# LOCOMOTIVE ENGINEER

# JOB ANALYSIS

BROTHERHOOD OF LOCOMOTIVE ENGINEERS

MAY, 1997

## TABLE OF CONTENTS

## I. INTRODUCTION

The last comprehensive analysis of the work of the craft of locomotive engineer was performed over fifteen years ago, and was produced by the Association of American Railroads (AAR), which is the industry's lobbying group. Since that time, the landscape at the locomotive engineer's workplace has changed dramatically. Modernized work rules have expanded greatly the tasks that may be required of a locomotive engineer. State-of-the-art locomotive technology has brought along with it the need for new skills. And the introduction and expansion of federal regulatory oversight of locomotive engineers is forging greater standardization within the craft.

Historically, there has been a measurable degree of differentiation, among the various classes of service, with respect to the time spent doing particular tasks. That is no less true today than it was thirty years ago. Yard engineers are likely to spend a greater part of their workday throwing switches, for example, than road engineers. Similarly, road engineers can expect to use computerized braking systems far more often than yard engineers. Nonetheless, there is a need to update existing studies, so they reflect the ongoing evolution of the craft.

It is our intention to be as thorough as possible in detailing the various tasks that a locomotive engineer must perform, and the skills that he/she must master. Therefore, we set out to detail what may be required of any engineer, rather than what will always be required of every engineer. While this may represent a departure from past methodologies, our approach is warranted by the fact that the work required of a locomotive engineer has become both more physical and more technology-related over the past twenty years, a trend that will continue into the foreseeable future.

## II. Duties, Tasks, and Functions

Over the past two decades, the duties, tasks, and functions of a locomotive engineer have been subject to a subtle, but steady, evolution. The typical work involved in operating a locomotive has been broadened to include a number of ancillary tasks. This incidental work, which includes functions historically associated with train service, shop crafts, and clerical forces, has been grafted onto the list of duties required of a locomotive engineer by the impact of technological change. Perhaps the most noteworthy consequence of this evolution is a marked increase in the amount of physical labor and the level of physical exertion now required of locomotive engineers.

In analyzing the contemporary duties of a locomotive engineer, several component tasks must be included. The core functions, of course, are those that pertain to the actual operation of a locomotive. Our study addresses incidental work that is not directly related to the operation of a locomotive according to the "traditional" railroad craft definition from which the work historically arises. For example, the performance of various ground duties by locomotive engineers actually is a transfer to their responsibility of some of the tasks once performed by train crew members. Moreover, many locomotive engineers have dual seniority, meaning that they may work part of the year in train service, depending upon the ebb and flow of business. Therefore, we have chosen to include traditional train service functions within the subsection of train service-related incidental work that engineers perform, with an appropriate caveat.

Likewise, given reductions in force among Maintenance of Equipment personnel within the industry, duties related to inspection, troubleshooting and minor repairs to equipment are set forth in their own section. Also included therein are the tasks associated with pre-trip inspections and tests. Finally, we have created a separate section to deal with duties that arise from new technologies. At present, these functions are few, and arise in only a limited number of settings. However, steady growth of this group of tasks over the next decade should be expected.

### A. Historic Locomotive Engineer Duties

This section contains only those functions that pertain to the operation of a locomotive. Therefore, these tasks apply to all locomotive engineers, regardless of the type of service they perform. Nonetheless, the ratio of time spent performing each task as compared to the others may vary, depending upon the class of service being performed, as well as peculiarities on a given railroad or in a specific area or location.

Locomotive engineers are responsible for their own safety. Therefore, they must ensure — to the greatest extent possible — safe access to and from their assigned work area, checking for potential obstacles and removing them as necessary. Furthermore, a locomotive engineer does not work in a vacuum. Because the engineer is responsible by railroad rule for ensuring rules compliance by others with whom he/she works, a locomotive engineer spends substantial time observing the performance of others.

Engineers must observe co-workers to see whether they properly utilize safety equipment, wear safety clothing (e.g., safety glasses, hard toe boots), and follow safety precautions and procedures in their work. Similarly, engineers must monitor the safety, conduct and performance of the train crew members.

Engineers must visually inspect their equipment to detect malfunctions or the need for adjustment and to ensure that it is in safe operating condition before starting work. They must ensure the proper placement of certain loads -- such as hazardous materials, and high or wide loads -- in trains. Engineers must review the train's consist, giving the physical makeup of the train, including weights, lengths, location of loads and empties, and cars requiring special handling.

While en route, engineers must ensure that all flags, lights and other signaling devices used by co-workers for protection are properly displayed and that all signals are properly used, including flag protection at the front and rear of the train, when required. The engineer must monitor the position of switches aligned by his/her crew, as well as supervising the calling of signals.

Finally, there are occasions when an engineer will observe and/or supervise the work of other locomotive engineers. For example, an engineer is responsible for supervising the handling and movement of a train when a student engineer is operating. In connection with that duty, the engineer must identify the needs of the student engineers in his/her charge. Similarly, an engineer may often be called upon to pilot, or supervise, the operation of a train when the engineer or conductor is not qualified on the physical characteristics of the territory.

In addition to observing the performance of co-workers, a locomotive engineer has the responsibility for vigilant observation of many other things. The locomotive engineer is responsible for monitoring the multiple processes that occur simultaneously during the operation of a train. Some are internal, occuring inside the locomotive; others are external, and are observed in the train's passing.

Among the observations that are connected with on-board phenomena are the interpretation of signals and indicators in the locomotive cab, including air brake gauges, load indicators, and speed indicators.[1] Engineers also must observe their locomotives during a trip to detect damaged or defective equipment. This is accomplished by listening for

1 For example, operating rules typically mandate that a locomotive engineer verify accuracy of the speed indicator at his/her first opportunity during each run and at other times as required.

infrequent sounds such as warning alarms, horns, or bells, or by detecting unusual vibrations or changes in sounds in terms of loudness, pitch, rhythm, or duration. Additionally, the engineer must be alert for the presence of odors or smells associated with burning, overheating, or process malfunctions. This ability to recognize equipment sounds and/or noises associated with malfunctions or irregularities is part of the responsibility to troubleshoot equipment.

The locomotive engineer also must observe, and react to, a variety of external stimuli. Among the most important is the responsibility to interpret and respond to audible signals and warnings (e.g., radio, engine whistles, bells, sirens, and exploding torpedoes). Likewise, the engineer must observe, distinguish and comply with indications conveyed by colors displayed by signals and apparatus (e.g., lights, flags, reflectorized devices, and colored placards). The engineer must monitor readings from the end-of-train (EOT) device, to ensure the device is operating properly. Also, the engineer must observe track conditions, including broken rails, defective switches, defective signals, track obstructions and weather-related problems. The engineer also must monitor train inspection devices, such as Hot Box Detectors (HBD), Dragging Equipment Detectors (DED), etc., for indication of any irregularities.

A number of other observations enable the engineer to anticipate operating problems. All of the following occur outside the locomotive cab, but are indispensable for the safe operation of the train: 1) observing the railroad right-of-way, passing trains, lading for shifted loads, defective blocking, spillage, etc.; 2) checking for vehicular traffic at crossings; 3) monitoring situations at all times for fire, spill hazards, suspicious or unauthorized activity; 4) monitoring for warning or emergency situations by visually identifying warning lights or flags, or changes in color, distance, brightness, speed or visual stimuli; and 5) observing for gross or small changes in the location, appearance, or relative position of equipment or objects.

