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Relationship between operator situation awareness and physiological states during complex and critical offshore well control scenarios

Ranjana K. Mehta†, S. Camille Peres, Wimberley Hoyle, and Ashley Shortz
Department of Environmental and Occupational Health
Texas A&M Ergonomics Center
Texas A&M University
College Station, Texas, 77843-3131

† Presenter E-mail: rmehta@tamu.edu

Abstract

Incident reviews of oil spill events (both large and small) suggest that human error, or more appropriately "systems error", is a contributor to 50% of well control incidents (primarily kicks). The purpose of this study was to examine operator situation awareness (SA) and associated physiological load, using heart rate and heart rate variability (HRV), during simulated offshore well control scenarios that differed in their complexity and criticality levels. Ten trained participants completed four scenarios (simple non-failure, simple failure, complex non-failure, and complex-failure) in an experimental session, lasting ~6 hours. Measures were obtained for each scenario, including speed and accuracy of the task performance, composite scores obtained from the Situational Awareness Rating Technique (SART), and operator heart rate and HRV measures. Greater errors were found in kick-related failure events, and complex scenarios were associated with longer reaction times. Participants perceived lower SA levels during complex scenarios, and a trend was observed for lowest SA during complex failure scenarios. Finally, physiological responses did not differ for any of the four scenarios, however, a trend of increasing physiological 'load" was observed with more complex and critical scenarios. High variability in participant covert and overt responses may increase the challenges associated with classifying high-risk well control scenarios. It is critical that scenario planners understand and recognize the variability in driller situation awareness and associated physiological load such scenario planners can then begin to start planning for alternative future scenarios.