INTERSTATE COMMERCE COMMISSION

REPORT NO. 3383

IN THE MATTER OF MAKING ACCIDENT INVESTIGATION REPORTS UNDER THE LOCOMOTIVE INSPECTION ACT OF FEBRUARY 17, 1911, AS AMENDED

CHICAGO, ROCK ISLAND & PACIFIC RAILROAD

March 12, 1951

Accident at Missler, Kans., on February 11, 1951, caused by an explosion in the engine crankcase of a Diesel-electric locomotive unit.

REPORT OF THE COMMISSION[1]

PATTERSON, Commissioner:

On February 11, 1951, about 6:15 p.m., at Missler, Kans., an explosion occurred in the crankcase of the engine of Chicago, Rock Island & Pacific Railroad Diesel-electric locomotive unit 95, the trailing unit of a three-unit locomotive which was hauling a freight train at a recorded speed of 31 miles per hour. The fireman was seriously injured.

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[1]Under authority of section 17 (2) of the Interstate Commerce Act the above-entitled proceeding was referred by the Commission to Commissioner Patterson for consideration and disposition.

DESCRIPTION OF ACCIDENT

Chicago, Rock Island & Pacific Railroad Diesel-electric locomotive units 44, 95-B, and 95, coupled in multiple unit control, departed from Pratt, Kans., February 11, 1951, at 12:25 p.m., hauling westbound freight train No. 2/91, and proceeded without unusual incident to Missler, Kans., 99.5 miles from Pratt, where, at about 6:15 p.m., an explosion occurred in the crankcase of the Diesel engine of the trailing unit, No. 95, while train was running at recorded speed of 31 miles per hour.

The locomotive units had been dispatched west from Armourdale Enginehouse, Kansas City, Kans., a maintenance point, for continuous freight service en route to Tucumcari, N. Mex., February 10, at 11:00 p.m., and had been serviced and crews changed at Herington and Pratt, Kans., 150 miles and 276 miles, respectively, from Kansas City.

At the time of the accident, the train consisted of 57 loaded and 15 empty cars, 2990 tons; rating for the three units in this district was 4400 tons. The engineer was in his usual and proper position in the cab and the fireman was standing at the isolation panel in unit 95, having just pulled the isolation switch to off-position, when the explosion occurred.

As result of the explosion, all cylinder head or top deck covers were blown off and the paint on underside of exhaust manifold shroud was blistered for its entire length.

The fireman was seriously injured and was taken to a hospital.

DESCRIPTION OF LOCOMOTIVE UNIT

Unit 95, type B-B, was built by the Electro-Motive Division of General Motors Corporation at La Grange, Ill., in April 1944. It was equipped with a "V" type, 16-cylinder, 567-A, 2-cycle, 8½-inch bore, 10-inch stroke, 1350 horsepower Diesel engine, direct connected to a generator which furnished electric power to four traction motors mounted on two 4-wheel swivel type trucks, all axles of which were motor driven through spur gears; ratio, 61/16; wheel diameter 40 inches; weight on driving wheels 222,180 pounds; tractive effort 55,550 pounds.

It was equipped with an electro-hydraulic type S-1 Woodward governor, oil gages, cooling system temperature gage, low lubricating oil alarm system and shut-down feature, hot engine alarm

system, wheel slip lights, and a ground relay for protection of electrical equipment. The Diesel engine was last completely overhauled in November 1949 at El Reno, Okla., since which time the unit had made approximately 146,000 miles to the date of the accident; total mileage since unit was built 865,683 miles.

DESCRIPTION OF PARTS INVOLVED

The drop-forged carbon-steel crankshaft of the Diesel engine was made in two sections and the main and crank pin journals, which were 7-1/2 and 6-1/2 inches in diameter, respectively, were surface hardened. There were ten main bearings, two of which were center, constructed with steel backs and bronze-lead-tin overlay, fitted without shims. The bearing shells had staggered tangs to locate and secure the shells. The upper and lower main bearing shells were held in the engine frame by bolted forged-steel bearing caps, which were secured against movement by serrated joint faces on the caps and on the main frame.

The connecting rods were of forked and blade type construction. The forked rods were located in left bank of engine and were equipped with a basket that clamped the bearing shells in position. The blade rods, located in the right bank of the engine, rode on the outside of the upper bearing shell and were held in position by a machined shoulder. The connecting rod bearings were steel backed with bronze-lead-tin wearing surfaces.

The crankcase was of welded construction and had eight 10 x 12 inch covered inspection holes on each side.

The lubricating system consisted of three separate systems, namely, the engine lubricating oil system, which supplied oil under pressure for lubrication of the various moving parts of the engine, a piston cooling system for cooling the pistons and lubrication of piston and pin bearing surfaces, and a scavenging oil system which supplied the other two systems with oil from the oil pan sump which was forced through filters and coolers to the suction strainer housing supplying the lubricating and piston cooling oil pump.

Two positive-displacement, self-priming, helical-gear type pumps were used; one for the scavenging oil system and the other, which furnished lubricating and piston cooling oil, had a division plate between the two sections of its housing which separated two sets of pumping gear thus providing two discharge outlets.

