5

1006 Database - Complete Listing

LEAK DESCRIPTION

Date of Leak : 07/14/72 Time: 21:35 MST
Line Number: 5
Location:
Milepost: 1279.00
City: Near Iron River County: Iron State: MI
Tract: M2-50
Landowner: Irene Johnson

Part of System Involved: Line Pipe
Item Involved : Longitudinal Weld
Cause: 36" Rupture of Long. Weld
Number of People Injured: 2
Number of People Killed : 0
Was there an Explosion ? Yes
Was there a Fire ? Yes
Leak enter Watercourse ? No

Estimated Damage: 114,000
Barrels Out: 5,500
Barrels Recovered: 0
Depth of soil cover: 0 ft.

Government Agencies: MI State Highway Commission
DOT Office of Pipeline Safety (Letter)
MI Dept. of Natural Resources

Was it DOT Reportable? YES
Was Drug Testing Performed? No
Temporary Repair: Date: / /
Permanent Repair: 25' new line installed. Date: 07/20/72
Line Shutdown: : / / Pressure at Shutdown:
Returned to Service: : / /
Pipe Analysis Performed? Yes

Pipe Information

Size: 30 In.
Wall Thickness: 0.3120
Date Installed: 01/01/53
Yield Strength: 52000
Manufacturer: Wickwire Spencer - Claymont Mill

Seam Type: SAW
Spec. Manufacturer: API-5LX
Coating: Primer, coal tar enamel, inner/outerwrap
Maximum Operating Press.: 0 psi

Hydrotest Data

Date: / / Test Press.: 0 psi Test Medium: Test Duration: 0 hrs

Internal Inspection:

Date: / / Type of Tool: Anomolies:

Disposition of Lost Commodity: Burned in fire
Land Restoration Method: hauled, fert, seeded
Comments: 3' rupture of long seam. Oil affected approx. 60 acres. Was unintentionally ignited injuring 2 people in a vehicle. Most oil burned in fire. Controlled burning of trees & residuals followed. Oil sateurated soil was hauled to Iron River Stn. and buried with approval from MI Dept of Public Health.

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Documentation of Pipeline breaks, leaks, failure, investigation, discovery & repairs

LAKEHEAD PIPE LINE COMPANY, INC.
IRON RIVER, MICHIGAN LEAK
MILE POST 1279
JULY 14, 1972

On July 14, 1972, at 11:30 p.m., CDT, a leak occurred in the 30-inch line at M.P. 1279, approximately seven miles downstream from the Iron River, Michigan, station. A longitudinal pipe seam, welded by the submerged arc process, failed and allowed approximately 5,500 barrels of crude oil to spill into the immediate area. The spilled oil followed a natural water course to the south of the pipeline, entered the ditches on both sides of U.S. Highway #2 through a system of culverts. A flare pot, adjacent to a highway caution sign, "Road Construction Ahead", was probably the source which ignited the vapors which, in turn, ignited the free surface of the spilled oil. The burning affected a 10 acre tract of land, destroying trees and underbrush. Two young adults who had stopped their automobile to investigate the fire were caught in an area of intense heat, after a gully adjacent and north of the highway containing a large quantity of crude oil, erupted into flames. They received burns on the portions of their bodies which were not covered by clothing. Medical treatment was administered shortly after the incident. Since then, their physical conditions have been reported to be serious, but not critical, and they are recovering under medical care.

Exhibits I and II show the location of the leak and the area affected by the burning (Exhibit II indicates other important information associated with the spilled oil and damaged area). Photographs 1 - 14 are appendixed as aids to more clearly illustrate the extent of the damage.

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Operations and Events

The 30-inch pipeline, traversing the distance between Superior, Wisconsin and Sarnia, Ontario, Canada, and passing through the northern parts of Wisconsin and Michigan, is a remotely controlled facility with the master control console located in the Superior, Wisconsin, station, (see Exhibit I, Systems Map). Prior to the leak, the Saxon, Wisconsin, station had been shut down to allow a specialty batch to by-pass the station. At approximately 10:05 p.m., CDT, the Saxon station units were brought on the line to increase the pressure, thereby increasing the rate. The increase in pressure is evident on the suction and discharge recording charts for Gogebic, Iron River and Rapid River stations, (see Exhibits III, IV & V). The charts for stations downstream of the Rapid River station have not been included in the exhibits because the pressure effect of starting the Saxon station diminishes with distance. The Rapid River station charts show this diminishing effect when compared to charts for Iron River and Gogebic Stations.

