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Mr. Cannon

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Pipeline

MECHANICS RESEARCH INC.

OBSERVATIONS TO DATE IN CONNECTION  
WITH A REVIEW AND EVALUATION OF  
THE APPROACH AND TECHNIQUES FOR

- 1) Alyeska Pipeline Service Company Audit  
of 1975 Welds/Radiographs.
- 2) Stumpf/Baker Project to Statistically  
Validate the Results of that Audit.

Discussion Outline



Arthur Andersen & Co.

June 30, 1976

MECHANICS RESEARCH, INC.

DISCUSSION OUTLINE

EXHIBITS GAL...  
undecided  
10070 up...  
ULT... SIN...  
-40  
-P

I. Introduction and Background

- A. Dispense with discussion of background prior to Arthur Andersen & Co. involvement.
- B. Arthur Andersen & Co. asked by MRI to review and evaluate the approach and techniques used in connection with:
  - 1. Alyeska Pipeline Service Company (Alyeska) in conducting an audit of 1975 welds/radiographs.
  - 2. Stumpf/Baker Project to statistically validate the results of that audit.
- C. Arthur Andersen & Co. not asked (and not able) to comment as to the results of the audit or Stumpf/Baker Project or to make judgments of an engineering nature. Nor are we able to comment as to the thoroughness or correctness of the interpretations of any radiographs by representatives or employees of Alyeska, Jack Baker or any other individual.
- D. Work performed to date:
  - 1. Documented the stated procedures and controls used in connection with:
    - a. Alyeska Audit
    - b. Stumpf/Baker Project
  - 2. Secured agreement that our documentation and understanding of above is correct.
  - 3. Performed limited tests of adherence to and reasonableness of stated procedures and controls.
  - 4. Secured agreement from appropriate Alyeska personnel or Dr. Stumpf as to the facts of our observations.
- E. It has previously been agreed that should our observations or our understanding of the Stumpf/Baker results cast doubt on the Alyeska audit, such information should be immediately discussed with MRI, the Alaska Pipeline Office of the Department of the Interior and the Department of the Interior.
- F. We believe we have reached that point.

II. Observations To Date From Review of Alyeska Audit Approach and Techniques BOB EDWARDS

The following observations and comments relate to the 1975 Alyeska Pipeline Service Company welds/radiograph audit (the audit). Such observations and comments are the result of our review of the procedures and controls followed by Alyeska Pipeline Service Company during the audit (Part A below) and limited testing of certain documentation supporting the "fingerprint" listing (Part B). We were informed by Alyeska Quality Assurance Personnel that the "fingerprint" listing included all radiographs read during the Alyeska audit and further that the information on this listing was used in conjunction with a computer program to identify potential duplicate radiographs. Our observations are set forth in the first paragraph of each numbered item and our comments are set forth in the second paragraph.

A. Procedures and controls followed by Alyeska Pipeline Service Company during the Alyeska audit:

- 1. The Alyeska audit was an audit of radiographs not physical welds. A limited attempt was made to reconcile the physical welds made in 1975 to the radiographs included in the audit.

\* Even though there have been some attempts by Alyeska to reconcile to 1975 quality control documentation on an individual weld number basis, there can be no assurance that radiographs for all physical welds made in 1975 were accounted for during the audit. This is because there was no positive accountability over weld number assignment or preparation of quality control documentation in 1975.

- 2. There were no written procedures setting forth the overall objectives of the audit or the steps each individual participating in the audit was to perform.

Because of the large number of individuals involved in the audit, the absence of written procedures could have resulted in inconsistencies in the way the same tasks were performed by different individuals.

During the audit there was no consistent control over, or documentation of, the issuance or receipt of the radiographs to or from other locations.

It is acknowledged by Alyeska that radiographs were issued to the field to assist in remedial work during the 1975 audit. However, there is no documentation available to assist in determining

YESMA USED  
IF SUPERVISOR  
AUDIT Jobs  
STANDARDIZATION  
OF Procedures?  
CDS since no  
category - can't tell  
radiographs have  
fingerprinted  
fingerprinted for quality  
welds, no 3.  
way to reconcile!

*Radiographs  
were stolen  
after issuance  
to Field.*

if such radiographs were interpreted and fingerprinted prior to being issued to the field. In February, 1976, Alyeska initiated an "out" film log procedure and in April, 1976, an "in" film log procedure in order to provide written documentation of all radiographs received into or issued from the film storage vault.



- 4. There was no single, comprehensive inventory listing prepared of all radiographs obtained by the quality assurance audit team for the audit.

The absence of such an inventory makes it difficult to ascertain which radiographs were available to the quality assurance audit team during the audit. An accurate reconstruction, based on the radiographs presently on hand of the radiographs available to the audit team is not possible due to the absence of documentation and records, prior to February and April, 1976, of radiographs received and issued.

- 5. There is no documentation to support that each radiograph was interpreted during the audit. (Documentation was prepared only for those radiographs which were of poor film quality or which were interpreted and deemed to be for defective welds.)

*OR MCF (Monday)  
Aud 17 Review*

Because of the lack of positive written documentation of each radiograph interpreted and the lack of the inventory listing described in 4 above, there is no written evidence that all radiographs in the possession of the quality assurance audit team were interpreted.

*Maximilian  
Scan*

- 6. The data for each radiograph fingerprinted was entered on a weld/x-ray comparison form. However, these forms were not numerically or otherwise controlled and accounted for.

*Developed  
Due to  
problem  
to SPENCER  
W.R.D.*

It is not possible to determine if all weld/x-ray comparison forms filled out have been retained for each section. Because of this and the lack of the inventory listing described in 4 above, there is no written evidence that all radiographs in the possession of the quality assurance audit team were fingerprinted.

*kept on*

- 7. The radiographs were read initially by Level II interpreters. Those radiographs which were of poor film quality, or which were interpreted and deemed to be for defective welds were subjected

to further review by Level III interpreters. Of the approximately 7,000 radiographs rejected by the Level II interpreters, approximately 3,000 were considered to be acceptable welds by the Level III interpreters. However, the Level III interpreters did not check the interpretation of the Level II interpreters for radiographs they deemed to be for acceptable welds.

→ 37  
PROBLEM WELDS

Level II Rejected  
7,000

Level III Rejected  
3,955

43% Reduction  
Compliance  
TO API 1104

We understand that the interpretation of radiographs is somewhat subjective and that the Level III interpreters disagreed with the Level II interpreters on approximately 43 percent of the rejects. Therefore, it may be reasonable to assume that there could also have been disagreement with respect to those radiographs deemed to be for acceptable welds by the Level II interpreters.

Level II  
To  
Level III  
7-10-  
11-11-

- 8. The cards filled out for the welds deemed to be defective during the interpretation of the radiographs were not prenumbered or otherwise controlled and accounted for. These cards were accessible during working hours to anyone in the quality assurance office. In addition, the cards for most sections were sorted and handled several times by different employees.

CARDS  
NOT  
SECURE

This increased the possibility of the unnoticed loss of cards.

- 9. Since the pipeline construction is divided into five sections, the Alyeska audit was conducted and the results accumulated by section. The data for each radiograph fingerprinted was compiled by section and the computer fingerprint data match program was run only for that data within a section.

2 X-Ray Contractors  
Hickshaw - 1-3  
EXAMS - 4-5  
NOT AT YUT OFF

Since the same x-ray contractor handled more than one section, the fingerprint data for all radiographs should have been matched rather than only that data within each section.

- 10. The fingerprint computer program used keypunched cards which had to be resorted and input each time the program was run. No card count controls were maintained during each execution of the program to insure that the number of cards used for the last run plus any additions less any deletions equaled the number of cards used for the current run.

See Anderson  
in HANDBOOK  
- NAD  
- NAD  
- NAD

This could result in the undetected loss or omission of cards from the fingerprint report.

11. The weld/x-ray comparison (fingerprint) forms were not batched nor were control totals taken prior to submission to keypunch. The output was not detail checked to the input forms.

There was no check to insure that all data on the weld/x-ray comparison forms were translated accurately to the fingerprint listing.

12. The fingerprinters could change data elements on the weld/x-ray comparison forms without a supervisor's approval or written explanation.

(Large number, crossouts and changes made)  
This could allow incorrect changes to the data.

13. The Level II interpreters for section 3 were Bechtel employees.

These individuals may not have been independent as to the results of the audit.

COMPLIANCE TESTING

- B. Limited testing of certain documentation supporting the fingerprint listing (see Exhibits I through VII for number of items reviewed and detail listing of exceptions found):

1. For 18 of the 95 1975 radiographs which were refingerprinted by Alyeska quality assurance personnel at our request, at least one of the four measurements showed a difference in excess of  $\pm .4\%$  from the measurement shown on the fingerprint report (as determined by Alyeska quality assurance personnel during the audit). But some measurements

It would appear that the fingerprinting process may be somewhat subjective and the measurements not always reproducible.

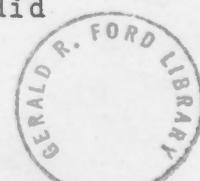
The following exceptions were based upon a review of documentation for 501 weld numbers.

