FAIRBANKS
Daily News-Miner
"America's Farthest North Daily Newspaper"
FAIRBANKS, ALASKA, FRIDAY, JANUARY 23, 1976
Jan. 23, 1976

71,400 gallons per day?

'Small' leaks may escape pipeline warning system

By RICHARD A. FINEBERG
Staff Writer
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The trans-Alaska pipeline's sophisticated leak detection system will have less than half the accuracy anticipated when it was conceived, and may be unable to warn of leaks smaller than 71,400 gallons per day, the Daily News-Miner has learned.

Data on the computerized leak warning system is contained in a 1974 report prepared for the federal Alaska Pipeline Office by Mechanics Research Inc., an engineering firm that provides technical staff support for the federal pipeline monitoring agency.

Although Alyeska is spending millions of dollars on the leak detection system, pipeline company engineers acknowledge detection of small leaks is still a problem. "Instrumentation and mechanical equipment always have their limitations," commented W.N. Sorensen, Alyeska's chief of design review.

The pipeline will be run from an operations control center at Valdez, the southern terminus of the line, where an operator will scan information relayed continuously from various points along the 800-mile route. If a break in the line were to cause a major leak, it would be indicated on the video display tube at Valdez, and an alarm would sound; the operator then could shut down upstream pump stations and block valves near the leak, limiting the size of the spill.

The Mechanics Research report, "Alyeska Pipeline Leak Detection System Evaluation," indicates a line loss smaller than 1700 barrels per day (71,400 gallons) would not trigger the alarm system. It is not clear from the report how long it would take the operator to learn of the problem.

Alyeska's Sorensen declined to discuss details of the Mechanics Research report, or the leak detection system. However, the pipeline company official did confirm the general accuracy of the report's data, which he said was derived from information Alyeska provided at the government's request.

Sorensen said even if a leak smaller than 1700 barrels per day did not trigger an alarm at Valdez, the data recorded at the operations control center might indicate to an experienced operator that something was amiss. How long would it be before the operator decided toanalyze the print-out of data flashed on the video panel? "Hopefully we'll never get a good experience fac-

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tor because we'll never get a leak," Sorensen replied.

Sorensen and Alyeska's oil spill contingency planner Dave Kauffman both stressed that the stringent quality control standards governing construction of the pipeline greatly reduce the possibility of leaks.

However, according to the Interior Department's 1972 environmental impact statement for the controversial project, "the performance record of pipelines in general and the abundance of environmental factors in Alaska that could contribute to pipeline rupture are such that perfect no-spill performance would be unlikely during the lifetime of the pipeline. It is therefore likely that some spills would occur."

The pipeline will have four separate leak detection systems. However, the Mechanics Research report said the most sensitive of the four—the line-volume balance system—would not function reliably because the failure of any of the numerous components could distort the final calculation flashed on the display screen at Valdez. To resolve this problem the report recommended that Alyeska employ additional measuring devices known as ultrasonic flowmeters at each pump station.

Alyeska subsequently awarded a $5-million contract to Westinghouse Electric Corp. for the flowmeters, which use high-frequency sound energy to measure changes in oil flow. According to The Oil & Gas Journal, the trans-Alaska pipeline will be the first large-diameter pipeline in which the high-accuracy devices will be used. Prototypes are to be tested this year.

According to the Mechanics Research report, the addition of ultrasonic flowmeters will provide much greater reliability, but the size of the smallest leak the system can detect will be increased. Data provided in the report indicates that at 1.2 million barrels per day—the pipeline's expected 1978 flow rate—the minimum leak detection capability of the modified system will be 1700 barrels per day.

This figure is considerably higher than had been anticipated. According to the 1972 environmental impact statement, "Alyeska expects to be able to detect a leak smaller than 31 barrels an hour by the line-volume balance method." This would be a line loss of 744 barrels per day.

