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NUCLEAR SAFETY ADVISORY COMMITTEE

REVIEW GROUP 6 (RESEARCH)

22 APRIL 2008

HUMAN FACTORS RESEARCH AND IMPLEMENTATION

Joint Paper by HSE and Licensees

Introduction

1. The main objectives of the Human Factors research are to identify, commission, and promulgate the results of research into nuclear safety issues so that licensees and the NII have the scientific and engineering knowledge necessary to make judgements about the adequacy of safety measures. This entails, amongst other things, running projects that provide practical benefits to the operating UK nuclear Licensed Sites whilst, at the same time, addressing issues raised by the NII in the Nuclear Research Index (NRI) and Sellafield Nuclear Safety Research Strategy Statements.

2. In October 2007 a progress statement was prepared for RG6 to inform the group of changing research strategy for human factors. ND's Human Factors Nuclear Topic Group proposed a change of direction towards one consolidated index, structured to present issues by lifecycle and assigned to licensees across the Directorate by relevance. The October statement reported activities already undertaken and presented further activities planned to progress this goal. It was agreed that NII would provide a further update of the research position; this note has been prepared in response to that agreement. At the October 2007 meeting, the licensees expressed the opinion that some of the organisational aspects of human performance represented the implementation of existing knowledge rather than the gathering of fundamental knowledge that needed to be addressed by research. In response to this argument, the Chair of RG 6 asked the licensees to write a paper (Action 07/3) explaining how they addressed NII's concerns in this area through the implementation of existing knowledge.

3. This paper has been written both to provide an update on the research position, following the completion of activities discussed at the October 2007 meeting and to address Action 07/03. This paper will demonstrate that as well as a healthy implementation of human factors knowledge and research findings by the nuclear licensees, there still remains the need for a significant research programme in the human factors area and that there is agreement between HSE and the licensees as to what research needs to be done.

Progress on the Development of ND's Human Factors Research Strategy

4. The Human Factors section of the Nuclear Research Index (NRI) was subject to a fundamental internal review reflecting Nuclear Directorate's position on the scope and direction of human factors research. In November 2007, the team began a consultation process with all of the UK's Nuclear Licensees, with a view to establishing the revised research strategy for the next programme. This involved human factors representatives from all licensees, and was observed by representatives of the RG6 committee. The strategy was presented to the group along with the results of the internal workshop, providing the basis for discussion and agreement. It was envisaged that this discussion would highlight relevant issues and promote the participation of all licensees in the NRI framework. The workshop produced a further revision of the index.

5. In addition to the consultation workshop, a technical exchange meeting was held on November 16th 2007 and the implications of the previous day's discussion on the future of the NRI were discussed. Licensees highlighted a number of problems in implementing a single, cross-licensee index. The major barriers were perceived to be the issue of different funding mechanisms and organisational priorities and particularly in regard to the definition of NRI issue priorities and the legislative requirement for research. Representation from NII's research unit confirmed that currently only operating reactor licensees were bound by the legal requirements to undertake nuclear safety research and that no extension to HSE's powers was proposed that would incorporate other licensees. This means that for some licensees participation in research is voluntary, whilst for others it is be a requirement with the potential to levy.

6. In addition, the licensees believed that the opportunity to liase with other licensees would be difficult to pursue as although research issues have generic elements, the research issue usually focuses on specific application and this would be different across licensees. These concerns were discussed by the human factors nuclear topic group, agreement was reached that:

- The licensees views represented substantive barriers to pursuing a common framework
- Collaboration between licensees would continue to be encouraged as research will be a permanent agenda item at future NII/UK licensee workshops and dialogue with licensees indicated that this could be achieved out with the formal programme.

7. It was therefore concluded that the current framework of two separate research programmes would be retained and the links between the two would be strengthened through liaison between the NII managers of the each index which would be facilitated by regular meetings of the human factors nuclear topic group, continued representation of Magnox and Sellafield human factors specialist at the NRI technical exchange meetings. In addition, British Energy and Magnox remain committed to sharing the output of the individual research programmes.

8. The NRI was subject to a further internal NII review to ensure that research issues were appropriately assigned and reflected current status. In addition, review of the British Energy declared schedules for the 2008/09 period considered the proposals to be adequate and balanced, with a number of projects being undertaken taking due account of the assigned priority and ecological validity (i.e. applicability to the real world), in that a number of high priority issues with a specific application have been selected., providing assurance that regulator concerns and organisational needs are being met.

9. The human factors section of the NRI has been updated to take account of the considerable review activity that the licensees and NII have undertaken during the 2007/08 period. This has involved removing some issues considered to be no longer relevant, placing some on hold to review the conclusions of associated research and adding issues to reflect newly identified knowledge gaps. The index includes a commentary in the status section of the current status of the issue and the arrangements in place to manage future progress. It has also taken account of the agreed Human Factors Research Programme for 2008/09. It should be recognised that human factors research is discharged through a number of programmes; the NRI, the chemical processes and waste and decommissioning strategy, the HSE Major Hazards Programme and work directly commissioned under the NSS framework. These various activities are informed by formal and informal links with the UK and international human factors community and internally through the human factors nuclear topic group.

