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Optimizing Staffing Levels and Schedules for Railroad Dispatching Centers

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13. ABSTRACT (Maximum 200 words)

This report presents the results of a study to explore approaches to establishing staffing levels and schedules for railroad dispatchers. The work was conducted as follow-up to a prior study that found fatigue among dispatchers, particularly those who worked permanent night shifts. The present study had four objectives: 1) document current industry practices, 2) assess impact of current schedules on dispatcher fatigue, 3) develop methodology for establishing staffing levels, 4) develop alternative scheduling strategies.

Through site visits to six dispatching operations, current industry approaches to dispatcher staffing and scheduling were documented. All six sites have three categories of jobs: regular, relief and extra board. Staffing levels are established through experience and management judgment. All of these sites use schedules that are categorized as non self-relieving 3-crew systems with a relief crew.

The Relief Factor Formulas (RFF), the shift relief factor and the optimal staffing formula, are suggested as alternative methods for establishing staffing levels at dispatching centers. These methods compute an objective staffing level based on management criteria and historical data for “not at work days.” Staffing projections using the RFF assume that absences are equally likely to occur on any day of the week or season of the year so it is possible that there will be a limited number of days when overtime may be necessary.

Current dispatcher schedules have a number of possible problems with regard to dispatcher fatigue and quality of work life. Alternative scheduling strategies that can relieve these are the following: A) Create a three crew self-relieving system, B) Allow fixed weekday shift for senior dispatchers and rotate days off for remaining positions, C) Assign relief dispatchers to a single shift and use extra board to cover unplanned vacancies on a single shift, D) Convert weekends to two 12-hr shifts. All of these options have the potential to reduce fatigue and ease the burden for schedulers who must fill last-minute vacancies.

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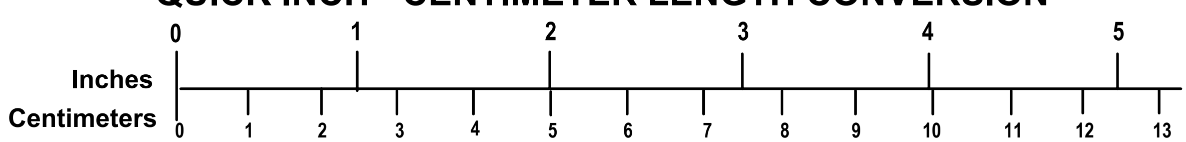

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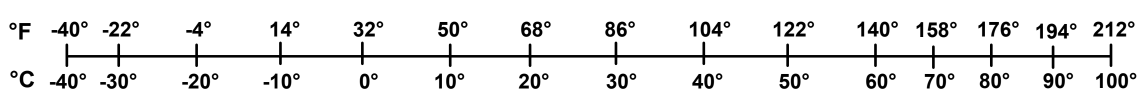

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This report presents the results of a research study to examine railroad industry practices with regard to the staffing and scheduling of dispatchers and to suggest alternative strategies that have the potential to alleviate the potentially fatiguing characteristics of present schedules and improve the quality of work life of dispatchers. The work was performed under contract DTFR53-95-C-00049 with guidance from Mr. Michael Coplen of the Office of Research and Development, Federal Railroad Administration (FRA). Dr. Thomas Raslear, also of FRA, recognized the need for this research and contributed to the design of the study. The authors especially wish to thank the six railroads that arranged for representatives of the study team to visit their facilities and meet with individuals involved in the processes for establishing staffing levels and scheduling dispatchers. These same railroads also provided representative dispatcher schedule data for their operations. Without this data the analysis described in this report would not have been possible.

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Executive Summary

The nature of railroading requires around-the-clock operation. Consequently, railroad personnel responsible for maintaining, servicing and operating this critical sector of the nation's transportation system must work at times outside the weekday hours common in many other industries. Railroad dispatchers are responsible for planning, coordinating and monitoring the safe and efficient movement of trains over the rail network. These employees perform a safety critical job in a time-sensitive environment. Their attention and concentration on routing of trains is key to the efficiency of the railroad's operations and the safety of its employees, the public and the environment.

Both work schedules and staffing levels can affect performance and safety. Schedules that require rapid rotations and compression of rest days can adversely affect shiftworkers' on-the-job alertness. Inadequate staffing levels may result in excessive overtime and utilization of staff on scheduled off-duty days. In some of these circumstances organizations may pay premium rates for sub-optimal, fatigue-impaired performance caused by loss of recovery time due to working on scheduled rest days. It is also possible that payroll costs may exceed those expended when an adequate work force is employed to meet service levels, without the need to rely on overtime and working days off. Over the long term, organizations with low staffing or traditional schedules may incur substantial health and safety consequences. They may also incur significant hidden costs, such as liability for personal injury, absenteeism and turnover, all of which can adversely affect competitiveness and profitability.

A recent FRA-sponsored study examined workload, stress and fatigue of railroad dispatchers. Dispatchers reported increasing levels of fatigue throughout all shifts, but the ratings for the night shift were significantly higher than those for the day and evening shifts. This research also found that dispatchers who worked nights reported "waking up tired" more frequently than those working days or evenings. Not surprisingly, the night workers were the most likely group to use split sleep and naps to obtain adequate rest. Overall, the results of this study indicated that dispatchers display characteristics typical for other shiftworkers, regardless of type of work.

Work schedules have been shown to greatly affect workers' performance, health and well-being. The impact of work schedules holds even greater importance in safety-critical jobs such as railroad dispatching, that require highly developed cognitive skills and vigilance. Yet, to date, there has been no attempt to assess the types of work schedules currently employed for railroad dispatchers.

The purpose of the research described in this report was to identify current staffing and scheduling strategies and, if appropriate, explore alternative strategies to current railroad industry practices with regard to the staffing level for dispatching operations and the scheduling of railroad dispatchers. Of particular concern were potential fatigue and quality of work life. The project had the following goals:

- Document current industry approaches to dispatcher staffing and scheduling.
- Assess impact of current schedules on sleep and fatigue.
- Develop or adapt a methodology for objectively determining optimal dispatcher staffing levels.
- Develop alternatives to current dispatcher scheduling systems.

The overall approach involved examination of current industry practices with regard to establishing staffing levels and scheduling dispatchers. Site visits to six dispatching centers provided insights on current industry practices. A method, used in many other industries, for establishing the optimal staffing level, was applied to dispatching operations. Then current dispatcher scheduling systems were characterized in terms of potential fatigue and quality of work life. Finally, alternative strategies that correct some of the problems with the current scheduling system were developed drawing on experiences in other industries.

All dispatching centers have three categories of jobs: regular, relief and extra board. Regular jobs work five consecutive days on the same shift followed by two days off. Relief jobs fill in for regular dispatchers on their assigned days off and may rotate through different shifts. Relief jobs usually work a regular schedule of five consecutive days followed by two days off, but extra board dispatchers who fill in for regular and relief dispatchers, do not always work a regular schedule although they are guaranteed five paid working days a week. This standard dispatcher staffing model exposes both the extra board dispatchers to rapid and constant shift changes that can be physiologically fatiguing. In addition, extra board dispatchers have no regular work or rest patterns because they either fill for regular dispatchers on planned vacancies or cover short-term vacancies. The current schedules are a product primarily of the Hours of Service Act and the labor agreement between the railroad and its dispatchers.

Responsibility for the weekly schedule lies with the chief dispatcher, the scheduling clerk or, in the case of the large Class I railroads, a separately staffed scheduling department. Based on a sample of actual schedules provided by six railroads, someone other than the regularly scheduled dispatcher may be required to work a shift position from 10 to 25 percent of the time. Hours of Service and desk qualifications constrain the options available to the scheduler in filling a vacancy and many times a solution must be found on short notice.

Staffing levels at dispatching centers appear to be the product of management experience and judgment rather than a rigorous analysis. Relief Factor Formulas (RFF), specifically the shift relief factor (SRF) and the optimal staffing formula (OSF), are more objective alternatives that provide a systematic process for establishing staffing levels. The SRF is suitable for operations where the staffing by shift is consistent for every day of the week and the OSF, a variant of the SRF, is applied when staffing is *not* consistent. Both of these methods require historical data for the dispatching center regarding average absences for its dispatching staff. This data includes vacation days, sick days, training days and any other absences that the center allows. Both the SRF and the OSF will be a number greater than one. This value suggests the number of employees needed to staff one desk on one shift over the course of the week. For desks that operate 7 days per week on an 8-hr shift, the SRF will be in the range of 1.5 to 1.8.

When applying the RFF, two basic principles must be kept in mind:

1. Because the RFF are calculated using average employee work data, staffing projections using relief factor calculations are only valid as averages used over an extended period of time.
2. Calculations based on Relief Factor Formulas assume that absences are equally likely to occur on any day of the week or season of the year.

All of the railroads reviewed for this study follow the same schedule format: a 3-shift system with a relief crew filling in on the scheduled days off for the permanently assigned dispatchers and an extra board to cover both planned and unplanned vacancies. These schedules are categorized as *non self-relieving 3-crew systems with a relief crew.* The major problems with this type of scheduling system in terms of potential fatigue and quality of work life are the following:

- Less than one quarter of the dispatchers have two weekend days off per week. Less than half have one weekend day off per week.
- Relief dispatchers are likely to work a rapidly rotating schedule.
- Extra board dispatchers are not assured of the opportunity for two consecutive days off.
- Extra board dispatchers are subject to an unpredictable irregular schedule that is likely to involve a rapidly rotating schedule.

Alternative scheduling strategies that can relieve at least some of the above consequences are the following:

A. Create a three crew self-relieving system.

B. With "A" as a prerequisite, allow fixed weekday shifts for senior dispatchers and rotate days off for the remaining positions to equally distribute weekend time off.

C. With "A" as a prerequisite, assign relief dispatchers within a single shift and use extra board dispatchers to cover unplanned vacancies on a single shift.

D. Convert Saturdays and Sundays to two 12-hr shifts.

The extra board creates problems for not only the dispatchers who work those jobs but also railroad management. Schedulers, who have the responsibility for securing a replacement dispatcher, many times must accomplish this task on short notice. The four suggested options offer alternative strategies for reducing the problems with the present arrangement. However, implementation of any of these strategies will require teamwork from both labor and management. Once a strategy is chosen, potential impediments to implementation can be addressed. A pilot test of a new scheduling arrangement for one division within a large dispatching center might be a first step. Since the focus of this study was on developing schedules in consideration of human physiology and quality of work life, railroads will likely want to examine economic consequences of any change in either staffing level or schedule.

1 Introduction

1.1 Background

Safe, efficient and reliable railroad systems are vital to the health, growth and competitiveness of the nation's economy. While significant technological advances have enhanced the safety and performance of this transportation mode, no equivalent advances have occurred or will occur in human physiology. Yet, because people occupy a central and safety-critical role in the operation of railroads, appreciable enhancement of human reliability and performance is essential to sustain the advancement of safety and performance.

The nature of railroading, the movement of goods and people, requires around-the-clock operation to reach distant destinations in a competitive and time efficient manner. Consequently, many thousands of personnel responsible for maintaining, servicing and operating this critical transportation service work shifts, or even irregular unpredictable work patterns, having varying start times and duty periods. The need to operate unscheduled trains that are assembled and run based on customer demands, traffic volumes and priorities, many times complicated by weather conditions, determines the schedule of train crews.

The work patterns of another group of safety-critical employees, dispatchers, although normally more predictable than those of train crews, also involve around-the-clock work. Dispatchers are responsible for planning, coordinating and monitoring the safe and efficient movement of "trains and other vehicles/equipment that travel on or along the rail safely and efficiently, and [for] protecting those individuals who work on or around the track" (Reinach, Gertler & Kuehn, 1998). They do so in accordance with set rules and policies and by employing various train control systems. Dispatchers perform essential safety critical jobs in a time-sensitive environment. Their attention and concentration on routing of trains is key to the efficiency of railroad operations and the safety of its employees, the environment and the public. Dispatcher errors resulting in conflicting train movements may lead to accidents.

Shiftwork is defined as any pattern of work in which most of the work hours are outside the period 8 a.m. to 4 p.m. As most dispatching centers provide monitoring and train control services around-the-clock, seven days a week, dispatchers are considered shiftworkers. Shiftwork and night work can pose exceptional challenges to human performance, due to sleep loss and circadian disruption. Research has also shown that individuals who are shiftworkers have higher rates of health problems and accumulate a higher sleep debt than individuals who work during daylight hours (Wedderburn, 2000).

Work schedules, particularly those of safety-critical shiftworkers, can affect performance and safety. Schedules that require rapid rotations and compression of rest days can adversely affect shiftworkers' sleep duration and quality, leading to sleep deprivation and overall disruption of the sleep-wake cycle. This can result in chronic fatigue, the manifestations of which can include poor job performance, increased sickness, errors and accidents. Inadequate staffing levels may result in excessive overtime and utilization of staff on scheduled off-duty days. In these circumstances organizations often pay premium rates for sub-optimal, fatigue-impaired performance caused by loss of recovery time due to working on scheduled rest days. It is also possible that payroll costs may exceed those expended when an adequate work force is employed to meet service levels, without the need to rely on overtime and working on days off. Over the long term, organizations with inadequate staffing or traditional schedules may incur substantial health and safety consequences. They may also incur significant hidden costs, such as liability for personal injury, absenteeism and turnover, all of which can adversely affect competitiveness and profitability.

A recent FRA-sponsored study examined workload, stress and fatigue of railroad dispatchers through a field study. Dispatchers reported increasing levels of fatigue throughout all shifts, but the ratings for the night shift were significantly higher than those for the day and evening shifts. This research also found that dispatchers who worked nights reported "waking up tired" more frequently than those working days or evenings. Not surprisingly, the night workers were the most likely group to use split sleep and naps to obtain adequate rest. Overall, the results of this study indicated that dispatchers display characteristics typical for shiftworkers, regardless of type of work (Popkin, Gertler & Reinach, 2001).

Work schedules have been shown to greatly affect workers' performance, health and well-being. The impact of work schedules holds even greater importance in safety-critical jobs, such as railroad dispatching, that require highly developed cognitive skills and vigilance. Yet to date, there has been no attempt to assess the types of work schedules currently employed in the railroad industry for dispatchers.

While good schedule design may appear to require only a limited number of mechanical calculations aimed at identifying staffing requirements to meet job load, this is not the case. Other less tangible but equally important factors, such as adequate recovery time, need to be integrated into work schedule design to ensure railroad safety, performance and dispatcher well-being within budgetary limits.

1.2 Purpose

The purpose of the research described in this report was to explore alternatives to current railroad industry practices with regard to the staffing level for dispatching operations and the scheduling of railroad dispatchers. The project had the following goals:

- Document current industry approaches to dispatcher staffing and scheduling.
- Assess impact of current schedules on sleep and fatigue.
- Develop or adapt a methodology for objectively determining optimal dispatcher staffing levels.
- Develop alternatives to current dispatcher scheduling systems.

In addition to providing information to the FRA, this report is designed to serve as a resource for railroad officials, at both passenger and freight railroads, who oversee dispatching operations and are responsible for determining staffing requirements and establishing schedules. As each dispatching center is unique in terms of workload, size and dispatching technology, the methods and findings of this analysis are intended as a guide to optimization of dispatching center staffing levels and work schedules.

1.3 Overall Approach

The overall approach to this project began with an examination of current industry practices for establishing staffing levels[1] and scheduling dispatchers. Site visits to six railroad dispatching centers and interviews with dispatching operations management provided insights on current industry practice and experience. Development of optimal work schedule strategies began with a staffing analysis to determine optimal staffing levels. The staffing analysis is based on an examination of days that dispatchers are not available to work or "not at work days." Then characterization of the current schedule in terms of potential fatigue and quality of work life led to identification of its potentially problematic aspects. Alternative strategies that correct some of the problems with the current scheduling system were developed drawing on experiences in other industries.

1.4 Report Organization

Section 2 describes current industry practices with regard to staffing and scheduling of dispatching centers, both overall and specifically for six individual railroads. A methodology for establishing the optimal staffing level is the subject of Section 3. Section 4 assesses current schedules in terms of factors that are potentially problematic with respect to worker fatigue and quality of work life, and Section 5 identifies four alternative strategies that can correct or reduce the schedule problems. The conclusions and recommendations of the research are presented in Section 6. References are listed in Section 7 and four Appendices contain supporting data and explanatory material.

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[1] Staffing level refers to the total number of dispatchers at a dispatching center.

2 Current Industry Procedures

A prerequisite to exploring alternatives to current dispatcher schedules is an understanding of current industry procedures. Site visits to six railroads provided the means to become familiar with current practices. Table 1 presents the characteristics of the six sites that were visited. The six railroads represent Class I, commuter and switching/terminal railroads. The purpose of the site visits was to gather information about the railroad's current processes for determining the appropriate staffing level, establishing schedules and filling planned and unplanned vacancies. Each of the six railroads also provided a description of current work assignments and one month of data to illustrate planned vs. actual work assignments. Subsection 2.1 provides an overview of industry practices with regard to the staffing and scheduling of railroad dispatching centers. The subsequent sections describe each dispatching operation and provide information on processes for establishing staffing levels and schedules and managing vacancies.

Table 1. Characteristics of case study sites

	Type of Railroad	Number of Desks/ Chiefs	Total Staff	Location of Dispatching Center
Conrail Shared Assets	Switching/ Terminal	3/1	24	Mt. Laurel, NJ
Metra Railroad	Commuter	4/1	24	Chicago
Metro-North Railroad	Commuter	10/2	52	New York City
Long Island Rail Road	Commuter	5/1	33	Jamaica, NY
Burlington Northern and Santa Fe Railway	Class I	98	518	Ft. Worth, TX
Union Pacific	Class I	N/A	375	Omaha, NE

2.1 Overall Patterns

The nature of railroad operations requires that dispatchers work around the clock. To meet the demands of 24-hr operation, for the most part, railroads staff their dispatching centers with three 8-hr shifts. There are three categories of jobs in all dispatching centers: regular jobs, relief jobs and extra board jobs. Regular jobs work five consecutive days on the same shift followed by two days off. Relief jobs fill in for regular dispatchers on their assigned days off and may rotate through different shifts. (In other industries this is referred to as a "grasshopper crew.") As is the case with the regular jobs, relief jobs usually work five consecutive days followed by two days off. The extra board dispatchers fill in for regular and relief dispatchers during vacations, training and road days and when there is an unplanned absence. On occasion, a regular dispatcher on a rest day may fill a vacancy if an extra board dispatcher is not available. All of the operations described in the following sections have a guaranteed extra board. This means that every extra board dispatcher is guaranteed five paid workdays every week, but the days and shifts that each individual works are not fixed. In addition, most agreements do not guarantee two consecutive days off for extra board dispatchers. Although most railroads no longer have tower or block operators, in those locations that do (e.g., Metra and the Long Island Rail Road), the tower operators may serve as the pool of extra board dispatchers. This situation is the exception rather than the rule.

The current schedules are a product of a number of factors. Most important are the Hours of Service regulations and the labor agreement between the railroad and its dispatchers. The Hours of Service Act requires that a dispatcher may not remain on duty for more than 9 hr, whether consecutive or in the aggregate, in any 24-hr period in operations that employ two or more shifts. Where only one shift is employed, the dispatcher may remain on duty up to 12 hr in any 24-hr period. During an emergency situation, the regulations allow dispatchers to remain on duty for an additional 4 hr in any 24-hr period for a maximum of three days over the course of seven consecutive days. (49 C.F.R. § 228) These regulations limit the length of the dispatcher's shift and provide for a minimum rest period between shifts.

The labor agreement typically stipulates provisions for hourly wages, vacation days, sick time and other benefit days off. It will also provide for a seniority-based method for assigning work. Since all dispatchers earn the same hourly wage after five years on the job, allowing the most senior dispatchers to choose the job that they work rewards longevity on the job. ("Job" refers to the specific shift and days on duty.) The labor agreement will provide the rules as to how the seniority system works. The seniority rules may also govern the assignment of overtime, which is typically paid at 1½ times the regular hourly rate. Some dispatchers are anxious to work overtime while others, typically the more senior dispatchers, prefer to work only their regular 40-hr week.

Depending upon the size of the operation, responsibility for the weekly schedule lies with the chief dispatcher, the scheduling clerk or, in the case of the large Class I railroads, a separately staffed department that manages the dispatcher schedules. Each of the railroads visited as part of this study provided one month of actual dispatcher schedules for examination. Based on this small sample, the percentage of shifts that were staffed by someone other than the regularly scheduled dispatcher ranged from 10 percent to 25 percent. For example, for a center that has 300 shift positions over a four-week period, the individual(s) responsible for the schedule are likely to have to find replacement dispatchers, from either the extra board pool or the regular or relief dispatchers between 30 and 75 times over a month. The limitations of the Hours of Service requirements and the desk qualifications of each individual dispatcher complicate this replacement process. Since many replacement assignments are due to vacations and other planned absences, these assignments do not create the level of last minute uncertainty that these figures might imply.

Most schedulers have developed paper and pencil methods to schedule dispatchers at their operation. The larger Class I railroads have developed software to assist their schedulers with the task. Regardless of the method used, the individuals who perform this task are proficient at it. Just as dispatchers can work out complicated train movements, schedulers are able to work out strategies for filling vacancies. The strategy may involve re-assigning several dispatchers due to desk qualifications and Hours of Service limits. On rare occasions the only feasible solution to a vacancy may violate the Hours of Service rules. In these cases, the FRA may impose a fine.

Since the basic structure of the dispatching jobs[2] tends to remain the same, unless there is re-alignment of territories or a merger of dispatching operations, the primary responsibility of the schedulers is to handle scheduled vacancies and unplanned absences. The unplanned absences are more difficult because of the short notice involved.

Staffing levels tend to remain constant over time unless changes in traffic or a merger necessitate the addition of new desks. The staffing level is usually determined based on the experience and judgment of management rather than a rigorous analysis.

2.2 Conrail Shared Assets

2.2.1 Nature of the Operation

Conrail Shared Assets, owned jointly by CSX and Norfolk Southern, is effectively a switching and terminal railroad. The dispatching center, located in Mt. Laurel, NJ, has three desks plus an assistant chief. (Prior to the breakup of Conrail this center had an additional 11 desks.) The train volume and train mix varies by territory. All desks are in operation for all shifts, seven days a week, with shift changeovers occurring at 7 a.m., 3 p.m. and 11 p.m. Each of the four dispatching desks has four permanent positions, first trick[3], second trick, third trick and a relief position. In addition, a rotating relief position works one day unassigned to a specific desk, then one position on each of the four desks over the week.

The territories controlled from this center are a mix of centralized train control (CTC), track warrant control and dark territory. Two of the three territories still have a limited number of block operators. This mix of different technologies, and therefore, different training, impacts position scheduling and staffing. Currently there is a total of 24 people who staff the center, ten of whom have less than two years of experience. There are between eight and twelve dispatchers qualified for each desk. Nine dispatchers are qualified on more than one desk, one qualifying on all four. Job tenure is fairly evenly distributed among dispatchers qualified for each desk. Those dispatchers qualified on multiple desks tend to cluster in the middle of the job tenure continuum.

2.2.2 Scheduling System

The current work schedule has been in place since the beginning of Conrail. Scheduling is a manual task performed with pencil and paper sheets; no special software is used. The scheduling clerk prepares the weekly schedule on a paper form. (See Figure 1.) The current assignment clerk, who creates these schedules, was trained by his predecessor and had 1 month of on-the-job training. The assignment clerk also handles the scheduling for four block stations in North Jersey and three block stations in Detroit. In addition, this person handles the payroll for all dispatchers and block operators as well as all yardmasters and clerks in the Operations Department.

Unexpected vacancies in the work schedule due to illness or other emergency situations are addressed in several ways. If the dispatcher calls in sick between 7 a.m. and 3 p.m. Monday-Friday, s/he will speak directly with the assignment clerk. After hours and on weekends, the

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[2] Job refers to a pattern of daily work periods and assigned days off.
[3] Trick is a railroad term referring to shift.

dispatcher calls the assistant chief dispatcher desk to mark off. Filling these vacancies is covered under the collective bargaining agreement, and is based upon seniority, qualifications and Hours of Service constraints. Under the collective bargaining agreement the extra list must be available 3 hr prior to the start of each shift. For this reason, dispatchers are asked to give at least 3 hr lead-time for schedule changes. Because the center is adequately staffed, little overtime is available, but when required, overtime is paid at time and one half rate.

Vacation scheduling is handled in a systematic manner. A vacation calendar is prepared several months prior to the start of the new year. Vacation weeks are bid on and assigned based on seniority with the constraint that only three people may take vacation simultaneously. Single vacation days may be taken with 48 hr notice provided there is an extra dispatcher to fill the vacancy.

2.2.3 Staffing

The length of employment determines the number of vacation, sick and personal days that each employee earns. Tables 2 through 4 break down the number of days by job tenure. There are no holiday or shift pay differentials. Dispatchers on the extra board are guaranteed 40 hr work a week. Management feels the center is adequately staffed as evidenced by the small (less than five) number of Hours of Service violations incurred during the preceding year.

After 25 years of service, dispatchers have approximately 50 days per year away from their normal position (25 vacation days, 10 sick days, 10 personal days and 5 road days). These non-workdays, which account for about 10 percent of total position time, have to be added into the staffing requirements via the appropriate number of extra board personnel.

This center requires a minimum of 17 people to cover all shifts over the four desks. Center management determines this number as follows:

(12 positions X 7 days = 84 slots / 5 shifts per dispatcher) = 16.8 people

The center currently has 24 dispatchers or seven beyond the minimum workforce. The additional staff of seven dispatchers compensates for the various off times. Management feels that this approach to staffing has led to an appropriate number of dispatchers at the Mt. Laurel operation.

TRAIN DISPATCHER DESK North Jersey A	SAT	SUN	MON	TUE	WED	THU	FRI
07:00 AM - 03:00 PM S & S							
03:00 PM - 11:00 PM M & T							
11:00 PM - 07:00 AM W & T							
TRAIN DISPATCHER DESK Detroit B							
07:00 AM - 03:00 PM M & T							
03:00 PM - 11:00 PM T & W							
11:00 PM - 07:00 AM T & F							
TRAIN DISPATCHERS DESK South Jersey C							
07:00 AM - 03:00 PM S & M							
03:00 PM - 11:00 PM T & W							
11:00 PM - 07:00 AM T & F							
TRAIN DISPATCHERS DESK Asst. Chief D							
07:00 AM - 03:00 PM F & S							
03:00 PM - 11:00 PM S & M							
11:00 PM - 07:00 AM T & W							

A:SCHEDULE.FRM (DISKETTE 1)
6/13/96

Figure 1. Sample Conrail weekly dispatcher schedule form

Table 2. Vacation accrual rate for Conrail

Years of Service	Vacation (weeks)
1	2
9	3
17	4
25	5

Table 3. Sick leave accrual rate for Conrail

Years of Service	Sick Leave (days)
1	2
2	4
5	6
10	10

Table 4. Personal days accrual rate for Conrail

Years of Service	Personal Leave (days)
1	2
3	4
6	8
9	10

2.3 Metra Railroad

2.3.1 Nature of the Operation

Metra is a commuter rail operation that dispatches its trains from its Consolidated Control Facility (CCF) in Chicago. Currently the CCF has five desks. Three desks operate around the clock seven days a week; the fourth desk is staffed for only first and second tricks Monday through Friday and the fifth desk operates two shifts, six days a week. Shift changeovers occur at 6 a.m., 2 p.m. and 10 p.m. Currently 23 qualified dispatchers staff the CCF. Twenty dispatchers hold regular assignments, including four regular relief, two guaranteed extra board positions and one Assistant Chief. The remaining three individuals hold positions in towers and function as the extra board. The relief dispatchers work a fast forward rotating work schedule of two days, two afternoons and one night each week. An effort is made to provide consecutive off days to all extra board dispatchers, but this is not always possible.

Metra qualifies trainees on all five desks to facilitate the filling of vacancies. The dispatcher must work a desk at least once during the year to retain his/her qualification for the position.

2.3.2 Scheduling System

The Senior Manager Train Operations is responsible for scheduling. The same system has been in place at Metra since the opening of the CCF in 1994. There is no formal training for work scheduling at this point but the Senior Manager Train Operations feels that he could easily train another individual through on-the-job training. Given the size of the work force, the Senior Manager Train Operations is able to manage the task with a paper-and-pencil system employing calendar forms. An easy to read calendar is prepared monthly for each desk in the CCF. Work schedules are produced at least one month in advance and are placed in each extra board dispatcher's mailbox.

Metra currently uses scheduling software for scheduling train and engine crews. The software takes into account seniority, Hours of Service rules, and labor agreement information in arranging the work schedules. The CCF management indicated that they would find this type of tool helpful for dispatcher scheduling and they hope to have an automated tool at some point in the future, particularly if the CCF expands.

Advance notice for a personal day is 48 hr. For a sick day there is no prescribed advance notice but CCF management asks that employees call with enough advance notice so that a replacement can be identified and called. When a dispatcher calls in sick or requests a personal day, a replacement is selected based on Hours of Service and seniority. Relief and extra board dispatchers are tapped before contacting the permanent staff for an overtime assignment. The Senior Manager Train Operations handles changes during first trick, the Chief handles them during second trick and during third trick and on weekends the crew callers identify a replacement.

Vacation time is bid on in September and reviewed in November. The dispatchers must indicate their first and second choices for their vacation time. Vacation assignments are based on seniority.

Procedures for filling longer-term vacancies are governed by Metra's union agreement. A short-term vacancy is one that is less than 30 days duration. If a guaranteed extra board dispatcher is not available, then one of the extra board dispatchers fills this type of vacancy. The availability of the guaranteed extra board dispatchers, not seniority, determines which one fills the position. The first one to mark up as available gets the assignment. A temporary vacancy, defined as a vacancy of more than 30 days but less than six months, is posted and the most senior dispatcher requesting the position fills the position. If the vacancy will exceed six months, then the job is advertised as a permanent position and it is filled based on the seniority of the applicants.

There are seasonal variations in workload, mostly due to heavy track maintenance in the summer time. If the desk becomes too busy, as determined by management, it is split and staffed by relief and extra board personnel for its duration.

