

SMS Best Practice Submission			
ANSP	NAV CANADA	Date of submission	August 2024
SoE Study Area	7.1 Fatigue Risk Management		
Best Practice Title	Fatigue PowerBi App		
In use since	2019		
ANSPs using this practice			

Details:

There are many factors that cause or contribute to a person ‘feeling fatigued’. In 2019 a PowerBi report was developed to help us understand the Company’s exposure to this risk from a shift schedule point of view, the Fatigue Risk Report.

The application extracts the schedule information from NAV CANADA’s Employee Scheduling System (ESS) daily, running it against a set of fatigue science criteria and operational parameters, which represent proxies for actual sleep measures (the potential impact of the schedule in the quality and quantity of sleep opportunities).

It is important to highlight that there is never an inference to the level of ‘tiredness’ of a particular individual, or of a group of people, may be experiencing; nor is the dashboard meant to be the sole source of data for evaluating exposure to fatigue. Rather, this tool allows us to monitor scheduling practices that could potentially lead an individual to experience fatigue, to identify facilities where a higher level of awareness is required, or to provide an impetus for further exploration regarding drivers of fatigue risk.

In 2022 NAV CANADA adjusted its operational shift rules to better align with fatigue mitigation principles. To further understand and monitor fatigue metrics, two additional PowerBi reports were developed, using the same technical principles applied to the existing PowerBi:

- Fatigue Limit Exceedance: runs the ESS data against the set of adjusted shift rules, monitoring for compliance.
- Fatigue Review: aggregated the scientific rules and shift non-compliance rules for use in support of Safety Investigations. Access to this report is only permitted to members of the Safety Investigation team. In it, users can select a specific time period relevant to an investigation and evaluate both ESS fatigue data sets as part of their investigation. This report identifies the individual for follow up if required, and only in support of the investigation. Privacy of the individual is maintained through the application of Just Culture principles, data governance, and system-level access restrictions.

These three reports are bundled into a PowerBi App as a single point of contact with the data.

These reports went-live on September 1st, 2022 (fiscal 2023).

PowerBI provides the opportunity for internal comparison of the ‘in play’ operational fatigue limits that were exceeded (which are functional limits that were possible to institute given staffing limitations) with the scientific principles-based database (that is more in alignment with ICAO guidance, fatigue science and industry best practice). It provides a tool to see how the organization is doing, which is essential if the FRMS is to evolve and improve.

The PowerBI dashboard has eliminated the reliance on manual reports for fatigue duty limit exceedances (for all instances except for Time in Position). This has significantly decreased operational manager workload and, as the report is based on actual shifts worked, it has improved

the accuracy of the reporting to 100%. Since its adoption, as it is an automated process, it has also eliminated non-adherence to reporting requirements.

Definition of metrics:

1. Fatigue Science

NAV CANADA uses four scientific factors to assess the risk of fatigue in schedules. These are:

- Acute Sleep Disruption
 - a. Rule 1: Rest is less than 12 hours
 - b. Rule 3: Night shifts, defined as a shift with any amount of time between 23:30 and 05:30
- Chronic Sleep Disruption
 - a. Rule 5: Time between non-consecutive shifts is less than 48 hours
 - b. Rule 6: More than five consecutive shifts worked and at least one night shift (see Rule 3)
 - c. Rule 7: Three or more consecutive night shifts
 - d. Rule 8: Two consecutive night shifts
- Continuous Wakefulness
 - a. Rule 2: Shift is longer than 12 hours
- Circadian Rhythm Disruption
 - a. Rule 4: Sum of hours of a shift and rest period is less than 21 hours
 - b. Rule 9: Backward shift rotation, defined as the latter shift starting three or more hours earlier than the start time of the previous shift
 - c. Rule 10: Duty-rest cycle exceeds 27 hours in block of consecutive shifts

2. Shift Limits

- a. **Since the last submission, as part of the regular practice with an FRMS, NAV CANADA monitored the impact of planned amendments to the fatigue limits. There were several unforeseen impacts noted that did have a negative impact on operational personnel and on their ability to manage fatigue. The data from the Fatigue Risk Dashboard as well as survey data and discussions were utilized to make changes to the implemented limits to better fit the current staffing environment while still managing fatigue risks.**

NAV CANADA has since implemented the following amended compliance rules to the shift schedules:

