STATEMENT OF JOHN W. BARNUM, DEPUTY SECRETARY OF TRANSPORTATION, BEFORE THE SENATE INTERIOR AND INSULAR AFFAIRS COMMITTEE, REGARDING CONSTRUCTION OF THE TRANS-ALASKA PIPELINE SYSTEM, WEDNESDAY, JULY 21, 1976.

MR. CHAIRMAN AND MEMBERS OF THE COMMITTEE:

I appreciate this opportunity to appear before you to discuss problems with the construction of the Trans-Alaska Pipeline System (TAPS).

First I would like to describe in general terms the role of the Department of Transportation (DOT) in the oversight of the design and construction of the pipeline.

Under the authority of the Transportation of Explosives Act (18 USC 831-35), DOT has established safety regulations for the design, construction, operation and maintenance of pipelines operated by carriers engaged in interstate commerce which transport liquid hazardous materials, including petroleum and petroleum products (49 CFR Part 195). These standards apply to TAPS. DOT's responsibilities with respect to pipelines are handled by the Office of Pipeline Safety Operations (OPSO), which is an element of the Department's Materials Transportation Bureau (MTB).

In 1969 the Alyeska Pipeline Service Company (Alyeska) applied to the Department of the Interior (DOI) for right-of-way permits across Federal lands. In early 1974 Alyeska and DOI executed an Agreement and Grant of Right-Of-Way which, among other things, stipulates that Alyeska shall

design, construct, and operate the pipeline in accordance with DOT safety standards. DOI established an Alaska Pipeline Office (APO), assumed the primary Federal responsibility for the project and provided a large inspection force to monitor the construction of the pipeline. Given these DOI initiatives, DOT determined that it would be a duplication of Federal resources if it were to establish a special field inspection force for TAPS since we were assured that DOI was devoting adequate resources to ensure that the pipeline was constructed in accordance with DOT pipeline safety standards, as well as in accordance with the stipulations in the DOI-Alyeska agreement.

In this connection I should mention that the DOI-Alyeska stipulation imposes two requirements that exceed the requirements of DOT pipeline safety regulations. First, DOT requires that girth welds of a liquid pipeline be tested nondestructively. DOI has required that such nondestructive testing be performed by means of radiography. Secondly, the DOT regulations require that 10 percent of a welder's daily output be tested, except in the case of welds under roads or water crossings, which must be tested 100 percent. DOI has required that 100 percent of all welds in the pipeline be tested nondestructively by radiography.

DOT and DOI agreed that during the construction of the pipeline, DOT would supplement DOI's monitoring activity

to the degree necessary to assure compliance with DOT regulations and that DOT would provide needed technical support. In this regard, OPSO served as a member of DOI's Technical Advisory Board, which was established as part of a DOI task force on Alaskan oil development. In that capacity OPSO provides technical advice to DOI concerning the design and construction of the pipeline, as well as the development of the environmental impact statement for the pipeline.

In addition, the OPSO assigned a staff engineer in Washington, D.C., to serve as coordinator of DOT activities. Inasmuch as statistics compiled by OPSO demonstrate that the chief cause of leaks for both oil and gas pipelines throughout the country has been corrosion, OPSO activity has focused on the corrosion control plan for the pipeline. OPSO has also been concerned with the structural design of the pipeline as well as approval of a valving plan to be used in compliance with a DOT regulation. With regard to girth welds, OPSO statistics indicate that less than 2 percent of the liquid pipeline failures have been attributable to such weld failures.

With respect to corrosion control, our primary concern during the construction of this pipeline has been directed towards ensuring that effective corrosion control measures are being taken in accordance with DOT regulations and the

corrosion control plan for the pipeline specifically approved by OPSO in May 1975. Any modifications of this plan requested by Alyeska are subject to the approval of DOT. The pipe manufactured for the Alaska pipeline was coated for corrosion protection with a thin film epoxy in the coating mills in Alaska in 1971. We inspected the coating operation at the Fairbanks mill to assure that the coating was being applied in accordance with sound construction procedures. Pursuant to our recommendation, the procedures were revised to eliminate excessive dust left on the pipe after shot cleaning and prior to coating. To improve corrosion control protection, OPSO examined and approved two tapes which were proposed to be used over the mill-coated epoxy to provide what we consider to be necessary additional corrosion protection as part of Alyeska's corrosion control plan.