2.3.3 Staffing

CCF management feels they currently have adequate staff, as evidenced by the fact that in the first half of 2000 there were only three instances where a staffing problem resulted in an assignment that exceeded Hours of Service limitations. Dispatcher retention is quite high, currently losing less than one per year.

Metra dispatchers receive a number of benefits and have the opportunity to occasionally earn premium pay. Per Metra's labor agreement, all dispatchers are entitled to ten sick days a year. The numbers of vacation and personal days are commensurate with the number of qualifying years with Metra, as defined by the agreement.

Table 5 and Table 6 show, respectively, the vacation and personal day accrual rates for Metra dispatchers.

Overtime at Metra is paid at the time and a half rate. As is the case with many other commuter railroads, beginning in 2000, holiday work at Metra is also paid at 1.5 times the regular rate.

Table 5. Vacation accrual rate for Metra

Years of Service	Vacation (Weeks)
1	1
2	2
7	3
17	4
25	5

Table 6. Personal day accrual rate for Metra

Years of Service	Personal Leave (Days)
1	1
8	2
17	3
20	4

2.4 Metro-North Railroad

2.4.1 Nature of the Operation

Metro-North Railroad dispatches its commuter operation from its Operations Control Center (OCC) at Grand Central Terminal in New York City. The OCC has ten desks staffed by 52 dispatchers–41 permanent positions and 11 guaranteed utility or extra board. All desks are staffed weekdays first and second trick, and five desks are staffed nights and weekends (third trick Friday through end of second trick Sunday). Shift changeovers occur at 6:45 a.m., 2:45 p.m., and 10:45 p.m. The morning rush hour runs from 6 to 10 a.m., with 7 to 9 a.m. being the busiest period, and the afternoon rush hour is from 4 to 8 p.m. The scheduling workweek is Wednesday through Tuesday.

2.4.2 Scheduling System

The first trick schedule clerk constructs schedules using Microsoft Excel. Scheduling is accomplished through the use of qualification sheets, past work schedules, and knowledge of seniority. Work schedules are posted at least 48 hr ahead of time, though permanent position dispatchers generally know their schedules for the year. When a dispatcher calls in sick, the utility or extra board is used to fill the slot (known as wild positions) based on qualifications, seniority and Hours of Service constraints. The schedule clerk handles schedule changes during first trick. If a dispatcher calls during second or third trick to mark off, then the chief or assistant chief makes the necessary schedule changes. By agreement, all dispatchers, including the extra board dispatchers, must have two consecutive off days. If this is not possible, then the dispatcher must be paid overtime.

Metro-North management is satisfied with the current scheduling system. They feel it is effective, as evidenced by the fact that only 64 hr of overtime (spread across nine shifts) was required during a recent holiday week. Only in extremely rare weather situations have Hours of Service violations occurred.

Vacation time is bid between November and January for the coming year. The schedule clerk must assure that all vacation time is assigned for each dispatcher. Vacation slots are awarded based on seniority, but no more than six dispatchers may be off for any one-week period, though seven dispatchers may be off for a one-day period. Under union agreement, sick time must be called in at least 8 hr ahead of the shift otherwise sick day payment can be withheld. Eight hr is usually enough time to reschedule without difficulties, but dispatchers must request personal days at least 48 hr ahead, otherwise the request may not be granted.

Positions that will become open cannot be advertised until the incumbent has officially vacated the position. These positions are filled through a seniority bidding process. When a position opens up temporarily but for at least five consecutive days, dispatchers can submit Hold Down applications, enabling them to switch their regular shift/desk with the open one. (Hold Downs are awarded on the basis of seniority.) A temporary opening can lead to a cascade effect if many dispatchers wish to work other positions, but this situation does not arise very often.

Both the number of desks at the OCC and the work schedules tend to remain unchanged from year to year. There are no more than one or two changes to the nominal work schedule within a calendar year. Rarely is a desk split and it is always done due to extraordinary workload considerations (for example, heavy MOW at night). If a permanently assigned dispatcher is moved involuntarily, then the company is required to pay an additional penalty payment.

2.4.3 Staffing

There are 41 permanent dispatchers and 11 extra board dispatchers at this facility. Full pay for a dispatcher is approximately $35 per hour. New hires are paid 70 percent of this full pay their initial year after first qualifying on a desk. Subsequently they receive 75 percent, 80 percent, 85 percent, and 90 percent for their second through fifth years, after which they receive full pay. The rate is adjusted yearly by 2.5 to 3 percent to reflect cost of living adjustments. Railroad employees switching crafts into dispatching will retain their previous rate until they qualify on a desk. Once qualified, the dispatcher will either keep his or her current rate or take the 70 percent dispatcher rate, whichever is greater.

Turnover rate is very low at this center, at most two people per year. Once hired, replacement dispatcher trainees take two to three months of classroom time to train a new dispatcher and then another three months of posting prior to qualifying for their first desk position. Nearly all new hires make it through the training process and become dispatchers.

Metro-North dispatchers receive a number of benefits and have several ways to earn premium pay. The number of vacation days is based on seniority, ranging from two to five weeks after the first year is completed. Twelve sick/personal days are also provided to each employee, though very few take all these days. There are 11 holidays in which a pay rate of 2½ times the regular rate is applied. Overtime is paid at a rate of 1½ times the regular rate and is therefore minimized. An additional 15 min is paid to each dispatcher transferring into a single desk, and 20 min for transferring into a double (collapsed) desk.

A dispatcher must be qualified on both the desk and the shift. At any time there are four or five Metro-North extra board dispatchers who know each territory and shift. The current number of dispatchers and the dispersion of their qualifications seems adequate as the railroad exceeds Hours of Service limits at most only three or four times a year.

The current staffing level was not the result of a rigorous analysis. Rather, it evolved from budgetary constraints. Senior management determines the center's staff budget within which the Center's manager must operate. The Vice President of Operations is the only person able to create new positions, and would only do so 1) to cut cost (from overtime or violations) or 2) if there were a "significant risk of probable harm." Positions can be traded with other operating divisions, however, if the manager has the budget to support an additional position.

2.5 Long Island Rail Road

2.5.1 Nature of the Operation

The Long Island Rail Road (LIRR) is the largest commuter operation in the country. It has a non-centralized dispatching operation consisting of 13 towers, each staffed by some combination of train movement directors and block/tower operators, and five dispatching desks located at the LIRR Operations Center in Jamaica Station.

The LIRR distinguishes three types of dispatchers: permanent, relief and utility (extra board). Both permanent and relief dispatchers are on permanent assignments while utility board dispatchers are used to fill the gaps in the day-to-day schedules. Shift changeovers for the dispatchers are staggered between desks. Three desks have changeovers at 6 a.m. and 2 p.m., while the other two change at 7 a.m., 3 p.m. and 11 p.m. Two of the desks work 24/7, two work 16/5 and one works 16/6. There are 11 permanent dispatchers and three relief dispatchers. In addition, there are four utility or extra board positions. One of the relief positions works two days at a dispatching desk and on the other three days is responsible for the public address system.

2.5.2 Scheduling System

A crew dispatcher is responsible for all scheduling of both tower or block operators and central train dispatchers. This individual is also responsible for scheduling train and engine crews, yard masters and other operations personnel. As this is a first trick position (8 a.m. - 4 p.m.), shift supervisors/chiefs make emergency changes during the other two shifts.

The Operations Center has dispatchers and relief dispatchers assigned to work expressly at the facility. Utility board personnel work in the towers when they are not needed at the Operations Center. The LIRR makes an effort to ensure that there are enough qualified extra board dispatchers within their pool of tower operators/dispatchers. The LIRR's long range plans include phasing out the towers and creating a centralized operation. At that time additional dispatching positions may be necessary in the Operations Center.

Overtime is awarded on a seniority basis. The pay differential for overtime varies as a function of seniority and location, ranging from 60 to 70 percent for the central office and 40 to 50 percent for the towers. In early 2000 the LIRR paid significant overtime due to sudden schedule changes resulting from illness or other unanticipated activities.

When a sick call is logged, which can be as close as 3 hr prior to start of work, the crew dispatcher or chief will first check the dispatchers s/he has available at the central office who fall within Hours of Service and are qualified for the position. The relief board is reviewed first for a solution. If no relief dispatchers are available, then overtime is offered to the permanent dispatchers.

The scheduler performs his or her dispatcher scheduling duties using paper-and-pencil methods (roster, key sheets, and prior schedule) that have been in use for the past 20 to 25 years. In contrast, s/he uses a special software package for scheduling train and engine crews. Eventually, once the towers are consolidated, dispatcher scheduling will migrate to this package. It currently takes the scheduler between 1 and 2 hr each week to draw up the succeeding week's schedule. The current work scheduling system is learned on-the-job from the incumbent, and requires about six months of training and practice before the scheduler becomes proficient at creating work schedules.

Vacation time and other planned off time is elected by the beginning of the year. Vacation time is assigned based on seniority. There are no seasonal variations in the center's operations, and therefore vacation time is spread out as evenly as possible.

Upcoming open dispatcher positions are announced the first and third Wednesday of the month. Open positions, which number about 1 or 2 per year, are filled using a bid system. These positions are bid and then awarded based on both seniority and "marks." ("Marks" reflect disciplinary or performance issues.) A person of lower seniority but with fewer negative marks may win the position over someone who has higher seniority but more marks.

2.6 Burlington Northern and Santa Fe Railway

2.6.1 Nature of the Operation

The Burlington Northern and Santa Fe Railway (BNSF) maintains the largest centralized dispatching facility in the United States. It currently employs 533 dispatchers to cover 98 desks in its Network Operations Center located in Ft. Worth, TX. The majority of dispatchers hold a permanent or permanent relief position, the remaining slots, approximately 10 percent, being filled by extra board positions. Permanent positions are scheduled to have two consecutive off days while the extra board dispatchers usually do not have consecutive days off. Nearly all desks are staffed 24X7 with shift changeovers occurring at 6:40 a.m., 2:40 p.m., and 10:40 p.m. Less than 4 percent of the desks are combined at night or on weekends.

2.6.2 Scheduling System

Between 1993 and 1995 seven field offices were consolidated into the Fort Worth centralized Network Operations Center. Prior to this move, the regional offices used paper-and-pencil methods for scheduling their dispatchers. The centralized operation, however, was too large to be scheduled in this fashion, and as a result, special in-house scheduling software was developed. This software now keeps track of postings and awards, scheduling, produces manpower and utilization reports, names of people covering various jobs and possible alternates with their qualifications and seniority, etc. Qualifications are both desk and shift specific. Therefore, to work Desk A first and second trick would require two separate qualifications.

Those dispatchers on regular duty or regular relief know their work schedules for a year at a time, barring personnel changes and shifts. People on the extra board are generally provided their work schedules one to two weeks prior to duty time. Vacation time for the coming year is put to bid in October, based on seniority and need. Any changes in dates that occur after January 1 must go through a management/labor review process.

Schedules are created by either Managers of Dispatcher Scheduling, who are responsible for scheduling and manpower planning of seven zones, or by zone chiefs. The zone chiefs actually prefer to have the ability to schedule their personnel, even though it is an additional burden. They are familiar with the strengths and weaknesses of their different dispatchers and may make extra board selection choices that would not result from simply following the set selection rules. Zone chiefs use pencil-and-paper formats while the schedule managers use the developed software solution.

Schedule changes can occur rapidly. When a sick call comes in, the scheduling manager or chief first consults the extra list for a replacement. If none are available with the proper qualification or rest time, then the relief board is examined and overtime granted. Sometimes it is possible to shift a dispatcher who is already assigned to work the shift from his/her original desk to another desk on which s/he qualifies in order to facilitate an extra board or relief board replacement. The software package makes theses types of changes much easier as it can keep track of the entire decision space. The software keeps track of sick days, and can show individual and position reports to detect problems, either with particular dispatchers or in staffing levels.

Vacation time is allocated prior to the beginning of the current year. Thirty-five people are allowed to be on vacation on any particular day during peak vacation times, i.e. major holiday, school breaks and summer time, 25 people at other times. Changes in vacation time are usually allowed if they do not require more than one shift of overtime to be paid to the replacement.

When a position becomes available through retirement, and it is a non-exempt job[4] it is posted several weeks prior to the incumbent's departure. The position is filled based on seniority and qualifications. In most cases a new person will have been selected and ready to replace the retiree the day after the retirement. In contrast, exempt jobs cannot be posted prior to the incumbent dispatcher actually retiring. While the replacement rules are similar to those used by

[4] A non-exempt job is governed by a collective bargaining agreement. Only some former Santa Fe positions are still exempt.

the non-exempt jobs, there typically is some lag, and therefore reliance on the extra board, before the position is permanently filled.

The scheduling software is fairly intuitive and easy to use. It was developed through brainstorming efforts of the chiefs, and now incorporates various Hours of Service and union rules. While it takes one to two weeks to understand the software, it generally takes about two months before the user can start producing schedules, and six months before producing efficient schedules. Part of the delay is the chief learning the strengths and weaknesses of the people under him or her, which usually takes four to five months.

This software is also used to keep personnel records and track the progress of the dispatchers. One such activity is its maintenance of a qualification list. Each time a dispatcher trains or qualifies on a new position or shift that information is entered into the software's database. The dispatchers review this information on a regular basis, and thus they have the opportunity to verify and update their file as necessary. This is especially important as the earlier versions of the software did not manage qualification information accurately.

2.6.3 Staffing

A minimum of 4.2 dispatchers is needed to cover a 24/7 desk. The center is currently operating at about 6 dispatchers per 24/7 desk. About 25 percent of the dispatchers at the facility are on the extra board. The center is currently operating with a 10 percent turnover rate, which is planned for in the operating budget for new hires. Current staffing levels are considered to be appropriate as the center encounters no more than five situations a year that exceed Hours of Service limitations.

It takes approximately 26 weeks from hiring to filling a desk position. For an external apprentice dispatcher with no railroad experience, there are 14 weeks of schooling and 7 weeks of on-the-job training. Dispatchers must qualify on each shift of each desk. Each desk requires approximately six weeks posting and each additional shift requires one to three weeks of posting. Therefore, during the first year of employment the dispatcher will only actually fill a position for 26 weeks. Dispatchers are paid a reduced rate of $183.55 a day during the training period, except for those transferring crafts within BNSF. Dispatchers start at 80 percent pay after training for the first 60 days or until they qualify for a desk, whichever comes first. They are then paid at the full rate of $229.43 per day.

Dispatchers have to work 110 days the first year in order to qualify for 10 days vacation the following year. Table 7 contains the benefit-day accrual rates for BNSF dispatchers.

There is no pay differentiation between shifts or for holidays. There are pay premiums, however, for position, overtime and training. Specifically, if a dispatcher is asked to work more than eight hr, s/he is paid at a rate of 1.5 times the regular rate. Dispatchers who oversee a trainee at their desk receive an extra 10 percent during the days a trainee is posting with them. In addition to vacation and sick days, dispatchers are budgeted for five to ten days of training per year and one week of road trips every third year.

When the Center first opened, the BNSF was hiring, training and placing dispatchers at a rate of 100 to120 per year. The attrition rate has since stabilized, and is now around 60 dispatchers per year. Occasionally new positions are opened when a desk is split due to excessive workload (as determined from wait time, number of calls in to dispatcher, and incumbent complaints) and the acquisition of a new territory.

Table 7. BNSF dispatcher vacation, personal and sick day accrual rates

Time worked	Vacation Days	Personal Days	Sick Leave
120 days	10	0	2
2 years	10	0	5
3 years	10	0	10
8 years	15	1	10
17 years	20	2	15
20 years	20	3	20
25 years	25	3	20

2.7 Union Pacific Railroad

2.7.1 Nature of the Operation

The Union Pacific Railroad (UP), a Class I freight operation, is dispatched primarily from the Harriman Dispatching Center in Omaha, Nebraska. Most of the 67 desks in the center operate around the clock, seven days a week. This center had 375 active dispatchers on its staff in 2000 and an additional 36 apprentice dispatchers in training, all of whom were expect to qualify by the end of the year. While most of the former Southern Pacific (SP) desks are still located in the Harriman Center, they continue to use their DigiCon Dispatching System that differs from that employed for the UP Harriman Center dispatching desks. Because of the differences in dispatching technology, Union Pacific's Union Switch & Signal CAD-II system and the former SP DigiCon system, the two operations cannot share dispatchers and as a result, to some degree, they are unique and separate operations. UP is working on the design of their next generation dispatching system CAD-III, which will result in the consolidation of the two operations.

2.7.2 Scheduling System

Prior to 1998, dispatchers were responsible for the scheduling of railroad dispatchers. Each region had one dispatcher assigned to scheduling activities. This dispatcher's job included one day per week for this activity. At that time there was no computer software support, no generated reports, and no means of obtaining data, other than those found in administrative messages and memoranda.

In early 1998 UP created a Scheduling Department to coordinate and manage the assignment of qualified and apprentice train dispatchers for the Center. The goal was to ensure maximum manpower utilization for safe, efficient and uninterrupted dispatching of trains. Significant effort was expended to organize and establish workable scheduling processes.

The Scheduling Department assists in forecasting staffing needs and manages workforce distribution. As apprentice dispatchers complete the classroom phase of training, schedulers and Managers of Train Dispatching (MOTD) match the skills of each individual apprentice with staffing needs of each zone. Some of the considerations include traffic volume, mode of operation, confidence level and prior railroad experience in a specific geographic area.

Schedulers, in conjunction with MOTD's, match apprentices with experienced dispatchers on assigned territories, ensuring dispatchers with less than one year of experience do not train apprentices or other dispatchers with less than one year of experience. Scheduling managers also arrange for pre-qualification road trips and rules reviews. The Scheduling Department handles coordination of apprentice "qualification" work with MOTD's schedules.

The 67 train dispatching positions are divided into fifteen zones. Each zone is made up of three to six positions, averaging five positions per zone. The number of dispatchers per zone ranges from 18 to 34. When permanent vacancies arise, the scheduling manager puts out a bulletin requesting that interested parties apply. Vacancies are awarded based on seniority.

Zones consist of territories that share the same region and dispatching system (US&S CADII or DigiCon). Most are operationally and geographically connected. The assignment-by-zone concept balances staff, offers structure for relief jobs, and allows UP to maximize the number of dispatchers with a single-shift schedule. The BNSF has worked to arrange job assignments so that most relief jobs do not rotate between shifts.

Each zone includes:

- Assigned "incumbents" who work one position five days per week.
- Relief positions that cover one, two or three positions, on assigned, 5-day schedules. Most relief positions are also single-shift. Some of the relief positions cover desks in more than one zone.
- Extra board dispatchers who are trained on three positions to cover scheduled and unscheduled vacancies. The extra board workweek also consists of five days.
- Shift changeover times are at 7 a.m., 3 p.m. and 11 p.m.

To the extent possible, staffing managers work closely with dispatchers to schedule all vacancies. Extra board dispatchers who are scheduled based on qualifications, availability, experience/proficiency, and minimal schedule disruption normally fill vacancies. Occasionally when qualified dispatchers are not available to fill a vacancy, an assigned dispatcher is asked to perform overtime work on their rest day.

Vacations are scheduled at the end of each year for the following year, allowing no more than three dispatchers to take vacations at the same time in each zone. During peak vacation (i.e. summer) and holiday periods, extra board dispatchers are utilized to the fullest.

Currently, all dispatchers are scheduled using a specially developed Microsoft Access database product. This system allows the schedulers the ability to maintain consistent data and ensure accurate reports on:

- Work histories of all dispatchers.
- Dispatcher "seniority" dates.
- Dispatcher position qualifications.
- Details of vacancies.

- Regional statistics.
- Dispatcher evaluations.

Many reports have been built into the system, ranging from a simple work history of a specific dispatcher to detailed reports regarding work history, rest days worked, office demographics, etc. The original purpose of the system was simply to be able to identify the qualified candidates for filling vacancies and to track work schedules. The system has evolved, and now possesses additional capabilities such that, for example, Hours of Service availability and qualification level of employees are checked and ordered when a scheduler queries the system looking for viable replacements for a vacancy. In addition, the system alerts the scheduler when a conflict is detected, such as attempting to schedule a dispatcher with less than one year of experience to work a daylight position on a weekday.

Every effort is made to give dispatchers a predictable schedule and one of no more than five consecutive days. Work performed on rest days is currently running at approximately 0.3 percent of the total number of shifts.

Schedulers receive on-the-job training from experienced schedulers. A new scheduler will work in conjunction with an experienced scheduler until s/he is completely familiar with all scheduling policies and software. People with experience in Excel, Access and a computer background are highly desirable for this type of work. UP also looks for people with good interpersonal skills since the schedulers work closely with the dispatchers on a daily basis as they arrange their work schedules. Schedulers maintain day trick office hr, but remain available to handle emergencies on a 24/7 basis.

3 Methodology for Establishing Optimal Staffing Level

The optimal staffing level for any dispatching operation is a function of both the number of dispatcher positions that must be staffed and the extent to which someone other than the regularly assigned person works each position. The term “shift position” is used in the following subsections to refer to a specific desk and shift. This section presents a methodology for computing optimal staffing level. It is important to keep in mind that this method is based on the *average* number of positions required over the course of a week and the *average* level of absenteeism for the center. It is still possible that, due to unusual circumstances on a given day, there may be a need for individuals to work on a regularly scheduled day off. Section 5 discusses strategies for scheduling dispatchers that will minimize the occasions when this will be necessary.

Subsection 3.1 addresses computation of the average number of daily shift positions and subsection 3.2 describes the relief factor formulas for establishing the appropriate staffing level for a dispatching center. There are two relief factor formulas, the shift relief factor and the optimal staffing formula. Subsection 3.2 explains the circumstances that dictate when one approach versus the other is appropriate.

3.1 Average Number of Positions to Meet Workload

Assuming center management has established the number of desks that must operate and the days and shifts that each will be staffed, the staffing analysis can proceed. The first step in estimating the optimal staffing level is to determine the average number of shift positions that must be staffed over the course of the week. The number of positions may be the same each day and shift or it may vary. In general, the average number of daily shift positions is computed as:

$$\frac{\text{Total dispatcher-days per week}}{\text{Total number of service days per week}}$$

The average number of daily shift positions can be computed as a total for the entire dispatching center or by shift. This section describes how the average number of daily positions is computed for three different scenarios. Items (1) and (2) below address computations across all shifts and item (3) illustrates the method to use when circumstances require staffing levels by shift.

1. Constant staffing levels across shifts and days

When the number of dispatchers scheduled to be on duty is constant for every workday, that number will also be the number of shift positions to be staffed. For example, many dispatching operations for the freight railroads discussed in Section 1 operate with the same number of dispatchers regardless of day of the week or shift. If a center has 8 desks that operate for each of the three shifts, then there would be 24 daily shift positions at this center.

2. Varying Staff Levels on Various Work Days

When the number of dispatchers scheduled varies with workdays, as may be the case to accommodate workload fluctuations, the average number of shift positions per workday is calculated as follows:

1. Determine the number of dispatchers who will be on duty on each day of the week across all shifts (shift positions).

2. Sum the numbers from step 1 above.
3. Establish and count the number of days where at least one dispatcher is scheduled for work.
4. Calculate a quotient by dividing the sum obtained in step 2 by the count obtained in step 3.

For example, assume that a dispatching center requires a total of 12 dispatchers daily Monday thru Friday and 8 are required on weekends. (See Table 8.)

Table 8. Staffing requirements by day

	M	T	W	T	F	S	S	Total Dispatcher Days
Number of On-Duty Dispatchers	12	12	12	12	12	8	8	76

There is a total of 76 dispatcher days at this center. Since the center operates 7 days per week, the average number of daily shift positions is 76/7 = 10.86 or 11.

3. Computing average daily shift positions by shift

When staffing requirements vary by shift, it may be desirable to calculate the number of daily positions by shift. In this case the procedure for determining the average number of daily positions is as follows:

1. Establish per-week dispatcher-day totals for each shift.
2. Ascertain the number of service days per week, by shift.
3. For each shift, divide the total number of dispatcher-days obtained in step 1 by the total number of service days obtained in step 2; the resultant quotient will equal the average number of daily positions to be staffed.

$$\text{Average number of shift positions} = \frac{\text{Total dispatcher days}}{\text{Total service days}}$$

Table 9 provides an example of a dispatching center where the number of dispatchers on duty varies by shift and day of the week. The right-hand column contains the number of dispatcher-days by shift for this center.

Table 10 contains the total dispatcher-days and total service days per week.

Table 9. Staffing requirements by shift and day of week

Number of Dispatchers on Duty								
	Day of Week							Total Dispatcher Days
Shift	M	T	W	T	F	S	S	
1	7	7	7	7	7	7	7	49
2	8	8	8	9	12	12	0	57
3	5	5	5	5	5	0	0	25

Table 10. Average number of daily positions by shift

Shift	Total Dispatcher Days	Total Service Days	Average Number of Daily Positions
1	49	7	7
2	57	6	9.5
3	25	5	5

The average number of daily positions for each shift (far right column of Table 10) is calculated as

$$\frac{\text{Total dispatcher days}}{\text{Total service days}}$$

The average number of daily positions will be utilized in the relief factor formulas in the next subsection.

3.2 Relief Factor Formulas

Once the workload is determined, and based on that, the average number of daily dispatcher positions is confirmed, the center can establish the total number of dispatchers it will need to staff all shift positions. There are two methods for calculating the optimal staffing level: shift relief factor (SRF) and optimal staffing formula (OSF). Both are referred to as the relief factor formulas and both are based on the average time that a dispatcher at the center is *not* at work.

The shift relief factor is suitable for operations where the staffing by shift is consistent for every day of week. For example, a center that has eight dispatchers working first and second shift and seven on third shift every day, Monday thru Sunday, can use the shift relief factor. This is usually the case for freight railroads.

The optimal staffing formula is a variant of the shift relief factor. It is applied when staffing is *not* consistent within each shift. For example, if the number of dispatchers on duty on Saturday and Sunday differs from weekdays, then the optimal staffing formula must be used.

Large dispatching operations, such as those at the BNSF and the UP, consist of groups of desks organized into divisions or corridors. Dispatchers tend to work only within one division. To a certain extent each division functions as a mini-center within the overall systemwide dispatching center. Given this arrangement, the SRF and OSF can be applied separately to each division. Then staffing estimates for each division can be combined to determine overall staffing requirements.

3.2.1 Shift Relief Factor

Shift relief factors are used to identify the number of employees required to staff a given number of shift positions (a shift position refers to a position or desk staffed on one shift every day of operation). Specifically, a shift relief factor is a single number that suggests the number of employees needed to staff one desk on one shift over the course of the week. Shift relief factors have values greater than one and can be interpreted as the number of employees or dispatchers per desk per shift. Shift relief factors are directly related to the number of days that the position or desk operates; the more days that the desk operates, the higher its relief factor. Table 11 presents typical values for shift relief factors as a function of number of days per week that the position is staffed.

Table 11. Typical shift relief factors as function of number of days of operation

Number of Days of Operation	Typical Shift Relief Factors
5	1.1 – 1.4
6	1.3 – 1.6
7	1.5 – 1.8

The shift relief factor is calculated as

$$\frac{\text{Number of days that the center operates}}{\text{Average annual employee on duty days}}$$

Since railroading is a 24 hr per day operation year round, for most dispatching operations, the number of days that the center operates will be 365. Average employee on duty days is calculated as 365 less the days that the employee is not at work.

Dispatcher days not at work fall into one of two categories: 1) regular days off or 2) benefit and other days off. Labor agreements typically provide for two regular days off per week or 104 regular days off per annum. Benefit and other days off include the following:

- Holidays
- Vacation
- Sick leave
- Compensatory time off
- Funeral leave
- Personal leave
- Family emergency
- Military leave
- Education leave
- Road trips
- Training
- Special assignments

Calculation of the shift relief factor is as follows:

365/(365 – 104 – benefit and other days off)

If experience at a dispatching center for one year indicates the following average absences for the dispatching staff:

Vacation days	21.0
Sick days	6.0
Training days	3.0
Other absences	2.6
Total annual days not at work	32.6

then the shift relief factor for this center will be

365/(365 – 104 – 32.6) = 365/228.4 = 1.6

The optimal staffing is defined as

Shift relief factor X average number of daily positions

Assuming the average number of daily positions for this center is 11. Then the center requires

1.6 X 11 = 17.6

or 18 dispatchers. The SRF can be computed for either an entire center or a single shift.

3.2.2 Application of the SRF

This subsection presents an example of the application of the SRF to a dispatching center that has eight desks. Eight desks operate first and second shifts. On third shift two desks are combined so that only seven dispatchers are required to staff the center. The remainder of this subsection applies the process described above, step-by-step, to this hypothetical operation.

Tables 11 thru 15 apply the process and steps reviewed above to determine optimal staffing levels based on application of the SRF. These tables illustrate the progression of calculations and steps in gathering and using historical dispatcher center data to determine optimal dispatcher staffing levels.

Table 12 illustrates the various components of benefit and other time off. This data must be computed from historical records for dispatchers who work regular desk jobs on each shift. (Appendix A presents an approach for recording and assembling this data from historical records.) The total average benefit and other time off is converted to number of 8-hr working days in the right-hand column of Table 12. This calculation does not include regular days off provided by the schedule, but does include hr for holidays and hr of training per person. In this example, including vacation, the average 1st shift dispatcher was absent for 33 8-hr days, the average 2nd shift dispatcher was absent for 32 8-hr days, and the average 3rd shift dispatcher was absent for 36 8-hr days. (See right-hand column of Table 12.)

Note that the relief crew is not calculated in the SRF because in determining the optimal level of dispatchers per shift, the SRF automatically calculates the required relief. Since every absence needs to be covered to protect uninterrupted traffic movement, more absences means a greater need for built-in relief.

