Comprehensive Monitoring Program Report

A Look at Alyeska Pipeline Service Company's Operation of the Trans-Alaska Pipeline System 1999/2000

February 2001

Prepared by: **Doug Lalla, Operations Program Lead**
Bob Krenzelok
Jon Strawn
Lee Sires
Joe Hughes
Joe Dygas
Mike Wrabetz

Joint Pipeline Office
Comprehensive Monitoring Program - Operations

1.0 Introduction and Purpose

The Comprehensive Monitoring Program (CMP) was reorganized in 1999 to focus on four key oversight areas: Construction, Maintenance, Operations, and Culture. This report presents the Joint Pipeline Office's (JPO) principle oversight results in the area of operations. This report does not comprehensively include all areas of operations on the Trans-Alaska Pipeline System (TAPS). The majority of work presented in this report consists of follow up monitoring on issues originally presented in the February 1999 Operations CMP. The scope of this CMP is expanded from the 1999 Operations CMP with the inclusion of results from two assessments of Alyeska's Risk Management Program. Close scrutiny is also given to significant operational incidents which occurred on TAPS since the 1999 Operations CMP.

2.0 Methodology/Scope

The scope of this report includes JPO oversight of TAPS operations from January 1999 through December 2000. This report focuses on the procedures, equipment, software and training that assure the TAPS pipeline runs safely and can deal with contingency situations. The analysis answers the following three questions:

- Is the pipeline system operating safely and in accordance with the Grant/Lease and regulatory requirements during normal operation?
- Are adequate procedures and hardware safety barriers in place in the case of abnormal operation?
- Are adequate contingency plans in place to deal with emergency situations?

2.1 Normal Operations

In order to assure that the pipeline is operating within safe operating limits, pipeline controllers must accurately know existing pipeline pressures. Procedures must be in place and followed to shutdown and startup the pipeline under a variety of conditions. Leak detection systems must be monitored to assure that pipeline integrity has been maintained and the Supervisory Control and Data Acquisition System (SCADA) must function adequately. In addition, contingency plans must be place in case of emergencies. In this regard the following areas are assessed:

- Pressure Set Points and Calibration
- Pipeline Hydraulic Model

- Operating Pressure at the Pinch Points
- Planned Shutdown and Restarting of the Pipeline
- TAPS Leak Detection
- Year 2000 (Y2K) Readiness and Performance
- Cold Restart Plan
- Atigun Pass Heat Pipe Operation
- Mainline Refrigeration Site No. 2 Operation
- System Control and Data Acquisition (SCADA)
- Oil Spill Contingency Plans

2.2 Risk Management

In order to assure TAPS can be operated safely under Normal Operating conditions, risk management is essential. Alyeska's Risk Management Program provides policies and procedures for identifying risks to ensure the safe and efficient operations of TAPS, estimating the severity and likelihood of the identified risks, developing risk mitigation recommendations and providing timely guidelines for risk mitigation implementation. Although the program is primarily a non-regulated discretionary activity, the timely and adequate closure of the recommendations made by the risk management program are essential to the safe operations of TAPS. The following areas were assessed:

- Adequacy of the Follow Up System
- Closure Time Requirements
- Adequacy of Closure Documentation

2.3 Abnormal Operations

Assessment of major pipeline operational difficulties to determine their root cause and consequence are essential to minimize reoccurrence. This report examines the following incidents:

- The Pipeline Overpressure of August 5, 1998 (Follow up from 1999 Operations CMP)
- Backpressure System Damage/Pig#4 Incident
- Milepost 170 Pipeline Movement
- Check Valve 74 Incident

2.4 Audit Item Resolution

The previous Operations CMP reported that 5 audit items remained opened from the 1993 TAPS Audits out of 4920 identified audit action items. Currently 2 audit items remain open. This report will examine the status of previously reported 5 items:

- AAI Item 2113- Qualification and Development Program

- AAI Item 5052 – Pump Station Tank Farm Containment
- AAI Item 2076 – RGV Control System Replacement
- AAI Item 1955 – Host Audit Item
- AAI Item 50528 – Access Road and Workpad Bridges

3.0 Grant/Lease and Regulatory Requirements

3.1 Agreement and Grant of Right-of-Way for Trans-Alaska Pipeline

The following requirements of the Agreement and Grant of Right-of-Way for Trans-Alaska Pipeline are the primary operations requirements under review:

> Principle 3: Permittees shall manage, supervise and implement the construction, operation, maintenance, and termination of the Pipeline System in accordance with sound engineering practice, to the extent allowed by the state of the art and the development of technology. In the exercise of these functions, Permittees consent and shall submit to such review, inspection and compliance procedures relating to construction, operation, maintenance, and termination of the Pipeline System as are provided for in this Agreement and other applicable authorizations. The parties intend that this Agreement shall not in any way derogate from, or be construed as being inconsistent with, the provisions of Section 203 (d) of the Trans-Alaska Pipeline Authorization Act, 87 Stat. 585 (1973), relating the National Environmental Policy Act, 83 Stat. 852, 42 U.S.C. 4321 *et seq.*
>
> Stipulation 1.21.1: Conduct of Operations: Permittees shall perform all Pipeline System operations in a safe and workmanlike manner so as to ensure the safety and integrity of the Pipeline System, and shall at all times employ and maintain personnel and equipment sufficient for that purpose. Permittees shall immediately notify the Authorized Officer of any conditions, problem, malfunction, or other occurrence which in any way threatens the integrity of the Pipeline System.
>
> Stipulation 3.2.1.1: Pipeline System Standards: All design, material and construction, operation, maintenance and termination practices employed in the Pipeline System shall be in accordance with safe and proven engineering practice and shall meet or exceed the following standards…

3.2 Right-of-Way Lease for Trans-Alaska Pipeline

The following requirements of the Right-of-Way Lease for Trans-Alaska Pipeline are the primary operations requirements under review:

> Principle 3: Leesees shall manage, supervise and implement the construction, operation, maintenance and termination of the Pipeline in accordance with the best practicable engineering technology available, particularly with regard to permafrost and seismic areas, to the extent allowed by the state of the art and the development of technology. In

the exercise of these functions, Lessees consent and shall submit to such review, inspection and compliance procedures relating to construction, operation, maintenance, and termination of the Pipeline as are provided for in this Lease and other applicable authorizations.

Stipulation 1.21.1 Conduct of Operations: Lessees shall perform all Pipeline operations in a safe and workmanlike manner so as to ensure the safety and integrity of the Pipeline, and shall at all times employ and maintain personnel and equipment sufficient for that purpose. Lessees shall immediately notify the Pipeline Coordinator of any condition, problem, malfunction, or other occurrence which in any way threatens the integrity of the Pipeline.

Stipulation 3.2.1.1 Pipeline System Standards: All design, material and construction, operation, maintenance, and termination practices employed in the Pipeline shall be in accordance with safe and proven engineering practice and shall meet or exceed the following standards:

4.0 Results

4.1 Normal Operations

4.1.1 Instrumentation and Calibration

• **1999 Status:** The previous Operations CMP found that Alyeska did not follow their quality control practices for calibrating and maintaining pressure control devices and documenting the results. However, they had implemented corrective action plans to fix this problem, including a plan to increase surveillance of tracking and controlling pressure relief system devices to prevent the problems from recurring.

• **2000 Status:** JPO conducted surveillances in April 1999 at specific pump stations that verified Alyeska is following their quality control practices for calibrating and maintaining pressure control devices and documenting the results.[1] JPO will continue to monitor pipeline pressure control devices on a regular basis to ensure Alyeska is in compliance with all applicable policies, procedures, laws and regulations.

Regulatory Compliance

In accordance with 49 CFR, Part 195.428, United States Department of Transportation Office of Pipeline Safety (OPS) conducted a system wide pressure control systems analysis in July 2000 to verify settings of pressure switches according to OCC-3.01 procedures and to open as many relief valves on TAPS as possible to verify their ability to function. From the Operations Control Center in Valdez, Alyeska reduced the pressure controller set points at pump stations PS01,

[1] JPO-99-S-009 and JPO-99-S-089 surveillance reports dated 04/21/99 and 08/9/99 respectively.

PS05, PS07 and PS12 until the relief valves opened. All systems operated normally. In October 2000, OPS also conducted surveillances of pressure control system maintenance at PS01, PS03 and PS07 to determine maintenance intervals, procedure adequacy, technician training, and calibration accuracy. Alyeska was found to be in-compliance.[2]

In October 2000, USDOT/OPS verified that all TAPS pump stations were operating within the established hydraulic parameters, that all suction and discharge relief controllers and high pressure switches were set in accordance with OCC-3.01 and that all pressure control devices were properly calibrated and labeled.[3]

Details:

TAPS has safety mechanisms in place to maintain oil pressure within safe operating limits and prevent overpressure along the pipeline. Alyeska's Quality Assurance Program is to ensure proper procedures are in place to maintain the integrity of the pipeline. Pipeline pressure is controlled and maintained according to Alyeska' s quality control procedures. Each operating pump station along TAPS has pressure control devices to prevent oil pressure from exceeding safe operating limits.

Pipeline controllers follow written procedures for maintaining pressure control. The procedures cover both normal and abnormal operation. Controllers must use specific settings when adjusting devices to control oil pressure. These settings are referred to as pressure control set points. Set points are critical because they control relief valves that help to prevent exceeding maximum oil pressures allowed by U.S. Department of Transportation regulations. For example, if oil pressures exceed the set point value, relief valves automatically open to reduce the pressure. Alyeska's hydraulic engineers have calculated set point values for each pump station based on flow rate and pipeline configuration. The set point values are identified in Alyeska's operating manuals. The Operations Control Center (OCC) in Valdez has the responsibility for ensuring the settings and maintenance of the field pressure control set points along TAPS. OCC controllers input the set point values in the automated pressure control system for the entire pipeline.