The pumps were located at the front of the engine and were gear-driven from the crankshaft. The oil lines were equipped with necessary strainers, filters, and a relief valve for protection of the lubrication system from overpressure.

The large portion of the dual oil pump delivered oil to a "V" shaped manifold extending the length of the engine below the cylinder banks; thence oil was forced under pressure through steel tubing secured in cores in the engine frame, down to and into the crankshaft main bearings, and through drilled passages in the crankshaft to and into the connecting rod bearings, from where it dropped into engine oil pan then to the sump. The small portion of the oil pump supplied piston cooling oil to two manifolds extending the length of the engine from which it was forced through pipes (P pipes) into the hollow crown of the pistons to cool pistons and lubricate wrist pin bearings, thence dropping into engine oil pan. The larger portion of the oil pump also supplied oil under pressure for other lubrication points.

Two electric switches, consisting of spring-loaded diaphragms actuating a pair of electric contacts, were used in the lubricating system; one was used as a low-oil-pressure switch, and the other as a low-oil-supply switch on suction side of pump. Functioning of either switch would bring the engine to idle, light the warning lights, and sound the alarm.

An electric switch was also used in the cooling system which, in event of a hot engine, would light the hot-engine red lights and ring the alarm bell.

A temperature gage was also installed in the cooling system.

EXAMINATION OF LOCOMOTIVE UNIT AND PARTS INVOLVED

The explosion had displaced all cylinder covers and the paint on the underside of the exhaust manifold muffler shroud was blistered by the fire which followed the oil drain pipes from cylinder head drain channel. All crankcase and air box covers were in place, properly fitted with gaskets, and securely fastened. The lubricating oil was found at the full level mark on the bayonet measuring gage. There was no water present at the bottom of the sump 76 hours after the explosion. Numerous fine particles of bearing material were in suspension in the oil. A sample of oil taken from the crankcase and tested showed flash point 450 degrees and viscosity 1092 seconds, the carrier's instructions are to drain when flash point is 400 degrees and viscosity 800 seconds; blotter test medium dirty, carrier's instructions are to change when dirty. The test made of the oil

after the explosion may or may not show the true condition for the test was made from a sample taken from cold oil in the crankcase four days after the explosion and the process of the explosion could account for the medium dirty oil as a result of unburned carbon. The carrier's last test of the oil prior to the explosion, made at El Reno, Okla., February 10, 1951, showed flash point 430 degrees, viscosity 1091 seconds, slightly dirty; remarks O.K. Last oil change was made at El Reno, Okla., October 10, 1950 - Approximate mileage 45,000; instructions are to change at 72,000 miles.

The oil-pressure relief valve was tested at the bench and opened at 50 pounds, carrier's standard setting. The valve seat was in good condition and free of any foreign particles.

The blower oil seals were in good condition.

The oil pumps were dismantled for inspection and found to be in good condition.

The oil drain pan, the sump, pipe to filters, filters, and all strainers were found coated with a heavy deposit of fine and coarse particles of bearing material.

Low-oil-pressure switch was tested and functioned as intended; opened at 11 pounds pressure and closed at 15 pounds pressure. Carrier's standard setting, 6 pounds and 12 pounds, respectively.

The suction-oil switch, which worked as intended when tested, functioned at an operating vacuum of 7 inches of mercury.

A thorough examination of all oil lines under 60 pounds air pressure disclosed no leaks of any consequence.

The water had been drained from cooling system immediately after the accident to prevent freezing. A representative of the carrier stated the system had been found full of water after the explosion.

The hot-engine alarm switch was found to be set above 212 degrees F. When adjusted to operate at 195 degrees F., carrier's standard, it functioned properly.

The glass of the cooling system temperature gage was shattered but the gage was found to register correctly when tested.

All main bearings showed evidence of heat; the Nos. 1 and 3 had been overheated and No. 3 had been very hot; both were broken and half turned in the housings which had shut off the oil supply. Part of No. 3 bearing was frozen to the crankshaft journal. Both journals were badly cut and scored. Nos. 2, 4, 5 and 6 bearings were pounded out with journals badly cut and scored. Nos. 7, 8, 9 and 10 bearings had started to wipe but their journals were not appreciably scored.

All connecting rod bearings and rods were in good condition with the exception of No. 4 which was badly cut, the journal was scored and the lower end of the rod showed evidence of overheating.

The "A" frame of engine was sprung and closed in at Nos. 1 and 3 main bearing locations.

A compression test, using 90 pounds air pressure, was made on all cylinders. All pistons, rings, and liners were found to be in good condition.

Main bearing and piston-cooling-oil pressure gages were tested and found to be accurate.

INSPECTION AND REPAIR REPORTS

The last monthly inspection was made January 22, 1951. The last main air reservoir, hydrostatic and hammer tests, and last insulation test were made March 1, 1950; all at El Reno, Okla.