At the Superior station the operator was in the process of balancing the line to establish a rate of 17,000 bbls./hour. From the start of a thruput increase it takes approximately two hours to achieve a balanced operation - minimum units operating with a maximum differential across each station and pumping at the rate called for by the daily pumping orders issued by the Oil Movements Department in the Edmonton, Alberta, Canada offices. The Superior operator was concentrating on the discharge pressure displays for the stations immediately downstream from the Saxon station. The rate at the time of the leak was 16,500 bbls./hour, and while monitoring the console displays, the operator noted a pressure loss at the Iron River station, followed by a low-pressure shut-down of the only unit which was in service. The time was 11:33 p.m., CDT. This time is evident on the exhibited pressure charts for the Gogebic, Iron River and Rapid River stations,

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showing the sudden loss of suction and discharge pressures at 9:33 p.m., Mountain Standard Time (or 11:33 p.m., CDT). (All pressure recording devices are set on Mountain Standard Time throughout the system.)

After checking the console displays to make certain that no other section of the line was in jeopardy, the Superior operator telephoned Edmonton Dispatching at 11:40 p.m., CDT, to report the sudden pressure drop at the Iron River station. It was decided that the entire line should be shut down, and this process was started at 11:45 p.m., CDT.

The telephone supervisory circuits, which connect the remote station consoles to the Superior master console, were lost at 11:52 p.m., CDT. The telephone circuits are arranged so that all remote consoles are on one circuit when each and every facility is working properly. However, there are provisions in Western Union's facilities in Minneapolis, Minnesota to disconnect a group of stations on a branch circuit which might have difficulties. At 11:52 p.m., CDT, the entire supervisory circuit for the remote control facility was lost, and four minutes later the branch circuit, which is common to Gogebic, Iron River, and Manistique Stations, was isolated, allowing supervisory control for all of the other stations. The telephone circuits into the Iron River station are mounted on electrical power poles which are located on the north side of U.S. Highway #2. Approximately 3/8 of a mile of this pole line had to be replaced as a result of the fire.

The Western Union Wire Chief in Minneapolis called out the telephone service man at Iron Mountain, Michigan who, in turn, isolated the Iron River station from the branch circuit at 12:18 a.m., CDT. This placed all stations, except the Iron River station, under supervisory control thirty-six (36) minutes after the first indication of circuit trouble. The Iron River station circuit was restored shortly after the long distance telephone line and power line reconstruction had been completed

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on July 15, (the following day).

The telephone service man in Iron Mountain, Michigan, was the first to report to the Company that a fire had occurred. He made telephone contact with the Saxon station and the message was relayed to the Superior station at 12:20 a.m., CDT. The Superior operator, in turn, called the telephone service man at Iron Mountain to verify the report of the fire. At this time it was learned that two young adults had been injured, and that they had been hospitalized.

The two young adults were traveling by automobile from Iron River toward Crystal Falls, Michigan along U.S. Highway #2. It had been reported that as they approached from the west they saw a fire in the highway ditch, surmised that the fire was the result of an automobile accident, stopped their automobile, got out, and proceeded to investigate. As they approached the fire, the oil in a gully on the north side of the highway ignited, subjecting them to intense heat. They ran to their automobile to escape. Since it would not start, they were forced to abandon it and make their way to safety on foot. In the process, the portions of their bodies not covered by clothing were burned and/or blistered. A passing motorist took them to an Iron River, Michigan hospital, where they received treatment.

Shortly after entering the hospital the young woman was released, but was later re-admitted. The young man remained hospitalized, but was transferred to a hospital better equipped to handle these types of injuries. At some later date an insurance report will furnish more details concerning the welfare of these people. Exhibit II has been marked to indicate the approximate location of these two individuals when they were exposed to the intense heat.

