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NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C.

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Forwarded to:

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SAFETY RECOMMENDATION(S)

R-85-21

About 3:58 a.m., mountain standard time, on April 13, 1984, Burlington Northern (BN) Railroad Company freight trains Extra 6714 West, and Extra 7820 East, collided head-on on the single main track about 1,027 feet west of the west turnout of the passing track at Wiggins, Colorado. Seven locomotive units derailed and were destroyed in the collision and burning diesel fuel was released from ruptured fuel tanks; 40 cars derailed, 26 of which were destroyed. Five train crewmembers were killed and two were injured. Total damage was estimated to be $3,891,428. Nine days later at about 4:56 a.m, mountain standard time, on April 22, 1984, eastbound BN freight train Extra 7843 East struck the rear of BN freight train Extra ATSF 8112 East on the main track at Pedro passing track near Newcastle, Wyoming. During the collision and subsequent derailment sequence, several cars of freight train Extra 5533 East, which were standing unattended in the Pedro passing track, were also struck and derailed. As a result, 5 locomotives units, a caboose, and 21 cars derailed. The locomotive units, caboose, and 13 cars were either destroyed or heavily damaged. Two train crewmembers were killed, and two were injured. Total damage was estimated to be $1,358,993. 1/

Aside from the fact that both accidents occurred within 10 days of each other on the same region of the BN system, there were numerous factors common to both the Wiggins and Newcastle accidents. Both accidents occurred between midnight and 6 a.m., the time of day when human performance under normal conditions is typically at its lowest ebb. Both occurred on busy single-track main lines where trains were operated by the indications of automatic signals of a Centralized Traffic Control (CTC) system. In both accidents, one of the trains involved was not being operated in compliance with restrictive signal aspects because the engineer and a second crewmember on the controlling locomotive unit either fell asleep or was otherwise impaired, or both. None of these men had even minimal bed rest over long periods before the accidents. Moreover, the investigation revealed that the engineers of these trains were under the influence of

1/ For more detailed information, read "Railroad Accident Report: Head-on Collision of Burlington Northern Railroad Freight Trains Extra 6714 West and Extra 7820 East at Wiggins, Colorado, April 13, 1984, and Rear-end Collision of Burlington Northern Railroad Freight Trains Extra 7843 East and Extra ATSF 8112 East Near Newcastle, Wyoming, April 22, 1984 (NTSB-RAR-85-04)."

either alcohol or drugs. The engineer and firemen of Extra 6714 West in the Wiggins accident had been drinking beer for 6 to 7 hours before reporting for duty; the engineer of Extra 7843 East in the Newcastle accident was a marijuana user and admitted that he had smoked a marijuana cigarette before going to work. He refused to say whether or not he had smoked marijuana after going to work, but evidence established that he had.

The Safety Board's investigations established that there was a lack of uniform understanding of BN Rules 34 and 804(B) which relate to crewmember responsibility for taking action when their engineers fail to comply with restrictive signal aspects. High-ranking divisional, regional, and system officers, including those who headed the safety and rules department, stated that these rules apply to crewmembers on cabooses, as well as to those on locomotives. However, only one of the train crewmembers involved in these accidents interpreted the rules that way. The trainmaster, who directly supervised the train crewmembers in the Newcastle accident, stated that the rule did not apply to crewmembers in the caboose. A similar dichotomy appears to have existed in the interpretation of the "subject to duty" provision of BN's Rule G.

A significant factor in both accidents was the manner in which the engineer and fireman of Extra 6714 West in the Wiggins accident and the engineer and head brakeman of Extra 7843 East in the Newcastle accident spent their off-duty hours before the accidents. Because all had gone without sleep, or at least had failed to get adequate restful sleep when they had the opportunity, they were critically fatigued when they went to work.

The 34-year old engineer of Extra 6714 West had been off duty for more than 25 hours before being transported as a passenger to Akron on April 12. This relatively long period of rest, coupled with the fact that the trip to Akron was made in a little more than 2 hours, increased the likelihood that the engineer would spend his time in Akron engaging in activity other than sleeping. Friends and coworkers of the engineer told Safety Board investigators that he was a habitual drinker; he probably had a "few beers" every day at home or at layover points. The engineer was well known by name and appearance to the employees, proprietors, and customers of the taverns in Akron. On the night of the accident, he and the fireman had each consumed at least 6 or 7 beers in Akron taverns between the hours of 8 p.m. and about 1:45 a.m. The engineer was observed by the on-duty proprietor of the BN-contracted crew rest facility between 2 and 2:30 a.m., visibly affected by his drinking. The proprietor, who was very familiar with him, thought his speech was a little slow, "like his tongue was a little bit heavy," and he later remarked to the fireman that the engineer "seemed a little bit high." The proprietor was concerned enough to ask the fireman if he was going to run the train in the engineer's place. By the time he drove the crew to their train, the engineer had apparently used mouthwash to clear his breath and his speech seemed normal. If the conductor or any other crewmember thought the engineer was less than his usual self, they evidently took no action to ensure that he did not operate the train.