Because the Alaska pipeline is unique for cross-country pipelines in that stresses due to temperature and seismic activity must be provided for, as well as the usual stresses which act on a pipeline from internal pressures, we believed it necessary for us also to concern ourselves with stress design considerations. With contractor assistance, we made an extensive review of those factors during the design approval stage in order to determine satisfactorily that the final stress design would result in adequate margins of safety against structural failure.

Because the pipeline alignment crosses many rivers and in many instances followed the floodplain of a number of other rivers, OPSO did an extensive study and approved the valving plan for the pipeline in 1974 to be used to comply with its regulations on the placement of valves. This study evaluated the need for valves along the length of the pipeline based on the relative risk of pipeline failure and the potential spillage in case of a leak. Alyeska added eight valves and relocated four others as a result of the OPSO study.

I would now like to discuss the girth weld quality problem and specifically DOT's concern in this matter.

The problem first came to the attention of OPSO in early September 1975, when Peter Kelly sued his former employer, Ketchbaw Industries. Ketchbaw was the contractor providing radiographic inspection of girth welds on the pipeline south of the Yukon River. The suit alleged falsification of some radiographs by Ketchbaw.

The OPSO learned of Alyeska's efforts to audit the radiographic inspection of girth welds on an inspection trip made during the last two weeks in September 1975.

On October 31, 1975, OPSO received the Alyeska audit report for Section 3 of the pipeline. (The pipeline is divided into five construction sections.) About the time of the receipt of the first audit report, we were advised that the audit would extend to the entire pipeline.

During the last week in March OPSO was informed by DOI that the audit was nearing completion and that a large number of welds and radiographs were found to be irregular. In early April, OPSO wrote to DOI and to Alyeska requesting a complete briefing on the weld quality problem.

In response to this request, a meeting was held in Anchorage on May 4 and 5, 1976, to discuss the results of the audit. Present at the meeting were representatives of DOI, the State of Alaska, Alyeska and OPSO. A summary of the complete audit received by OPSO at that meeting covered all of the approximately 30,800 radiographs of girth welds taken in 1975. The radiographs had been read and reinterpreted and identifying features of each of the radiographs has been put into a computerized data bank. The audit identified 3,955 weld irregularities.

The weld problems can be broken into two general categories. The first category concerns missing, incomplete, duplicate, or otherwise defective radiographs of certain welds. The second category concerns welds which, as a result of the Alyeska audit, were found to be in violation of DOT regulations. The DOT regulations require that welds be in accordance with Section 6 of American Petroleum Institute Standard 1104 (API 1104). The majority of the weld irregularities which fall into the second category are welds which, because of size or type of defect, do not meet the standards of acceptability established by Section 6 of API 1104.

With regard to the first category of 1975 welding problems -- missing or defective radiographs -- Alyeska is investigating the possibility of employing new inspection techniques to inspect the welds in this category which, by virtue of their location, i.e. under rivers or buried in the permafrost region, would be costly and time consuming to excavate and radiograph. This new technique is called acoustic imaging. It uses ultrasonic energy to produce an optical image or picture of the weld being tested. The advantage of the acoustic imaging inspection technique would be that only the inside of the weld has to be exposed. In radiography the radiation source and the film must be on opposite sides of the weld, which means that a buried weld must be exposed by excavation in permafrost or by pulling pipe out from under a riverbed.

On May 27, 1976, a laboratory demonstration of the acoustic imaging system was conducted in Richland, Washington. Representatives from DOI, the State of Alaska, and OPSO attended the demonstration. Significant technical questions regarding the system remained unresolved at the conclusion of the Richland tests, but because of the potential for resolving these problems, DOT engaged the National Bureau of Standards (NBS) to assist in the evaluation of the acoustical imaging system.

Alyeska plans to conduct further tests, under field conditions, in Fairbanks, Alaska. These tests, originally scheduled for the week of July 12, 1976, have been postponed, and at this time no future date for the tests has been announced. DOT representatives and NBS ultrasonics and acoustical imaging experts will attend the tests when held and subsequently we will determine whether the technique can identify weld defects in a manner equivalent or superior to radiography.