Small sample  
out of 30,000  
checked

2. Twenty-six weld numbers for which a 1975 radiograph and weld/x-ray comparison form was available did not appear on the fingerprint listing.

This appears to have been the result of the weaknesses observed in A.6 and 11 above.

3. The data on the weld/x-ray comparison form did not agree with the data in the fingerprint report for ten weld numbers.



This is probably due to a keypunch error or a weld/x-ray comparison form which superseded the one in the book. Exceptions such as this appear to be the result of the weaknesses observed in A.6 and 11 above.

4. The lead numbers shown on five radiographs did not agree with the weld number on the fingerprint report. The lead weld numbers had been crossed out in ink and another weld number written in. We were informed by quality assurance personnel that the ink changes were made by the quality control inspector in the field and that the inked in number was assumed to be the actual weld number.

We have no comment on this observation.

5. <sup>Incomplete weld number</sup> The weld number was missing or a digit dropped from the weld number on one of the radiographic belts for eleven weld numbers (two or four belts generally comprise a complete radiograph for a weld). We were informed by quality assurance personnel that the radiographic belts are always compared to insure they are for the same weld by comparing those portions of the belts which overlap.

Again, we have no comment on this observation.

6. Three radiographs which were listed on the fingerprint report could not be physically located and were not listed in the out log.

It is not possible to ascertain if this occurred because of weaknesses in the 1975 audit procedures or because of a breakdown in the present procedures for controlling the receipt and issue of radiographic film.



DR. W. J. T. A. C. H.

III. Observations To Date From Review of Stumpf/Baker Project  
Approach and Techniques

DON BUNCH

Our review of the Stumpf/Baker project was divided into two specific areas: (1) the statistical model used, and (2) the procedures and related controls used for selecting the sample.

Our observations have been summarized into the following subsections:

- A. Statistical model. [NO LISTING OR WELD LOG]
- B. Procedures and controls relating to the execution of the sample selection process. [FINGERPRINT REPORTS]
- C. Other tasks completed.

A. Statistical model:

During Dr. Stumpf's initial work on the sampling method, he determined that the percent of welds rejected by the audit was not the same for all five sections of the pipeline. In fact, the reject rate varied from 9.2 percent to 17.5 percent with the average being around 12.6 percent. Because of this, he selected a statistical model from the text book Elementary Survey Sampling and used a formula which weighted the sample size of each section in accordance with the expected error. We reviewed the structure of the model with Dr. Stumpf and recomputed the sample size based on the data available. Since our calculated sample size (1729) was less than Dr. Stumpf's (1802), we did not request that he recompute his sample size (the sample of 1802 radiographs would provide a more conservative approach).

B. Procedures and controls relating to the execution of the sample selection process:

Dr. Stumpf used a random number table from Standard Mathematical Tables (published by the Chemical Rubber Co.) to select the sample for each section. At his request, Alyeska provided him with the final weld/x-ray comparison reports (the so called fingerprint listing) for each section. These reports had a sequential number (card number) associated with each radiograph. As he drew random numbers, he matched them with the card number to find the corresponding weld number. The weld number, random number and section number for each

600  
12.6  
666  
60  
60  
6.000  
problem

weld selected were recorded on a card, which was given to Jack Baker. For each weld number, Jack had the radiograph pulled from the appropriate location in the storage vault, interpreted the film and recorded his comments on the card.

When we began our work, Jack Baker had already started to statistically sample and interpret the radiographs. After reviewing the procedures used to select the sample, we determined that several problems existed which, if not corrected, could negate the results of the Stumpf/Baker statistical model. The following identifies those problems and the steps taken to correct them.

1. Jack Baker was not checking the weld number when he read each radiograph to verify that he was reading the correct one.

We asked that Jack check the weld number on each radiograph when he read it. In addition, during the course of his work, periodically each day we checked weld numbers on three or four radiographs Jack read to verify that they agreed with the numbers indicated on the sample cards. In every case we reviewed, the weld number on the radiograph was the same as that on the sample card.

2. In the case of cut out welds, the weld/x-ray comparison report contained a separate fingerprint for each weld, whether or not a cut out. Since this report was used as the radiograph population for selecting the sample, we identified welds which were selected in the sample that had been cut out and were no longer physically in place. Because the audit was only concerned with the welds in place at that time, these cut out welds should have been eliminated from both the population and the sample.

We reviewed each weld listed on the report to identify cut out welds which were selected in the sample. These welds were then removed from both the population and the sample. New weld numbers were randomly selected from the universe of valid radiographs to replace those removed from the initial sample.

3. Remedial work has continued since the audit and welds have been replaced and/or repaired and new radiographs have been made. These radiographs have been placed in the appropriate storage box and the superseded radiographs have been stored separately in special boxes. However, procedures were not established to insure that Jack read the radiograph which corresponded to the weld in place as of the audit.

CUTOUTS  
 sub in  
 site Boyer's  
 correct  
 in place  
 Final Bofo

We reviewed a list ("welds completed or cleared") prepared by Alyeska of all welds corrected subsequent to the audit and compared this list to the Baker/Stumpf sample to determine which welds could have had radiographs made after the audit. We found that 15 remedial welds in section 2 and 15 remedial welds in section 3 had been repaired or otherwise "cleared" as of June 6, 1976. It should be noted that we did not attempt to verify the accuracy of this list, since 1976 welds and remedial work were outside the scope of our initial arrangement.

WELD FILMS  
 bob, 6 Good)  
 FROM DELTA  
 (2 broken locks)  
 were returned  
 DEFECTS  
 repairs could  
 made  
 sent to  
 for repairs

In section 2, we found that 11 radiographs were stolen and Jack had read 1976 film for the other four. Upon further investigation, we found that the 1975 radiographs for three of these four were also stolen. The 1975 radiograph for the remaining weld was located and fingerprinted to verify that it was the one used in the audit. Jack then read the film and rejected it. In summary, of the 15 welds identified as corrected subsequent to the audit, 14 were classified as stolen, and thereby assumed to be rejects since the stolen radiographs were presumably for welds that were being repaired, and one was classified as a technical reject.

In section 3, we found that Jack had read the correct film for 12 of the 15 radiographs and that he had read verification film for the other three. Of these three, two radiographs were missing (which was confirmed by the Alyeska audit report) and the appropriate 1975 radiograph for the third film was a double exposure and therefore classified as "unreadable". This radiograph was also classified as unreadable by the Alyeska audit.

4. The Alyeska audit report stated that certain radiographs were duplicates but a procedure had not been established to verify the figures in the report.

A list of potential duplicate radiographs in the samples for sections 2 and 3 was prepared using the Alyeska match report of potential duplicate radiographs. (This report was used by the audit team to select radiographs for Alyeska's duplicate analysis.) This list was given to Jack Baker and he read the radiographs and indicated whether any of them were duplicates. In section 2, Jack found no duplicates, which concurred with the Alyeska audit for the welds in the Stumpf/Baker sample. In section 3, the audit indicated that twelve radiographs in the sample should be duplicates. Of these, Jack identified five as duplicates and two as non-duplicates. The remaining five did not appear on the match report and therefore Jack could not have classified them as matches. Upon further investigation, Jack found that four of these five were, in fact, duplicate radiographs and that the fifth was not a duplicate. According to Alyeska personnel, four radiographs not listed on the match report were listed on match reports printed both before and after the report used in the Stumpf/Baker analysis. An explanation could not be given as to why they were not printed on the report used, or why the fifth radiograph was not listed on any report. In summary, the duplicate analysis conducted by Jack differed with the duplicate analysis of the Alyeska audit.

5. Verification radiographs are made to confirm that an existing radiograph corresponds to a physical location or to aid in locating a specific weld for remedial work. Although verification radiographs were rarely fingerprinted by the audit team, a procedure had not been established to determine if any were included on the fingerprint report, and if so, to eliminate them from the population and the sample.

We reviewed the weld/x-ray comparison report to identify verification radiographs (those marked with a "V" or "DUP"). In section 2, we found no verification radiographs and in section 3 we found five. New weld numbers were randomly selected from the weld/x-ray comparison report to replace these five verification radiographs.

6. Alpha suffixes (PPP, ZZZ, etc.) were used during the audit to distinguish phase 2 and 3 radiographs from those of phase 1. (The audit was conducted in three phases.) These alpha suffixes appeared on the weld/x-ray comparison report but not on the radiographs. Procedures had not been established to insure that Jack read the correct radiograph.

A list of radiographs with alpha suffixes corresponding to the sample was prepared. In each case, a review was made to determine if Jack read the appropriate radiograph. The radiographs in question were refingerprinted and compared to the weld/x-ray comparison report to identify the correct radiograph selected in the sample. Jack then reread these radiographs to verify that he had read the correct one.