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The leak occurred on high ground and the spillage followed a natural water course. It flowed through a culvert system under the main highway, and eastward in the ditches along both sides of the highway. The open flames of the flare pot must be assumed to have ignited the vapors, which, in turn, ignited the free surface of the spilled crude oil (see Picture #11). Apparently, the flames traveled westward and then north towards the leak location. The oil burned for approximately one hour until little or no liquid remained.

Around midnight, July 14, 1972, the district superintendent with headquarters in Manistique, Michigan, was contacted by telephone at his residence. He, in turn, called out the district pipeline maintenance crews after being briefed about the then-known details concerning the emergency. The Company crews were on the site around 6:00 a.m. the following morning when plans were formulated for clean-up and leak repairs.

The division manager was notified and he arrived at the Superior station at 12:20 a.m., July 15, at which time he was appraised of the situation. Besides verifying that the pipeline crews were being moved out, he dispatched employees to close the main line gate valve at Mile Post 1283.10, (approximately 4 miles downstream from the leak). This valve was closed after Rapid River Station had been operated so as to pump oil in the line away from the leak location.

The Rapid River station is 956 feet lower in elevation than the Iron River station, and at 12:40 a.m., CDT, July 15, a unit was started at Rapid River to pull oil away from the leak site. The unit ran until it shut down on low suction - which occurred at 1:12 a.m., CDT. It was started again at 1:15 a.m., CDT, and was stopped six minutes later for the final time. This operation can be visualized by reviewing the pressure chart variations for the Rapid River station (Exhibit V). The maneuver was effective, demonstrated by the fact that the ruptured pipe

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section was dry when the maintenance crews removed it. There is no way of calculating the reduced spillage as a result of this operation except to point out the fact that only about 5,500 barrels of oil spilled out of the line and was consumed by fire in one hour's time. However, if the pumping had not taken place, it is estimated that about three to six times this amount would have been spilled. The trees and underbrush burned until 3:30 a.m. the following morning, although the area smoldered for a longer period of time. The Iron River Fire Department was on the scene, responding to a telephone call by the residents of the property where the leak occurred.

There were three station electrical supervisors who arrived at the scene at various time intervals. The first Company employee on the scene was the Iron River Station Electrical Supervisor who was notified of the emergency by a local resident. He arrived at the Iron River station about 3/4 of an hour after the leak occurred. He was not able to make telephone contact with the Superior station because the long distance telephone service out of Iron River, Michigan, was inoperative. He proceeded to Great Lakes Transmission Line's compressor station near Crystal Falls, Michigan, where he relayed telephone and radio messages. This same employee closed the main line gate valve at Mile Post 1283.10 at 2:30 a.m. Closing this valve isolated the main line section in which the leak occurred. The Iron River Station Electrical Supervisor drove through the burned area several times, and at one point, asked the fire department not to direct high pressure streams of water at the burning crude. He also discovered the hole in the ground above the ruptured pipe around 4:00 a.m., when daylight was occurring.

An electrical supervisor from the Saxon station was in the area attending to a planned work schedule, and he was at the Iron River station during most of the emergency. It was this employee who closed the east

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header gate of the station.

Rapid River's electrical supervisor was at the scene around 2:30 a.m. He supported the state and local patrol officers in directing traffic along U.S. Highway #2. This employee remained at the site until the immediate emergency was over and for some time after the Company crews were on the site.

A representative of the Michigan Department of Natural Resources (DNR) was informed by telephone about the emergency shortly after 1:30 a.m., CDT, July 15. He arrived by automobile from Mount Pleasant, Michigan at around 8:30 a.m. Prior to departing from his home, he made arrangements by telephone for DNR equipment to proceed to the location. Their bulldozer was on the site around 3:30 a.m., and was used to clear the ground at the leak location (immediately south of the pipeline) of bushes and other burned or burning materials. After the fire had burned itself out and the bulldozer had performed its clearing operation it was removed - around 6:30 a.m., CDT.

