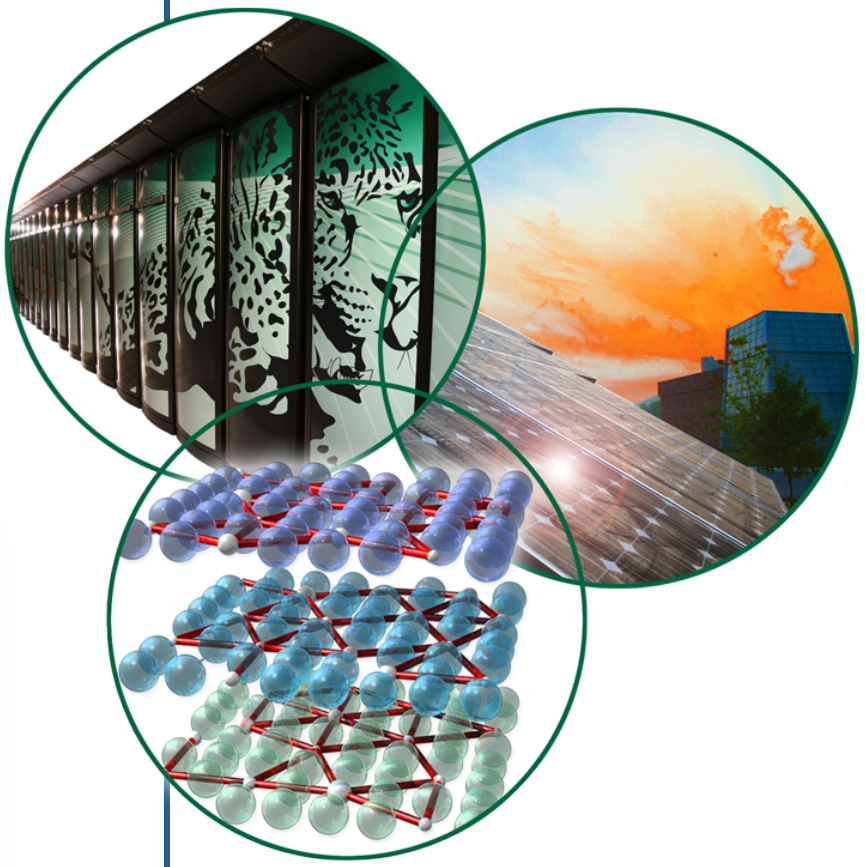
The Reliability and Risk Management Program at the High Flux Isotope Reactor

Eric L. Griffis

Oak Ridge National Laboratory
Research Reactors Division



U.S. DEPARTMENT OF ENERGY

OAK RIDGE NATIONAL LABORATORY
MANAGED BY UT-BATTELLE FOR THE DEPARTMENT OF ENERGY

Reasons for implementing a reliability program

- No regulatory requirements for a reliability program
- Existing reliability concerns
  - Availability & predictability of HFIR was not meeting expectations
    - From 2001 to 2006 - 157 of 550 operating days were not delivered as scheduled due to equipment reliability issues
  - Several pieces of equipment currently in operation have been in place since HFIR began operating in 1965
- Potential reliability concerns
  - Began operating new Cold Source facility in 2007
    - Historical operation of cold source facilities at other reactors had proven to be a reliability challenge
- The HFIR reliability improvement initiative began in 2007 due to these concerns.

Program Development

- The initial phases of program development included:
  - Management team benchmarking trips to power reactors
  - Engagement of staff to identify existing reliability threats
  - Review of existing industry guidance and tools related to reliability including: IAEA, EPRI, INPO, and other facility specific implementing procedures/policies
  - Establishment of a partnership with EPRI
  - Contracting with a reliability subject matter expert
- Developed a pilot process based on *INPO AP-913 Equipment Reliability Process Description* consisting of a comprehensive bottoms-up review of plant systems, structures, and components (SSC) that included:
  - Maintenance bases
  - System risk models
  - Performance monitoring plans
  - Life cycle and spare parts management plans
  - System condition assessments
  - Participation by a team of no less than 10 members

Initial Lessons Learned

- The pilot process was never completed for the first system
  - Too resource intensive to be sustainable
  - Largely yielded results that were commonly known
  - Value of many of the resulting products was unclear
  - Did not make effective use of existing processes (duplicated information and effort)

We quickly realized that the plant was not here to support the reliability program, rather a reliability program was needed that would support the plant!