C. Other tasks completed:

As part of our review of the sampling controls and procedures, we performed certain tasks to check compliance with the sample and compared certain of the Stumpf/Baker results with audit results. The following summarizes this effort:

1. We redetermined the specific radiographs to be sampled in section 3 by selecting the random numbers from the appropriate table and identifying the corresponding weld number on the weld/x-ray comparison report. We found 55 errors, all of which resulted because a portion of the sample had been selected from the wrong weld/x-ray comparison report. In addition, we found three random numbers which were not used in the sample, but should have been; and three random numbers which were used but were not included in the random number table within the range of the sample size selected. The correct weld numbers were selected and placed in the sample for the 55 errors, the three random numbers omitted from the sample were used, and the other three random numbers used in error were omitted from the sample.
2. In section 2, we selected a block of five random numbers and two at random. For each number, we traced the random number to the fingerprint report and compared the weld number in the sample to that in the report. In addition, we observed Dr. Stumpf's verification of the sample that was selected and reviewed each change that he made for appropriateness.
3. During his review, Jack Baker found one radiograph in section 3 which was missing from the storage box. We noted that the radiograph had been signed out on the "in/out" log in accordance with the stated procedures. As of June 27, we understand that Jack has not gone to the field to interpret this radiograph. We understand it has been "deemed" defective for purposes of the preliminary Stumpf/Baker analysis for section 3.



4. In section 1, we selected a block of ten sample cards plus cards for three radiographs Jack rejected. (Jack indicated on each card whether it was an 1104 reject. He also indicated whether he believed the reject was serious enough to require remedial work.) Of the thirteen selected, all were accepted during the audit. However, Jack indicated that six were standard 1104 rejects (presumably the basis for rejection by the audit team) and that two of the six were so serious he personally would request repair work to be done.
5. In sections 2 and 3, we compared the accept/reject interpretation of every radiograph Jack read with the accept/reject determination made in the Alyeska audit. The following summarizes this comparison:

Section 2    Section 3

a. Number of welds rejected by the Alyeska audit in accordance with standard 1104 and radiographic deficiencies	22	8
b. Number of welds (from "a" above) accepted by Jack	0	3
c. Number of welds Jack rejected in accordance with standard 1104 and radiographic deficiencies	50	77
d. Number of welds (from "c" above) accepted in the Alyeska audit	47	72
e. Number of welds which Jack indicated were so serious that he believed remedial work is required	2	7
f. Number of welds (from "e" above) accepted in the Alyeska audit	2	7

SECTION OF  
COMPLIANCE WITH  
104.

14

REVIEW OF 1975 ALYESKA WELD/RADIOGRAPH AUDIT  
SUMMARY OF NUMBER OF EXCEPTIONS NOTED  
IN LIMITED TESTING OF DOCUMENTATION SUPPORTING  
THE FINGERPRINT LISTING



	Number of Radiographs					
	Total	Section 1	Section 2	Section 3	Section 4	Section 5
Selected for Review - Test 1	501	98	95	118	95	95
a. Radiographs not on hand but accounted for as stolen or "checked out" for remedial work per Alyeska records	31	6	5	2	5	13
b. 1975 radiograph and weld/x-ray comparison form available, but weld number did not appear on the fingerprint listing	26	25	1	-	-	-
c. The data on the weld/x-ray comparison form did not agree with the data in the fingerprint report	10	-	2	7	1	-
d. The lead numbers shown on the radiographs did not agree with the weld number on the fingerprint report	5	-	5	-	-	-
e. The weld number was missing or a digit dropped from the weld number on one of the radiographic belts	11	-	9	2	-	-
f. Radiographs which were listed on the fingerprint report but could not be physically located or accounted for by Alyeska	3	-	-	2	-	1

REVIEW OF 1975 ALYESKA WELD/RADIOGRAPH AUDIT  
 SUMMARY OF NUMBER OF EXCEPTIONS NOTED  
 IN LIMITED TESTING OF DOCUMENTATION SUPPORTING  
 THE FINGERPRINT LISTING

	Number of Radiographs					
	Total	Section 1	Section 2	Section 3	Section 4	Section 5
2. Selected for Review - Test 2	95	19	19	19	19	19
a. For those radiographs refinger- printed by Alyeska at our request, at least one of the four measurements showed a difference of <u>+.4</u> " from the measurement shown in the fingerprint report	18	3	4	6	3	2
3. Number of radiographs per Alyeska fingerprint report	31,423	6,243	3,966	5,123	5,085	11,006

REVIEW OF 1975 ALYESKA WELD/RADIOGRAPH AUDIT  
EXCEPTIONS NOTED IN LIMITED TESTING  
OF DOCUMENTATION SUPPORTING THE  
FINGERPRINT LISTING

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1975 radiograph and weld/x-ray comparison form available  
but weld number did not appear on the fingerprint listing.

Weld Numbers

Section 1

1547	1560
1548	1561
1549	1562
1550	1563
1551	1564
1552	1565
1553	1566
1554	1567
1555	1568
1556	1569
1557	1570
1558	1571
1559	

Section 2

17486

REVIEW OF 1975 ALYESKA WELD/RADIOGRAPH AUDIT  
EXCEPTIONS NOTED IN LIMITED TESTING  
OF DOCUMENTATION SUPPORTING THE  
FINGERPRINT LISTING

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The data on the weld/x-ray comparison form did not agree with the data in the fingerprint report.

	<u>Long Seam 1</u>	<u>Long Seam 2</u>	<u>First + Restart</u>	<u>First - Restart</u>
<u>Section 2</u>				
16990				
Weld/x-ray comparison form	0	+ 161	+ 66	- 70
Fingerprint report	2000	+ 161	+ 66	- 70
18592				
Weld/x-ray comparison form	+ 138	- 43	+ 55	- 65
Fingerprint report	+ 13	- 43	+ 55	- 65
<u>Section 3</u>				
30889				
Weld/x-ray comparison form	- 94	- 154	+ 72	- 63
Fingerprint report	- 94	- 154	+ 71	- 61
30892				
Weld/x-ray comparison form	- 44	+ 269	+ 63	- 7
Fingerprint report	- 44	+ 269	+ 61	- 64
30898				
Weld/x-ray comparison form	- 64	+ 147	+ 54	- 48
Fingerprint report	- 64	+ 147	+ 54	- 47
30909				
Weld/x-ray comparison form	- 72	+ 134	+ 78	- 52
Fingerprint report	- 72	+ 134	+ 77	- 57
31071				
Weld/x-ray comparison form	+ 26	- 65	+ 70	- 92
Fingerprint report	+ 26	- 65	+ 61	- 10
31090				
Weld/x-ray comparison form	- 279	- 58	+ 64	- 46
Fingerprint report	- 279	- 58	+ 64	- 47
322250				
Weld/x-ray comparison form	+ 138	- 100	+ 72	- 51
Fingerprint report	+ 138	- 160	+ 72	- 51

Section 4

48555				
Weld number on radiograph			48555	
Weld number on weld/x-ray comparison form			48355	
Weld number on fingerprint report			48555	

REVIEW OF 1975 ALYESKA WELD/RADIOGRAPH AUDIT  
EXCEPTIONS NOTED IN LIMITED TESTING  
OF DOCUMENTATION SUPPORTING THE  
FINGERPRINT LISTING

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The lead numbers shown on the radiographs did not agree with the weld number on the fingerprint report.

<u>Weld Number</u> <u>on Finger-</u> <u>print Report</u>	<u>Lead Number</u> <u>on</u> <u>Radiograph</u>
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Section 2

17007	16007
17009	16009
17011	16011
17003	16003
17005	16005

REVIEW OF 1975 ALYESKA WELD/RADIOGRAPH AUDIT  
EXCEPTIONS NOTED IN LIMITED TESTING  
OF DOCUMENTATION SUPPORTING THE  
FINGERPRINT LISTING

The weld number was missing or a digit dropped from  
the weld number on one of the radiographic belts.

Weld  
Number

Section 2

16760  
17463  
17475  
17008  
17002  
17006  
16998  
17000  
17004

Section 3

30064  
30083



REVIEW OF 1975 ALYESKA WELD/RADIOGRAPH AUDIT  
EXCEPTIONS NOTED IN LIMITED TESTING  
OF DOCUMENTATION SUPPORTING THE  
FINGERPRINT LISTING

Radiographs which were listed on the fingerprint report  
but could not be physically located or accounted for by Alyeska.

Weld  
Number

Section 3

31844  
32225C

Section 5/6

89558

REVIEW OF 1975 ALYESKA WELD/RADIOGRAPH AUDIT  
EXCEPTIONS NOTED IN LIMITED TESTING  
OF DOCUMENTATION SUPPORTING THE  
FINGERPRINT LISTING

For those radiographs refingerprinted by Alyeska at our request, at least one of the four measurements showed a difference of +.4" from the measurement shown in the fingerprint report.