JPO conducted surveillance activities referenced in the 1999 Operation CMP Report to: 1) verify that the OCC controllers were operating the pipeline in accordance with the pressure control set points developed by Alyeska's hydraulic engineers, and 2) verify that the equipment used to support the operation of the pressure relief system was calibrated in accordance with Alyeska's quality program. Controllers were using the set points specified by hydraulic engineers, but Alyeska had problems following their quality control practices for calibrating and maintaining the pump station pressure control devices. Set points were not consistently documented and labeled on some of the devices used to control pipeline pressure. JPO could not verify calibration and frequency of calibration due to: 1) missing labels on the pressure control devices, and 2) missing calibration documentation. Alyeska requires calibration labels to be attached to

[2] REF:DOT-IOCS 89849
[3] REF:DOT-IOCS 87023

all pressure control equipment, since they contain essential set point value information. Without them, pipeline controllers cannot be assured the settings are maintained within the safe operating parameter. Alyeska concurred with the finding and took action to re-calibrate pressure control devices and revise their tracking and documentation procedures.

In a follow-up to the February 1999 CMP report, JPO committed to continue monitoring critical process instrumentation pressure control set points as referenced in *DO-14, Trans-Alaska Pipeline Controller Manual.* JPO conducted surveillances in April 1999 at specific pump stations that verified Alyeska is following their quality control practices for calibrating and maintaining pressure control devices and documenting the results.[4] JPO will continue to monitor pipeline pressure control devices on a regular basis to ensure Alyeska is in compliance with all applicable policies, procedures, laws and regulations.

4.1.2 Pipeline Hydraulic Model

•**1999 Status:** In the 1999 Operations CMP it was found that the procedures for the use and maintenance of the pipeline hydraulic model need clarification in Alyeska's manuals. While major problems were not found, much confusion could be eliminated if procedures for the hydraulic model were clearly stated in the appropriate manuals.

•**2000 Status:** JPO verified that the Alyeska commitments were met by conducting a surveillance in January 2000.[5]

Details: The hydraulics and internal pressures of the pipeline are continuously displayed and monitored on the OCC pipeline controller's computer screen. The "pipeline hydraulics model" is a tool controllers use to determine pipeline pressures during near steady state operations. A 1998 JPO surveillance contained two findings: 1) The Oil Movements Gradient Drawing had not been recently updated, and 2) milepost calculations in Alyeska's Engineering Data Management System (EDM) were inaccurate.[6] It was reported in the previous Operations CMP that Alyeska had agreed to clarify their manual procedures and update the EDM to remove inconsistencies.[7] JPO verified that the Alyeska commitments were met by conducting a surveillance in January 2000.[8]

[4] JPO-99-S-009 and JPO-99-S-089 surveillance reports dated 04/21/99 and 08/9/99 respectively.
[5] JPO-00-S-007 surveillance report dated 1/13/00
[6] JPO-98-S-059 surveillance report dated 04/28/98
[7] Alyeska Letter No. 98-13134 dated 06/12/00
[8] JPO-00-S-007 surveillance report dated 1/13/00

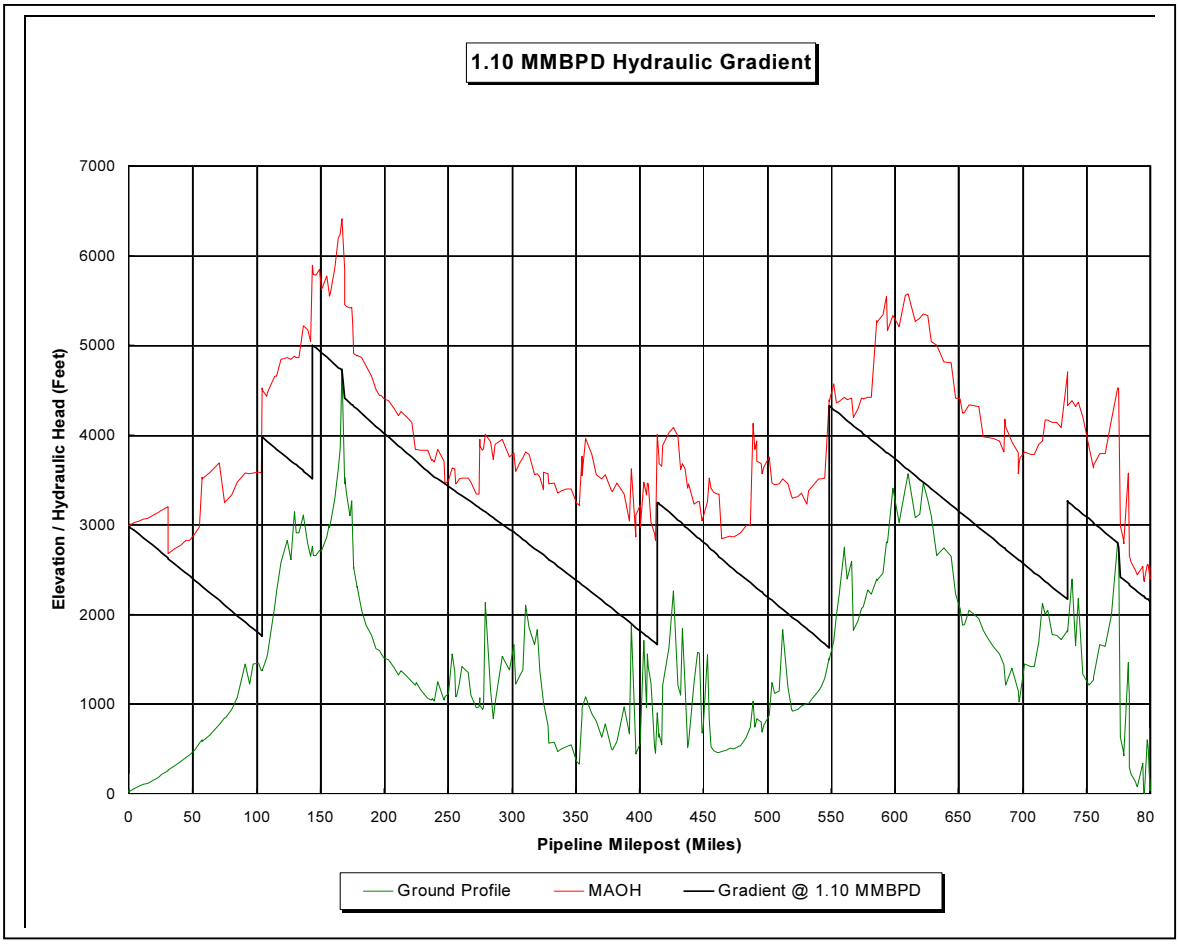

Figure 1 Hydraulic Gradient - Pipeline Head Pressure Must be Maintained Below the Maximum Allowable Operating Head (MAOH) Line

4.1.3 Verification of Safe Operation Pressures During Normal Operations

1999 Status: New Initiative in 2000.

2000 Status: A review was conducted to measure Alyeska's compliance with the Maximum Allowable Operating Pressure (MAOP) limitation set forth in 49 CFR Part 195 and to determine if known corrosion damaged pipe identified by corrosion pig surveys were being prudently managed from a pipeline integrity standpoint. Over the scope of this study Alyeska is found to be managing the operating pressure of the pipeline in a safe manner so as to ensure the safety and integrity of the Pipeline System.

Details: The TAPS mainline internal operating pressure data was sampled on randomly selected days at nine locations along the pipeline. The nine locations were selected based on the

hydraulic significance (pinch points), corrosion derates and pig calls. The investigation found that at one location, milepost 247, the MAOP was exceeded by a slight margin (less than .5%) on several occasions during three of the four days sampled.

A maximum pressure of 905 psi at 2000 hours on 1/1/99 was recorded with a median pressure of 878 psi for the sample data at MP 247, as compared to a MAOP of 901 psi. A review of the data suggests the OCC Controller took prompt actions to bring pipeline pressure back to or below MAOP. [9]

4.1.4 Planned Shutdown and Re-starting of the Pipeline

•**1999 Status:** Alyeska's performance in re-starting the pipeline system improved during the last shutdown covered in the 1999 reporting period. However Alyeska needed to better plan restarts to 1) ensure attention to detail on procedure revision, 2) complete functional testing of new and repaired hardware, 3) document changes in operating status, and 4) develop contingencies for activities conducted during shutdowns to avoid reoccurrence of events from previous re-starts.

•**2000 Status:** Four planned pipeline shutdowns and restarts were observed during this reporting period. Other than 1 variance from the written procedure during the September 1999 shutdown, which did not affect pipeline integrity, all planned pipeline shutdown and restarts were conducted in accordance with procedure. Alyeska is found to be conducting planned pipeline shutdowns and restarts in a safe manner.

Details:

The JPO records of pipeline maintenance shutdowns from August 1, 1997, August 8, 1997, June 20 1998, and September 25 and 26, 1998 were reviewed and compared to the shutdown of September 11 and 12, 1999. Alyeska appeared to have initiated a high level of preplanning and oversight for the September 11 and 12, 1999 shutdown. The implementation of the Incident Command Center at the Fairbanks War Room provided a central point of coordination for the activities associated with the shutdown. JPO surveillance noted that Alyeska personnel at Operations Control Center (OCC) at Valdez allowed a variance from the OCC-2.05 procedure during the pipeline re-start.[10] This is similar to the situation reported by JPO during a start up in 1997, when Temporary Operating Procedure 1.05 was modified during the activity.[11] In 1997, the modification deleted requirements intended to prevent over pressuring the pipeline. In 1999, the variance from the established procedure did not affect pipeline integrity. This still reflected the continued practice of changing procedures without following the quality program.[12]

A second planned pipeline shutdown and restart was observed by JPO on November 13, 1999. The pipeline was restarted in accordance with procedure. After the September 1999 startup, JPO

[9] JPO-00-E-003 engineering report dated 01/20/00
[10] JPO-99-E-025 engineering report dated 09/12/99
[11] JPO-97-A-005 assessment dated 08/27/97 and JPO-97-E-026 F/02 dated 08/18/97
[12] JPO-00-A-002 assessment dated 02/01/2000

had recommended Alyeska look at their pipeline startup procedures to provide sufficient flexibility for pipeline controllers along with appropriate cautions. The result of Alyeska's review was reflected in the Nov 13, 1999 startup procedure. The procedure used provided the essential guidance and necessary flexibility for potential variation in pipeline initial startup conditions.[13]

A third planned pipeline shutdown and restart was observed by JPO on September 16-17, 2000. The pipeline was shutdown and restarted in accordance with procedure.[14] Prior to the shutdown, JPO noted that the relief set points were not included in the Trans-Alaska Pipeline Controller Operating Manual (DO-14), Department Operating Procedure (DOP), OCC-3.01, Table 3.10 for PS 12, for the condition with the relief system on and PS 12 bypassed (PS 2, PS6, PS8 and PS10 Bypassed). Alyeska indicated that there was another procedure to cover this situation, SUP 0.14, Rev 0. They, however, agreed to modify Table 3.10.

