Focusing on Safety Culture and Human Performance at HFIR

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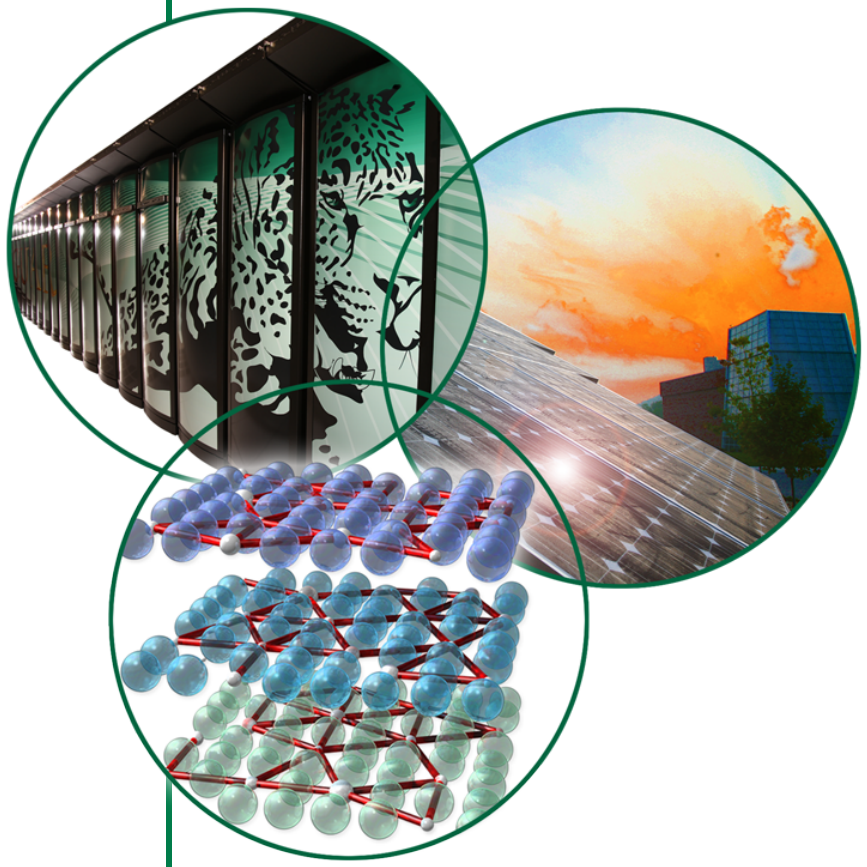

U.S. DEPARTMENT OF ENERGY

OAK RIDGE NATIONAL LABORATORY
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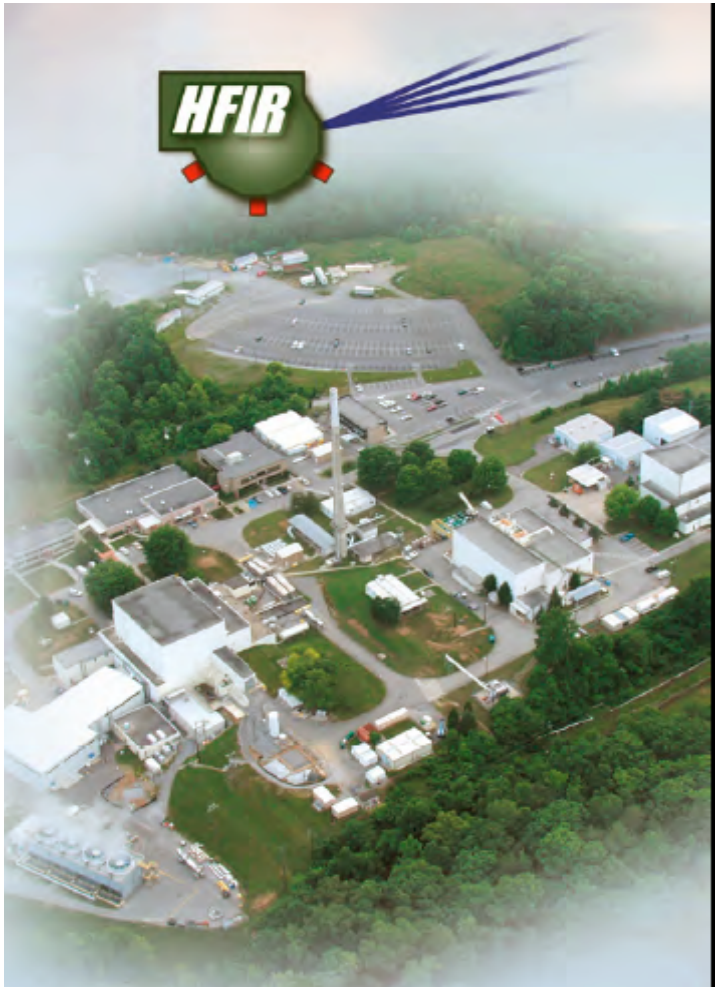
Research Reactors Division