With regard to the welds in the second category -- those which have unacceptable defects as revealed by existing radiographs -- DOT safety regulations require that all such irregularities be corrected by repair or replacement. Alyeska has instituted a program for correcting the welding defects identified in the audit of 1975 construction welds. DOT is requiring Alyeska to submit to DOT a plan and schedule for correcting all of the weld deficiencies identified in their audit and will require satisfactory verification of Alyeska's corrective action. If the Alyeska audit has not identified all of the existing girth weld irregularities, DOT will require a supplemental plan and schedule for correcting all additional irregularities. You should also know, however, that Alyeska has indicated in correspondence with DOI, and at meetings with DOT, that it does not believe that all of the identified irregular welds would have to be repaired. Alyeska has identified 1,015

of the welds in both categories --missing radiograph or unacceptable defects -- as "critical welds," which Alyeska defines as those welds "located in sensitive and/or very difficult access related areas in which [they contend] any remedial work will likely degrade the end product quality and/or create substantial environmental concerns." Alyeska has proposed in a letter to DOI that an alternative method to API 1104 standards be used to test the welds for acceptability. Alyeska has commissioned the British Welding Institute to conduct a program of critical fracture mechanics to determine the acceptability of this alternative method. Alyeska believes that the alternative method for determining weld acceptability will not affect the integrity of the pipeline under stress conditions to which the welds would be subject during operations.

DOT has not received a request from Alyeska for a waiver of its welding requirements and therefore has not made a determination concerning the merits of the Alyeska proposal. As I stated earlier, DOT's present position is that all of the weld irregularities should be corrected in compliance with our safety regulations.

However, DOT is prepared to evaluate any reasonable proposal, together with supporting data. The Trans-Alaska pipeline does reflect some pertinent advances in the state-of-the-art, particularly in metallurgy. The problem

is to evaluate the effect on integrity of the pipeline that is in the ground. The objective is to attain assurances that all corrective action required for system integrity is completed, without requiring further action that would not contribute to integrity assurance but would add to the cost and time to complete the pipeline. In this respect we are not unmindful of the benefits of timely completion. Accordingly, although there is not any waiver request pending before us, DOT is pursuing independent action to investigate and evaluate weld quality and resulting effects on system integrity.

While DOT has expertise in many of the disciplines required for these purposes, other resources will also be used as required. For example, DOI has initiated discussion with Southwest Research Institute with a view to the development of a fracture mechanics test program to evaluate Alyeska's proposal. DOT is also pursuing an active and independent role in the investigation of weld quality. Since the proper evaluation of any alternative standard involves the resolution of complex technical issues, the Department has again retained the services of NBS which, together with personnel within DOT, will monitor the development of and evaluate this possible alternative standard of acceptability to API 1104. To date NBS fracture mechanics experts have attended the initial meeting at

Southwest Research Institute and have been briefed in London by the British Welding Institute on the work being performed for Alyeska.

Thus, we have begun at an early stage to observe the fracture mechanics test and analysis work being undertaken by Alyeska and DOI. This will facilitate DOT's independent review of the results of these efforts, and our determinations as to further action by DOT.

The DOI has had Arthur Andersen & Company review and evaluate the approach and techniques used by Alyeska in conducting its 1975 audit of welds and radiographs. In a preliminary audit report, received by DOT early this month, and in a progress report received on Monday, Arthur Andersen made a number of observations concerning several areas of the audit, including: the computer analysis of weld characteristics, the rereading of the radiographs, and the verification of data input documents.

Some of the indicated problems may be resolved after Alyeska has had an opportunity to respond to the Arthur Andersen report. It appears likely, however, that re-examination of 1975 welds and radiographs on a statistical basis will be advisable.

Due to the developments which indicate there has been some falsification of records concerning compliance with DOT regulations, we have reexamined our earlier commitment

of personnel and resources to the fulfillment of our specific responsibilities regarding the construction of the TAPS. We have concluded that the Department should be represented on the TAPS project in Alaska on a continuous basis and we have initiated continuous onsite surveillance by DOT personnel to assure compliance with our regulations and to maintain liaison with APO concerning their surveillance functions.