A fourth planned pipeline shutdown and restart was observed by JPO on Oct 8, 2000. The pipeline was shutdown and restarted in accordance with procedure.[15] JPO verified prior to the shutdown that Table 3.10 was modified with a Note (7), which specifies the criteria for determining the required relief controller setting.

4.1.5 TAPS Leak Detection System

•**1999 Status:** The new transient volume balance system (TVB) improved TAPS leak detection capability, but still needed a performance reporting capability or, in other words, a measure of how well the leak detection system was working. This recommendation was made in the 1999 Operations CMP and the *Trans-Alaska Pipeline System Pipeline Oil Discharge Prevention and Contingency Plan Finding Document and Response to Comments* under Issue #14, *Leak Detection for Crude Oil Pipelines.* Small slow leaks were undetectable by the leak detection systems.

•**2000 Status:** Alyeska implemented an automated system for measuring the performance of the TVB. The system complies with the recommendations made in the 1999 Operations CMP and the *Trans-Alaska Pipeline System Pipeline Oil Discharge Prevention and Contingency Plan*. In addition, the computer software and hardware were modified to meet the requirements of Y2K. Small slow leaks are still undetectable by the current leak detection systems.

Details: In response to the recommendations made in the 1999 Operations CMP and the *Trans-Alaska Pipeline System Pipeline Oil Discharge Prevention and Contingency Plan*, Alyeska has been providing monthly Transient Volume Balance Leak Detection System (TVB) performance data since January 1999 which include: analysis of false alarms per month categorized into causal groups; a performance summary characterizing the quality of the data input; a monthly

[13] JPO-99-S-129 surveillance report dated 12/08/99
[14] JPO-00-S-055 surveillance report dated 09/18/00
[15] JPO-00-S-057 surveillance report dated 10/08/00

summary of the median threshold range for each segment for the 30 minute, 2 hour and 8 hour averaging periods. Except for the leak alarm categorization, the reporting has been an automated function since January 2000. Due to Y2K concerns, the TVB system was converted to a new computer platform and went into operation just prior to January 2000. The new system operated successfully through Y2K.[16]

The Leading Edge Flow Meters (LEFM) performance was monitored during the September 2000 shutdown.[17] The LEFMs monitor the flow rate of oil through the pipeline segments. It was noted that LEFMs produced erratic readings during the low flow conditions of shutdown and startup. There was a need to reboot many of the LEFMs during startup. The bad data during shutdowns increases detection thresholds. The increase of detection thresholds gradually improves as the bad data works it way out of the long-term flow balance averages. Alyeska indicated that a study to determine how to improve the LEFM performance had been initiated.

4.1.6 Year 2000 (Y2K) Compliance

1999 Status: JPO found Alyeska's Year 2000 (Y2K) effort to be well planned and organized. Alyeska's late start may have increased the cost of the Y2K program but there was no concern about its effectiveness.

2000 Status: JPO observed no significant problems with Alyeska transition through the Y2K dates. It should be noted that not all equipment that could cause Y2K problems in the future was removed. Some equipment was only deemed ready for its current use and the fix did not include equipment capabilities not currently in use. In order to track the "ready" system, Alyeska created a comprehensive inventory database of all SCADA/Process Control systems and devices which contained embedded chips. In addition, warehouse spares are identified in the Alyeska PassPort database as Y2K compliant or ready. The JPO considers the use of this and other Y2K tools critical to an adequate management of change program. JPO notes that there is no mention of these important databases in Alyeska's current PM-2001 manual. JPO will monitor the use of these tools as part of our future oversight.

Details: The Y2K problem arises because for many years computer programmers ignored the two digits which denote the century. This problem could affect hardware, embedded firmware, computer languages and their compilers, operating system, security services, database management, real time processing, control systems and literally any phase of operations which has been touched by the computer age. Alyeska approached the Y2K problem with a structured approach which included assigning criticality ratings to system and devices, conducting detailed inventories of Y2K system and devices, performing assessments to determine Y2K compliance, remediation and testing. In addition, Alyeska prepared contingency plans in event of Y2K failures. JPO participated in drills and monitored Alyeska program preparedness.

[16] JPO-00-S-002 surveillance report dated 01/06/00
[17] JPO-00-S-055 surveillance report dated 09/18/00

Prior to the Y2K cross over date, JPO conducted surveillance that randomly sampled Alyeska critical system documented preparedness. All systems sampled were found to be documented as prepared for Y2K.[18] JPO personnel monitored the status of the TAPS Y2K cross over from Wednesday, December 29, 1999 through January 2, 2000. Situation Reports were distributed to the JPO Executive Council, selected staff, agency officials, and the California Energy Commission throughout the weekend. A formal surveillance was conducted at OCC in Valdez to verify that the TAPS critical systems were still operational through the Y2K transition.[19] The TAPS pipeline system operated normally through the Y2K transition.

Alyeska successfully dealt with the Y2K problem. Their remediation effort, however, did not render all equipment Y2K compliant; some equipment was just deemed Y2K ready. A "compliant system"[20] will accurately process date/time data for rollover into the twenty-first century and for leap-year calculations. "Ready systems" are suitable for continued use as installed, but could create problems later if modifications are made or if systems are tied together. In order to track the "ready" system, Alyeska created a comprehensive inventory database of all SCADA/Process Control systems and devices which contained embedded chips, and a comprehensive list of manufacturers and suppliers for current and obsolete devices. This information is critical for future maintenance and modifications. Warehouse spares are identified in PassPort as Y2K compliant or ready.

4.1.7 Cold Restart

1999 Status: The ramp down of PS 6,8,10 combined with modifications made at PS 5 made the original TAPS Design Basis cold restart plan unusable. This situation was not addressed by Alyeska during the ramp down planning process. Ongoing communications between Alyeska and the JPO regarding the cold restart were unsuccessful in producing a new cold restart procedure.

2000 Status: On November 5, 1999, JPO ordered Alyeska to provide a reliable schedule for the final development and implementation of a cold restart procedure. On October 31, 2000, Alyeska delivered a draft interim cool restart plan.[21] The cool restart plan is designed to assure that the pipeline will not be overpressured if the pipeline is restarted with crude oil temperatures below 40° F. It does not provide assurance that the pipeline could be restarted in extended winter shutdown conditions. The data necessary to determine if the pipeline could be restarted under the design basis requirements of a 21-day shutdown with an ambient air temperature of -40° F is still being analyzed by Alyeska. To assure restart, under extended winter shutdown conditions, Alyeska indicates that it will install additional equipment in 2001. After the equipment is installed, Alyeska will provide a final cold restart procedure. Until Alyeska has a final cold restart procedure and has adequate equipment in place to implement this plan, Alyeska

[18] JPO-99-S-145 surveillance report dated 12/17/99
[19] JPO-00-S-002 surveillance report dated 01/06/00
[20] Alyeska Y2K SCADA Control Compliance Specification, 06/29/98, Computational resources that "satisfy the General integrity, Date integrity, Explicit century and Implicit century criteria" is considered "Year 2000 Compliant."
[21] Alyeska Letter NO. 00-16439, dated 10/31/00

is not in compliance with the TAPS Design Basis (DB-180), and its ability to restart the pipeline under these extreme conditions remains uncertain.

Details:

On December 17, 1996, JPO requested Alyeska update the TAPS Design Basis regarding the ability to restart the pipeline under an extended winter shutdown. The ramp down of PS 6,8,10 combined with modifications made at PS 5 made the original TAPS Design Basis cold restart plan unusable. This situation was not addressed by Alyeska during the ramp down planning process and was not discovered by the JPO until after the ramp down process was complete. Ongoing communications between Alyeska and the JPO regarding the cold restart was initially unsuccessful in producing a new cold restart procedure.[22]

JPO ordered Alyeska to provide a reliable schedule for the final development and implementation of a cold restart procedure on November 5, 1999.[23] On December 22, 1999, JPO required that interim deliverables be formally provided to the JPO, so progress could be tracked for the completion of the cold restart procedure.[24] JPO met with Alyeska in June 2000 to discuss the progress made on cold restart. The fundamental problem identified in the studies is that the oil had higher than expected strength (yield point) at low temperatures. This high yield point would greatly increase the required pressure during startup of the pipeline after an extended shutdown under winter conditions. Earlier Alyeska crude tests had not indicated problematic yield strengths. Later tests in which Alyeska cooled the oil more slowly, more akin to what would happen in a real world cold shutdown, indicated a significant rise in yield strengths.

Alyeska indicated that because of results from tests on the current crude oil mix, the revised cold restart procedure development would be delayed by one year. Alyeska proposed to provide an interim cold restart plan by November 2000.[25] Alyeska delivered an interim cold restart plan on October 31, 2000. The cool restart plan is designed to assure that the pipeline will not be overpressured if an attempt is made to restart the pipeline with crude oil temperatures below 40° F. The data necessary to determine if the pipeline could be restarted under the design basis requirements of a 21-day shutdown with an ambient air temperature of -40° F is still being analyzed by Alyeska.

