

# **Executive Summary**

## **Joint Pipeline Office Comprehensive Monitoring Program TAPS Maintenance & Sustained Useful Life January 2001 – May 2002**

### **Introduction and Purpose**

The Joint Pipeline Office (JPO) Comprehensive Monitoring Program (CMP) reports were initiated to allow for periodic communications with stakeholders on the status of Trans-Alaska Pipeline System (TAPS) issues relative to a specific subject area. Numerous CMP reports on various subjects have been published in recent years; this report is the third such publication specific to the area of Maintenance. This report addresses the work completed to date to identify the various maintenance strategies to preserve the functional requirements of critical TAPS systems. The work associated with this effort focuses on the maintenance requirements and strategies necessary to ensure operational safety, environmental responsibility, and functional reliability of TAPS systems and equipment for the duration of the TAPS physical life.

The work plan leading to this CMP report is based on application of proven practices in asset management and designed to (1) comprehensively evaluate Alyeska Pipeline Service Company (APSC) monitoring and maintenance strategies and program structure; (2) identify the maintenance requirements of critical TAPS systems necessary to ensure safety and reliability for continued safe operation and right-of-way renewal; and (3) provide a foundation for continuous improvement to TAPS maintenance strategies.

This is an ongoing CMP effort, which provides TAPS oversight based on application of current engineering practices and associated management processes. The work has been largely technical; likewise, this report is largely technical.

### ***Risk-Based Oversight***

Since the inception of JPO, it has been the intent to provide oversight to the operation and maintenance of TAPS in a risk-based manner. Over the past years, several comprehensive risk assessments have been completed on TAPS, which JPO has considered in development of its comprehensive monitoring programs. An objective of this CMP effort has been to provide a “closed loop” to the results of these risk assessments; that is, ensure there are monitoring and maintenance tasks in place to protect against high risk, high consequence failures. Attachment (8) provides tabular results of this review.

The issue of deferred maintenance and inadequate predictive maintenance has been a central theme of many concerned employee complaints for the last 10 years. JPO has conducted risk-based oversight to focus on the critical elements of those concerns that could affect the integrity of TAPS.

### ***JPO Position on TAPS Maintenance and Useful Life***

The term “useful life” has not been clearly defined in the requirements documents referenced above, however, the useful life of TAPS seems clearly meant to describe the remaining life of the TAPS physical assets (economic viability is assumed), which in turn, is dependent on the following:

- The original design criteria of those physical assets
- The materials used to build those physical assets
- The installation of those physical assets
- How physical assets have been maintained/replaced over the last twenty-five years
- The maintenance requirements to sustain the physical functions of TAPS

### ***APSC Maintenance Management Commitments***

APSC formally agreed in a written *Memorandum of Agreement* (MOA), signed January 9, 2001, to support the implementation of this CMP effort. Attachment (1) to this report provides a copy of this MOA. Additionally, APSC is currently enhancing its management system and many of their business processes, inclusive of elements of the maintenance process, to more effectively prioritize corrective actions for continued safe and reliable operation of TAPS. APSC is applying the concept of knowing the operating requirements and understanding the potential risks and consequences of failure as an effective tool for identifying and prioritizing maintenance activities.

The current APSC effort to improve the integration of its management system and the efficiency and effectiveness of specific business processes such as budgeting, maintenance, engineering, and project management should ensure the results are monitored and the processes themselves are improved over the long haul.

Portions of this management system enhancement effort are summarized in a JPO/APSC Memorandum of Agreement, signed March 6, 2002. Attachment (9) to this report provides a copy of this MOA.

## **Methodology**

### ***RCM and TAPS Systems Oversight***

The JPO has established a “systems-based” approach to the oversight of TAPS maintenance. This was conceived to provide JPO with a disciplined oversight strategy,

which specifically identifies the physical systems and sub-systems that comprise TAPS, the associated user functions with the associated performance standards, and the method of function preservation for safe operations. As such, the current JPO maintenance oversight efforts have been designed to assess the maintenance requirements of particular TAPS systems and sub-systems, the adequacy of systems and sub-system monitoring for potential functional failures, and the effectiveness of transitioning monitoring results into corrective maintenance work activities. A maintenance strategy formulation technique called *Reliability Centered Maintenance* (RCM) has been used to facilitate this effort.

