# Fatigue Risk Management Systems for Personnel in the Refining and Petrochemical Industries

ANSI/API RECOMMENDED PRACTICE 755
SECOND EDITION, MAY 2019


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## Contents

# Fatigue Risk Management Systems for Personnel in the Petroleum and Petrochemical Industries

## 1 Scope

This recommended practice (RP) is based on sound science and also recognizes operational issues. It provides guidance to all stakeholders (e.g. employees, managers, supervisors, contractors) on understanding, recognizing, and managing fatigue risk in the workplace. Owners and operators shall establish policies and procedures to meet the purpose of this recommended practice.

This RP was developed for refineries, petrochemical and chemical operations, natural gas liquefaction plants, and other facilities, such as those covered by the OSHA Process Safety Management Standard, 29 CFR 1910.119. This document is intended to apply to a workforce that is commuting daily to a job location.

On-site contractors involved in process safety sensitive actions shall have fatigue risk management systems consistent with the criteria outlined in this document.

### 1.1 Overview

It has been documented that excess cognitive fatigue in the workplace is a risk to safe operations and that prescriptive “hours of service” rules are necessary but insufficient to mitigate the risk. Thus, fatigue risk mitigation shall be addressed through a comprehensive fatigue risk management system (FRMS) that is integrated with other safety management systems, as necessary.

Similar to other safety management systems, everyone—the workforce through senior management—has a role in recognizing the importance of workplace fatigue risk mitigation and actively working to support the goals of the FRMS.

The FRMS shall be developed and implemented in consultation with key stakeholders. The FRMS shall include a process for review and continuous improvement.

## 2 Normative References

This document contains no normative references. For a list of documents and articles associated with API RP 755 and fatigue risk management, please see the Bibliography.

## 3 Terms and Definitions

For the purposes of this publication, the following definitions apply.

**3.1**
**call-out**
Summoning an employee to the work site to perform work when they were not scheduled.

**3.2**
**extended shifts**
Work periods greater than 14 hours regardless of the scheduled shift length.

**3.3**
**fatigue**
Reduced mental and physical functioning caused by sleep deprivation and/or being awake during normal sleep hours. This may result from extended work hours, insufficient opportunities for quality sleep, failure to

use available sleep opportunities, or the effects of sleep disorders, medical conditions, or pharmaceuticals that reduce sleep or increase sleepiness.

**3.4**
**normal operations**
Operations that are not during outages.

**3.5**
**open shifts**
Foreseeable or planned vacancies on a scheduled shift where overtime will be required to fill the vacancy (non-emergency). Examples include extended sick leave, special assignment, open position, or vacation.

**3.6**
**outages**
Planned or unplanned significant interruption in the normal operations of a unit or plant, including mobilizing and demobilizing. Outages include, but are not limited to, turnarounds and unit shutdowns.

**3.7**
**shift**
Four or more consecutive hours worked, regardless of the nature of the work.

**3.8**
**shift work**
An organization of work where workers succeed each other at the same workplace while performing similar operations at different times of the day, thus allowing longer hours of operation than recommended for a single worker.

**3.9**
**work sets**
Work that takes place between minimum required rest periods (see Section 4.8).

# 4 Components of a Comprehensive Fatigue Risk Management System (FRMS)

## 4.1 Roles and Responsibilities

The FRMS shall clearly define the roles and responsibilities for positions such as:

— management;

— immediate supervisors;

— individual employees;

— key support functions (e.g. medical, HR, safety, workforce planning, and scheduling).

## 4.2 Positions Covered by the Fatigue Risk Management System

These guidelines shall apply to all employees involved in process safety sensitive actions who are working night shifts, rotating shifts, extended shifts, extended work sets, or call-outs (“covered positions”). They should also be considered for others making process safety-sensitive decisions.

## 4.3 Employee—Workload Balance

The FRMS shall include an initial and periodic assessment of the staffing levels and workload balance, such that the implementation of the hours-of-service guidelines discussed below are feasible and that fatigue risk is adequately managed. The FRMS should recognize the workload variability across shifts, weeks, and

months, taking into account start-ups and shutdowns, as well as unplanned events (e.g. hurricane recovery) and emergency management situations. These assessments should also assess current and anticipated employee attrition and absentee issues.

An employee-workload balance assessment should be conducted on a unit-by-unit or department basis and may include the following items:

— total vacation eligibility hours of all unit employees;

— historical absenteeism hours for the unit employees;

— historical overtime hours for the unit employees;

— full-time off-unit positions (i.e. unit trainers, procedure writers, coordinators, etc.);

— expected and/or historical hours spent out of the unit performing special projects (out of the shift rotation) (i.e. non-full-time, such as TA planning, PHA team, etc.);

— expected or historical hours spent upgrading to cover supervisor vacancies;

— known and anticipated attrition;

— operators trained up for relief at a higher position by unit;

— expected or historical hours of training by unit;

— expected or historical open shifts by unit;

— exceptions since the last review.