	<u>Long Seam 1</u>	<u>Long Seam 2</u>	<u>First + Restart</u>	<u>First - Restart</u>
<u>Section 1</u>				
879T				
Refingerprint	+ 88	- 58	2000	- 54
Fingerprint report	+ 88	- 52	+ 79	- 53
1816				
Refingerprint	- 27	- 234	+ 49	- 77
Fingerprint report	- 25	- 235	2000	2000
12102PPP				
Refingerprint	+ 67	- 44	+ 58	- 75
Fingerprint report	+ 67	2000	+ 57	- 76
<u>Section 2</u>				
17467				
Refingerprint	- 290	+ 238	+ 79	- 101
Fingerprint report	+ 111	+ 238	+ 78	- 101
17475				
Refingerprint	2000	- 101	+ 17	- 67
Fingerprint report	- 195	- 97	+ 19	- 64
15123				
Refingerprint	0	- 107	+ 56	- 32
Fingerprint report	+ 27	- 75	+ 32	- 47
17106				
Refingerprint	+ 247	- 202	+ 62	- 73
Fingerprint report	+ 250	- 233	+ 65	- 69
<u>Section 3</u>				
30053				
Refingerprint	+ 18	+ 377	+ 36	- 35
Fingerprint report	+ 19	+ 376	+ 15	- 34
30066				
Refingerprint	+ 65	- 72	+ 44	- 41
Fingerprint report	+ 65	- 72	+ 40	- 46
31832				
Refingerprint	+ 382	- 343	+ 54	- 58
Fingerprint report	+ 377	- 317	+ 17	

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REVIEW OF 1975 ALYESKA WELD/RADIOGRAPH AUDIT  
EXCEPTIONS NOTED IN LIMITED TESTING  
OF DOCUMENTATION SUPPORTING THE  
FINGERPRINT LISTING

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	<u>Long Seam 1</u>	<u>Long Seam 2</u>	<u>First + Restart</u>	<u>First - Restart</u>
<u>Section 3 (Cont.)</u>				
30902				
Refingerprint	+ 74	- 70	+ 41	- 59
Fingerprint report.	+ 75	- 69	+ 73	- 58
31071				
Refingerprint	+ 88	- 64	+ 61	- 91
Fingerprint report	+ 26	- 65	+ 61	- 10
30124				
Refingerprint	+ 54	+ 382	+ 50	- 50
Fingerprint report	+ 56	- 382	+ 50	- 17
<u>Section 4</u>				
50114				
Refingerprint	+ 35	- 374	+ 59	- 77
Fingerprint report	+ 33	- 377	+ 57	- 38
47491				
Refingerprint	+ 91	+ 188	+ 54	- 78
Fingerprint report	+ 90	+ 187	+ 52	- 2000
50186				
Refingerprint	+ 148	- 267	+ 56	- 51
Fingerprint report	+ 148	- 266	2000	- 51
<u>Section 5/6</u>				
81757				
Refingerprint	+ 213	- 189	+ 48	- 58
Fingerprint report	+ 213	- 188	+ 49	2000
85115				
Refingerprint	+ 109	- 150	+ 83	- 72
Fingerprint report	+ 110	- 150	2000	- 70

[June 1976]

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The President has directed Secretaries Kleppe and Coleman to make a preliminary report to him tomorrow on the Trans-Alaska Pipeline situation.

Because the Department of Transportation is responsible for pipeline safety, Secretary Coleman -- at the President's direction -- has instructed his Undersecretary, John Barnum, to head a fact-finding team to Alaska early next week to assess what this may mean in terms of delays, additional costs, and environmental impact, to evaluate the new testing procedures, and to make recommendations for further action.

This fact-finding team will include representatives of OMB and FEA.



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7/6

Jim:

THE WHITE HOUSE  
WASHINGTON

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John.

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[July 1976]

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Interior [July 1976]  
INFORMATION  
Pipeline



FEDERAL ENERGY ADMINISTRATION  
WASHINGTON, D.C. 20461

OFFICE OF THE ADMINISTRATOR

MEMORANDUM FOR THE PRESIDENT

THRU: ELLIOT L. RICHARDSON  
FROM: FRANK G. ZARB  
SUBJECT: STATUS REPORT: ALASKA PIPELINE



The Executive Committee of the Energy Resources Council met this morning to receive an interim report from Under Secretary Barnum on his fact-finding trip to Alaska last week and to discuss several activities which Secretary Kleppe currently has underway in connection with the issues investigated by John Barnum.

Working under the coordinating auspices of the ERC, the two Departments will prepare a joint report that should be ready for your review by early next week. This report will lay out the problem areas, indicate corrective actions that will be needed, and the possible impact of those actions on the costs and completion date of the pipeline.

Although it is premature to come to any final conclusions, Alyeska and the relevant government agencies are already at work on the following:

- . Reexamining and correcting any problems associated with the 3,995 questionable welds detected in the Alyeska audit of the 1975 welding program.
- . Rechecking, as a result of the Arthur Anderson Report prepared for the Department of the Interior, the other 30,800 welds completed during the 1975 welding program which the Alyeska audit determined to be acceptable. The procedure to be used in this rechecking effort is still under review.
- . Establishing unquestionable quality control procedures for all post-1975 welds, including those already completed in 1976.

Both Interior and DOT are firm in their position that all outstanding questions will be resolved before use of the pipeline is permitted; the structural and environmental integrity of the pipeline cannot be relaxed in any way. Both departments are still guardedly optimistic that all corrective actions can be completed on the pipeline in time to permit operation of the system by mid-1977, the current target.

Interior and DOT officials will be testifying tomorrow before the Senate Interior Committee providing information along the above lines.

The final report of the Arthur Anderson Company -- which raises substantial questions as to the acceptability of past quality control procedures -- has been given to House and Senate Committees and will become public either today or tomorrow.

After reviewing the final report from Arthur Anderson Company, Secretary Kleppe concluded that additional instructions must be issued to Alyeska. Under Secretary Frizzell has today dispatched a letter to Alyeska which provides as follows:

- . Submit a plan for producing fully auditable records of all welds completed in 1975.
- . Complete two radiographs for all future welds and provide one to the Department of the Interior.
- . Immediately establish a technique for marking each weld in a manner that is visible to the naked eye and by x-ray so that all radiograph film can be positively identified with each weld; or, if this is not technically feasible, develop an acceptable alternative.
- . If an acceptable marking technique or alternative is not approved by Interior, welding must be stopped by 10:00 A.M., July 25. (Interior is confident that welding will not need to be stopped.)

Some items in this folder were not digitized because it contains copyrighted materials. Please contact the Gerald R. Ford Presidential Library for access to these materials.

## TRANS-ALASKA PIPELINE

### Question

Ron, What is the President going to do about the problems with the welds on the Pipeline under the tundra in Alaska?

### Answer

From the beginning of this project, the Government has been determined to enforce high technical standards. One of the reasons there have been problems over the welding is because the present standards are higher than any pipeline standards ever set on any project.

The President is well aware of the current problems involving the welds joining the pipeline, including the recent audit report made public last Friday which showed that there may be more flaws than originally thought.

Late last week, the President directed Secretaries Kleppe and Coleman to report to him by Wednesday, July 7, concerning the present status of the Trans-Alaska Pipeline. Moreover, both the Departments of Interior and Transportation have been monitoring this situation closely. They will continue to inspect the progress of the pipeline and, as I understand it, will soon have full time people on the site to inspect the construction of the pipeline until its completion.



JRH  
7/6/76

# The Washington Post

AN INDEPENDENT NEWSPAPER



## *The Pipe Under the Tundra*

**T**HE ALASKAN PIPELINE first got off to an awkward start with years of litigation over environmental standards. Now it is entangled in further controversy over the quality of the welding that joins the sections of this gigantic tube. There is a tendency in

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## *The Pipe Under the Tundra*

**T**HE ALASKAN PIPELINE first got off to an awkward start with years of litigation over environmental standards. Now it is entangled in further controversy over the quality of the welding that joins the sections of this gigantic tube. There is a tendency in this part of the country to see the whole pipeline as merely a desecration of the wilderness. But the real significance of the case points in precisely the opposite direction. The government has been showing admirable determination to enforce high technical standards on this gigantic project. The contractors are in trouble over the welding because the inspec-

apparently judged not serious enough to affect the strength of the seams.

The Interior Department hired an independent accounting firm to go over the records again. Meanwhile Alyeska x-rayed the joints that it could reach, or re-welded them. The hard questions now involved some 1,350 welds buried deep in the permafrost or under rivers, where digging them up would compound the ecological damage already done. Alyeska and the Departments of Interior and Transportation are now looking into a technique to inspect welds by sound waves; the acoustical system can be operated

THE WHITE HOUSE

WASHINGTON

July 6, 1976



MEMORANDUM FOR: JIM CANNON  
FROM: JUDY HOPE  
SUBJECT: Trans-Alaska Pipeline: Welding Problems

I attach the proposed question and answer for Ron Nessen if he should be asked about presidential knowledge on the welding problems on the Trans-Alaska Pipeline. Particularly in view of the thoughtful and correct editorial in the Washington Post dated July 5, I think we should just be prepared to respond to questions on this matter, rather than taking the initiative here. I attach a copy of the editorial for your information.