Safe, reliable, and efficient HFIR operation to support the neutron science mission.

Neutron and Nuclear Sciences

Be the world's foremost center for neutron sciences, providing unprecedented capabilities for understanding the structure and properties of materials across the spectrum of biology, chemistry, physics, and engineering; provide leadership in isotope production and the study of exotic nuclei.



The High Flux Isotope Reactor

- Capabilities: 85 MW_{TH} , 2.6 x 10^{15} neutrons/(cm^2 – sec)
- 200 full-time employees
  50-70 in-house scientists
- Experiment Capabilities:
  - Materials irradiation
  - Activation analysis
  - Neutron Scattering with Thermal and Cold neutrons

- 373 unique users in FY2010 (up from 358 in FY2009)

Safety Culture Defined

- **Safety Culture is…**

"the organization's values and behaviors modeled by its leaders and internalized by its members that serve to make nuclear safety the overriding priority."

Institute of Nuclear Power Operations

HFIR is a nuclear reactor and should, therefore, seek to exhibit the best practices of our DOE facility peers and the nuclear power industry as applicable to the HFIR mission and operating environment

Principles and Attributes of a Strong Nuclear Safety Culture

- Everyone is personally responsible for nuclear safety
- Leaders demonstrate commitment to safety
- Trust permeates the organization
- Decision-making reflects safety first
- Nuclear technology is recognized as special and unique
- A questioning attitude is cultivated
- Organizational learning is embraced
- Nuclear safety undergoes constant examination

Institute of Nuclear Power Operations

Human Performance Improvement

Human Performance Improvement (HPI) and Nuclear Safety Culture are complementary and promote an environment conducive to meeting the HFIR mission

HPI is…

a) Minimizing the frequency of human error

b) Minimizing consequences of errors by managing defenses

Reactor personnel and scientific personnel alike can affect the ability to perform experiments

"Every neutron is sacred" -- neutron scattering staff member

Human Performance Improvement

- The risk of human error at HFIR: safety, operation, science, user confidence

- Managing risk of human error:
  - Understanding of where we are and course we are on
  - Address people, processes, equipment
  - Management and leadership support
  - HPI tool usage (communication, training, observation)

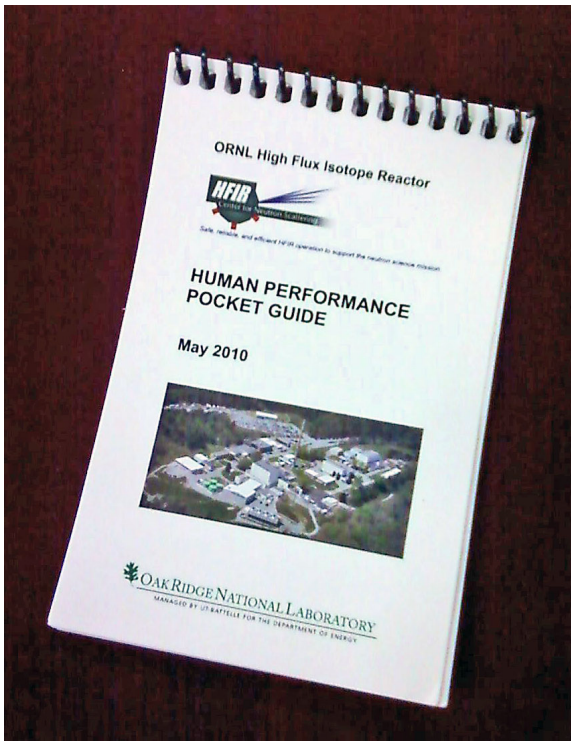
Human Performance at HFIR

- 3 external assessments in FY10 gauged status of safety culture and human performance risk management
- Human Performance Improvement Fundamentals training module developed and provided to all staff
- Internal 'needs assessment' to determine which human performance tools to emphasize. Managers will train their staff
- Discussions with neutron scattering division to identify human performance issues