The Company crews excavated at the location of the leak, and removed a 25-foot pipe section (30" outer diameter x 0.312" wall thickness) containing the rupture. The replacement was a new pipe section with the same specifications, which had been pretested. This section was set in place and secured by using Weld-Plus couplings. The Company crews worked all day Saturday and well into the evening to complete the repairs. The main line pumping operation was started around 11:30 p.m., CDT, July 15. It was on full stream service by 2:30 a.m. A main line shut-down occurred on July 20, and the Weld-Plus couplings were welded to make a permanent repair.

On Sunday, July 16, Company crews, as well as contract labor and equipment, began the clean-up operation. Dams were erected to prevent any possibility of unburned oil entering the creek which drains into Lake Emily.

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It was impossible for the DNR agent and the Company representatives to resolve matters over the telephone with the state geologists and health officers concerning the clean-up and disposal of debris as related to the ecology. After an inspection trip to the leak site, a meeting was held at Iron River, Michigan, on Monday, July 17, at which the varied interests from the state presented their views. The method for clean-up was resolved and an acceptable disposal pit on the Iron River station property was selected where burning and burial operations were approved. The clean-up of the site, etc., followed the directives of the state authorities. The state also made contact with the landowner and laid the ground work to satisfy his interests as well as the state's interests regarding the damage to the highway and the ecology.

By Tuesday afternoon the clean-up work had begun. Rains did occur with no serious consequences. The rains removed the ash deposits from the burned area and, apparently, this elementary material has been absorbed by the peat bog and vegetation in the swamp which forms a natural barrier between the leak site and the creek.

Other Eye Witnesses to the Fire

An elderly couple had left Crystal Falls for Iron River, Michigan, and as they approached from the west, they could see fire in the ditches on either side of the highway. The time is judged to be close to 11:30 p.m., CDT, July 14. They stopped their automobile a safe distance from the site and watched. After a period of time they saw and felt an increase in fire intensity. They did not note the time, but this could have been the moment the two young adults on the opposite side were caught in the intense heat.

This couple observed that three automobiles passed their parked car and entered the burning area. Apparently, all three automobiles made it

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to the other side without incident. There have been no reports from these motorists.

Historical Data on the Pipe That Failed

The pipeline in which the failure occurred was constructed in 1953 for Lakehead by the Bechtel Corporation. The 30" (outer diameter) x 5/16" (wall thickness) pipe was manufactured by the Wick Wire Spencer Division of the Colorado Fuel and Iron Company in accord with Specification X-52, High Test Electric Weld Line Pipe, National Tube Division Designation NEWP-1, revised in November, 1952. The Claymont, Deleware mill fabricated the pipe and met the 40-foot requirement of the purchase order by welding 20-foot sections together. Each 20-foot section was subjected to a plant hydrostatic test of 975 PSIG before the sections were welded together to form the 40-foot length. The 975 PSIG test pressure is 90% of Specified Minimum Yield Strength (SMYS).

Bechtel Corporation completed the construction late in 1953 and the line from Superior to Sarnia was hydrostatically tested in sections for 12-hour periods. The test pressures were designed to impose a stress of approximately 90% of SMYS at the low point of each section, and 125% of proposed maximum operating pressures at each station discharge point. This qualified the line for operating as designed at a stress level of 60% SMYS based upon a nominal wall thickness. The specifications permit a wall thickness tolerance of -10%.

The approved discharge pressure at the Iron River station by the above criteria permitted a discharge pressure of 600 PSIG. In 1965 the maximum operating pressure at the Iron River station was raised to 65% of minimum yield (703 PSIG). The performance of a 6-hour running test was witnessed by the Michigan Public Service Commission. The data gathered during the test was submitted in a formal report, and after a review, the Michigan

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Public Service Commission approved the increase of the maximum discharge pressure to 65% of SMYS. During the test, the discharge pressure at the Iron River station was held at 773 PSIG, which would subject the pipe section which failed to a pressure of approximately 690 PSIG. The maximum discharge pressure of 65% of SMYS permits a discharge pressure of 703 PSIG. Since 1965 the Iron River station discharge pressure controller has been set to limit such pressure to a maximum value of 616 PSIG.