ADDITIONAL DATA:

1. The draft Arthur Anderson audit, revealing many more potentially faulty welds than originally believed, went public Friday when DOI made it available at a hearing on the Hill.
2. The final Arthur Anderson audit will be ready today or tomorrow.
3. To supervise the DOT task force which will be going to Alaska, John Barnum has identified a just - retired Coast Guard Admiral who (a) had 3 years' duty in Alaska; (b) has an engineering background; and (c) is not beholden to the construction industry. Late this week, he will head a group of Coast Guard officials going to Alaska to inspect welding and quality control techniques. On July 11th or 12th, John Barnum will go to Alaska to check on new testing techniques now being instituted.
4. Representatives of DOI and OMB are also planning to be in Alaska next week on the pipeline issue: DOI's jurisdiction rests on (a) the fact that the pipeline goes through Federal lands; (b) the statutory responsibility for safeguarding the permafrost, tundra, flora and fauna in the area; DOT's jurisdiction is safety under the Transportation of Explosives Act, 18 U.S.C. §§ 831-835.
5. It should be noted that both DOT and DOI have gone to Alaska regularly since construction began, to inspect quality controls and corrosion protection aspects of the project.

*Job  
to  
Barnum  
Adm*



# United States Department of the Interior

OFFICE OF THE SECRETARY  
WASHINGTON, D.C. 20240

July 7, 1976



NOTE TO THE PRESIDENT

From: Secretary of the Interior

## SUMMARY

The Department's plan for resolving the questions which have been raised with respect to the quality of welds on the Trans-Alaska Pipeline is as follows:

First, our independent auditors, Arthur Andersen & Co., in conjunction with the Alyeska Pipeline Service Co., will verify the authenticity and accuracy of all welding records presently in existence.

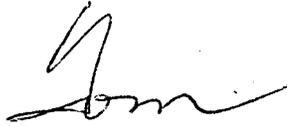
Second, in those cases where welding records indicate deficiencies those deficiencies will be repaired where access can be gained to the weld without undue damage to the environment. In those instances where the weld is located in permafrost or beneath rivers and streams where considerable environmental damage could result from digging up the pipe, independent testing by recognized welding experts will determine through a system of fracture mechanics analysis whether any deficiencies present will actually affect pipeline strength and integrity. If pipeline strength and integrity are affected repairs will be made to the pipe in place or if necessary the pipe will be removed for repairs.

Third, in those instances where no records exist with respect to welds, new radiographs will be made where possible. Where the welds are not accessible for radiographs we have asked an independent team of recognized welding experts to determine whether a new system of acoustical imaging will accurately and thoroughly assess the integrity of those welds. In the event this alternative method of testing is determined to be reliable it will be utilized. Welds found to be insufficient by these tests will also be repaired.

Operation of the Alaska Pipeline will not be permitted to begin until we have assured ourselves through the best engineering techniques available that the structure and welds of this pipeline are in full compliance with our high standards to assure the complete integrity of this pipeline.



We cannot say at this time what, if any, delays will be encountered in the completion date of the Alaska Pipeline. We are hopeful that the pipeline can be brought into operation by its scheduled completion date of July 1977, however, our primary objective will be to assure ourselves of the integrity of the pipeline.



Secretary of the Interior

Attachment





# United States Department of the Interior

OFFICE OF THE SECRETARY  
WASHINGTON, D.C. 20240

July 7, 1976

MEMORANDUM TO THE PRESIDENT, THE WHITE HOUSE  
Through: James A. Cannon, Director  
Domestic Council

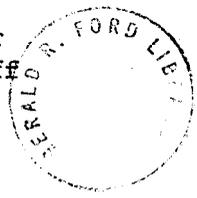
FROM: Secretary of the Interior

On November 16, 1973, the Trans-Alaska Pipeline Authorization Act was signed into law. The Act charged the Secretary of the Interior with the authority to make grants of rights-of-way and to determine the conditions to be attached to such grants. On January 23, 1974, Secretary Morton executed the agreement and grant right-of-way with the owners of the Trans-Alaska Pipeline System. Along with the grant of right-of-way, the agreement imposes strict administrative environmental and technical stipulations and procedures. The stipulations and procedures are designed to assure the performance of all activities associated with construction of the pipeline in a technically and environmentally sound manner. In some areas, they constitute far more stringent constraints than any other Federal statutes and regulations applicable to the safety and operation of the Trans-Alaska Pipeline. Our stipulations require that the engineering designs of the permittees be subjected to our intense scrutiny and review. They impose strict standards of pollution control, standards of erosion control, and requirements for revegetation of the disturbed areas. Specific standards are established for fish and wildlife. The stipulations further require all design materials and construction operations and maintenance practices employed in the pipeline system to be in accordance with safety-approved engineering standards. Specifically, the stipulations require radiographs of all mainline girth welds prior to placing the system in operation.

I have charged my Authorized Officer, Major General Andrew P. Rollins, to give oversight to the execution of all provisions and stipulations of our permittee agreement. Under General Rollins' oversight, Alyeska Pipeline Service Company, the construction agent of the owners



of the pipeline system, began an investigation in August of 1975 of certain welding irregularities. This investigation was enlarged in September and in October of 1975, expanded to include all welds executed thus far in Section 3 of the pipeline. This investigation of the welds executed in the construction season of 1975 was extended section by section until finally the last of the six sections was included at the end of January 1976. This investigation was completed and presented to members of my staff on May 4 and 5, 1976. During this investigation and "audit", Alyeska represented they had found 3,955 welds to be deficient either by presence of defects in the welds as reflected by radiographs or deficient by the absence of radiograph records. This number was determined after review of the 31,000 welds executed during the 1975 construction season. After a briefing on May 7, 1976, of the results of the Alyeska "audit", Under Secretary Kent Frizzell, immediately imposed upon Alyeska Pipeline Service Company their requirement that all welds executed hence forth must not be covered prior to written certification by Alyeska of their possession of a positive radiograph. This written certification was to be presented to our Authorized Officer. Further, we directed that Alyeska "audit" be validated. To this end, on May 24, 1976, we employed the accounting firm of Arthur Andersen & Company. Arthur Andersen & Co. discussed on June 30, 1976, with members of my staff and a representative of DOT the status of its validation effort.

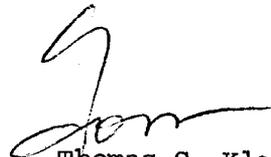


In the simplest of terms, Arthur Andersen indicated they would be unable to certify the accuracy of Alyeska's audit due to serious procedural deficiencies in Alyeska's record keeping. That is, as Alyeska's records now stand, an independent auditor cannot attest to either the audit's accuracy or inaccuracy. Clearly, our stipulation requiring radiographic inspection has implicit in it the requirement of the maintenance by permittees of intelligible, auditable records by the permittees. A meeting is scheduled to take place in Los Angeles next Monday, July 12, 1976, between Arthur Andersen & Co., Alyeska Pipeline Service Company, and members of my staff to further define deficiencies in Alyeska's records maintenance. As has been our custom throughout the management of this project, we have extended an invitation to DOT to participate in this meeting. Following the meeting, we anticipate early receipt of Arthur Andersen & Company's final report. Upon receipt of such report, we intend to direct Alyeska Pipeline Service Company to take all necessary steps to bring their records of all pipeline welds, and radiograph inspections of such welds, to a level acceptable to our independent auditor. •

There is a second facet to the welding problem. Over 200 of the welds executed in 1975 were found to be buried without radiographic inspection records. Alyeska Pipeline Service Company has embarked on a means of inspection of these welds employing accoustical imaging, a method of inspection utilizing ultrasonic testing techniques to create an image of the defects in such welds. They have requested

our oversight of their development of this technique and requested our acceptance should they prove to our satisfaction that it is indeed a means of inspection alternate and equivalent to radiographs. To this end, tests are presently scheduled in Fairbanks next week to demonstrate the effectiveness of this testing method. Again, we have extended an invitation to the DOT to witness these tests. Certain of the welds determined to be deficient by virtue of defects present within the welds lie buried beneath rivers or deep in permafrost, making access to them for inspection and repair extremely difficult and potentially damaging to the environment. Alyeska proposes to address the sufficiency of these welds by rigorous mathematical analysis employing fracture mechanical analysis and, to this end, has conducted elaborate tests to determine the acceptability of various defects in the sizes within the welds. To assist us in the oversight of this program, we have retained a nationally eminent welding metallurgist as well as the services of Southwest Research Institute, one of the leading centers of pipe welding expertise. Again, we have invited DOT to participate with us in this endeavor.

We have indicated to the permittees that the initiation of operations of the pipeline will not be permitted until such time as we are fully assured of the integrity of each weld in the pipeline. With this knowledge, Alyeska has in turn told us that they do not anticipate a consequential delay in the pipeline. We are treating this matter with the greatest sense of urgency and with all available resources. We shall keep you informed of the steps taken to solve the welding problems.



Thomas S. Kleppe

TRANS-ALASKA PIPELINE WELD PROBLEMS

Chronology of events since May 1975



August, 1975--Surveillance by Interior Department and its special consultant, Mechanics Research, Inc., reveals quality control problems in girth (circumferential) welds joining pipeline lengths.

August, 1975--Alyeska Pipeline Service Company begins audits of X-rays in two sections of the pipeline. Irregularities, including possible falsification of some X-rays, are found.

September 11, 1975--At his request, Interior Under Secretary Kent Frizzell holds meeting with principal owners of the pipeline system; the owner companies assure Interior of their intentions "to improve quality control program and to do so with a sense of urgency."

September, 1975--Alyeska undertakes a more extensive X-ray audit, section by section, on a 100 per cent audit basis.