## 4.4 Safety Promotion: Training, Education, and Communication

The FRMS shall include a process for educating all stakeholders on the causes, risks, and potential consequences of fatigue. This education should acquaint all stakeholders with the basic scientific principles of sleep, sleep disorders, alertness, circadian, and fatigue physiology so that they can make informed decisions that will help them reduce the fatigue risk for themselves, their colleagues, and the people they may supervise or manage. This education should also provide information designed to increase family member awareness of how they can help the stakeholder stay alert, safe, and healthy.

All employees in covered positions shall receive initial and recurring training that should include the following:

— the scientific basis, the structure and the management of the corporate FRMS, and how it is integrated within the corporate safety management system;

— basic sleep, circadian, and fatigue physiology;

— strategies for achieving good-quality, restorative sleep;

— recognizing the symptoms of sleep disorders and how to obtain appropriate medical advice and treatment;

— managing an alert and healthy lifestyle;

— understanding the specific risks of fatigue impairment in their own work environment and work duties;

— recognizing the signs of fatigue impairment and knowledge on the healthy and effective ways of mitigating them;

— knowledge verification.

In addition, those who approve exceptions, supervise, or manage other employees in covered positions shall receive initial and recurring training that should include the following:

— the influence of staffing levels on employee fatigue;

— the effects of work and rest scheduling on employee fatigue, and how to schedule work to minimize the risk;

— how to manage a team of employees to minimize fatigue risk within the group;

— how to detect when employees are excessively fatigued;

— understanding company policies and procedures for times when employees or contractors should be removed from duty due to fatigue;

— the continuous-improvement process for assessing, updating, and increasing the effectiveness of the FRMS through a data-driven process.

## 4.5 Work Environment

To promote alertness, indoor work spaces occupied by personnel covered by this document should be well lit, using lighting sources positioned to avoid glare and eye strain (see API RP 540 for guidance). However, light sources at night should be selected to minimize circadian system disruption.

Indoor temperature should be controlled at the lower end of the comfortable range. Humidity should also be controlled within a comfortable range.

## 4.6 Individual Risk Assessment and Mitigation

Companies shall encourage individuals to be continuously aware of their level of fatigue and take appropriate steps to enhance their alertness while on duty. If and when individuals determine that they are too fatigued to work safely, they shall report this to their supervisor. Individuals should also be alert to evidence that others in the workplace may be fatigued and bring their concerns to the employee and their supervisor. In order to encourage fatigue awareness, a culture of fatigue risk management should be created. This culture should instill confidence in workers and contractors to disclose their personal sleep or fatigue status, and seek assistance consistent with the company protections afforded to reporting other safety concerns.

A FRMS shall take into account the type of work that is being done. Adequate opportunity for work breaks should be made available, based in part on the nature of the work. Individuals working in shifts and others who may be involved in working extended hours/days should be encouraged to use their time off the job to get appropriate sleep and maintain their alertness and fitness for duty.

Factors that may affect alertness and fitness for work include restricted sleep, stress, medical conditions, and the use of certain medications. A fitness-for-duty assessment may be used to detect fatigue-related impairment regardless of the underlying cause. Consideration should be given to validated objective assessment approaches that may aid in making fitness-for-work determinations.

Supervisors shall be alert to signs of excessive fatigue in employees and contractors. Supervisors shall be given the responsibility and the authority to take appropriate steps to ensure employees are alert enough to safely perform their work. Individuals who experience repeated bouts of excessive fatigue should be referred to their health professional or medical department for further evaluation and advice regarding actions they can and should take to maximize their alertness.

Because illness, stress, and physical fitness impact fatigue, programs that are designed to encourage prevention and management of medical conditions, including sleep disorders, and promote psychological and physical fitness should be implemented.

## 4.7 Incident/Near-miss Investigation

The investigation of incidents shall be conducted in a manner that facilitates the determination of the role, if any, of fatigue as a root cause or contributing cause.

Each company shall define criteria for when incident investigations should consider the role of employee fatigue. Information collected should include: the time of the incident; the shift pattern (including the number of consecutive shifts worked); the number of hours awake; the number of hours of sleep in the past 24 hours and 48 hours by the individuals involved; the shift duration (and any overtime worked); whether the incident occurred under normal operations or an extended shift; whether an outage was occurring; and other fatigue factors. It should be noted that, for specific incidents, often no definitive conclusion regarding the role of fatigue may be possible. However, aggregate analysis of incidents may reveal patterns suggestive of the role of fatigue that is not apparent by evaluating incidents individually.