Should a leak occur, Sorensen said, the best leak detection device is still the human animal. On most pipelines, he explained, aerial patrols and reports from affected land owners and other ground observers are the principal sources of leak reports.

Alyeska plans aerial and ground patrols, but rough flying conditions, coupled with the remoteness of the 800-mile line, reduce efficiency of these methods. There's another problem with visual inspection: It is not clear how quickly an underground leak would appear on the surface of the ground. Approximately 250 miles of pipe will be buried; the remainder will be elevated above the ground on pilings.

A small underground leak caused by a small hole in a 48-inch pipeline in northern Minnesota last year took four to six weeks to surface, according to a source at the Lakehead Pipeline Company. Lakehead is believed to be the only other pipeline company in the U.S. using 48-inch pipe to transport oil.

The leak occurred near the Clearbrook, Minn. pump station April 3, 1975 and was estimated at 350 barrels. Lakehead personnel believe the leak was caused by a combination of internal corrosion and a defect in the pipe.

Although Lakehead has had trouble with other, smaller diameter pipelines in its system, the leak at Clearbrook is the only problem the company has encountered with its 48-inch pipe. Lakehead has about 120 miles of 48-inch pipe similar to Alyeska's. Most of the Lakehead pipe was manufactured in Japan, as was Alyeska's.

Alyeska's experience with fuel line leaks in the workpad beneath pipeline construction camps also indicates underground seepages can continue for extended periods of time, even in populated areas, before they surface.

A leak in a buried fuel line at the Galbraith Lake camp last winter went undetected until the fuel began seeping to the surface after breakup in June. By that time it is estimated that more than 100,000 gallons of fuel may have been lost. Other camps have had similar problems.

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What happens if . . .?

From the time the operator at the pipeline's Valdez operations control center learns there's a leak, it will take approximately 10 minutes to shut down upstream pump stations and close block valves adacent to the break, isolating the problem area.

The question is: How soon after a break in the trans-Alaska pipeline will the shutdown signal be sent from Valdez?

Every ten seconds new information from various points along the pipeline route will be flashed on a video display screen at Valdez. One of the items screened will be the results of a computation made by the line-volume balance leak detection system, the most accurate of Alyeska's four leak detection systems (the others note changes in pressure and temperature for various segments of the line). A new line-volume balance computation will be made every 30-minutes.

If there's a line loss over a certain specified amount, the information will flash with an alarm message and a warning will sound. But data from a technical report indicates the warning won't sound unless the line loss is greater than 1700 barrels per day

Why not set the alarm to warn the operator if a one-barrel discrepancy is indicated? The answer is that measuring liquids, whose volume can change with temperature and pressure, is a tricky business and it is difficult to achieve precise measurement.

If a small discrepancy shows up on the data display screen at Valdez, either the computer or the operator must determine whether the imbalance is due to line loss or metering error.

When you're dealing with a large volume, such as the 1.2 million barrels per day the pipeline is expected to be pumping in 1978, even a small meter error can add up to a lot of oil. If each meter measures the flow with a precision factor of one-tenth of one per cent (0.0001), one can expect a probable meter error of 1,200 barrels per day from each meter.

The line-volume balance system will record the difference between two meters. And, according to a mathematical formula used in the Mechanics Research report, for any two meters with an error factor of 1200 barrels per day, the combined probable error would be 1700 barrels per day.

According to non-project scientists, that's the best Alyeska's most sensitive leak detection system can do.

If the alarm level were set at a figure lower than 1700 barrels per day, it might sound continuously due to probable meter error.

There is, of course, the possibility that the meters will be working accurately—or that their respective errors will cancel each other out —and there really is a leak of 1699 barrels per day, even though no alarm indication is given.

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APO disputes report figures

The Alaska Pipeline Office (APO) questions the report in today's Daily News-Miner that a 1700 barrel-per-day line loss is the smallest leak that definitely will trigger an alarm on the trans-Alaska pipeline.