- Rule 1 (Time between shifts): The minimum rest time between shifts is 10 hours (Amendment - Minimum rest between shifts is ten (10) hours. However, a unit or individual may elect to reduce time between shifts to a minimum of 8 hours once per cycle** on a voluntary basis.)
- Rule 2 (Total hours of work – Full): The maximum consecutive calendar days of work is eight (8) days or maximum of seventy-two (72) hours of work in a defined work period, whichever occurs first. (No change)
- Rule 3 (Recovery time – Full): The minimum non-duty time between work periods is one (1) calendar day off, provided the last shift worked ended before 22:30. In the event the last shift worked extends beyond 22:30, the first shift following the calendar day off must not start before 06:30 (amendment - Limit is applied at schedule publication, with the following exception post-publication: on a voluntary basis, employees can elect to apply 36 hours of rest time between shifts if the rest period for a calendar day off exceeds 36 hours.)

- Rule 4 (Night duty shifts – Full): The maximum consecutive night duty shifts worked is three (3) shifts, unless the work period consists of a block of night duty shifts, which are limited to six (6) in a row. (Amendment - Limit is applied at schedule publication, with the following exception post-publication: On a voluntary basis, consecutive nights can be extended provided the employee does not exceed eight (8) working calendar days. No set pattern required.)
- Rule 5 (Night duty shift recovery – Full): The minimum non-duty time after three (3) consecutive night duty shifts is one (1) calendar day off and the first shift following the calendar day off must not start before 06:30. In the event the work period consisted of a block of night duty shifts, the minimum non-duty time between work periods is two (2) calendar days off. (Amendment - Limit is applied at schedule publication, with the following exception post-publication: On a voluntary basis, employees can elect to apply 36 hours of rest time between shifts if the rest period for a calendar day off exceeds 36 hours.)
- Rule 6 (Start and end times – Full): The minimum start time for a shift is 05:30. The maximum end time for a night duty shift is 08:30. (No change)
- Rule 7 (Shift length): The maximum consecutive hours of work in a shift is twelve (12) hours, exclusive of handover duties. (No change)

3. Operational Metrics

The following metrics are used to evaluate operational scheduling patterns:

- The number of consecutive shifts
- The shift duration
- The rest period duration between consecutive shifts
- The total hours worked within blocks of consecutive shifts
- The total days of rest between blocks of consecutive shifts

PowerBi Report Principles

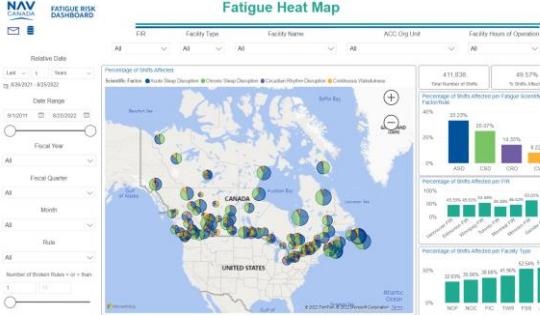
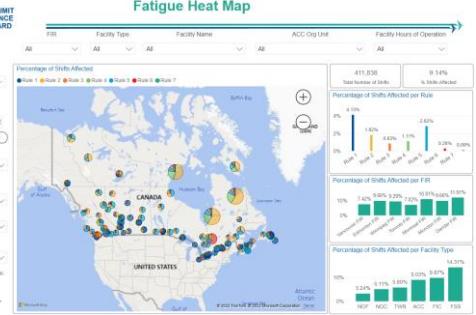
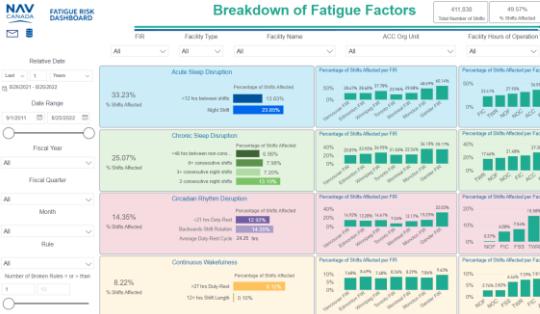
The reports were developed in Microsoft Power BI and is automatically refreshed daily.