10. The human factors team believes that this report discharges the commitment given to NuSAC at the October RG6 meeting with regard to rationalising the research programme and demonstrates a strong position to enable management of current and future human factors research. Considerable NII attention and resource has been applied to the index and this has been complemented by detailed and constructive dialogue with the relevant licensees and the wider nuclear human factors community. These activities and the processes put in place as part of the review exercise provide assurance of NII's management of human factors research; the current index contains a range of issues that represent an agreed perception of the significant knowledge gaps. There is a secured licensee commitment to addressing these issues. As such, the human factors team intends to report progress against the NRI through normal due process.

British Energy Human Factors Research and Implementation

Research

11. Human Factors research is relevant to all aspects of BE's activities. Research in this technical area is concerned with enhancing human performance by means such as improvements to: assessment methods, job design, equipment design, procedures and training. In 2008/09, there are a number of Human Factors research projects as set out in the BE Nuclear Safety Research Schedule:

- to improve the consistency, accuracy and validity of human reliability assessments included in probabilistic safety assessments and safety cases through a human reliability methodology known as Nuclear Action Reliability Assessment (NARA).
- to understand obstacles to organisational learning and identify barriers that could be used to minimise or remove the obstacles so that safety performance can be continuously improved.
- to review BE's current practices in the writing, modifying and use of nuclear plant operations and maintenance procedures in order to identify opportunities to improve human factors input into the current procedure modification process and the use of procedures.
- to determine whether the noise levels from a steam pipe failure would prevent operations staff from performing their essential duties.
- to take part in the EURATOM 7th Framework programme, Man-Machine-Organisation Through Innovative Orientations for Nuclear (MMOTION), to analyse the current and the future needs for Human Factors research at existing European nuclear stations, identifying gaps within the areas of man-machine-interface, organisational factors and man-machine organisation evaluation.

Implementation

12. BE has an ongoing programme to improve human performance and nuclear safety culture, the primary objectives of which are to:

- Minimise the frequency and consequences of events through effective organisational and process defences and consistent application of error reduction techniques;
- Reinforce behaviours that contribute to event free operation at all levels in the organisation;
- Ensure that behaviours of all personnel result in safe and reliable operation;

- Learn from past events and current trends to target error likely tasks/activities.

13 To this end, BE has developed and successfully implemented a nuclear safety culture programme. This followed staff and contractor consultation and cross-comparison of data with other utilities, leading to a package of engagement, education, encouragement and ongoing embedding of nuclear safety culture being rolled out across BE. This was a major BE effort on Human Factors implementation through attendance of over 6700 staff and contractors at 400 Nuclear Safety Culture Workshops. The continuing Human Performance programme at stations and within the central support function has maintained a raised awareness of human fallibility and the requirement to identify and mitigate error traps using the Human Performance tools. A series of Human Performance exhibitions have raised awareness and shared learning. The task observation process has allowed local managers to target areas of weakness, for example at Dungeness B there is an initiative to improve procedural use and adherence.

Magnox Electric Human Factors Research and Implementation

14. A major initiative that involved rolling out Human Performance/Human Factor (HP/HF) measures across Magnox North was completed during 2007/08. Through group exercises, videos and discussion groups these well-attended workshops provided awareness training in human performance issues and an opportunity for staff to raise 'burning' issues with senior management.

15. Broad based HP/HF 'research' continues through cross industry bodies, including oil and gas, and chemical sectors, to promote good practice development. In particular we are keeping a watching brief on research around Human Performance issues such as effects from an ageing workforce, safety culture development and assessment, and management of contractors.

16. Two specific HP/HF-focussed R&D projects were realised during 2007/08 with the implementation of the output planned for 2008/09:

Project 42_07/08.

- A major baseline review was carried out by independent human factor specialists to identify any gaps in the HP/HF tools and methods applied within Magnox North. The results show that our personnel have access to suitable and good practice methods, techniques and standards, with no apparent gaps. The challenge identified through this work is to make all the techniques, methods and standards available to all Magnox North sites and functions with the awareness or when and where they need to be applied. With this in mind a developed on-line guidance manual is being developed accessible to both specialist and manager/leader to aid raising awareness of HP/HF tools, techniques standards and guidance in their application. This will

also be backed by the new HP/HF co-ordinators network established in Feb 2008 with sponsors and co-ordinators on each of the Magnox North sites and functions who have a role in communication and coaching.

Project 34_2007/08.

- This was a project used a decision explorer tool (applying cognitive mapping) to identify any discriminatory attributes for successfully delivered medium sized (~£1m+) projects. Six projects were assessed using the tool, and comprised conducting structured interviews with appropriate project teams. Results have shown strong discrimination of attributes for successful projects. The project has also identified key behavioural and organisational skills (including Safety) for project leaders. These can be included in training for project leaders and managers. Further work will be required to transfer these findings into action. This work is also being written up and presented at international forums.