At the time of the failure, the Iron River station was discharging at 540 PSIG, and it has been estimated that the pipe section which failed was subjected to 460 PSIG - a pressure well below design and approved values.

In 1971 the Company, in an effort to evaluate the physical condition of the pipeline, ran an AMF Tuboscope instrumented pig device (Linalog) through this and other sections of the pipeline. Various minor discontinuities were found upon reviewing the Linalog charts, which record instrument values related to corrosion, buckles and other mechanical damage. The Linalog charts which relate to the pipe section that failed record no discontinuity which might suggest any deficiencies.

Instruments are provided at the Iron River station to record, limit and shut down the station when line pressures exceed preset values. The discharge pressure is controlled at 616 PSIG and should this value be exceeded, another device shuts down the entire station if the pressure reaches 635 PSIG. All of the pressure sensing devices operate continuously except for short periods of time when the electrical supervisor checks their operation and performs calibrations. These devices are calibrated twice a year, usually in the spring and fall, and at other times when it has been noted that the read-outs have drifted off calibration. There is no history of the discharge pressure exceeding the maximum control point or shut-down value.

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Pipe Failure

The failure occurred in a longitudinal seam, and a section of pipe 25 feet long was removed in the process of making repairs. The pipe still had the original markings visible on the interior surface at one end, identifying that the pipe was fabricated at the Claymont mill. The split in the seam was 45" long. The west end traversed the circumferential weld, migrating into the adjoining pipe section approximately 5 inches. A 5-foot section containing the split has been shipped to the Battelle Memorial Institute at Columbus, Ohio, where it will undergo extensive investigation.

Conclusions

There is no evidence that operating pressures exceeded designed or permitted values; while it is a reasonable assumption that the initial failure occurred in the center portion of the split and in the weld of the longitudinal seam, this can only be conclusively determined after an extensive engineering investigation.

NCF/mkr

ENBDNR0004717

February 1, 1973

GCD:454

Mr. Charles Maxwell
Michigan Public Service Commission
Seven Story State Office Building
Lansing, Michigan 49813

Lab Report No. 1467

Dear Mr. Maxwell:

This is further to the report on the failure of the 30" 5/16" wall API Specification X52 line pipe operated by Lakehead Pipe Line Company, Inc., which occurred on July 14, 1972 near Iron River, Michigan (SW ¼ NE ¼ Section 23 T43N R34W Iron County). The pipe which failed in the longitudinal weld was replaced with a new section of pipe and the defective pipe sent to Battelle Laboratories for detailed metallurgical inspection.

A copy of the research report by Battelle Laboratories, Columbus, Ohio, dated November 2, 1972 is enclosed. The cause of failure is attributed to a combination of a number of minor defects at one location. These defects consisted of a lamination in the plate, misaligned weld repair, excessive weld reinforcement, extreme hardness in the heat affected zone and toe cracks or high residual stresses as a result of cold expansion.

It seems reasonable to assume that during the process of forming in the manufacturing process some peaking was left in the plate at the weld line. Cold expansion with such a condition would definitely result in toe cracks in the extremely hard heat affected zone, or at least very high residual stresses. Such a condition would then lead to stress sulfur cracking in the heat affected zone. The extreme hardness of this heat affected zone probably resulted from a low heat input during welding mainly associated with the mill repair weld.

Examination of the independent mill inspection reports following the completion of the order for some 30,000 ft. of pipe from this manufacturer shows there was not an excessive amount of inside weld repair in association with manufacture of this pipe.

It is most unlikely that such a combination of defects would occur again, and for this reason we are of the firm opinion that the remaining pipe of

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GCD:454 February 1, 1973

this manufacturer in the system (approximately 5 miles) is adequate for continuing service. However to be completely assured of the integrity of the remaining pipe, it is planned to requalify this section of the line by hydrostatic testing to approximately 125% of the maximum operating pressure.

We are satisfied that the above requalification will insure the quality of the line to permit safe operation in the future.

Yours very truly,

W. C. Emmons

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Enclosure

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