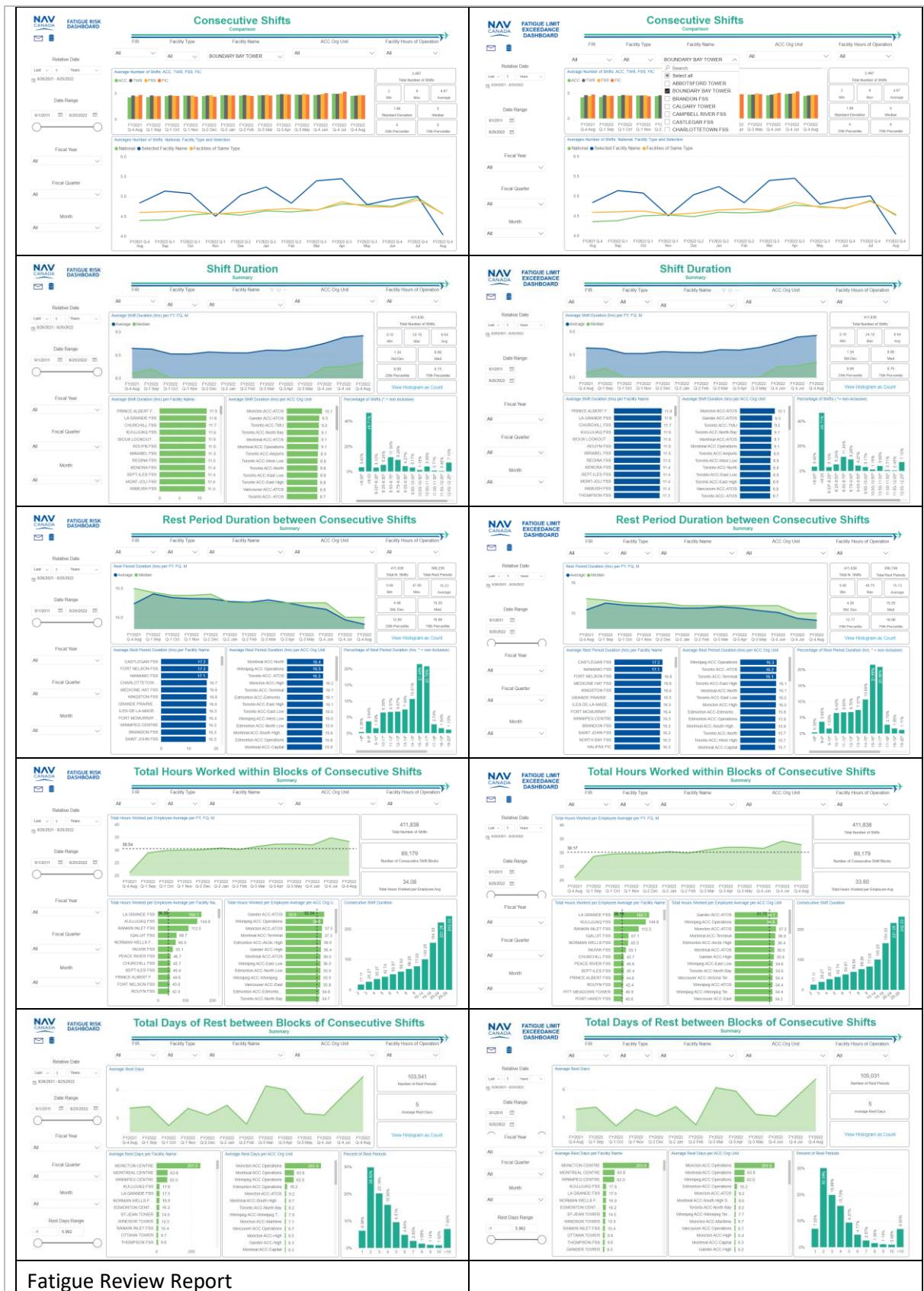
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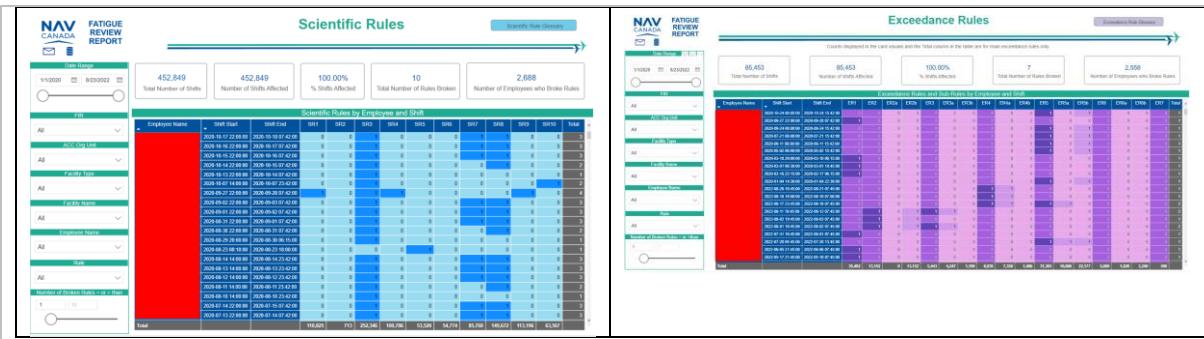
- Date
- Flight Information Region
- Facility Type (example: Tower, ACC, FSS, etc.)
- Facility Name (example: Toronto Tower, Vancouver Tower, etc.)
- ACC Specialty (example: Gander Oceanic, Toronto Terminal, etc.)
- Facility Hours of Operation (24 or non-24 hours)
- Rule (Fatigue Science or Shift Compliance) criteria