To assure restart under extended winter shutdown conditions, Alyeska indicates that it will install additional equipment in 2001. After the equipment is installed, Alyeska will provide a final cold restart procedure.

[22] JPO Engineering Report JPO-00-E-025, dated 08/04/00
[23] JPO Letter Number 99-083-JH dated 11/05/99
[24] JPO Letter Number 00-097-JH dated 12/22/99
[25] Alyeska Government Letter No. 00-16047, dated 07/24/2000

4.1.8 Atigun Pass Heat Pipes

Figure 2: Forest of Heat Pipes to Keep Ground Frozen Near Atigun Pass

1999 Status: In parts of Atigun Pass the pipeline is buried in bedrock laced with ice. In order to keep the ground frozen, freestanding heat pipes were installed in conjunction with the insulated boxes. It was reported in the 1999 Operation CMP that the heat pipes were no longer functioning at pipeline milepost 167.2. In addition, installation of a thermistor string was needed to determine the effectiveness of the exiting heat pipes.

2000 Status: JPO conducted surveillance which found that thermistor strings were installed and heat pipes damaged by avalanches were replaced in September 1999.[26] [27]

[26] JPO-99-S-111, surveillance report dated 10/20/99
[27] JPO Letter, JPO-99-082-JH dated 11/09/99

4.1.9 Mainline Refrigeration Site No. 2

Figure 3: MLR-2, Pipeline Buried with Thermistor String (white) and Monitoring Rods (blue), Refrigeration Plant Building in Foreground

1999 Status: The Main Line Refrigeration Site No 2 (MLR-2) is a 2-mile long buried section of pipeline near the Gulkana River north of Glennallen, Alaska. This area of the pipeline system requires mechanical refrigeration to ensure the soils remain frozen to prevent pipeline settlement. Because of lack of adequate refrigeration, some of the soils below the pipe at MLR-2 thawed, resulting in settlement and curvature of the pipeline. Analysis by Alyeska and review by JPO indicated that the pipe curvature at the Mainline Refrigeration Site No. 2 (MLR-2) is not a pipeline integrity concern provided: 1) the curvature remains constant or decreases, 2) oil temperature does not significantly increase, and 3) pipe wall wrinkling does not occur. JPO requested that Alyeska monitor the pipe monthly until the new permanent refrigeration plants were on line, verify that no wrinkles formed in the pipe, and submit a design basis waiver to address the conditions at MLR-2.

2000 Status: New permanent refrigeration plants are now in operation. Alyeska analysis of the VETCO deformation pig data and JPO's review of the data indicated that no pipe wall deformation has occurred in the areas of highest curvature.[28] JPO's analysis of the monitoring rod data indicates that in areas of highest curvature the pipe is rebounding at a rate of about 0.8 inches/year.[29] Alyeska submitted a design basis waiver for MLR-2, which is currently under review by the JPO. JPO will continue to review the monitoring rod data and will review the curvature pig data from the August 2000 run.

[28] Alyeska Letter No. 99-14091 dated 02/18/99
[29] Alyeska Monitoring Rod Data 1997, 1998, 1999, 2000

Regulatory Compliance

On February 10, 2000, the USDOT/OPS issued a Notice of Probable Violation (NOPV) relating to a 49 CFR 195.401(b) non-compliance. OPS alleges that Alyeska was aware as early as 1992 that the underground insulation at the MLR-2 site was surrounded by water and that no cathodic protection was provided. Therefore, Alyeska operated a section of TAPS at a level of safety lower than that required by regulation and did not correct it within a reasonable amount of time. Alyeska disputes the finding and has requested a hearing.[30]

4.1.10 Milepost 710.77 Corrosion Dig

Figure 4: Milepost 710 Gouge

2000 Status: On May 19, 2000 during a scheduled underground corrosion investigation at MP 710 on TAPS, Alyeska discovered mechanical damage to the pipeline. The damage included gouges to the outside of the pipeline in 5 areas, which appear to have been caused by mechanical equipment during construction. The deepest gouge was 80% of the pipe wall thickness. Repairs have been completed, which included smoothing and grinding the sharp edges of the gouges, installing steel sleeves, recoating, and derating the maximum operating pressure from 901 to 838 psi. Presently, the pipeline is operating at 620 psi at a throughput of 1.1 million bbls/day. Further, because the corrosion pig underestimated the extent of the pipe damage, JPO/OPS is evaluating the magnetic and transverse flux pigs to determine their ability to better define the extent of pipe damage due to gouges and corrosion at girth welds.

Regulatory Compliance

USDOT/OPS asserts that Alyeska increased the pressure at MP 710.76 at a time when it had been discovered that the pipeline was in indeterminate condition caused from a severe

[30] REF:DOT-CPF 520000002

mechanical damage to the pipe wall. OPS is pursuing a Notice of Probable Violation (NOPV) relating to a 49 CFR 195.422 (pipeline repair) non-compliance.[31]

4.1.11 System Control and Data Acquisition (SCADA)

2000 Status: During the September 2000 system wide shutdown of TAPS, JPO/OPS personnel conducted an assessment of the SCADA system on TAPS. The SCADA systems assessed included SCADA coverage, platform, architecture, control rooms, applications, displays, operations and training. The current SCADA system was installed in 1985. Although the original computer hardware has been replaced, the SCADA monitoring and control software is of the original vintage and no vendor-provided support is available for the installed SCADA platform. There are very few companies who are still using this particular SCADA software. In addition, the current hardware platforms are approaching the end of their expected service lives and the processor loads during peak times reach into the 90% utilization range.

Alyeska's OCC and SCADA system are stable and mature. The base SCADA software does provide the typical features and abilities of 1985 technology, but it has not been upgraded since that time. There have been no recent internal reviews conducted on data points and alarm parameters. However, there have been additions to the basic SCADA functions. Sophisticated computer models have been developed and enhanced over the years and are in place to assist pipeline controllers with line balance and transient condition monitoring.

Management has recently established an elaborate development program to guide the training and performance measurement of the controller staff. Although technical support personnel over the years have developed a thorough knowledge of the SCADA system, technical support personnel do not receive formal training, have no performance measurement system, and rarely participate in formal technical training.

Although a number of low order concerns were identified during the OPS evaluation, no major exposures that would be directly detrimental to pipeline safety were found. Alyeska has modest exposures to business limitations and interruptions from aging computer hardware and SCADA software and a limited pool of technical resources to support these systems.[32]

4.1.12 Contingency Plans – Stipulation 2.14

These stipulations state that no discharge of oil or other pollutant should occur on land or water; and that Permittees must recognize their prime responsibility for the protection of the public and the environment from the effects of spillage. Multiple agencies are involved in the review and approval of Alyeska's oil spill contingency plans, and the Alaska Department of Environmental Conservation (ADEC), the Environmental Protection Agency (EPA) and the Bureau of Land Management (BLM) each have staff in the JPO who coordinate joint reviews of the plans. Presently, the oil spill contingency plans in place for the pipeline and the Valdez Marine

[31] REF: DOT-IOCS 87026
[32] REF DOT:IOCS 87026

Terminal are in compliance with Grant requirements and the requirements of ADEC, EPA, the US Department of Transportation and the US Coast Guard.

During the review and approval process for the Pipeline Oil Discharge Prevention and Contingency Plan (Alyeska Document CP-35-1), ADEC and BLM imposed 21 conditions on the plan approval. The conditions ranged from better spill prevention measures at storage tanks to completion of the testing of the mainline valves to improved response capability in the Copper River Drainage. Most of the conditions are now complete and require no further actions. Several conditions, although complete, are ongoing, as they require periodic submissions, such as monthly updates to the emergency telephone directory and quarterly reports on drills and exercises. Only a limited number of conditions are not yet met. One of these conditions requires the demonstration of adequate corrosion protection under Tank 190 or a leak detection system as required in state regulations. All other open conditions are fundamentally resolved but require further documentation before closure. In August 2000, Alyeska entered into a Settlement Agreement with the Alaska Department of Environmental Conservation in response to a Notice of Violation issued by the Department in June 2000. As a result of this enforcement action, monthly leak testing of pipeline turbine fuel tanks was begun, thus closing out a condition of approval.

All conditions identified in the 1997 approval of Alyeska's Valdez Marine Terminal Oil Discharge Prevention and Contingency Plan (Alyeska Document CP-35-2) have been met and closed. A revised edition of the plan was reviewed in late 1999 and approved in early 2000. ADEC and BLM imposed conditions on the approval of the new plan version. There are ten Conditions of Approval that range from holding monthly meetings with oversight agencies to a multi-year exercise schedule to improving on-land response by reviewing existing drainage/settling ponds and developing a tactics guide to aid responders. Because it is still fairly early in the three-year plan cycle, only a few conditions came due during fall 2000, most of the conditions are now actively being worked.

4.2 Risk Management

1998 Status: An initial JPO assessment[33] of Alyeska's Risk Management Program found that: 1) the Alyeska Passport Action Tracking System Database (PassPort) contained an incomplete record of Alyeska's risk assessments; 2) many risk mitigation recommendations, some of which dated back to 1995, had not been brought to closure; 3) existing procedures applied by Alyseka to ensure that risk recommendations are recorded, tracked and closed did not appear to be adequate or implemented.

2000 Status: Alyeska now has an adequate system in place to track risk assessment recommendations finds.[34] Alyeska has made significant progress in reducing the backlog of unresolved risk assessment recommendations. The greatest weakness found in the program is that projects are delayed without a documented process in place to assess the risk of delay. In addition, a thorough written justification is not provided for declining many recent risk assessment recommendations. The lack of this written justification makes it difficult to judge from the database record the significance of not taking or completing the recommended actions.