Winter, 1975-76--Audit is extended and continued as work on welding ends for the season.

May 4-5, 1976--Alyeska presents X-ray audit to Interior Officials showing that of more than 30,000 girth welds made in 1975, a total of 3,955 require examination and possible corrective action.

May 7, 1976--Under Secretary Frizzell telegraphs Alyeska, pointing out that Interior stipulations require satisfactory X-rays of all girth welds before the pipeline can be put into operation. His message demands that the company state specifically how it intends to meet this requirement. It directs Alyeska to supply written, detailed evidence of procedures to prevent future deficiencies; and it directs that all girth welds henceforth be left exposed until an X-ray of each has been obtained and certified in writing.

May 24, 1976--Interior engages Arthur Andersen & Co., independent CPA firm, to validate Alyeska's audit of its 1975 welding program. Interior also employs W. A. Saylor, independent metallurgical expert, and Southwest Research Institute, independent center of welding expertise, to help analyze problem welds.

May 27, 1976--Alyeska's owner companies tell Interior they are moving as quickly as possible to re-examine and repair problem welds. (By June 21, some 1,700 of the 3,955 welds identified as questionable by Alyeska audit have been brought into compliance with Interior stipulations.)

June 7, 1976--Alyeska outlines means by which it proposes to comply with Interior stipulations, pointing out that there are no X-rays for more than 200 welds, some of them in joints buried beneath rivers or deep in permafrost. Alyeska inquires whether Interior would consider "alternative equivalent" examination techniques in place of X-rays.

June 11, 1976--Frizzell says Interior is willing to review "alternative but equivalent" inspection methods, without committing itself to acceptance of such methods. A test is scheduled for Fairbanks in mid-July of acoustical holography --obtaining pictures by sound wave, a technique that has been used on weld examination, but yet to be proven sufficient under actual field conditions inside a pipeline.

June 30, 1976--A briefing is held by Arthur Anderson & Co. for members of the Secretary's staff of the firm's efforts to validate Alyeska's audit.

x x x

(prepared July 1976)



# United States Department of the Interior

OFFICE OF THE SECRETARY  
WASHINGTON, D.C. 20240



July 7, 1976

NOTE TO THE PRESIDENT

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Operation of the Alaska Pipeline will not be permitted to begin until we have assured ourselves through the best engineering techniques available that the structure and welds of this pipeline are in full compliance with our high standards to assure the complete integrity of this pipeline.



We cannot say at this time what, if any, delays will be encountered in the completion date of the Alaska Pipeline. We are hopeful that the pipeline can be brought into operation by its scheduled completion date of July 1977, however, our primary objective will be to assure ourselves of the integrity of the pipeline.

A handwritten signature in black ink, appearing to be 'J. M.', written in a cursive style.

Secretary of the Interior

Attachment



# United States Department of the Interior

OFFICE OF THE SECRETARY  
WASHINGTON, D.C. 20240

July 7, 1976



MEMORANDUM TO THE PRESIDENT, THE WHITE HOUSE  
Through: James A. Cannon, Director  
Domestic Council

FROM: Secretary of the Interior

On November 16, 1973, the Trans-Alaska Pipeline Authorization Act was signed into law. The Act charged the Secretary of the Interior with the authority to make grants of rights-of-way and to determine the conditions to be attached to such grants. On January 23, 1974, Secretary Morton executed the agreement and grant right-of-way with the owners of the Trans-Alaska Pipeline System. Along with the grant of right-of-way, the agreement imposes strict administrative environmental and technical stipulations and procedures. The stipulations associated with construction of the pipeline in a technically and environmentally sound manner. In some areas, they constitute far more stringent constraints than any other Federal statutes and regulations applicable to the safety and operation of the Trans-Alaska Pipeline. Our stipulations require that the engineering designs of the permittees be subjected to our intense scrutiny and review. They impose strict standards of pollution control, standards of erosion control, and requirements for revegetation of the disturbed areas. Specific standards are established for fish and wildlife. The stipulations further require all design materials and construction operations and maintenance practices employed in the pipeline system to be in accordance with safety-approved engineering standards. Specifically, the stipulations require radiographs of all mainline girth welds prior to placing the system in operation.

I have charged my Authorized Officer, Major General Andrew P. Rollins, to give oversight to the execution of all provisions and stipulations of our permittee agreement. Under General Rollins' oversight, Alyeska Pipeline Service Company, the construction agent of the owners



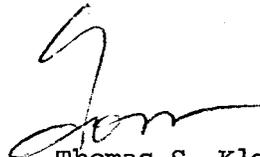
of the pipeline system, began an investigation in August of 1975 of certain welding irregularities. This investigation was enlarged in September and in October of 1975, expanded to include all welds executed thus far in Section 3 of the pipeline. This investigation of the welds executed in the construction season of 1975 was extended section by section until finally the last of the six sections was included at the end of January 1976. This investigation was completed and presented to members of my staff on May 4 and 5, 1976. During this investigation and "audit", Alyeska represented they had found 3,955 welds to be deficient either by presence of defects in the welds as reflected by radiographs or deficient by the absence of radiograph records. This number was determined after review of the 31,000 welds executed during the 1975 construction season. After a briefing on May 7, 1976, of the results of the Alyeska "audit", Under Secretary Kent Frizzell, immediately imposed upon Alyeska Pipeline Service Company their requirement that all welds executed hence forth must not be covered prior to written certification by Alyeska of their possession of a positive radiograph. This written certification was to be presented to our Authorized Officer. Further, we directed that Alyeska "audit" be validated. To this end, on May 24, 1976, we employed the accounting firm of Arthur Andersen & Company. Arthur Andersen & Co. discussed on June 30, 1976, with members of my staff and a representative of DOT the status of its validation effort.

In the simplest of terms, Arthur Andersen indicated they would be unable to certify the accuracy of Alyeska's audit due to serious procedural deficiencies in Alyeska's record keeping. That is, as Alyeska's records now stand, an independent auditor cannot attest to either the audit's accuracy or inaccuracy. Clearly, our stipulation requiring radiographic inspection has implicit in it the requirement of the maintenance by permittees of intelligible, auditable records by the permittees. A meeting is scheduled to take place in Los Angeles next Monday, July 12, 1976, between Arthur Andersen & Co., Alyeska Pipeline Service Company, and members of my staff to further define deficiencies in Alyeska's records maintenance. As has been our custom throughout the management of this project, we have extended an invitation to DOT to participate in this meeting. Following the meeting, we anticipate early receipt of Arthur Andersen & Company's final report. Upon receipt of such report, we intend to direct Alyeska Pipeline Service Company to take all necessary steps to bring their records of all pipeline welds, and radiograph inspections of such welds, to a level acceptable to our independent auditor. \*

There is a second facet to the welding problem. Over 200 of the welds executed in 1975 were found to be buried without radiographic inspection records. Alyeska Pipeline Service Company has embarked on a means of inspection of these welds employing accoustical imaging, a method of inspection utilizing ultrasonic testing techniques to create an image of the defects in such welds. They have requested

our oversight of their development of this technique and requested our acceptance should they prove to our satisfaction that it is indeed a means of inspection alternate and equivalent to radiographs. To this end, tests are presently scheduled in Fairbanks next week to demonstrate the effectiveness of this testing method. Again, we have extended an invitation to the DOT to witness these tests. Certain of the welds determined to be deficient by virtue of defects present within the welds lie buried beneath rivers or deep in permafrost, making access to them for inspection and repair extremely difficult and potentially damaging to the environment. Alyeska proposes to address the sufficiency of these welds by rigorous mathematical analysis employing fracture mechanical analysis and, to this end, has conducted elaborate tests to determine the acceptability of various defects in the sizes within the welds. To assist us in the oversight of this program, we have retained a nationally eminent welding metallurgist as well as the services of Southwest Research Institute, one of the leading centers of pipe welding expertise. Again, we have invited DOT to participate with us in this endeavor.

We have indicated to the permittees that the initiation of operations of the pipeline will not be permitted until such time as we are fully assured of the integrity of each weld in the pipeline. With this knowledge, Alyeska has in turn told us that they do not anticipate a consequential delay in the pipeline. We are treating this matter with the greatest sense of urgency and with all available resources. We shall keep you informed of the steps taken to solve the welding problems.



Thomas S. Kleppe

## TRANS-ALASKA PIPELINE WELD PROBLEMS

### Chronology of events since May 1975

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(prepared July 1976)



# United States Department of the Interior

OFFICE OF THE SECRETARY  
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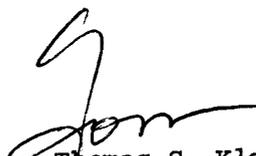
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(prepared July 1976)





THE SECRETARY OF TRANSPORTATION  
WASHINGTON, D.C. 20590

July 7, 1976



MEMORANDUM FOR THE PRESIDENT

SUBJECT: Welding Problems on the Alaska Pipeline

On July 2 you requested the Department of Transportation (DOT) to submit to you today a preliminary report concerning welding problems in the construction of the Trans-Alaska Pipeline System (TAPS).

At the outset I would like to describe in general terms the past role of 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) and assumed the primary Federal responsibility for the project. DOI provided a large inspection force to monitor the construction of the pipeline. 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.



