Knowledge share from a wide scope approach to HF in nuclear defuelling

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SUMMARY

The Human Factors (HF) team conducted a holistic, wide scope review of the Fuelling Machine at a nuclear power station undergoing defuelling to support the maintenance of high safety standards. The team worked collaboratively with the fuel route operators to identify issues and prioritised them using a novel mapping of PSFs onto EPCs. The collaboration extended to the development of proportionate and pragmatic recommendations, ultimately improving safety during defuelling operations.

KEYWORDS

HF assessment, collaboration, nuclear

Introduction

HF is uniquely and inherently subjective among engineering fields, and overemphasis on a prescriptive approach may fail to capture complex realities. A more inquisitive, wide scope approach, conducted in direct collaboration with those performing the work, offers the opportunity to supplement the conventional systematic approach. A human-centred optimisation strategy aims to improve system usability and reduce the potential for errors, in support of the maintenance of rigorous nuclear safety standards, through the production of proportionate and pragmatic recommendations that champion the needs of the operators.

The wide scope approach was applied by the authors during a site visit to a nuclear power station currently undergoing defuelling, Dungeness B (DNB). At this stage in a station's lifetime, the end of work is approaching and operator motivation may decrease accordingly. Meanwhile, the cumulative effect of modifications made to a system over the station's life may have resulted in creep from its design basis, potentially introducing new human factors issues. Further, the role and safety reliance on an operator may have changed, slowly declining from engineered solutions to a greater reliance on operator actions to maintain safety. Conscious of these factors and keen to maintain high safety standards, a Fuel Route Operations Team Leader at DNB invited a HF assessment.

Method

The wide scope assessment involved reviewing a list of operator-reported challenges, conducting a walkdown to review the known issues and identify additional ones, prioritisation of the issues, co-designing recommendations with operators, and writing up the findings. This contrasts with a standard HF assessment, which involves reviewing a given safety case claim in a structured way consisting of problem definition, an Operating Experience review, a site walkdown (if required), task analysis, qualitative (and, if required, quantitative) analysis, and writing up of the findings in a report.

The first step of the wide scope assessment was to solicit a general list of areas for improvement from fuel route Operate Technicians (Op Techs) at DNB in advance of the site visit. No restrictions were placed on the issues or frustrations that operators could submit. A walkdown of the fuelling machine was then conducted, accompanied by unstructured, open-ended discussions with several Op Techs. The walkdown followed a conventional approach but extended its scope to include operating experience and user-centred design considerations that may be overlooked in an error-focused assessment.

The output of the walkdown was a list of issues that included those identified in advance by the Op Techs, direct observations by the HF team, and topics raised in discussions. The issues were categorised by the Performance Shaping Factor (PSF) that fit them most closely. The PSFs were then mapped onto Error Producing Condition (EPC) to indicate the potential Affect. The mapping tool used was developed based on practitioner judgement for general use, and it identifies common correspondences between PSFs and EPCs. Where multiple EPCs may apply to a given PSF, the one with the higher Maximum Affect was selected. The categorised list was then prioritised according to Maximum Affect, providing a rough approximation of issue significance. The prioritisation suggested the recommendations that would provide the greatest relative benefit, without having to conduct a quantitative analysis on each. In this way, it adapted widely accepted tools and techniques for analysis into tools for prioritisation and communication.

HF facilitated a wash up post walkdown with the Fuel Route Ops Team Lead to discuss the findings and any potential recommendations to ensure the recommendations follow the ‘Working with Appropriate Rigour’ ethos and keep risk ‘As Low as Reasonably Practicable’. The recommendations were then written up by the HF team and passed back for review. The iterative process ensured operator buy-in and ensured that the proposed improvements were feasible, suitably grounded, and correctly aligned with their needs. The final recommendations were then formally issued through the standard process.

Results

The result of this broader approach was a rich understanding of the working environment and operational context that may not have been obtained through a conventional approach. Additionally, the project contributed to an effective working relationship between HF and Operations.

The walkdown produced insights that benefitted from both familiarity on the operators’ side and fresh eyes on the HF team’s side. The categorised findings, grouped by EPCs, revealed a diverse set of areas for improvement. A total of 14 issues were identified, and several were actioned by the operators prior to the publication of the report.

The process also contributed to a positive relationship between the HF team and the operators, shifting a dynamic that often feels like observation to one of collaboration. In addition to identifying relevant issues, the project raised awareness of HF among the operators. Further, it opened the door to similar assessments of other areas of the plant, such as the Irradiated Fuel Disposal Facility (IFDF).

Key takeaways

Overall, the project demonstrated the value of a wide scope, participatory HF approach for surfacing areas for improvement that may otherwise be overlooked and building a positive relationship between HF and Operations. The use of PSFs and EPCs enabled the grouping and rough prioritisation of the issues, and the open ended and participatory process resulted in clear, actionable recommendations.

As HF specialists, we acknowledge the importance of proven methods, but also see value in adapting our approach, when required, to remain pragmatic and outcome focused. Internally, this project has worked as a proof of concept for the approach, which we are currently building a toolkit around for future engagements, including an upcoming assessment of the IFDF.