

INTERSTATE COMMERCE COMMISSION

REPORT NO. 3309

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

ATLANTIC COAST LINE RAILROAD

March 27, 1950

Accident (boiler explosion) near Tarboro, N. C., on February 24, 1950, caused by overheating of the crown sheet due to low water.

REPORT OF THE COMMISSION¹

PATTERSON, Commissioner:

On February 24, 1950, about 6:09 p.m., near Tarboro, N. C., the boiler of Atlantic Coast Line Railroad locomotive 411 exploded while the locomotive was hauling a freight train at an estimated speed of 20 miles per hour. The engineer, fireman and brakeman were killed.

¹Under 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

Atlantic Coast Line Railroad locomotive 411 departed from South Rocky Mount, N. C., February 24, 1950, at 9:30 a.m., on local freight run known as the Williamston Turn. The run to Williamston, N. C., a distance of 47 miles, was made without any known unusual incident and the locomotive departed at 3:50 p.m., hauling southbound extra freight train No 411 en route to South Rocky Mount. The train departed from Tarboro, N. C., at 5:57 p.m. and, at about 6:09 p.m., when about 2 miles south of Tarboro, approximately 33 miles from Williamston, the boiler of the locomotive exploded while the train was running at an estimated speed of 20 miles per hour. The engineer, fireman, and brakeman were killed.

The train consisted of 28 cars, totaling 984 tons, and a caboose; the tonnage rating of the locomotive in this district was 2200 tons. At the point of the accident, the grade was 0.66 per cent ascending and the track was tangent.

The force of the explosion tore the boiler from the locomotive frame and hurled it forward 150 feet where it struck the road bed front end downward, then settled back, headed south, on the right of and approximately parallel with the track, and tipped at an angle of about 30 degrees. The back end fouled the track about 6 inches.

The lower part of the smoke box and front end of the boiler were stove in. The mud ring was broken at all four corners and the sides bulged outward. The front end door was blown off, the sand box was thrown off and various parts of the locomotive were found scattered over a radius of 500 feet. The cab was thrown 170 feet forward of the boiler and 20 feet to the right of the track and was completely demolished. The cab apparently struck a telegraph pole in the course of its flight, tore off the cross arms and broke the wires.

The right rail of the track was kinked $1\frac{1}{2}$ inches at the point of explosion. The engine frame was broken in four places in front of the trailing truck. The right side of trailing truck A-frame was broken. The rear deck casting bolts were sheared and the deck casting and tail piece were torn off. The drawbar between the engine and tender was badly bent and broken through front pin hole. The front tender truck had been lifted from the track and all four wheels derailed. The engine chassis, tender, and first car ran past the wrecked boiler and stopped with the front end 300 feet from the point of explosion. The two tender feed water hose were torn off and all the water had drained from the tender cistern.

The body of the engineer was found 425 feet forward from the point of the explosion and 5 feet to the right of the track. The body of the fireman was found on top of the tender. The body of the brakeman was found in the wreckage of the cab.

DESCRIPTION OF LOCOMOTIVE

The locomotive was of the 4-6-2 type; built by the Baldwin Locomotive Works in 1914; cylinders were 22 inches in diameter with 28-inch stroke; driving wheels 69 inches in diameter with new tires; weight on drivers 145,100 pounds; rated tractive effort 33,400 pounds; working steam pressure 200 pounds per square inch. The tender was of the rectangular type, capacity 9,000 gallons of water and 11 tons of coal. The tender was equipped with I.T.T. telephone system, mounted on top of tender back of fuel space.

The boiler was a three-course conical type with a wide radial stayed firebox and a sloping back head. The inside diameter of the first course was 64-5/8 inches and that of the third course 76-1/2 inches. The boiler was equipped with a combustion chamber 24 inches in length, 24 5-1/2 inch flues and 183 2-inch flues, 16 feet 6 inches in length, a Franklin No. 8 mechanically operated fire door, a type A superheater and two lifting injectors.

