Tenth International Conference on Managing Fatigue: Abstract for Review

DEVELOPING AND IMPLEMENTING FATIGUE RISK MANAGEMENT SYSTEMS IN PIPELINE CONTROL ROOMS IN THE UNITED STATES AND CANADA

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Problem The Pipeline and Hazardous Materials Safety Administration (PHMSA) of the United States Department of Transportation issued safety regulations in 2011 that required pipeline control rooms to implement methods "to reduce the risks associated with Controller fatigue that could inhibit a Controller's ability to carry out the roles and responsibilities the operator has defined." The methods included providing Controllers off-duty time sufficient to achieve eight hours of continuous sleep; establishing a maximum limit on Controller hours-of-service; providing education in fatigue mitigation strategies and how off-duty activities contribute to fatigue; and providing training on how to recognize the effects of fatigue.

Method PHMSA did not provide specific guidance on how to reduce the risks associated with Controller fatigue other than indirectly through guidance provided in the inspection criteria and PHMSA's fatigue mitigation website, but recommended the use of a Fatigue Risk Management System (FRMS). Companies did not have knowledge or experience with the use of a FRMS. Therefore, it was necessary to identify fatigue management practices in other transportation modes, with particular reliance on the aviation and railroad industries in the United States, Canada, and Australia. The authors used the definition by the International Civil Aviation Organization of a FRMS as "a data-driven means of continuously monitoring and maintaining fatigue related safety risks, based upon scientific principles and knowledge as well as operational experience that aims to ensure relevant personnel are performing at adequate levels of alertness" as a starting point in the development of a FRMS. Fatigue modeling software, fatigue hazard analysis software, control room environmental assessments, and workload assessment ratings all based upon scientific principles and standards are used to identify the potential schedule-related and task-related fatigue risks. Roles and responsibilities of all personnel were clearly defined. Training programs for annual training courses on the required fatigue management subjects were developed and delivered in classroom settings. Ongoing fatigue educational materials included managing fatigue calendars and a monthly one-page article that is provided to hundreds of people in the pipeline industry. The FRMS includes fatigue countermeasures, tools for self-assessment of fatigue signs, a method for quantification of the potential contribution of fatigue in operational accidents, and methods for evaluating the effectiveness of the FRMS.

Results The authors have assisted over 100 pipeline control rooms with the development and implementation of Fatigue Risk Management (FRM) systems and workload assessments that

include controller alertness ratings. Companies that did not have any FRM programs in 2011 now have a FRMS that includes these elements: shift length, schedule rotations, commute time analysis, staffing analysis, FRM training, FRM education, environmental and ergonomic factors, fatigue countermeasures, maximum non-emergency hours of service, emergency deviations from maximum hours of service, incident investigation for fatigue-related factors, observation or self-assessment for signs of fatigue, fatigue self-reporting, employee issues that affect alertness, and evaluation of FRMS and fatigue training/education program. The workload assessments, primarily designed to ensure that Controllers have time to respond to alarms, provide indicators about task-related fatigue if workload exceeds industry standards and controller alertness ratings throughout a shift. Before PHMSA issued the fatigue mitigation regulations, there was only one documented pipeline accident where Controller fatigue was deemed a contributing factor. There have been no documented pipeline accidents in the years 2011-2016 where Controller fatigue has been found to be a contributed factor. The results that are more evident are in changed behaviors by both Management and Controllers. Before the use of FRM systems, most companies had minimal staffing and used overtime to cover Controller absences. Now staffing has been increased and the hours of service are carefully monitored to avoid deviations. Individuals are more likely to use off-duty time for sleep and rest, and to seek medical help for sleep problems.

Discussion The authors and some pipeline companies are using FAID® fatigue modeling software as part of their FRM systems. Companies have to demonstrate to PHMSA that their FRMS has a scientific basis for the provisions of their plan. FAID® provides one means of documenting the scientific basis because the software was developed based on the results of research undertaken by Professor Drew Dawson and Dr. Adam Fletcher at the University of South Australia's Centre for Sleep Research. The authors use the software for evaluating shift schedules for potential fatigue risk, showing Controllers times during shifts when they are most likely to be fatigued, as part of fatigue hazard analysis, for quantifying the potential contribution of fatigue in incidents, for comparing one shift schedule to another, and for building FAID® scenarios for clients based on different overtime situations. The PHMSA regulations emphasize the importance of training and education, but only require that fatigue training be provided at least once each calendar year. The authors believe that a more effective fatigue training and education program is one that provides regular, ongoing messages to Controllers and their Managers about the subjects that PHMSA indicates should be emphasized. At this point, the authors have provided 72 monthly articles to hundreds of people in control rooms. Those articles complement the content in a managing fatigue calendar that companies provide to their Controllers and their families. In addition, the authors and their colleagues have published two books related to human factors and health and fitness for shiftworkers.

Summary There are several control rooms that could serve as case studies. The authors have worked with the people in these control rooms since 2008. PHMSA has conducted Control Room Management audits in these control rooms and found no deficiencies in the fatigue mitigation regulatory requirements or the workload assessment requirements. More importantly, all of the personnel have made positive changes in their personal fatigue management practices. Those changes include using off duty time between shifts to sleep, getting regular health checkups including sleep studies, applying what they have learned about

the dangers of drowsy driving to change behaviors, using less caffeine as a fatigue countermeasure, getting more regular exercise, and eating more healthful foods. In addition to identifying and reducing the risks of a fatigue-related accident, the PHMSA regulations have had the additional benefits of providing Controllers opportunities to improve their abilities to handle the rigors of working rotating shifts.