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, DOT served as a member of DOI's Technical Advisory Board, which was established as part of a DOI task force on Alaskan oil development. DOT provided 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, and committed a staff engineer in Washington, D.C., to serve as coordinator of DOT activities.

Statistics compiled by OPSO demonstrate that the chief cause of leaks for both oil and gas pipelines throughout the country has been corrosion, not welding. Indeed OPSO statistics indicate that less than 2 percent of the liquid pipeline failures have been attributable to girth weld failures, and therefore they were not a subject of primary concern to DOT. DOT activity has focused primarily on the corrosion control plan for the pipeline. DOT 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.

DOT first became aware of possible welding irregularities in early September 1975 when Peter Kelley brought suit against his former employer, Ketchbaw Industries. Ketchbaw Industries was the contractor providing radiographic inspection of girth welds on pipeline construction south of the Yukon River. Mr. Kelley alleged that Ketchbaw crews had falsified some radiographs.

Alyeska dispatched an audit team to check Mr. Kelley's complaint and subsequently conducted an audit of radiographs made of all girth welds in Section 3 (the project is divided into five construction sections). On September 14, 1975, Alyeska decided to audit all radiographs in the other sections south of the Yukon based on preliminary findings in Section 3. Eventually the audit was expanded to include the sections north of the Yukon. The audit involved two aspects: (1) all radiographs taken in 1975 (approximately 30,800) were read and reinterpreted and (2) identifying features of each of the radiographs were put into a computerized data bank in order to isolate, by a "fingerprinting" process, potentially duplicated radiographs which might be falsifications.

OPSO received the audit report for Section 3 on October 31, 1975, and the audit report for Section 2 on January 30, 1976. A review of these two reports indicated that there were irregularities in the radiographic inspection of welds. About the time of the receipt of the first report, we were advised that the audit would extend to the entire pipeline.

Shortly after receipt of the first audit report, the welding of the pipeline was halted for the winter and was not resumed until the spring of 1976.

During the last week in March 1976, DOT learned that the audit was nearing completion and that a large number of welds had been found to be irregular. This was confirmed by Mr. Rollins of APO by telephone on April 7, 1976. Based on this information, DOT forwarded a letter on April 9, 1976, to Mr. Rollins indicating the necessity of a meeting to discuss these irregular welds, and another letter to Mr. Ed Patton, President of Alyeska, expressing concern over the welding issue and requesting a meeting to ascertain the full dimensions of the problem and to be informed of Alyeska's course of corrective action.

On May 4 and 5, 1976, Alyeska conducted a meeting in its office in Anchorage to present and discuss the results of the complete audit. The meeting was attended by representatives from OPSO, APO, the State of Alaska, and various consultants from the Department of the Interior. Alyeska presented the summary and analysis of the audit. This summary showed that there was a total of 3,955 welds with irregularities that included missed radiographs, falsified radiographs, and welds with defects not acceptable under 49 CFR 195.228.

On May 27, 1976, Deputy Secretary John W. Barnum and Mr. James T. Curtis, Jr., Director of MTB, attended a briefing concerning the radiograph problem arranged by Under Secretary of the Interior Frizzell and conducted by Alyeska and the companies who own the pipeline.

On June 21, 1976, John Barnum testified before the House Interstate and Foreign Commerce Subcommittee on Energy and Power regarding the construction problems on the TAPS. At that time, in addition to describing DOT's past actions, he indicated that we would furnish a full report to that



Subcommittee on future DOT action plans for resolving the welding problems and monitoring the continuation of the construction of TAPS. As promised, that report has been delivered. At my request Mr. Barnum has also responded to a letter from Senators Jackson and Metcalf on the same subject.

In the interim DOI retained Arthur Andersen and Company, an independent certified public accounting firm, to validate Alyeska's audit of their 1975 welding program. A report of their preliminary results was made available to us on July 1, 1976. We understand that a final report will be available shortly.

The issues regarding the welding and monitoring problems can be categorized as follows:

Issue No. 1: The first issue concerns welds performed during the 1975 construction season which, upon reexamination by the auditors for Alyeska Pipeline Service Company (Alyeska), are acknowledged not to meet the specifications in the DOT regulations. The DOT regulations require welds to meet the standards specified in Section 6 of American Petroleum Institute Standard 1104 (API 1104). The majority of the welds identified by Alyeska as not complying are welds which do not meet the API 1104 standards because of size or type of defect.

Issue No. 2: The second issue concerns missing, incomplete, or otherwise defective radiographs of welds performed during the 1975 construction season. The DOT regulations in 49 CFR 195.234(a) permit welds to be nondestructively tested in any manner that will clearly indicate any defects that may affect the integrity of the weld. The DOI Agreement and Grant of Right-of-Way in Stipulation 3.2.2.3, however, requires that all main line girth welds be radiographed.

Issue No. 3: The third issue concerns assuring that the construction of the remainder of the pipeline complies with DOT requirements.

With respect to the first two issues, DOT is requiring Alyeska to submit to DOT a plan and schedule for correcting the weld deficiencies identified in its audit of the 1975 girth weld radiographs. DOT 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. In addition, DOT is taking the following actions to resolve these issues:

Welds not in compliance with DOT regulations:

The position of DOT is that all welds must meet DOT standards for pipeline integrity. Welds which do not comply with DOT regulations must be repaired. If an alternative standard of weld acceptability which will not adversely affect the integrity of the pipeline is established through DOT's formal waiver process, all problem welds will be individually evaluated using this newly established standard.

Although DOT has not received a formal application for a waiver of the API 1104 standards for those welds, Alyeska in a letter to DOI has stated that there is under development a program to establish an alternative standard to API 1104 which may prove to be satisfactory for testing the acceptability of welds that are "located in sensitive and/or very difficult access related areas in which any remedial work will likely degrade the end product quality and/or create substantial environmental concerns." Since the evaluation of any alternative standard will require the analysis of complex technical issues, DOT has retained the National Bureau of Standards (NBS) which, together with personnel within DOT, will monitor the development of and evaluate this possible alternative standard of acceptability to API 1104.

Defective or missing radiographs:

Alyeska has proposed to employ a new technique to inspect welds in critical areas which have missing, duplicated, or otherwise defective radiographs. This new technique is called acoustic imaging. It uses

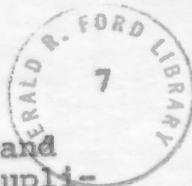
ultrasonic energy to produce an optical image or picture of the weld being inspected. The advantage of the acoustic imaging inspection technique would be that only the inside of the weld has to be exposed. In radiography, the radiation source and the film must be on opposite sides of the weld, which means that a buried weld must be exposed by excavation in permafrost or by pulling pipe out from under a riverbed. The acoustic inspection device would be used to inspect the welds from inside the pipe.

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 DOT attended the demonstration. Significant technical questions regarding the system remained unresolved at the conclusion of the Richland tests. Alyeska plans to conduct further tests, under field conditions, in Fairbanks, Alaska, commencing the week of July 12. NBS will also assist DOT in the resolution of this issue. DOT representatives and NBS ultrasonics and acoustical imaging experts will attend the Fairbanks tests and subsequently we will determine whether the technique can identify weld defects in a manner equivalent or superior to radiography.

#### Future construction:

Due to the developments which indicate falsification of the records that determine 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. As a result, we have concluded that the Department should be represented on the TAPS project in Alaska on a continuous basis and we have this week initiated continuous onsite surveillance by OPSO personnel to assure compliance with our regulations and to maintain liaison with the APO concerning their surveillance functions.

To supplement the increased OPSO efforts, we will assign five additional Departmental personnel to Alaska to assist in the monitoring of the welding



operations, including the radiographing of welds and weld repairs. This activity is not intended to duplicate the function being performed by APO, but will be essentially an oversight function to assure compliance with DOT regulations.

The DOT task force in Alaska will be supervised by Rear Admiral Joseph R. Steele (USCG Ret.), who is being briefed in Washington today and tomorrow and who will proceed to Alaska on Friday. Admiral Steele has a solid technical and management background, has a long and distinguished career in the Coast Guard and has spent three years in Alaska.

On Sunday (July 11), in accordance with your instructions, John Barnum will go to Alaska with a team of DOT pipeline, metallurgy and environmental experts. He will also be accompanied by a representative of the Federal Energy Administration. In Alaska he plans to meet with Governor Hammond and other officials of the State of Alaska, with representatives of DOI and Alyeska, and with our own task force and consultants, among others. The fact-finding team will attempt to assess the implications of the welding problem in terms of delays, any additional costs in construction of the pipeline, and any environmental impact. Alyeska testified in the House hearings that the approximate cost of correcting the problem welds would be \$35 to \$55 million, depending on the development of acoustic imaging equipment and the requirements of DOI and DOT for correcting the problem welds. Alyeska also testified that it did not think that there would be any delay in completing the project as a result of these problems. We are not presently in a position to comment on those statements, but will address those questions in the report we submit to you following John Barnum's visit to Alaska.