"We can't agree that the figures you have computed are either relevant or accurate," an APO spokesman told the Daily News-Miner Thursday. But the spokesman declined to provide his own estimate of the pipeline leak detection system's capability.

The 1700 barrel per day figure was derived from data presented in a report prepared for APO by Mechanics Research Inc., an engineering firm that provides technical support for the federal pipeline monitoring group. Non-project scientists who examined the report for the Daily News-Miner said figures provided in the Mechanics Research study indicate the minimum leak detection capability (at the expected 1978 flow rate of 1.2 million barrels per day) would be 1700 barrels per day.

The APO spokesman also contested the Mechanics Research report's conclusion that the installation of additional measuring devices known as ultrasonic flowmeters would provide greater reliability but less accuracy than the system originally proposed by Alyeska. "In our opinion the ultrasonic flowmeter system will very probably be more reliable and more accurate," the spokesman said. Alyeska has decided to purchase the new devices, and prototypes are to be tested later this year.

The APO spokesman said "we feel the system proposed is capable of doing the best job that current technology permits." He said the federal pipeline monitoring group has approved the leak detection system in concept.

State Pipeline Coordinator Chuck Champion said a 1700 barrel per day minimum for the leak detection system would not surprise him. "I was not terribly impressed with the numbers they were talking about back in 1972."

Champion said Alyeska's application for notice to proceed on the supervisory control system "has generated a number of questions."

"So far as we're concerned," Champion said, "the application is incomplete. . . ! You can bet we're going to place an extremely high priority on the supervisory circuitry because it's the key to minimizing operational damage to the environment."

Champion noted that "the state of the art is improving" and that "we've still got 18 months prior to start-up."

An Alyeska spokesman said pipeline company officials did not wish to comment on the Daily News-Miner's report, which is based on an analysis of the Mechanics Research report, consultation with non-project technical specialists and interviews on the subject with project Mechanics Research and APO personnel over a 12-month period.

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Questions abound on leak detection

By RICHARD A. FINEBERG
Staff Writer

The authors of the study were gracious: the subject of the study was curt; the agency that commissioned the study walked a tightrope and other scientists put in their two cents worth.

But it still is not clear how well Alyeska's computerized leak detection system for the trans-Alaska oil pipeline will work.

In telephone interviews:

—Alyeska news media supervisor John Ratterman refused to comment on a report that a study for the federal Alaska Pipeline Office (APO) indicates the smallest line loss that will trigger the leak warning system for the pipeline is 71,400 gallons (1700 barrels) per day.

"I don't even want to hear the questions," Ratterman snapped before he hung up the telephone Wednesday.

—APO spokesman Robert Gastrock repeated his doubts about the 1700 barrel-per-day figure, but he did not provide figures of his own.

—Non-project scientists said the report does indicate the leak detection system "would have an error of 1700 barrels per day associated with it" for a pipeline volume of 1.2 million barrels per day.

—A consultant retained by Mechanics Research Inc., the engineering firm that prepared the report for APO, agreed to respond to written questions. He said his reply would have to be channelled through APO.

Gastrock repeated his concern that the 1700 barrel per day figure might not be "relevant or accurate." But the APO spokesman's statement was qualified: "We're not saying it (the 1700 barrel per day figure) is wrong absolutely," Gastrock said.

Asked to provide his own interpretation of the report, or another estimate for the pipeline system's minimum leak detection capability, Gastrock replied, "we are not in a place to say exactly what our computation would be."

Gastrock said he didn't know whether the figures in the report, which were based on a daily line volume of 600,000 barrels per day could be used to ascertain the accuracy of the system at 1.2 million barrels per day, the line's expected 1978 throughput.

The Mechanics Research report states the system Alyeska plans to use would have an 850 barrel per day minimum detection capability at a line volume of 600,000 barrels per day. Based on this figure, the Daily News-Miner reported last Friday that the system would have a 1700 barrel per day accuracy at 1.2 million barrel daily throughput.