The investigation failed to develop sufficient factual information to establish with certainty the quantitative level of alcohol in the engineer's body or its effect on his behavior when and after he boarded the train. The available evidence indicated that he had consumed about 1 ounce of alcohol per hour over a period of 6 to 7 hours.

Having spent the evening making the rounds with the engineer, the fireman's intake of alcohol was probably about the same as that of the engineer. At least that is the testimony of witnesses. He, too, had gone without sleep. Unlike the engineer, he seemingly did not exhibit outward indications of intoxication, at least while he was with the proprietor. However, the toxicological scan of blood and urine samples recovered from the fireman yielded findings of 0.056 percent blood alcohol level and .09 percent urine alcohol concentration. The fact that the urine level was more than 35 percent greater than the blood concentration indicates that the fireman was in the postabsorbtive state at the time of his death and that blood alcohol would have been higher at an earlier time. Assuming that the fireman had nothing to drink after leaving the Akron bar about 2 hours before the accident, it is calculated that his blood alcohol level was about .085 percent when he received the call to report for duty and about .070 percent when he boarded the train.

A blood alcohol concentration in the .07 to .09 percent range in the typical individual can cause impaired response to both audible and visual stimuli, even though outward appearance may be normal. Given the known propensity for alcohol to complicate the effects of fatigue caused by lack of sleep and irregular work/rest cycles, its use by the engineer and fireman of Extra 6714 West must be considered a major contributing factor to the reason they fell asleep, and therefore, it relates directly to the cause of the Wiggins accident.

The blood and urine samples obtained from all the surviving train crewmembers in the Newcastle accident and the blood and tissue samples obtained from the men who had been killed were submitted to toxicological testing. All the samples were negative for alcohol and illicit drugs other than cannabinoids. Positive findings for cannabinoids were reportedly found through the Enzyme Immunoassay Technique (EMIT) by one laboratory in the urine samples obtained from the engineer and conductor of Extra 7843 East; the head brakeman of Extra ATSF 8112 East; and the engineer and rear brakeman of Extra 5533 East. These findings were confirmed in every case (except that of the conductor of Extra 7843 East) by means of Thin-Layer Chromatography testing at the same laboratory. The latter findings were also confirmed through the use of the more sensitive and reliable Gas-Liquid Chromatography/Mass Spectrometry (GC/MS) method of screening at the Armed Forces Institue of Pathology (AFIP).

Subsequent testing of portions of the whole blood samples was performed at the University of Utah Center for Human Toxicology. Testing for the presence of cannabinoids in the blood is the most definitive procedure and the quantitative level of positive results gives an accurate indication of recency of usage. Three different cannabinoids were tested for in the blood samples - Delta 9 Tetrahydrocannabinoid (THC), Hydroxy Acid (OH) metabolite, and Carboxylic Acid (COOH) metabolite (the first two named are psychoactive substances in the blood). Delta 9 THC peaks rapidly, then diminishes from about 100 ng/ml to about 1 ng/ml in 6 hours. The OH metabolite is undetectable after about 3 hours. The COOH metabolite diminishes gradually and has been detected in the blood for up to 1 week after marijuana use. If this metabolite is detected in the urine, it should also be present in the blood. The blood testing detected cannabinoids in the samples as follows: THC and COOH in the engineer of Extra 7843 East; COOH in the rear brakeman of Extra 7843 East; THC, OH, and COOH in the head brakeman of Extra ATSF 8112 East; COOH in the rear brakeman of Extra ATSF 8112 East; COOH in the engineer of Extra 5533 East; and THC and COOH in the

rear brakeman of Extra 5533 East. No trace of cannabinoids was found in the sample taken from the conductor of Extra 7843 East, or any of the other crewmembers of the three trains.

