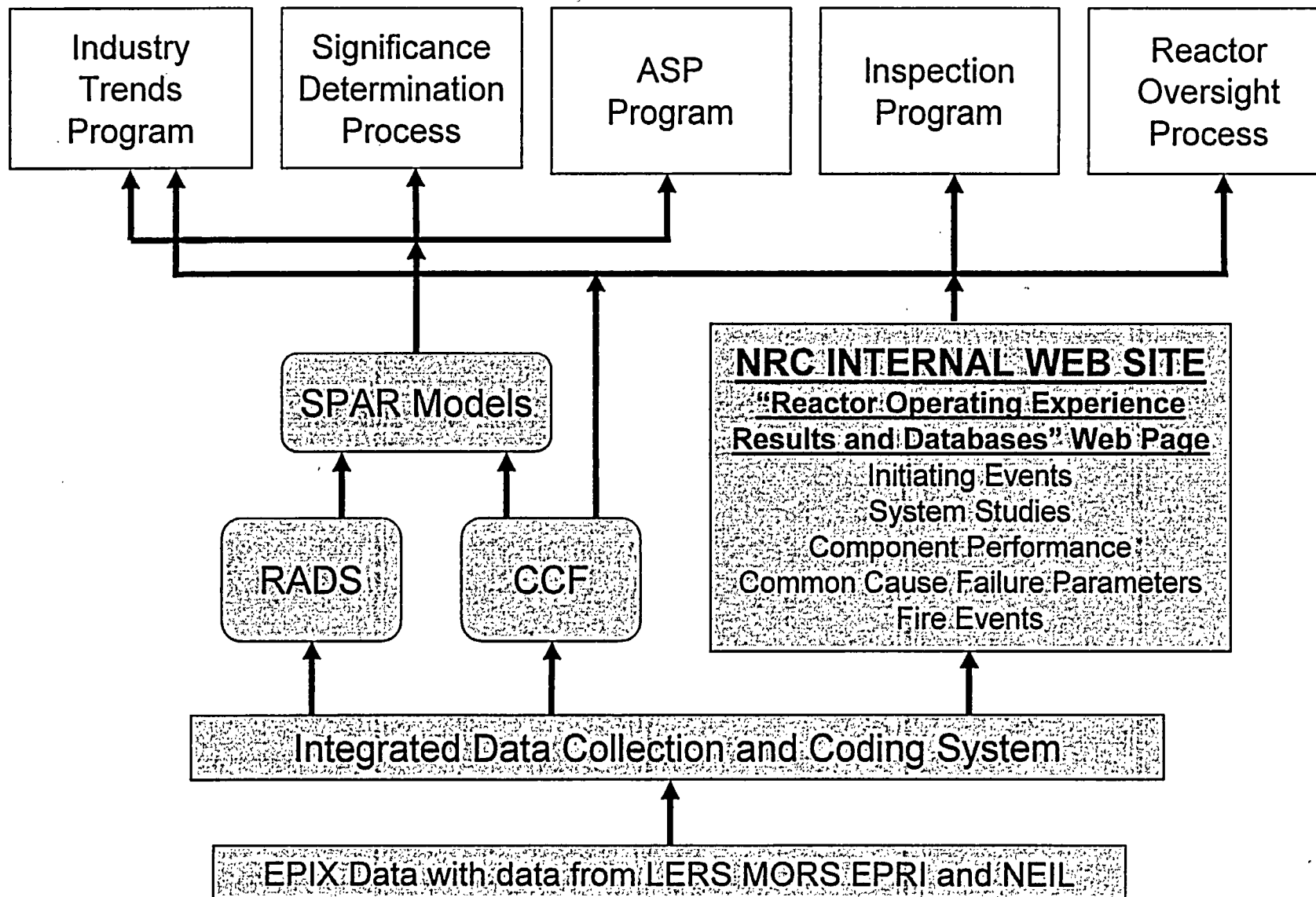
- EPIX data provide input into NRC databases
 - Reliability and Availability Data System (RADS)
 - Integrated Data Collection and Coding System
 - Common-Cause Failure Database (CCFDB)

- RADS and CCFDB provide PRA parameter estimates for SPAR models

- SPAR Models and RADS data used in
 - Industry Trends Program
 - Significance Determination Process
 - ASP Program
 - Inspection Program
 - Indicator Development for ROP

EPIX DATA IN THE NRC REGULATORY PROCESS

Regulatory Programs



EXPANDED USE OF EPIX DATA

- SPAR Models
 - EPIX/RADS data will be used to estimate more up-to-date component failure probabilities and failure rates for SPAR models

- RADS
 - Number of risk-significant components being expanded from about 20 to about 40
 - New component types being added to support SPAR models include
 - Chillers
 - Check valves
 - Circuit breakers
 - Gas turbine generators
 - Electrical fans