These observations also require the processing of the information obtained, for the purpose of making judgments. For example, an engineer must monitor the train's actual movement against time schedules or time limits imposed by order or warrant, and adjust his/her style and method of operation accordingly. Such adjustment in operating methods also could come into play as a result of an engineer observing the distances and speeds of vehicles approaching grade crossings, in an attempt to prevent a collision.

The communications responsibility of the locomotive engineer begins when he reports for duty. The crew is responsible for conducting for what is termed on most railroads as a "job briefing" — a meeting among the crew to review pertinent information on the work they are to perform on that day. Among the items discussed in the typical job briefing are applicable track warrants, track bulletins, timetable schedules, track and speed restrictions, classification of trains, and train precedence. The job briefing also is the first opportunity to communicate information to train crew members concerning movement instructions, stops and anticipated delays for oncoming trains. A locomotive engineer may face discipline for failing to conduct a proper job briefing if a communications breakdown later leads to an operational problem.

During the course of a tour of duty, a locomotive engineer will communicate with others almost constantly. The engineer may be the originator, the recipient, or merely a means of relaying a communication. Communications involving locomotive engineers occur through a variety of media. Communications may be written or they may be oral. Oral communications can occur face-to-face, over a telephone, radio or other electronic device, or may take the form of hand, lamp, wayside, cab and whistle signals. Communications may be had with train crew members, train dispatchers, operators, yardmasters, or various supervisory personnel.

No communication can be considered less important than any other, as there are safety risks inherent in all misunderstood communications when the movement a of train is affected. Good communication is imperative in many situations, like the following, which are by no means all-inclusive:

- communicating wayside signals in a clear and audible manner to co-workers for verification of meaning to avoid errors in interpretation;
- instructions indicating which cars are to be switched and the track on which they are to be placed;
- reporting the results after observing the condition of a passing train;
- reporting signaling and switching equipment failures to appropriate personnel;
- reporting any irregularity or other condition affecting the movement of trains; and
- alerting others to unsafe conditions, including communicating with fire departments, emergency squads, police, etc.

Locomotive engineers often must tap their communication skills in order to keep the railroad running. Engineers must accurately report and take appropriate action to correct equipment breakdowns as quickly as possible. Failing that, they must identify or analyze defective units and indicate the necessary corrective action. If necessary because of a reduced train crew, they must provide flag protection to their head end while awaiting a rescue, and to communicate their location to other trains.

Locomotive engineers also provide most of the on-the-job training that is given to student engineers. Once again, communication skills are needed, because it is the role of the engineer as instructor to explain to the trainee the technical information he or she needs to grasp, such as what is being done, why it is being done, and what the results mean. Also, engineers must evaluate the performance of students in their charge both to the student and to the training staff.

Most of the communicating an engineer does at the end of a tour of duty is in written form, but it is important, nonetheless. The engineer must prepare required reports such as time slips, delay reports, unusual occurrence reports, accident reports, and the engine inspection or work report. Moreover, the engineer may be required to explain the nature of defective equipment or other problems to a supervisor in person or by telephone. When footboard relief is being provided, the engineer being relieved must review all orders, instructions, and authorities with the relieving engineer, making certain they are understood. In the alternative, if the relieving engineer is not present upon arrival, the engineer being relieved may need to write notes describing actions taken or providing other information for the benefit of the relieving engineer. In sum, good communications skills are a must for a locomotive engineer.

As the only railroad industry workers who must maintain federally-mandated certification in order to ply their trade, locomotive engineers constantly amass and process information from a variety of sources, including the observations and communications that we refer to elsewhere in this section. Engineers also amass and process information from a variety of written sources, with which they must be intimately familiar. Obviously, engineers must be capable of applying various laws and regulations pertaining to hours of service, hazardous materials, locomotive inspection, brake testing, engineer certification, the use of alcohol and drugs, and the like.

The list of railroad-specific information with which an engineer must be conversant is even larger. The litany of general knowledge that a locomotive engineer brings to work every day begins with the operating rules. Additionally, the engineer must stay informed of General Orders, Bulletin Orders, Division Notices, Timetable Special Instructions, and any other information relevant to train movements in his/her assigned territory. This includes the ability to interpret any special instructions as required.

In addition to this general railroad-wide knowledge, each locomotive engineer must be proficient on the physical characteristics of the territory over which he/she is expected to operate. This includes keeping mental track of grades, curvatures, mile posts, stations, switches, and other pertinent locations. It means knowing the length of sidings, and committing to memory the various restrictions — speed, height, width, etc. — on various tracks at various locations.

Keeping abreast of these requirements necessarily means reading and understanding posted bulletins, memoranda, train movement instructions, regulations and rule books, circulars, and/or other messages. It also means reading and understanding the basic information and data provided in rule books, timetables, and special instructions. And, with the advent of 21st Century locomotive technology, today's engineer must be able to read and comprehend written technical training material such as textbooks on equipment operation, troubleshooting procedures, equipment tolerances, and equipment capabilities.

Moreover, in these times of larger trains and smaller crews, it is now more important than ever that each locomotive engineer have a solid understanding of a railroad's safety rules, practices, and emergency procedures. Armed with this information and knowledge, the locomotive engineer is now ready to actually begin a tour of duty and make a trip. The informational aspect of the remainder of the engineer's day includes building on the foundation described in the preceding paragraphs.

At sign-up time, the engineer once again will examine and review with the train crew all applicable general orders, special instructions, bulletin notices, track warrants, track bulletins, timetable schedules, track and speed restrictions, classifications of trains, and train precedence to ensure compliance. The engineer also will synchronize his/her watch with a standard clock (or the dispatcher) and with the conductor to ensure that the crew has the correct time.

Next, the engineer will inspect the locomotive consist for operational readiness, to verify that the proper quantity of fuel, sand, water, flagging equipment, and other supplies have been provided, as required by federal and company rules. The engineer also will perform the "seatbox" air brake test on the locomotive, and the initial or intermediate terminal air brake test on the train, as required by federal power brake law and company rules.

Prior to leaving the terminal, the engineer will receive any authority for movement that was not previously given, ensuring the accuracy of dictated track warrants and track bulletins. While en route, the engineer will both receive and generate additional information. Movement authority will be extended as the need arises and the opportunity presents itself to the dispatcher. To accomplish this safely, the engineer will need to record the times of departures and arrivals at all locations, and verify for the dispatcher the location of his or other trains through electronic or verbal means. Finally, whether compelled by rule or not, locomotive engineers typically maintain a record of all authorities received, unless it becomes necessary to physically turn the authority over to a relieving engineer.

The essence of being a locomotive engineer lies in the exercise of judgment. Railroads refer to the "safe and efficient" movement of trains, and the balance lies in the hands of the engineer. Whether the job involves moving a train over the road, classifying cars in a yard, or spotting cars at an industry, it is the skill of the locomotive engineer that realizes the railroad's goal. The task is not simply one of operating throttle and brake to control the speed of the train.