The associate director of the Center for Human Toxicology testified as an expert witness at the Safety Board's public hearing held in Denver, Colorado, June 4, 1984. He stated that the most common effect of marijuana use is euphoria. "There's a feeling of high, spaced if you want to call it that; that type of feeling, euphoric." He also stated that during experiments he had observed, none of the subjects fell asleep during the first hours after using marijuana, and he related that there are no firm studies in the area of the effects after euphoria ends. He did not think there was as yet sufficient data to extrapolate levels of cannabinoids in the human system to presumptive effects on performance and behavior; however, he said that research of which he was aware revealed measurable human performance degradation up to 6 hours after marijuana use. There is experimental evidence that marijuana impairs psychomotor performance, such as reaction time, coordination, and tracking tasks, for as long as 4 to 8 hours after use. Research has not established that adverse behavioral effects do not occur for longer periods. Further, the metabolic characteristics of marijuana are such that it may actively affect the nervous system long after it is no longer detectable in the blood. Moreover, the long-term behavior effects of casual and/or chronic use of marijuana have not been confirmed or eliminated by research.

The expert witness also gave his interpretation of the test results. In his opinion, the statements of the engineer of Extra 7843 East, as to how often he smoked marijuana and when he had last smoked it, were inconsistent with the test results. According to the expert witness, the test results indicated that if the engineer was a casual user of marijuana, as he testified, then he had smoked a marijuana cigarette 4 to 6 hours before his blood was drawn for testing. Since nearly 4 hours had elapsed between the sample collection and the accident, this indicated the engineer had smoked marijuana some time during the 2 hours preceding the accident. The Safety Board concludes that, on this basis, the engineer was under the influence of THC at the time of the accident; therefore, his failure to respond to the signals may have been the result of his use of marijuana.

The rear brakeman of Extra 7843 East said he had tried marijuana about 3 years before the accident, but hadn't used it since. The expert witness interpreted the low but positive detection of COOH in the brakeman's blood as inconsistent with his testimony. He said that if the brakeman was an infrequent user, he had last used marijuana about 6 days before the accident.

The head brakeman of Extra 8112 East stated that he had been using marijuana for 6 to 7 years, currently used it once or twice a week, and recalled last using it 5 to 6 days before the accident. The expert witness also found this testimony inconsistent with the test results which revealed concentrations of THC, OH, and COOH in the man's blood. The levels detected, according to the expert witness, indicated usage of a highly potent grade of marijuana about 3 hours before the samples were taken, or about 1 1/2 hours after the accident occurred. From 6 to 8 a.m., April 22, the head brakeman was away from the accident site and had yet to be contacted and instructed by a supervisor to submit to testing. Therefore, he had ample opportunity to use marijuana unobserved during that period.

Testing of the blood sample recovered from the body of the rear brakeman of Extra ATSF 8112 East detected the presence of COOH. In the expert witness' opinion, the low level of the metabolite indicated use of marijuana by the brakeman about 6 days before the accident.

According to the engineer of Extra 5533 East, he had used marijuana for 2 to 3 years, and had used it about 10 times during that period. He also stated that he had last used marijuana about 10 days before the accident. The expert witness testified that these contentions were not consistent with test findings that indicated use of marijuana 24 to 48 hours before the accident.

The rear brakeman of Extra 5533 East related that he had used marijuana since 1969, currently used it once or twice a week, and had last used it a week before the accident. The expert witness again disagreed, stating that the current and recent usage statements were not borne out by the detection of THC and COOH in the man's blood. He said the levels detected indicated the brakeman used a very potent grade of marijuana and had last used it 4 to 6 hours before his blood sample was obtained. As with the engineer of Extra 7843 East, this indicated usage during the 2-hour period preceding the accident.

Given the expert witness' interpretation of the time implications of the levels of cannabinoids found in the samples of 6 of the 12 BN train crewmembers involved in the Newcastle accident, it can be concluded that 3 were relatively casual or infrequent users of marijuana, 1 had used marijuana shortly after the accident (and conceivably could have been under the influence of THC at or before the time of the accident), and two had used marijuana within a period of 2 hours before the accident (and were under the influence of THC before and at the time of the accident).

BN's assistant vice president of safety and rules testified at the Safety Board's public hearing that he interpreted BN's Rule G as meaning that before employees go on duty, they must be entirely free of the effects of the substances covered by the rule, namely "alcoholic beverages, intoxicants, narcotics, marijuana, and other controlled substances." He said, "When they come on duty, they must be free from the effects of these substances." He further stated that he thought this required freedom from the substances in the employees' systems, necessitating total abstinence from the use of marijuana, and at times, total abstinence from the use of alcohol. However, the rule prohibits the use of the substances by employees on duty and when they are subject to duty, and it states employees must not report for duty under the influence of the substances. It does not say they must be totally free of the effects of the substances, nor does it define "influence" or "subject to duty." The Safety Board's investigation left little doubt that BN Denver Region employees had been left to interpret for themselves the rule and its fine points, particularly the "subject to duty" provision.