DOT has established an onsite task force headed by retired Coast Guard Admiral Joseph R. Steele to monitor pipeline construction and testing progress during the balance of the 1976 construction season. The first two members of the task force from DOT's Office of Pipeline Safety Operations began overall onsite surveillance on July 7. They were joined on July 14 by five additional DOT welding experts whose principal task is to inspect welding and radiography of girth welds, including the repairs and reradiographing being performend on the 3,955 girth welds initially made during the 1975 construction season and later identified by Alyeska as being questionable. In addition, DOT intends to follow up in three areas: statistical verification of 1975 welds and radiographs; technological assessment of weld defect safety margins; and weld-by-weld analysis of the optimum remedy for each identified problem.

Last week, at the President's direction, I led a fact finding team to Alaska to ascertain the extent of the problems and the possible consequences with respect to increased costs, construction delays, and environmental impacts. While in Alaska I met with Governor Hammond, and with representatives of DOI and APO, DOI's technical contractor Mechanics Research, Inc., Alyeska, Alyeska's construction and quality control contractors, and concerned unions. I am now in the process of preparing a full report for the President on the results of my fact finding trip.

Mr. Chairman, this ends my prepared statement. I would be pleased to answer any questions you or other members of the Committee might have.

SUPPLEMENTAL STATEMENT OF JOHN W. BARNUM, DEPUTY SECRETARY OF THE U.S. DEPARTMENT OF TRANSPORTATION, BEFORE THE INTERIOR AND INSULAR AFFAIRS COMMITTEE OF THE U.S. SENATE, REGARDING THE CONSTRUCTION OF THE TRANS-ALASKA PIPELINE SYSTEM, WEDNESDAY, JULY 21, 1976

On July 11, at the direction of the President, I took to Alaska a fact-finding team to investigate the alleged defects in the girth welds on the Trans-Alaska Pipeline System and the radiograph records which Alyeska Pipeline Service Company (Alyeska) is required to maintain with respect to such welds. In addition to officials and experts of the Department of Transportation (DOT) and its Office of Pipeline Safety Operations (OPSO), I was accompanied by John Hill, Deputy Federal Energy Administrator, and we were joined in Alaska from time to time by representatives of the Department of the Interior (DOI) and the Environmental Protection Agency.

We spent three and a half days in Alaska, returning to Washington on July 15. During that period we met with Governor Jay Hammond and his staff, we interviewed in depth numerous officers and employees of Alyeska, and we interviewed representatives of Alyeska's contractors, the principal labor unions, DOI's Alaska Pipeline Office (APO), and its principal technical support contractors. We were briefed on certain experimental testing techniques, inspected Alyeska's radiograph records of welds, and spent one day on the pipeline to observe the welding, radiography and other construction and quality control procedures.

It is important to note that the problems of field welding of girth joints between adjacent sections of main line pipe, and the radiographic inspection of such welds, relate primarily to the 1975 construction and quality control programs, not the current ongoing welding and radiographic programs. These problems group themselves into three separate but related areas: the welding itself; the radiographic inspection of girth welds; and the adequacy and reliability of existing records of welding and of radiography.

In each of the areas associated with the weld/radiographic problems, the ongoing 1976 program is improved from the 1975 program. Quality control procedures have been revised in pertinent respects. In addition, compliance with established quality control procedures has been significantly improved. For example, in both seasons a quality control inspector is required to be on the site before welding can commence. There are indications that in 1975 that rule was all too frequently ignored. Now Alyeska's contractors have been required to cut out welds made in the absence of a quality control inspector and reweld the joints with a quality control inspector present. In 1975 radiography frequently was several days behind the welding gangs. Each of Alyeska's radiographic contractors is now required to complete by the end of each day radiographs of not less than

75 percent of the weld production for that day, with the remaining welds being radiographed the following day. The results of each day's radiographic analysis is made available and reviewed with appropriate production and quality control personnel of Alyeska and its contractors by 7:00 a.m. of the following day. That permits prompt detection and elimination of a problem which would affect further welding, such as the use of a batch of welding rods with improper moisture content. Improvements have also been made in the form, review and distribution of records relating to welds and radiographs. Alyeska is now processing records of substantial sections of pipeline with a view to clearance for hydrostatic proof testing. As part of that program, the record relating to each weld within a section under consideration for hydrostatic test scheduling is reviewed. This permits detection and cure of recordkeeping deficiencies. Finally, preparation of "as-built" drawings is underway, and since this requires checking details of an entire section of pipeline, this process also leads to the detection and correction of recordkeeping deficiencies.