Safe train movement requires a timely response to signals from a variety of sources, including wayside signals, cab signals, color light signals, position signals, torpedoes, flags, and hot box and dragging equipment detectors, as well as hand, flag, lamp and radio signals from crew members. This visual information must be rapidly coordinated with such considerations as locomotive and train characteristics, terrain, and weather conditions, for the locomotive engineer to determine the appropriate time to initiate braking or acceleration.

Some railroads contend that operating rules and procedures are drafted with sufficient attention to detail that a locomotive engineer needs to exercise little, if any, judgment. In other words, those railroads argue, the engineer's role is limited to identifying and selecting from a set of alternatives the most appropriate course of action to solve a problem based on available guidelines. However, that contention assumes something that can never be assumed in an industrial setting — especially when the plant is outdoors — namely, that things will work as designed and intended at all times.

The reality — as any locomotive engineer knows — is that engineers often must solve problems in cases where policy, current procedure, or past practice is not available. It is precisely at that point where the knowledge previously detailed becomes paramount, for the cornerstone to successfully handling unexpected problems begins with an engineer's familiarity with rules, territory and equipment. From that base, the engineer can observe and correctly recognize situations that are likely to develop into problems and, then, determine which potential courses of action would endanger personnel or property.

Particularly in this day and age of centralized dispatching operations, often thousands of miles removed from the actual operation, the locomotive engineer serves as the eyes and ears of the Train Dispatcher. Therefore, information on conditions that could adversely affect train movement is vital. For example, the safe and expeditious handling and movement of a train during severe weather is among the greatest challenges a locomotive engineer can face. It is the engineer's responsibility to apply his/her knowledge of the territory, including terrain, grades, curves, and grade crossings, in order to operate the train in a safe and satisfactory manner.

It also is the engineer's responsibility to respond appropriately to unusual conditions or circumstances, and to take appropriate action when impending accidents or other emergency conditions exist. The engineer must successfully modify his/her train handling techniques in response to problems, malfunctions, and changing conditions, such as determining the speed of a moving train if the speed indicator malfunctions. The engineer also must take appropriate emergency actions in the event of equipment malfunction, using safe, temporary methods when an emergency situation dictates action, such as bringing a train to a controlled stop following an unintentional emergency application of the brakes. Given the variety of train make-ups and differences in terrains, there is no "one-size-fits-all" operating instruction that will always produce the safest outcome when a situation arises that demands a split-second judgment on the part of the locomotive engineer.

Some of the tasks an engineer performs are repetitive or sustained. An engineer performs a variety of work activities — especially on yard assignments — that require making quick or repeated flexing movements (e.g., bending, stretching, twisting, reaching) with arms, legs, or body. Moreover, a locomotive engineer must react and respond quickly when the appearance of a stimulus requires the initiation of an appropriate response (for example, responding to alarms or to sounds indicating an equipment malfunction or a less favorable signal indication).

A locomotive engineer must remain sitting for more than one-half of every work day and/or for extended periods of time. Further, the engineer must repeat the same non-strenuous physical tasks or activities for an extended period of time. Operating a locomotive requires the use of fingers and hands, and often involves the use of hands simultaneously when each hand is performing a different part of an operation. This requires coordinating both gross hand movements and fine hand movements with visual information, and generally requires keeping the hands and arms in a steady, set position with minimal tremor.

However, the job of a locomotive engineer can in no way be considered sedentary. Engineers routinely lift and carry objects or materials weighing up to 20 pounds, regularly pull and push weights between 20 and 50 pounds, and can be required to handle weights up to 85 pounds. Locomotive engineers must climb ladders and/or stairs to board locomotives. Locomotive handbrakes must be released and applied as required. The level of reading required by the "paper railroading" that has evolved throughout the industry can produce minor eyestrain. Moreover, locomotive engineers can be required to engage in all these activities for up to twelve hours per day,[2] with as little as eight hours off duty between shifts, often with weeks passing without a relief day.

### B. Duties Arising From Incidental Train Service Work

Besides the numerous historic duties that have carried through to the present, today's locomotive engineer also performs a variety of tasks that traditionally have been classified as train service work. There are two reasons for this change. The first is that the reduction of engine and train crew sizes over the past 35 years have caused certain work in connection with the movement of locomotives to be assigned to the locomotive engineer, because the locomotive fireman and the head brakeman — who used to perform that work — no longer exist.

The other cause stems from the use of train service workers as the source of supply for future locomotive engineers. Many locomotive engineers also have seniority as conductors/brakemen, and continue to work in that capacity when the manpower needs of a particular railroad dictate. It should also be noted that engineers on light engine and

2 Interim periods of release of four or more hours at designated terminals can extend the workday beyond twelve consecutive hours.

helper crews fall into this second category on many railroads, because there is no conductor or brakeman on such jobs; therefore, light engine crew and helper engineers literally "do it all."

When coupling locomotives for multiple or in-tow operations, locomotive engineers now must align drawbars by lifting, pulling, or pushing on the drawbar, and pull the pin-lifter rod to raise the knuckle pin. When making light engine moves, the engineer must operate and insure the proper alignment of various designs of track switches (e.g., puzzle, spring) and derails (e.g., hand-thrown, dual control or electric) to change the route of the engine within yards or on the road. Moreover, the engineer is required to handle weights of 50 pounds or more, and must be able to maintain his/her balance while working in or around moving equipment, on uneven terrain, or on track ballast.

For engineers with dual seniority, it is necessary to go further, and specify train service duties that have not, heretofore, been detailed. The "traditional" work of a conductor can be subdivided into three subcategories — clerical, supervisory and physical. The clerical duties include: 1) verifying the wheel report by comparing it against the actual cars on train; 2) arranging train pick-ups and/or set-outs by determining which tasks should be performed, in what order; and 3) recording or logging set-outs and pick-ups at industry sites.

The supervisory duties of a conductor are similar to those of a locomotive engineer, as enumerated above. Conductors read switch lists and oversee switching operations, and ensure proper setting of hand brakes and loading of cars. Conductors also coordinate the work of others, ensuring that they understand the activities involved and following up to verify that activities are completed effectively. On the ground, conductors signal crew members, including the locomotive engineer, for movement of the engine or train using lantern, hand and/or flag signals, or radio to indicate when to start, stop, back, or set or release air brakes.

Conductors also perform a variety of physical tasks. In the yard, conductors perform flat and hump classification switching to properly group cars, which requires operating brake cut-out and bleeder valves, switches and cutting levers. They ride moving cars by hanging on grab irons or ladders, sometimes for extended periods of time. Conductors get on and off moving or stationary equipment while performing industrial, station, or yard switching to set or release hand brakes, or to perform other duties, although some of these functions are becoming rare, as increasing numbers of railroads have placed restrictions on boarding or riding moving equipment in recent years. These situations also frequently arise when it is necessary to provide protection against vehicular traffic at grade crossings.

On the road, conductors are responsible for adding and setting off cars, as necessary. In connection therewith, conductors may be required to inspect all cars that are picked up during the trip before leaving the yard or when required (e.g., air hoses, angle cocks, knuckle coupling, hand brake, shifted loads, EOT and all running gear, wheels, axles, trucks, and brake riggings). When the train is reassembled, the conductor must carry and attach the EOT to the last car of the train, connecting it to the air brake system.