Table 12. Average benefit and other time off

Shift	Number of Desks	Avg. Vacation Time (h)	Avg. Sick Time (h)	Avg. Other Absences (h)	Avg. Training (h)	Total Avg. Time Off (h)	Avg. Benefit Time Off (d)
1st	8	168.2	48.3	20.6	24	261.1	32.6
2nd	8	168.0	44.2	21.3	24	257.5	32.2
3rd	7	153.9	38.6	31.4	24	247.9	35.4

Table 13 uses the benefit time off data in Table 12 to calculate the total number of 8-hr days that a dispatcher is not at his/her desk. These “not at work days” (NAWD) consist of the non-schedule-related absences (such as vacation time, sick time, excused absences/other, and special training hr), plus scheduled absences (the number of days per year that the dispatcher is not scheduled to work). On the current 8-hr schedule there are two scheduled days off per week or a total of 104 days annually.

Table 13. Annual not at work days (NAWD) per dispatcher by shift

Shift	Benefit Time Off	Scheduled Days Off	Total NAWD Per Person
1st	33	104	137
2nd	32	104	136
3rd	36	104	140

Once the total average "not at work days" per shift group are determined, the Shift Relief Factor can be calculated. Table 14 illustrates how the NAWD from Table 13 is used to calculate the shift relief factor (SRF) for each of the three shifts. The SRF is calculated as

$$\text{SRF} = \frac{\text{Number of days that the center operates}}{\text{Average annual employee on duty days}}$$

Thus, for 1st Shift dispatchers with a NAWD of 137 days, the SRF equals (365) / (365 - 137), or (365 / 228), which equals of 1.60.

The SRF essentially weights the number of desk positions per shift by level of absences that need to be filled. The SRF indicates nothing by itself; it is only relevant when applied to the staffing calculation, as shown in Table 15.

Table 14. Shift Relief Factor by shift

Shift	Total NAWD Per Person	Shift Relief Factor (SRF)
1st	137	1.60
2nd	136	1.60
3rd	140	1.62

Table 15. Calculation of Optimal Staffing Levels by shift

Shift	Number of Desks	SRF	Optimal Staffing
1st	8	1.60	13
2nd	8	1.60	13
3rd	7	1.62	12
Total			38

Table 15 uses the SRF in Table 14 to calculate the optimal staff levels. The optimal staffing is computed as follows:

SRF X minimum number of positions X number of shifts per day.

The result is the total number of dispatchers needed to optimally staff a three-shift dispatching operation. For example, the 1st Shift staffing level is (1.60) X (8 dispatchers minimum per crew)

X (1-1st shift per day) = 12.8 total 1st Shift dispatchers needed. Since the number is greater than 12.33 (1/3 of a person), it is rounded up to 13. The rounding up number factors in the NAWD for the additional personnel. The optimal 1st Shift dispatchers are rounded up to 13. The optimal number of 2nd Shift dispatchers is rounded down to 13 and the optimal number of 3rd Shift dispatchers is rounded up to 12. The optimal staffing level for this center is a total of 38 dispatchers.

Table 16. Optimal Staffing Levels by shift

Shift	Number of Desks	SRF	Optimal Staff	Extra Board and Relief Required
1st	8	1.60	13	5
2nd	8	1.60	13	5
3rd	7	1.62	12	5
Total	23		38	15

Table 16 uses the optimal staff levels for each shift from Table 15 to determine the number of extra board staff needed to cover for relief. To cover 23 daily shift positions, this center needs a total of 38 dispatchers. The difference between the total staff and the number of daily shift positions is the number of relief and extra board dispatchers required. Based on the SRF analysis, this center requires 23 regular jobs and 15 relief and extra board jobs.

The SRF is equally applicable for shifts of any length. Appendix B provides an example of the SRF calculation for non-standard shift lengths.

3.2.3 Optimal Staffing Formula

The optimal staffing formula (OSF) is a variant of the SRF that is applied when the number of active desks on a shift is not the same every day. Dispatching operations at commuter railroads typically have this situation. The OSF method is frequently used in industries with seasonal fluctuations where it is desirable to determine staffing levels by season.

Like the SRF, the OSF uses historic data regarding dispatcher absences. In contrast to the SRF, the OSF is computed using labor-hr rather than days and it calculates the staffing level directly. The formula is expressed as follows:

$$\text{OSF} = \frac{\text{Total scheduled labor-hr of work}}{\text{Average work hr per dispatcher}}$$

Total scheduled labor-hr of work refers to the total number of hr that the desks in the center are staffed. Average per annum dispatcher work-hr is calculated by deducting the “not at work” hr from the total scheduled labor-hr of work per dispatcher. Once both the total scheduled labor-hr of work and the average work hr per dispatcher are determined, the staffing level can be computed.

3.2.4 Application of the OSF

This subsection presents an example of the application of the OSF to a dispatching center that has four desks. Four desks operate on first shift, three on second and one at night. In addition the number of days that each shift is in operation varies by shift. (See Table 17.)

Table 17. Dispatching center with differences in staffing needs by shift

Shift	Number of Desks	Weekly Days Operating	Annual Days Operating	Annual Scheduled Labor-Hr
1st	4	7	365	11,680
2nd	3	6	313	7,512
3rd	1	5	261	2,088
Total				21,280

The annual scheduled labor-hr by shift in the right-hand column of Table 17 is computed as

8 hr X annual days of operation X number of desks

Assume the benefit and other time off is the following:

Vacation hr	168.2
Sick hr	48.3
Training hr	24.0
Other absences hr	20.6
Total hr off	261.1

Then

Average scheduled work hr for one person = 52 x 40 = 2080 hr

Average work hr for one person = (2080 – 261.1) = 1819 hr

and

$$\text{OSF} = \frac{\text{Total scheduled labor-hr of work}}{\text{Average work hr per dispatcher}}$$

or

$$\text{OSF} = \frac{21280}{1819} = 11.69$$

The optimal staffing level for this center, which has 4 desks with varying patterns of operation over three shifts, is a total of 12 dispatchers.

3.2.5 Determining the Effect of Additional "not at work" Days on Staffing Level

Both the Shift Relief Factor and the Optimal Staffing Formula can be used to determine the point at which additional "not at work" hr will necessitate additional dispatchers. Assume benefit and other days off total 32.6 days and the center has 11 daily shift positions to staff and a current staffing level of 18. (See example in subsection 3.2.1.) Assume management wants to know how many additional days off will require increasing the center's staff to 19.

Let x = the number of additional "not at work" days that will result in the need for another dispatcher. Since

$$\text{Staffing level} = \text{SRF X Daily Shift positions, and}$$

$$\text{SRF} = 365/(365 - 104 - \text{benefit and other days off}),$$

the data for this center can be substituted in the staffing level formula as

$$19 = [365/(365 - 104 - 32.6 - n)] \text{ X } 11$$

Solving this equation for n the result is 17. In other words, another dispatcher would be needed to staff this center if average "not at work" days increased by 17 days to a total of 153.6 days.

Individual dispatching centers can perform a similar analysis with their specific data to determine how sensitive their staffing level would be to increases in "not at work" days. This type of analysis might be helpful if increases in training or road days are under consideration.

The total staffing requirement is a function of both the "not at work days" and average number of daily shift positions that must be staffed. Figure 2 illustrates this relationship for average daily shift position levels of 8, 11 and 15. The relatively flat slope of the lines on this chart illustrates that significant increases in NAWD must occur before hiring an additional dispatcher can be justified. Similar curves can be developed for any number of shift positions. The minimum value of average NAWD on the chart is 114 because all dispatchers have 104 scheduled weekend days off and 10 days of vacation. The minimum total staff requirement for each of the daily shift position levels will be greater than the number of daily positions to account for these NAWDs.

3.2.6 Limits of the Relief Factor Formulas

By anticipating and projecting staffing absences based on historical absenteeism data, it is more likely a dispatching center will be able calculate average employee numbers needed to staff a given number of positions, knowing that vacancies will occur. The SRF can be used to determine the number of dispatchers that should be scheduled in order to insure a specified average number report to work to protect operational needs based on projected vacancies.

For example, in a center with four desks, five dispatchers may be scheduled to report for work. Due to absences such as vacation, sickness and road trips, only four may report. Since each dispatcher works 5 days a week, seven dispatchers will provide a total of 35 staff-days per week. If distributed uniformly over all seven days of the week, these staff-days will provide five on-duty dispatchers each day of the week – one more dispatcher per day than is required. The additional dispatcher scheduled on each day of the week will not, on average, result in overstaffing. S/he will, on average, be working a desk.

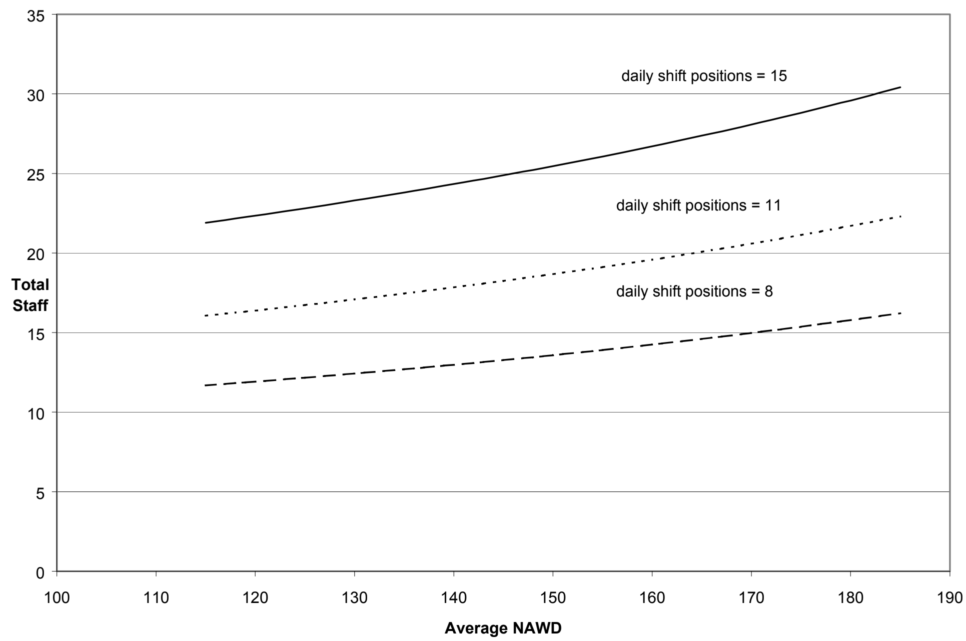

Figure 2. Total staff as function of not at work days and average daily shift positions

To understand why this is the case, a distinction must be made between the number of dispatchers that are scheduled to be on duty and the number that actually report for work. The relief factor formulas is the link between these two numbers. In the example above, five dispatchers will be scheduled to report each day. On the average, however, only four will actually report for work due to absences because of vacations, holidays, illness and other reasons. As a result, even though the number of dispatchers who report for work each day will average four, the number who actually appear, on a day-to-day basis, will often be greater or less than this long-term average.

Restating this observation, Relief Factor Formulas are used to determine how many dispatchers should be scheduled in order to insure that a specified average number of dispatchers would actually report for work.

Two basic principles guide the use of the RFF as follows:

1. Because the RFF are calculated using average employee work data, staffing projections using relief factor calculations are only valid as averages used over an extended period of time.
2. Calculations based on Relief Factor Formulas assume that absences are equally likely to occur on any day of the week or season of the year.

In summary, using the RFF, staffing levels reflect *average* employee absences over an extended period of time. The RFF is not intended to project dispatcher fluctuations on a day-to-day basis.

3.2.7 Protecting Minimum On-Duty Dispatcher Levels

Generally, the RFF offers a simple and accurate means to determine dispatcher staffing levels that provide an average number of on-duty dispatchers. However, dispatching centers, like emergency services, need to have sufficient on-duty dispatchers to meet workload demands. Stopping trains due to a lack of dispatchers is not an option. There are a number of options to ensure day to day dispatcher absences not projected by the RFF do not impair train movement. This may involve the use of emergency overtime, consistent with the terms of the Emergency Provisions of the Hours of Service Act.

To prevent dropping below a minimum number of on-duty dispatchers when an excessive number of regularly scheduled dispatchers are absent, minimum staffing levels may be maintained using the procedures that railroad schedulers already employ. Extra board dispatchers or dispatchers on their regularly assigned day off may be requested to work. On a short-term basis the center may incur extra staffing costs to protect required minimum staffing levels. These costs occur regardless of the surplus staff that may appear for work on other days, or whether the average number of dispatchers equals the minimum staffing level.

For example, where the minimum on-duty staffing level is four dispatchers for a shift, seven days a week, the actual number of dispatchers reporting to work on each day during one week is as shown in Table 18. On Wednesday and Friday, one less than the minimum staffing level of four reports for work. On both days one dispatcher must fill the vacancy to protect minimum staffing needs.

Table 18. Example of deficit staffing

	M	T	W	T	F	S	S	Staff Days
Min. Staffing	4	4	4	4	4	4	4	28
Actual on Duty	5	5	3	4	3	4	4	28
Deficit Tours			1		1			2

4 Characteristics of Current Dispatcher Schedules

This section begins with a description of a typical dispatching center schedule. Then these schedules are described in terms of characteristics that affect both human physiological limits and sociological considerations. These characteristics are the following:

- Fixed or rotating shifts
- Number of consecutive work hr and days
- Fixed or staggered days off
- Equitable distribution of off-duty days
- Shift start and stop times
- Quality and quantity of weekend time off
- Off-duty time between consecutive workdays
- Variable on-duty staffing by day of week
- Length of shift
- Relief crew and placement of extra board dispatchers

4.1 Schedule Classification

All of the railroads reviewed in Section 1 follow the same schedule format: a 3-shift system with a relief crew filling in on the scheduled days off for the permanently assigned dispatchers and an extra board to cover unplanned vacancies. These schedules are categorized as *non self-relieving 3-crew systems with a relief crew*. Non self-relieving refers to the fact that there are not dedicated extra board dispatchers who fill in on only one shift.

Appendix C contains schedules for each of the six centers. Since the schedules for the regular and relief dispatchers are on a one-week cycle, meaning that they work the same days and shift each week, only one week is shown for these jobs. However, the extra board dispatchers do not have a regular schedule so one month of actual work history is shown for these positions.

A typical schedule for one division within a large dispatching center is shown in Figure 3. In this example there are 23 regular jobs, 9 relief jobs and 10 extra board jobs for a total staffing level of 42 dispatchers. Nearly half of the dispatchers, the relief and extra board people, by the nature of this type of schedule, must work rapidly rotating shifts. Rapidly rotating shifts are known to be fatiguing due to human maladaptation to changes in sleep schedule. Because the Hours of Service regulations require at least 15 hr off before returning to work, the rotations cannot be backward rotating, which is known to be even more fatiguing.

Appendix C also contains raster plots for all of the regular and relief jobs and one extra board job at each of the six centers. Raster plots offer a means to graphically display the work pattern of each job over an entire work cycle, which is one week for regular and relief jobs. This graphical method is used to review job schedules and facilitates identification of undesirable

	SHIFT/ID		Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Regular Scheduled Jobs (1 Week Cycle)	D	1	D	D	D	D	D	-	-
	D	2	D	D	D	D	D	-	-
	D	3	D	D	D	D	D	-	-
	D	4	D	D	D	D	-	-	D
	D	5	D	D	D	D	-	-	D
	D	6	-	D	D	D	D	D	-
	D	7	-	D	D	D	D	D	-
	D	8	D	-	-	D	D	D	D
	E	9	E	E	E	E	E	-	-
	E	10	E	E	E	E	E	-	-
	E	11	E	-	-	E	E	E	E
	E	12	-	E	E	E	E	E	-
	E	13	-	E	E	E	E	E	-
	E	14	-	-	E	E	E	E	E
	E	15	-	-	E	E	E	E	E
	E	16	E	E	E	-	-	E	E
	N	17	N	N	N	N	N	-	-
	N	18	N	N	N	N	-	-	N
	N	19	N	-	-	N	N	N	N
	N	20	N	N	-	-	N	N	N
	N	21	N	N	-	-	N	N	N
	N	22	-	-	N	N	N	N	N
	N	23	N	N	N	-	-	N	N
Relief Jobs (1 Wk)	R	24	D-7	D-1	-	-	D-6	D-6	D-7
	R	25	-	-	D-3	E-7	E-7	E-6	E-6
	R	26	E-4	N-4	-	-	D-4	D-4	E-4
	R	27	E-1	E-1	N-1	-	-	D-1	D-1
	R	28	D-5	E-5	E-5	N-5	-	-	D-5
	R	29	N-4	N	N-5	N-6	N	-	-
	R	30	-	-	N-1	N-6	N-3	N-3	N
	R	31	E-8	E-8	N-7	-	-	D-8	D-8
	R	32	E-2	N-7	-	-	-	E-3	E-3
Extra Board Jobs (4 week cycle)	X	1	N	N	-	N	N	-	-
			N	-	-	N	N	N	-
			-	-	-	-	-	-	-
			D	-	-	N	N	N	N
	X	2	-	E	-	-	-	-	-
			-	-	-	-	-	-	E
			-	-	-	-	-	-	-
			-	-	-	-	-	D	-
	X	3	-	E	N	-	-	D	D
			E	E	N	-	-	D	D
			E	-	-	-	-	-	-
			N	-	-	-	N	N	-
	X	4	D	-	-	N	-	-	N
			-	-	-	D	-	-	N
			D	-	-	N	N	N	N
			-	-	-	-	-	D	D
	X	5	-	-	-	-	D	-	-
			-	D	-	-	-	D	D
			-	-	D	-	D	-	-
			-	-	-	-	-	-	-
	X	6	-	-	-	-	D	N	-
			-	-	-	-	-	-	-
			E	-	-	E	E	-	-
			-	-	-	-	-	-	E
	X	7	N	-	-	-	-	E	E
			-	-	-	D	D	-	-
			-	-	-	-	-	-	-
			-	-	-	-	-	-	N
	X	8	-	-	-	-	-	-	-
			-	-	-	-	-	-	-
			-	-	-	-	-	-	-
			-	N	-	-	-	-	-
	X	9	-	-	-	-	-	-	-
			-	-	-	-	-	-	-
			-	-	-	-	-	E	E
			-	-	-	-	-	-	-
	X	10	N	-	-	D	D	D	-
			-	-	-	-	-	-	-
			-	N	-	-	-	-	-
			-	-	-	-	-	-	-

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Figure 3. Typical Dispatching Center Schedule

characteristics of a work schedule. In this representation of a work schedule, the vertical axis corresponds to the days of the week and the horizontal axis indicates the hour of the day. The black horizontal bars represent the work periods that make up the work schedule. Consecutive days are represented on the horizontal axis so that overnight work periods are apparent.

Figure 4 displays the raster plot for extra board dispatcher X-3 in Figure 3. The raster plot illustrates the irregular pattern of this dispatcher's work schedule. This individual worked a desk 13 times over the four-week period. Job X-3 worked a total of 4 days, 4 evenings and 5 nights. During the first two weeks the individual rotated rapidly through each of the three shift periods. Since this is a guaranteed extra board position this individual worked the additional 7 days during this period to become qualified on additional desks. These "posting" or training days are not included on the raster plot.

Examination of the raster plots for extra board positions at all six railroads (see Appendix C) reveals similar patterns.

4.2 Schedule Characteristics

Research has shown that there are a number of characteristics of a work schedule that determine whether or not the schedule can be potentially fatiguing. (Wedderburn, 1991; Rosa, 2001) This section discusses current dispatcher schedules in terms of these characteristics. These characteristics are summarized in Table 19. Each is discussed below along with alternatives to current practice. These alternatives are designed to alleviate the potentially fatiguing and socially disruptive aspects of the current schedule design.

Fixed or Rotating Schedules

Fixed schedules assign a dispatcher to a specific shift and s/he remains on that shift for each duty cycle. (The duty cycle for dispatchers is 1 week.) Rotating schedules require dispatchers to work more than one shift in a given duty cycle. The dispatching centers described in Section 1 utilize a combination of both fixed and rotational schedule formats. The majority of the dispatchers are assigned to one of three shifts; day, evening, or night shift. The relief dispatchers are usually assigned to rotate through at least two of the three shifts. The larger Class I centers are frequently able to arrange their relief jobs so that a given job involves work on only one shift but covers desks in two divisions. The extra board dispatchers are not assigned to any particular shift, but fill in for absences based on qualifications for specific desks within Hours of Service limitations.

There are benefits to both fixed and rotating schedules. Fixed shift schedules are preferred because they allow dispatchers to stabilize their lifestyle around a particular shift. Novice dispatchers look forward to the opportunity to bid into a preferred shift. Many fixed shift schedules based on 8-hr shifts have two major drawbacks. First, they require some dispatchers to rotate through all three shifts within one week, and, in addition, weekend time off is limited to a select few of the most senior dispatchers. Rotating schedules are preferable when a balance of skills is required throughout each shift and when the labor force prefers to share in an equitable distribution of days off, including weekends off.

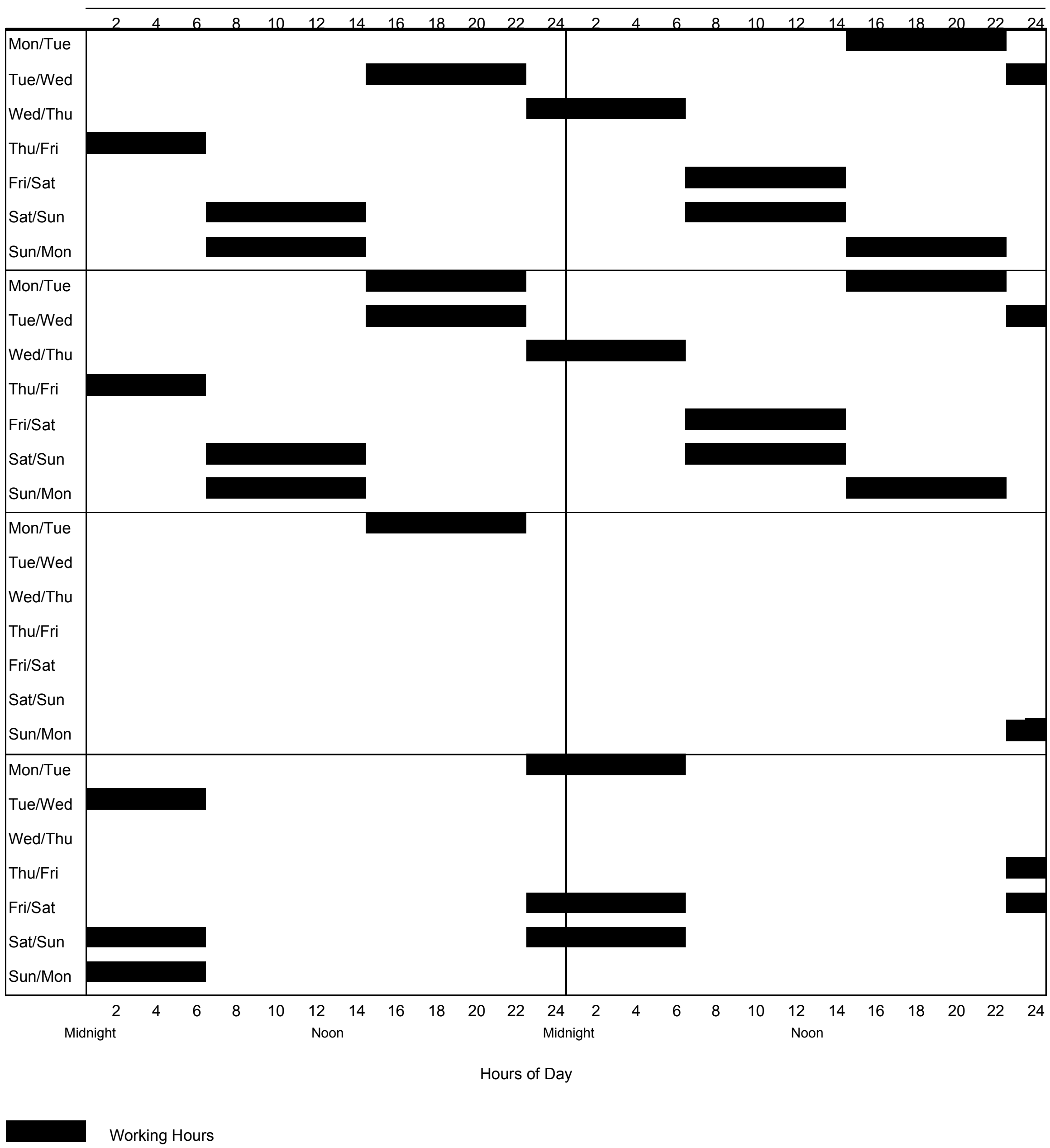

Figure 4. Sample raster plot for extra board position

Table 19. Characteristics of current schedules at dispatching centers

Characteristic	Dispatcher Schedule
Fixed vs. Rotating	3 crews on fixed shifts. Relief crew rotates through shifts.
Consecutive Work Hours and Days	8–hr shift length per day with 2 consecutive days off in a row for regular and relief jobs. Extra board not usually guaranteed two consecutive days off.
Fixed vs. Staggered Days off	Days off are fixed for regular and relief jobs and staggered for extra board jobs.
Equitable Distribution of Days Off	Days off are determined by seniority.
Shift Start and Stop Times	Shift starting and stopping times are fixed based on an 8-hr shift.
Quality and Quantity of Weekend Time Off	Weekend time off is limited to seniority and availability.
Off-duty Time Between Consecutive Workdays	All dispatchers must have at least 15 hr off-duty between shifts. Days off for extra board not necessarily consecutive.
Variable On-duty Staffing By Day of Week	Staffing by day of week is dependent on each center's needs. Commuter railroads have lighter staffing at nights and on weekends.
Length of Shift	All centers limited to 9 hr on duty per 24-hr period.
Relief and Extra Board Placement	Relief dispatchers are fourth crew rotating through the shifts. Extra board fills in randomly.

Number of Consecutive Work Hours and Days

The current Hours of Service regulation limits the dispatcher to working no more than 9 hr in any 24-hr period. This rule requires the use of 8-hr shifts. (Eight hr are a multiple within the 24-hr day.) The dispatch centers examined utilize a five-day consecutive shift duty period with two consecutive days off. Although this appears similar to a normal daytime workweek of Monday through Friday, this is not the case for dispatchers. Each job consists of a fixed consecutive five days on in accordance with the center's need by desk, time of day, and day of week. Within a seven-day period, the five days on and two days off need not follow what is considered a standard Monday to Friday daytime workweek. An example could be working

Thursday through Monday on night shift, having Tuesday and Wednesday off. Though there is nothing that can be done for consecutive work hr, given the Hours of Service rule, there are other formats for consecutive workdays, while maintaining fixed shifts. A common option would be to increase the consecutive days worked to six or seven to allow all dispatchers to receive an equitable distribution of days off. The shifts are fixed, but the days off rotate through a set pattern. (Section 5.4 discusses alternatives to regularly assigned days.)

Fixed or Staggered Days Off

Fixed days off can be in two formats, one format is a multiple of seven days. Other fixed days off formats use a multiple of seven, i.e. 14 or 28 days. Current dispatcher schedules employ the first format. All dispatchers have a fixed 2 days off consecutively. The other fixed days off formats, being a multiple of 14 or 28, are schedules where all or a set of dispatchers in a shift rotate their days off equally in a fixed pattern. Employees rotate through the schedule in groups and all those rotating in the fixed pattern receive the same days off as each other.

Staggered days off are schedule formats where the on/off-duty cycle is not a multiple of seven days. A common fixed schedule with staggered days off has six consecutive days on with two consecutive days off. All dispatchers share the same days off in a staggered pattern based on the eight-day cycle.

Equitable Distribution of Off-Duty Days

Equitable distribution of off-duty days means that all dispatchers rotate their on duty/off-duty days. As mentioned above, this is not the case with the dispatch centers reviewed. These centers function on a seniority system, common throughout the railroad industry, that allows the most senior dispatchers to choose which shift and days they will work. This process is repeated down to the dispatcher with the least seniority. The primary concern of this characteristic of scheduling is that it causes sociological disruption for the majority of dispatchers. This disruption can result from never having any regularly scheduled weekend time off, or working fixed night shifts with no weekend time off. Compounding the issue is that there are relief dispatchers who rotate through all the shifts while never receiving weekend time off.

The same principle applies here as with the concept of fixed or staggered days off. If there is the desire for all to receive some equitable days off, then the schedule needs to have some staggered pattern to allow all or some of the dispatchers to stay on fixed shifts, but rotate the days on and days off pattern.

Shift Start and Stop Times

Shift start and stop times, in general occur at 7 a.m., 3 p.m. and 11 p.m. Centers may have shift change times up to 1 hr earlier or may stagger them. A primary concern with respect to shift change times is that they not require employees to commute during times of reduced alertness.

Humans have two peaks in alertness and two troughs. Alertness is at its lowest between 3 a.m. and 5 a.m. Based on individual circadian profiles, the actual nadir period can occur between midnight and 6 a.m. This is the time that most individuals who work around the clock identify as the most difficult to maintain their vigor and alertness on the job. During this period, many talk about "hitting the wall" when they feel waves of tiredness wash over their consciousness.

As hard as it is to maintain alertness while at work during the nadir period when stimulated by and responding to the rigors of a job, it is even more difficult to maintain vigor when driving. To help ensure the safety of dispatchers during their commutes to and from work it is recommended that shift start and stop times not occur during this most difficult time of day. This does not appear to be an issue for dispatchers.

Quality and Quantity of Weekend Time Off

A key social characteristic in schedule design for most dispatchers is having as many weekend days off as possible. However, in a continuous 24/7 operation, someone must work the weekends. In practical application, rotating 8-hr schedules allow between one quarter and one half of the staff to have both weekend days off. Fixed shift and day off schedules provide some 40 to 50 percent of the staff with at least one weekend day off. This appears to be the case for railroad dispatchers. For example, at one of the Class I dispatch centers reviewed, the dispatcher schedules provided for at least one weekend day off for 47 percent of the dispatchers while the remaining 53 percent do not receive any weekend time off. Of the 47 percent who receive weekend time off only, less than half receive a full weekend off each week. For this Class I railroad, only 21 percent of the regularly scheduled jobs provide for two weekend days off each week.

