

**DPP DS492 - Comments on Document Preparation Profile, “Human Factors Engineering in Nuclear Power Plants”  
(a new Safety Guide)**

COMMENTS BY REVIEWER				RESOLUTION			
Comment No. / Reviewer	Para/Line No.	Proposed new text	Reason	Accepted	Accepted, but modified as follows	Rejected	Reason for modification/rejection
DE 1	6. Overview	<p>1. INTRODUCTION Background Objective Scope Structure <u>2. HFE PROGRAM MANAGEMENT</u> <u>3. OPERATING EXPERIENCE REVIEW</u> <del>42. FUNCTIONAL REQUIREMENTS ANALYSIS AND FUNCTION ALLOCATION</del> <del>53. TASKS ANALYSIS, STAFFING AND QUALIFICATION</del> <u>6. STAFFING AND QUALIFICATION</u> <u>74. HUMAN RELIABILITY ANALYSIS</u> <del>85. HUMAN SYSTEM INTERFACE DESIGN</del> <u>9. PROCEDURE DEVELOPMENT</u> <u>10. TRAINING PROGRAM DEVELOPMENT</u> <u>116. HUMAN FACTORS VERIFICATION AND VALIDATION</u> <u>127. DESIGN IMPLEMENTATION</u> <u>138. HUMAN PERFORMANCE MONITORING</u></p>	<p>A HFE Program Management is necessary to fulfill the task of ensuring that all aspects of the Human System Interface (HSI) will be implemented by using accepted HFE principles.</p> <p>Operating Experience Review is important to identify HFE-related safety issues and should be implemented into the scope.</p> <p>The Task Analysis should be treated separately from Staffing and Qualification, because of the different kinds of analysis.</p> <p>Procedures are essential to plant safety because they support and guide personnel interactions with plant systems and their response to plant-related events.</p> <p>Training of plant personnel is an important factor in ensuring safe and reliable operation of nuclear power plants.</p>	x			
ENISS 1	Section 6	<p>1. INTRODUCTION Background Objective Scope Structure 2. FUNCTIONAL REQUIREMENTS ANALYSIS AND FUNCTION ALLOCATION 3. TASKS ANALYSIS, STAFFING AND QUALIFICATION <del>4. HUMAN RELIABILITY ANALYSIS</del></p>	<p><b>Delete Content item 4</b> – Human Reliability Analysis. This guide is associated with the use of Human Factors Engineering in the design process of Nuclear Power Plants. Human Reliability Analysis is a different subject related to the safety assessments of plant</p>			x	HRA is not a plant PSA issue, but an issue of looking at reliability to try and improve the decisions on human engineering design. Similarly, if we carry over this argument to hardware it would say that we should not do hardware reliability

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		4. HUMAN SYSTEM INTERFACE DESIGN 5. HUMAN FACTORS VERIFICATION AND VALIDATION 6. DESIGN IMPLEMENTATION 7. HUMAN FACTORS TRAINING PROGRAMME 7.HUMAN PERFORMANCE MONITORING	faults etc. It is a large subject in it's own right. ENISS would have expected it to be subject of a separate Safety Guide rather than included here. <b>Add new item 7.</b> Human Factors training programme. For strengthening the expected performance main attributes of a training programme should be required.				analysis because PSA covers it.
ENNIS 2	Section 6	1. INTRODUCTION Background Objective Scope Structure 2. FUNCTIONAL REQUIREMENTS ANALYSIS AND FUNCTION ALLOCATION 3. TASKS ANALYSIS, STAFFING AND QUALIFICATION <del>4. HUMAN RELIABILITY ANALYSIS</del> 4. HUMAN SYSTEM INTERFACE DESIGN 5. HUMAN FACTORS VERIFICATION AND VALIDATION 6. DESIGN IMPLEMENTATION <ul style="list-style-type: none"> <li>• PLANT LAYOUT</li> <li>• EQUIPMENT LAYOUT</li> <li>• PROCEDURES</li> </ul> 7. HUMAN FACTORS TRAINING PROGRAMME 7.HUMAN PERFORMANCE MONITORING	As this Guide will refer to SSR-2/1 the main areas where the design process is focused on should be referenced (SSR-2/1 5.55)	x			It will be covered; typically we do not provide that many details in DPP.
JAPAN 1	General	This proposal is development of a new safety guide, which is not included in the reference list of IAEA safety standards for the long term. This reference list was established after strict discussion by CSS and Secretariat, indicating that the number of the IAEA Ss should be maintained within manageable number of publications. This implies that the standard specific for individual technology area should not be developed.				x	HFE is a cross-cutting activity that affects I&C design, plant procedures, training, and many other things and that addresses the interfaces between these things. It is not just an I&C issue and it would be inappropriate to cover it in an I&C document. Although the main I&C points are already in DS 431, it is an evident gap in the IAEA

