Controller Workload

Pipeline control rooms are mentally demanding, safety-critical environments where performance failures are more often caused by excessive cognitive workload than by lack of skill. When workload exceeds mental capacity, situation awareness degrades, response times slow, and the risk of error increases, making workload assessment a critical component of effective Control Room Management (CRM).

Although PHMSA regulations require operators to identify, evaluate, and manage Controller workload, they do not prescribe a specific method. The most effective approach is structured, repeatable, and multidimensional, recognizing that workload is driven by a complex interaction of operational demands, system design, staffing, and Human Factors - not just activity levels like alarms or calls.

The most defensible workload assessments integrate multiple data sources collected during real operations, using practical, nonintrusive methods. This comprehensive approach enables Operators to identify high-risk periods, optimize staffing and scheduling, understand fatigue, and improve overall system performance.

Ultimately, Controller workload is dynamic and cannot be captured by a single metric. When embedded within CRM programs, a data-driven, multidimensional assessment approach becomes a powerful tool for reducing risk, improving human performance, and ensuring safe, reliable pipeline operations.

The Challenge

PHMSA regulatory requirements 195.446(e)(5) and 192.631(e)(5) require that operators of hazardous liquids, gas transmission, and gas distribution control rooms monitor the general activity of their Controllers to make sure they have enough time to analyze and respond to alarms. The regulation emphasizes that Operators monitor what Controllers do and how often they do these activities.

The objective is to measure Controller workload using a structured process that is easy to implement, minimally disruptive to operations, and produces reliable, valid results that lead to meaningful and actionable conclusions.

Incorporating fatigue alongside workload provides a more complete picture, as fatigue directly impacts cognitive capacity and performance. Task-based analysis and system data further enhance understanding by revealing how Controllers spend their time and when peak demands occur.



PPG and Workload Assessments

PPG's methodology, used in over 540 assessments, in over 115 control rooms, over the past 15 years, centers on frequent, self-reported workload ratings that capture cognitive load, including effort, frustration, and performance. These self-report measures are highly sensitive indicators of overload and are most effective when combined with objective data such as system activity, task distribution, and operational conditions.

For the initial assessment, PPG conducts onsite reviews to observe operations, tailor the workload methodology, and brief Controllers on the process. This assessment includes a comprehensive Human Factors evaluation, benchmarking the control room against data from over 2200 Controllers across key CRM areas such as roles and responsibilities, HMI design, training, fatigue, communication, and procedures. The result is a detailed, data-driven report with practical recommendations to improve Controller performance, workload management, and overall control room effectiveness. We also consider factors such as workspace conditions, work environment, and the number of hours worked, as these can affect Controller workload, situation awareness, vigilance, and attention. We provide recommendations for improvements in these areas in a separate Human Factors Report.

PPG reviews the company's procedures and records in the control room. Our onsite visit aims to observe operations, customize the workload methodology, and brief Controllers on the workload assessment procedures. A schedule is established for collecting workload data. Controllers complete hourly online surveys during their assigned shifts over a four to six-week period. These shifts will include days, nights, and weekends to ensure a representative sample of workload is obtained. Once the data is collected, PPG provides a draft of the workload assessment report for the company's review. After receiving feedback from the company, we finalize the report. Our assessment of Controller workload will yield a clear statement regarding the current capacity utilization of the consoles. The assessment will include a summary of findings related to workload, Human Factors, and recommendations for improvements.

PPG combines doctoral-level qualifications in Human Factors with extensive practical experience in pipeline operations. We offer a workload assessment methodology that is both scientifically sound and practical to implement. Our assessment provides valuable insights into how the console workload compares to our industry benchmarks based on over 540 assessments.

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