According to Art Ogawa and Gary Jensen, California specialists who operate a small consulting firm that specializes in control systems and video display equipment, "there is a direct relationship between the pumping rate and the error figure" for the system described in the report. In other words, Jensen and Ogawa said, "the error would double if the pumping rate doubled."

Gastrock reiterated his statement that the system Alyeska plans to install will be both more reliable and more accurate than the system the pipeline company originally proposed. But he declined to present even approxmate numbers to support his contention.

When Alyeska sought approval for the pipeline project, a minimum leak detection capability of less than 750 barrels per day was anticipated. The accuracy of that system would have increased with the volume of oil in the pipeline.

However the 1974 Mechanics Research report found the original system would not have been reliable and recommended revisions. The revised system works differently, and the accuracy of that system would not be related to volume, according to specialists who have studied the report.

Mechanics Research is evaluating the entire pipeline control system, which includes the leak detection apparatus, for APO. The engineering firm has retained pipeline specialist Frank Stivers of Houston for this task.

Stivers was employed by Exxon for 30 years before retiring in 1973. Exxon is one of the major owners of the trans-Alaska pipeline.

APO's Gastrock told the Daily News-Miner he did not believe Stivers' long affiliation with Exxon compromised the consultant's position as an independent evaluator of the pipeline's control system.

According to Gastrock, APO considered the possibility the federal pipeline monitoring agency might employ industry personnel before Mechanics Research was retained.

"We were satisfied that a potential conflict of interest was unlikely (before we awarded the contract)," Gastrock said. "To date we have been satisfied that no such conflict has occurred."

Stivers headed Mechanics Research Alaska pipeline team until Sept. 1, when he resigned. Now working for Mechanics Research as a consultant, he visited Alaska last week to update himself on the pipeline supervisory control system, which he is evaluating.

ADN 2/2/76

Alyeska hits leak story

Alyeska Pipeline Service Co. Friday took marked exception to reports earlier this week that its oil pipeline leak detection system would be less accurate than the company had portrayed two years ago.

A news account reported the pipeline's sophisticated leak detection system will have less than half the accuracy anticipated when it was conceived.

ALYESKA, however, says the reporter was referring to a supplemental — or backup — system instead of the major leak detection system.

The newspaper report indicated that at full pipeline capacity of 1.6 million barrels of oil per day, the computerized leak warning system could not detect leaks smaller than 1,705 barrels (71,600) gallons. The report is based upon a 1974 study prepared for the federal pipeline office by its consultant, Arthur D. Little Research, Inc.

ALYESKA SAYS a Fairbanks reporter evidently misinterpreted information in the study.

An Alyeska spokesman said Friday the pipeline will employ four leak detection methods, the most sensitive of which will be the "line volume balance method" capable of detecting leaks down to an accumulation of 750 barrels (31,500) gallons in a 24-hour period at a flow of 600,000 barrels. As flow increases, the detection capability increases.

Basically the line volume balance method of detection is one of maintaining a calculated volume balance between oil entering and departing the pipeline and accounting for all variations in net volume. Statistical reliability of this method is calculated at 99.7 per cent.

ALYESKA SAYS it appears the line volume balance — or primary pipeline leak detection system — was ignored in the news reports while a supplemental system for monitoring leaks between pump stations was actually discussed.

That system, employing ultrasonic flow meters, would detect leaks down to 954 barrels (35,700) gallons within 2 hours at a rate of 800,000 barrels, but would experience a decrease in volumetric sensitivity as flow increases. Under the supplemental system, at 1.2 million barrels per day, its efficiency of detection would be one-tenth of one per cent — or approximately 1,700 barrels per day as reported in the news story. Although the supplemental system has greater overall reliability, because its efficiency decreases with an attendant increase in throughput volume, it was relegated to a

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How large a leak can slip through detection system?