Off-duty Time Between Consecutive Workdays

Ergonomic work schedules provide two consecutive days off to allow the worker adequate time for relaxation and restorative sleep. With the fixed 3-shift schedule, the off-duty time between consecutive workdays is 16 hr. The off-duty time between consecutive workweeks is two full days, but a total of 64 hr between on-duty cycles. This is the case unless a dispatcher is called in to work on his/her day off. For the relief crew, the time off between consecutive same shifts is 16 hr, but the time between forward rotating shifts (e.g., day to evening shift) can be 24 hr or more. Off-duty time for relief dispatchers between consecutive workweeks can vary based on what shift ends the workweek and what shift begins the next workweek. The shortest period is when a relief dispatcher ends the workweek on a night shift and starts back to work the following week on the day shift. This leaves the dispatcher with a disruptive schedule only 48 hr off. Since extra board dispatchers at most centers are not guaranteed two consecutive days off, their off-duty time between consecutive days must be at least 15 hr and will vary from week to week. This group of dispatchers is not assured of the opportunity for two consecutive days off and thus may never be adequately rested.

Variable On-Duty Staffing by Day of Week

A strategic characteristic of any schedule design is the staffing by time of day and day of week. If the staffing is equal through each shift, then the scheduling format can be kept simple and equitable. When staffing varies by time of day, day of week, or through seasonal fluctuation, the scheduling format can become more complex with the use of proportional staffing.

All of the freight dispatching centers reviewed (both Class I and shortline) have relatively even staffing by time of day and day of week. In contrast, the commuter railroads have a variation in staffing at nights and during the weekend period. On the weekends, they have fewer staff assigned by day and shift.

Length of Shift

The Hours of Service regulation limits the length of a dispatcher's shift to a maximum of 9 hr and requires an off-duty period of at least 15 hr between work periods. As consecutive hr within a given shift and/or the number of consecutive workdays in a work block increase so does cumulative fatigue. Thus when the schedule design limits the number of "scheduled" consecutive workdays based on the shift length, the schedule method turns to a more fixed days on and off pattern.

Shiftwork and fatigue research has shown that the number of consecutive workdays should be limited to a maximum of seven 8-hr shifts within a block of consecutive workdays (Wedderburn, 1991). The Hours of Service regulations do not address this aspect of the dispatcher's work schedule. What needs to be noted with the Hours of Service rule of 9 hr is that it significantly reduces the options available to schedule dispatchers in comparison to other critical workplace operations.

Relief Crew and Placement of Extra Board Dispatchers

All of the dispatching operations described in Section 2 use a relief crew that works on five consecutive days followed by two rest days. While the relief dispatchers work a regular schedule, their schedule frequently requires rapid forward rotation, an arrangement that is potentially fatiguing. The extra board dispatchers are guaranteed five days but not on any set schedule. The extra board is solely used to cover for any absences of the regularly assigned dispatchers, including the relief jobs. As a result extra board dispatchers work varying shifts, within the Hours of Service limitations, usually do not have two consecutive days off and in general have an unpredictable schedule unless they are filling in for someone on scheduled vacation leave or other scheduled absence.

5 Schedule Design Strategies

Railroads are not unique in their requirement to operate 24 hr a day, 365 days a year. Public service organizations such as fire and police must be available around the clock. Manufacturing and process industries with significant investments in facilities operate on a 24-hr schedule as well. While these businesses differ from railroading, their workers' concerns with regard to hr of work and schedule do not. The innovations in schedule design that have developed in other environments suggest some options for consideration in railroad dispatching centers (Stenzel & Buren, 1983). This section presents a framework for schedule design and suggests some alternative strategies to current dispatcher schedule systems.

5.1 Schedule Design Options

There are fundamental variations and structures in work schedule designs. Each produces a schedule to meet a specific set of constraints and objectives. In some cases, none of these methods will produce acceptable schedules. When this occurs, minor modification of the constraints or objectives frequently makes use of one of the methods feasible, but sometimes other types of schedules must be considered. On the other hand, in some cases more than one method may produce acceptable schedules. When this happens, the design method may be selected arbitrarily, or useful but secondary constraints and objectives may be added until only one method remains. Before proceeding to identify options for the scheduling of railroad dispatchers, it is useful to understand commonly used schedule designs for shiftwork operations.

There are four major schedule designs. They are the following:

1. *Fixed Bracket* – A schedule in which each dispatcher or group of dispatchers works the same 7 day bracket (or pattern) each week, whether fixed or rotating shifts. With this arrangement each employee has regular assigned days off.
2. *Basic Duty Cycle* – A schedule that has a repeating pattern of shift assignment and days off in a work schedule. Basic Duty Cycles are all multiples of seven days (schedules with 7, 14, 28 day patterns).
3. *Extended Duty Cycles* – Schedules with greater than 28 day patterns that are not a multiple of 7 days.
4. *Proportional Rotating Schedule* – A cyclic schedule that provides rotating days off and staffing levels proportional to service demands by day of the week. Dispatchers start and finish at the same times each day. Multiple Shifts, a variant of the proportional rotating schedule, has workers report to work at different times of the day. For example, police rosters add a "bar shift" on Thursday through Sunday from 4 p.m. to 2 a.m.

These four types are not mutually exclusive and any given scheduling system may include elements of more than one method (Stenzel, 1985). In fact, the dispatching center schedules described in Section 2 are a combination of fixed bracket and basic duty cycle schedules. Appendix D provides more detail on each of these four methods.

5.2 Assessment of the Current Dispatcher Schedule Format

All of the centers described in Section 2 follow the same format, a "Fixed Bracket System" with "Basic Duty Cycles." The Fixed Bracket property of these schedules allows for most dispatchers to be permanently assigned to the same shift of eight hr and have the same days on and off-duty on the same days each week. The Basic Duty Cycle refers to the characteristic that all dispatchers follow the same pattern of shift assignments and off-duty days.

Each of the centers utilizes a four crew, three shift system of eight hr each, in which they permanently assign three crews of dispatchers to a day, evening, or night shift. The three fixed crews work in a fixed bracket format of permanent days on and days off and a basic duty cycle of seven days with five days on and two days off. This minimum staffing by shift and number of desks per any given day is characterized for fixed shifts to be non self-relieving. Relief dispatchers are utilized in a fourth crew and extra board. The center utilizes a relief crew that functions as a "swing shift" in which the relief crew dispatchers rotate, on a permanent basis, the days off of the dispatchers on the three fixed crews. The relief crew dispatchers are also fixed bracket and have a basic duty cycle of seven days, with five days on and two days off. The relief crew is typically assigned to rotate through two or more shifts in a given week.

The remaining dispatchers or extra board are utilized to fill in any gaps of days off of the four crews and cover for all of "Not at Work Days" such as vacations, sick days and training days. These extra board dispatchers have no fixed bracket schedule format. The basic duty cycle does follow a seven-day cycle of 8-hr shifts, five days per week with two days off. The days on and days off are randomly assigned, based on desk qualifications, to cover any of the day, evening, or night shifts in a given week.

5.3 Advantages and Disadvantages of the Current System

As with all schedule design formats, there are positive and negative aspects to all systems given the characteristics described in subsection 5.1. The major advantage to the present arrangement, which explains its commonality across many industries, is that it has been in place since the Fair Labor Standards Act initiated the 40-hr workweek over 60 years ago. Since the inception of the 40-hr workweek, all dispatch centers have gravitated to maintaining fixed shifts to address the seniority system incorporated in labor agreements. Other advantages of the system are the following:

- Fixed shifts allow for the three fixed crews to maintain a stable lifestyle, both by shift and by days on and off.
- The fixed bracket of days on and days off for the three crews allows for seniority to dictate the best duty cycle pattern.
- The 8-hr shift allows for a significant amount of recovery time before coming back to work on the following day.
- Five days on with two days off is fundamentally what is accepted as the normal workweek.
- Fixed shift schedules allow for the ease of variable staffing by day of week and by time of day.
- Fixed shift schedules allow for dispatchers to develop a rapport with regular co-workers and their chief.
- Non self-relieving shifts allow for accessibility of a larger pool of dispatchers to fill in for unexpected absences.

- Fixed shifts have been the accepted norm for many decades so that the system is familiar to both dispatchers and their management.
- Both fixed shifts and relief/extra board shift rotation allow for a wide variety of lifestyle options to bid into based on seniority.

The major disadvantage is that this system offers only the most senior of the dispatchers with the most favorable duty cycles. The majority of the remaining dispatchers have limited choices with regard to shift and days off patterns. Other disadvantages are the following:

- Fixed shifts for the three fixed crews force the relief crew and extra board to rotate through the shifts.
- The fixed bracket of days on and days off for the three crews forces the least senior of the dispatchers, which may total as many as half of the dispatchers at a center, to not have weekend time off.
- The 8-hr shift forces the need for more dispatchers on the weekends, reducing the number of dispatchers who can be off on the weekends.
- The non self-relieving 4-crew fixed format forces the need for a "swing" or relief crew, and an extra board without any permanent assignments.
- Fixed shift schedules force a fixed night crew into sleep cycles that run counter to human physiology.
- Fixed shift schedules force the least senior dispatchers to wait many years before the opportunity to bid out of an undesirable shift.
- Non self-relieving shifts force fewer dispatchers to be assigned to fixed shifts of day, evening, or night shift.
- Fixed shifts have been the accepted norm for many decades so that the system breeds a reluctance to change.
- Relief/extra board shift rotation requires multiple supervisors to oversee the performance of these dispatchers.

5.4 Options for Optimizing the Current Dispatcher Scheduling System

The current dispatching schedule format does have many desirable characteristics. However, there are some significant modifications that have the potential to lessen the negative features identified in subsection 4.2. The range of options is limited by the Hours of Service regulations, current labor agreements, a weekly payroll system, assignments based on seniority and the expectation, in some locations, of overtime. This section suggests options. Some are based on the work of Knauth et al (1982) and Schwarzenau et al (1986). The situation in each individual dispatching center will determine whether or not any of these are feasible in that environment.

5.4.1 Option A: Create three crew self-relieving system

Once the proper staffing analysis has been established for each shift, whether day, evening, or night shift, place the optimum number of dispatchers on each shift and make the shifts self-relieving.

For example, assume the day shift has eight desks, operates 7 days per week, and the Shift Relief Factor (SRF) is 1.60. The optimal number of dispatchers for the day shift is 8 X 1.60 = 12.8 or 13 dispatchers. In other words, a total of 13 dispatchers are assigned to work days. The same process is applied to the evening and night shift. Depending upon the current staffing level, this approach need not lead to an increase in total staff.

Making the crews self-relieving by assigning the optimal staff to cover for "Not at Work Days" on any given shift, the solution increases the number of people working fixed work shifts. That is, it can potentially free the relief crew and most of the extra board from working rotating shifts. Maximizing the workforce on fixed shifts will allow the maximum number of dispatchers to stabilize their physical and social lifestyle around a fixed pattern. From a performance measurement and team building perspective, the more dispatchers assigned to a fixed shift, the greater the accountability and cohesiveness within each shift. With this arrangement, the additional dispatchers assigned to the fixed shifts would have to qualify on all desks. Some railroads have already chosen to have their extra board dispatchers qualify on all desks so this arrangement may be feasible in these locations.

5.4.2 Option B: Allow fixed shifts to maximize weekend time off

Option A is a prerequisite to implementation of Option B. Once the 3-crew system is optimized to the appropriate staffing level, keep the senior dispatchers on the fixed days off with weekend time. Keep the remainder of the dispatchers on each of the fixed shifts but rotate the days off schedule to 6 on/2 off, 7 on/2 off, 7 on/4 off. Table 20 illustrates the schedule for the non-senior dispatchers. This arrangement would allow the non-senior dispatchers, including the extra board dispatchers, to receive a long weekend off–Saturday, Sunday, Monday, and Tuesday–every 25 days. Overall this option equally distributes weekend time off. If desirable, this schedule can be implemented seasonally, as with the summer time, and it need not be implemented for all three shifts. This option includes a limited extra board to fill the "relief" positions at the center. This option need not be applied to all shifts.

Table 20. Typical fixed 6 – 2, 7 – 2, 7 – 4 schedule

Week	Mon	Tue	Wed	Thu	Fri	Sat	Sun
1	-	Relief	X	X	X	X	X
2	X	-	-	X	X	X	X
3	X	X	X	-	-	X	X
4	X	X	X	X	X	-	-

5.4.3 Option C: Utilization of relief dispatchers and extra board dispatchers

Option A is a prerequisite to implementation of Option C. If there is a necessity to distinguish between relief and extra board dispatchers, assign the relief dispatchers to cover for unexpected absenteeism within their designated fixed shift and allow the extra board to fill-in for vacations, long-term training or disability.

The relief dispatchers being assigned to their appropriate fixed shift will be more alert to take on unexpected absences when they are on the fixed shift. (The utilization of relief dispatchers on only one shift currently occurs at both the BN and UP.) The extra board, covering all other long term fill-in days off, will have the opportunity to slow down the randomness of the traditional extra board schedule by staying on the same shift longer with less rotation between work assignments.

5.4.4 Option D: Mon – Fri 8-hour shifts, Sat – Sun 12-hour shifts

Convert Saturdays and Sundays to two 12-hr shifts. If an exemption or waiver from the Hours of Service regulations could be obtained, the extension of hr only on the weekends is possible. This option would guarantee three-quarters of the dispatchers some weekend time off. The change on Saturdays and Sundays may be accomplished while maintaining all of the positive aspects of a fixed shift system. Table 20 illustrates this type of schedule. A key feature of this option is that it does not include an extra board. The other options have an extra board that is smaller than under the current system.

This option works as follows:

- The Day shift (25 percent of the total dispatchers) works Monday through Friday and has every full weekend off.
- The Evening shift (25 percent of the total dispatchers) works Tuesday through Saturday and has Sunday and Monday off every week.
- The Night shift (25 percent of the total dispatchers) works Saturday and Sunday for 12 hr on night shift, two 8-hr night shifts Monday and Tuesday, and then has 3 days off, Wednesday through Friday, every week.
- The Relief shift (25 percent of the total dispatchers) works 12 and 8-hr evening shifts on Sunday and Monday, respectively, has Tuesday off, then works three night shifts Wednesday through Friday, is off on Saturday, and returns to work on Sunday at noon. This would be for the swing shift every week.

This schedule allows for a four-crew system where three shifts are fixed. Three out of four crews receive some weekend time off every weekend and the night crew does not have weekends off but has three days off consecutively.

Table 21. Typical fixed 8 and 12-hour schedule

Crew	Mon	Tue	Wed	Thu	Fri	Sat	Sun
Day	D8	D8	D8	D8	D8	-	-
Evening	-	E8	E8	E8	E8	E12	-
Night	N8	N8	-	-	-	N12	N12
Relief	E8	-	N8	N8	N8	-	E12

6 Conclusions and Recommendations

The work schedules for US railroad dispatching operations are non self-relieving three fixed shifts with a relief crew. The current system is easy to manage because of the fixed assignments inherent in it. The system has been in place for over 60 years and both railroad management and labor have become accustomed to both its advantages and disadvantages. One of the disadvantages is that this system requires an extra board to fill in for occasions when the regularly assigned dispatcher is unavailable to work.

The extra board creates problems for both railroad management and the dispatchers who work those jobs. Based on data provided by six dispatching centers, during any given week as many as 25 percent of the assigned shifts may require the use of extra board dispatchers. Schedulers have the responsibility for securing a replacement dispatcher. Many times this must be done on short notice and, due to Hours of Service limitations and qualifications of available dispatchers, several dispatchers must be re-assigned to accommodate the vacancy. The scheduler's job may also require being on call to resolve last minute staffing problems. From the dispatchers' perspective, as many as one quarter of a center's dispatching staff may be subject to the random and potentially fatiguing work schedule inherent in an extra board position. Also, under the present system, relief dispatchers may have rapid forward rotation in their schedules. While relief dispatchers have a regular schedule, rapid rotation is not a preferred arrangement with regard to potential fatigue. In centers where relief dispatchers work a rotating schedule, as many as half of the center's dispatchers may be working a potentially fatiguing schedule.

Another major shortcoming of dispatcher schedules involves off-duty time. Industries that operate around the clock, 365 days a year require people to work when they would likely either be sleeping or spending social time with their family and friends. The present scheduling system for dispatchers results in an inequitable distribution of off-duty time with some having nights and/or weekends off and other always working at those times. The current arrangement limits weekend off-duty time to less than half of the staff. Less than a quarter of the staff have two weekend days off. The inability to spend social time with family and friends may be further compromised if the dispatcher works nights.

Many public sector services and US industries have found alternatives to the non self-relieving fixed shift arrangement common to railroad dispatching operations. Innovative scheduling strategies from non-railroad environments offer options that have the potential to alleviate the issues identified in this study. The options that show promise for both reducing employee fatigue and easing the job of the scheduler in filling vacancies are:

A. Three crew self-relieving system.

B. Fixed shifts with variable days off.

C. Targeted utilization of relief and extra board dispatchers.

D. 12-hr weekend shifts.

Both labor and management are likely to benefit from any change in the present system, but implementation of any of these options will require teamwork from both groups. One approach to exploration of alternative scheduling options would be to establish a committee to identify the scheduling concerns at the dispatching center. This committee should include representatives of all stakeholder groups, including trick dispatchers, chief dispatchers, schedulers and management of the dispatching center. If there is consensus that a change is desirable, then a specific scheduling strategy can be selected and impediments to the change can be addressed. Factors that are important to consider include the terms of current labor agreement, a weekly payroll system, and any dispatcher expectations regarding the opportunity to earn overtime pay. The Hours of Service will be a concern if 12-hr weekend shifts are desirable. However, the FRA has a waiver procedure whereby a railroad can request an exemption from the regulations. If a railroad wanted to implement an alternative schedule that was potentially less fatiguing overall for its dispatcher work force, the FRA is likely to consider such a request. A large Class I dispatching center may want to select one division and conduct a pilot test of an alternative schedule design.

The focus of this study was on determining objective staffing levels that accommodate the “not at work days” pattern of a center. Human physiology and quality of work life considerations were the basis for the evaluation of dispatcher schedules. Cost was not considered directly in this analysis. Before implementing any of the suggestions offered in this report, railroads will likely also want to examine the economic consequences of any change in either staffing level or schedule.

A staffing analysis based on the shift relief factor may suggest a change in the total number of dispatchers at a center. Only a detailed analysis of the salaries and payroll costs for a specific dispatcher center will reveal if the change will bring about an overall increase or decrease in the cost of operating the center. With regard to changes in work schedules, the motivation for considering an alternative work schedule is because it offers benefits to the work force and is cost neutral. Alternative schedules, such as the four suggested in this report, have benefits in terms of reduced fatigue and an improved quality of life for the dispatcher work force. These benefits are qualitative and not easily translated into a monetary equivalent.

7 References

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Appendix A: Capturing Historical Data for Computing Not at Work Days (NAWD) and Staffing Level

Computation of the SRF and OSF requires data on all non-desk days for which a dispatcher is paid. This appendix suggests a format for recording and assembling the required data. While each railroad may vary in how they describe or classify these days, the more important point is that all such days are captured and included when determining annual non-work non-desk days for each dispatcher. The following example illustrates a method for aggregating this data and using it to calculate the shift relief factor.

Step 1: Record All Non-Desk Days Per Dispatcher Per Annum

Job Number	Employee ID	Vacation	Sick Leave	Training	Float	Tag	Personal Leave	Comp Time
1st Shift								
1	**6004**	128.0	40.0	24.0	4.0	5.0	16.0	8.0
2	**6009**	168.4	32.0	24.0	8.0	0.0	8.0	0.0
3	**6237**	208.0	48.0	24.0	0.0	3.0	0.0	4.0
4	**6238**	168.4	40.0	24.0	4.0	0.0	10.0	12.0
5	**6239**	208.0	32.0	24.0	0.0	2.0	0.0	16.0
6	**6240**	168.4	60.0	24.0	12.0	0.0	8.0	8.0
7	**6241**	168.4	80.0	24.0	4.0	5.0	12.0	12.0
8	**6259**	128.0	54.0	24.0	2.0	2.0	0.0	0.0
Total Average Hr		**168.2**	**48.3**	**24.0**	**4.3**	**2.1**	**6.7**	**7.5**

Step 2 - Calculate the RFF Using Aggregate Absenteeism Data

Vacation	**168.2**
Sick Leave	**48.3**
Training	**24.0**
Float	**4.3**
Tag	**2.1**
Personal	**6.7**
Comp	**7.5**
Total Avg. Hr Not at Work	**261.1**
Average Not at Work Days	**32.6**
Regular Days Off	**104.0**
Total per annum NAWD	**136.6**
RFF for 1st shift=	**365/(365-136.6) = 1.60**
Staffing level for 1st shift=	**8 * 1.60 = 12.8 or 13**

Appendix B: Calculating Staffing Level For Non-Standard Shift Lengths

The SRF can be applied to any operation regardless of the shift length. This appendix provides an example of an operation that utilizes four 10-hr shifts per week. In this case each dispatcher has three regular days off per week. This increases the regular days off to156, per dispatcher per annum (i.e., 3 x 52 = 156). Using the example of Appendix A, the total number per annum days off per dispatcher increases from 136.6 to 188.6. Based on this, the SRF would change to:

$$SRF = 365/(365 - 156 - 32.6)$$

or

$$SRF = 365/(365 - 188.6) = 365/176.4 = 2.1$$

The increased SRF for the 4/10 schedule results from the shift now providing 70 hr of coverage per week (10 hr per day x 7 days) instead of 56 hr, an increase of 25 percent. In the above case, the relief factor has increased from 1.6 to 2.1, up more than 25 percent. This happens as the same number of employee benefit days off actually provide more hr off when 10-hr shifts are used, e.g., 10 holidays now results in 100 off-duty hr per annum, instead of 80.

Appendix C: Representative Dispatcher Schedules and Raster Plots

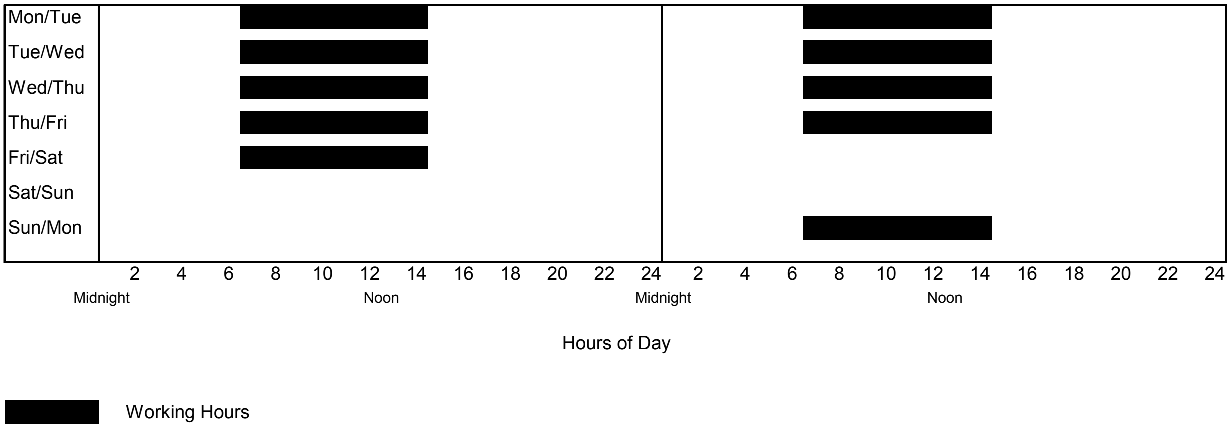
This appendix contains dispatcher schedules and corresponding raster plots for each of the six dispatching operations described in Section 2.

CONRAIL TRAIN DISPATCHER SCHEDULE FORMAT

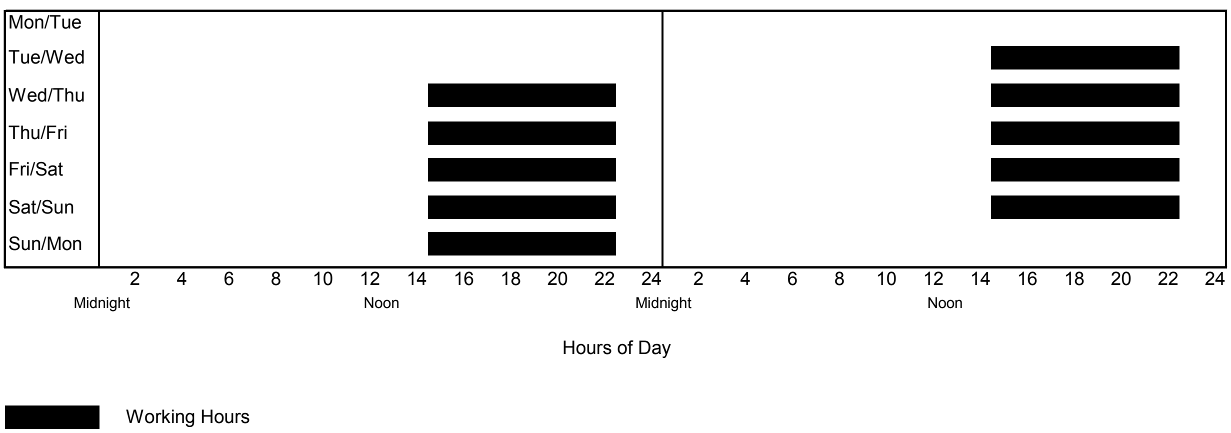
5On - 2Off Non Self Relieving 3 Fixed Shifts with Swing Relief Crew

SHIFT/ID			Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Reg. Scheduled Jobs (1 Week Cycle)	D	1	*D*	*D*	*D*	*D*	*D*	-	-
	D	2	-	-	*D*	*D*	*D*	*D*	*D*
	D	3	-	*D*	*D*	*D*	*D*	*D*	-
	D	4	*D*	*D*	*D*	*D*	-	-	*D*
	E	5	-	-	*E*	*E*	*E*	*E*	*E*
	E	6	*E*	-	-	*E*	*E*	*E*	*E*
	E	7	*E*	-	-	*E*	*E*	*E*	*E*
	E	8	-	*E*	*E*	*E*	*E*	*E*	-
	N	9	*N*	*N*	-	-	*N*	*N*	*N*
	N	10	*N*	*N*	*N*	-	-	*N*	*N*
	N	11	*N*	*N*	*N*	-	-	*N*	*N*
	N	12	*N*	-	-	*N*	*N*	*N*	*N*
Relief Jobs (1 Wk Cycle)	R	13	*E-1*	*E-1*	*N-1*	-	-	*D-1*	*D-1*
	R	14	*D-2*	*D-2*	*E-2*	*N-2*	*N-2*	-	-
	R	15	*D-3*	*E-3*	*E-3*	*N-3*	-	-	*D-3*
	R	16	*E-4*	*N-4*	-	-	*D-4*	*D-4*	*E-4*
	R	17		*E-2*	*N-4*	*N-1*	*N-3*		
Extra Board Jobs (4 week cycle)	X	1	-	-	-	-	-	*N*	*N*
			N	*N*	*N*	-	-	-	-
			-	*E*	-	-	*E*	-	*D*
			D	-	*N*	-	-	*N*	-
			-	-	*N*	-	-	-	-
	X	2	-	-	-	-	-	*E*	*E*
			-	*D*	-	-	-	*D*	-
			-	*E*	-	*N*	-	-	-
			-	*E*	-	-	-	-	*E*
			E	*E*	-	*N*	-	-	-
	X	3	-	-	-	-	-	*N*	*N*
			-	-	*N*	-	*N*	*N*	-
			-	-	-	-	*N*	-	*E*
			-	*E*	*E*	*N*	*N*	-	-
			-	-	-	-	-	-	-
	X	4	-	-	-	-	-	-	*E*
			E	*E*	-	*D*	*D*	*D*	-
			-	-	-	-	-	-	*D*
			-	*D*	*D*	-	-	-	-
			-	-	-	-	*N*	-	-
	X	5	-	-	-	-	-	-	-
			-	*D*	*D*	*D*	-	-	-
			-	-	*N*	*N*	-	-	-
			-	-	-	-	-	*E*	-
			-	*E*	*E*	*E*	*E*	-	-
	X	6	-	-	-	-	-	*E*	-
			-	*D*	-	*D*	-	-	-
			-	-	-	-	-	-	-
			-	-	-	-	-	-	-
				-	-	-	*N*	-	-

