# SAN FRANCISCO BAR PILOTS

## FATIGUE RISK MANAGEMENT SYSTEM

MAY 30, 2024

# Contents

1. Purpose....3

2. Scope....4

3. SFBP Fatigue Risk Management System Model....4

3.1 FATIGUE RISK ASSESSMENTS....4

3.2 PILOT POWER AND WORKLOAD....6

3.3 WORK HOURS....7

3.4 FATIGUE AND SLEEP TRAINING....8

3.5 MEDICAL HEALTH ASSESSMENT....9

3.6 WORKPLACE ENVIRONMENT....10

3.7 FATIGUE MONITORING....10

3.8 INCIDENT INVESTIGATION....12

4. Continuous Improvement....13

5. Roles....14

6. Supporting Documentation....15

7. Definitions....15

8. CIRCADIAN Endorsement Letter....17

# SAN FRANCISCO BAR PILOTS

# FATIGUE RISK MANAGEMENT SYSTEM

# MAY 30, 2024

## 1. Purpose

The purpose of this Fatigue Risk Management System (FRMS) is to guide the San Francisco Bar Pilots (SFBP) in managing and reducing the risk of fatigue.

This FRMS is based on established science, recognizes operational issues and is data driven, monitored, and controlled. The FRMS includes prevention, education, and training in fatigue risk mitigation. It also includes a process to review, enhance, and continually improve the FRMS over time.

The SFBP recognize that the management of fatigue is a shared responsibility among all pilots. However, it is the responsibility of individual pilots to utilize rest periods and education to obtain sufficient rest, appropriate nutrition, and exercise necessary to report for duty rested and alert. SFBP have developed standards that incorporate appropriate schedules, work environment, policies, and education to allow pilots an opportunity to obtain sufficient rest to perform their duties in a safe manner.

The premise for an FRMS is that preventing and managing fatigue involves more than prescribing hours of service and minimum rest. A typical FRMS goes further and may include such elements as medical treatment for sleep disorders, excused absences due to self-reported fatigue, incident reporting and analysis, management commitment to the FRMS, as well as training and education focusing on the causes of fatigue, the best environments and times for restorative sleep, and the various means of mitigating fatigue.

# 2. Scope

This FRMS applies to all San Francisco Bar Pilots.

# 3. SFBP Fatigue Risk Management System Model

The FRMS model is based on the multiple accident causation theory which states that most major industrial and transportation accidents are the result of multiple latent points of system failure. Accidents are not just the immediately obvious active error of the human at the controls.

The specific prevention and mitigation measures are:

- Fatigue Risk Assessment
- Pilot Power and Workload
- Hours of Work
- Fatigue and Sleep Training and Education
- Medical Assessment
- Workplace Environment
- Fatigue Monitoring
- Incident Investigation

These eight layers are underpinned by the FRMS, which in addition to prevention and mitigation, includes program purpose, scope, and roles. The FRMS will be periodically reviewed and updated by SFBP. Any updates will be subsequently reviewed and approved by the Board of Pilot Commissioners (BOPC).

### 3.1 FATIGUE RISK ASSESSMENTS

In response to the Harbors and Navigation Code Section 1196.5, the BOPC contracted for a fatigue study with the San Jose State University Research Foundation (SJSURF) in collaboration with NASA's Ames Research Center. The scope of the study included "the effects of work and rest periods on psychological ability and safety for pilots" and an evaluation of "sleep and human-related factors for pilots." Further, the study was

required to include “information and recommendations on how to prevent pilot fatigue and ensure the safe operation of vessels.”

Additionally, SFBP conducted an internal Fatigue Risk Assessment (FRA) to review fatigue vulnerabilities and assist in the development of the FRMS. SFBP or BOPC may decide to conduct additional FRAs or studies when changes in conditions, pilot power, job tasks, or working rules could impact fatigue. An FRA may also be conducted following a serious incident citing fatigue as a causal factor. This FRMS incorporates recommendations from both the BOPC’s study and the SFBP FRA.