Should equipment trouble develop on the road, the conductor must inspect the train, which sometimes involves walking the length of the train to distances of more than a mile, frequently over uneven terrain. If necessary, the conductor must remove or replace broken knuckles, and carry replacement knuckles to the location of the break. Similar repairs may have to be effected to the braking system, such as replacement of air brake hoses and/or gaskets. Failing those repairs, the conductor would be required to chain and set out cars with broken couplers or irreparable brake defects.

## C. Duties Arising From Work On or About Equipment

Locomotive engineers have come to perform increasing amounts of incidental mechanical work because of consolidations of railroad mechanical facilities, which has resulted in greater reliance on locomotive engineers to perform daily locomotive inspections and a certain degree of maintenance. While each locomotive engineer is not responsible for the daily inspection of his/her consist at the beginning of each tour of duty, the responsibilities and tasks listed in this section can arise on any given day.

The centerpiece of incidental mechanical work is the locomotive inspection, which is performed in accordance with FRA regulations and/or railroad policy. The FRA-mandated inspection normally is performed in the field, while other pre-trip inspections may be performed on an engine service track. The locomotive engineer may need to inspect literally dozens of equipment components.

Inspection of the air brake equipment and brake apparatus must include brake shoes, beams, hangers, rods and associated equipment, ensuring that all angle cocks, cut-out cocks, etc., are properly lined. The engineer must inspect interior cab components such as bells, windshield wipers, horns, seats, etc., and all locomotive doors, to ensure they are properly secured and not defective. The engineer must also inspect the locomotive(s) for any visible or audible leaks in sand, water, fuel, air or oil lines, as well as levels of all these supplies. The inspection may include a check of all safety appliances, including hand holds, sill steps, grab irons, brake platforms, running boards, uncoupling levers, etc. Exterior components that must be inspected as part of a daily inspection include: wheels, in particular flanges, rims, treads, plates, hubs, axles, and bearings; friction journal bearings and wedges for proper lubrication; truck sides and truck bolsters, for defects, cracks, etc.; and car frames and car bodies for holes, cracks, and other defects.

Depending upon the condition of the locomotive(s) assigned to the engineer, any variety of physical tasks may be required in order to render the consist fit for service. The engineer may begin by turning his/her engines on a wye or turntable so that the cab faces properly. It may also be necessary to start one or more locomotives, by operating switches, valves, and circuit breakers in the proper sequence.

Putting together a multiple unit consist involves several steps, starting with aligning the drawbars of all locomotives, and pulling on the knuckles to open them for coupling. The next step is the coupling of air and electrical connections between all locomotives in the consist (which may require an engineer to operate small hand tools such as screwdrivers, wrenches, or pliers), setting the brake valves for trailing and leading positions as appropriate. The engineer must also check fluid levels -- hydraulic, lubricating, fuel, cooling, etc. -- and sand for traction. The consist must be supplied with all necessary materials such as ice, drinking water, sanitary supplies, tools, and spare parts, and the cab may need to be swept. Prior to departing, the engineer must perform an initial terminal air brake test as required by FRA, AAR, and railroad rules and regulations.

Several other physical tasks are associated with incidental mechanical work. They include: applying and releasing hand brakes; lifting and carrying objects weighing between 20 and 50 pounds; shutting down engines and draining water from cooling systems in cold weather; and performing other work activities that require bending, stooping, or crawling.

Once the initial inspections have been completed, locomotive engineers must continue to monitor the performance of the locomotive(s) for the remainder of their tour of duty. Beyond mere observation, engineers must diagnose and troubleshoot a variety of problems that may arise. Among the conditions an engineer must monitor are: malfunctions in diesel engines, air equipment, trucks, or other components; pneumatic equipment such as air valves, flow control devices, air pressure switches, or gauges; mechanical or electro-mechanical equipment; electrical equipment such as relays, switches, control devices, or programmable controls; electronic and microprocessor-based equipment including communications systems, analyzers, control systems, or logic control; and high voltage equipment such as circuit breakers, load breaker switches, or transformers.

While en route, engineers also must act on certain types of mechanical failures. For example, in response to a "hot box" detector alarm on a locomotive axle, the engineer must apply a temperature stick to the axle and interpret the results, setting the locomotive out, if necessary. Similarly, locomotive engineers must diagnose other minor malfunctions, reset protective devices, and perform minor maintenance and servicing activities when maintenance personnel are not available.

## D. Duties Arising From New Technology

Twenty-first century technology has impacted locomotive engineers in two ways. The first is increased usage of on-board computerization and radio telemetry. The other is the broadening or modification of duties as a result of computerization of railroad record-keeping.

As noted in preceding sections classifying various tasks, "hind-end" technology has evolved to the stage of the end-of-train (EOT) device, which is a radio telemetry unit that transmits the status of brake pipe pressure at the rear of the train to a receiver on the locomotive. The original EOT has been refined to the point where a return signal can be transmitted from the locomotive that initiates a brake application from the rear of the train, in the event of a brake pipe interruption. Radio telemetry also is used for remotely-controlled locomotives used in the middle of long unit trains.

The latest generation of locomotive technology also includes a variety of computerized or computer-assisted processes. Through this technology, locomotive engineers now monitor conditions via one or more computer screens in computer-aided or computer-controlled processes. They also read and interpret information from computer monitors or computer printouts.

Off the locomotive, engineers are affected by computer technology in several ways. Many railroads have introduced computer-assisted crew dispatching, and increasing amounts of time and crew record-keeping are now handled strictly by a computerized process. Locomotive engineers can interface with this process either via a specialized piece of equipment like the "gridpad," a standard computer terminal, or a telephonic messaging system. On some carriers, locomotive engineers can access information concerning their standing, train line-ups and the like via a home computer equipped with a modem.

The railroad of tomorrow will be even more technology-driven than today's industry. Testing is underway of different types of remote radio-controlled yard locomotives, with the objective being that the engineer can both "have a hand on the throttle" and perform some ground duties at the same time. Also being tested is a technology called Positive Train Separation (PTS), which is a computer-assisted dispatching system that relies upon satellite tracking of train positions, as reflected by on-board transponders. To be certain, this subsection of locomotive engineer tasks is likely to grow more quickly than any other.

## III. PHYSICAL REQUIREMENTS

The physical requirements for working as a locomotive engineer arise from several sources. At the present time, the Federal Railroad Administration (FRA) has promulgated standards for visual and hearing acuity as part of its rule on certification of locomotive engineers. Furthermore, both FRA and the U.S. Department of Transportation have promulgated rules governing the use of alcohol and drugs by locomotive engineers. Strictly speaking, these also impose physical requirements.

Also to be considered in this category is the physical exertion imposed by actually performing the varied tasks that may be required of a locomotive engineer. These run the gamut of the traditional descriptions applied in the analysis of all types of work. Finally, there are the physical requirements imposed by the railroad, through its medical department.

The industry doubtless will argue that we have things backwards, and that the railroad's own standards must be the starting point, because one does not become a locomotive engineer without passing through the railroad's medical department several times, from the pre-employment physical, to promotion, and regularly thereafter for the duration of his/her career. We reject that analysis, for several reasons.

First, in large measure, medical standards among the various railroads are not dissimilar with respect to major conditions that would disqualify one from working as a locomotive engineer. Second, FRA has already taken steps, although tentative, to "federalize" at least visual and hearing standards. In the light of recent findings by the National Transportation Safety Board that the fatal New Jersey Transit accident in early 1996 was caused by an engineer misreading a stop signal because of a diabetes-related vision problem, it should be apparent that the trend will be toward more, not less, standardization.

