Design and evaluation of new overview screens for the LABIHS simulator

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The development and evaluation of Human-System Interfaces (HSIs) for control rooms is a research area at the Human-System Interface Laboratory (LABIHS). The main objective of this laboratory is to develop and evaluate projects of HSIs for industrial plants using different methodology construction. The evaluation of the interfaces is carried out in the LABIHS simulator at the Nuclear Engineering Institute (IEN). Previous evaluation of the overview screen of the nuclear power plant (NPP) simulator of the LABIHS showed the necessity of additional information to reduce the operator workload. To overcome this issue, a set of three 52-inch LCD TV was acquired to replace the projector in the task of showing the overview screen to the simulator operators. A new set of screens was developed to gather information in the three LCD screens. The approach used on the development of the new screens was based on human factors guidelines and recommendations [1],[2]. The objective of this work is present the design of these new overview screens and to evaluate their contribution to reduce the operators mental workload in this new scenario.

Fig. 1 presents the original overview screen of the simulator. In the design phase of this interface screen, no consideration was taken into account to satisfy the guidelines of HSI.

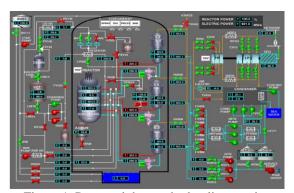


Figure 1. Proposed thermo-hydraulic overview screen

Fig. 2 presents the new developed left overview screen and Fig. 5 the screens used by the operator where information met to compose this screen.

					TRIP ALARM					
REACTIVITY	RHR	R RCS		HOD CONTROL			MS/TS		CONDENSES	PWS
HEACTIVITY HANGAL SI BCT TRIP	CTMT PRESS H & SI BCT TRIP	PRZ	BCS LO FLOW AT HE PARE BCT TREP	MANUAL BCT TRIP	POWER RANGE IN FLICK IN SETTET INCT THIP		MSL PRESS LOW SI ISO RCT TRIP	TBN TRP & P-7 RCT TRP		SG 1,2,3 WATER LEVEL LO-L SICT TRIP
OVERTEMP ATEMP RCT TRP		PRESS IN RCT TRIP	BCS LO FLOW AT LO PWH RCT TRIP	SOURCE RANGE HI FLUX RCT TRIP	PHIS BANCE HIFLUX LO SETPT RCT TRIP		REACTOR TRIP P-4 TION TRIP	TEN OVERSPEED HE TEN TRIP	CONDENSER VACUUM LO TEN TRIP	SG 1,2,3 WATER LEVEL III-I TEN TRIP
OVERPOWER ATEMP BCT TRP		PRZ PRESS LO & P-7 RCT TRIP		INTIMO RANGE HI FLUX RCT TRIP	PINT BANCE HI FLUX RATE RCT TRIP					
					ALARMS					
RHR		RCS		ROD CONTROL		cycs		HS/TS	CONDENSER	FWS
OCHIS OUTLET TEMP	ACCIM TK PRESS H	PRZ POSTV OPENING	RCS 1,2,3 Tary H	INTIMO RANGE HI FLUX ROD STOP	CONTROL BANK O BOD FULL WITHOGAWAL	WATER LEVEL	VCT PRESS III	MSIV	CONDENSER WATER LEVEL III	96 1.2,3 WATER LEVEL LO
PRESS LO	ACCEM TK PRESS LO	PRZ PRESS HI ALERT	BCS 1,2,3 Tang MACT Tang MLO	OVERPOWER BOD STOP	TWO OR MORE ROOS AT BOTTON	WATER LEVEL LO	PRESS LO	MSL 1,2,3 PRESS BATE III	CONBENSER WATER LEVEL LO	SG 1,2,3 STH FW FLOW DEVIATION
EIMT BAD H	SPEAV ACTUATED	PRZ PRESS LO ALERT	RCS 1,2,3 FLOW LO ALERT	AXIAL POWER DISTRIBUTION LIMIT	CONTROL BANK	CHARGING VALVE WATER FLOW	ORLITEL LFORM	MES. PRESS BATE IN STEAM ISO	CONECNISER ABS PRESS HI	TEMP HE
PRESS HI 3 ALERT	CTMT PHASE B ISO ACTUATED	PRZ PRESS LO BACKEP HEATER ON	PRT TEMP H			CHARGING VALVE WATER FLOW LO	OUTLET FLOW	MSL 1,2,3 PRESS LOW	CONDENSATE TK.	FW PUMP DESCHARGE PRESS III
PRESS HI 2 ALERT	CTMT SUMP WATER LEVEL HE-M	PRZ PRESS LO SI ACTUATED	PRT PRESS M			BCP SEAL BU WATER FLOW LO	OUTLET TEMP		COMBENSATE TK. WATER LEVEL LO	THE
CTMT PRESS HE1 ALERT	CTMT SUMP WATER LEVEL H	PRZ WATER LEVEL HI REATER ON	BCP 1,2,3 TRIP	REACTIVITY		WATER LEVEL LO-LO	L/D RHOX OUTLET TEMP III	ELECTRICAL	CONDENSATE TK.	AFW (MB) ACTUATED
CTMT MOISTURE H	CTMT AR TOMP H	PRZ WATER LEVEL LO HEATER OFF		Tres-MUCT Tang				OPEN	CONSERNATE PUMP WATER FLOW LO	
	STATUS				CF	ST		PLA	ANT CONDITI	ION
CONTROL.		PERMISSIVE			VIOLATION			ACCEENT	TRANSIENT	STATUS
C-1	c-3	P-4	P-11		SUBCRITICALITY	BCS INTEGRITY		LOCA	PORV	NOEMAL.
C-2	C-8	P-6	P-12		CORE COOLING	CTMT		SGTR	MFWISO	DON'T KNOW
C-3	C-8	P-7	P-13		HEAT SINK	COOLANT		STILIUP		
0-4	C-11	P-8	P-14					FWLDR		
c-s	C-16	P-10								

Figure 2. Proposed Alarm overview Screen.

The new right overview screen integrates information to the operators about the position of the rods of the control and shutdown banks in the reactor core, the thermo-hydraulic operation point of the plant in a pressure versus temperature curve (P-T curve), and plant mode operation. Fig. 3 presents the new developed Pressure-Temperature Curve overview screen

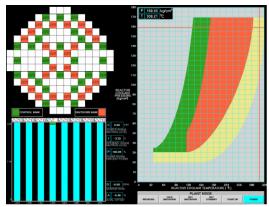


Figure 3. Proposed PT-Curve overview screen

References

[1] O'HARA, J.; STUBLER, W.; NASTA, K. Human-system interfaces management: effects on operator performance and issue identification. Upton: Brookhaven National Laboratory, 1997.

[2] NUREG-0700, **Human System Interface Design Review Guidelines**, Washington: U.S. Nuclear Regulatory Commission, 2002

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