Details:

Alyeska formally defined its Risk Management Program in 1995 in Section 16 of its Safety Manual SA-38. The program primarily provides a set of procedures and policies for conducting and tracking risk assessments. The use of these tools is primarily discretionary. The Risk Management Program does not comprehensively capture and prioritize all Alyeska sources of issues and potential corrective actions which might cause TAPS to be out of compliance with the Federal Grant and State Lease of Right of Way. A recent special review of the corrective action Process by Alyeska identified over 60 sources of independent and informal sources of issues to be considered for corrective actions. Alyeska indicates that it is now developing a comprehensive corrective action program. Until Alyseka prioritizes its many recommended corrective actions by risk ranking, its Risk Management Program will not be a comprehensive program for managing risk. It will simply be a set of procedures and policies for conducting and tracking risk assessments.

JPO's latest assessment follows the JPO's February 1998 Assessment of Alyeska's Risk Management Program. It reviewed the recording, tracking, and closure of risk assessment recommendations through May 5, 2000 as evidenced by the Alyeska PASSPORT Action Tracking Request Report.

Alyeska has made significant progress in reducing the backlog of unresolved risk assessment recommendations. Significantly, Alyeska has closed out twenty-seven risk assessments with their associated recommendation in 1999. The February 1998 assessment (sampled 09/18/97) found that only 5% of the 1995 risk assessments, 17% of the 1996 risk assessments and 0% of the 1997 risk assessments had been closed out. As of May 5, 2000, 90% of the 1995 risk

[33] JPO-98-A-003 assessment dated 02/10/98
[34] JPO-00-A-005 assessment dated 06/30/00

assessments, 83% of the 1996 risk assessments and 67% of the 1997 risk assessments were closed out.

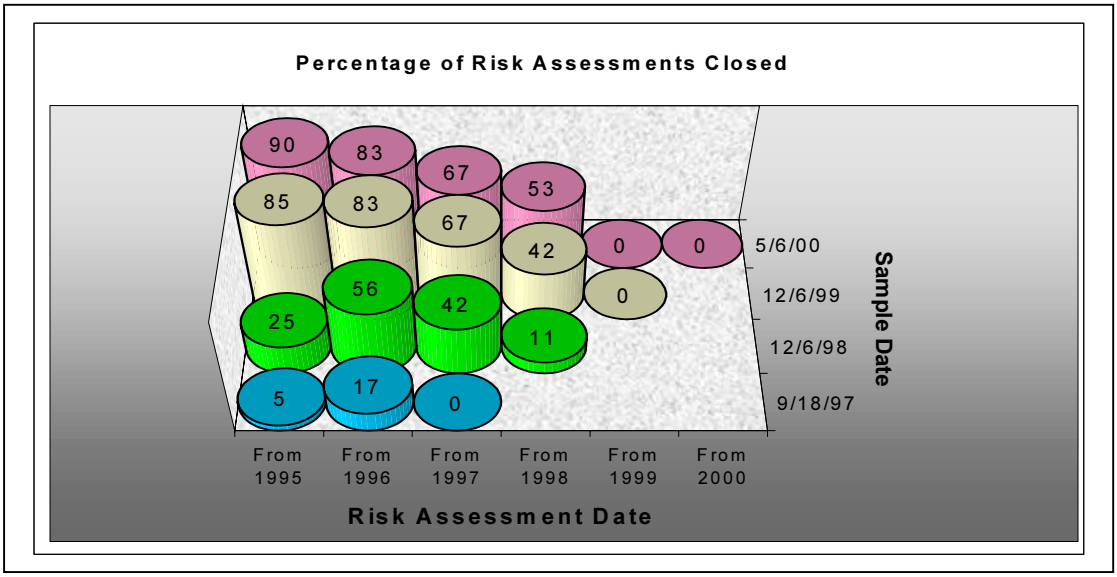

Figure 5: Recommendation Closure Trends

Alyeska Risk Program could be enhanced by addressing the following observations:

- As of May 5, 2000, there were 26 risk assessments, 2 dating back to 1995 with open risk recommendations. Of these 26 risk assessments, 16 had their due dates changed from the original proposed time lines.

- A thorough written justification is not provided for declining many recent risk recommendations. The lack of this written justification makes it difficult to judge from the database record the significance of not completing the recommended action. Alyeska has closed out the majority of the risk recommendations for recent scheduled risk assessments: Pipeline System HAZOP (85%), Pipeline Control System QRA (50%) and OCC Controller Human Factor Analysis (75%) with the single phrase "Not a system integrity issue." In general the scheduled risk assessments have a broader scope and bring in outside expertise to facilitate the risk assessment process. Alyeska's Risk Coordinator indicated that recommendations were carefully reviewed and the risk level 2 recommendations concerned financial loss and loss of production and not matters of safety, environment, or pipeline integrity.

4.3 Abnormal Operations

4.3.1 Pipeline Overpressure of August 5, 1998

1999 Status: The previous Operations CMP noted that an Alyeska engineering review concluded that pipeline damage was unlikely, however JPO was in the process of evaluating past overpressure pipeline pig data to verify Alyeska's conclusion. It was also noted that it was an oversight priority to ensure Alyeska implements preventive measures in order to minimize future occurrences.

Regulatory Compliance

On March 15, 1999, the USDOT/OPS issued a Notice of Probable Violation (NOPV) relating to 49 CFR 195. 406(b). OPS alleged that on August 5, 1998, the pressure in the pipeline exceeded 130 % of the maximum allowable operating pressure (MAOP). Further, on August 2, 1997 the pressure in the pipeline exceeded 119% of MAOP. Alyeska did not contest the finding, they paid the civil penalty and have completed the requirements of the Compliance Order.[35]

2000 Status: JPO compared the deformation pig data prior to the August 5, 1998 incident to deformation data measured in October 1998 after the event and verified Alyeska's conclusion that there was no observable damage. JPO also verified that additional logic changes had been implemented in the pipeline control system to reduce the likelihood of this type of event in the future.

Details:

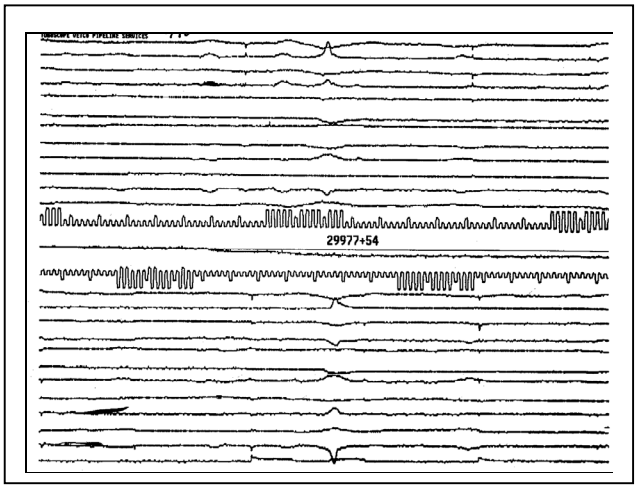

Figure 6: July 1998 VETCO Pig Data Prior to Overpressure Event Showing 1 inch Dent at 6:00 Position

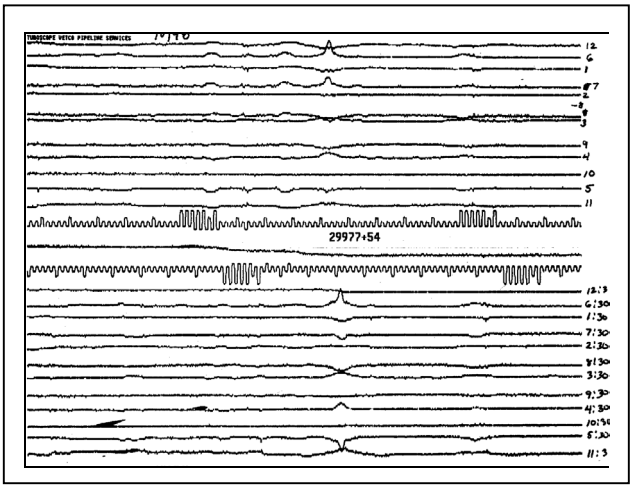

Figure 7: October 1998 VETCO Pig Data After Overpressure Event Showing no Change

[35] REF:DOT-CPF 59502

On August 5, 1998, a significant overpressure of the Trans-Alaska Pipeline System occurred. Hydraulic pressure exceeded 110% maximum allowable operating pressure (MAOP) in the 32-mile segment between Pump Station 9 and 10. Alyeska completed a hydraulic analysis indicating that the pressure had peaked at 130% MAOP near Pipeline Milepost 568, south of Delta Junction, Alaska. Alyeska investigated the condition of the pipe after the event with the VETCO Deformation Pig. Alyeska found no change in the condition of the pipe after comparing the deformation data to previous Deformation Pig investigations.[36] JPO verified the analysis by comparing deformation data before and after overpressure event.[37] No change in pipe condition was found.

Alyeska implemented auto control logic changes to make it more difficult for a controller to make the same mistakes that occurred during the August 5, 1998 event. JPO monitored the testing of the new logic during the November 13, 1999 planned shutdown. The logic appeared to work as designed.[38] Other enhancements proposed by Alyeska such as enhanced OCC visibility of the pipeline during MV20000 failure are dependent on the completion and implementation of the new RGV control system.