Third, the consolidation of the industry over the past twenty years means there is less, not more, deviation, at least among the Class I railroads. Although a plethora of short line carriers have been created during this same period, that fact cannot weigh against the development of broad, general standards. The same hazardous tank car that was transported over the Class I railroad is spotted at the plant by a short line engineer — often on track that is markedly inferior in quality to the Class I trackage. It would be folly to suggest that the medical criteria for the short line engineer may be vastly different from that of his/her Class I counterparts.

### A. STATUTORY AND REGULATORY REQUIREMENTS

At the present time, the only statutory and regulatory requirements that pertain to the physical fitness of a locomotive engineer are those codified in Parts 219 and 240 of Title

49 of the Code of Federal Regulations. Generally speaking, the regulations cover three specific areas -- hearing acuity, visual acuity and the use of alcohol and drugs.

FRA's requirements for hearing acuity focuses on the degree of loss at the lower frequencies, covering the range that includes human speech. It is mandatory, except in the narrow circumstance specifically provided for in the certification rule. Specifically, 49 CFR §240.121(d) rule requires that the locomotive engineer "does not have an average hearing loss in the better ear greater than 40 decibels at 500 Hz, 1,000 Hz, and 2,000 Hz with or without use of a hearing aid," when tested using an approved audiometric testing device.

However, Section 240.121(e) provides for an exception, permitting the railroad's medical examiner to certify a locomotive engineer, notwithstanding the failure to meet the requirements, and making such certification "conditioned on any special restrictions the medical examiner determines in writing to be necessary." While there is no requirement under FRA's rule to conditionally certify all similarly afflicted locomotive engineers, the rule's appeal process for denial of certification contemplates disparate treatment as grounds for seeking reversal of a railroad's decision to deny certification or re-certification. Accordingly, it is to be expected that conditional certifications will be few and far between.

FRA's vision acuity requirements are three-fold. They are designed to standardize the acceptable limits of distance vision, field of peripheral vision, and the ability to distinguish colors. FRA's requirements, as stated in 49 CFR §240.121(c), are: 1) "for distant viewing either (i) distant visual acuity of at least 20/40 (Snellen) in each eye without corrective lenses or (ii) distant visual acuity separately corrected to at least 20/40 (Snellen) with corrective lenses and distant binocular acuity of at least 20/40 (Snellen) in both eyes with or without corrective lenses;" 2) "a field of vision of at least 70 degrees in the horizontal meridian in each eye;" and 3)"the ability to recognize and distinguish between the colors of signals.".

Once again, the rule provides for an exception, at Section 240.121(e), permitting the railroad's medical examiner to certify a locomotive engineer, notwithstanding the failure to meet the requirements, and making such certification "conditioned on any special restrictions the medical examiner determines in writing to be necessary." As with hearing, it is likely that conditional certifications for vision problems will seldom be granted.

While many analysts treat the impact of FRA's alcohol and drug regulations as germane only to the realms of discipline or "decertification," such a view limits its focus on the outcome of enforcement actions triggered by positive test results. We believe it is just as important to factor the preventive effects of FRA's rule, because they have a definitive impact on whether a locomotive engineer is physically able to work.

Section 240.119(b)(1) of FRA's certification rule unambiguously renders a locomotive engineer ineligible for certification if diagnosed with an active substance abuse disorder, and the engineer remains ineligible for whatever period said disorder remains active. Moreover, even after the primary rehabilitation treatment plan has rendered the disorder inactive, Section 240.119(d) mandates that, re-certification is conditioned on continuing successful participation by the engineer in whatever after-care program the railroad's counselor deems appropriate, including unannounced follow-up testing for five years.

FRA's regulations for the control of alcohol and drug use, codified at 49 CFR Part 219, are similarly stringent. The industry's traditional prohibition against the use or possession of alcohol or controlled substances, naturally, is carried through to the regulation. However, that is merely the beginning of the rule's impact.

With respect to alcohol, a blood alcohol concentration of .04 or greater constitutes presumptive impairment under 49 CFR §219.101(a)(2)(ii). A blood alcohol content between .02 and .039 renders the engineer ineligible to work for eight hours, or until his/her next scheduled duty tour, whichever comes first. The rule prohibits the consumption of alcohol less than four hours prior to the start of a duty tour, unless the engineer is called to report to work in less than four hours, in which case the prohibition begins with the call to work. This prohibition also includes medicinal alcohol; therefore, engineers are restricted from consuming any over-the-counter medication containing alcohol for a period that begins four hours prior to a duty tour, and extends through the entire duty tour.

FRA's rule with respect to controlled substances is similarly strict. Section 219.102 absolutely prohibits the use by locomotive engineers of any non-prescribed controlled substance at any time, whether on duty or off duty. Section 219.103(a) even prohibits the use of prescribed medications, except when "[t]he treating medical practitioner or a physician designated by the railroad has made a good faith judgment, with notice of the employee's assigned duties and on the basis of the available medical history, that use of the substance by the employee at the prescribed or authorized dosage level is consistent with the safe performance of the employee's duties," and, then, only when "[t]he substance is used at the dosage prescribed or authorized." The section also provides that when "the employee is being treated by more than one medical practitioner, at least one treating medical practitioner [must be] informed of all medications authorized or prescribed and [must] determine[] that use of the medications is consistent with the safe performance of the employee's duties."

## B. THE DEMANDS OF BEING A LOCOMOTIVE ENGINEER

The duties and responsibilities of a locomotive engineer place strenuous physical, mental and psychological demands on every man and woman charged with safely and efficiently operating his/her train. While the list of specifically-identifiable requirements designated as psychological demands is brief, it must be remembered that a locomotive engineer's overall psychological well-being is indispensable in order for him/her to adequately meet the arduous physical and mental demands of the job.

The physical demands placed on a locomotive engineer by the tasks and functions he/she must perform can be broken down into three general categories — physical capabilities, psychomotor abilities, and perceptual, or sensory, abilities. In term of raw muscle power, locomotive engineers must possess the ability to exert muscular force against objects to push pull, lift, lower and carry objects, including the ability to use sufficient muscular strength for safe job performance. Engineers must also have the ability to exert muscular force quickly.

At the same time, locomotive engineers must possess physical flexibility, which is defined as the ability to flex or extend the body limbs to work in awkward or contorted positions, including the ability to assume and maintain body positions necessary for safe performance. Furthermore, engineers must have balance, or the ability to assume and maintain the body in a stable position, including the ability to resist forces that cause a loss of stability. Finally, the job requires a high degree of coordination, which is the ability to sequence movements of the arms, legs, and or body, which result in skilled action.

The specific psychomotor abilities an engineer must possess are several in number, and fall into two separate subcategories. The first is general manual dexterity, which is the ability to make skillful coordinated movements of one hand, or a hand in conjunction with its arm. This requirement pertains to the coordination of movement with the limb, and includes the following components: the ability to make exact, steady arm-hand positioning movements, where both the need for strength and speed are minimized; the minimization of tremor and drift while maintaining a static arm position, and steadiness during movement; and the ability to make discrete movements of the fingers, hands, and wrists quickly and accurately for grasping, holding, or manipulating objects or controls. Also, there is a need for multi-limb coordination, which is the ability to coordinate two or more limbs simultaneously.