Human Performance at HFIR

Implementation seen in…

- Training
- HPI Pocket Guide & HPI Tools
- Observation Checklist
- Procedure and process revisions to incorporate HPI
- Evidenced by inclusion in meetings and conversations



- Include human performance and Just Culture in problem investigations and critiques
- Every in-core or in-pool experiment reviewed per RRD EG-1
- All scattering experiments reviewed in Research Safety Summary

HFIR Human Performance Tools

- **Pre-Job Brief**
- **Take a minute**
- **Self Checking (STAR)**
- **Peer-Checking**
- **Verification Practices**
- **Procedure Use and Adherence**
- **Communication Practices** (three-way communication, approved phonetic alphabet and acronyms)
- **Stop when Unsure**
- **Post-Job Review**

Human Performance in Neutron Scattering

- **Neutron Scattering experiment development and execution: seeking to maximize neutrons on target and minimize instrument downtime without increasing risk to the reactor.**

Cold Triple-axis Assembly Team

Neutron Scattering Instrument Reliability

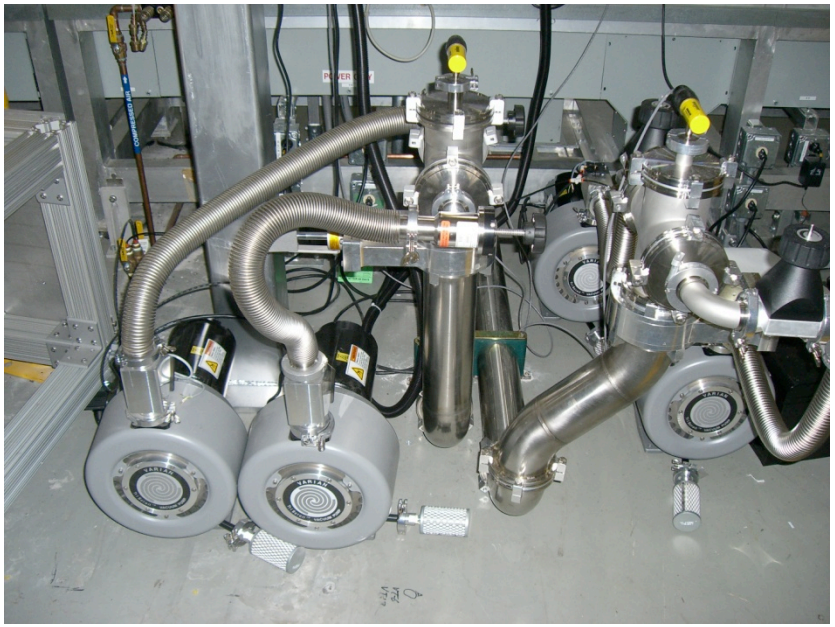
- Scientists come from all over the world come to the HFIR to conduct experiments on our neutron scattering instruments

- A typical experiment runs anywhere from 48 to 120 hours

Four-Circle Diffractometer

Neutron Scattering Instrument Use of HPI

- **Identify critical equipment** that, when it fails, can take out experiment availability
  - A single water-cooled vacuum pump that was responsible for the entire beam-line operations in cold-guide hall
  - Replaced with two dry scroll pumps and a back-up that is ready to valve in at a moments notice
- Use of **communication tools** and **pre-job brief** has led to improved experiment installation
  - Input from installation craft upfront on engineering design
  - Result: Installation is a smoother process, ahead of schedule, provides more neutron time to the instrument scientist for commissioning