Both the BOPC study and the SFBP FRA included a review of the following fatigue risk factors:

- Hours of Work: Potential fatigue induced by the work schedule. Typically, night work periods present the greatest challenge to maintaining alertness. Work period start/end times as well as the on/off pattern and the length of time off between work periods can also influence fatigue.
- Job demands and type of work: Potential for fatigue imposed by specific job tasks, occupations and the type of work being performed.
- Working Environment: Contributing factors of fatigue in the work environment.
- Sleeping Environment**:** Sleeping environments can enhance or detract from obtaining adequate quality and quantity of sleep, a major factor in fatigue management.
- Transportation: Transport to and from assignments may decrease the amount of time that can be dedicated to rest and sleep prior to the shift. This may result in reduced alertness and increased fatigue while on duty. Extended travel to attend training (at times internationally) requires specific review on a case-by-case basis. Fatigue mitigation measures in these instances include judicious planning to minimize travel time and enhance rest opportunities. A pilot’s return to the board may also be delayed following extended travel.

- Fatigue Management Training**:** Formal fatigue management training can assist in the management of personal actions to understand and proactively manage fatigue.

## 3.2 PILOT POWER AND WORKLOAD

Having a sufficient number of qualified pilots to adequately address the needs of the operation is the primary tool in fatigue management.

### 3.2.1 Adequate Pilot Power

Adequate pilot power is defined as having a sufficient number of qualified pilots to conduct the following:

- Meet the pilotage needs of the operation and customers.
- Minimize excessive work hours that create fatigue situations.
- Provide coverage for scheduled and unscheduled absences, training and special assignments.
- Consistently meet the requirements of the FRMS.

### 3.2.2 Pilot Power Analysis

Pilot Power: Pilot Power is periodically reviewed by the BOPC. Based on workload, personnel, and pilotage demand forecasts, the BOPC may decide to adjust the number of pilots to manage fatigue.

### 3.2.3 Assignment of Off-Watch Pilots

Occasionally, meeting operational requirements may necessitate bringing in off-watch pilots to cover pilot assignments to mitigate fatigue. Any such recalls shall be voluntary and managed to minimize disruption of recovery rest periods prior to the start of a regular work rotation. Other measures to increase the number of pilots available on the board include, but are not limited to, suspending continuing professional development protocols, cancelling scheduled meetings or committee assignments, cancelling

previously granted compensatory time requests, and deferring scheduled training sessions.

### 3.3 WORK HOURS

To protect pilot health and safety, and the safety and environmental stewardship of operations, SFBP has adopted the following work hours policies:

Pilots are assigned by a first-in, first-out strategy that incorporates the following:

- 10-hour minimum rest period (MRP) between work periods. SFBP views this as a cornerstone policy of effective fatigue mitigation. Departures from the minimum rest period will be made only in the event of an immediate threat to the safety of persons, property, vessels, or the marine environment.
- A Pilot work rotation will be 15 or fewer consecutive days of being available for assignment.
- Pilots working 14 or 15 consecutive days shall have a longer rest period of at least 12 hours between work periods at or around the midpoint of their work rotation.
- Work periods that do not include nighttime hours (0000-0600) shall be limited to 14 hours in duration.
- Work periods that include nighttime hours (0000-0600) shall be limited to 12 hours in duration unless there is a rest opportunity of at least 2 hours on the offshore station boat between assignments. With such a rest opportunity, the work period duration may extend to 14 hours.
- Consecutive nighttime work periods are limited to a maximum of 18 nighttime hours (0000-0600) worked in any 72-hour period. If the 18-hour limit is reached, the following work period shall be during day work hours, commencing no earlier than 0800 on the calendar day next following the calendar day on which the 18-hour limit was reached.

SFBP will monitor and review the FRMS for effectiveness and modify as needed to seek optimum fatigue mitigation while also seeking to minimize delays to pilotage service users. Changes to the FRMS will be reported by the Port Agent to the BOPC for review and approval.

It should be noted that circumstances may arise that might pose an immediate threat to the safety of persons, property, vessels, or the marine environment. When, in the opinion of the Port Agent, there is reasonable cause to believe that the risk to the safety of those persons, property, vessels, or the marine environment exceeds the risks associated with authorizing a departure from the FRMS or other policies, the Port Agent may authorize a departure. Departures shall be reported to BOPC.

