



reducing human error

Nuclear professionalism – a way forward

The nuclear professional is thoroughly imbued with a great respect and sense of responsibility for the containment safety of the reactor core, fuel, associated plan and support mechanisms—and all their decisions and actions take this unique and grave responsibility into account.

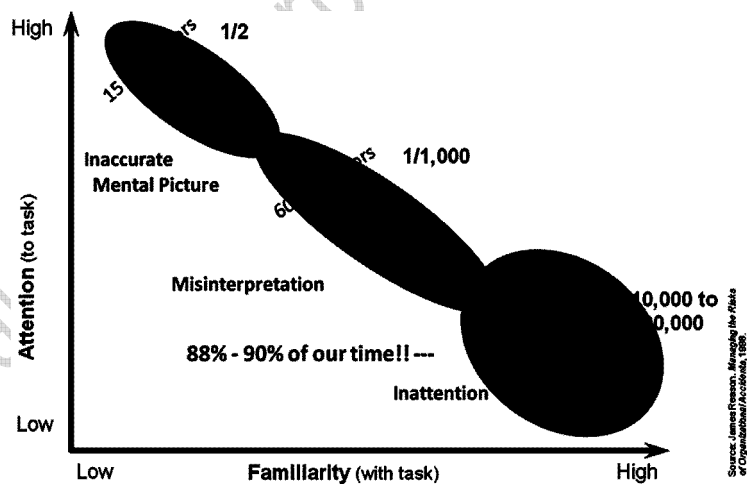
A comprehensive programme of behavioural change that incorporates the determination of required level of individual and organisational competency in nuclear professionalism against the world best industry standards is essential. Everyone who has a hand in defining, designing, developing, manufacturing, installing or maintaining any part of a nuclear power plant should be confident in their ability to behave as a 'nuclear professional'.

Background

All too often latent errors only become apparent on site when the power plant is operational. As professionals, about **25% of the work is skill-based**; behaviour associated with highly practiced actions in a familiar situation usually executed from memory without significant conscious thought.ⁱ

RB or **rule-based** behavior (approximately **60%** of work) is based on the selection of stored rules derived from one's recognition of a work situation; it follows an *IF* (symptom X), *THEN* (situation Y) logic.ⁱⁱ

KB or **Knowledge-based** behavior is a response (occurs about **10-15%** of the time) to a very unfamiliar situation (no skill or rule recognisable to the individual). The person must rely on his or her understanding and knowledge of the system, the system's present state, and the scientific principles and fundamental theory related to the system.ⁱⁱⁱ The diagram above illustrates the likelihood of creating an error in each of the modes described. The probability of creating an error increases when time pressures are applied or for example, incorrect specifications are given.





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The nuclear professionalism process

Programme management

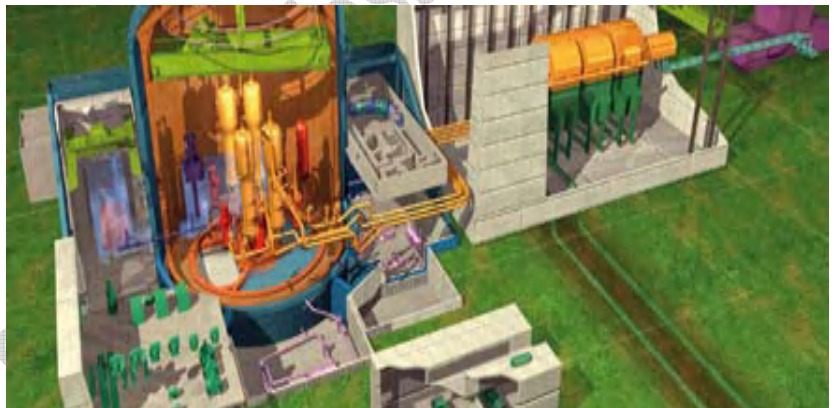
Against glossary of operating standards and expectations, define key human performance and nuclear professionalism standards.

Conduct a determination of the gap by evaluation of current contractor and staff capability in nuclear safety against world best industry standard. Safety culture evaluation based on IAEA INSAG – 4, INPO TecDoc 1329 and other world-recognised industry standards.