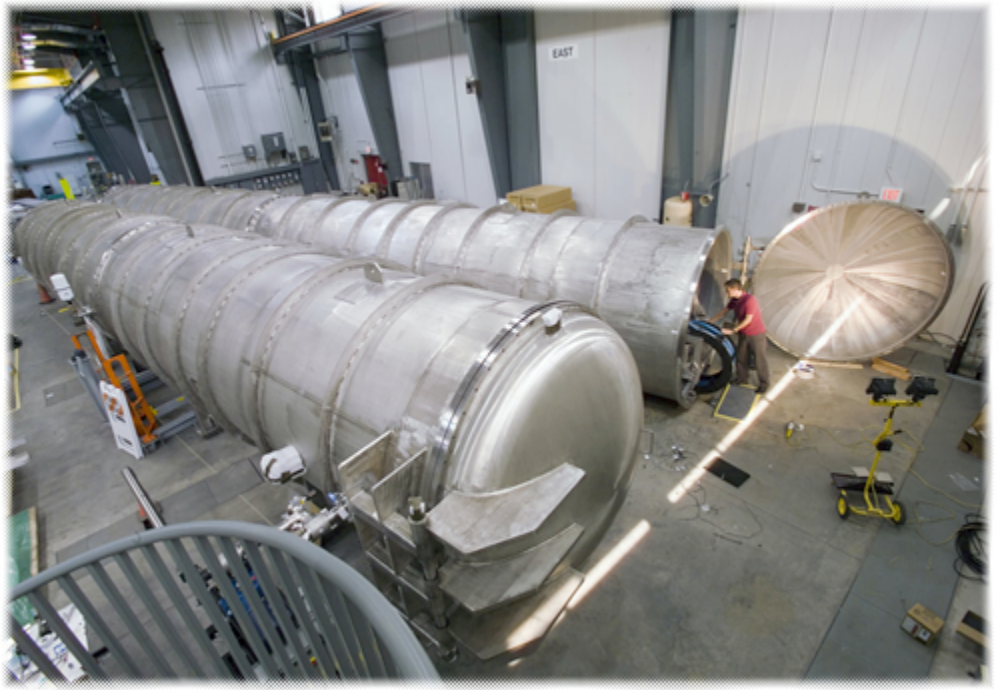
Neutron Scattering Instrument Use of HPI

- Use post-job briefs to reduce instrument downtime
  - Change-out of spare SANS detector during operations
  - First time through we used a pre-job brief and JHA and it took us 5 hours to complete the task
  - Conducted a post-job brief, identified more efficient work steps and reduced the job time to 2 hours to complete
  - Change-out of velocity selector during operations
  - Task would routinely take up to ½ day to complete
  - Conducted a post-job brief, developed an equipment design mod based on input, reduced the downtime to 1 hour

Human Performance in Neutron Scattering

- Raw data from the instruments is the first fruit of a researcher's experiment. Current network and backup capabilities have been identified as vulnerable to human error. Improvements being discussed between RRD and researchers.

- Reduction of error precursors in the sample environment mounting process.
- Increasing number of stations → schedule pressures. Now using CNC process for repeatable quality and timely product.



Monitoring Progress

We are not where we want to be. To get there, use…

- Observation program using HFIR Observation Checklist and trending
- Periodic surveys on HPI and safety culture
- Internal and external assessments
- Corrective action program (ACTS)
- Careful performance indicator development
- Listen to reporting from staff 'on the floor'

HFIR Observation Checklist

TASK PREPARATION

	OK	OFI
1.0 Pre-Job Brief *Ref. MMP-0803, ADM-0108*		
1.1 Review the scope of work		
1.2 Critical Step review		
1.3 Review Error Traps		
1.4 Review Hazards & Job Site		
1.5 Discuss barriers		
1.6 Cover contingencies		
1.7 Discuss past experience		
1.8 Attended by proper staff		
2.0 PPE *Ref. RRD-JHA*		
2.1 Head Protection		
2.2 Eye/Face Protection		
2.3 Hearing Protection		
2.4 Body Protection / Clothing		
2.5 Hand/Arm Protection		
2.6 Foot Protection		
2.7 Fall Protection		
2.8 Respirator		
3.0 Tools and Equipment *Ref. MWP, MMP-0800*		
3.1 Availability		
3.2 Selection & Use		
3.3 Condition & Calibration		
3.4 Handling of rad area tools		
4.0 Job Site Observation *Ref. MMP-0800, RRD-JHA*		
4.1 Housekeeping		
4.2 Walking/Working Surfaces		
4.3 Storage & Labeling		
4.4 Industrial Hygiene		
4.5 Lighting		
4.6 As expected from PJB		
4.7 Proper Hazard Postings		
5.0 Tagging Practices *Ref. ADM-0200*		
5.1 Permit approved by IA		
5.2 Appropriate tagging applied		
5.3 Tag on right component		
5.4 Hazard isolated		