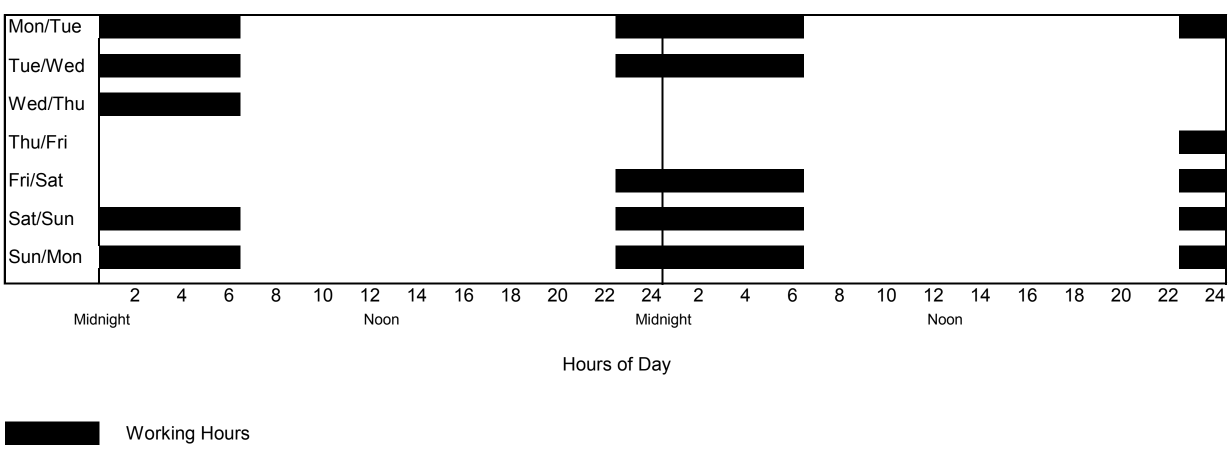
1st Shift (D1) -Conrail



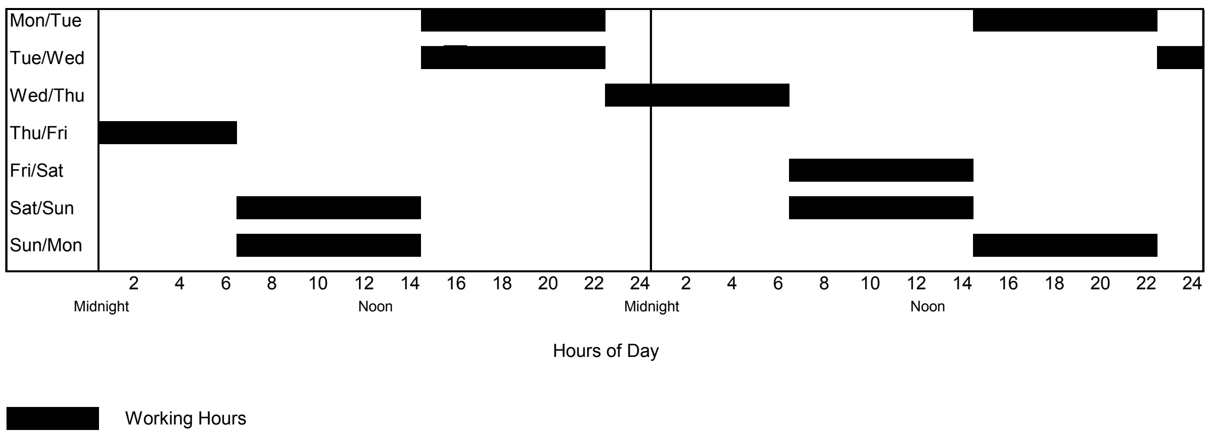
2nd Shift (E5) -Conrail



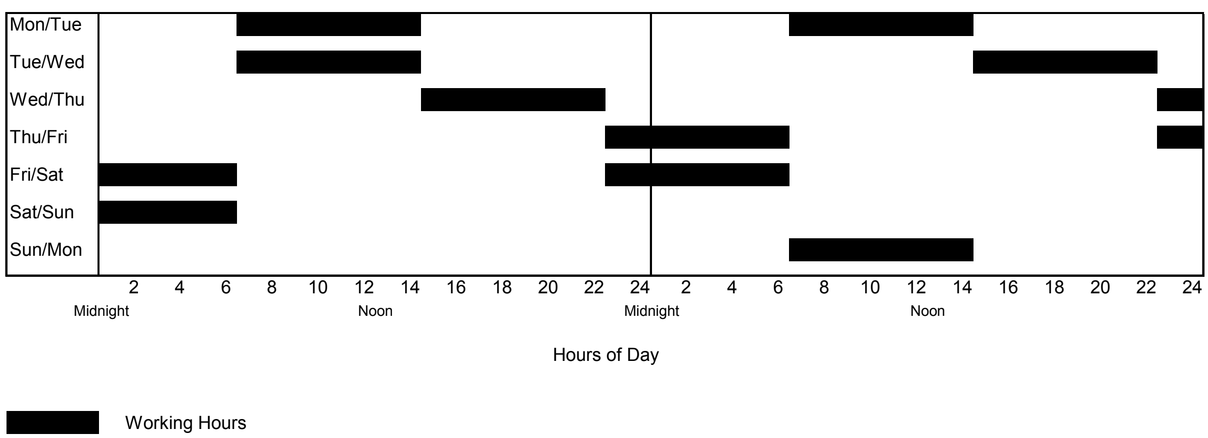
3rd Shift (N9) -Conrail



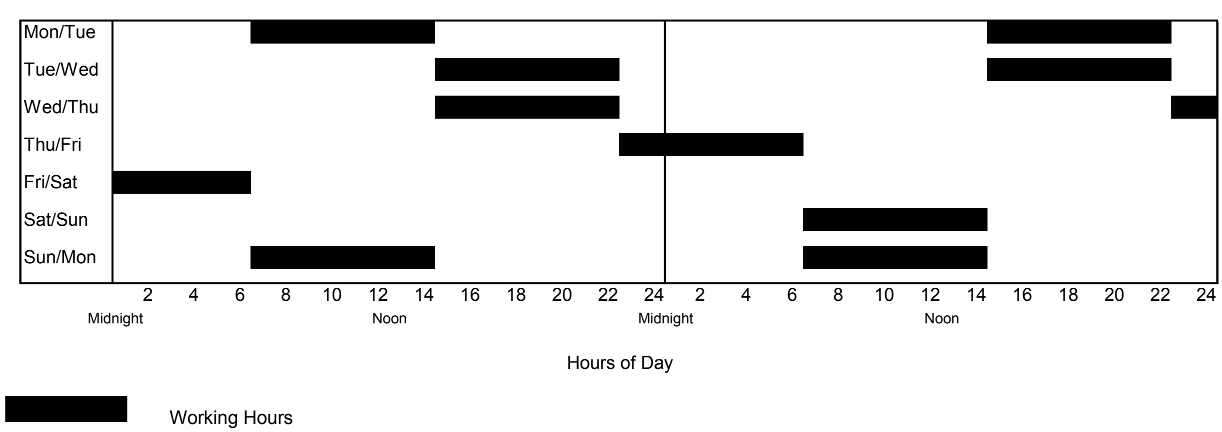
Relief Shift (R13) - Conrail



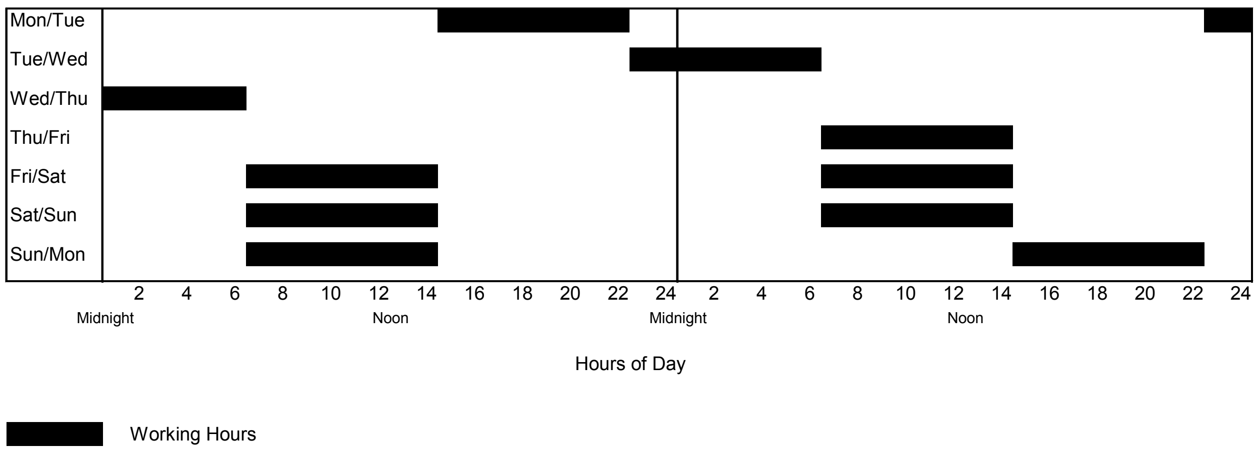
Relief Shift (R14) -Conrail



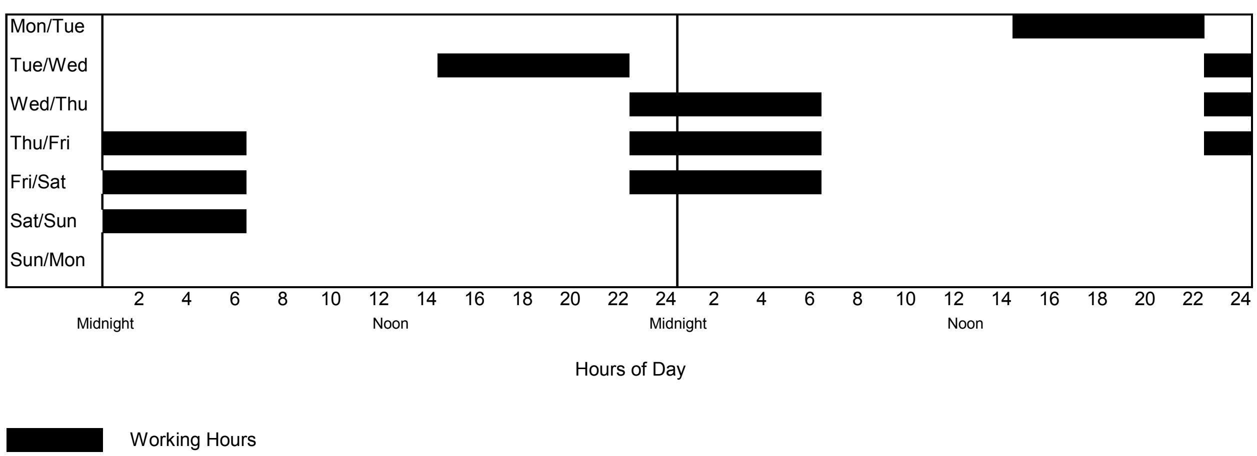
Relief Shift (R15) -Conrail



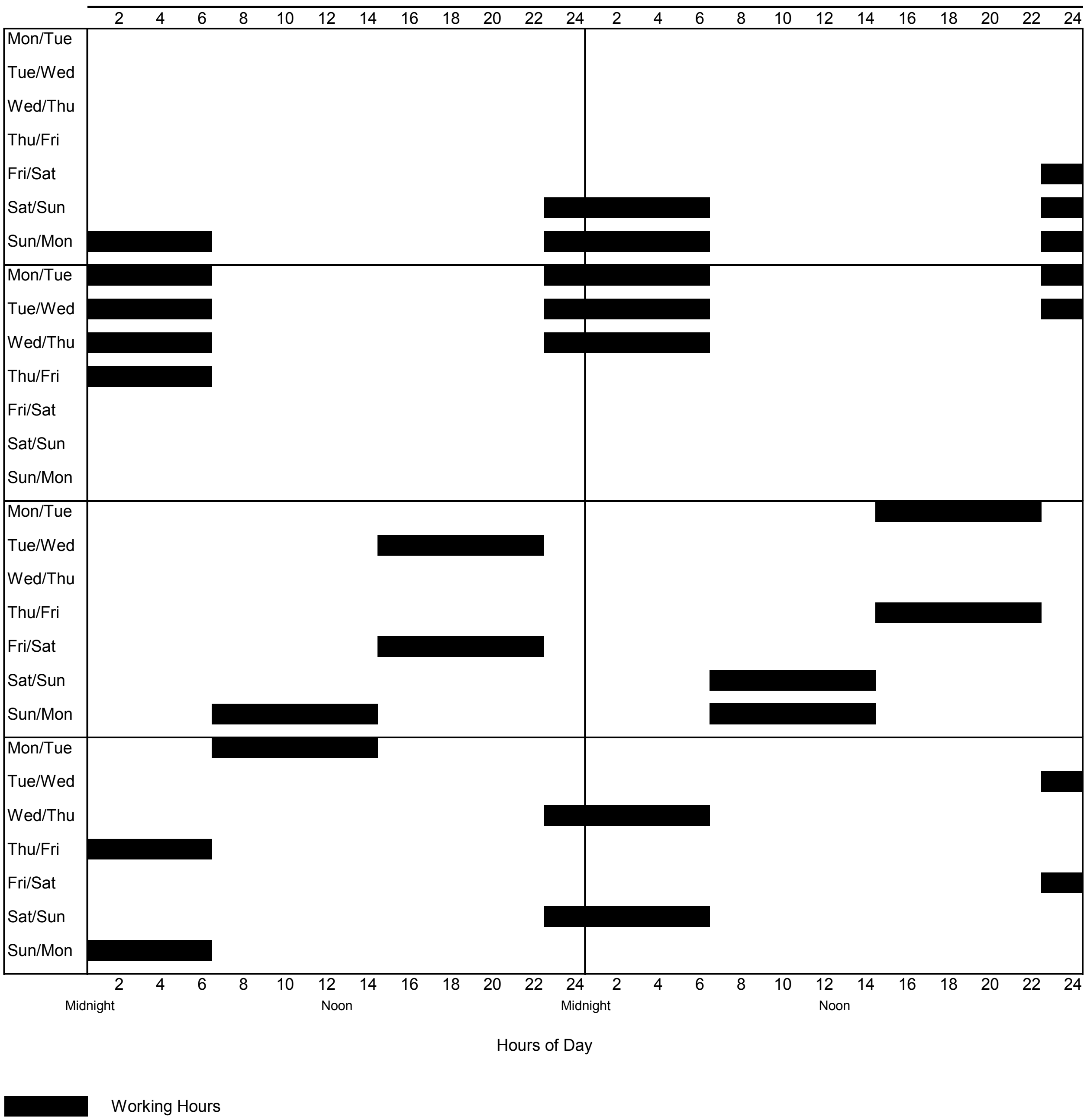
Relief Shift (R16) -Conrail



Relief Shift (R17) -Conrail



Extra Board Shift X1 - Conrail

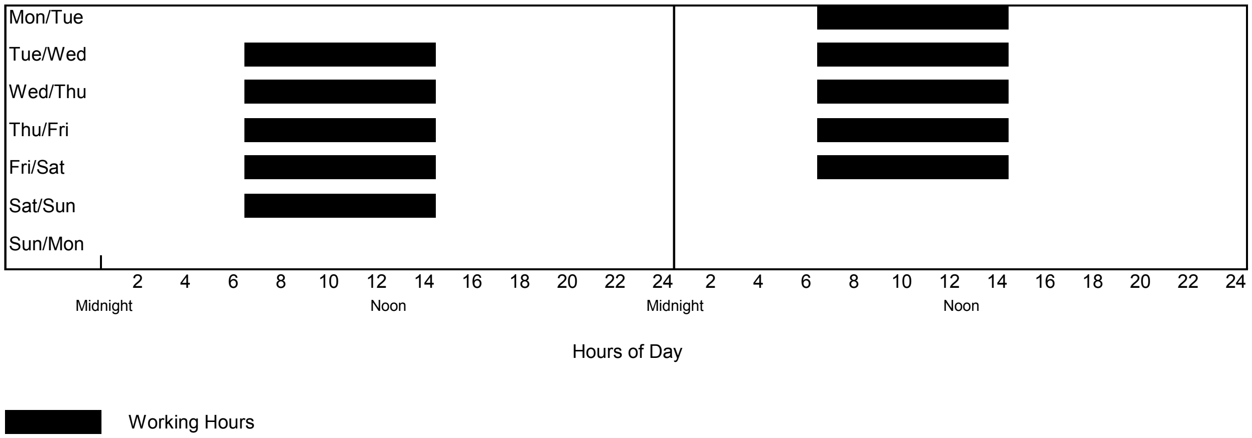


METRA TRAIN DISPATCHER SCHEDULE FORMAT

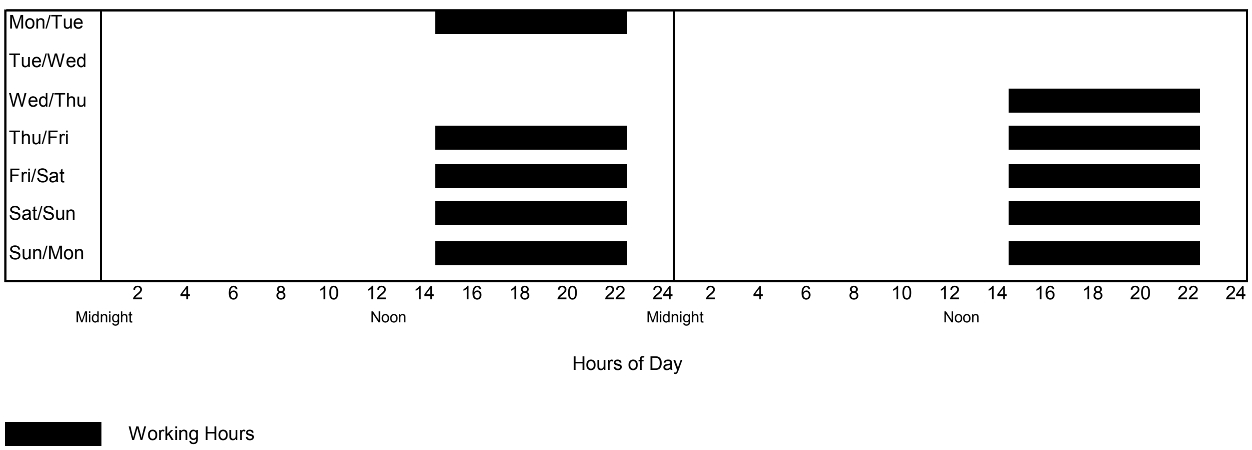
5On - 2Off Non Self Relieving 3 Fixed Shifts with Swing Relief Crew

SHIFT/ID			Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Reg. Scheduled Jobs (1 Week Cycle)	D	1	-	D	D	D	D	D	-
	D	2	D	D	D	D	-	-	D
	D	3	D	D	D	D	D	-	-
	D	4	D	D	D	D	D	-	-
	E	5	E	-	-	E	E	E	E
	E	6	-	E	E	E	E	E	-
	E	7	-	-	E	E	E	E	E
	E	8	E	E	E	E	E	-	-
	N	9	N	N	-	-	N	N	N
	N	10	-	-	N	N	N	N	N
	N	11	N	-	-	N	N	N	N
Relief Jobs (1 Wk Cycle)	R	12	D-1	E-1	N-1	N-1	-	-	D-1
	R	13	N-2	N-2	-	-	D-2	D-2	E-2
	R	14	E-3	N-3	N-3	-	-	D-3	D-3
	R	X	E-2	E-3	E-1	-	-	-	-
Extra Board Jobs (4 week cycle)	X	1	E	-	D	D	D	-	D
			D	-	-	-	-	-	D
			D	D	D	D	D	-	-
			-	-	D	D	D	D	D
	X	2	-	D	-	-	N	N	N
			-	-	-	E	-	-	-
			-	E	E	-	E	E	E
			-	E	E	-	-	-	-
	X	3	-	-	-	-	-	D	-
			-	-	-	-	-	-	-
			-	-	-	-	-	-	-
			-	-	-	-	-	-	-
	X	4	-	-	-	-	-		-
			-	-	-	N	-	-	-
			-	-	-	-	-	-	-
			-	-	-	-	-	-	-
	X	5	-	-	-	-	-	-	-
			-	D	D	D	-	-	-
			-	-	-	D	-	-	-
			D	-	N	-	-	-	-
	X	6	-	-	-	-	-	-	-
			-	-	-	-	-	-	-
			-	-	-	-	-	-	-
			E	-	-	-	-	-	-
	X	7	-	N	N	-	-	-	-
			-	-	-	-	-	-	-
			-	-	-	-	-	-	-
			-	-	-	-	-	-	-
	X	8	-	-	-	-	-	-	-
			-	-	-	N	-	-	-
			-	-	-	-	-	-	-
			-	-	-	-	-	-	-

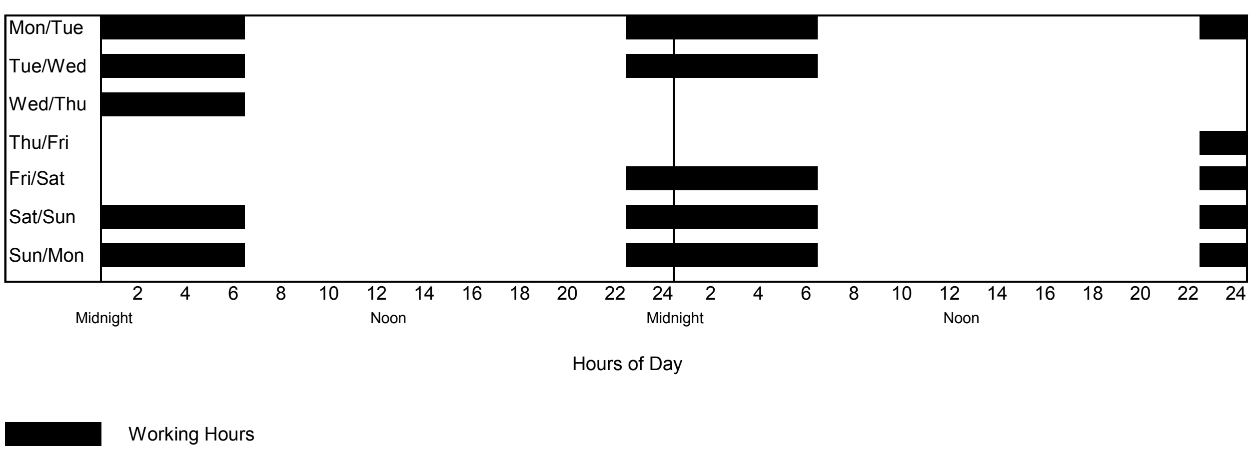
1st Shift (D1) - Metra



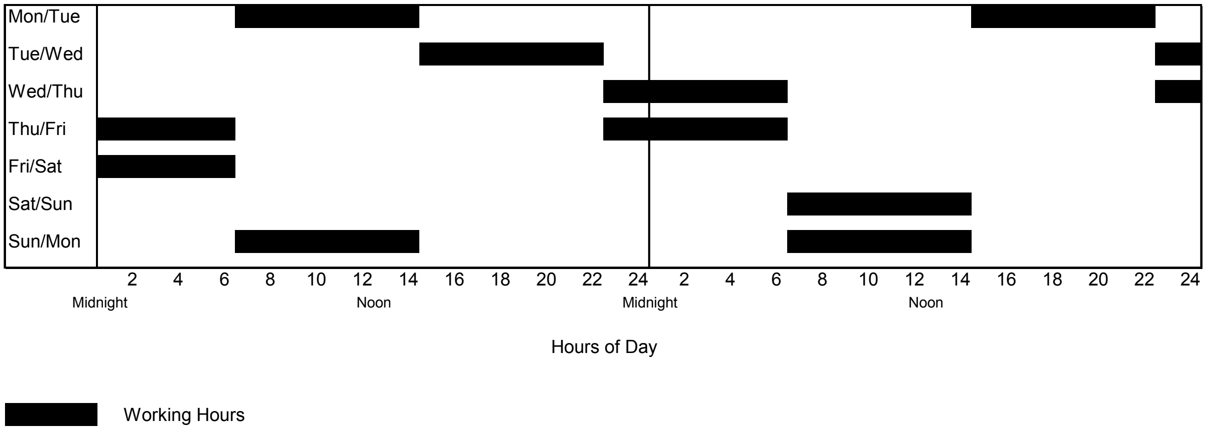
2nd Shift (E5) - Metra



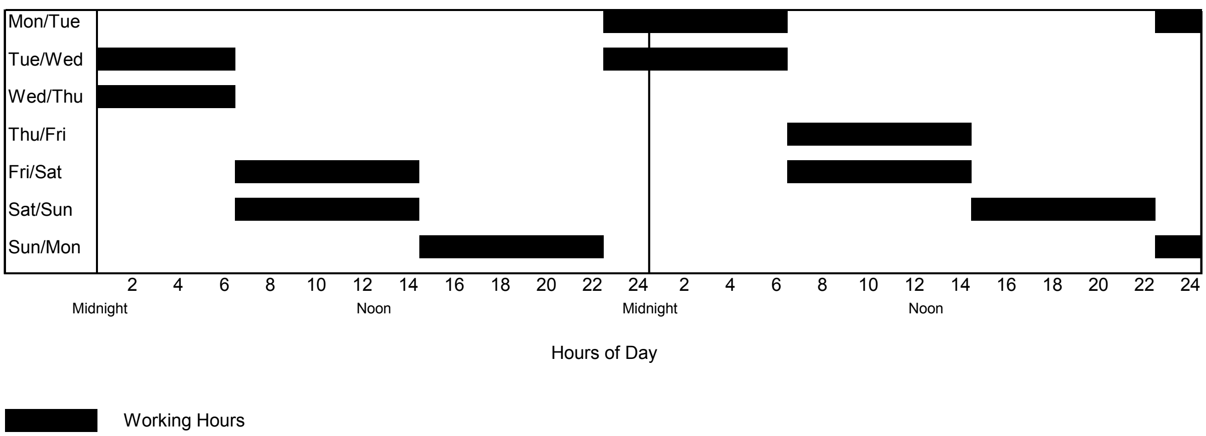
3rd Shift (N9) - Metra



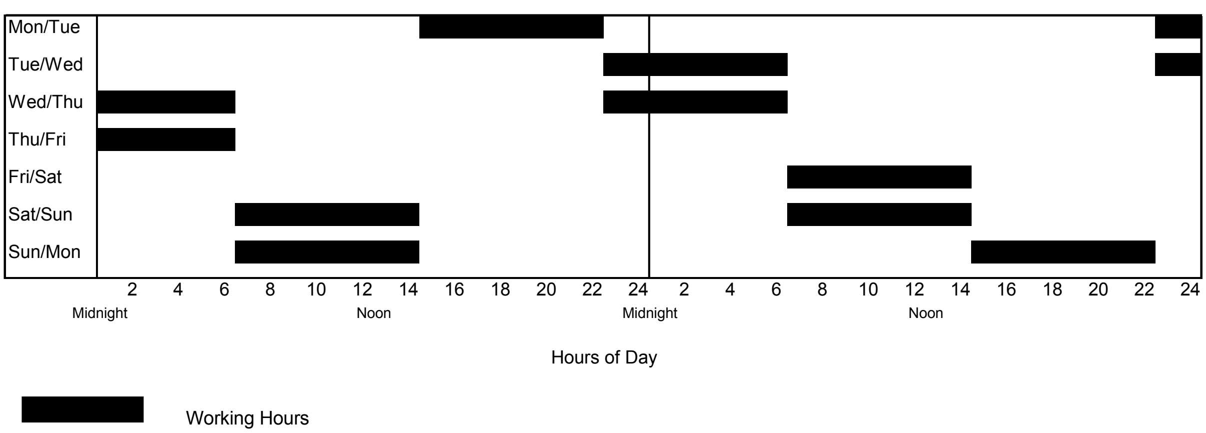
Relief Shift (R12) - Metra



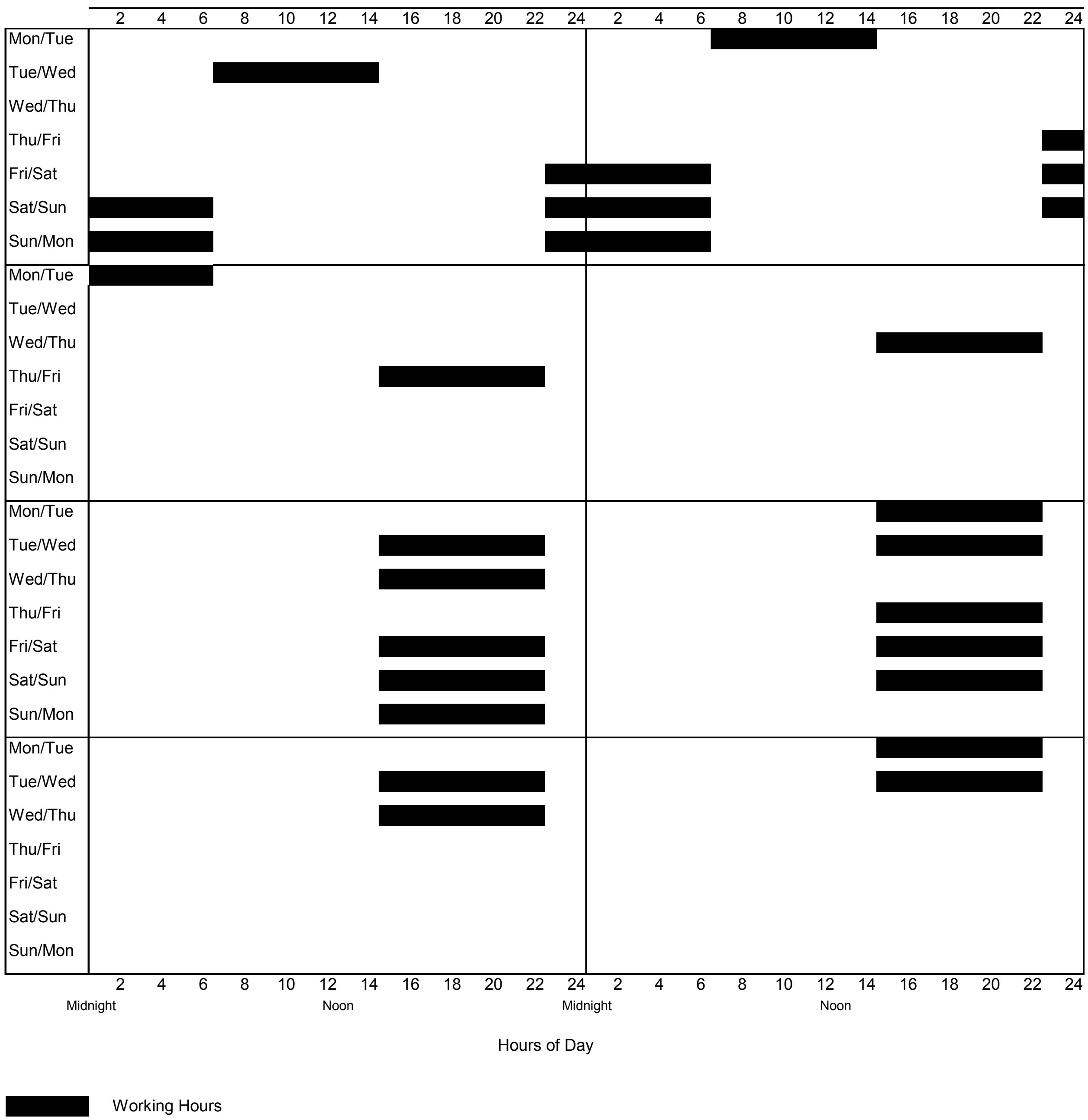
Relief Shift (R13) - Metra



Relief Shift (R14) - Metra



Extra Board Shift X2 -Metra

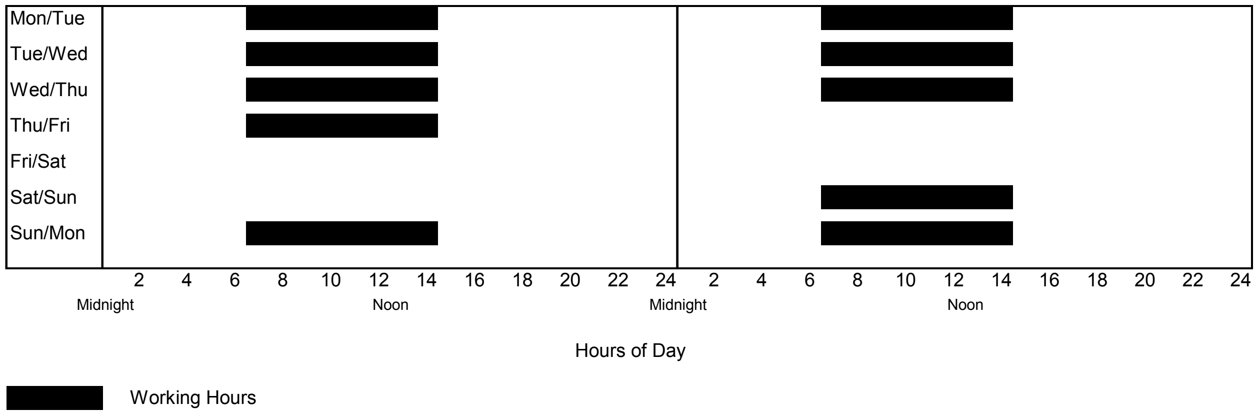


Metro North TRAIN DISPATCHER SCHEDULE FORMAT

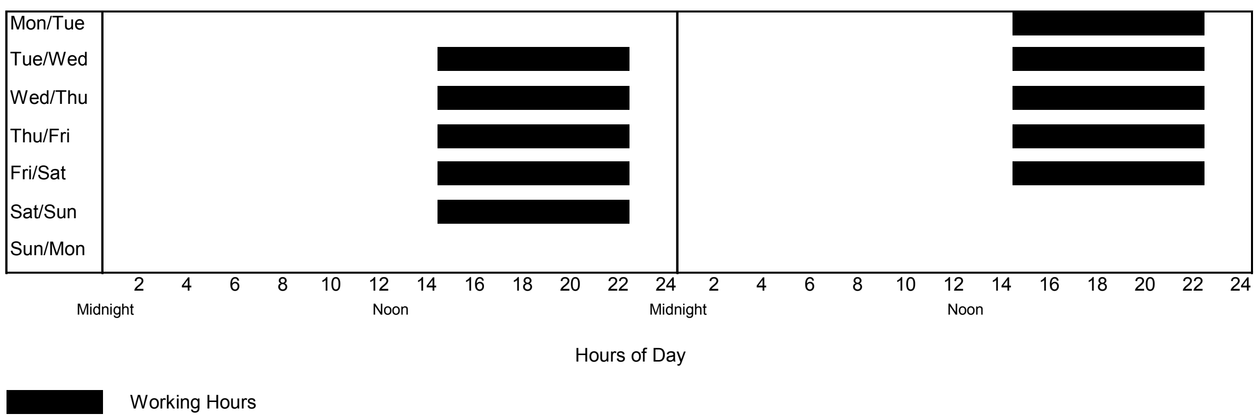
5On - 2Off Non Self Relieving 3 Fixed Shifts with Swing Relief Crew