To increase the predictability of pilot work schedules, SFBP has established minimum advance notice requirements for ordering pilot services, as follows:

- Vessel Arrivals: 24-hour, 12-hour and 6-hour notice is required.
- Vessel Departures from San Francisco, San Pablo, or Suisun Bay: For orders placed between 0600 and 1800, the request for a pilot shall be made at least 4 hours before the pilot is required on board. For orders placed between 1800 and 0600, the request for a pilot shall be made at least 8 hours before a pilot is required on board.
- Vessel Departures from Stockton or Sacramento: The request for a pilot shall be made at least 8 hours before the pilot is required on board.
- Cancellations must be made at least 4 hours prior to any scheduled arrival or departure.

### 3.4 FATIGUE AND SLEEP TRAINING

State regulation requires all pilots receive fatigue training every 5 years. The training includes topics on how to identify fatigue, understand the potential risks of fatigue and how those risks can be mitigated. Pilots have a professional responsibility to use the training to ensure that they are rested and fit for duty when they report for work, and have the duty to refuse an assignment if they are too fatigued to complete an

assignment safely. These requirements are found in Title 7, California Code of Regulations, Section 215.

The training includes:

- Understanding the causes of fatigue: work related factors, circadian rhythms, individual differences, and lifestyle and off-duty activities.
- Recognizing the signs and symptoms of fatigue.
- Circadian rhythms and biological implications of shift work.
- The need for sleep and awareness of fatigue-related hazards: consequences of fatigue on health, safety, and work performance, and on driving, incidents, and accidents.
- Sleep physiology, sleep hygiene, effects of medication and other coping substances on sleep.
- Information with respect to an appropriate recovery period after awakening.
- How to identify sleep issues – sleep patterns, deficits, and sleep disorders.
- Nutrition and exercise, timing and content of food.
- Effects of medication and other substances on alertness.
- Fatigue countermeasures: effective strategies, when and how to apply.
- The performance requirements and the roles and responsibilities required by statute and regulation.

**3.5 MEDICAL HEALTH ASSESSMENT**

Annually, all pilots are required to undergo both a state and federal physical exam. The exam requires a thorough medical review and is documented on the form CG-719K.

The medical exams assess, among other things, personal and physiological factors that may impact upon the ability of an individual to perform in the maritime environment.

Form CG-719K requires disclosure by the applicant of: “Any sleep problems (for example, obstructive sleep apnea, restless leg syndrome, narcolepsy, shift work sleep disorder, or insomnia)”

The Merchant Mariner Medical Manual (chapter 19) describes sleep disorders as neurologic conditions of concern. They are subject to further review and may be determined disqualifying.

## 3.6 WORKPLACE ENVIRONMENT

### 3.6.1 Work Environment

Pilots are not able to control most factors in their work environment. However, it is important to be aware that the work environment may significantly impact alertness and cause fatigue. Pilots should adopt appropriate and available countermeasures to manage alertness and mitigate fatigue.

### 3.6.2 Sleep/Rest Environment

Sleeping accommodations on the offshore pilot boats have been fitted to help pilots obtain adequate rest.

Pilot accommodations on board the boats have at minimum the following:

- Controlled temperature environment.
- To optimize sleep during daytime: window tinting, curtains and/or coverings to make accommodations completely dark.
- Comfortable mattresses.
- Signage notifying that pilots are resting and designated quiet zones for sleep.

## 3.7 FATIGUE MONITORING

Even with proper training and guidance, occasionally individuals in continuous operations are subject to becoming fatigued, which may create a safety risk. An additional proactive measure against fatigue-related incidents includes an approach to

detect fatigue during ongoing operations and implement appropriate countermeasures and corrective actions.

Pilots can use the knowledge from their training to monitor fatigue. If an individual is too fatigued to start or complete a work period, the individual Pilot is to immediately notify the Port Agent to determine appropriate action.

Pilots working more than 7 consecutive days should be aware of the cumulative effects of fatigue and take appropriate mitigation measures. The Port Agent may review the work/rest history of these pilots and reassign as necessary to achieve required rest.