TASK EXECUTION

	OK	OFI
6.0 Human Performance *Ref. HP Pocket Guide*		
6.1 Take-A-Minute before starting		
6.2 Critical Steps performed		
6.3 Procedure Use & Adherence		
6.4 Effective Communication		
6.5 Checking (Self/Peer)		
6.6 Questioning Attitude		
6.7 Stop When Unsure		
6.8 Phonetic Alphabet		
6.9 Workers alert and ready		
7.0 Radiological Safety *Ref. SBMS: Radiological Work*		
7.1 ALARA Practices		
7.2 Contamination Control		
7.3 Rad-worker Practices		
7.4 RWP Knowledge		
7.5 Survey technique		
7.6 Donning/Doffing		
8.0 Body Position / Care *Ref. RRD-JHA, HP Pocket Guide*		
8.1 Ascending/Descending		
8.2 Eyes on Path		
8.3 Eyes on Task/Work		
8.4 Body Mechanics		
8.5 Pinch Point		
8.6 Assistance		
8.7 Work Pace		
8.8 Heat Stress Avoidance		
9.0 Procedure Use *Ref. ADM-0101, MMP-0800*		
9.1 Latest MWP or Proc in-hand		
9.2 Precautions & Prereqs		
9.3 Communicate Hazards		
9.5 Confined Space Reqmnts		
9.6 Lift Plan		
9.7 Material Cert and Handling		
9.8 Foreign Material Exclusion		
9.9 Fire Protection Concerns		
9.10 Place-keeping use		

OFI – Opportunity for improvement

TASK FOLLOW-UP

	OK	OFI
10.0 Post-Job Practices *Ref. MMP-0804, ADM-0108*		
10.1 PMT Satisfied		
10.2 Egress		
10.3 Post-Job Review for LL		
10.4 Worker Feedback gathered		

Follow-up actions noted / Explain Opportunity for Improvement

Path Forward

Continuing to focus on safety culture and human performance improvement will minimize adverse human impact on research and strengthen relationship between scientific and reactor-support staffs.

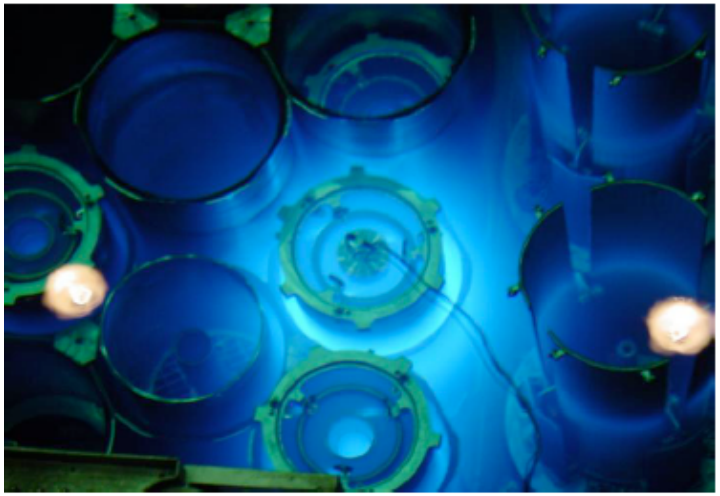
- Follow through with training modules based on 'needs analysis' to implement HPI tools
- Continue to reinforce the value of human performance and safety culture principles as way of life at HFIR
- Collaborate with other DOE research labs and power industry on HPI
- Monitor 'closeness to expectation' through observations and periodic self assessments
- Continued interaction with and listening to research community

Conclusions

- In HFIR's complex, specialized environment, human errors can lead to reactor and research downtime.
- Recognize hazards and reduce errors → Reduce rework, reduce downtime, increase productivity → more neutrons on target and secure data
- Better planning, communication, defenses → improved task efficiency, fewer violations, reduced downtime → more neutrons on target and secure data

Emphasizing a strong Nuclear Safety Culture and Human Performance Improvement promotes the right behaviors and provides the quality processes necessary to operate the reactor and perform research so that advancements in neutron science have a higher chance of being realized.

Questions or Comments?



Instrumented Gamma Irradiation Experiment

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