4.3.2 Backpressure System Damage/Pig#4 Incident

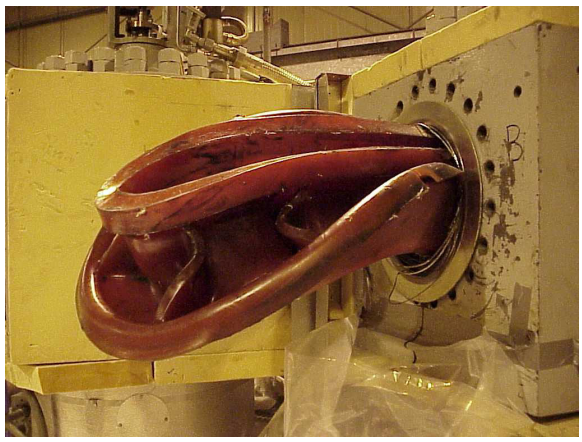

Figure 8: Backpressure System Valve B, 18"Oil Entrance Filled with 48" Pig Cups

Figure 9: Steel Screen Destroyed by Pig

[36] Alyeska report "Pig Data Review PS09 to PS10" dated 01/22/00
[37] JPO-00-S-053 surveillance report dated 10/02/00
[38] JPO-00-S-129 surveillance report dated 12/08/99

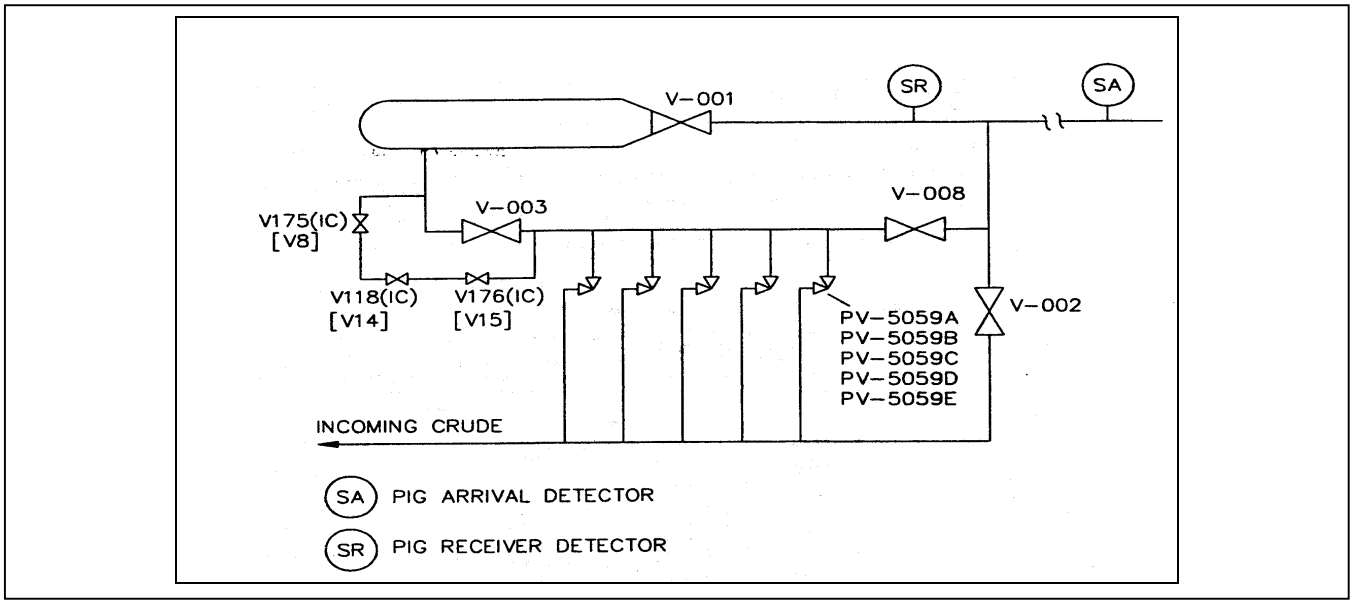

Figure 10: Piping & Valves Connection Pig Trap and Backpressure System

2000 Status: On January 30, 2000, the backpressure system at the Valdez Marine Terminal was damaged primarily as the result of failing to follow and use procedures for the capture of a scraper pig in the pig trap. In addition, the management of change process was not followed to prepare a procedure for receipt of two pigs in the pig trap. The failure to follow procedure and poor change management represents an incident where safe and workmanlike pipeline operations were not followed as required by Grant and Lease Stipulation 1.21. The damage to the backpressure system has been repaired and is now in operation. Without the backpressure system in operation and with oil flow rate below 1.4 million/barrel day, vibrations due to oil vapor bubble collapse are induced into the TAPS pipeline just below Thompson Pass. JPO directed Alyeska to report the effect of the vibrations on pipeline integrity. The report's calculations show that the worst location, if the backpressure system remained offline, that in 1.5 years the pipe would reach an indeterminate condition for continued operations. There would be a 2% chance of the initiation of a crack in the pipe. The length of time to propagate this crack through the pipe wall is unknown. If the backpressure system is kept online and with 12 shutdowns/year it would take 24 years to reach a cumulative design fatigue damage of 100%.[39]

JPO will evaluate the TAPS maintenance and useful life requirements in a comprehensive manner by conducting reliability centered maintenance analyses of critical TAPS systems. This analysis includes the backpressure system and the pipe at Thompson Pass. Further details of this analysis can be found in the 2000 TAPS Maintenance CMP.

[39] SSD, Inc., "Extension of Fatigue Damage Calculations for Additional Dent Locations South of Thompson Pass" dated, August 2000

Details: On January 30, 2000, the backpressure system at the Valdez Marine Terminal was damaged primarily as the result of failing to follow and use procedures during the capture of a scraper pig.[40] JPO directed Alyeska to provide: 1) a plan and schedule for the repair of the backpressure system; 2) a briefing on the causal factor analysis of the damage to the backpressure system; 3) an estimate of how long the backpressure system could remain off line without a danger to the integrity of the pipeline.[41]

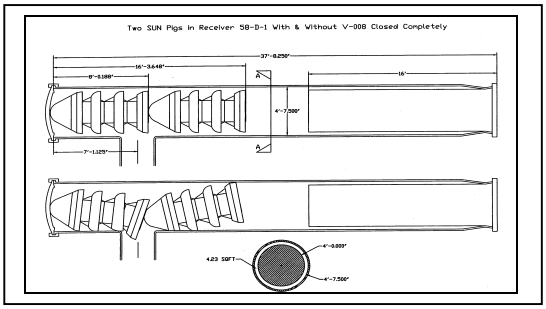

Figure 11: Effect of Two Pigs in Pig Trap (modified from Alyeska RCA)

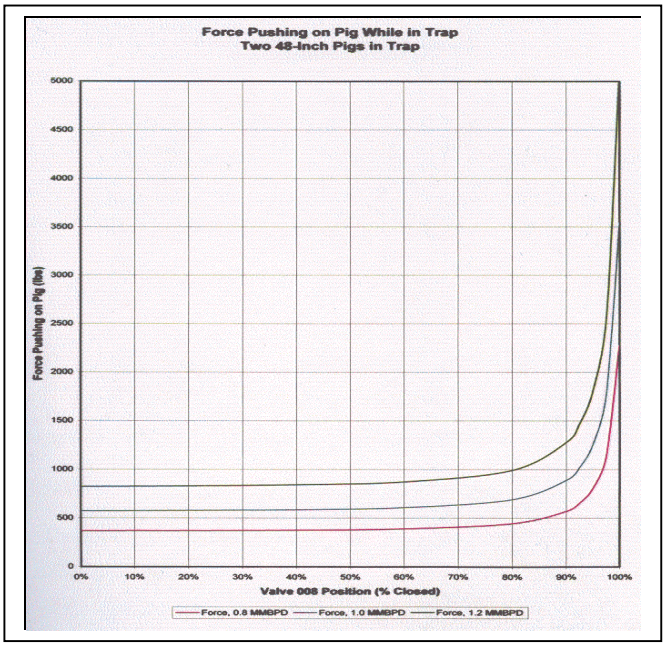

Figure 12 Effect of Closing Valve 008 (modified from Alyeska RCA)

Alyeska brought the backpressure system back on line February 21, 2000.[42] JPO personnel participated in the causal factor analysis which was completed on April 5, 2000.[43] The incident was caused by closing valve V-008 more than 75% forcing the cleaning pig into the backpressure system. Alyeska completed its incident investigation and found a number of contributing causes including not following QA36-1, PIP 3.6 Change Management & PIP 5.2 Controlled Work Site and Department Procedures, and not developing Temporary Operating Procedures for washing pigs (*the pig is left in the pig traps with oil flowing over it to wash away the accumulated wax, oil and other grit*) with two pigs in the receiver.[44] Alyeska noted that two incidents similar to this one occurred in the past at PS-10. JPO's analysis of the event concur

[40] JPO-00-S-015 surveillance report Finding#1, dated 02/01/00
[41] JPO Letter No. 00-007-JH dated 05/11/00
[42] Alyeska Letter No. 00-15476, dated February 24, 2000
[43] Alyeska "Pig Run #4 Incident Investigation Report, April 7, 2000"
[44] Alyeska "Pig Run #4 Incident Investigation Report, April 7, 2000"

with the causal factor findings.[45] JPO is satisfied that Alyeska has taken adequate steps to prevent this incident from repeating.

Without the backpressure system in operation and with oil flow rate below 1.4 million/barrel day, vibrations due to oil vapor bubble collapse are induced into the TAPS pipeline just below Thompson Pass. These vibrations could induce fatigue damage, and subsequent crack development in the pipe if the vibrations are large enough and happen often enough. Because of the concern of potential fatigue damage JPO directed Alyeska to report on the effect of the vibrations on pipeline integrity. Alyeska reported back to JPO the results of their contractor's analysis.[46] The report shows the need for keeping the backpressure system online. The report calculations show that the worst location would reach indeterminacy in 1.5 years. If the backpressure system were kept online, with 12 shutdowns/year, it would take 24 years to reach a cumulative design fatigue damage of 100%.[47]

[45] JPO-00-S-015 surveillance report Finding#1, dated 02/01/00
[46] Alyeska Letter No. 00-16280, dated September 18, 2000
[47] SSD, Inc., "Extension of Fatigue Damage Calculations for Additional Dent Locations South of Thompson Pass" dated, August 2000

4.3.3 Milepost 170 Pipeline Movement

Figure 13: View of Pipeline near Milepost 170 from Road after Event

Figure 14: Pipeline Shoe Nearly Off Support

Figure 15: Anchor Platform Moved Against VSM

2000 Status: A design change of August 22, 1999 did not adequately take into account the hydraulic conditions resulting from timing of the opening of RGV-31, given a slack line condition below RGV-31. A pressure pulse was generated. The forces generated tripped seven pipeline anchors, sheared steel bolts on the anchor frames and moved the pipeline south up to 23 inches. Alyeska surveillance failed to find the damage until over a month after the incident is believed to have taken place. Subsequently, Alyeska has changed the timing at RGV-31, conducted soil gas monitoring and found no anomalous soil gas readings at the other below ground valves and modified their surveillance process by painting orange marker lines on the pipe anchor supports to make movement more evident.