These fine motor skills must come together to perform a number of larger tasks. Engineers must make the controlled muscular movements necessary to operate the controls of a locomotive, including the ability to make these movements quickly and repeatedly to exact positions. Similarly, it is necessary to possess the ability to select and initiate the appropriate response relative to a particular stimulus where two or more stimuli are possible and where the appropriate response is selected from two or more possibilities. It is this ability — called response orientation — that relates to the speed with which the action can be initiated, not the speed in which the response can be carried out. Connected with response orientation is reaction, or the ability to quickly initiate a single motor response after the onset of a single stimulus.

In addition to the physical and motor skills identified above, locomotive engineers must also possess several sensory abilities. These are the detailed requirements that provide the physiological basis for FRA's hearing and vision requirements. Among the visual requirements are:

- Visual tracking — the ability to follow symbols and objects with coordinated eye movements.
- Visual acuity — the ability to receive and differentiate between various optical sights, including the ability to perceive and react to sensory stimuli necessary for comprehending language symbols and for seeing objects at near and far distances.
- Visual memory — the ability to remember and state verbally or recall and reproduce through writing some past visual experience, including the ability to use immediate and long-term memory for performance.
- Figure ground discrimination — the ability to select the important figure from the surrounding background.
- Perceptual constancy — the ability to recognize familiar symbols despite the fact that they are shown in a different manner or are a different size.
- Visual color discrimination — the ability to match or discriminate between colors, including the ability to detect differences in color purity or brightness.
- Night vision — the ability to process visual information in the absence of adequate lighting.
- Depth perception — the ability to distinguish which object of several is nearer to or further away from the observer and to judge the distance of an object from the observer.
- Glare sensitivity — the ability to perceive objects in bright ambient lighting or glare.
- Visual inspection — the ability to make quick and accurate comparisons of the similarities and differences between objects or to determine that objects do not match "standards" or specifications, including the ability to perceive visual details in a complex and distracting visual background.
- Visual comparison — the ability to check information in text, tables, printed forms, or computer displays for accuracy and completeness, including the ability to be thorough and make sure that all relevant details are included and are accurate.

- Visual monitoring — the ability to detect changes in the location, position, or orientation of objects, including the ability to detect deviations or exceptions from normal, to identify "unusual" visual information from among competing, "ordinary" signals, and to respond to infrequent visual signals such as warning lights.

Physical requirements pertaining to hearing include three primary elements. The first is auditory tracking, which is the ability to locate sound, find its source and follow its movement. The second is auditory acuity, which is the ability to receive and differentiate between sounds and their corresponding pitch and intensity, as well as the ability to perceive and react to sensory stimuli necessary for two-way communication and for detecting safety warnings on the job. The third is auditory memory, or the ability to recognize and reproduce previous auditory experiences, using immediate and long-term memory for performance, when necessary.

The mental requirements upon locomotive engineers can be broken down into seven categories. Each is detailed below, although not necessarily in any particular order of importance.

Among the requirements that can be classified as language skills are reading comprehension that encompasses both general and technical material. This includes the ability to read and understand text, identify themes, make inferences, and draw conclusions that accurately reflect material of a general nature. Moreover, it requires having the ability to read, understand, and interpret technical written information to learn concepts, answer questions, solve problems or complete job tasks, as well as the ability to compare and combine technical information from several different documents. Engineers also must possess the ability to define, cross-reference, evaluate, and organize the written information needed to make decisions, answer questions, or provide input to others.

At noted previously — in the section pertaining to duties, tasks, and functions — locomotive engineers are engaged in a great deal of oral communication that has enormous impact on the safe movement of trains. The oral communications skills demanded of engineers include: 1) the ability to understand and perceive relevant detail from oral information that is presented in a one-on-one or group situation; 2) the ability to make oneself understood orally when speaking to people in a one-on-one situation, including speaking over the telephone or radio to others; 3) the ability to present information effectively and understandably in small groups, as in a crew briefing; 4) the ability to communicate information of a technical or specialized nature to people who lack background in an area, including the ability to explain technical terms and abbreviations; 5) the ability to phrase questions in a manner that conveys knowledge of the information required and leads to appropriate responses; and 6) skill in "breaking in" a student engineer, or qualifying conductor or brakeman, or otherwise instructing or directing others.

Locomotive engineers also must possess written communication skills, two of which are of primary importance. The first is the ability to record or transcribe numbers, letters, or words accurately on paper without making "clerical mistakes" such as omissions, number reversals, or other mistakes. The other is the ability to prepare short written records and documents such as work status reports, timeslips, locomotive inspection reports, accident reports, and narrative statements of events concerning an incident under investigation, that are concise and clearly present intended information. Similarly, locomotive engineers must have sufficient numerical skills to add, subtract, multiply, and divide whole numbers, including the ability to count accurately, to identify multiples of numbers, to compare numbers with one another, and to determine whether numbers are within acceptable numeric limits.

The cornerstone of a locomotive engineer's ability to operate his/her locomotive(s) and train are a variety of learning and memory skills. First and foremost among these is the ability to learn and apply new work methods effectively, and the ability to learn, recall, and apply the procedures needed to perform a variety of tasks. Engineers also must possess the ability to design and conduct experiments to determine how a particular consist or train reacts to various power and braking methods. This skill includes the ability to formulate and test hypotheses concerning system behavior in an effective and efficient manner.

Locomotive engineers also require the aptitude to learn new material and methods for performing work, and to selectively recall and apply the newly-learned material within a short period of time (e.g., hours or days). Likewise, locomotive engineers must be able to learn new material and methods for performing work, and to selectively recall and apply the information at a later point in time (e.g., after several weeks or months).

The skills described above provide the basis for a locomotive engineer's analytical skills. Engineers must have the ability to analyze many sources of information on many different levels, and must:

- Anticipate, evaluate, and consider the consequences of a particular course of action when making decisions or solving problems, logically evaluating information and recognizing when and where to seek additional information.
- Analyze and interpret information to formulate rules, policies, or general principles, taking an analytical approach to aid in problem identification and solution.
- Set priorities, plan and coordinate work activities, and obtain and manage resources so that work objectives are accomplished on time.

- Use established physical, mechanical, or scientific principles and perform appropriate tests to identify and solve problems encountered on the job, locating and isolating the problem, identifying possible solutions, and selecting approaches which are practical and effective.

Equipped with the skills described above, the locomotive engineer is prepared to develop the specific talents needed to ply his/her craft, primarily the ability to operate a locomotive light, coupled in multiple, or at the head or hind end of a train. This presumes at least a rudimentary knowledge of basic mechanical or physical science or physics principles, and their application to the operation of equipment and machinery.

At the foundation of a locomotive engineer's technical knowledge and competency skills is the ability to understand and apply safety procedures and guidelines outlined in the railroad's materials and manuals, manufacturers' manuals, and other sources of safety information. Next comes the ability to learn and recall the physical characteristics of the territory (e.g., grades, curvatures, length of sidings, mile posts). These must then be integrated with the ability to observe and interpret visual signals (e.g., wayside signals; hand signals employed during construction, maintenance, and repair activities; blue flag signals) and displays (e.g., analog and digital indicators on equipment, communication equipment, and locomotive cab displays). Finally, in the industry's increasingly "high-tech" locomotives and information systems, there also is the need to understand and use computer systems to input, access, modify, or output information or to control equipment.

