



# **PETROTECH ALASKA**

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## **Review of the Valdez Marine Terminal Maintenance Program**

**RCAC Contract No: 504.0801**

**Prepared by PetroTech Alaska  
For the  
Prince William Sound Regional Citizens' Advisory Council**

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## **Executive Summary**

### **Overview**

The 800-mile long Trans-Alaska Pipeline System (TAPS) and Valdez Marine Terminal (VMT) has been operated and maintained by the Alyeska Pipeline Service Company (Alyeska) since its startup in June 1977. Alyeska is a separate corporation owned by a consortium of North Slope crude oil producers and exists for the sole purpose of operating and maintaining the TAPS and the VMT on behalf of the consortium, which owns these assets. The pipeline was built to transport liquid hydrocarbons produced on the North Slope of Alaska. The VMT was built to receive and hold the hydrocarbons from the pipeline and transfer those hydrocarbons to tanker ships.

Before seeking the renewal of a series of Right-of-Way (ROW) grants and leases for the TAPS and the VMT, Alyeska researched best methods and technologies applicable to their ongoing maintenance programs for the TAPS and the VMT. An objective was to provide evidence of a total maintenance program that would ensure the long-term integrity of the TAPS and the VMT.

The application of principles and concepts embodied by Reliability Centered Maintenance (RCM) programs was determined to be the best way to sustain the integrity of most of the equipment and facilities associated with the operation the TAPS and the VMT. This determination was reached following significant input from and support from the Joint Pipeline Office (JPO), a regulatory oversight agency comprised of seven state and six federal agencies that shared overlapping regulatory and management responsibilities related to common carrier pipelines in Alaska.

Reliance on Alyeska's ability to successfully develop and implement an RCM program customized to specifically meet the operational needs of TAPS and the VMT was important in the JPO's evaluation of Alyeska's applications for the renewal of a series of ROW grants and leases that had been obtained from federal and State of Alaska government agencies.

The original permits, which were to expire in 2004, were subsequently renewed, in large part based on the JPO's confidence that properly implemented RCM principles would provide the highest degree of integrity for the TAPS and VMT equipment and facilities.

Through diligent and time consuming efforts, a comprehensive RCM and total maintenance programs can be designed for most industrial operations, including pipelines and marine terminals. A resulting RCM and total maintenance program may appear “on paper”, to reflect the proper application of the controlling RCM principles and the embodiment of maintenance concepts that have been generally proven in other industries.

However, the true effectiveness of an RCM based maintenance program requires on-going reviews of the maintenance program, regular training to ensure competence of maintenance teams, and the development of metrics that measure real indicators of the sustained effectiveness of the total maintenance program over a period of years.

A detailed review and evaluation of all maintenance programs for the VMT would be cost and time prohibitive. The Prince William Sound Regional Citizens Advisory Council (PWSRCAC), the Alyeska VMT management team, and the JPO oversight management team agreed that a two day VMT Maintenance Survey Workshop that included in-depth reviews of selected RCM programs would facilitate an understanding of the current RCM and total maintenance program at the VMT. Such a workshop was scheduled for and held on August 21 & 22, 2007 in Valdez, AK.

A key objective for the workshop was for the VMT maintenance team to demonstrate the development, evolution, and maturation of the VMT RCM programs to meet the specific need for the VMT to conduct reliable operations with safety and integrity.

PetroTech Alaska was contracted to assist the PWSRCAC as a Consultant because it had performed a “Review of Reliability Centered Maintenance Documents” associated with the VMT portion of the Alyeska “Right-of-Way Renewals Project in July, 2002 and had some historic knowledge of the VMT RCM program.

The Consultant subsequently participated in the VMT Maintenance Survey Workshop (see attached photo) by assisting PWSRCAC’s process of determining whether the maintenance program at the VMT meets the real maintenance and operational needs of the VMT while meeting the public’s expectation for VMT operational safety and integrity. The workshop content was based on the review of the specific RCM programs developed for a few select systems, chosen jointly by the Consultant and the PWSRCAC.

The Consultant and the PWSRCAC expected that the two day VMT Maintenance Survey Workshop would also demonstrate the level of knowledge, skill, and overall competence of the VMT maintenance staff. The two days of extensive, in-depth presentations of and discussions between the Consultant, PWSRCAC, JPO, and VMT maintenance staff were supplemented by on-site tours of operations and facilities related to the selected RCM programs.

This report examines and evaluates the specific aspects of the Alyeska Management System that sets forth policies and procedures in place that reflect both the development and maturation of the RCM and total maintenance programs at the VMT.

In the opinion of the Consultant and PWSRCAC, adequate information has been provided to evaluate both the development and maturation of the RCM and total maintenance program at the VMT.

There was strong evidence that the current RCM program and total maintenance program at the VMT are achieving Alyeska's objectives of providing the highest degree of integrity for the TAPS and VMT equipment and facilities.