Alyeska management of change process was inadequate for the change valve opening timing at RGV-31 because it did not identify critical conditions to be considered for an adequate design. In addition, availability of critical records did not appear to be adequate given that the reasons for the original 25% open condition were not readily apparent to the design team.

Alyeska's surveillance and monitoring were inadequate since they failed to find the damage until at least a month after its occurrence. There were indications that prior pressure pulse events may have moved the pipe from its optimal position along the supports in this pipeline segment.

Regulatory Compliance

USDOT/OPS conducted an investigation into the tripped anchor incident at MP 170 on TAPS and has concluded that Alyeska is in probable violation of the following safety regulations:

1) 49 CFR 195.401(a): Alyeska failed to recognize all the hydraulic factors associated with the timing of opening RGV-31 and that elimination of the 15 minute hold time during start-up contributed to a significant pressure pulse being generated.
2) 49 CFR 195.402 (c) (3): Alyeska personnel did not follow normal operating procedures when they removed the RGV-35A control card for maintenance without first requesting OCC to inhibit the RGV Auto Control logic, which caused the pipeline to shutdown to prevent overpressure.
3) 49 CFR 195. 402 (d) (1): Alyeska did not respond to, investigate, and correct the cause of the abnormal condition on TAPS which occurred on November 13, 1999 and February 10, 2000. OPS is pursuing a NOPV for above mentioned regulatory non-compliance.[48]

Details: May 15, 2000 a pipeline pig launch crew discovered seven tripped pipeline anchors north of RGV-31. In addition to the tripped anchors, subsequent investigation found that the pipe had moved south up to 23 inches and some anchor frames' steel bolts were sheared off. A JPO surveillance specialist was dispatched to the incident site. JPO directed Alyeska to provide a formal briefing on the incident, measures taken to prevent its reoccurrence, and surveillance procedures to assure quick detection of similar events in the future.[49] In addition, JPO directed Alyeska to monitor all culverts, drainage pipes, galleries, pipeline surface-subsurface entry and exit points, and any other areas south along Atigun Pass where oil might appear if a release

[48] REF:DOT-IOCS 87023
[49] JPO Letter No. 00-086-LM dated 05/17/00

occurred in an adjacent buried section of pipeline. Alyeska was also directed to monitor all buried valves between RGV 31 and Pump Station 5 for possible oil vapors indicating a leak.[50]

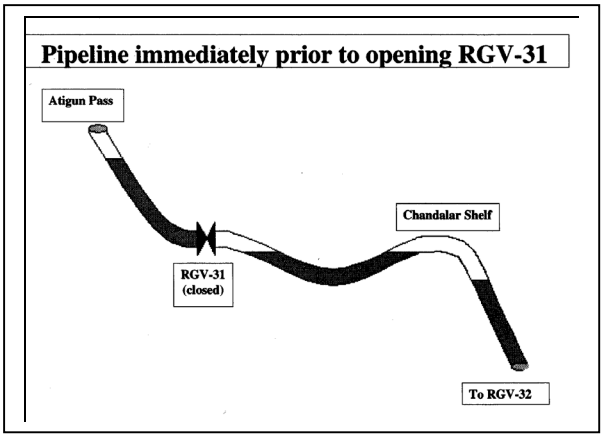

Figure 16: Oil Position Prior to RGV 31 Opening (modified from Alyeska RCA)

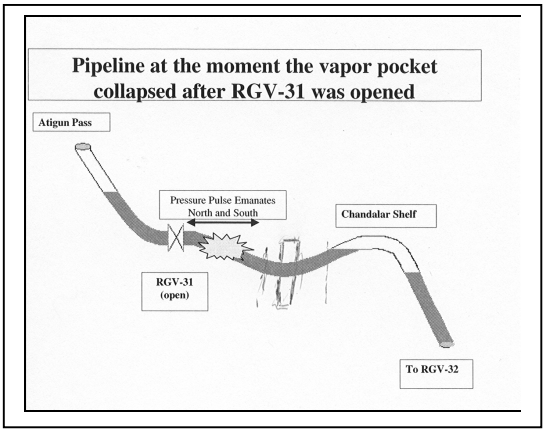

Figure 17: Collision of Oil Columns (modified from Alyeska RCA)

The Alyeska root cause analysis (Alyeska RCA) found that a pressure pulse was caused by the collapse of a vapor pocket just south of RGV-31 when RGV-31 was reopened after a pipeline shutdown on April 17, 2000.[51] This pressure pulse caused the damage to the pipeline supports. Figure 16 (above) shows the position of the oil in the pipeline prior to the opening of RGV-31. Once RGV-31 was fully open, the oil column above RGV-31 traveled and collided with the column down stream shown in Figure 17. The impact caused a pressure pulse to move downstream and upstream. Most of the upstream section of pipe is aboveground. The above ground pipe is designed to move in a controlled manner and absorb energy using various sacrificial elements such as aluminum honeycomb absorbers at the pipeline anchors. The below ground pipe is restrained by the surrounding soil and does not experience lateral or transverse movement.

The root cause of the pressure pulse was a failure of the design which was implemented on August 22, 1999, by Project B023, to recognize all the hydraulic requirements associated with the timing of the opening of RGV-31. [52] Prior to August 22, 1999, pipeline restart for RGV-31 was held at 25% open for 15 minutes before allowing full opening of the valve. The hold point was removed to speed up restart. Alyeska engineering reviewed and approved the change based on extensive prior analysis of valve closure analysis.[53] Even though a management of change process was undertaken, it proved inadequate because the analysis was based on a faulty assumption. The opening sequence should have taken into account the slack line condition down stream of RGV-31.

[50] JPO Letter No. 00-092-LM, dated 05/26/00
[51] Alyeska report: "Milepost 170 Pipeline Movement Root Cause Analysis," dated 06/23/00
[52] Alyeska report: "Milepost 170 Pipeline Movement Root Cause Analysis," dated 06/23/00
[53] Alyeska Briefing: "TAPS Milepost 170 Pipe Movement"

The Alyeska root cause analysis subsequent to the event did a thorough job identifying the cause of the event. Significant findings included:

- Two other pipeline restarts generated pressure pulses prior to the April 17, 2000 event, one on November 13, 1999 and another on February 10, 2000. The cumulative effect of these events might have moved the pipe to its final position, although no movement was noted by Alyeska surveillance for the previous events.

- The pressure data acquisition rate does not allow an accurate measurement of the pressure pulse; thus OCC would not be aware of the magnitude of event. The pressure sensor only transmits the pressure every minute yet the pressure pulse is only 8 seconds wide. It is therefore unlikely that the true pulse height would be captured. Counter to the effect of under estimating the pulse height because of sampling rate, is the amplification of a rapid pressure change by nitrogen left in the pressure sensing line. The nitrogen is inserted to keep wax and drag reducing agent from plugging the line. The current pressure measurement sensors are designed to measure slow changes in pressure, not the rapid rise pulse produced by this event.

- Alyeska estimated the magnitude of the pressure pulses by modeling with their surge analysis program PAULA. The primary variables were the amount of oil trapped behind RGV-31 prior to opening, size of the slack line gap below RGV-31 and the timing of the opening. These variables determined the speed and momentum of the oil "train" flowing down hill.

- Modeling indicated that even the valve opening of 25% could create a significant pressure pulse. The causal factor analysis reviewed history of past events and found that anchors were tripped north of RGV-31 in 1995.

- Alyeska's surge analysis indicates that pressure reached 109.8% of the Maximum Allowable Operating Pressure (MAOP) at milepost 169.27, which is just below the DOT 110% limit for abnormal events. This represents 63.6% of the Specified Minimum Yield (SMYS) of the pipe. The actual damage to the pipe supports is related to the rapid rate of change of the pressure wave, not the absolute value of the pressure.

Conclusion: JPO concluded that:

- Alyeska management of change process was inadequate for the logic change at RGV-31 because it did not identify critical conditions which should be considered for an adequate design. In addition, availability of critical records does not appear to be adequate given that the reasons for the original 25% open condition requirement were not readily available to the design team.

- Alyeska's surveillance and monitoring were inadequate since the damage was not discovered until at least a month after its occurrence. There are indications that prior

pressure pulse events may have moved the pipe from its optimal position along the supports.

- **Follow up:**

- Alyeska changed the opening sequence at RGV-31 to allow only 20% initial opening for ten minutes. Surge calculations indicate that this will prevent similar events in the future.[54]

- Alyeska conducted soil gas monitoring and found no anomalous soil gas readings[55] and modified its surveillance process by painting orange marker lines on the pipe anchor supports to make movement more evident.[56]

- Alyeska has completed the repair of the pipe supports at MP 170.

- JPO awaits the Curvature/Deformation Pig data to verify the condition of the below ground pipe downstream from RGV-31. The pig was run August 2000. The data is expected to be available by early in the year 2001.