Determination of appropriate methodology, communication and 'in-house' resources to support enablers:

Human Performance

- Determination of appropriate human performance tools and techniques gleaned from recognised world best practice
- SIMON – Safe Intelligent Motivated Observant Nuclear Professional (includes observation and coaching (peer and leader)
- Database to monitor and pinpoint areas for improvement
- Visible reporting mechanism to aid accountability process
- Improving visibility and accessibility of knowledge workers.



Communications

- Improving regulator/stakeholder communications
- Reward and recognition system is in place.
- Regular 'nuclear professional' knowledge worker newsletters.

Support

- Mechanisms for recognition of nuclear safety issues.
- Incorporation of Nuclear Safety Concerns into a company reporting process.
- Nuclear Professional/ Nuclear Safety intranet.
- Nuclear safety focus and dedicated nuclear safety plan.

Operating experience(OE)

- Establish an Operational Experience Group to learn from events



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- Formation of an Operating Experience Forum (OEF) to involve other industry groups and OE representatives.
- Endorsement by organisation management of all events that are adverse to quality at an Event Review) Meeting.
- Prioritisation of all event actions.
- Making OE readily available to staff in a user-friendly system to facilitate inclusion in pre-job briefing, training and procedures.
- Effectiveness reviews
- Conduct regular self-assessments.
- Root and apparent cause analysis to provide pinpoint focus for behavioural and cultural change.

Nuclear safety culture – the team 'character and personality'

Individual

- Everyone is personally responsible for nuclear safety whether design engineer, communications expert, finance manager, stores manager or other non operational member of the team



Leader

- Leaders demonstrate commitment to safety
- A questioning attitude is cultivated

Organisational processes and values

- Trust permeates the organisation
- Decision-making reflects safety first
- Nuclear technology is recognised as special and unique
- Organisational learning is embraced
- Nuclear safety undergoes constant examination

Systematic delivery and execution of nuclear professionalism programme

- Roll out the nuclear professionalism 'intervention' to people within organisation and the major supplier partners via cascade workshops



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- Deliver clear and visible leadership
- Establish and communicate rights and responsibilities for leaders and individuals
- Remove organisational barriers preventing excellence in nuclear professionalism
- Ensure consistent encouragement and accountability (open reporting)

Benchmarking and learning organisation

- Enable attendance at nuclear safety conventions.
- Enable periodic reviews and internal seminars on nuclear safety
- All training incorporates nuclear professionalism element reinforcement and simulation exercises to reinforce key elements
- A



dedicated leadership group to provide oversight of nuclear safety and assurance.



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Why do you need Human Performance and Nuclear Professionalism in your knowledge based area?

¹Many areas for improvement are associated with engineering performed by companies for the generating organisation. Causes include:

- Weak communications, including lack of detailed specifications and few quality interactions between station and vendor personnel
- Inconsistent participation in plant walk-downs and design review meetings
- Fast-track scheduling without compensatory controls
- Incomplete review and verification
- Over-reliance on vendor expertise, which may have eroded over time¹

There is a strong perception that there are weaknesses within the knowledge worker arena:

- Often associated with design and licensing bases, integrated system interactions, and specialty information
- Often caused by staff changes from reorganisations, attrition, and rotational assignments
- Points to weaknesses in turnover, supervisory effectiveness, and position-specific continuing training

Supported by the lack of application of critical thinking and questioning attitude

- Not enough attention to detail by individual engineers
- Not proactively identifying failure modes and effects or understanding the risks and consequences of technical decisions
- Not thoroughly reviewing engineering vendor products

Margin management shortfalls

- Known margins issues not integrated into other plant processes
- Actions not taken to identify latent issues before self-revealed
- Actions not taken to prioritise and improve margins; margin information not used in decision making
- Calculations and other design basis information not maintained, or known weaknesses not addressed

¹ Source Institute of Nuclear Power Operators (INPO) 2007



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ⁱ Reason. *Human Error*. 1990; p.56.

ⁱⁱ Center for Chemical Process Safety. *Guidelines for Preventing Human Error in Process Safety*, American Institute of Chemical Engineers. 1994; pp.78-80

ⁱⁱⁱ Reason. *Human Error*. 1990; pp.53-55.

non operational nuclear professionalism