The primary metric used to benchmark performance when considering the rules (either scientific or shift compliance) is the percentage of shifts that had at least one of the respective rules triggered ("Percentage of Shifts Affected"). The user can also select the minimum number of rules triggered per shift (e.g. only show the shifts that triggered at least 4 rules). Unit benchmarking is also possible, where a certain unit (Facility Name or ACC Specialty) can compare their metrics against the national average, as well as facilities of the same type (e.g., select a tower, the average from other towers is displayed). The operational metrics can be viewed as average, median, min, max, 25th and 75th percentile, standard deviation, as well as in histogram distributions.

Below are screenshots of the different pages in the dashboard.

Fatigue Risk Report (Fatigue Science)		Fatigue Limit Report (Shift Compliance)	
<div> <p>FATIGUE RISK DASHBOARD</p> <p>Fatigue Heat Map</p>  <p>Facility Type: All, Facility Name: All, ACC Org Unit: All, Facility Hours of Operation: All</p> <p>Relative Date: Last 1 Year, Date Range: 9/1/2021 - 8/31/2022, Fiscal Year: All, Fiscal Quarter: All, Month: All, Rule: All, Number of Broken Rules = 0 or > 1, 1</p> <p>Scientific Factors: Auto-Sleep Disruption, Chronic-Sleep Disruption, Circadian-Rhythm Disruption, Continuous Watchfulness</p> <p>Facility Heat Map: Shows locations of facilities across Canada and the US with colored dots representing fatigue levels. A legend indicates the color scale for different fatigue levels.</p> <p>Facility Statistics: 411,830 Total Number of Shifts, 49.57% % Shifts Affected, 49.57% % Shifts Affected per Facility</p> <p>Facility Type Statistics: 32.95%, 24.85%, 16.84%, 14.20%, 14.89%</p> <p>Facility Hours of Operation Statistics: 411,830, 21.25%, 29.02%, 14.20%, 8.02%</p> </div>	<div> <p>FATIGUE LIMIT DASHBOARD</p> <p>Fatigue Heat Map</p>  <p>Facility Type: All, Facility Name: All, ACC Org Unit: All, Facility Hours of Operation: All</p> <p>Relative Date: Last 1 Year, Date Range: 9/1/2021 - 8/31/2022, Fiscal Year: All, Fiscal Quarter: All, Month: All, Rule: All, Number of Broken Rules = 0 or > 1, 1</p> <p>Shift Compliance: Rule 1 (Blue), Rule 2 (Orange), Rule 3 (Green), Rule 4 (Red), Rule 5 (Yellow), Rule 6 (Purple), Rule 7 (Grey)</p> <p>Facility Heat Map: Shows locations of facilities across Canada and the US with colored dots representing shift compliance levels. A legend indicates the color scale for different shift compliance levels.</p> <p>Facility Statistics: 411,830 Total Number of Shifts, 9.14% % Shifts Affected, 9.14% % Shifts Affected per Rule</p> <p>Facility Type Statistics: 3.45%, 3.45%, 3.25%, 3.11%, 3.00%, 0.88%, 11.85%</p> <p>Facility Hours of Operation Statistics: 411,830, 1.40%, 1.40%, 3.40%, 3.11%, 0.88%, 11.85%</p> </div>		
