American Petroleum Institute

Tool for Incorporating Human Factors During Process Hazard Analysis (PHA) Reviews of Plant Designs

API Human Factors Task Force

Regulatory Analysis & Scientific Affairs Department

March 2004

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INTRODUCTION

The following tool contains screening questions for incorporating human factors in process design. To make the tool more useful, example situations and potential solutions were added. Please note that it is not a comprehensive listing of all scenarios. In addition, your company may have different company-specific requirements that vary from those in the potential solution column. These Human Factors guidelines are not meant to be applied retroactively to existing plants, but are intended for future designs. See Glossary for definitions of underlined words.

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Human Factors Issue	Example Situation	Potential Solution
I. Blinds and Blanks		
1A. Location for blind has not been specified, or the blind is not included on a blind list	1. At unit battery limit 2. The blind is not rolled or inserted; incorrect isolation 3. The blind is removed	a. Identify and label preferred blinding/isolation locations on drawings and actual piping. b. Specify which blinds are to be removed and which spectacle blinds are to be turned prior to, or during startup.
1B. Access to the blind is not defined or is difficult [e.g., too high, reach is excessive, obstructed, weight is >51 lb (>23 kg)[1]]	1. Blind is located under a vessel or beyond the reach of a platform 2. Access to the blind is restricted by the facility or other equipment 3. Blind is oriented horizontally, so lifting equipment is ineffective 4. Blinds are associated with valves or lines which are themselves difficult to access 5. Emission occurs at blinding location—H_2S/flammable hydrocarbons	a. Develop specifications for lifting equipment and ensure access to blind by lifting equipment. b. Equip blinds heavier than 51 lb (23 kg)[1] with a lifting handle. c. Ensure blinds heavier than 102 lb (46 kg)[2] are oriented vertically and equipped for and accessible by a lifting device. d. Ensure lifting capability is built into equipment associated with blind (e.g., davit, hydraulic jack, beam for chain falls). e. Equip blind with handholds for more than one person. f. Ensure room to maneuver tools (e.g., sledgehammer for horizontal blinds.) g. Consider different material to reduce weight of blind. h. Identify and label preferred blinding/isolation locations on drawings and actual piping. i. Provide temporary/permanent platform with handrails/easy egress.
1C. The blind does not have associated bleed and drain valves or no clearly defined safe drain location	1. Pressure on blind not relieved.	a. Install display to indicate excess pressure or liquid levels. b. Ensure that pressure relief or drains are located downstream of blind and are identified on or near the blind flange.

[1] The NIOSH Load Constant (LC), which is used in the Recommended Weight Limit (RWL) equation is defined as fixed weight of 51 lb (23 kg); generally considered the maximum load nearly all healthy workers should be able to lift under optimal conditions. The RWL is defined for a specific set of task conditions as the weight that nearly all healthy workers (i.e. 95%) could perform for up to 8 hours without an increased risk of lifting-related low back pain (LBP). [NIOSH Publication No. 94-110 (1994)]

[2] The NIOSH defines a Lifting Index (LI) as the ratio of the lifted weight / RWL (Recommended Weight Limit). This limit should not exceed 2.0 without engineering intervention. The maximum weight that can be lifted at an LI of 2.0 is 51 lb x 2 = 102 lb (46 kg).

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Human Factors Issue	Example Situation	Potential Solution
1D. The blind is an unfamiliar design not used before in the plant (e.g., proprietary blind)	1. Hammer blind	a. Write procedures on the operation of the blind. b. Train operators in the operation of the blind before startup. c. Develop and install warning signs near blind to alert operator to novel design.
1E. The blind is used in an extreme service [toxic exposure, pressure >50 barg (>725 psig), temp. >200 degC (>390 degF)]	1. Blind is associated with valves that are used frequently or in an emergency	a. Blind is accessible from grade or from a platform. b. Warning signs are developed and installed near blind to alert operator to hazardous service. c. Vents and drains are installed and routed to safe location. d. Procedures are written on the installation and removal of blinds and operators are trained.
2. Emergency Equipment		
2A. Operator of the "fire monitor" does not have a clear line of sight to the target	1. Potential fire area is blocked by a structure	a. Raise monitor using a platform. b. Develop a portable system that is available for "blind" areas.
2B. Operator access to fire monitor or hydrant is obstructed	1. Operator is unable to access hydrant or monitor	a. Ensure alternate method of accessing hydrants and monitors based on fire scenarios.
2C. Operator is unable to initiate deluge as he or she is leaving the area	1. Local deluge activation box is not located in an escape route	a. Ensure that emergency exit routes are identified and that the deluge activation box is located on the route and clearly labeled so operator doesn't have to search for it. b. Ensure box is well signed so operator will not have to search for it. c. Consider duplicate or separate deluge activation boxes for inaccessible or multiple egress locations. d. Ensure that the operator receives feedback that the deluge system is operating. e. Ensure that the operation of the system is communicated to the emergency control station. f. Consider "automatic" activation of deluge.

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2D. Operator is unable to initiate deluge from the battery limit station (BLS)	1. Main deluge panels are not located at unit periphery (B/L)	a. Ensure that the deluge panel for the unit that is serviced by the BLS is at that station. b. Ensure that the operator receives feedback that the deluge system is operating. c. Ensure that the operation of the system is communicated to the emergency control station. d. Consider "automatic" activation of deluge.
2E. Operator initiates the deluge system in the wrong geographical area	1. Main deluge panels contain controls for three or more geographical coverage areas	a. Ensure that the deluge systems are functionally separated on the panel. b. Order the systems geographically using an appropriate mimic display. c. Ensure that the display is designed to provide feedback to the operator. d. Ensure operator has confirmation, either visually or by communications with the control center, that the proper system has operated.
2F. Operator in the unit/field does not see/hear flashing lights/alarms on automated emergency systems during emergency response	1. Toxic gas release in area – personnel do not know 2. Person inside an enclosed, loud compressor area and is unable to hear the alarm	a. Ensure indication is visible / audible at entry points to area of concern. b. Include initial PPE and gas testing plan in emergency response plan. c. Ensure that a visual alarm indication is installed in the proper location in all work areas where the audible alarm may be masked by noise. d. Ensure that highly important emergency systems have special identification (e.g., reactor depressurizing, heater fuel isolation).
2G. Voice communication systems are chosen for reliable operations for the settings in which they will be used	1. System failure	a. Ensure that there are back-up and/or alternative communication systems.

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