## 4.8 Hours-of-service Limits

The FRMS shall specify hours-of-service limits that shall not exceed those in this section, taking into account the exception process discussed below. These limits have been developed in the context of the existence of a comprehensive FRMS. Because consistently working at the limits shown over multiple consecutive work-sets may lead to chronic sleep debt, the overall FRMS shall be designed to prevent employees from frequently working at or near these limits over the long term. The objective of these limits is to establish the triggers at which additional fatigue risk evaluations shall be performed prior to exceeding hours-of-service limits.

These hours-of-service requirements may be superseded if site-specific, validated data is available to demonstrate at least equivalent levels of safety utilizing scientific principles of fatigue risk management.

### 4.8.1 Normal Operations

The hours of service listed below are maximum allowable limits and are not intended to be the basis for the design of regular shift schedules.

— Total hours (including hand-offs, holdovers, and overtime) shall not exceed:

  — 14 hours per shift;

  — 92 hours per work-set (for straight day assignments, the work-set limits may be extended up to 105 hours).

— Extended shifts shall occur only when necessary in order to avoid an unplanned open safety critical position or accomplish an unplanned critical task, and shall be treated as an exception (see 4.8.4).

— A work-set shall be considered complete when an employee is off work for at least:

  — 34 hours if the work-set did not include four or more night shifts;

  — 46 hours if the work-set did include four or more night shifts.

### 4.8.2 Outages

— Total hours worked (including shift turnovers, holdovers, and overtime) shall not exceed:

  — 14 hours per shift;

— 182 hours per work-set.

— Extended shifts shall only be used to fill unplanned open shifts and shall be treated as exceptions.

— A work-set is completed when an employee is off for a minimum of 34 hours off after the work-set.

### 4.8.3 Call-Outs

Because call-outs by their nature involve unpredictable patterns of work and rest, attention should be given to call-out practices to ensure adequate rest prior to returning to work. All call-outs shall count towards the hours-of-service limits.

— Call-outs that occur (start or end) within 8 hours of a scheduled shift shall be included as time worked in the closest scheduled shift, and extended shift limits/guidelines shall apply.

NOTE The time between the call-out and the adjacent shift should be included in calculation of the hours-of-service limits.

— For call-outs that result in extended shifts, a minimum of 8 hours off is required between the completion of the extended shift and returning to work.

— For situations where an individual is called out to work multiple times throughout the same 24-hour period, the duration of call-outs shall be added. The hours-of-service limits shall apply to the total of the call-outs per individual.

### 4.8.4 Exception Approval Process

If any of the mandatory requirements (i.e. those indicated in “shall” statements) specified in the hours-of-service limits are expected to be exceeded or an extended shift is contemplated, an established management exception approval process shall be completed prior to the start of the exception. It is anticipated that exceptions to the hours-of-service limits may be required. The exception approval process is a very important component of an overall fatigue risk management system, and shall involve two management or supervision representatives, of which at least one shall be on-site.

The following scenarios may pose significant fatigue risk; thus, senior site management shall be notified of any of these exceptions and the mitigation steps taken to minimize these risks not later than the first business day after the exception.

— work more than 18 hours in a single shift;

— return to work prior to having 8 hours off;

— work more than one extended shift (greater than 14 hours) per work-set.

Exceptions are counted for each shift worked until the mandatory rest period is satisfied. The exception process shall include a documented risk assessment and mitigation plan, such as the following:

— the reason requiring the additional work hours or work days in excess of the hours-of-service limits;

— exception/extended shift under consideration;

— details on tasks and work to be completed and the number of individuals and timeframe involved.

The risk assessment and mitigation plan should include the following:

— types of hazards;

— task considerations (e.g. highly complex, physical exertion, time of day, etc.);

— individual considerations (e.g. consecutive shifts in current work-set, day or night shift, consecutive hours in current shift, previous hours off, commute time, etc.);

— dialogue between employee and supervisor concerning the assessment of the current level of fatigue of the employee;

— mitigation plan (e.g. increased breaks, double staffing, appropriate use of caffeine, travel arrangements, local hotel).

## 4.9 Periodic Review of the FRMS to Achieve Continuous Improvement

The FRMS shall be subject to periodic assessments of its effectiveness and opportunities for continuous improvement. Targets shall be set for key parameters of the FRMS and metrics shall be used to determine whether those targets are being met.

Examples of targets may include, but are not limited to, percentage overtime (median, mean—top of 10 % of employees), number of open shifts, number of extended shifts, length of work-sets, and number of and type of exceptions. Targets shall be reviewed with key stakeholders periodically (at least every 2 years) and incorporated into the FRMS. Plans shall be developed to close any gaps between targets and actual FRMS performance.

In addition, key outcomes that may be impacted by fatigue (e.g. absenteeism, healthcare costs, safety and hazard loss data, and aggregate analysis of incident investigation results, etc.) should be monitored. While these outcomes should be assessed to aid in the determination of the effectiveness of the FRMS, it should be noted that many factors other than fatigue may impact them, so judgment will be required in the interpretation of this information.

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