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							safety standards. The HFE in the design of human-machine interface is an important topic which is worth of a safety guide. We need to provide detailed recommendations to meet specific requirement 32 of SSR 2/1. Moreover, the HFE is a mandatory chapter in the plant safety analysis report.
Japan 2		DPP says in section 3 that Several IAEA Member States and Standard Design Organizations (SDOs), such as the International Electrotechnical Commission, are implementing particular requirements and comprehensive guidance for the design, implementation and safety demonstrations of human factors engineering in nuclear power plants. This description does not reflect why the IAEA Safety Standard is developed. The IAEA SSs were established on the basis of the fundamental principles "IAEA Safety Standards for protecting people and the environment". IAEA is not such an organization that IAEA do as other SDOs do. The underlined portion of description should be deleted.				x	It is certainly outside of the scope of IEC SC45A to take on more than I&C specific topics. The IAEA safety standards consider relevant SDO standards It is important to provide a harmonized approach or at least not to contradict among them.
PAK 1	Section 5	Interface of <b>NUREG 0711, Rev.3- 2012</b> instead of <b>NUREG 0711, Rev.2- 2004</b>	The <b>NUREG 711, Rev.3</b> may be used for interface of this guide, as new version provides better guidance for HFE design of NPPs.	x			
PAK 2	Section 5	The following standards may also be considered for interface of this guide: i. NUREG 0700-2002, "Human-System Interface Design Review Guidelines". ii. IEEE 1289-1998, "Guide for the Application of Human Factors Engineering in the Design of Computer-Based Monitoring and Control Displays for Nuclear Power Generating Stations". iii. IEEE1023-2004, Recommended Practice for the Application of Human Factors Engineering to	As these standards provides comprehensive guidance for the review of HFE aspects of NPPs.	x	But we do not intend to go in such details.		

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		<p>Systems, Equipment, and Facilities of Nuclear Power Generating Stations and Other Nuclear Facilities”.</p> <p>iv. IEC 60964-2009,Nuclear Power Plants–Control Room– Design”.</p> <p>v. NUREG-0696-1980 Functional Criteria for Emergency Response Facilities</p>					
PAK 3	Section 6	<p>The following HFE elements may also be considered in contents of safety guide:</p> <p>i. HFE Program Management</p> <p>ii. Operating Experience Review</p> <p>iii. Procedure Development</p> <p>iv. Training Program Development</p>	The input of these elements is also very important and used in HFE program of NPPs.	x			
ROK 1	Section: 6. Overview	<p>1. INTRODUCTION Background Objective Scope Structure</p> <p>2. FUNCTIONAL REQUIREMENTS ANALYSIS AND FUNCTION ALLOCATION</p> <p>3. TASKS ANALYSIS, STAFFING AND QUALIFICATION</p> <p>4. HUMAN RELIABILITY ANALYSIS</p> <p>5. HUMAN SYSTEM INTERFACE DESIGN</p> <p>6. PROCEDURE DEVELOPMENT</p> <p>7. TRAINING PROGRAM DEVELOPMENT</p> <p><del>6-8.</del> HUMAN FACTORS VERIFICATION AND VALIDATION</p> <p><del>7-9.</del> DESIGN IMPLEMENTATION</p> <p><del>8-10.</del> HUMAN PERFORMANCE MONITORING</p>	The results of HFE analysis and Human System design provide input data for procedure contents and training requirements. Therefore, the elements of “Procedure Development” and “Training Program Development” should be included in the contents.	x			
UA 1	Chapter 4	<p>As stated in Chapter 4 “the analysis and consideration of the human-machine interface and factors related to the interaction of the operating and maintenance personnel with the plant systems and controls will constitute the focus of the safety guide”.</p> <p>Taking into account that DS-431 “Design of I&amp;C Systems for NPP” contains chapter “Human-Machine Interface Consideration”, it is recommended to decide in what scope DS 492 will complement DS-431.</p>	Clarification/avoiding duplication			x	HFE is a cross-cutting activity that affects I&C design, plant procedures, training, and many other things and that addresses the interfaces between these things. It is not just an I&C issue and it would be inappropriate to cover it in an I&C document. Anyway, the main I&C points are already in DS 431.

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USA 1	General	<p>The justification and Scope of DS492 are vague. There is a need for more elaboration of how this guidance will address compliance with SSR 2/1 requirement #32 with more details in the contents of the guidance presented on page 4:</p> <p><b>Requirement 32: Design for optimal operator performance Systematic consideration of human factors, including the human-machine interface, shall be included at an early stage in the design process for a nuclear power plant and shall be continued throughout the entire design process.</b></p> <p>In this context, the guidance should clearly address:</p> <ul style="list-style-type: none"> <li>- The design for a nuclear power plant shall address the critical number of operating personnel needed; incorporation of operational experience and lessons learned from operation;</li> <li>- The design support of operators in the fulfilment of their duties limiting the effects of operating errors on safety.</li> <li>- The human-machine interface design to provide the operators with comprehensive but easily manageable information, in accordance with the necessary decision times and action times.</li> <li>- The crucial information that needs to be provided to the operator to support his/her functions such as: (a) assessment of the general state of the plant in any condition; (b) operation of the plant within the specified limits (e.g.; operational limits and conditions); (c) confirming that safety actions for the actuation of safety systems are automatically initiated; (d) determining both the need for and the time for manual initiation of the specified safety actions.</li> <li>- The design shall be such as to promote the success of operator actions with due regard for the time available for action, the conditions to be expected and the psychological demands being made on the operator.</li> </ul>	Clarity and completeness to present key issues to address SSR/2/1 Safety Requirement #32.	x	Typically, we do not provide full text of specific requirements in DPP. Nevertheless in this very case we propose to include the original Wording of SSR 2/1. Requirement in Section 4 "Objectives and scope". We would like to point out that the text provided in the USA 1 comment slightly differs from SSR 2/1 in several instances (e.g. Clear instruction of operational functions in case of cyber-attack is not included in SSR 2.1).		