A new firebox was applied in August 1928 and back flue sheet had been renewed since this date. The firebox was of four-piece construction, consisting of flue sheet, door sheet, inside throat sheet, and crown and side sheets of one-piece construction; all seams were welded. The flue sheet was 1/2 inch thick and all other sheets were 3/8 inch thick. The firebox was 72-1/4 inches wide and 108-1/4 inches long. The firebox was equipped with four 3-inch arch tubes supporting a brick arch.

The crown sheet was supported by 12 longitudinal and 31 transverse rows of stays. The first 5 transverse rows back of the flue sheet, extending to and including the 6th longitudinal row on each side of center line, were tapered flexible stays 1-3/16 inches in diameter at bottom end, 1-1/6 inches in diameter at top end, and 15/16 inch in reduced body section. Back of the first 5 transverse rows, the first 6 longitudinal rows on each side of center line were tapered driven head stays 1-3/16 inches in diameter at bottom end, and 15/16 inch in reduced body section. The 7th and 8th longitudinal rows on each side of center line were 15/16-inch flexible radial stays;

the remainder of the stays in the firebox were 15/16-inch rigid stays with the exception of 15/16-inch flexible stays in the breaking zones. The stays in the firebox were spaced approximately $3\text{--}7/8 \times 3\text{--}7/8$ inches. The taper of the tapered ends of the stays was 1-1/2 inches in 12 inches with a pitch of 12 threads per inch.

EXAMINATION OF BOILER AND APPURTENANCES

BOILER

The front end of the crown sheet had been overheated and the entire crown sheet, together with the top parts of back flue sheet, side sheets, and door sheet had been blown down on the engine frame. The collapsed area was torn practically free from the remaining firebox sheets. The four arch tubes had been blown out and the arch brick scattered in all directions.

The overheated area extended from the 6th longitudinal row of stays on right side of center to the 3th longitudinal row on left side, from the flue sheet to about the 15th transverse row, then tapered upward and backward to the 20th transverse row from flue sheet, a maximum width of about 45 inches and length of 76 inches, covering an area of approximately 22 square feet. The area was a deep blue color and evidence of overheating was definite. The line of demarcation showed the water level to have been 3 inches below the highest part of the crown sheet.

The initial rupture occurred through the top row of superheater flue holes, and the tear extended entirely across the flue sheet. On the right side, the tear continued diagonally downward through the combustion chamber sheet and into the side sheet and irregularly back and downward to the mud ring, a distance of 11 feet 3 inches, along the mud ring for a distance of 3 feet, thence upward to the corner of the door sheet and diagonally down through door sheet to the top of the fire door opening, a distance of 7 feet 2 inches. On the left side, the tear through the superheater flue holes continued in similar manner through combustion chamber sheet and into side sheet, then irregularly down and back for a distance of 5 feet 4 inches, to a point 3 feet 11 inches above the mud ring, then backward 7 feet 3 inches, then upward and back to the corner of the door sheet and diagonally down through the sheet to the top of the fire door opening, a distance of 5 feet 7 inches.

The crown sheet pulled from 556 stays, left side sheet 253 stays, right side sheet 383 stays, and door sheet 98 stays, - total of 1090 pulled stays. Eight scattered staybolts were broken and 23 staybolts were fractured prior to the explosion as indicated by the broken ends.

APPURTENANCES

Safety valves. The boiler was equipped with two 3-inch, heavy duty, Consolidated safety valves, one muffled and one open type. These valves were applied and tested on locomotive 415, the same type as locomotive 411. The muffled valve began to open at 198 lbs., opened wide at 200 lbs., seated at 190 lbs., and leaked slightly. The open type safety valve began to open at 205 lbs., opened fully at 208 lbs., and seated at 203 lbs.

Steam gage: The boiler was equipped with one Ashton steam gage, graduated to 400 lbs. It was damaged to such extent that it could not be tested. The siphon valve fitting was broken off flush with the wrapper sheet and was found open. The siphon pipe and connections were open and clean.