With respect to the 1975 construction program, Alyeska has found that, of the welds that were accepted in 1975, some 3,955 welds were apparently not radiographed in conformance with applicable requirements, or were radiographed and found not to be in conformity with DOT construction

standards (49 CFR Part 195), and in particular the requirements for weld acceptability, weld repair, and replacement of defective welds. These findings were the product of Alyeska's reexamination of 1975 radiographs in the course of a process commonly referred to as the "Alyeska audit." It consisted essentially of two parts. Each radiograph was examined and four physical characteristics of the weld were measured. A computer analysis of those measurements was then made to search out possible duplications within the same section - that is, possible instances where radiographs that purported to show two or more different welds were in fact duplicate x-rays of one acceptable weld. The second principal element of the audit was a rereading of certain radiographs.

DOI (through its technical support contractor) has had Arthur Andersen & Company review and evaluate the approach and techniques used by Alyeska in conducting an audit of 1975 welds and radiographs. Arthur Andersen made a number of observations in several areas of the audit. With respect to the computer analysis of weld characteristics, for identification of possible duplications, the Arthur Andersen observation indicates some shortcomings, most of which can probably be cured by reverification of the computer input data, and modest additions to the analytical program. With regard to the rereading of radiographs, Arthur Andersen observed more serious deficiencies. One

is that when a Level II radiographer interpreted a radiograph as showing a nonacceptable weld, he passed that radiograph to a Level III radiographer for review. The Level III radiographer disagreed with, and overrode the decision of, the Level II radiographer in approximately 40 percent of the cases. Yet, none of the radiographs passed by the Level II radiographer as acceptable was reread by a Level III radiographer.

Since it is universally agreed that interpretation of radiographs is highly subjective, the high incidence of disagreements on the Level II rejects strongly suggests that there should be a high level of disagreement on the Level II acceptances. Thus, at this point, it cannot be said that Alyeska has eliminated the possibility that there are additional defective welds from the 1975 program which were undetected.

Arthur Andersen also observed that at a number of data input points, there was a serious lack of control over document verification. For that and other reasons, the Alyeska audit has limited usefulness for current or future evaluation of the adequacy and reliability of radiographic records.

Some of the indicated problems may be resolved after Alyeska has had opportunity to respond to the Arthur Andersen report. It appears likely, however, that reexamination of 30,800 welds and radiographs made in 1975 on a statistical basis will be advisable. We are formulating a specific recommendation with respect to such a verification program. It may also be desirable to compare the "fingerprints" of the radiographs in each section against the radiographs of other sections to determine whether there are duplications between sections.

Finally, there is the question of what remedial action should be required with respect to defective welds that are now or hereafter identified. The DOT regulation requires that all defective welds be replaced or, in permissible cases, repaired. That requirement is designed to give full assurance of system integrity, and DOT's position is that the requirement of integrity must be met. Alyeska has embarked upon a remedial program, but it has suggested that some welds which do not meet the DOT standard (or the industry standard on which it is based) are not so seriously defective as to impair system integrity. If that be the case, rigid application of the standard would not contribute to system integrity, or the assurance of system integrity, but would increase the time and cost for completion of the project, and could in some cases have adverse environmental consequences.

When we were in Alaska, Alyeska management stated that by September 15, 1976, it could remedy or replace every identified defective weld. I understand that they have subsequently suggested that November 1976 is a more realistic target date, and that they may still need a waiver of certain existing standards. We think that even the November date is overly optimistic. While substantially all of the remedial work could be completed by November, it appears that in fact some work might well carry over into 1977.

In the southern (no. 1) section, the Klutina River crossing requires remedial work. There the fish window (during which the contractor is permitted to work in the river crossing) is December through April.