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		<ul style="list-style-type: none"> <li>- The need for intervention by the operator on a short time scale shall be kept to a minimum.</li> <li>- The design shall be such as to ensure that, following an event affecting the plant, environmental conditions in the control room or the supplementary control room and in locations on the access route to the supplementary control room do not compromise the protection and safety of the operating personnel.</li> <li>- <b>Clear instruction of operational functions in case of cyber-attack.</b></li> <li>- The design of workplaces in accordance with ergonomic concepts.</li> <li>- Inspection, verification, and validation, including use of simulators.</li> </ul>					
USA 2	General	The document lacks addressing interface between safety and security in consideration of human factors in design and operation. We believe it is necessary that the document lists interface with security guideline documents such as NST036 (Computer Security I&C); NST009 (Building Capacity for Nuclear Security); NST020 (Sustaining Nuclear Security Regime); and NST041 (Preventive and Protective Measures against Insider Threat).	We believe the guidance should address interface between safety and security in consideration of human factors in design and operation.	x	This new safety guide intends to provide recommendations to meet provisions of the SSR 2/1 Requirement 32. It will reference security publications without providing details.		
USA 3	Sect. 2, Para. 3/3; page 1	“Inadequate human-machine interface <del>cannot and</del> should not be compensated..”	Some HMI deficiencies CAN be resolved by training, etc. The point is that design deficiencies should not be resolved by loading up the operator(s).	x			
USA 4	Sect. 2, Para. 4/2; page 1	“The human intervention on plant remains an aspect that cannot <u>easily</u> be diversified.”	We do provide some human diversity via requirements for “Technical Support Center or TSC.	x			
USA 5	Sect. 4, Para. 5/1; page 2	“The safety guide will address the human factor engineering related to operation <b>and maintenance</b> of plant systems...”	The addition of maintenance to the document is significant and deserves repetition.	x			
USA 6	Sect. 5;	Add references for procedure design, systems	Design process should integrate	x			

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	page 3	approach to training.	the design of the human/machine interface, the procedures, and the training.				
USA 7	Section 5	NUREG 0711, Human Factors Engineering Program Review Model Revision <u>3</u>	The current NUREG 0711 reference on p. 3 is to Rev. 2, which has been superseded by Rev. 3.	x			
USA 8	Section 6	The Safety Guide should consider providing guidance and recommendations specific to the development of an Human Factors Engineering (HFE) Program & Management Plan (PMP)	To ensure compliance with Requirement 32 of IAEA SSR-2/1, guidance should be developed and included in the document to assure that HFE will be properly developed, executed, overseen, and documented throughout the entire design process.	x			
USA 9	Section 6	The Safety Guide should consider providing guidance and recommendations specific to the review of Operating Experience	To ensure compliance with Requirement 32 of IAEA SSR-2/1, guidance should be developed and included in the document to confirm that previous plant designs have been examined to preclude the introduction of any negative HFE features in the new design.	x			
USA 10	N/A; general comment	Will the document address the selection of a design team or qualifications of the HF lead?	An important aspect that needs to be included. Many in the industry still think that anyone can design HMI, "It's just common sense."	x			
USA 11	N/A; general comment	Will the document address the consideration of design alternatives?	Guidance is needed re choosing and documenting the decision as to which is the "best" of various design alternatives and why.	x	Probably yes, do not know yet.		
USA 12	N/A; general comment	Will the document address the use of cost/benefit in the design process?	Poor cost/benefit is why many designers tend to choose to load the operator with tasks, i.e., because they don't recognize all of the costs associated with manual actions. Guidance is needed.			x	Although a cost benefit analysis is an important element, this new safety guide is not going to provide specific recommendations on that subject.

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USA 13	N/A; general comment	Will the document address the issue of operator/crew workload in the design process?	Guidance is needed on how to measure operator/crew workload.	x	Probably, yes.		
USA 14	N/A; general comment	Will the document address the issue of new or evolving tools?	Guidance is needed re how to use new and future design tools, such as rapid prototyping, operator/crew modeling, 3D animation.	x	If we can provide technology neutral recommendations, in that case yes.		
USA 15	N/A; general comment	Will the document address "beyond design basis" mitigation?	Shouldn't we be designing control room HMIs to support BDB response, e.g. FLEX guidelines, in addition to other procedures?			x	This guide will address the specific requirements of SSR 2.1 for all operational states and accident conditions. This safety guide focuses on permanent installations, not portable devices.