Daily inspection reports on file at various terminals where the locomotive unit had been during the 30 days prior to date of the accident were examined. Particularly noted was the inability of the carrier to furnish trip inspection reports, as required by rule 203, for points en route, at the end of Divisions or Districts where the unit had been cut off trains and moved to roundhouses for changing crews, servicing, etc., and a laxity in the proper handling of these reports. The following items which may have a bearing on this accident were found reported:

> February 2, en route Liberal, Kans. to Dalhart, Tex., reported by engineer: "Hot engine light burning and bell ringing on this unit, engine running under normal temperature." Notation: "Blocked out." Item signed for and report approved by a foreman at Armourdale Enginehouse, Kansas City, Kans.

February 2, en route Dalhart, Tex. to Tucumcari, N. Mex., reported by engineer: "Bells cut out at Dalhart." "Red light on at all times." Items signed for as repaired and report approved by a foreman at Armourdale Enginehouse, Kansas City, Kans.

The unit had passed through a number of other points where trip inspections should have been made but there were no reports on file. The hot engine alarm switch was found inoperative when inspected during this investigation, apparently it was blocked out by moving the adjustment above 212 degrees F. water temperature.

February 10, en route Herington to Kansas City, Kans., reported by engineer: "Glass broken in temperature gage." - Shown repaired. "Engine out of balance." - Not signed for as repaired and no explanation. Glass was found broken when inspected during our investigation; its condition indicated that it had been broken for some time.

February 11, en route Herington to Pratt, Kans., reported by engineer: "Clean oil off engine room deck, cocker arm covers leaking oil and oil fumes - oil leaks governor end." Form was found on unit at Armourdale, Kans. after the explosion. No repairs were shown and the form was not approved.

February 11, en route Pratt to Liberal, Kans., no time; reported by engineer: "Oil pressure main bearing very low runs around 20 lbs. when wide open, when at idle goes down to 8 lbs. Have to race eng to hold up oil pressure before will go on line." This notation was made on inspection form by the fireman during the trip and before the explosion occurred.

SUMMARY OF EVIDENCE

The engineer stated that no trouble was experienced with unit 95 until about 30 miles beyond Pratt, Kans., where the warning alarm sounded as he made transition from No. 2 to No. 3 position; that the fireman went back through the units to unit 95 and found the low-oil-pressure switch had functioned bringing the Diesel engine to idle. The fireman placed the engine

back on the line while the train was moving into a passing track at Joy, Kans., and when train headed out of the passing track all three units were on the line. At Bloom, Kans., 33 miles from Joy, the low-oil pressure switch again functioned on unit 95 and at this time the engine was left off the line until the train left Fowler, Kans., a distance of 18 miles. After departure from Fowler, the fireman put the engine back on the line and the train proceeded 16 miles to Missler, Kans., where again the low-oil pressure switch functioned on unit 95 as he was making transition from No. 1 to No. 2 position. The fireman then went back into engine room of unit 95 to isolate the engine and in a short time he came back, badly burned about the head, and stated the engine was on fire. The head brakeman who was in the cab of leading unit grabbed a fire extinguisher and went back to unit 95. The brakeman reported that he found a few sparks of fire around the air box filters which he extinguished and that the Diesel engine was dead. The train was stopped immediately, and he (the engineer) went back to unit 95 where he found the engine dead, the fire out, and all the top deck covers lying in the passageways. He then cut the units from the train and took the fireman 10 miles to Plains, Kans., for medical attention. There he notified the dispatcher of the accident and with the head brakeman acting as a fireman returned the units to Missler and took his train to Liberal, Kans., with unit 95 dead in train. No further unusual incident occurred.

The fireman corroborated the engineer's statements and stated in addition that the temperature of the cooling system was 150 degrees F., main-bearing oil pressure 8 pounds at idle, and piston cooling-oil pressure 18 pounds when he arrived in the engine room the first time the low-oil-pressure switch functioned; to get engine on line layshaft was used to speed engine up; that main-bearing pressure came up to 20 pounds, piston-cooling pressure 26 pounds and that the throttle was in No. 8 position when the engine was put on the line; at Fowler, after the one-hour delay, it was not necessary to use the layshaft to speed up the engine to get it on the line; he was in engine room of unit 95 after proceeding 10 miles from Fowler and at that time main-bearing pressure was 24 pounds and piston-cooling pressure about 26 pounds; that he was in cab of leading unit when low-oil-pressure alarm sounded the third time; he immediately went back to the engine room of unit 95 and as he pulled the isolation switch from Run to Idle position the explosion occurred. Temporarily blinded, he pulled his jacket over his head and went to the cab and notified the engineer.

DISCUSSION

As no contributory defective condition was found in the lubricating oil system, the functioning of the low-oil-pressure switch evidently was caused by reduction in oil pressure resulting from main-bearing failure. The engine was found in such damaged condition that it was impossible to ascertain the sequence of main bearing failures and thus determine the bearing which initially failed. Number 3 main bearing showed greatest evidence of overheating and could have been responsible for the ignition of crankcase oil vapor.

CAUSE OF ACCIDENT

It is found that this accident was caused by a crankcase explosion resulting from overheated main crankshaft bearings.

Dated at Washington, D. C., this 12th day of March, 1951.

By the Commission, Commissioner Patterson.

SEAL

W. P. BARTEL,

Secretary.