<div> <p>FATIGUE RISK DASHBOARD</p> <p>Breakdown of Fatigue Factors</p>  <p>Facility Type: All, Facility Name: All, ACC Org Unit: All, Facility Hours of Operation: All</p> <p>Relative Date: Last 1 Year, Date Range: 9/1/2021 - 8/31/2022, Fiscal Year: All, Fiscal Quarter: All, Month: All, Rule: All, Number of Broken Rules = 0 or > 1, 1</p> <p>Acute Sleep Disruption: 33.23% % Shifts Affected, 10-12 hrs Below Optimal, 12 hrs Above Optimal, 24-28 hrs, 30-34 hrs, 36-40 hrs, 42-46 hrs, 48-52 hrs, 54-58 hrs, 60-64 hrs, 66-70 hrs, 72-76 hrs, 78-82 hrs, 84-88 hrs, 90-94 hrs, 96-100 hrs, 102-106 hrs, 108-112 hrs, 114-118 hrs, 120-124 hrs, 126-130 hrs, 132-136 hrs, 138-142 hrs, 144-148 hrs, 150-154 hrs, 156-160 hrs, 162-166 hrs, 168-172 hrs, 174-178 hrs, 180-184 hrs, 186-190 hrs, 192-196 hrs, 198-202 hrs, 204-208 hrs, 210-214 hrs, 216-220 hrs, 222-226 hrs, 228-232 hrs, 234-238 hrs, 240-244 hrs, 246-250 hrs, 252-256 hrs, 258-262 hrs, 264-268 hrs, 270-274 hrs, 276-280 hrs, 282-286 hrs, 288-292 hrs, 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1908-1910 hrs, 1910-1912 hrs, 1912-1914 hrs, 1914-1916 hrs, 1916-1918 hrs, 1918-1920 hrs, 1920-1922 hrs, 1922-1924 hrs, 1924-1926 hrs, 1926-1928 hrs, 1928-1930 hrs, 1930-1932 hrs, 1932-1934 hrs, 1934-1936 hrs, 1936-1938 hrs, 1938-1940 hrs, 1940-1942 hrs, 1942-1944 hrs, 1944-1946 hrs, 1946-1948 hrs, 1948-1950 hrs, 1950-1952 hrs, 1952-1954 hrs, 1954-1956 hrs, 1956-1958 hrs, 1958-1960 hrs, 1960-1962 hrs, 1962-1964 hrs, 1964-1966 hrs, 1966-1968 hrs, 1968-1970 hrs, 1970-1972 hrs, 1972-1974 hrs, 1974-1976 hrs, 1976-1978 hrs, 1978-1980 hrs, 1980-1982 hrs, 1982-1984 hrs, 1984-1986 hrs, 1986-1988 hrs, 1988-1990 hrs, 1990-1992 hrs, 1992-1994 hrs, 1994-1996 hrs, 1996-1998 hrs, 1998-2000 hrs, 2000-2002 hrs, 2002-2004 hrs, 2004-2006 hrs, 2006-2008 hrs, 2008-2010 hrs, 2010-2012 hrs, 2012-2014 hrs, 2014-2016 hrs, 2016-2018 hrs, 2018-2020 hrs, 2020-2022 hrs, 2022-2024 hrs, 2024-2026 hrs, 2026-2028 hrs, 2028-2030 hrs, 2030-2032 hrs, 2032-2034 hrs, 2034-2036 hrs, 2036-2038 hrs, 2038-2040 hrs, 2040-2042 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By submitting this document, your organisation is willing for the proposed Optimised or Good Practice to be shared with other ANSPs.

For Optimised Practices, this document should be sent together with the SoE in SMS questionnaire, to:
soe_2022@eurocontrol.int by 31st July 2022 at the latest.

Submissions for consideration as Good Practices may be sent by the above date. They may also be identified during the survey interview sessions with the survey team, following which a Good Practice submission document will be requested.