Water level indicating devices: The boiler was equipped with one double-face Hanlon bulls-eye type water glass and three Nathan double-seated gage cocks. The water glass, which had seven staggered eyes on each face, and a 6-inch clear reading, was mounted on the back head on left side of center line; the nipple of the bottom connection entered the boiler 14-1/2 inches to left of the center line, extended into water space 2-1/2 inches, and had a 9/16-inch opening. The top water-glass shut off valve fitting which entered the wrapper sheet 9-3/4 inches to left of center line and 7-1/8 inches from the back head had a 5/8-inch opening and was connected to the water glass by a 5/8-inch outside diameter copper pipe, 25 inches in length. An extension handle, 15 inches in length, was connected to the top shut off valve through a universal joint; was supported by a strap bracket, 9 inches long, with a 2-inch foot that was attached to the boiler by a stud which supported the water-glass gage lights. The top water-glass shut off valve fitting was broken off flush with the wrapper sheet and remained attached to the steam pipe and extension handle. The steam pipe was broken off at connection to the top of water glass. The water glass, lower connection, and drain valve remained attached to the boiler. As a result of the accident, the top water-glass shut off valve extension handle was bent to an angle of approximately 90 degrees at the point where it passed through the strap

bracket and was fouled by the bracket and left cab brace in such a manner that the top shut off valve could not be operated. It was necessary to cut the bracket in order to free the extension handle in order that the shut off valve could be operated. This top shut off valve was found in closed position. Two full turns of the stem opened the valve fully. The bottom water-glass shut off valve and drain valve were found in closed position. It required four full turns to open the bottom shut off valve. The lowest reading of the water glass was 5-5/8 inches above the highest part of the crown sheet. The fittings, steam pipe, and openings into boiler were open and clean.

The three Nathan double seated gage cocks were mounted in the knuckle of the back head on the right side, spaced approximately 3 inches vertical centers. The lowest gage cock was 5 inches above highest part of crown sheet. The gage cock fittings extended into the water space approximately 3 inches; the 1/4-inch openings were open and clean. The gage cock dripper and drain pipe were open. The gage cock nipples were in place and had visible clearance over dripper.

Injectors: The boiler was equipped with two type A, No. 10 Hancock lifting inspirators, rated capacity 4060 gallons per hour with 200 lbs. steam pressure, one mounted on each side of the boiler in the cab. These inspirators were applied and tested on locomotive 415 of the same type as locomotive 411. At 200 lbs. steam pressure the right injector put 2 inches of water in the boiler in 2 minutes, with water valve wide open. The test was started with two bulls-eyes of water showing. The left inspirator steam valve stem was bent as a result of the accident, causing the valve to leak so badly it would not prime; it was dismantled and the tubes were found tight, clean, and in good condition. The main steam valve at turret, together with inspirator steam valves, were found open and unobstructed. The delivery pipes were open and clean.

Boiler checks: Hancock, double vertical, 2-inch check valves, with double stop valves, were applied to the top of the first course. The left check valve has 1/2 inch lift, the right check valve has 3/8 inch lift. They were open and clean and the seats in good condition. The opening into the boiler was unobstructed. Each delivery pipe was equipped with a line check which was clean and free. The delivery pipes were clean and open.

Blow-off cocks: The two manually operated Talmage 1 1/2-inch blow-off cocks, one on each side of boiler near front corner of mud ring, had been broken off. One Okadec 5/32-inch manually

operated continuous blow-off cock was connected by a nipple to back head near mud ring, left side, the nipple was badly bent and operating handle broken off. A 1/2-inch valve, connected into back head near crown sheet, right side, and used in connection with a rail washer, was found in closed position.

Feed water tank, tank valves, hose, and strainers: The feed water tank, having capacity 8000 gallons, was provided with a collapsible wooden measuring stick, designed to be inserted in a pipe water leg whereby the quantity of water in the tank could be determined.

Both feed pipe hose were torn off. The interior lining of each hose appeared to have been in good condition prior to the accident. The interior of the tank was clean and in good condition. Screens provided for the tank wells were in place and clean.