RCM is a highly prescriptive process used to identify the maintenance needs of a physical asset to ensure operational safety, environmental responsibility, and functional reliability. The RCM analysis involves the asset operators, maintainers, and responsible engineering resources in a comprehensive and interactive manner. The RCM process entails asking seven questions about the asset or system under review, as follows:

- What are the functions and associated performance standards of the asset in its present operating context (*functions*)?
- In what ways does it fail to fulfill its functions (*functional failures*)?
- What causes each functional failure (*failure modes*)?
- What physically happens when each failure occurs (*failure effects*)?
- In what way does each failure matter (*failure consequences*)?
- What can be done to predict or prevent each failure (*proactive tasks and task intervals*)?
- What should be done if a suitable proactive task cannot be found (*default actions*)?

An RCM analysis results in three tangible outcomes, as follows:

- Schedules to be done by the maintenance department
- Revised operating procedures for the operators of the asset
- A list of areas where changes must be made to the design of the asset or the way in which it is operated to deal with situations where the asset cannot deliver the desired performance in its current configuration.

Of the list of actions resulting from an RCM analysis, many are identified in order to address failure modes where the consequences of failure are classified as hidden, safety, or environmental. Tracking implementation of these tasks will be a core CMP element for ongoing JPO oversight. Attachments (4) and (5) provide reports that describe the RCM actions that JPO intends to track.

Note: An RCM analysis does not provide a “score” or “grade” of prior TAPS maintenance activities. Prior maintenance was not critiqued. Rather, structured analyses, provided by the RCM methodology, were conducted to provide a fresh perspective on TAPS system functions and the strategies necessary to preserve those functions.

## **Results**

The TAPS RCM analyses identify and document the relationship between equipment maintenance strategies and the preservation of associated sub-system functions. As such, these analyses enhance the maintenance practices employed by APSC on specific TAPS sub-systems. The result of an RCM analysis is a list of actions to be performed to prevent the system from failing to perform its desired functions. There are two programmatic elements necessary to successfully perform asset maintenance management using the RCM methodology: (1) conducting the RCM analyses; and (2) implementing the results (maintenance actions) of the analyses.

### ***TAPS RCM Analyses***

APSC has applied the Reliability Centered Maintenance (RCM) process to various physical assets since 1997. To date, 23 RCM analyses have been conducted on the Valdez Marine Terminal (VMT), 25 have been conducted on the Pipeline. These 48 analyses encompassed approximately 60 critical sub-systems of TAPS. Detailed reports for each RCM analysis are maintained by JPO and APSC.

The tables included in section *5.0 Results and Discussion*; provide the status of the TAPS RCM analyses. Data totaling the functions, functional failures, and failure modes from each completed analysis is provided.

### ***RCM Results Implementation***

As APSC proceeds with implementation of the identified RCM tasks, JPO will be conducting periodic checks to validate accomplishment of the tasks prescribed to address the failure modes identified as having hidden, safety, or environmental consequences. These checks will be documented as JPO surveillance or technical reports allowing JPO (and APSC) to track maintenance implementation (and therefore sub-system function preservation) in a very quantifiable manner. Monitoring implementation of the RCM results will be a core CMP element for ongoing JPO oversight.

## **Conclusions**

### ***TAPS Maintenance and Sustained Useful Life***

As presented in this report, the JPO considers the “useful life” of TAPS to be directly related to the design criteria used to build TAPS and the maintenance strategies deployed to preserve the associated functional requirements throughout the life of the system. As such, JPO intends that APSC continue to demonstrate a commitment to a maintenance management strategy that ensures operational safety, environmental responsibility, and functional reliability.

Throughout this CMP effort, APSC has worked cooperatively to conduct RCM analyses of complex TAPS systems. The result has been the implementation of a structured, disciplined, and documented approach to TAPS maintenance. APSC has committed, via a Memorandum of Agreement (MOA), dated June 27, 2002, to continue to maintain TAPS in a manner consistent with the intent and terms of the Federal *Agreement and Grant of Right-of-Way* and the *Alaska State Lease of Right-of-Way*, and to revise the TAPS Maintenance Manual, MP-167, to align with the RCM program incorporated through this CMP effort. Attachment (10) provides a copy of this MOA. The commitments of this MOA represent a commitment on the part of both APSC and the JPO to continuously evaluate the maintenance practices employed on TAPS.

Based on the RCM analyses conducted to date, and the associated programmatic changes APSC has made to its TAPS maintenance strategies, JPO concludes that the physical life of TAPS can be sustained for an unlimited duration. Further, the commitments made to JPO through the various MOAs presented in this report, serve to demonstrate APSC's willingness to work cooperatively with JPO to continue to sustain TAPS in a functionally reliable state.

## **JPO Managers**

James Lusher, P.E.  
JPO Engineering Manager

Jerry Brossia  
BLM Authorized Officer

John Kerrigan  
DNR State Pipeline Coordinator