By RICHARD FINEBERG

How large a leak can escape the trans-Alaska pipeline's leak-detection system, and for how long?

With some components of the complex leak-detection apparatus already in place on the line and others about to be installed, the answers are no more apparent today than they were seven months ago, when the Daily News-Miner disclosed that leaks smaller than 71,400 gallons (1,700 barrels) per day might not trigger the alarm that warns the line's operator at Valdez that something is amiss on the 800-mile not-oil pipeline.

The 71,400-gallons-per-day amount is the smallest leak that devices known as ultrasonic flowmeters would be able to detect if these instruments— unproven in large pipeline service— work as accurately as their manufacturer promises when the completed line is pumping 1.2 million barrels of oil per day. That figure was derived from data in state and federal documents obtained by the Daily News-Miner.

The 71,400 gallons per day is also more than twice the size of the smallest leak Alyeska said it would be able to detect when the firm sought and secured approval from the state and federal governments to build the line. According to the project's 1972 Enivronmental Impact Statement, "Alyeska expects to be able to detect a leak smaller than 31 barrels an hour (31,248 gallons per day) by the line-volume balance method."

Although the line-volume balance system might be as accurate as Alyeska suggests, and would be more reliable than ultrasonic flowmeters, it's also less reliable, according to a November, 1974, engineering report prepared for the Interior Department's Alaska Pipeline Office (APO) by Mechanics Research Inc., a California-based engineering firm that provides technical support for the federal agency under a $17 million contract.

The Mechanics Research report warned that the line-volume balance system, which relies on more than 70 inter-related components for proper operation, could be immobilized by equipment failure and recommended Alyeska install ultrasonic flowmeters at each of the line's 12 pump stations as a back-up system. Although Alyeska still plans to use the line-volume balance system, the company has added flowmeters to provide added detection of small leaks. (Three other leak detection devices would warn the operator at Valdez of a major break in the line, but these instruments would not trigger the alarm for small leaks.)

Alyeska still regards the line-volume balance system as its principal small-leak warning device, but the Daily News-Miner has been unable to learn whether any testing has been done to determine how much of the time that system might be out of commission.

Bob Carter, project manager for the Harris Corp. Controls Division team that designed the pipeline supervisory control system in Melbourne, Fla., told the Daily News-Miner last week he did not know how much of the time the line-volume balance system would be in operation— a seemingly important question in view of the Mechanics Research report.

Nor would the Harris project manager hazard a guess on the accuracy of the back-up ultrasonic flowmeters. These devices, which are being manufactured by Westinghouse and measure flow by bouncing ultrasonic waves across the inside of the 48-inch pipe, never have been used in a large-diameter pipeline before.

Asked about the operation of the small-leak detection systems, Carter replied, "We don't supply the instrumentation and I don't have the information necessary to comment."

Harris, Carter explained, does not have "overall end-to-end system responsibility" for the pipeline control system. However, a 1973 abstract of the Harris project says, "In 1969, Harris was selected by Alyeska to design and impliment the supervisory control system for the pipeline."

According to Carter, the line's master computer console to govern line operations from Valdez was shipped to Alaska earlier this month for installation after extensive testing at Harris' Florida headquarters.

Alyeska news media supervisor John Ratterman told the Daily News-Miner that Alyeska itself has responsibility for all testing, but the pipeline company spokesman would not, or could not, discuss the detailed workings of the leak-detection system.

Ratterman reiterated the company's faith in the line-volume balance system. However, he declined to offer test data that would counter concerns about the line-volume balance system's reliability expressed in the 1974 Mechanics Research report.

"The system is still being developed and we will make submission to the federal government as required six months before the system goes into operation," Ratterman said. "At that time it will be a matter of public record."

Despite the fact that the system is still "being developed," the Daily News-Miner has learned that at least one ultrasonic flowmeter has been installed in the pipeline. According to a federal surveillance team member who asked not to be identified, a flowmeter was set in the completed mainline recently at Pump Station 4 on the north side of the Brooks Range.