4.3.4 Check Valve 74 Incident

Figure 18: Check Valve 74 Seat Ring on BJ Curvature Pig

2000 Status

[54] Alyeska Change Management for OCC Personnel: "RGV-31 Triconex Ladder Logic Modifications", dated 09/14/00.
[55] Alyeska Letter No. 00-16069 dated 07/31/00
[56] Alyeska Briefing: "TAPS Milepost 170 Pipe Movement"

On June 26, 2000, Alyeska launched a scraper and curvature (instrumented) pig from PS04 through the 48" pipeline. On July 4, 2000, the scraper pig arrived at the Valdez Marine Terminal (VMT) with significant damage to the scraper disks. On July 6,2000, the curvature pig arrived with a seat ring from a WKM check valve attached. Data analysis confirmed that a check valve seat ring was missing from CV-74. Further analysis indicated that the damage to the pig occurred at CV-81. It was therefore concluded that the scraper dislodged the valve seat ring at CV-74, carried it to CV-81, and the curvature pig hit the seat ring and carried it to Valdez. As a result, on September 16, during a scheduled TAPS shutdown, Alyeska replaced CV-74.

JPO/OPS personnel reviewed the CV-74 replacement procedures and the critical path management plan. The replacement of CV-74 was successfully completed in 48 hours. Subsequently, JPO/OPS personnel conducted an internal valve/pipeline inspection of CV-74 to determine the extent of damage caused by the seat ring dislodging. The pipe did not sustain any internal damage. The check valve sustained minor ring scraping on the inside body of the valve.[57]

Details

CV-74 Causal Factor analysis

Alyeska conducted a causal factor analysis in August 2000 to determine the reason the seat ring dislodged from the CV-74 valve body. It was determined that the retaining pins were not properly seated into the seat ring. At least 2 of the 12 retaining pins did not sufficiently protrude beyond the outside diameter of the seat ring, thus not securing the ring to the valve body. The analysis concluded that an error in assembly of the retaining pins was the primary reason the ring became disengaged from the valve body.

CV-74 Risk Assessment

A risk assessment was conducted on September 26, 2000 to determine possible risks to pipeline integrity. JPO/OPS personnel participated with the Alyeska risk assessment team to identify potential hazard/accident scenarios.[58] The highest risk scenarios included:

- The valve ring could gouge the inside of the pipe at 3-D bends (Tanana/Taslina rivers) and could gouge existing internal pipeline dents that are over 1” in height.

- Risk of loosing additional seat rings from valves due to pigging.

Recommendations for corrective actions include:

- Assessing the feasibility of pigging the pipeline with a tool that accurately assesses longitudinal oriented defects.

[57] REF:DOT-IOCS 89849
[58] Alyeska Risk Assessment: “Check Valve Seat Extraction Risk Assessment Final Report”, December 1, 2000.

- Performing UT (ultrasonic) inspections on the 3-D bends at Tanana/Tazlina rivers
- Compare the 2001 instrumented pig data against 1998 pig data at known dent locations
- Consider installing a pig receiver/launcher at PS09 to minimize the impact on valves due to pigging.

Conclusion: JPO is monitoring Alyeska's development of corrective and preventive risk mitigation plans.

4.4 Audit Action Items Resolution

- **Alyeska closed two of the remaining five open Audit Items since the previous Operations CMP dated February 1999.**

4.4.1 AAI Item 2113 Closed - Qualification and Development Program (QDP)

The qualification and development program initiated during 1994 was the result of the 1992 owners safety audit, the BLM audit and the TAPS assessment addressing the technician capabilities. The final Audit Action Item 2113 was closed by JPO after surveillance confirmed Alyeska's Qualification and Development Program was fully implemented and satisfied the implied requirement of Stipulation 1.21.1 of the Grant and Lease, i.e., trained pipeline controllers are implicit in operating TAPS in a "safe and workmanlike" manner.[59] The surveillance checked to see that the QDP identified the qualification of workers assigned core task. The surveillance confirmed that job disciplines were identified and core elements within each discipline were identified. Workers were required to demonstrate that they were proficient at each core task before they were allowed to perform the task unsupervised. It was found that records were kept which were current and accurate.

4.4.2 AAI Item 5052 Closed – Pump Station 1 Tank Farm Containment

AAI 5052 found evidence that the containment dike for Pump Station 1 appeared to be inadequate to contain a spill generated by a major rupture of the tanks at Pump Station 1. Alyeska completed work to rectify this condition in 1999. The work included constructing a gravel berm and adding material to raise the pads to approximately 30 feet elevation to create an adequate containment volume. The completion of the work was confirmed by JPO surveillance and the AAI was closed.[60] Because of the underlying permafrost, JPO will revisit the site to confirm that there is no significant settlement in the berm or the pads that could impact the spill containment volume.

4.4.3 AAI Item 50528 Closed – Access Road and Workpad Bridges

Status: The primary purpose of this audit item was to bring the access road and workpad bridges in conformance with Alyeska operational requirement of being able to withstand a 50-year flood, seismic requirements and to resolve the requirements for low-temperature steel. JPO has verified the work for workpad bridges is complete.[61]

[59] JPO-00-S-017 surveillance report dated 02/16/00
[60] JPO-99-S-146 surveillance report dated 12/14/99
[61] JPO surveillances: JPO-00-S-028, 029, 030, 031, 037, 038, 039, 040, 041, 042, 043, 044, 051, 073, 074, 083, 084, 085, 086, 087, 088, 089, 090, 091, 092, 093

Figure 19: Pungs Crossing Workpad Bridge

4.5 Audit Action Items Remaining Open

4.5.1 AAI Item 2076 – RGV Control System Replacement

AAI 2076 Closure action plan was designed to minimize the chance for unplanned Remote Gate Valve (RGV) closures. The audit item references 3 unplanned closures as reasons for the need for a change to the RGV Control System.

Status: By the end of 1999, Alyeska had completed all actions required by the plan except replacing the old Systronic master terminal units at the pump stations with triple modular redundant control units. This project is also discussed in the Construction CMP.

Details: The upgrades installed include:

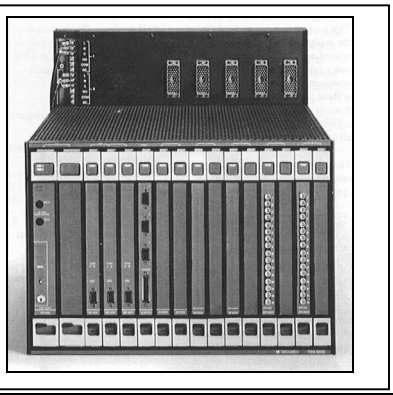

Figure 20: Triconlite Remote Terminal Unit

- New triple redundant remote terminal unit at all 62 RGV sites.
- Current sensors that monitor the valve movement which alerts the remote terminal unit to abort an uncommanded closure.
- Lengthened valve closure time to allow a response by the OCC to valve closure.
- Redundant power supplies for the remote terminal units.
- New motor control centers at each RGV.

In addition to these items, Alyeska has implemented an operation procedure to shutdown the pipeline if the status of the RGV can not be confirmed by OCC. The procedure was discussed in detail in the previous Operation CMP.

At the OCC SCADA host computer Alyeska has implemented software to automatically shutdown the pipeline if the RGV's begin a move that is not uncommanded. This software is called Auto Logic.

Work Remaining: The Master Terminal Units at the Pump Stations have yet to be installed. The installation of the Master Terminal Units was halted because Alyeska found the Kanas Fiber Optics System did not meet contractual reliability requirements.[62] The additional bandwidth was required to use the full capabilities of the new control system.

4.5.2 AAI Item 1955 – Host Audit Item for 15 other AAIs.

[62] Alyeska Letter No. 00-16511 dated 11/28/00

Status: This audit item remains open. Details are discussed in the Construction CMP. The audit item is a designated host for 15 other AAIs with programmatic similarities such as TAPS drawings and data not being current and inaccurately representing the existing systems.

4.6 Conclusions:

4.6.1 Normal Operations:

This reports finds that TAPS mainline pressure control devices are calibrated, maintained and operational. Four pipeline start and restarts were observed during this reporting period. Other than 1 variance from the written procedure during the September 1999 shutdown, which did not effect pipeline integrity, all planned pipeline shutdowns and restarts, observed from OCC, were conducted in accordance with procedure. In addition, it was verified that the Alyeska qualification and development program was fully implemented, thus a training program is in place.

4.6.2 Abnormal Operations:

Three major incidents that occurred since the 1999 Operations CMP and a follow up on a fourth incident were reviewed in this report. The incidents were the follow up on the Pipeline Overpressure of August 5, 1998, the Backpressure System Damage/Pig#4 Incident, the Milepost 170 Pipeline Movement and the Check Valve 74 Incident.

Pipeline Overpressure of August 5, 1998: USDOT/OPS issued a NOPV on March 15, 1999 relating to 49 CFR 195.406(b). Alyeska did not contest the finding; paid a civil penalty and completed the requirements of the Compliance Order. JPO has verified that the overpressure event caused no change in pipe shape by comparing deformation data before and after the overpressure event. JPO verified Alyeska has implemented auto control logic changes to make it more difficult for a controller to make the same mistakes that occurred during the August 5, 1998 event.

Backpressure System Damage/Pig#4 Incident: Alyeska completed its incident investigation and found a number of contributing causes including not following Alyeska's procedures. JPO's analysis of the event concurs with the causal factor findings. JPO is currently satisfied with Alyeska's corrective actions and considers this instance of noncompliance as remedied.

Milepost 170 Pipeline Movement: USDOT/OPS is pursuing a NOPV because of probable violation of safety regulation 49 CFR 195.401(a), 195.402(c), 195.402(d) related to this incident. JPO concludes that Alyeska's management of change process was inadequate for the logic changes at RGV-31 because it did not consider critical conditions which should be considered for an adequate design. Deficiencies in change management accounted for approximately 40% of the 1993 Quality Technology Company audit findings. JPO is currently satisfied with Alyeska's corrective actions and considers this instance of noncompliance as remedied. However, the general issue of adequate management of change remains an open issue from last year's Operations CMP.

Alyeska's surveillance and monitoring were inadequate since they failed to find the damage until at least a month after its occurrence. JPO is still reviewing Alyeska pipeline surveillance program.

The Check Valve 74 Incident: JPO views this incident as a case of latent construction deficiency. JPO will monitor implementation of the risk assessment recommendations.