SHIFT/ID			Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Regular Scheduled Jobs (1 Week Cycle)	D	1	D	D	D	D	-	-	D
	D	2	D	D	D	D	D	-	-
	D	3	-	D	D	D	D	D	-
	D	4	D	D	D	D	D	-	-
	D	5	D	D	D	D	D	-	-
	D	6	D	D	D	D	-	-	D
	D	7	D	D	D	D	D	-	-
	D	8	D	D	D	D	D	-	-
	D	9	-	-	D	D	D	D	D
	D	10	D	D	-	-	D	D	D
	D	11	D	D	D	D	-	-	-
	E	12	-	E	E	E	E	E	-
	E	13	E	E	E	E	E	-	-
	E	14	E	E	E	E	-	-	E
	E	15	E	E	E	E	E	-	-
	E	16	E	E	-	-	E	E	E
	E	17	E	E	E	E	E	-	-
	E	18	E	E	E	E	E	-	-
	E	19	E	E	E	E	E	-	-
	E	20	-	-	E	E	E	E	E
	E	21	E	E	-	-	E	E	E
	N	22	N	N	N	N	-	-	N
	N	23	-	N	N	N	N	N	-
	N	24	N	N	N	N	-	-	N
	N	25	N	N	N	N	N	-	-
	N	26	-	-	N	N	N	N	N
	N	27	N	N	-	-	N	N	N
Relief Jobs (1 Wk Cycle)	R	28	D	-	-	-	D	D	D
	R	29	N	-	-	-	E	E	N
	R	30	E	-	-	-	D	D	E
	R	31	-	-	E	E	N	N	-
	R	32	E	E	E	E	-	-	-
Extra Board Jobs (4 week cycle)	X	1	-	-	-	-	-	-	-
			D.5	D.5	D.5	D.5	D.5	-	-
			D.5	D	-	-	-	-	-
			-	-	-	-	-	-	-
	X	2	-	D	D	-	-	-	D
			D.5	-	-	-	D.5	D.5	D.5
			D.5	-	-	-	D.5	D.5	D.5
			D.5	D.5	-	-	-	-	-
	X	3	-	D	-	-	D	-	-
			D	D	E	E	-	E	E
			-	-	-	-	D	-	D
			D	-	D.5	D.5	D.5	D.5	D.5
	X	4	D	E	E	E	E	-	-
			-	-	E	E	E	N	N
			-	-	-	D	D	D	D.5
			D	D.5	D.5	D.5	-	-	-
	X	5	-	-	-	-	-	E	E
			E	E	E	E	E	E	-
			-	-	-	E	E	-	-
			-	E	-	-	E	E	E
	X	6	E	-	-	-	-	-	-
			-	-	-	-	-	-	-
			-	-	-	-	N	-	-
			N	N.5	N.5	N.5	-	-	E
	X	7	D	-	D	D	-	-	D
			D	D	D	-	-	-	D
			D	D	D	D	-	-	-
			-	-	-	-	-	-	-
	X	8	-	D	-	-	D	-	-
			-	-	D	D	D	-	-
			-	-	-	-	-	-	-
			-	-	D	D	D	D	-
	X	9	-	-	-	-	-	-	-
			E	-	-	E	-	-	D
			N	N	N	N	N	N	-
			-	E	-	E	E	-	-
	X	10	E	-	-	-	-	-	-
			N	N	N	N	N	N	N
			-	-	-	-	-	-	-
			-	-	E	E	-	-	-

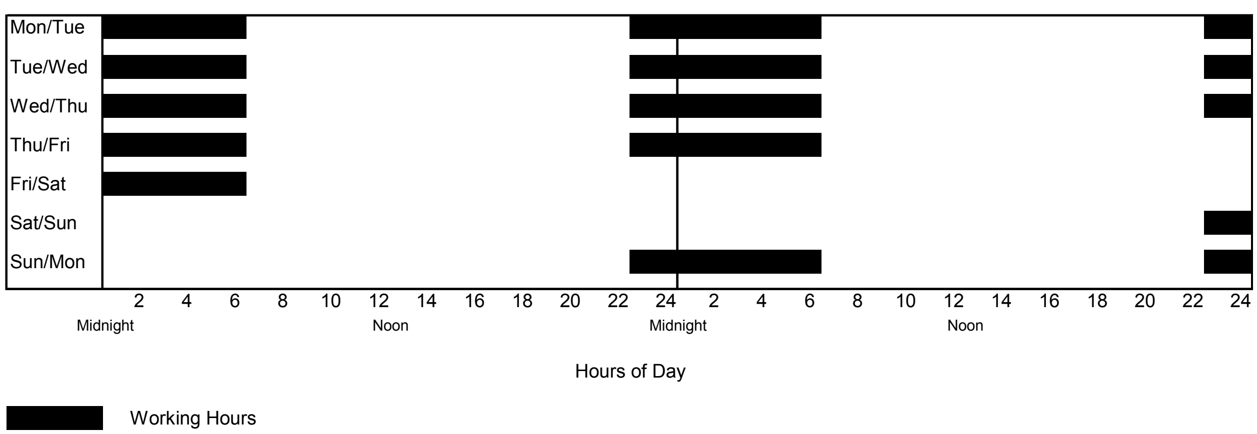
1st Shift (D1) -Metro North



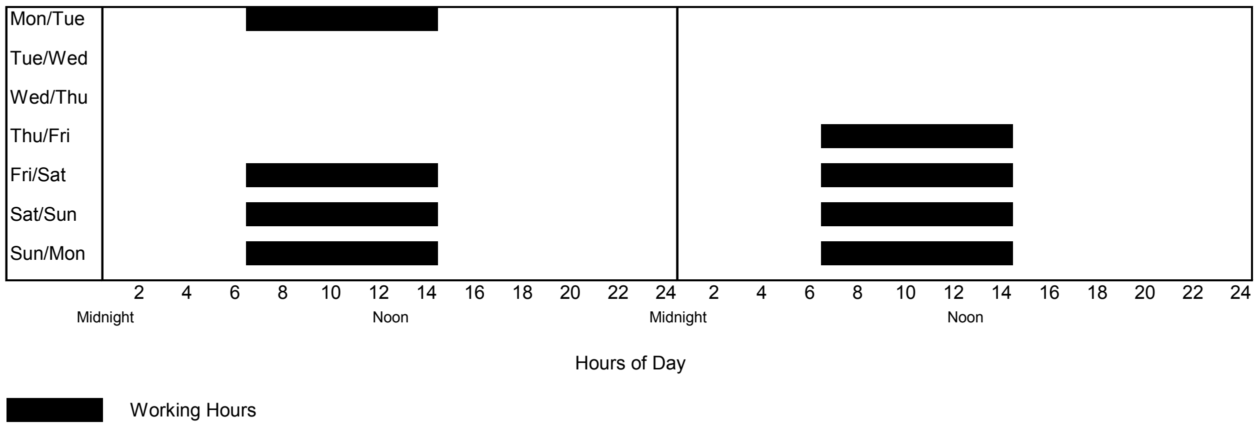
2nd Shift (E12) -Metro North



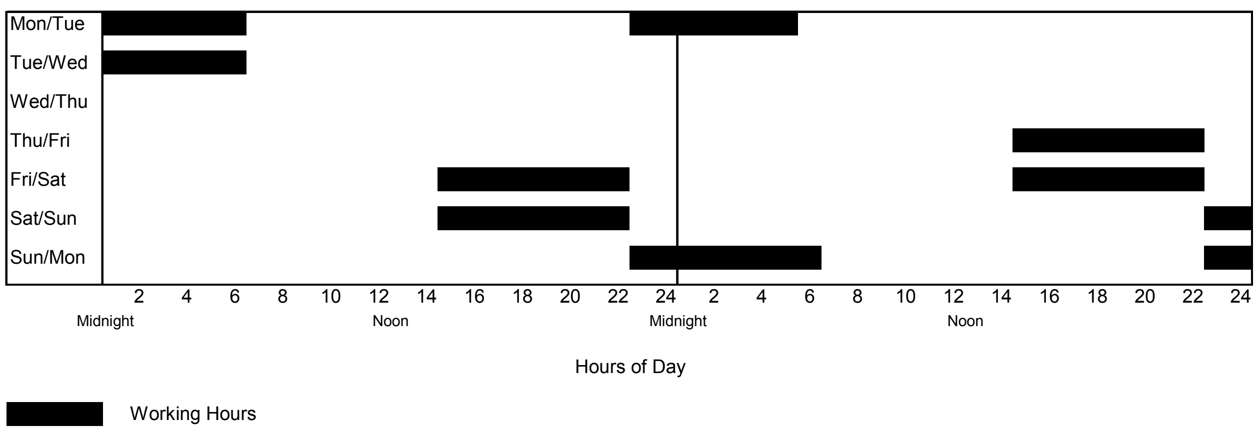
3rd Shift (N22) -Metro North



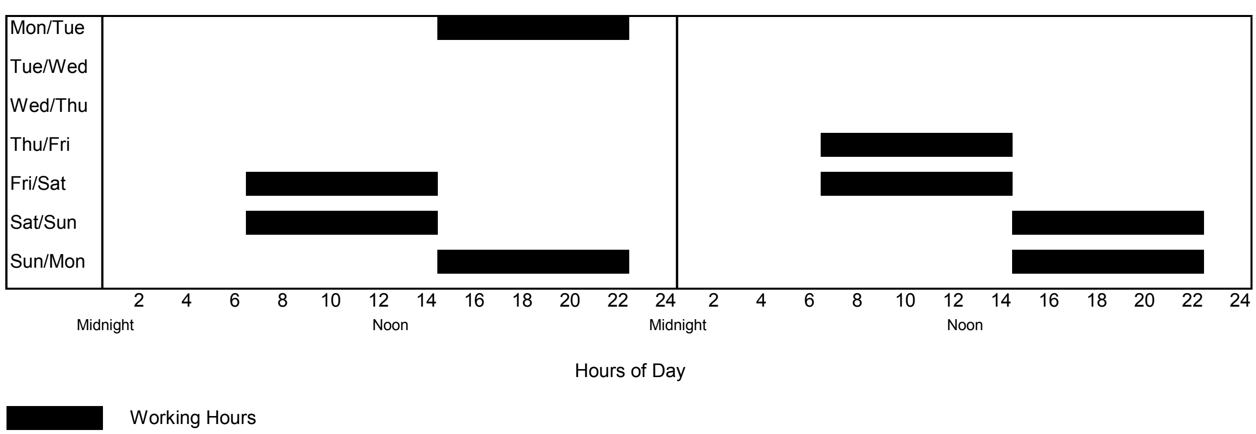
Relief Shift (R28) - Metro North



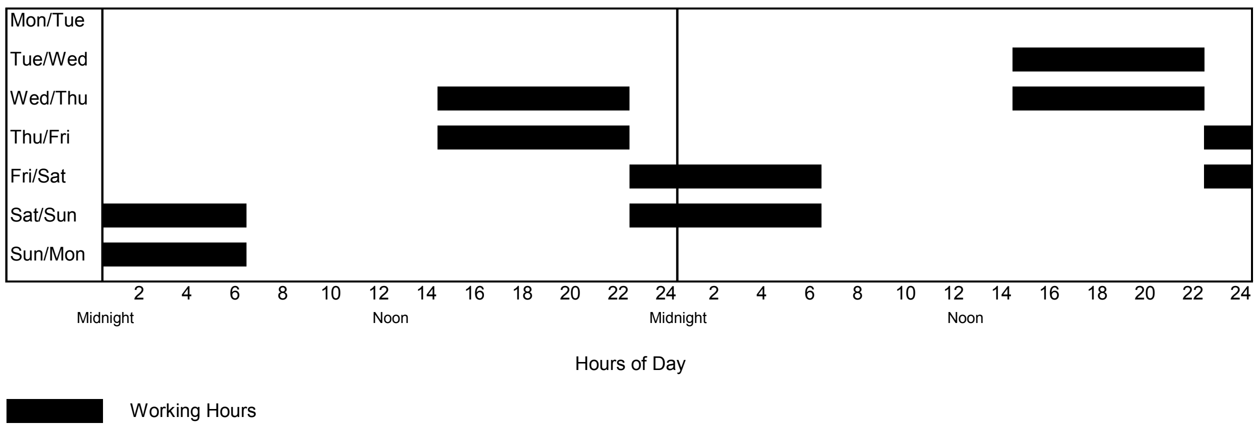
Relief Shift (R29) -Metro North



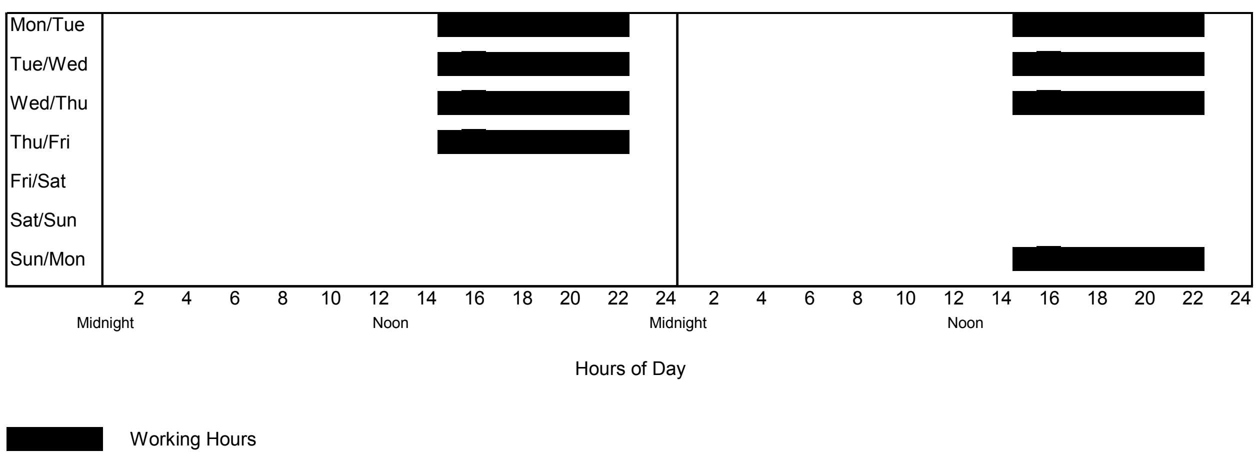
Relief Shift (R30) -Metro North



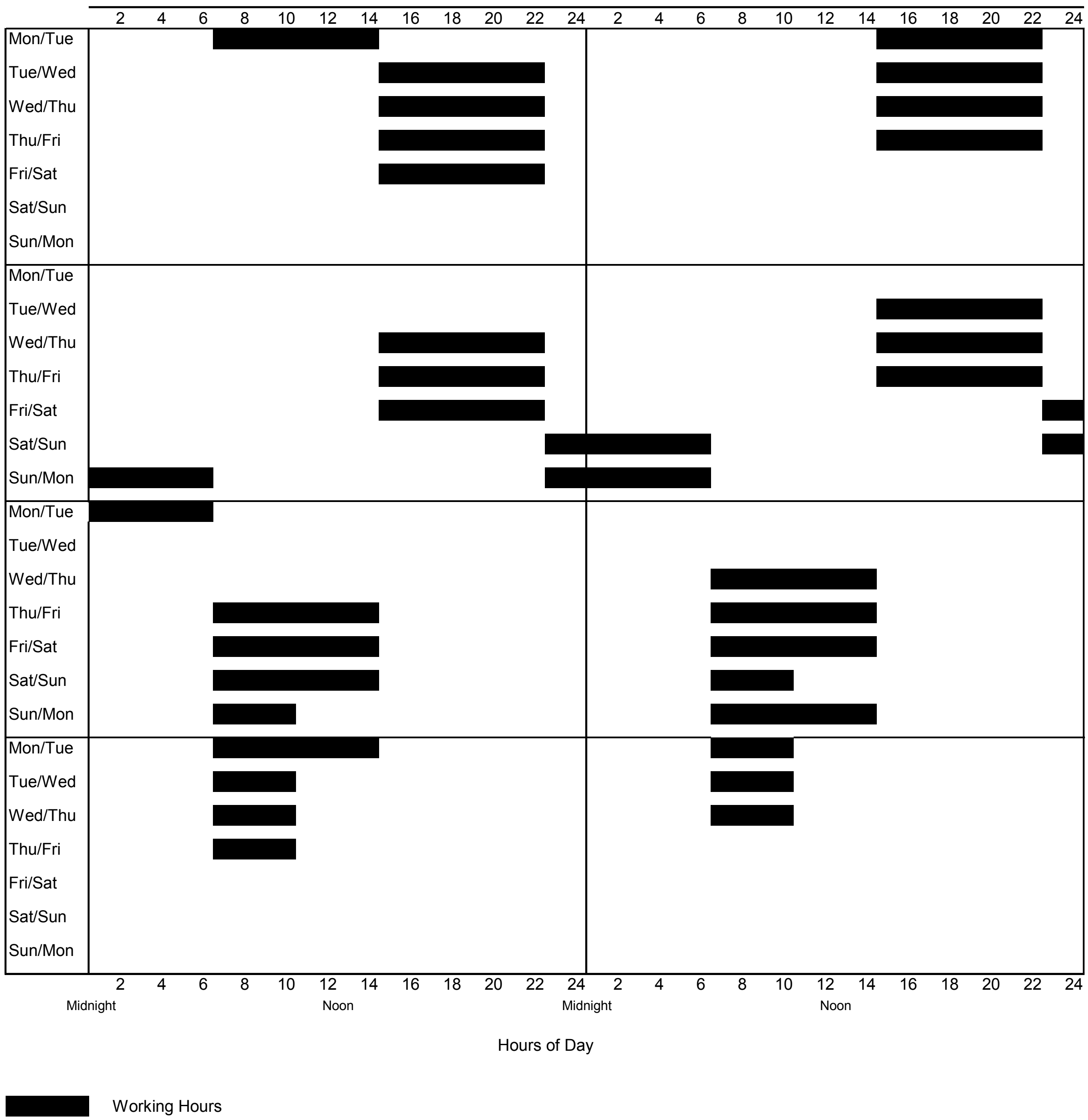
Relief Shift (R31) -Metro North



Relief Shift (R32) -Metro North



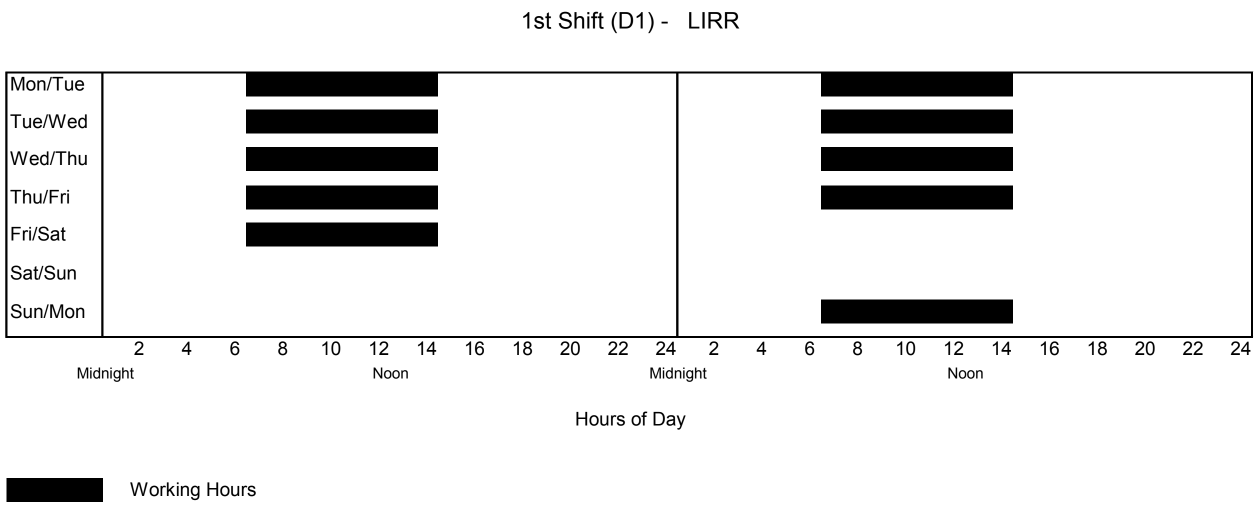
Extra Board Shift X4 -Metro North

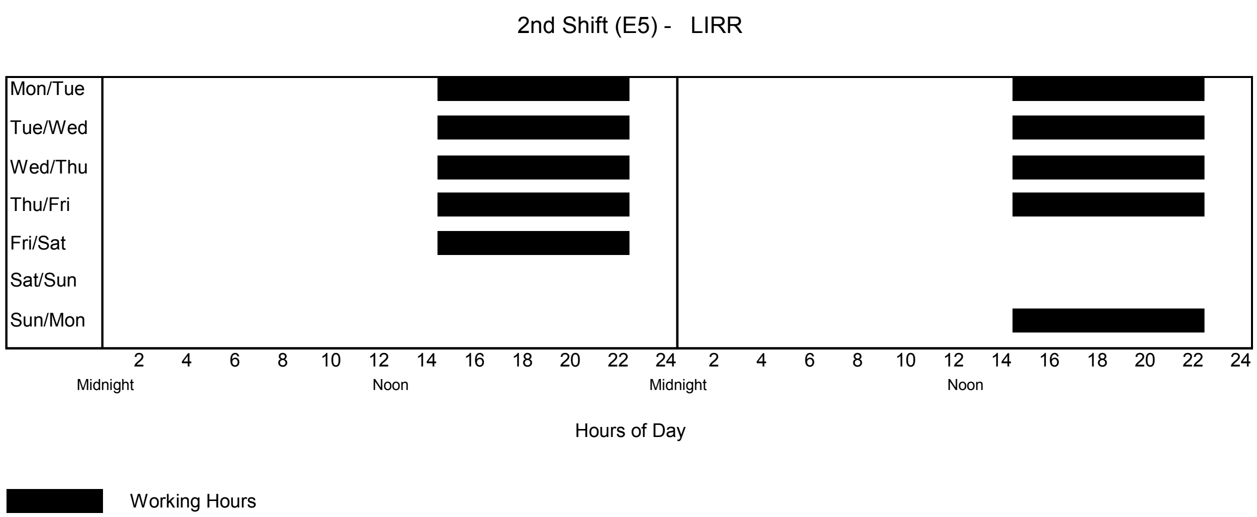


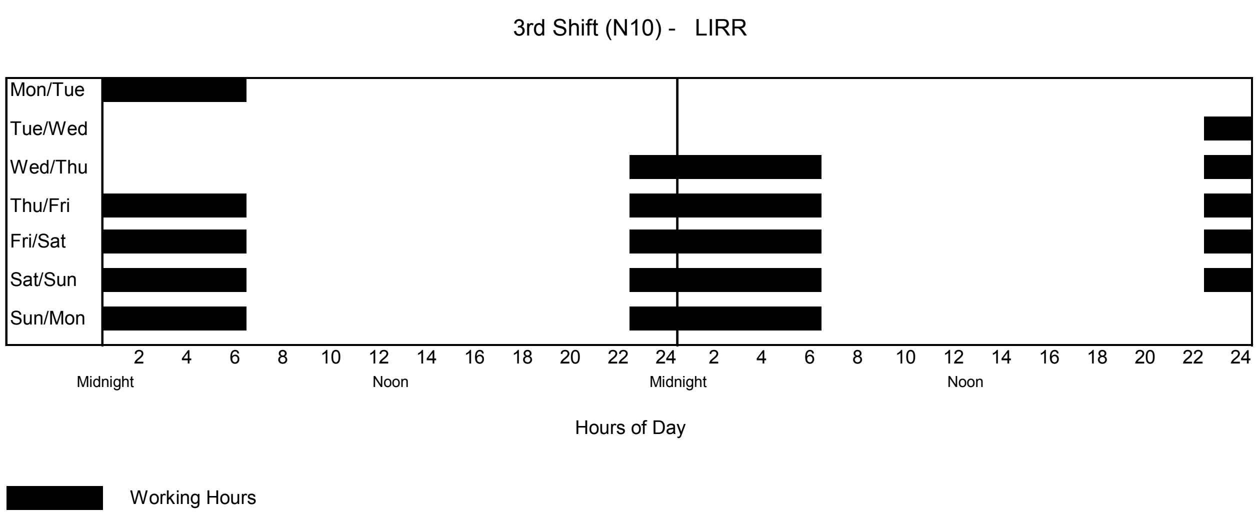
LIRR TRAIN DISPATCHER SCHEDULE FORMAT

5On - 2Off Non Self Relieving 3 Fixed Shifts with Swing Relief Crew

SHIFT/ID			Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Regular Scheduled Jobs (1 Week Cycle)	D	1	*D*	*D*	*D*	*D*	*D*	-	-
	D	2	*D*	-	-	*D*	*D*	*D*	*D*
	D	3	-	*D*	*D*	*D*	*D*	*D*	-
	D	4	*D*	*D*	*D*	*D*	*D*	-	-
	D	5	*D*	*D*	*D*	*D*	*D*	-	
	E	5	*E*	*E*	*E*	*E*	*E*	-	-
	E	6	-	*E*	*E*	*E*	*E*	*E*	-
	E	7	*E*	*E*	*E*	*E*	-	-	*E*
	E	8	*E*	*E*	*E*	*E*	*E*	-	-
	E	9	*E*	*E*	*E*	*E*	*E*	-	-
	N	10	-	-	*N*	*N*	*N*	*N*	*N*
	N	11	*N*	*N*	-	-	*N*	*N*	*N*
Relief Jobs (1 Wk Cycle)	R	12	*D-3*	*D-2*	*D-2*	*N-2*	-	-	*D-3*
	R	13	*N-1*	*N-1*	-	-	*E-3*	*E-3*	*E-1*
	R	X	*E-2*	-	*N-2*	-	-	-	-
Extra Board Jobs (4 week cycle)	X	1	-	-	-	*N*	*N*	*N*	-
			-	*D*	*E*	-	-	-	*N*
			N	*N*	*N*	*N*	-	-	-
			-	-	-	-	*D*	-	-
	X	2	-	-	*D*	*D*	*D*	-	-
			D	*D*	-	*E*	*E*	-	*D*
			-	*D*	*D*	*D*	*D*	-	-
			D	*D*	*D*	*D*	*D*	*D*	*D*
	X	3	*E*	-	*D*	-	-	-	*D*
			E	-	*E*	-	-	*E*	*E*
			E	*E*	*E*	*E*	*E*	-	-
			-	-	-	*D*	-	-	-
	X	4	*D*	*D*	-	*D*	*D*	-	-
			-	-	*N*	-	-	-	-
			-	*D*	-	-	-	*D*	*D*
			-	-	*N*	-	-	-	*D*