A prototype flowmeter is being tested in a Louisiana pipeline. Although Alyeska engineers expect the flowmeters to provide an accuracy of 0.1 per cent— the accuracy promised by Westinghouse— results from the Louisiana test are not yet available.

The Mechanics Research report provides a formula for determining line loss by comparing measurements from ultrasonic flowmeters at successive pump stations. According to this formula, when the line is pumping 1.2 million barrels of oil per day, the smallest leak that could be determined by the flowmeters at two pump stations, each with an accuracy of 0.1 per cent, is [illegible] gallons.

Smaller amounts recorded by the system would be dismissed as normal metering error, and would not trigger the alarm to alert the line operator.

[illegible] review of Alyeska's plans for the pump stations and terminal complex at Valdez, Alyeska's failure to consider instrument source errors such as these a "deficiency" that could be "critical to pipeline leak detection." That report, also prepared by Mechanics Research for APO, recommended Alyeska be required to submit detailed plans for determining the significance of metering error.

However, according to Harris project manager Carter, no allowances for metering errors were made in the pre-delivery tests of the [illegible]. "The inputs we simulated were accurate . . . (they) were supplied by somebody else," Carter said.

An APO spokesman was unable to say what, if any, action APO took on the Mechanics Research recommendation.

The pipeline portion of the project is scheduled for completion later this year and start-up is expected next summer, according to Alyeska.

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Detection of leaks on pipeline takes time

By RICHARD A. FINEBERG
Daily News correspondent

FAIRBANKS — The leak detection system for the trans-Alaska pipeline sounds frequent false alarms at the pipeline's control center in Valdez, according to Alyeska Pipeline Service Company engineers and federal officials.

The most sensitive of the pipeline leak detectors — the computerized line volume balance system — provides the pipeline controller in Valdez with a new report of conditions along the 800-mile pipeline every 30 minutes. That system issues a leak warning approximately once every 48 hours, according to Arlan Kohl, project manager for the Interior Department's Office of Special Projects. Additionally, less sensitive leak detection systems sound hundreds of alarms daily according to reports from Alyeska engineers.

The majority of the warnings are immediately identifiable as false alarms, but one out of every four alarms takes much longer — typically one to four hours — to diagnose, Kohl said. During that time the controller does not know whether the line is leaking.

According to Alyeska publications issued prior to construction, the leak detection system was supposed to provide the Valdez controller with "fast, accurate and sensitive detection of leaks." This information would enable the controller to "take immediate action to shut down pump stations, isolate sections of the line and initiate repair and recovery operations."

The pipeline, which carries 1,640,000 barrels of oil daily from Prudhoe Bay to Valdez, has not had a major spill since 1979, when the line broke in the Atigun Pass Brooks Range crossing, dumping a reported 5,200 barrels of oil. The line spilled oil for an estimated two to four days before the spill was spotted from an aircraft.

At that time, Kohl said, the line volume balance system was set to go off at 3,000 barrels per day. At that level it produced false alarms approximately 40 percent of the time. Alyeska has improved its monitoring system significantly since then, Kohl was quick to add.

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Pipeline alarm system working

Continued from Page B-1

In 1980 and 1981 Alyeska installed new metering equipment on the line, improved its computer and changed to a variable alarm level, but the warning system still malfunctions on a regular basis. The improved line volume balance system "generates an alarm about every other day," one engineer reports, while the less sensitive systems send "hundreds" of alarms daily.

To cope with this problem, Alyeska created an operator's manual that explains possible reasons for an alarm, according to Alyeska officials at the control center. Once or twice a year the manual can't explain an alarm. On these occasions, Kohl said, the controller institutes a line-wide search.

One Alyeska engineer said the pipeline company's current system is regarded as "state of the art" by others in the pipeline control field. Despite the fact that there have been no major spills in the last three years, Alyeska plans major improvements for 1984.