In the northern sections, remedial work has not yet been brought close to the rate needed to complete remedial work by September 15. Much pipe in that area is buried in "cold permafrost" which has been measured at temperatures ranging down to about 10°F. The contractor in the northern (no. 5/6) section advised the fact-finding team that it has made satisfactory progress in opening up the top and sides of the ditch, but it is experiencing severe difficulty in removing frozen soil from around the pipe. It is described as hard as concrete. It cannot be worked by machine for fear of damage to the pipe and hand removal is impractical.

Various methods have been tried for defrosting the aggregate, but none have proven satisfactory so far. During the time the fact-finding team was in Alaska, the contractor succeeded in exposing six welds in one day - its best up to that time. It needs to attain a rate of 12 to 15 per day if the target date is to be met.

Further, as noted above, the Alyeska audit does not provide certitude as to the acceptability of welds that were passed by the Level II radiographer and not reviewed by the Level III radiographer; and there are certain procedural and recordkeeping questions raised by the Arthur Andersen review. These difficulties must be resolved by further development of facts and the respective views of the interested parties, and probably also by some statistically sound verification procedures.

While its remedial program is underway, Alyeska is also pursuing a program, using destructive testing and related fracture mechanics analysis, to evaluate safety margins in respect to welding defects (excluding cracks, which must be cut out and replaced). Both DOT and DOI have undertaken programs in preparation for validation of any tests and evaluation of any fracture mechanics analyses that Alyeska might advance in support of an application for relief, should it be made.

It should be observed, however, that alternative approaches other than adherence to the API 1104 standard would involve analyses of fairly complex problems, such as temperature, fatigue cycling, and abnormal loading, which may influence the transition of a defect into a crack. Further, at best, any analysis of this type would have to be applied weld by weld. Similarly, the utility of ultrasonic inspection would have to be judged case by case, and may have to be backed up with other nondestructive techniques such as magnetic particle testing, dye penetration or eddy current tests.

In short, each problem weld must be examined uniquely for resolution of the problem - be it a new radiograph, use of alternative nondestructive testing, new analysis of defect safety margins, or weld repair or replacement.

Having found that some radiographs are missing or incomplete, Alyeska has contracted for the development of techniques and equipment for the inspection or non-destructive testing of girth welds by acoustic imaging. The advantage of that technique is that it could be done from inside the pipe, without requiring access to the exterior of the pipe. Thus, that technique would obviate undesirable excavation where a questionable weld is buried in permafrost, and permit access to welds presently buried under riverbeds without ecological disturbance.

On July 13, the fact-finding team observed a demonstration by Alyeska and Holosonics, Inc., in Fairbanks, Alaska, at which the potential of the technology was explained and the present state of development of the technology and equipment was demonstrated. The technique appears to be capable of detecting fractures, but has not been developed to the point where it can reliably detect porosity. It does not at present appear likely that this effort will produce an acceptable alternative to radiographic inspection for general use, at least in time to be useful to Alyeska in the resolution of weld and radiographic problems during the 1976 construction season.

In this connection, it was made clear by Alyeska that it is not relying on this effort for the resolution of those problems. Rather, Alyeska is proceeding on the basis of a 100 percent remedial program, or "zero variance" while, at the same time, pursuing the Holosonics effort on a cost-effective basis. Should the effort prove useful in substantiating any future petition for a waiver of DOT's pipeline construction specifications, the potential cost saving to Alyeska will far outweigh its relatively modest investment in the acoustic imaging program.

On the other hand, it may be possible to use the Holosonics equipment for a spot check verification of the

identity of welds for which there are radiographs on file. Also, use of conventional ultrasonic inspection techniques, which do not provide a recorded image, may be acceptable in a limited number of cases of missing radiographs of critical (under riverbed) welds, as a verification of production and visual inspection records. Both the conventional techniques and acoustic imaging might, in addition, assist in evaluation of some types of radiographed defects, particularly in establishing radial (weld depth) location and dimension.

Alyeska has estimated the cost of a full remedial, or zero variance, program for known defects to be $55 million. We understand that figure is an estimate of the direct cost of the remedial program. Indirect cost would be largely a function of time for completion and, in view of the uncertainties with respect to time referred to above, it is difficult to estimate indirect or total costs.