### 3.7.1 Fatigue Countermeasure Implementation

In most cases, the initial fatigue countermeasure is to provide a change in the immediate activity being conducted, for example:

- Physical activity: An individual in a sedentary task can often increase alertness through several minutes of physical activity.
- Nutrition and caffeine: Alertness can often be enhanced with caffeinated beverages. Fatigue can be induced if the individual has not had sufficient food or drink for an extended period.
- Sleep episode: Research confirms that the best method to recover from excessive fatigue is through a short restorative sleep episode. A short nap of between 10-20 minutes can provide up to 4 hours of increased alertness.

### 3.7.2 Fatigue Reporting Responsibility

Division 5, California Harbors and Navigation Code, Section 1146, provides as follows: *A pilot shall refuse a pilotage assignment if he or she is physically or mentally fatigued and has a reasonable belief that the assignment cannot be carried out in a competent and safe manner.*

Pilots must take personal responsibility to ensure that they are rested and fit for duty prior to assignment. However, in the event a pilot is unable to safely perform an assignment due to fatigue, that pilot shall notify the Port Agent as soon as practicable to determine appropriate action.

## 3.8 INCIDENT INVESTIGATION

Even with the proactive measures in place, occasionally individuals in continuous operations are subject to becoming fatigued, which may result in an incident. Thus, it is important to:

- Identify if fatigue was a prime or contributing cause of an incident.
- Determine if any FRMS measures were insufficient to prevent fatigue from causing or contributing to the incident.
- Use the information to continually improve the FRMS.

### 3.8.1 Identification of Fatigue as a Potential Causal Factor

The BOPC Incident Review Committee (IRC) will assess whether fatigue contributed to an incident and include that assessment in its report concerning the incident. Incidents determined to have high probability of fatigue as a causal factor should be evaluated to determine root cause and an action plan developed to prevent reoccurrence.

### 3.8.2 Corrective actions

When a fatigue-related incident is suspected or confirmed, the IRC may assess the probable cause of the fatigue. With this information, the BOPC may consider directing SFBP to review and revise the FRMS.

# 4. Continuous Improvement

The SFBP will meet periodically to review the FRMS with the goal of continual improvement.

Key elements to evaluate fatigue issues include:

- Evaluation of data reported to BOPC as required by California Code of Regulations, Title 7, section 237 (d):
    - Annual total of vessels moved, pilots assigned, and MRP exceptions
    - Monthly breakdown of pilot assignments per day
    - Annual total of bar crossings, bay moves, and river moves
    - Number of days pilots reported sick or injured
    - Number of days pilots were engaged in board-mandated training
    - Number of days pilots were engaged in administrative duties
    - Details and contributing circumstances of all reported MRP exceptions
    - Pilots pulled from regular rotation for multi-day pilotage
- BOPC incident reports in which fatigue was identified as a potential causal factor.
- Incident reports from other agencies such as U.S. Coast Guard (USCG) or National Transportation Safety Board (NTSB) in which fatigue was identified as a potential causal factor.
- Any other data that may be relevant. For example: number of light trips, changes off the front, special-assigned pilots (E-pilot and hand-hold pilots), and input from pilots.

# 5. Roles

A key element of this FRMS is to clarify specific roles for all parties involved.

Port Agent

- Establish, document, and maintain a Fatigue Risk Management System
- Review and revise the FRMS as needed, notifying BOPC of any changes and seeking approval for such changes
- Primary liaison between SFBP and the BOPC on fatigue risk management
- Report fatigue-related data to the BOPC as required

Pilots

- Understand risk factors at work that cause fatigue
- Complete and utilize all relevant training
- Report to work fit, rested and alert
- Monitor self for any signs of fatigue
- Notify the Port Agent if they believe they are suffering from fatigue
- Make the most of the opportunities available to get sufficient quality and duration of sleep

BOPC

- Review and approve changes to the SFBP FRMS
- Periodically review relevant data to mitigate pilot fatigue
- Ensure Pilot Trainee Exams are scheduled appropriately to maintain the required number of pilots
- Manage pilot power through pilot retirement surveys and training program oversight to ensure availability of replacement pilots

## 6. Supporting Documentation

- SJSURF/NASA Ames Research Center Fatigue Study
- California Harbors and Navigation Code, Division 5
- California Code of Regulations, Title 7
- BOPC Medical Assessment and Fitness Determination Guide
- USCG Merchant Mariner Medical Manual
- USCG Form CG-719K, Application for Medical Certificate