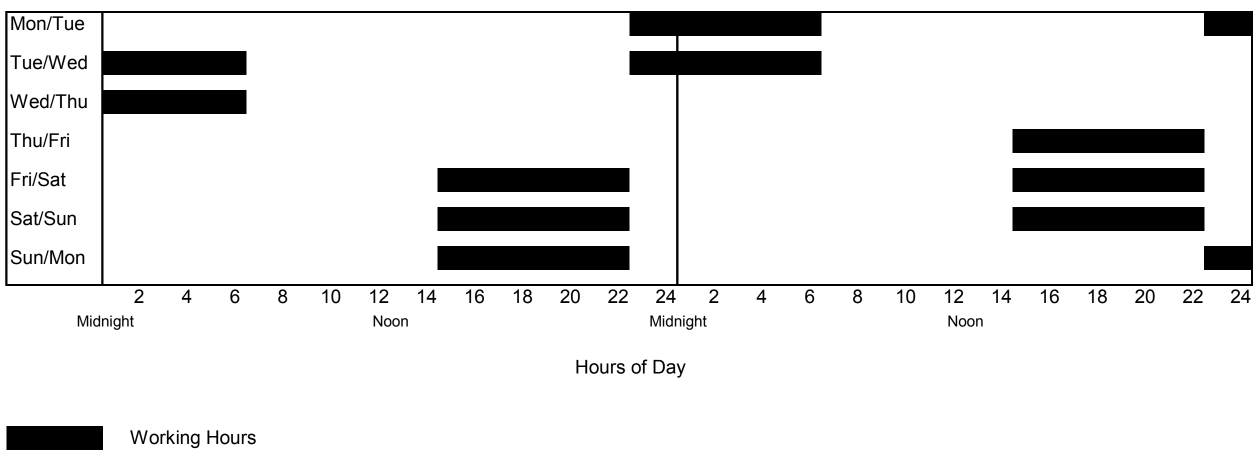

1st Shift (D1) - LIRR
Mon/Tue
Tue/Wed
Wed/Thu
Thu/Fri
Fri/Sat
Sat/Sun
Sun/Mon
2 4 6 8 10 12 14 16 18 20 22 24 2 4 6 8 10 12 14 16 18 20 22 24
Midnight
Noon
Midnight
Noon
Hours of Day
Working Hours


2nd Shift (E5) - LIRR
Mon/Tue
Tue/Wed
Wed/Thu
Thu/Fri
Fri/Sat
Sat/Sun
Sun/Mon
2 4 6 8 10 12 14 16 18 20 22 24 2 4 6 8 10 12 14 16 18 20 22 24
Midnight
Noon
Midnight
Noon
Hours of Day
Working Hours

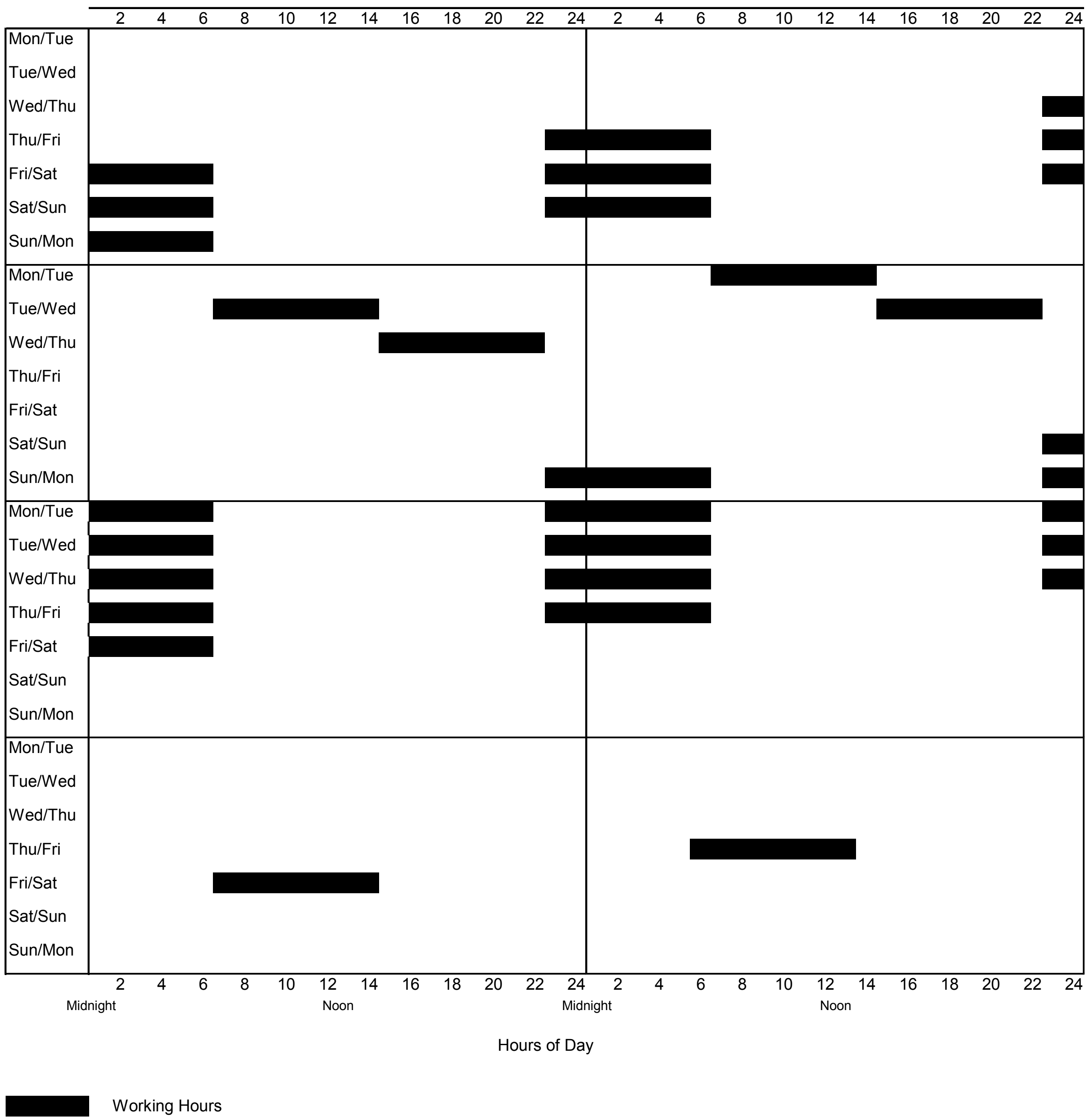

3rd Shift (N10) - LIRR
Mon/Tue
Tue/Wed
Wed/Thu
Thu/Fri
Fri/Sat
Sat/Sun
Sun/Mon
2 4 6 8 10 12 14 16 18 20 22 24 2 4 6 8 10 12 14 16 18 20 22 24
Midnight
Noon
Midnight
Noon
Hours of Day
Working Hours

Relief Shift (R12) - LIRR

Relief Shift (R13) - LIRR



Extra Board Shift X1 -LIRR

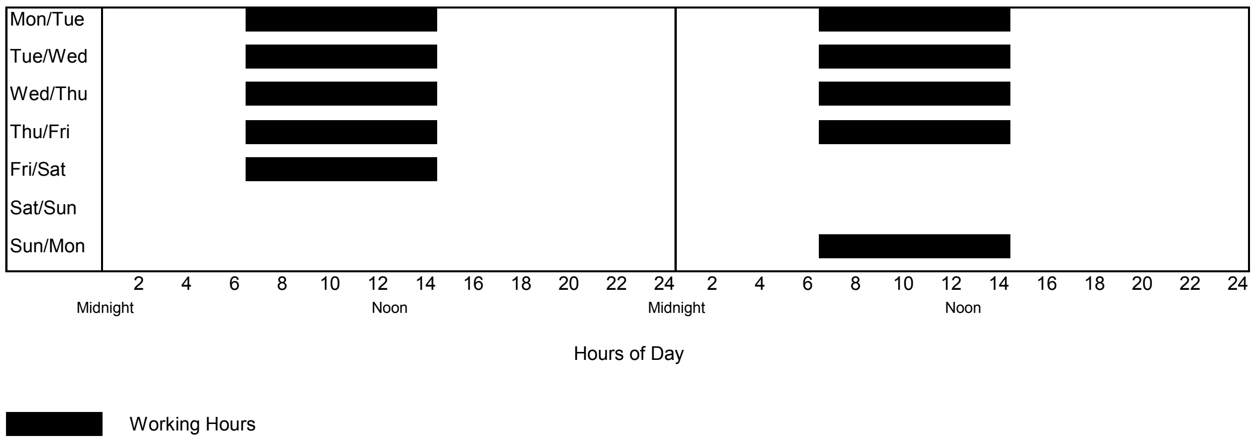


BNSF (SOUTHWEST) TRAIN DISPATCHER SCHEDULE FORMAT

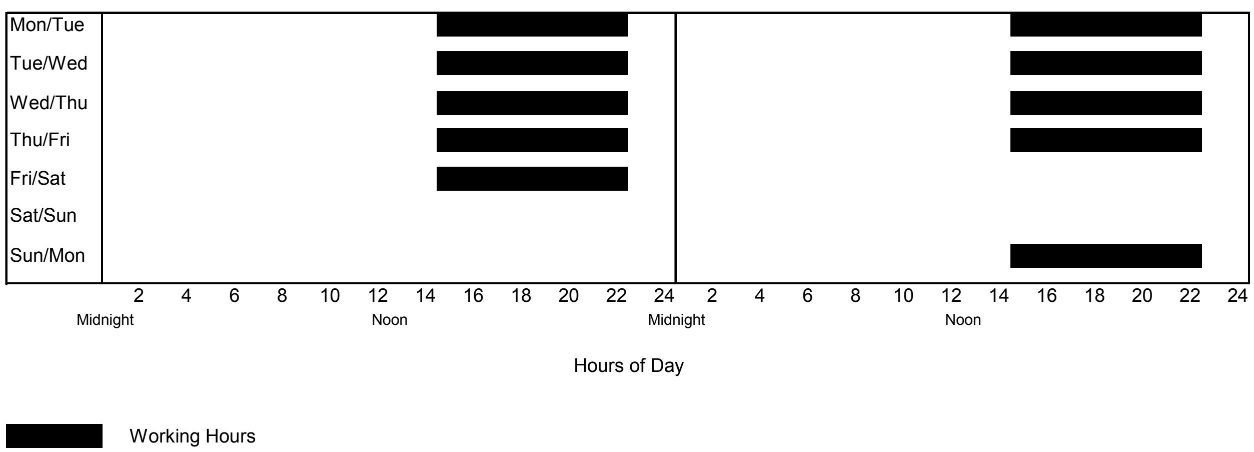
5On - 2Off **Non Self Relieving 3 Fixed Shifts with Swing Relief Crew**

SHIFT/ID			Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Regular Scheduled Jobs (1 Week Cycle)	D	1	D	D	D	D	D	-	-
	D	2	D	D	D	D	D	-	-
	D	3	D	D	D	D	D	-	-
	D	4	D	D	D	D	-	-	D
	D	5	D	D	D	D	-	-	D
	D	6	-	D	D	D	D	D	-
	D	7	-	D	D	D	D	D	-
	D	8	D	-	-	D	D	D	D
	E	9	E	E	E	E	E	-	-
	E	10	E	E	E	E	E	-	-
	E	11	E	-	-	E	E	E	E
	E	12	-	E	E	E	E	E	-
	E	13	-	E	E	E	E	E	-
	E	14	-	-	E	E	E	E	E
	E	15	-	-	E	E	E	E	E
	E	16	E	E	E	-	-	E	E
	N	17	N	N	N	N	N	-	-
	N	18	N	N	N	N	-	-	N
	N	19	N	-	-	N	N	N	N
	N	20	N	N	-	-	N	N	N
	N	21	N	N	-	-	N	N	N
	N	22	-	-	N	N	N	N	N
	N	23	N	N	N	-	-	N	N
Relief Jobs (1 Wk Cycle)	R	24	D-7	D-1	-	-	D-6	D-6	D-7
	R	25	-	-	D-3	E-7	E-7	E-6	E-6
	R	26	E-4	N-4	-	-	D-4	D-4	E-4
	R	27	E-1	E-1	N-1	-	-	D-1	D-1
	R	28	D-5	E-5	E-5	N-5	-	-	D-5
	R	29	N-4	N	N-5	N-6	N	-	-
	R	30	-	-	N-1	N-6	N-3	N-3	N
	R	31	E-8	E-8	N-7	-	-	D-8	D-8
	R	32	E-2	N-7	-	-	-	E-3	E-3
Extra Board Jobs (4 week cycle)	X	1	N	N	-	N	N	-	-
			N	-	-	N	N	N	-
			-	-	-	-	-	-	-
			D	-	-	N	N	N	N
	X	2	-	E	-	-	-	-	-
			-	-	-	-	-	-	E
			-	-	-	-	-	-	-
			-	-	-	-	-	D	-
	X	3	-	E	N	-	-	D	D
			E	E	N	-	-	D	D
			E	-	-	-	-	-	-
			N	-	-	-	N	N	-
	X	4	D	-	-	N	-	-	N
			-	-	-	D	-	-	N
			D	-	-	N	N	N	N
			-	-	-	-	-	D	D
	X	5	-	-	-	-	D	-	-
			-	D	-	-	-	D	D
			-	-	D	-	D	-	-
			-	-	-	-	-	-	-
	X	6	-	-	-	-	D	N	-
			-	-	-	-	-	-	-
			E	-	-	E	E	-	-
			-	-	-	-	-	-	E
	X	7	N	-	-	-	-	E	E
			-	-	-	D	D	-	-
			-	-	-	-	-	-	-
			-	-	-	-	-	-	N
	X	8	-	-	-	-	-	-	-
			-	-	-	-	-	-	-
			-	-	-	-	-	-	-
			-	N	-	-	-	-	-
	X	9	-	-	-	-	-	-	-
			-	-	-	-	-	-	-
			-	-	-	-	-	E	E
			-	-	-	-	-	-	-
	X	10	N	-	-	D	D	D	-
			-	-	-	-	-	-	-
			-	N	-	-	-	-	-
			-	-	-	-	-	-	-