In short, Alyeska has had problems in maintaining construction quality, some of which have been resolved. Remedial work remains to be done, but it should be completed if not by Alyeska's September 15 target, at least by mid-1977 when terminal construction is scheduled to be completed. Similarly, there are design and production problems, unrelated to quality control, that may delay pipeline completion but not system completion. Examples include routing and construction

problems in three especially difficult mountain passes. Another is completion of a 5.5-mile segment in the northern section that was to have been constructed from a snow pad, but was not completed when the snow pad melted early. The Valdez terminal completion schedule is tight because of certain material delivery delays. Alyeska has implemented improved procedures and tightened its production control during the 1976 construction season. While it is unclear, it may be that Alyeska could attain further improvement in production controls, with a resulting decrease in 1976 weld

There have been reports of other problems in pipeline quality. One is that the longitudinal weld seams, made at the mill during fabrication of the pipe, are in many cases cracked or otherwise defective. The fact-finding team was unable to find any substantiation of these reports. On the contrary, Alyeska has reason to be confident in the quality of the longitudinal weld seams. Specifications were rigid; quality inspections were made at the mill by an independent, expert contractor; and a representative task group of the owners visited the pipe mills from time to time to spot check production and the quality control inspections.

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heightened when a section of pipe ruptured under hydrostatic test on Friday, July 9. The cause of the rupture may have been excessive pressure application as the result of a failure in pressure measurement equipment and human error. If so, this single rupture would not indicate a general pipe quality problem, particularly in the light of the mill inspections mentioned above. Further, Alyeska and its several contractors all assert that the pipe used on this line was equal to and in most cases superior to that used on other pipelines.

Other reports of difficulties relate to the vertical support members (VSMs), horizontal cross beams and pipeline shoe assembly, which support pipe installed aboveground. There indeed are problems which have been, or are being, brought under control. It was found that after pipe had been "lowered-up" onto the pipeline shoe assembly, on which the pipe rests, there were variations in shoe height from one support to the next. The shoe height is adjustable, and adjustments have been and are being made. In addition, shoe heights will be determined by survey in each section before it is hydrostatically tested, and again after it is hydrostatically tested. This will permit detection of any settling as a result of weight-loading during hydrostatic testing, and Alyeska expects to take any required corrective action.

Secondly, there have been problems with respect to the lateral alignment of the pipe between the VSMs on either side of the pipe. Alyeska has determined that a principal cause of lateral alignment problems has been lack of precise control in the placement and degree of side bends made to the pipe in the field. While precise control of field bending is not ordinarily required, when the pipe is to be buried in a trench, precise control is now being required for bends in pipe to be installed aboveground. Also, five days after a pipe has been "lowered-up" onto the shoe, the lateral alignment is reinspected to determine whether the pipe has settled into an off-center position, and if so, whether corrective action is required.

Third, there have been instances of a VSM settling in melted permafrost. At the end of the 1975 construction season, some VSMs were installed without having required "heat pipes" in place. Those pipes are designed to transfer heat from the base to aluminum vanes at the top of the vertical members where the heat is dissipated into the air, thus promoting permafrost support at the base of the vertical members. Where the heat pipes were not installed, permafrost support did not return during the 1975-1976 winter. If all heat pipes are installed by the end of the 1976 construction season, permafrost support can be expected to form before

the line is placed in operation in 1977, thus putting an end to the problem. In the meantime, however, some VSMs were weight-loaded during hydrostatic testing, with some resulting sinking. In other cases, Alyeska supported the pipe with wooden cribbing to prevent weight-loading of the problem VSM, and thereby avoided settling.

Finally, a DOT representative, together with a representative of Environment and Ecology, Inc., which provides technical support to the Department of the Interior, observed surface water erosion of melted permafrost around some VSM members. If surface water runoff is not brought under control, continued flow around the VSMs will inhibit formation of the permafrost, which is needed for firm VSM support. The alignment problems, the settling and permafrost support problems, and indeed the design engineering of the support system, will require monitoring on an ongoing basis after commencement of operations.