Needless to say, the broad range of mental skills required of a locomotive engineer implies that strong psychological traits are a prerequisite. Three other specific, uniquely psychological skills must be considered, to fully round out what is physically required of a locomotive engineer. The first is positive interaction, or the ability to develop and maintain positive working relationships with co-workers, supervisors, and subordinates, and to effectively handle conflict situations. The second is leadership, which is the ability to forge a single-purpose commitment from a group of individuals — like a crew — motivating them to perform the job and work towards common objectives. The third is the ability to work well with others in a group, cooperate with others, offer help when needed, and foster a climate within the group where members are committed to a common goal.

## C. Potentially Disabling Medical Conditions

This is written at a time during which rail labor and rail management are locked in a protracted struggle to refine and update standards by which the occupational disability provisions of the Railroad Unemployment Insurance Act are to be applied in the future. It is to be expected, then, that this section of our analysis may provoke the strongest response from the industry. In anticipation of such a reaction, we thought it appropriate to quote from the personnel manual of a Class I railroad that speaks of the demands on a locomotive engineer, under the heading "Operational Stressors:"

"The operation of a locomotive is a highly technical job that requires a practiced ability to receive several forms of incoming stimuli. In addition to reception of information, the data must be sorted by priority and a complex decision making process completed before response. At any given moment, the engineer is receiving and processing visual, auditory, tactile, kinesthetic and labyrinthine information. Through experience, the engineer learns to arrange this data according to a hierarchy that includes both safety and operational goals.

"Speed and momentum factors make error correction difficult. In close parallel to airplane take-off, the operation of a locomotive includes 'points of no return'. Track condition, speed, equipment condition, environmental factors and signals are only a few of the input items that impact the engineer's decision making process. The safe and efficient operation of the locomotive depends on the engineer's ability to receive the stimulus data and respond to conditions that will be encountered ahead.

"The three primary human systems involved in this information reception are the visual, auditory and tactile systems. Any illness or disease that interferes with these receptor sense organs will pose a serious safety problem.

"In a chess game, one has the opportunity to observe and study the opponent['s] move and then, after a time of thoughtful consideration, a response move is made. The nature of locomotive operation requires the engineer to instantly process incoming information, formulate decisions, make adjustive moves and measure the effect of the adjustive moves on new incoming data. This frequently takes place at high speed and requires a superior level of concentrative ability."

The environment in which a locomotive engineer works must be added to our review of the craft's mental, physical, and psychological requirements, in order to provide a broad basis for considering the types of physical and/or psychological conditions that can be disabling. These environmental settings also can have a great impact on an engineer's physical or psychological well-being.

Work scheduling is, without a doubt, the environmental factor with the greatest impact on a locomotive engineer. Most road engineers are on call, either on an as-needed basis, or within more limited calling windows. Schedules regularly include both day and night hours, and encompass Saturdays, Sundays and holidays. Moreover, hours tend to be irregular, with the possibility of extended service hours or overtime. Consequently, engineers may be required to work when they are fatigued because of extra long or continuous hours. Compounding this effect is that fact that meal times can vary from day to day.

Assignments may frequently be revised, to accommodate shifting traffic patterns. Road freight work often requires extended time away from home, and engineers may be required to work in unfamiliar locations. This is of particular concern for newer engineers and those on extra boards or in pools that cover a wide geographical area.

Locomotive engineers frequently perform work outdoors, facing exposure to a variety of weather conditions. Although some cab temperatures are controlled, engineers often work with cab windows open, particularly in yards. In the summer, engineers not only are exposed to ambient temperatures, they work in cabs where locomotive-generated heat increases temperatures even further. Additionally, work is performed in the presence of noise, dust and fumes generated by diesel engines, air brake equipment, sanders, horns and radios.

Because of the dangers inherent in the operation of large equipment — such as locomotives and trains — locomotive engineers are also exposed to a variety of risks. There is always the potential for collision with other trains and locomotives, highway trucks (including vehicles carrying flammable material), cars and track obstructions such as slides, washouts, and obstructions placed by vandals. Engineers also are exposed to injury caused by objects thrown or dropped into the cab. Potentially hazardous track conditions include switch tampering, broken rails, and the like. Even a simple task like walking to and from locomotives brings with it inherent hazards related to moving trains or equipment and defects or debris along the right of way. And, simple maintenance tasks, like changing electrical fuses, expose the engineer to the danger of shock.

Our analysis of potentially disabling medical conditions covers two categories. One lists disabilities that generally arise from congenital medical conditions. The other addresses disabilities that also may arise from injuries or some other exterior cause.

The demands placed upon a locomotive engineer, when combined with the environmental factors identified above, obviously mean that the engineer must be in excellent physical condition. Any disease, illness, disorder or other condition that substantially impairs any of the bodily functions needed to perform the various tasks or functions required of a locomotive engineer — particularly those that affect cognitive ability or perception — has the potential of creating an increased hazard. Therefore, railroads typically have stringent medical requirements for locomotive engineers, which are waived only in the rarest of circumstances.

Many conditions have varying degrees of severity, and rates of deterioration or degeneration differ from individual to individual. Therefore, disability determinations necessarily are made on a case-by-case basis, and over a wide range of conditions. Nonetheless, there are certain classes of illnesses and diseases that can, and often do, reach a stage that prevents a locomotive engineer from continuing to work.

Of the four standard job classifications — heavy, medium, light and sedentary — the locomotive engineer clearly is in the medium category, although the requirements of his/her job often cross into the heavy category, especially since the broadening of incidental train service and mechanical duties has occurred over the past fifteen years. Thus, it is to be expected that medical conditions that frequently are disabling for other medium to heavy occupations will be disabling for locomotive engineers.

A variety of cardiovascular conditions can be disabling for a locomotive engineer, including: hypertension; myocardial infarction; rheumatic heart disease; second- or third-degree heart block; aortic aneurysm; chronic venous insufficiency; arteriosclerosis; arteriovenous fistula; a history of congestive heart failure; bypass; pacemaker installation; and valve replacement. Musculoskeletal conditions that may disable an engineer include: rheumatoid arthritis; osteoarthritis; nerve root compression; osteoporosis; chronic osteomyelitis; significant knee instability; disc herniation; replacement of the knee or hip; spinal laminectomy and/or fusion; and amputation of the hand, arm or leg.

In addition to the FRA standards for vision and hearing acuity outlined previously, other types of sensory impairments also may prove disabling to a locomotive engineer. The most significant of these conditions are glaucoma, and vision problems secondary to diabetes mellitus. Also, a variety of pulmonary impairments could result in an engineer becoming disabled, including the following: chronic obstructive lung disease; active lung cavitation due to tuberculosis; bronchial asthma with a tendency toward severe attacks; pleurocutaneous fistula with drainage; pneumoconiosis; silicosis; severe allergies to dust and fumes; and undergoing a pneumonectomy or pulmonary resection.