The Safety Board believes that the Wiggins and Newcastle accidents dramatically illustrate how imperfectly railroad employees and line supervisors understand subject to duty under Rule G. At the time of these accidents, BN comprised the largest single or combination railroad system in North America and operated virtually from coast to coast in the U.S. and Canada. It had a policy and a rule concerning the use of alcohol and drugs by its employees. There was a mechanism within BN's organization for developing and disseminating a uniform understanding of what that policy and rule required. BN had a safety and rules department with regional directors and field staff which had the responsibility of carrying the understanding and requirement to line supervisors and

employees through the vehicle of training and safety programs. Yet, the Safety Board's investigations have shown that there was a complete breakdown somewhere in this line of communication.

Testimony at the Safety Board's public hearing produced a broad range of opinions on the part of train service employees and line supervisors as to the meaning of subject to duty under Rule G. While some of this testimony may have been self-serving, the Safety Board believes that the situation was confused and that little effective effort had been made to give the employees and their supervisors a clear and uniform understanding of management's interpretation of the rule. During the 3 months preceding the Newcastle accident, safety meetings and rules examinations were held across the division, but no one used these opportunities to cover central questions such as, "When does the rule apply?" or "When are you under the influence?" and "When do you stop?"

The older and more experienced survivors of the Wiggins accident seemed to understand that they were subject to duty under Rule G and should abstain from drinking when they were "marked up," that is they were available to work whenever fully rested under the 8-hour rule. This could be construed to mean that they understood that they had to refrain from drinking early enough for them to be fit once they could be called to work. But even among these men, it was obvious that there was no common understanding on the subject. The veteran engineer of Extra 7820 East said that he had never heard a time specified in his experience, and that he really didn't know what was meant by subject to duty under Rule G.

Of the younger men who survived the Newcastle accident, six said that they thought they were subject to duty under Rule G when "the phone rang," or 90 minutes before they had to report to duty. They believed that their use of the prohibited substances had to cease 90 minutes before going on the job, providing of course that their call gave them the requisite lead time. The engineer of Extra 7843 East said it meant 4 to 5 hours before going to work, although he stated it was difficult to predict or to find out for certain when he would be called to work. The engineer of Extra 5533 East thought it meant when he was marked up, fully rested, and could be called. The conductor of Extra 7843 East called the subject, "a very gray area" that he had never heard defined. The trainmaster at Edgemont and his immediate supervisor, the assistant superintendent at Gillette, disagreed with those who said subject to duty started when the phone rang. Their interpretation was similar to that of the engineer of Extra 5533 East, that employees were subject to duty under Rule G after they had "received rest as provided by the hours of service law." Since the law permits putting a train service employee back to work 8 hours after he last went off work, this interpretation could conceivably permit his continued usage of a prohibited substance right up to the minute he reports for duty. As has so often been tragically demonstrated, users of alcohol or drugs characteristically fail to recognize that they are adversely influenced by whatever substance they have been using. Railroad users of alcohol appear to be as prone to this inclination as those from any other segment of society, and their lack of proper judgment in this regard can result in potentially catastrophic impact on their fellow employees and the public.

BN's Rule G, and the like rule of North America's entire railroad industry, is based on the Uniform Code of Operating Rules (UCOR). In recent years, BN and some other railroads have modified and expanded their Rule G, but some of the most critical aspects of the rule remain couched in ambiguous language that leaves far too much to individual interpretation. This is particularly true of the subject to duty provision which has never prescribed specific mandatory periods of abstinence from the use of alcohol and other

prohibited substances. The railroad industry management and the railroad brotherhoods, as well as the Federal Railroad Administration, seem unable and/or disinclined to provide railroad employees with specific timespan guidelines to follow. An example of this attitude was expressed by the assistant vice president in charge of BN's safety and rules department in his testimony that he didn't think the employees could live up to BN's Rule G unless they observed an abstinence period, but he didn't believe that the period needed to be specified "in light of our present Rule G." The Safety Board believes, however, that the interests of the railroad companies, railroad employees, and the public at large demand that the subject to duty provision of Rule G be thoroughly defined, and that its definition be disseminated to and interpreted for railroad employees. Inaction and "band-aid" remedies are not going to solve this problem.

Therefore, the National Transportation Safety Board recommends that the Association of American Railroads:

> Encourage its member railroads to define the "subject to duty" provision of their Rule G to stipulate a defined period of required abstinence from the use of alcohol and other substances by train crewmembers prior to their accepting calls to duty. (Class II, Priority Action) (R-85-21)

BURNETT, Chairman, GOLDMAN, Vice Chairman, and BURSLEY, Member, concurred in this recommendation.

By: Jim Burnett
Chairman