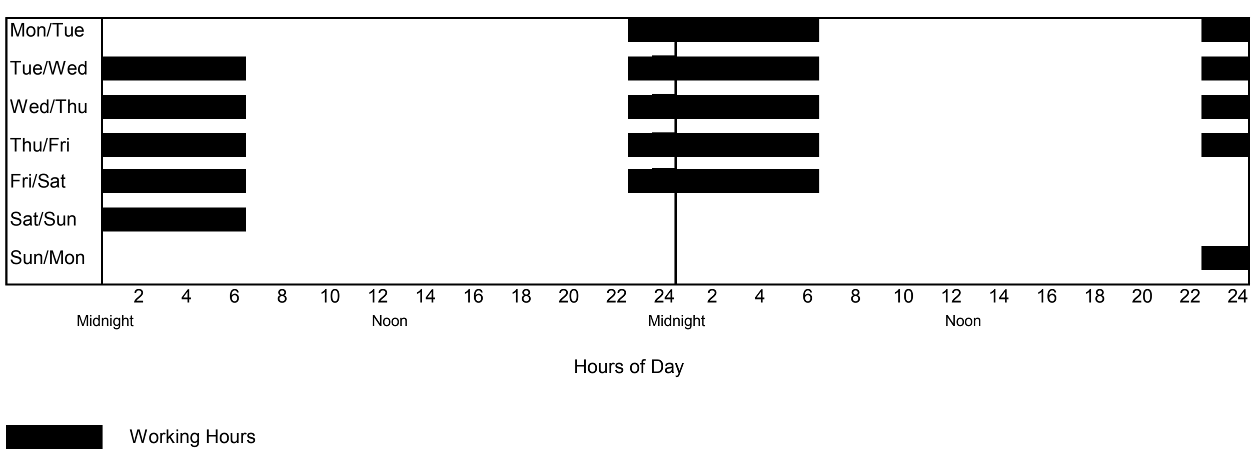
1st Shift (D1) - BNSF Southwest



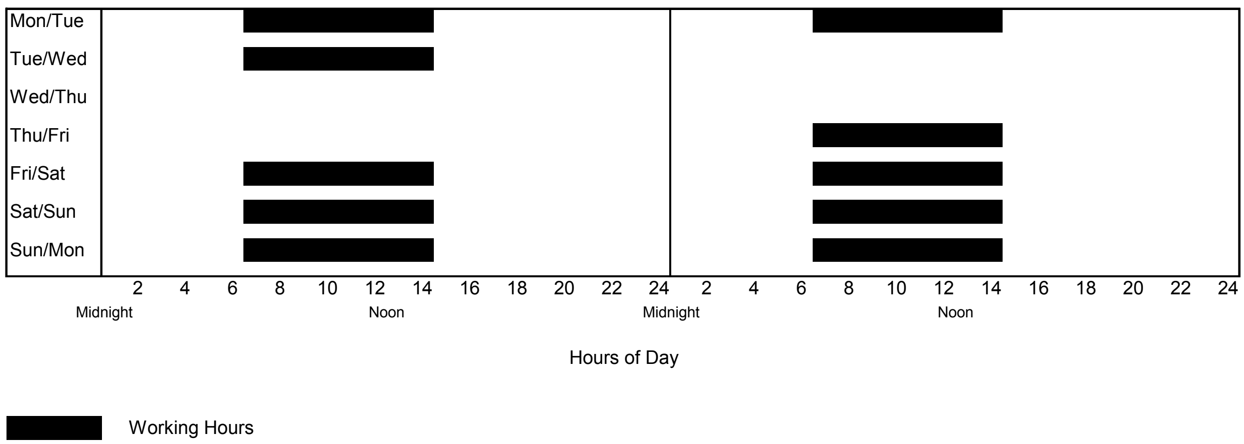
2nd Shift (E9) - BNSF Southwest



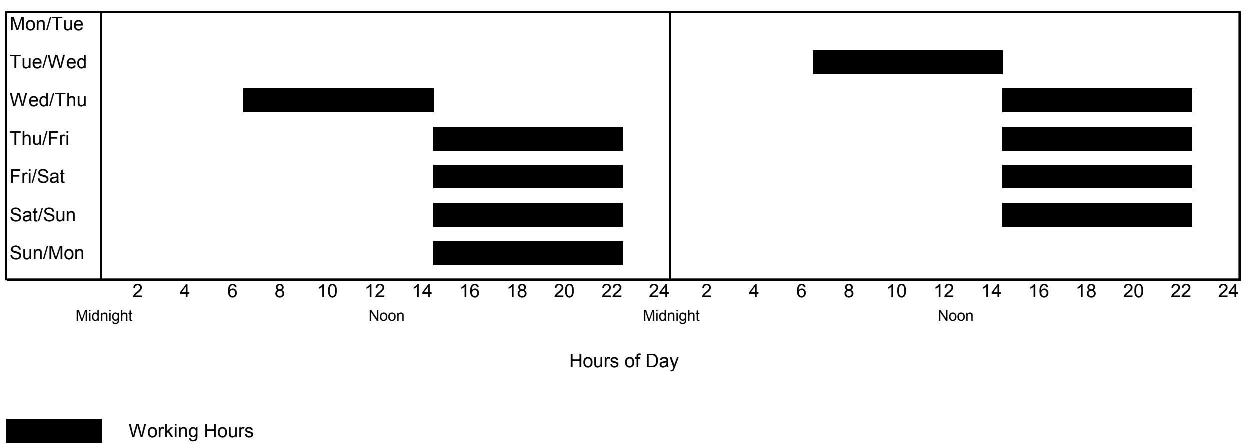
3rd Shift (N17) - BNSF Southwest



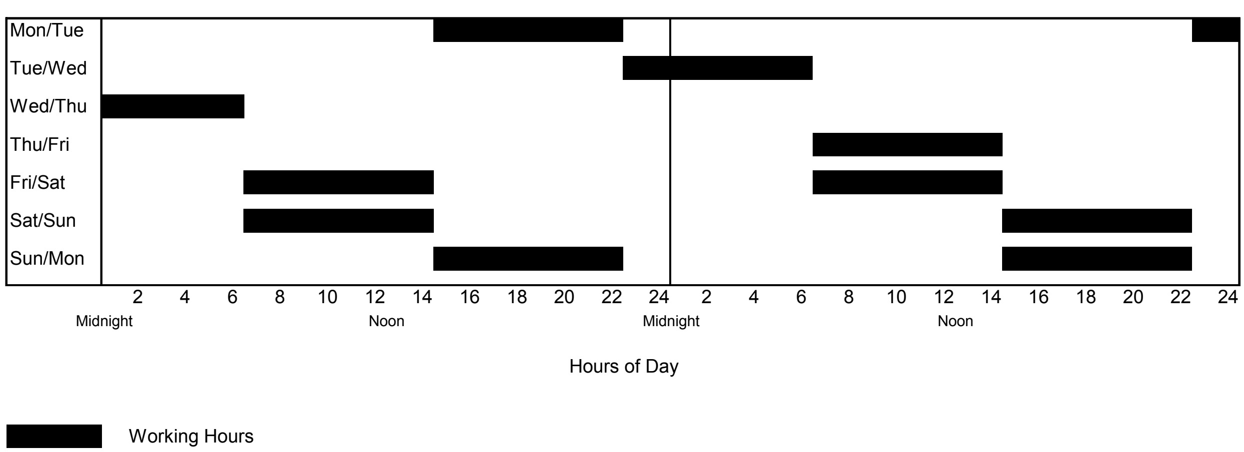
Relief Shift (R24) - BNSF Southwest



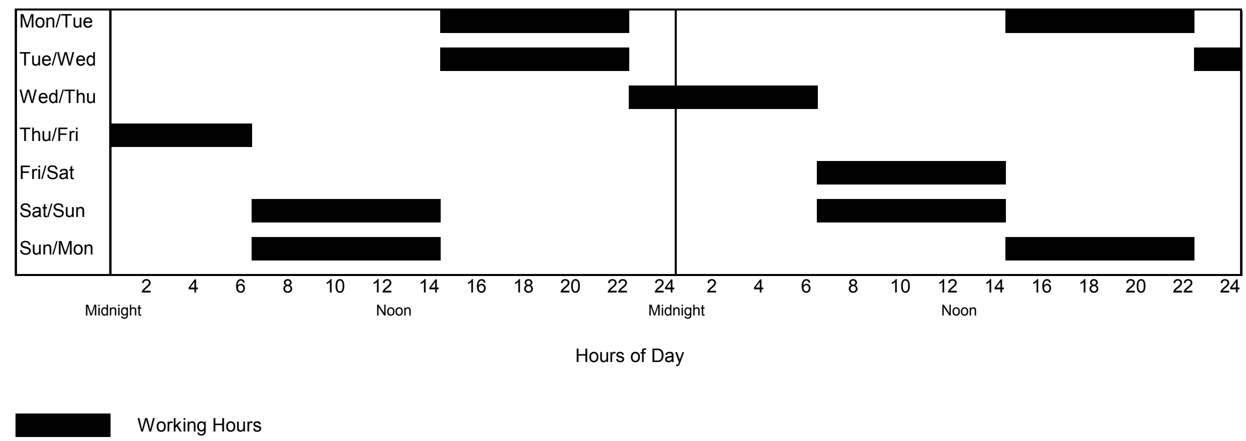
Relief Shift (R25) - BNSF Southwest



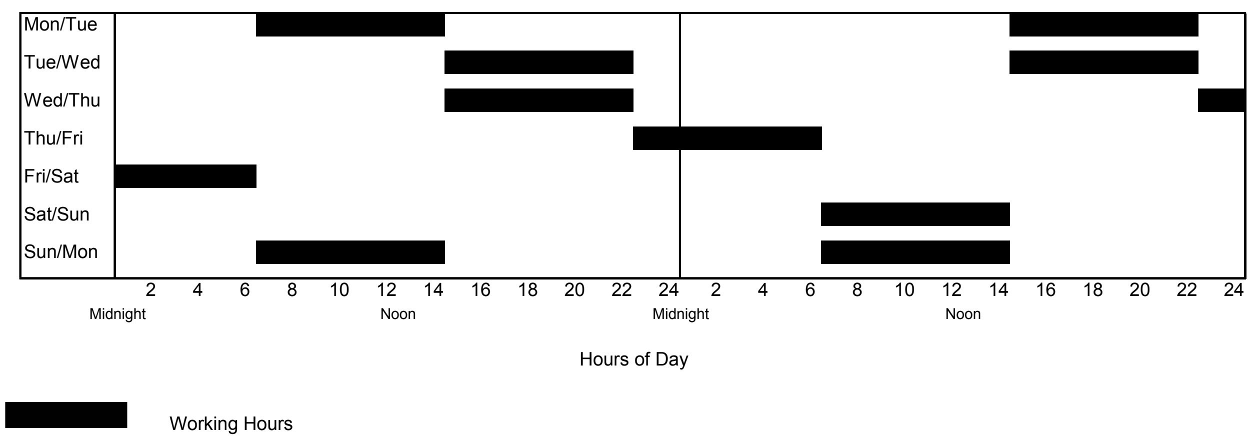
Relief Shift (R26) - BNSF Southwest



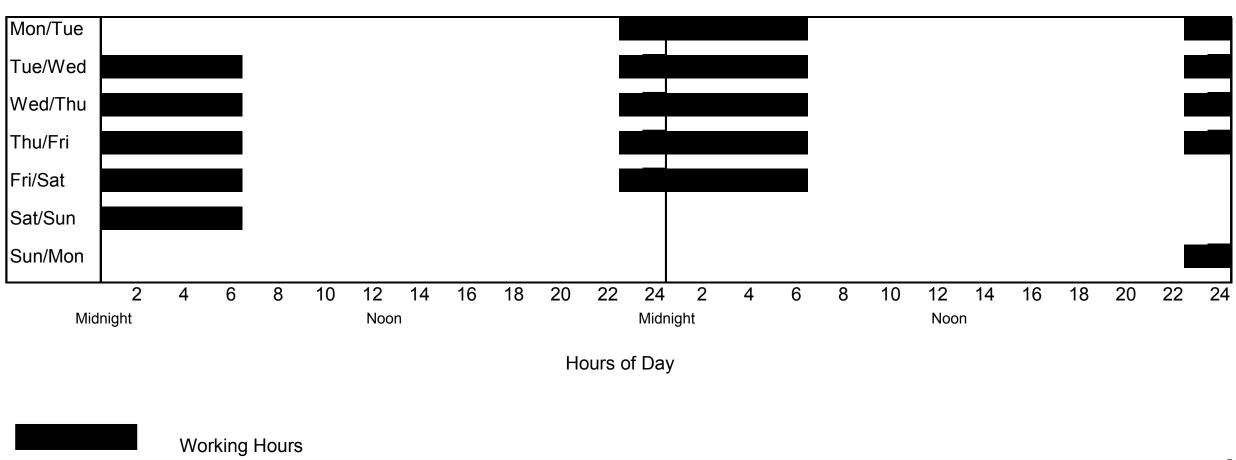
Relief Shift (R27) - BNSF Southwest



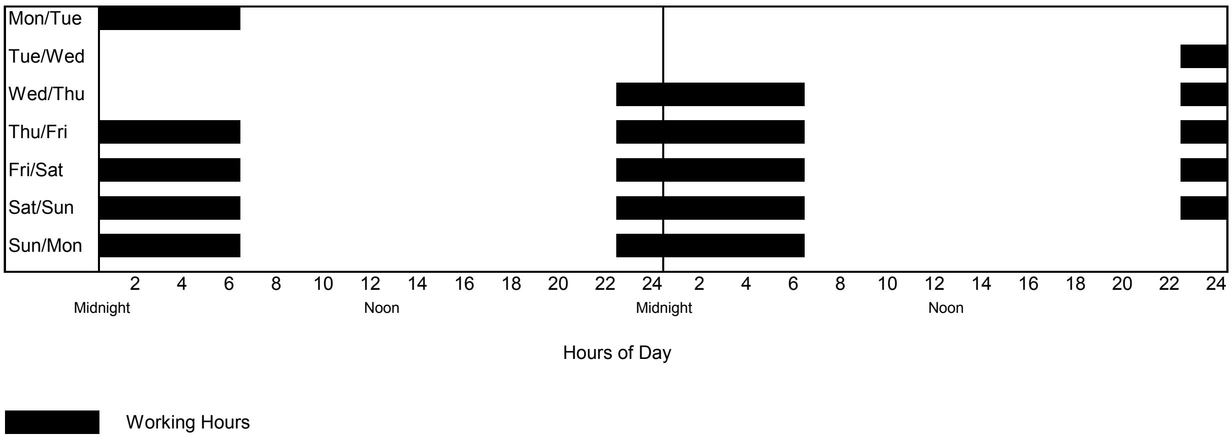
Relief Shift (R28) - BNSF Southwest



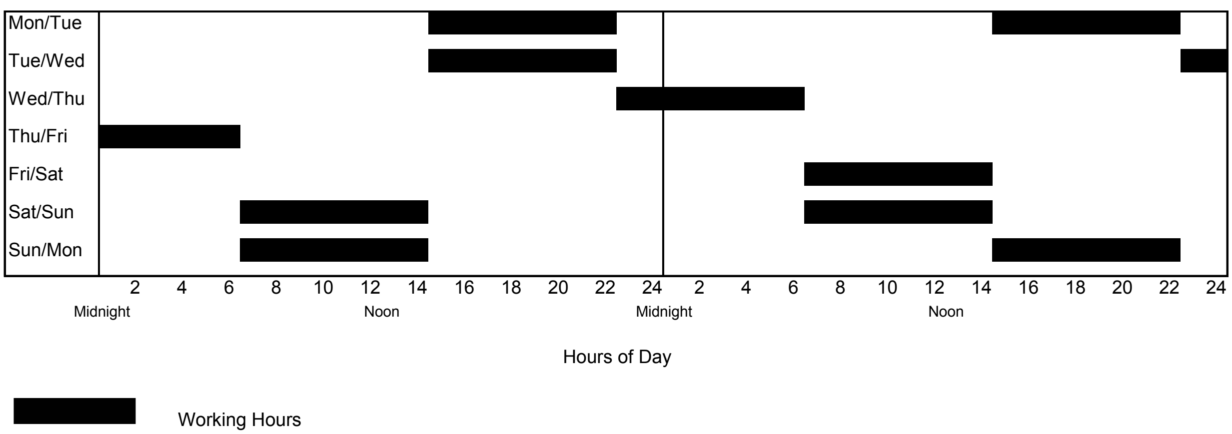
Relief Shift (R29) - BNSF Southwest



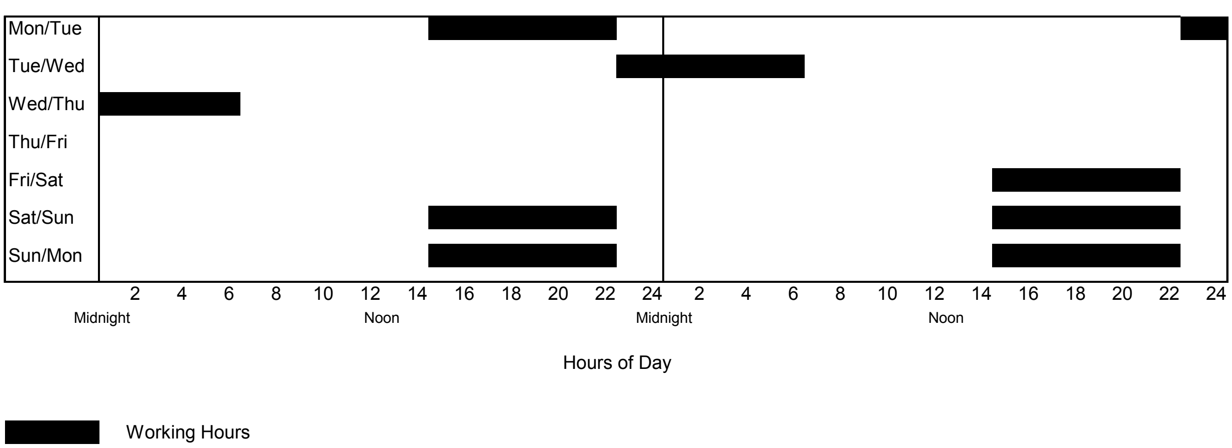
Relief Shift (R30) - BNSF Southwest



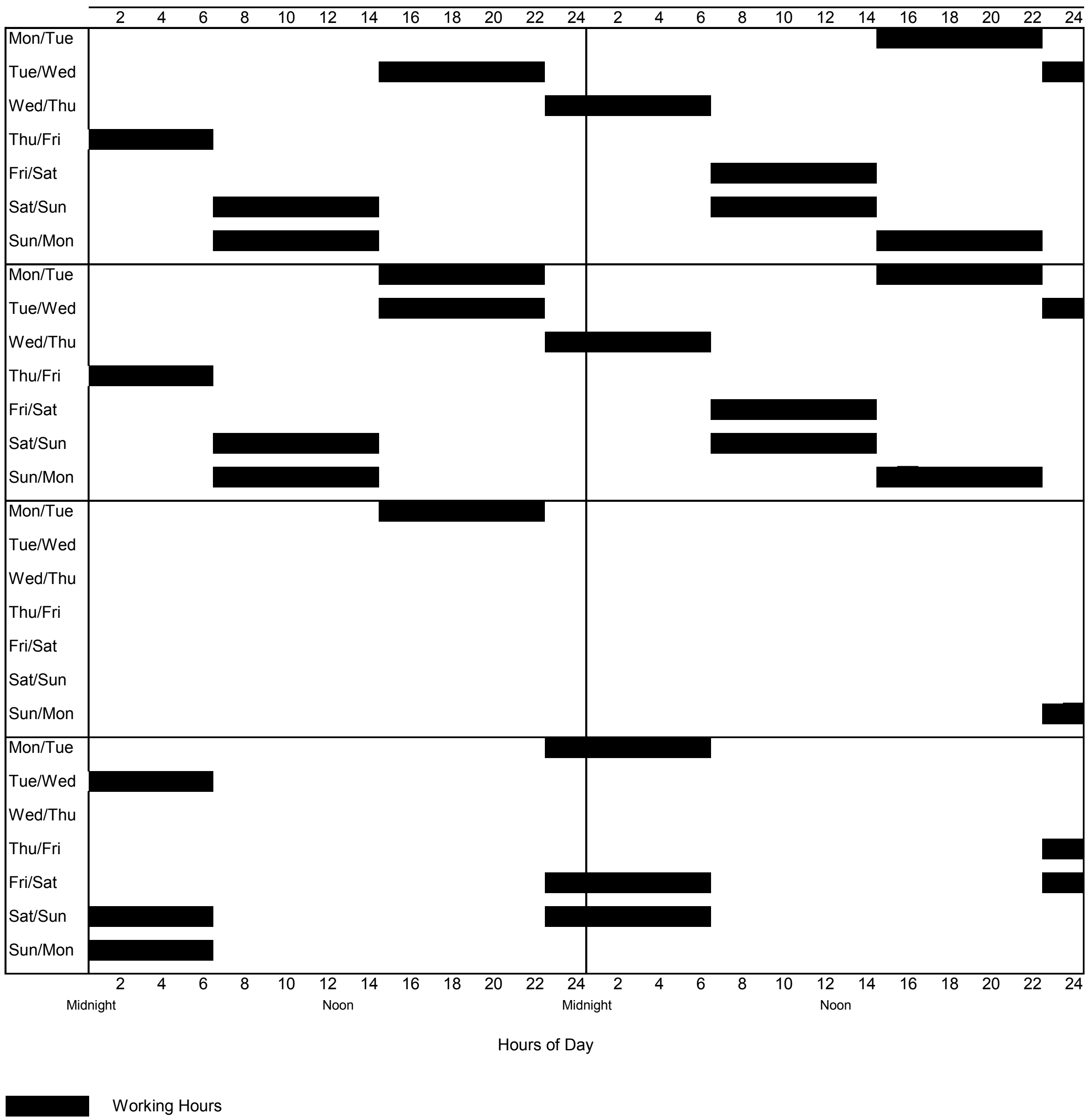
Relief Shift (R31) - BNSF Southwest



Relief Shift (R32) - BNSF Southwest



Extra Board Shift X3 -BNSF Southwest

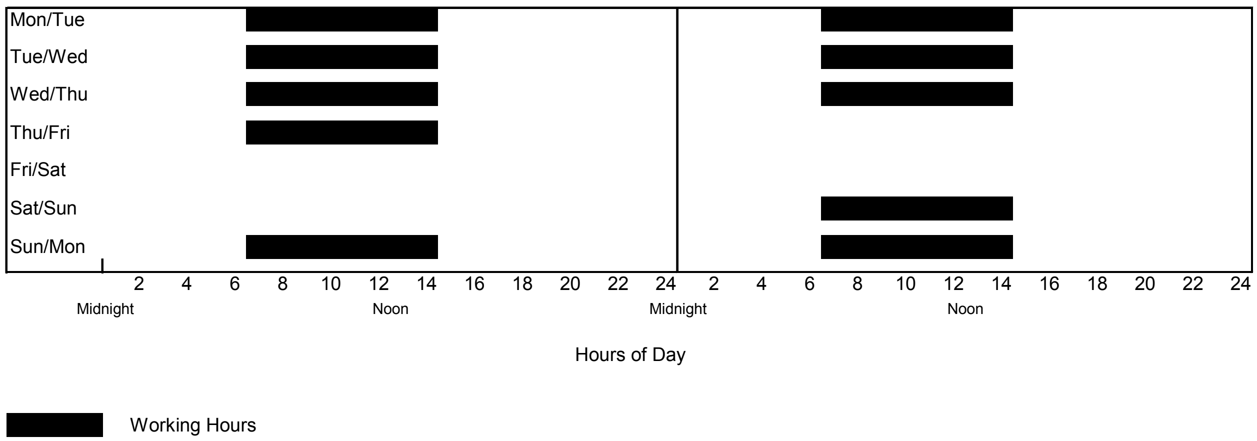


Union Pacific TRAIN DISPATCHER SCHEDULE FORMAT

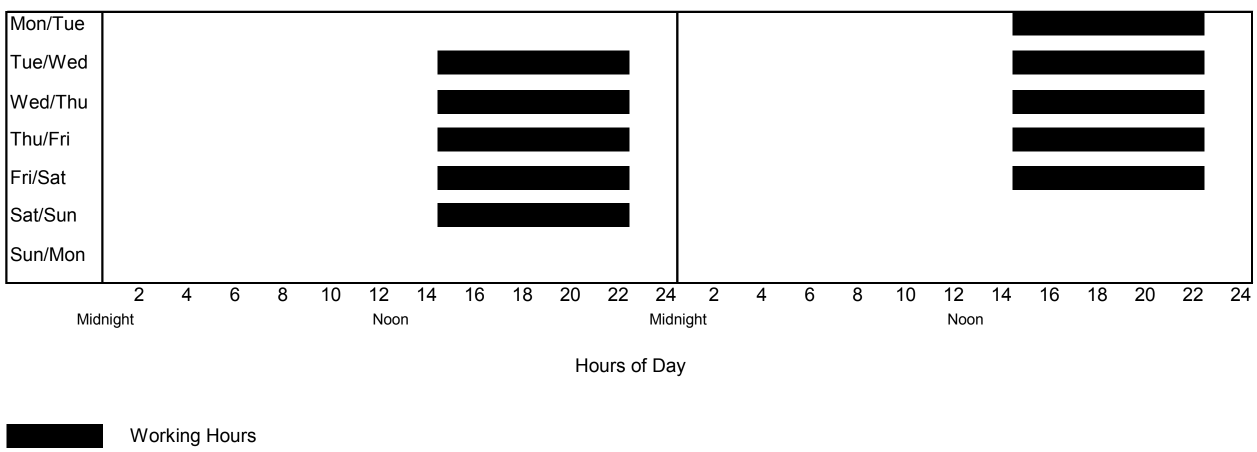
5On - 2Off Non Self Relieving 3 Fixed Shifts with Swing Relief Crew

	SHIFT/ID		Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Regular Scheduled Jobs (1 Week Cycle)	D	1	*D*	*D*	*D*	*D*	-	-	*D*
	D	2	*D*	-	-	*D*	*D*	*D*	*D*
	D	3	*D*	*D*	*D*	-	-	*D*	*D*
	D	4	*D*	*D*	*D*	*D*	-	-	*D*
	D	5	-	*D*	*D*	*D*	*D*	*D*	-
	D	6	*D*	-	-	*D*	*D*	*D*	*D*
	E	7	-	*E*	*E*	*E*	*E*	*E*	-
	E	8	*E*	*E*	*E*	-	-	*E*	*E*
	E	9	-	-	*E*	*E*	*E*	*E*	*E*
	E	10	-	*E*	*E*	*E*	*E*	*E*	-
	E	11	*E*	-	-	*E*	*E*	*E*	*E*
	E	12	*E*	*E*	*E*	*E*	*E*	-	-
	N	13	*N*	-	-	*N*	*N*	*N*	*N*
	N	14	*N*	*N*	*N*	*N*	*N*	-	-
	N	15	*N*	*N*	-	-	*N*	*N*	*N*
	N	16	-	-	*N*	*N*	*N*	*N*	*N*
	N	17	*N*	*N*	-	-	*N*	*N*	*N*
	N	18	*N*	*N*	*N*	*N*	-	-	*N*
Relief Jobs (1 Wk Cycle)	R	19	*D-5*	*D-6*	-	-	*D-4*	*D-4*	*D-5*
	R	20	*E-4*	*E-5*	*E-5*	-	-	-	*E-4*
	R	21	*N-4*	*N-4*	*N-5*	*N-5*	*N-6*	-	-
	R	X	-	*D-2*	*D-2*	-	-	-	-
	R	X	*E-3*	-	-	*E-2*	*E-2*	-	-
Extra Board Jobs (4 week cycle)	X	1	-	-	-	-	-	*N*	*N*
			-	-	-	-	*N*	*N*	*N*
			N	*N*	-	-	-	-	-
			-	-	*N*	*N*	*N*	*N*	-
	X	2	-	-	-	-	-	-	*N*
			-	-	*N*	*N*	-	*E*	*E*
			E	*E*	*E*	-	-	*N*	*N*
			-	-	*N*	*N*	-	-	-
	X	3	-	-	-	*D*	*D*	-	-
			D	*D*	-	-	*D*	-	*D*
			-	-	-	-	*D*	*D*	-
			-	-	-	-	-	-	-
	X	4	-	-	-	-	-	*N*	*N*
			-	-	-	-	-	*N*	*N*
			-	-	-	-	*N*	*N*	*N*
			-	-	*E*	*N*	-	*E*	-
	X	5	-	-	*E*	*E*	*E*	*E*	*E*
			-	*E*	*E*	*E*	*E*	*E*	-
			-	-	-	*E*	*E*	*E*	*E*
			-	-	*E*	*E*	*E*	*E*	*E*
	X	6	*E*	*E*	*N*	*N*	-	-	-
			-	-	-	*D*	-	*D*	*D*
			-	-	*D*	-	*D*	*D*	-
			E	*E*	-	-	*D*	*D*	-
	X	7	-	-	-	-	-	-	-
			E	*N*	*N*	-	-	-	-
			E	*E*	*E*	*E*	-	-	-
			-	*E*	*E*	-	*N*	*N*	*N*
	X	8	-	-	-	*E*	-	-	*E*
			E	-	-	-	*E*	*E*	*E*
			E	-	-	-	-	-	*D*
			E	-	-	*E*	-	*E*	-
	X	9	*D*	*D*	-	*D*	-	-	*D*
			D	*D*	*E*	*E*	-	-	*E*
			-	*D*	*N*	*N*	-	*E*	-
			N	-	-	*N*	*N*	*N*	-
	X	10	-	-	-	-	-	-	-
			-	-	-	-	-	-	-
			-	-	-	-	*N*	-	-
			N	*N*	*N*	*N*	*N*	-	-

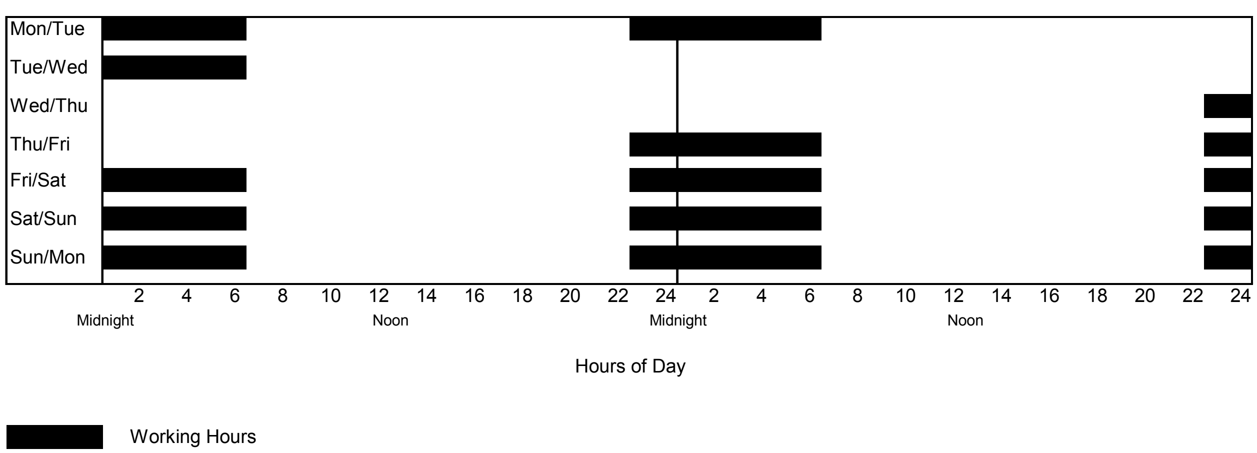
1st Shift (D1) - Union Pacific



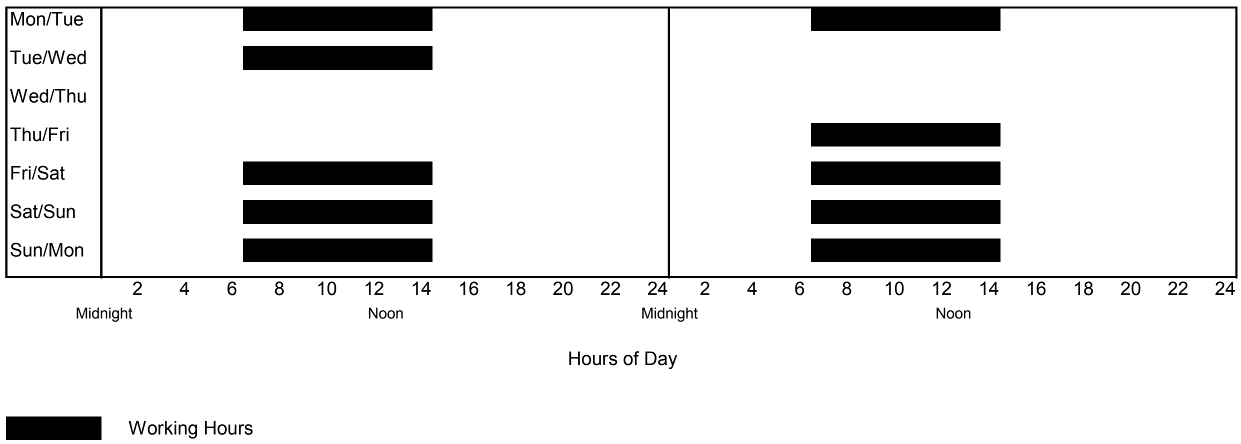
2nd Shift (E7) - Union Pacific



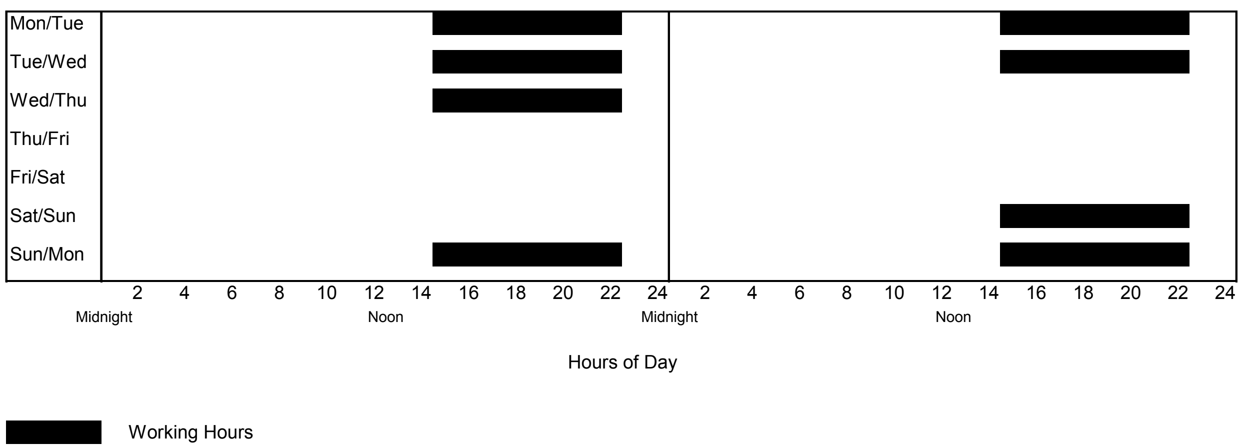
3rd Shift (N13) - Union Pacific



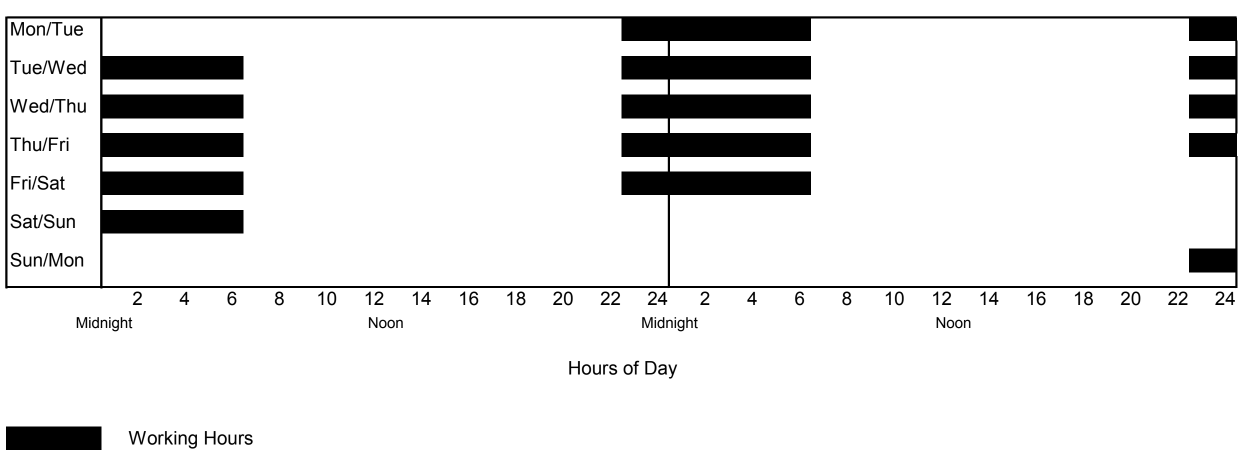
Relief Shift (R19) - Union Pacific

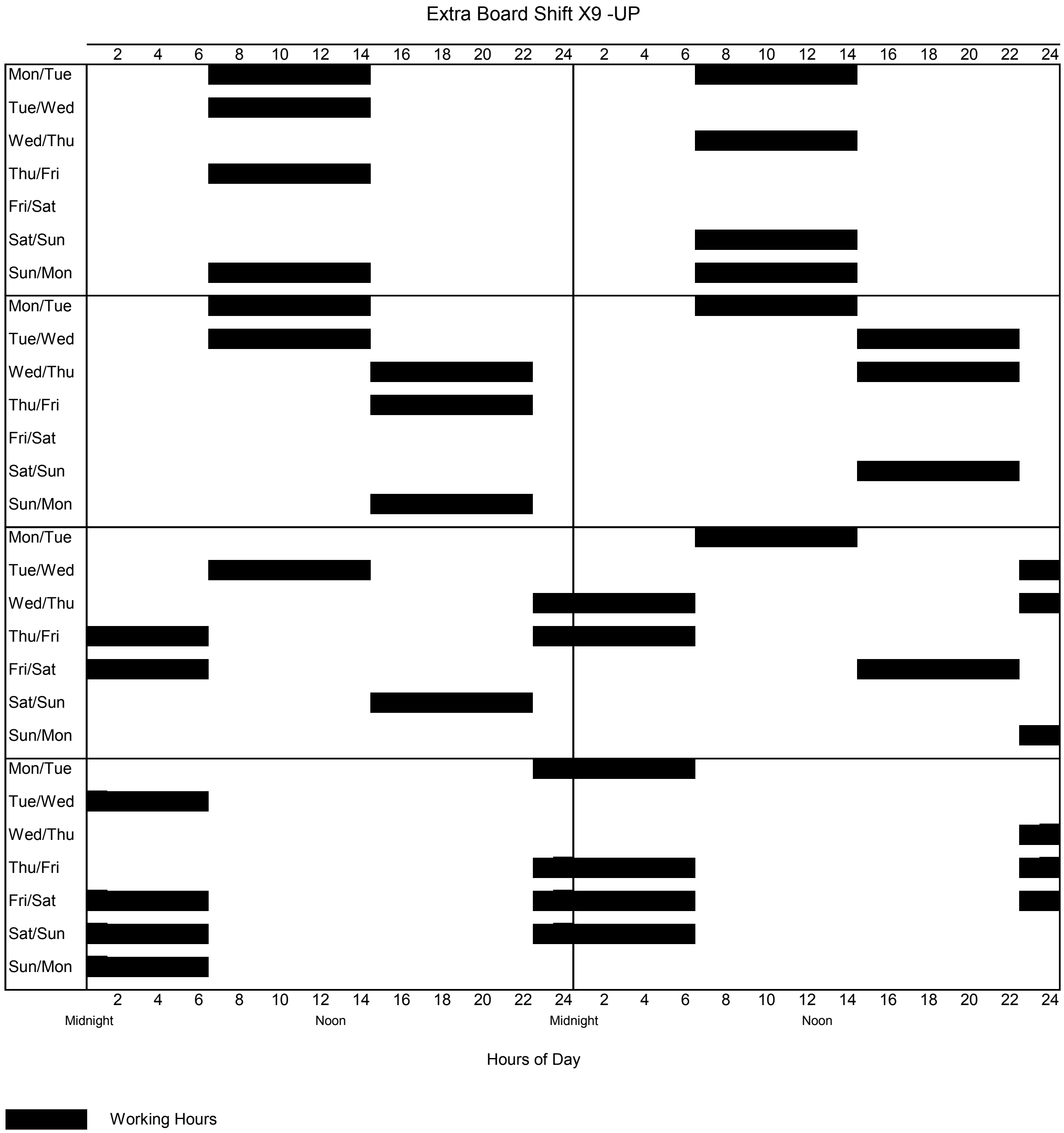


Relief Shift (R20) - Union Pacific



Relief Shift (R21) - Union Pacific




Extra Board Shift X9 -UP
2 4 6 8 10 12 14 16 18 20 22 24 2 4 6 8 10 12 14 16 18 20 22 24
Mon/Tue
Tue/Wed
Wed/Thu
Thu/Fri
Fri/Sat
Sat/Sun
Sun/Mon
Midnight
Noon
Midnight
Noon
Hours of Day
Working Hours

Appendix D: Alternate Schedule Formats

D.1 Fixed bracket (FB) schedules

- These schedules allow for each employee to be permanently assigned to the same shift. These types of schedule methods usually are of a seven day format where each employee is always off-duty on the same days each week (e.g., some dispatchers may be off-duty Saturday and Sunday, while others are off-duty on Tuesday and Wednesday). In addition, fixed bracket schedules have the following characteristics:
- Work and off-duty periods are usually uniform in length.
- Dispatchers are permanently assigned to a shift.
- The number of on-duty dispatchers may be uniform by day of week on each shift, or it may vary from day to day (e.g., in proportion to a cyclic day-of-week workload distribution).
- Dispatchers are on duty the same number of days and hr in every calendar week.
- Schedule equity, in terms of days off and shift assignments, is *not* provided.
- Complete team integrity and unity of command are *not* provided unless all team members and their supervisor are off-duty on the same days of the week.
- Holidays cannot be included as regularly scheduled off-duty days; and schedules are relatively easy to design compared to the other types of schedules discussed.

D.2 Basic duty cycle schedules

Principle properties of basic duty cycle schedules include the following:

- All dispatchers follow the same pattern of shift assignments and off-duty days (i.e., The duty cycle pattern), which continually repeats throughout the schedule design interval. The duty cycle is not necessarily restricted to seven days in length.
- Coverage is provided 7 days a week on each staffed shift.
- The number of on-duty dispatchers is nearly uniform by day of week on each shift.
- The number of on-duty dispatchers may be uniform by shift, or it may vary from shift to shift.
- Off-duty days are *not* fixed (e.g., An employee's off-duty days can change from week to week).
- Shift assignments are usually not fixed and may change within a single week or be fixed for several weeks (however, fixed shift assignments may be achieved by designing separate duty cycle schedules for each shift).
- In general, employees do not have to be on duty the same number of days and hr in every calendar week.
- Schedule equity, in terms of the number of on-duty assignments on each shift and the lengths of each employee's work and off-duty periods, is provided.

- Schedule equity, in terms of the number of off-duty periods, is also provided.
- The length, in days, of the duty cycle pattern is equal to the number of groups of dispatchers being scheduled.
- Complete team integrity and unity of command are not provided unless all team members and their supervisor are assigned to the same group.

D.3 Extended duty cycle schedules

This variant of the basic duty cycle schedule has all of the above properties of basic duty cycle schedules except that the length, in days, of the duty cycle pattern is a *multiple* of the number of groups of employees being scheduled. For example, if there are four groups of employees, then the duty cycle pattern might be 4, 8 or 12 weeks. In addition, extended duty cycle schedules have the following properties not necessarily provided by basic duty cycle schedules:

- "Better" schedules can be designed when the number of employees being scheduled is usually small.
- Work periods are uniform in length.
- Shift changes are less frequent than in basic duty cycle schedules.
- Extended off-duty periods are more easily provided than in basic duty cycle schedules.
- Scheduling of one-day off-duty periods and consecutive on-duty days on different shifts can usually be avoided.
- Over a long period of time(e.g., a year or more) the number of on-duty assignments on each shift, the lengths of work and off-duty periods, and the number of weekends and other days of the week included in off-duty periods, balance among employees.

D.4 Proportional rotating (PR) schedules (one-shift and multi-shift)

Principal properties of these schedules include the following:

- All employees follow the same duty cycle (the pattern of on- and off-duty assignments), which repeats continually throughout the schedule design interval.
- This duty cycle is a whole number of weeks in length.
- The number of groups of employees being scheduled is equal to the length of the duty cycle in weeks.
- The number of on-duty employees can be nearly uniform by day of week and shift, or it can vary from shift to shift, and by day of week on each shift.
- Employees' shift assignments can be fixed (one-shift schedules) or rotate periodically (multi-shift schedules).
- In general, employees are not on duty the same number of days and hr in every calendar week.
- There is schedule equity, in terms of the lengths of each employee's work and off-duty periods and the number of weekends and other days of the week included in each employee's off-duty periods.

- Multi-shift proportional rotating schedules are also equitable in terms of the proportion of each employee's time spent on duty on individual shifts.
- On- and off-duty periods of different lengths must usually be scheduled.
- For multi-shift schedules, employees are assigned to shifts for a whole number of weeks.
- Holidays can be easily included as regularly scheduled off-duty days.
- Team integrity and unity of command are not provided unless all team members and their supervisor are assigned to the same group.
- These schedules tend to be more difficult to design than fixed bracket or duty cycle schedules.

Abbreviations

BNSF	Burlington Northern and Santa Fe Railway
CTC	centralized train control
FRA	Federal Railroad Administration
LIRR	Long Island Rail Road
OSF	optimal staffing formula
RFF	relief factor formulas
SP	Southern Pacific Railroad
SRF	shift relief factor
UP	Union Pacific Railroad