17. Current plans for 2008/09 are associated with the continuation of research into successful awareness raising with respect to HP/HF and the updating of the DISC (ergonomics design) tool for use within Magnox North decommissioning projects.

Human Factors Implementation at Sellafield

18. This note lists recent or current activities and developments that are bringing about or will (in the near future) bring about HF improvements at a generic (site wide) level in plant design or operation, or in the accuracy and utility of safety assessments. HF support is also given to many individual plants and projects but these are not included here. Also this note only covers work directly supported by the HF group. There are many other developments being made by other groups such as the Human Performance group, WANO support group, conduct of operations group and occupational health, which are resulting in improvements to processes, procedures, equipment, interfaces, environments, competency etc and which therefore also contribute to improvements to operator reliability, welfare, health and safety.

Incorporation of HF principles into Sellafield Ltd Standards and Expectations

19. The EHS&Q Human Performance group and Human Factors group worked together in the development and issue of the revised standards and expectations booklet that has been issued to all Sellafield Ltd staff. This was done to help ensure that underlying causes of human performance issues are addressed (e.g. if errors are occurring on a particular task then the correct response is to examine whether there are any factors that create the conditions for error and remove them, rather than simply to tell the operators to follow the instructions more carefully). Rectifying these underlying causes usually require the involvement and commitment of leaders and the

organisation and so the responsibilities of these two groups are clearly identified in the revised standards and expectations booklet.

Improvements to alarm design and management

20. Human Factors input has been made and continues to be made to improve alarm management at the design and operations stage. To support design, input was given to the development of Technical Std.A.0356_1 Alarm Design Guidelines, along with improvements made to BNF.EG.0073_1_C Ergonomics Ergonomic principles for the design of control rooms, interfaces and the working environment.

21. To support improvements to alarm management in operations, support is being provided to the site alarms steering group and in the development of a revised site wide procedure (SSF12.01) which addresses issues such as: alarm logging, standing alarms, alarm suppression, alarm shelving, prioritisation and presentation issues. Training courses for end-users covering HF aspects of alarm management are being developed to support this.

Stress in the workplace

22. The Human Factors group's stress specialist has organised and run the company's stress risk assessment process which is designed to measure stress and identify causes of stress in order that these can be appropriately managed. In addition stress awareness training courses have been run along with on-line support and advice.

Human Factors walkthrough

23. Developments have been made to the process by which Human Factors are considered within the COSR process. This began with the introduction of plant walkdowns undertaken by HF specialists aimed at identifying HF deficiencies that may affect the safety of plant. Since then improvements have been made to the process to ensure that effort is focussed on the areas of greatest safety significance and that the level of effort expended is commensurate with the severity of the potential hazards and the level of risk.

24. The HF walkthrough is now an established part of the COSR process and over 40 plants have been examined by this procedure.

Human Factors Implementation at Dounreay

25. At Dounreay, Human Factors (HF) forms an integral part of the modern standards safety case methodology adopted by the site. Each facility is assessed by SQEP HF specialists using a variety of methods including plant walk-downs, task analyses and where appropriate human reliability techniques. The principle aim of these assessments is to assess the adequacy of task and system design to facilitate effective and error-free

human performance. Following one such assessment (coupled with a subsequent visit by an NII HF assessor) a number of recommendations were made to improve the ergonomics of a Surveillance Centre. The wide ranging improvements included the need for a new control desk with adjustable flat screen displays and appropriate seating, along with improvements to lighting and communication facilities. Also recommended were changes to the design of the SCADA displays, in particular the use of colour coding, alarm prioritisation and alarm response. A plan was drawn up that summarised the work to be done with priority based time scales for inclusion in the facility's forward programme.

26. Aside from safety case related work, the Dounreay HF specialists are asked for input as part of engineering design or to act as intelligent customer on behalf of an engineering project. The Dounreay Modification Report (DMR) system is being amended to ensure that, where appropriate, HF reviews of proposed modifications are carried out prior to authority to proceed. The site is developing a Human Factors Standard to guide its work in this area.

27. There are currently two SQEP HF specialists at Dounreay, one with a BSc in Psychology and 6 years of experience of practising HF, another with an MSc in Ergonomics with seven years HF experience.

Conclusions

28. ND's human factors team report that they have evolved a strong position to enable management of current and future human factors research. The current HF NRI contains a range of issues that represent an agreed perception of the significant knowledge gaps and there is a secured licensee commitment to addressing these issues. As such, the human factors team intends to report progress against the NRI through normal due process.

29. All licensees have a strong commitment to implementing the findings of HF research and using HF tools and good practice to improve human performance, so that incident-free operations can be achieved. Where errors occur on tasks, there is a commitment to determine whether there are any factors that create the conditions for error and remove them. Improvements to licensees' safety cultures are also promulgated through developing appropriate behavioural and organisational skills in operators and team leaders.

Recommendation

30. NuSAC Review Group 6 is invited to note and comment on the paper.