

Risk-Informed Safety Strategies for Research Reactor Users: Integrating Human Reliability and Working Culture in Operational Decision-Making

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EXTENDED ABSTRACT

In the ASRAM 2024 conference, we presented a cultural analysis of the working relationship between research reactor operators and users [1], applying Hofstede's cultural dimensions model [2,3,4]. This study revealed significant perception gaps related to authority, uncertainty avoidance, and individualism, all of which influence communication, decision-making, and safety behavior during operations. Building on this foundation, a broader regional perspective was introduced at the European Safety and Reliability (ESREL) and Society for Risk Analysis Europe (SRA-E) conferences. These subsequent presentations explored the cultural diversity among reactor users across ASEAN member states and emphasized the implications for human reliability in research reactor settings.

Thailand Case Study and Key Findings

Based on operational data and structured interviews conducted at the TRR-1/M1 facility, four primary themes emerged from user feedback

1. **Adaptive Safety Training**
Users expressed the need for scenario-based and experiment-specific training tailored to their diverse backgrounds and research objectives.
2. **Localized Radiation Shielding**
There were requests for flexible, modular shielding solutions that better align with various experimental configurations.
3. **Improved Communication and Feedback Mechanisms**
Users highlighted the importance of establishing real-time channels to report anomalies or suggest safety improvements.
4. **User-Centric Monitoring Systems**
Feedback emphasized the need for real-time, accessible displays of radiation levels near workspaces, enabling users to make informed safety decisions.

These recommendations have been synthesized into a human-factor-informed framework designed to complement existing safety protocols at research reactors. The conceptual structure of this integrated approach is illustrated in Figure 1, which shows how user feedback, cultural dimensions, and human reliability inputs can drive safety strategy development and lead to improved outcomes.

Commitment to Continuous Improvement

During the most recent ASEAN technical coordination meeting, stakeholders discussed and endorsed the following safety enhancement strategies, which reflect a shared commitment to continuous improvement

1. **Enhanced Safety Protocol Training**
Ensuring that all users, including temporary researchers and newcomers, receive regular, up-to-date training aligned with current safety standards and emergency procedures.
2. **Improved Communication Channels**
Establishing transparent, bidirectional pathways for users to report safety concerns, near-miss incidents, or operational challenges.
3. **Upgraded Monitoring Systems**

Implementing advanced real-time radiation monitoring and alert mechanisms in high-use areas to increase situational awareness and promote safer working conditions.

These ongoing initiatives contribute to regional knowledge exchange and foster a collaborative environment that supports safer and more efficient research reactor utilization throughout ASEAN.

Towards a Wider ASEAN Safety Understanding

This work will extend the discussion by presenting a comparative ASEAN user cultural profile, based on surveys and interviews with research reactor users in Thailand, Indonesia, Malaysia, Vietnam, and the Philippines. This session will engage participants in reflecting on

1. How cultural factors influence safety-related decisions and behavior
2. The similarities and differences in user perspectives across ASEAN
3. What lessons reactor facilities can learn from one another's human reliability challenges and user feedback

The presentation will include visual dashboards and statistical summaries to demonstrate how cultural understanding and user involvement can serve as key inputs to strategic safety management.

In conclusion, this work contributes to the development of user-informed safety strategies by incorporating cultural and human reliability insights into research reactor operations. It emphasizes the importance of listening to users' perspectives and comparing feedback across ASEAN countries. Future work will focus on expanding collaborative safety profiling, facilitating knowledge exchange, and refining strategic planning tools to better support human-centric safety practices in research reactors.

Human reliability and working culture must be considered as integral components of any comprehensive safety framework. Involving users as active stakeholders in safety planning and decision-making can lead to more adaptive, inclusive, and effective risk management practices. The Thailand case study offers a replicable model for research reactor facilities across the region. By fostering mutual understanding, sharing experiences, and listening to diverse user perspectives, ASEAN's research reactors can collectively advance toward enhanced safety, both technically and culturally.



FIGURE 1. Integrated Risk-informed Safety Model for Research Reactor Users

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