Among the neurological problems that may disable an engineer are: seizure disorder; Parkinson's Disease; myasthenia gravis; multiple sclerosis; Huntington's Chorea; cerebrovascular accident; a herniated nucleous pulposus; and peripheral neuropathy with mild incoordination. Disabling psychological disorders include chronic schizophrenia and severe manic-depressive illness.

Among the hemic and lymphatic system disorders that may disable a locomotive engineer are: polycythemia vera that is accompanied by increased red and white blood counts and increased platelet counts; Stages I and II of Hodgkin's Disease; and chronic leukemia. Addison's Disease, which is a condition marked by an underactive adrenal gland, also is a medically-disqualifying condition. Disabling digestive conditions include the following: chronic liver disease; chronic ulcerative colitis and/or regional enteritis; chronic renal failure; diabetes mellitus; an inoperable inguinal or ventral hernia; bladder and/or bowel incontinence; and a permanent colostomy.

Some of the conditions or disorders listed to this point may arise from either congenital or traumatic causes. In addition, a few may be caused or exacerbated by environmental conditions found in the locomotive engineer's workplace. There are also a few disorders that are related to the type of work a locomotive engineer performs that are in the early stages of study. Two worthy of brief mention here are the physiological effects of irregular schedules, and the relationship between certain aspects of engineers' work and cardiovascular disability.

With respect to the question of irregular work schedules, sleep deprivation and disturbances to the locomotive engineer's "biological clock," there is a growing body of work that can address far more authoritatively than we the specific disorders arising from current working schedules. However, it is worth mentioning that sufficient data exist linking work hours and accident rates that railroads throughout the United States and Canada are reviewing and, in some cases, implementing pilot programs ranging from narrow calling windows to encouraging "power naps" by locomotive engineers whose trains are held on sidings.

From this effort, we should expect that rates of both accidents and disorders that are related to engineer work schedules will decline in the future. More worrisome, however, is the link between certain, immutable aspects of the locomotive engineer's job and cardiovascular disease, because this may be a physiological problem that just "comes with the turf."

In 1989, the National Institute for Occupational Safety and Health (NIOSH) conducted a study that sought to find a correlation between various job activities and cardiovascular disease. Prior to this study, this field of research had been dominated by studies that were subjective, relying upon perceived stressors as a means of predicting perceived health problems. The NIOSH study set out to see what correlations could be developed by means of an objective study.

NIOSH merged a Social Security disability database consisting of 9,855 disabled people with a proprietary job analysis database comprised of 2,845 occupations. The merged database consisted of 7,875 workers, and was representative of 94% of the working population. The study measured the various job activities — based on the longest-held job — of workers disabled with the following cardiovascular diseases: rheumatic heart disease; hypertensive heart disease; ischemic heart disease; cerebrovascular disease; and diseases of the arteries, capillaries, and veins.

The results of the NIOSH study should sound both ominous and familiar to locomotive engineers. The job functions most frequently associated with cardiovascular disability were: 1) hazardous job conditions; 2) vigilant work and responsibility for people or materials; 3) exchanging job-related information; and 4) attention to devices and materials. The NIOSH study specifically cited locomotive engineers as being among air traffic controllers, airline pilots, and a number of similar stress-generating occupations, as leading candidates for cardiovascular disability, based on occupational stressors. In some quarters, the fallacy that a locomotive engineer's job can be classified as either light or sedentary continues to be perpetrated. Clearly, the list of medically disxqualifying conditions establishes otherwise.

## IV. Conclusion

The railroad industry presents diverse conditions throughout the nation. Generally speaking, these are a function of history and geography. For locomotive engineers, decades of collective bargaining -- or a lack thereof -- serves as an overlay in enumerating the various functions and tasks that comprise the work of the craft. Most recently, greater standardization in a few areas is the product of federal regulatory processes. Thus, it would be both difficult and foolish to attempt to develop a "one-size-fits-all" job description for locomotive engineers, even in static times. Furthermore, it would be impossible to create such a description in times like the present, when technology and continuing rationalizing in the industry are the predominant driving forces.

The carrier would seize on this point, as they have for the past fifty years, to contend that any attempt to quantify and analyze the work of a locomotive engineer is doomed to irrelevance, unless it reflects each individual railroad's concept of what it requires for its own operation. Of course, that position reflects little more than the continuing wish of every manager to manage his/her business free from any influence by labor unions or government. Nonetheless, it is an argument that we ignore only at our peril.

As noted at the outset, the particular mix of tasks and the frequency with which each may be required vary, depending upon the type of service involved, the railroad for which a given locomotive engineer is working, and even geographic or climatological considerations. Therefore, we have been careful to avoid the temptation to create the "boilerplate" engineer, whose work is comprised of "X" parts of physical labor, "Y" parts of cognitive ability, and a "Z"-type psychological profile. That approach would open this analysis to the very criticism by the industry that we hope to avoid.

Instead of trying to present what every engineer must encounter all the time, we have focused on what may be required of any engineer at any time. To be fair, we highlighted separately those tasks that were historically within the realm of another craft, so that they may be considered only on those railroads where they have become functions of the locomotive engineer. In this way, the requirements of a given railroad or for a particular assignment can be replicated by giving the appropriate weight to each task selected from the menu presented herein.

The tendency of the industry over the past two decades has been to seek greater flexibility in the assignment of work. This has been no less true for locomotive engineers than for any other craft. To those who may criticize this work on the basis that we have included some tasks that may now be only infrequently performed on their particular railroad, we would suggest that they recall how conditions have changed over the past twenty years, and keep in mind the type of changes in the assignment of work they hope to implement over the next two decades. We believe that our analysis will withstand the test of time, and need to be revised only to include tasks associated with technologies that we have not yet envisioned.

## V. BIBLIOGRAPHY AND SOURCES


Association of American Railroads, "Analysis of Administrability of Revised Occupational Disability Standards," July 31, 1995.

Association of American Railroads, PRODS Task Identification Project.

American Association of Railroads, various correspondence, memoranda, and documents pertaining to standards for occupational disability, 1978-present.

Association of American Railroads / HRStrategies, Inc., "Facilitators Guide to Producing Job Descriptions," March , 1992.

Association of American Railroads / Med-Tox Health Services, "Draft Disability Manual for Assessment of Occupational Disability Claims," 1996.

Association of American Railroads / Railroad Personnel Association. "Locomotive Engineer Railroad Industry Job Analysis," ©1981

Murphy, Ph.D., Lawrence R., "Job Activities Associated With Cardiovascular Disability," Division of Biomedical and Behavioral Science, National Institute on Occupational Safety and Health, 1989.

National Railroad Passenger Corporation personnel manual for locomotive engineers, pp. 3-4.

"Rail Transportation Workers," Occupational Outlook Handbook, 1996 ed.

Railway Labor Executives' Association and constituent member unions, various correspondence, memoranda, and documents pertaining to standards for occupational disability, 1978-present.

Sher, Judy, "Job Analysis of Locomotive Engineer/Hostler," 1996.

Sher, Judy, "Job Description for Diesel Mechanic," 1996.

"Vital Statistics — Hard Work," Newsweek, August 7, 1989, p. 8.

United States of America, Railroad Retirement Board, Form G-251, "Vocational Report."

United States of America, Railroad Retirement Board, various correspondence, memoranda, and documents pertaining to standards for occupational disability, 1978-present.