## 7. Definitions

| Word / Term | Definition |
|---|---|
| **Alertness** | The state of readiness to respond to stimulus. |
| **Circadian Rhythm** | A 24-hour cycle of the body reflecting functions such as temperature variations, hormone production levels and natural periods of sleep and attention peaks/troughs, etc. |
| **Fatigue** | An impaired physical and mental condition, which arises from an individual's exposure to physical and mental exertion and inadequate or disturbed sleep. |
| **Fatigue Risk Assessment (FRA)** | A process to identify, assess, prioritize, manage, and record the risks to health and safety arising from fatigue associated with extended hours and round-the-clock operations. |
| **Work Period** | Starts at the time a pilot would need to report to Pier 9 to begin an assignment and ends at the time a pilot, having completed the last of one or more assignments, would arrive back at Pier 9. Same as: Ride time to Bottom of Board (BoB) time. |
| **Rest Period** | The period between work periods. Same as: Bottom of Board (BoB) time to Ride time for next assignment. |
| **Pilot Assignment** | One ship assignment, or light trip to cover arrival. Pilots often complete two or more assignments per work period. |

| | |
|---|---|
| **Rest Opportunity** | A period when a pilot is between assignments and has access to sleeping accommodations on the offshore station boat. |
| **Work Rotation** | Consecutive days a pilot is available for assignment – not to exceed 15. |
| **Night Work** | 0000-0600 |
| **Day Work** | 0600-2400 |

# 8. CIRCADIAN Endorsement Letter

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March 26, 2024

Capt. John Carlier
Port Agent
San Francisco Bar Pilots
Pier 9 East End
San Francisco, CA 94111

Dear Captain Carlier,

Per your request, I have provided input and recommendations for the development of the San Francisco Bar Pilots (SFBP) Fatigue Risk Management System (FRMS).

In addition, I have independently reviewed and hereby approve the content and intent of the attached FRMS document which details the purpose and components of the San Francisco Bar Pilots Fatigue Risk Management System.

In my professional opinion as a Fatigue Management Subject Matter Expert, the FRMS provides the framework for a highly effective overarching fatigue risk management system. This FRMS is based on established science, recognizes operational issues and is data driven, monitored and controlled. The FRMS includes prevention, education and training in fatigue risk mitigation. It also includes a process to review, enhance and continually improve the FRMS over time.

The SFBP FRMS contains the appropriate and fundamental FRMS components detailed within several well established FRMS models, including:

- American National Standards Institute (ANSI) / American Petroleum Institute (API) Recommended Practice (RP) 755: Fatigue Risk Management Systems for Personnel in the Refining and Petrochemical Industries
- US DOT Federal Aviation Administration: 14 CFR Part 117 – Flight and Duty Limitations and Rest Requirements: Flight Crew Members
- US DOT Pipeline Hazardous Material Safety Administration (PHMSA): Control Room Management: Fatigue Risk Management: 49 CFR Parts 190-199.

Where appropriate, such as pilot annual physical examinations, the SFBP FRMS has been developed in line with US Coast Guard regulations.

The SFBP FRMS contains a work schedule pattern that has been well established and utilized within State Pilot organizations across the United States. The FRMS outlines numerous work hour polices designed to manage and mitigate fatigue.

In response to the Harbors and Navigation Code Section 1196.5, the BOPC contracted for a fatigue study with the San Jose State University Research Foundation (SJSURF) in

collaboration with NASA's Ames Research Center. Additionally, SFBP conducted an internal Fatigue Risk Assessment (FRA). This FRMS incorporates recommendations from both the BOPC's study and the SFBP FRA.

My evaluation and endorsement of the FRMS is based on 24 years of service as the Vice President Operations for CIRCADIAN, a recognized leader in Fatigue Risk Management. Under my direction and supervision CIRCADIAN has provided FRMS consulting services and/or FRMS training services for a multitude of industries domestically and internationally including 15 State Pilot organizations. CIRCADIAN has provided FRMS services for the American Pilot Association and the Maritime Pilots Institute.

Please let me know if you have questions or comments.

Sincerely,

[redacted]

William D. Davis
VP Operations
CIRCADIAN
[redacted]
www.circadian.com
[redacted]