/s/ William T. Coleman, Jr.  
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THE SECRETARY OF TRANSPORTATION  
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July 7, 1976

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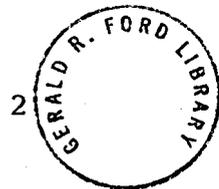


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Under the authority of the Transportation of Explosives Act (18 USC 831-35), DOT has established safety regulations for the design, construction, operation and maintenance of pipelines operated by carriers engaged in interstate commerce which transport 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) and assumed the primary Federal responsibility for the project. DOI provided a large inspection force to monitor the construction of the pipeline. 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.



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, DOT served as a member of DOI's Technical Advisory Board, which was established as part of a DOI task force on Alaskan oil development. DOT provided 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, and committed a staff engineer in Washington, D.C., to serve as coordinator of DOT activities.

Statistics compiled by OPSO demonstrate that the chief cause of leaks for both oil and gas pipelines throughout the country has been corrosion, not welding. Indeed OPSO statistics indicate that less than 2 percent of the liquid pipeline failures have been attributable to girth weld failures, and therefore they were not a subject of primary concern to DOT. DOT activity has focused primarily on the corrosion control plan for the pipeline. DOT 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.

DOT first became aware of possible welding irregularities in early September 1975 when Peter Kelley brought suit against his former employer, Ketchbaw Industries. Ketchbaw Industries was the contractor providing radiographic inspection of girth welds on pipeline construction south of the Yukon River. Mr. Kelley alleged that Ketchbaw crews had falsified some radiographs.

Alyeska dispatched an audit team to check Mr. Kelley's complaint and subsequently conducted an audit of radiographs made of all girth welds in Section 3 (the project is divided into five construction sections). On September 14, 1975, Alyeska decided to audit all radiographs in the other sections south of the Yukon based on preliminary findings in Section 3. Eventually the audit was expanded to include the sections north of the Yukon. The audit involved two aspects: (1) all radiographs taken in 1975 (approximately 30,800) were read and reinterpreted and (2) identifying features of each of the radiographs were put into a computerized data bank in order to isolate, by a "fingerprinting" process, potentially duplicated radiographs which might be falsifications.

OPSO received the audit report for Section 3 on October 31, 1975, and the audit report for Section 2 on January 30, 1976. A review of these two reports indicated that there were irregularities in the radiographic inspection of welds. About the time of the receipt of the first report, we were advised that the audit would extend to the entire pipeline.

Shortly after receipt of the first audit report, the welding of the pipeline was halted for the winter and was not resumed until the spring of 1976.

During the last week in March 1976, DOT learned that the audit was nearing completion and that a large number of welds had been found to be irregular. This was confirmed by Mr. Rollins of APO by telephone on April 7, 1976. Based on this information, DOT forwarded a letter on April 9, 1976, to Mr. Rollins indicating the necessity of a meeting to discuss these irregular welds, and another letter to Mr. Ed Patton, President of Alyeska, expressing concern over the welding issue and requesting a meeting to ascertain the full dimensions of the problem and to be informed of Alyeska's course of corrective action.

On May 4 and 5, 1976, Alyeska conducted a meeting in its office in Anchorage to present and discuss the results of the complete audit. The meeting was attended by representatives from OPSO, APO, the State of Alaska, and various consultants from the Department of the Interior. Alyeska presented the summary and analysis of the audit. This summary showed that there was a total of 3,955 welds with irregularities that included missed radiographs, falsified radiographs, and welds with defects not acceptable under 49 CFR 195.228.

On May 27, 1976, Deputy Secretary John W. Barnum and Mr. James T. Curtis, Jr., Director of MTB, attended a briefing concerning the radiograph problem arranged by Under Secretary of the Interior Frizzell and conducted by Alyeska and the companies who own the pipeline.

On June 21, 1976, John Barnum testified before the House Interstate and Foreign Commerce Subcommittee on Energy and Power regarding the construction problems on the TAPS. At that time, in addition to describing DOT's past actions, he indicated that we would furnish a full report to that

Subcommittee on future DOT action plans for resolving the welding problems and monitoring the continuation of the construction of TAPS. As promised, that report has been delivered. At my request Mr. Barnum has also responded to a letter from Senators Jackson and Metcalf on the same subject.

In the interim DOI retained Arthur Andersen and Company, an independent certified public accounting firm, to validate Alyeska's audit of their 1975 welding program. A report of their preliminary results was made available to us on July 1, 1976. We understand that a final report will be available shortly.

The issues regarding the welding and monitoring problems can be categorized as follows:

- Issue No. 1: The first issue concerns welds performed during the 1975 construction season which, upon reexamination by the auditors for Alyeska Pipeline Service Company (Alyeska), are acknowledged not to meet the specifications in the DOT regulations. The DOT regulations require welds to meet the standards specified in Section 6 of American Petroleum Institute Standard 1104 (API 1104). The majority of the welds identified by Alyeska as not complying are welds which do not meet the API 1104 standards because of size or type of defect.
- Issue No. 2: The second issue concerns missing, incomplete, or otherwise defective radiographs of welds performed during the 1975 construction season. The DOT regulations in 49 CFR 195.234(a) permit welds to be nondestructively tested in any manner that will clearly indicate any defects that may affect the integrity of the weld. The DOI Agreement and Grant of Right-of-Way in Stipulation 3.2.2.3, however, requires that all main line girth welds be radiographed.
- Issue No. 3: The third issue concerns assuring that the construction of the remainder of the pipeline complies with DOT requirements.

With respect to the first two issues, DOT is requiring Alyeska to submit to DOT a plan and schedule for correcting the weld deficiencies identified in its audit of the 1975 girth weld radiographs. DOT 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. In addition, DOT is taking the following actions to resolve these issues:

Welds not in compliance with DOT regulations:

The position of DOT is that all welds must meet DOT standards for pipeline integrity. Welds which do not comply with DOT regulations must be repaired. If an alternative standard of weld acceptability which will not adversely affect the integrity of the pipeline is established through DOT's formal waiver process, all problem welds will be individually evaluated using this newly established standard.

Although DOT has not received a formal application for a waiver of the API 1104 standards for those welds, Alyeska in a letter to DOI has stated that there is under development a program to establish an alternative standard to API 1104 which may prove to be satisfactory for testing the acceptability of welds that are "located in sensitive and/or very difficult access related areas in which any remedial work will likely degrade the end product quality and/or create substantial environmental concerns." Since the evaluation of any alternative standard will require the analysis of complex technical issues, DOT has retained the National Bureau of Standards (NBS) which, together with personnel within DOT, will monitor the development of and evaluate this possible alternative standard of acceptability to API 1104.

Defective or missing radiographs:

Alyeska has proposed to employ a new technique to inspect welds in critical areas which have missing, duplicated, or otherwise defective radiographs. This new technique is called acoustic imaging. It uses



ultrasonic energy to produce an optical image or picture of the weld being inspected. 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. The acoustic inspection device would be used to inspect the welds from inside the pipe.

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 DOT attended the demonstration. Significant technical questions regarding the system remained unresolved at the conclusion of the Richland tests. Alyeska plans to conduct further tests, under field conditions, in Fairbanks, Alaska, commencing the week of July 12. NBS will also assist DOT in the resolution of this issue. DOT representatives and NBS ultrasonics and acoustical imaging experts will attend the Fairbanks tests and subsequently we will determine whether the technique can identify weld defects in a manner equivalent or superior to radiography.

#### Future construction:

Due to the developments which indicate falsification of the records that determine 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. As a result, we have concluded that the Department should be represented on the TAPS project in Alaska on a continuous basis and we have this week initiated continuous onsite surveillance by OPSO personnel to assure compliance with our regulations and to maintain liaison with the APO concerning their surveillance functions.

To supplement the increased OPSO efforts, we will assign five additional Departmental personnel to Alaska to assist in the monitoring of the welding

operations, including the radiographing of welds and weld repairs. This activity is not intended to duplicate the function being performed by APO, but will be essentially an oversight function to assure compliance with DOT regulations.

The DOT task force in Alaska will be supervised by Rear Admiral Joseph R. Steele (USCG Ret.), who is being briefed in Washington today and tomorrow and who will proceed to Alaska on Friday. Admiral Steele has a solid technical and management background, has a long and distinguished career in the Coast Guard and has spent three years in Alaska.

On Sunday (July 11), in accordance with your instructions, John Barnum will go to Alaska with a team of DOT pipeline, metallurgy and environmental experts. He will also be accompanied by a representative of the Federal Energy Administration. In Alaska he plans to meet with Governor Hammond and other officials of the State of Alaska, with representatives of DOI and Alyeska, and with our own task force and consultants, among others. The fact-finding team will attempt to assess the implications of the welding problem in terms of delays, any additional costs in construction of the pipeline, and any environmental impact. Alyeska testified in the House hearings that the approximate cost of correcting the problem welds would be \$35 to \$55 million, depending on the development of acoustic imaging equipment and the requirements of DOI and DOT for correcting the problem welds. Alyeska also testified that it did not think that there would be any delay in completing the project as a result of these problems. We are not presently in a position to comment on those statements, but will address those questions in the report we submit to you following John Barnum's visit to Alaska.

*Bill*

William T. Coleman, Jr.