- A graded approach was needed
  - Replace large teams spanning the organization with small teams of system experts
  - More integration with strong established processes
  - Shift process from an emphasis on generating documentation to providing actionable information that influences decision making

Resulting Reliability Program Goals

- Understand current threats to reliability
  - HFIR Operations Top Ten List
  - HFIR Equipment Vulnerability List
  - System Health Indicators
- Identify and mitigate potential future threats
  - Condition Monitoring
  - System Health Reporting
  - Preventative Maintenance Optimization
- Track and implement resolutions to threats
  - HFIR 3-Year Plan
  - Integrated Work Plan
  - Plant Health Committee
- Avoid introducing new threats to reliability
  - Reliability-Focused Design Process

New Program Elements

System Health Reports and Indicators

- Conducted semi-annually by teams of 4 members from System Engineering, Nuclear Safety, Maintenance, and Operations
- Combined 112 existing systems into 19 system groupings to focus reporting effort
- Consolidate information from existing sources and create a snapshot of the health and reliability for each of the system groupings, including:
  - System Health Indicators (pictured)
  - Recommendations for resolution of poor indicators
  - Issues and concerns resolved since last report
  - Open existing equipment vulnerability threats
  - Other system reliability concerns
  - 3-year planning activities
  - Spare parts deficiencies
  - System configuration and material condition walk-downs
  - Summary of overall system health
- Reports are presented to the Plant Health Committee where actions are assigned, prioritized, and tracked

SYSTEM HEALTH REPORT	REV. 2	RRMF-3000.1 Page 1 of 4

System: Secondary System (66.000 & 81.000) Reporting Period: 01/2010–08/2010

	SYSTEM HEALTH INDICATORS	PREVIOUS REPORT	CURRENT
OPERATIONS	Unplanned Shutdowns during the reporting period	1	0
	Open Operator Work-Arounds	8	2
	Open Control Room Deficiencies	2	2
	Open Disabled Annunciators	0	0
	Unplanned Limiting Conditions for Operation (LCO) Entries	0	0
MAINTENANCE	Surveillance Test Procedures (STP) in the Second ½ of Grace	0	0
	Open Corrective Work Orders	8	13
	Open Corrective Work Order Backlog (greater than 90 days)	7	7
	Overdue Preventive Maintenance (PM)	0	1
	Condition Monitoring Analysis - equipment issues identified	1	1
ENGINEERING	Open Design Modifications (i.e.; ES, ECN, DCM and MM)	23	25
	Open Deviations	4	4
	Open Temporary Modifications	2	1
	Design Modifications Past 20 day and/or 110 day Closeout	1	0
	Open Drawing Discrepancy Notices for Ops Critical and Safety Basis	5	7

	Signature	Date
Primary System Engineer		08/25/2010
Operations Representative		8/25/2010
Maintenance Representative		8/25/2010
Safety Analyst	Jennifer R. Smith	8/25/2010

	System	Initial	System	Initial	System	Initial	System	Initial
Sub-System Engineers	81.000	CMS						

New Program Elements

PM Optimization

- The existing Maintenance Program at HFIR was largely based on PM tasks using vendor recommendations and had not been reviewed for accuracy or applicability in some time
- Implemented a methodology focused on improving maintenance effectiveness and equipment reliability by comparing our existing maintenance activities and frequencies to the EPRI PMDB of standard industry practices with consideration of our failure history
- Outcomes of this review include:
  - Shifted to a more condition based maintenance philosophy
  - Extended frequency of many intrusive “overhaul” time-based tasks
  - Removed several PM tasks that provided little to no benefit relative to their cost

New Program Elements

Plant Health Committee

- Comprised of members of the RRD management team and first line supervisors
- Tasked with monitoring plant performance and taking actions necessary to improve plant reliability
- The committee meets weekly and focuses on these areas:
  - Nuclear safety message
  - New emergent issues related to safe, reliable, efficient operations
  - Review of scheduled actions and reports, for example:
    - System health reports
    - Condition monitoring analysis reports
    - Outage critiques
    - Post-job reviews
  - Routine topics
    - Equipment vulnerability list
    - 3-year plan updates
    - Personnel safety improvements
    - HFIR Operations top-ten list
    - PHC action tracking
    - PM optimization metrics

Fine Tuned Existing Programs

- Condition Monitoring
  - Significantly expanded to include other technologies (lube oil, thermography, ultrasonic)
  - Began periodic reporting of data and analysis so that trends can be recognized
  - Trained craft and task leaders on data collection techniques
- Maintenance Processes
  - Implemented change to existing feedback process for task leaders and craft to ask pointed questions aimed at gathering information on maintenance effectiveness
- HFIR Equipment Vulnerability List
  - Actively identify, track, and review actions to address reliability threats
- Reliability-Focused Design Process
  - Integrated general safety and reliability principles as well as design considerations for system reliability in the existing design modification process.
- An RRD Reliability and Risk Management SharePoint site was developed to link all pieces of this program in one convenient accessible location

Results

- Availability and predictability of the HFIR is significantly improved
  - 2007-present – only 6 out of 550 scheduled operating days were not delivered as scheduled due to equipment reliability issues
- Significant improvement in resource utilization by optimizing Preventative Maintenance activities
  - Allowed the redeployment of existing resources to execute more planned equipment upgrades
- Recent assessment of program implementation found we had created a program that compares favorably to commercial power reactor reliability programs
  - We were invited to present our PMO approach to the EPRI PMDB user's group, comprised of commercial power representatives
- There have been no unanticipated failures of equipment currently monitored in the condition monitoring program

Cold Source Cold Box Wiring

Cooling tower fan motor replacement

Conclusion: It is possible to improve reliability at a research reactor by applying targeted reliability principles (a graded approach) with established goals and alignment of resources