The left tank valve was found in open position and stem was bent. The right tank valve was found in closed position, operative, and seat in good condition; however, this valve apparently was open at the time the accident occurred since more than one witness stated that water was discharging through both tank hose after the accident.

INSPECTION AND REPAIR REPORTS

The locomotive received last class 3 repair, April 29, 1947, at Rocky Mount, N. C.; last annual inspection was made on March 8, 1949, at Wilmington, N. C.; last quarterly inspection on December 7, 1949; last monthly inspection and boiler wash on February 9, 1950, and last daily inspection on February 23, 1950, the latter three at Rocky Mount, N. C.

Daily inspection and repair reports from January 20, 1950, to date of accident were examined and nothing was found reported that would have any bearing on the accident.

SUMMARY OF EVIDENCE

The conductor stated in effect that his last personal contact with the engineer and fireman was at Williamston at which time they appeared in normal condition for duty. He further stated that the locomotive was supplied with coal and

water at Parmele, N. C., 19 miles north of the point of the accident. He did not remember having heard any member of his crew comment on the condition of the locomotive. Following the accident, he walked to the front end of the train and saw water flowing from both right and left tank hose and he located the bodies of the locomotive crew.

The Superintendent of Motive Power, Northern Division, stated that he arrived at the scene of the accident at 7:30 p.m. and issued instructions that none of the valves or boiler appurtenances were to be touched. He saw that the throttle valve was closed, the automatic brake valve was in emergency position, the right injector was attached to the boiler with the operating lever in closed position and the left injector was on the ground with the operating lever in closed position. He further stated that the cab was badly damaged and distorted and the reverse lever was found forward of the front stop of the quadrant.

The engineer who operated the locomotive on Extra No. 411 North from Wilmington, N. C., to Rocky Mount, N. C., a distance of 123 miles, on February 23, on trip preceding the accident, stated in effect that he noticed slight foaming at different times while blowing the whistle and he blow down the boiler several times, probably a little more frequently than the 20-second blow down every 20 miles, as instructed by the mechanical department. He further stated that the injector and boiler water level indicating devices were operative and in good condition.

A hostler on the third shift, 11:30 p.m. to 7:30 a.m., stated that about 7:20 a.m. he went to locomotive 411 on the drop pit to place it on the outgoing track; he found the water glass bulls-eyes in the left face leaking; he notified the assistant night roundhouse foreman and a machinist to come to the locomotive; that he (hostler) closed the top water-glass valve and the machinist closed the bottom water-glass valve and tightened both with a wrench, then he moved the locomotive into the roundhouse and both were relieved from duty.

The machinist, who tightened the water glass valves, and his helper stated that they notified the first-shift forces to put on a new glass.

A first-shift machinist stated that he removed the defective water glass and applied a newly overhauled water glass. The water-glass valves were opened and the glass functioned properly. The helper corroborated this statement.

A first-shift hostler stated that at 8:15 a.m. he moved locomotive 411 from the roundhouse to outgoing track; that he

opened the water-glass drain valve and blew out the glass; that there were four eyes of water in the boiler when he left it; that he had no occasion to operate the injector, and that the water glass functioned properly.

A first-shift hostler helper stated that he was in the cab of locomotive 411 on the outgoing track and he noticed the eyes in the left face of water glass leaking slightly but said nothing about it to anyone.

DISCUSSION

All members of the crew on the locomotive at time of the explosion were killed and no evidence was found which would determine why or by whom the water-glass valves were closed.

During this investigation, the water glass was applied and tested on locomotive 415, under 200 lbs. steam pressure, and no leaks were noticed; after this test, the water glass was completely dismantled and nothing was found that would justify closing the valves.

CAUSE OF ACCIDENT

It is found that this accident was caused by overheating of the crown sheet due to low water.

Dated at Washington, D. C., this 27th day
of March, 1950.

By the Commission, Commissioner Patterson.

SEAL

W. P. BARTEL,

Secretary.