Nonetheless, the VMT Maintenance manager and members of his maintenance team properly acknowledge that the operations of equipment and facilities are dynamic and constantly changing; therefore, as with all properly designed RCM programs, the VMT's RCM and total maintenance program require continuous critical review by the VMT maintenance staff so that as operational equipment and systems age, as operational parameters change, as new maintenance technologies evolve, and as new information is developed, there is always a need to adjust and improve the maintenance programs accordingly. The principles of the RCM program allow for such adjustments.

The key to knowing where and when to adjust maintenance programs depends on a properly designed metrics that detect and measure changes in maintenance needs and trends. Based on the presentations made during the VMT Maintenance Survey Workshop, the Consultant concludes that the VMT maintenance program has strong maintenance management tools that properly measure the effectiveness of VMT's current maintenance program and provide for timely analysis of maintenance trends.

## **Observations**

The following observations/reviews were requested by or are made by the Consultant as part of the scope of services provided and are based on the assumption that the written materials and information presented before and during the two-day VMT Maintenance Survey Workshop accurately reflect the history and development of the VMT RCM and total maintenance programs currently in place. It is understood that these documents reflect the maintenance related compliance aspects of the Alyeska quality assurance program required by the Federal Grant of Right-of-Way (ROW) and State ROW Lease.

- 1) With regard to the Maintenance Strategy Process as set forth in Alyeska Management System document AMS-026:
  - A. It is the opinion of the Consultant that AMS-026 has properly set forth a systematic flow of RCM maintenance "activity" questions and process steps; set proper "key deliverables"; and identified the maintenance related employee position "accountable" for the specified "key deliverables". It properly achieves its purpose of documenting a process by which a risk-based maintenance strategy for the VMT assets can help assure VMT operability, integrity, safety, and regulatory compliance in a cost effective way.

- B. Comments made by Alyeska maintenance staff during the two-day workshop indicated a high level of understanding of general objectives of and specific workflow steps as set forth in AMS-026. The Consultant concludes that the Alyeska staff who were participants in the VMT Maintenance Survey Workshop were likely instrumental in writing the document, which is in its 5<sup>th</sup> revision, as of February 28, 2007.
- 2) With regard to the Maintenance Work Management Process as set forth in Alyeska Management System document AMS-027:
- A. It is the opinion of the Consultant that AMS-027 logically follows the systematic example of AMS-026 in the way that it breaks down the specific work activities necessary to perform the actual work tasks required to accomplish the RCM and total maintenance strategy objectives. It properly sets work task flow steps from the initiation or identification of a work task, through the planning and coordination of scheduling manpower and materials, to the accomplishment of the maintenance activity, and the documentation of the completion of the maintenance activity.
  - B. To the degree that any steps or activities set forth in AMS-027 are unique to the Passport work management software, there could be a potential need to re-write those steps if there is a future change in computer software resulting in changes to the steps or activities required. (Note: [Passport](#) is a comprehensive work management application that facilitates control and tracking of maintenance work orders.)
  - C. Comments made by Alyeska maintenance staff during the two day workshop indicated a high level of understanding of specific maintenance work flow steps and activities as they are set forth in AMS-027. The Consultant concludes that the Alyeska staff who were participants in the VMT Maintenance Survey Workshop were likely instrumental in writing the document, which is in its 8<sup>th</sup> revision, as of July 31, 2007.
- 3) With regard to the Passport Work Process Flow as set forth in Alyeska Management System document AMS-027-005:
- A. It is the opinion of the Consultant that AMS-027-005 logically follows the systematic examples of AMS-026 and AMS-027 in the way that it identifies how the Passport work management system is to be used as a tool to manage the specific administrative processes and the complex and detailed data associated with actual work steps and activities associated with the RCM and total maintenance management programs of the VMT.

- B. Passport appears to be a sufficiently robust work management software package to meet the needs of the VMT maintenance programs.
  - C. Comments made by Alyeska maintenance staff during the two-day workshop indicated a high level of understanding of Passport work process flow among the key maintenance staff personnel. Full use of and high levels of proficiency in Passport's capabilities appear to be limited to those few VMT maintenance staff members whose full time job responsibilities require such skills and abilities. The Consultant concludes that some of the Alyeska staff that were participants in the VMT Maintenance Survey Workshop were likely instrumental in writing the original document, Revision 0, as of March 31, 2007.
- 4) With regard to the selection of two RCM based systems/facilities at the VMT from a list of systems covered by the VMT's maintenance strategy:
- A. It is the opinion of the Consultant, after consultation with PWSRCAC, that RCM-VMT-030 for the "VMT Power Generation Overview RCM December 2002; and RCM-VMT-038 for the "VMT Ballast Water Recovered Crude Skimmers Z429 RCM December 2003" would be two RCM's that ought to demonstrate the manner and methods in which the VMT applies RCM principles and concepts to real maintenance needs. It was suggested that RCM-VMT-026 for the "VMT Berth 4 Redundant Firewater System RCM 2002" might also be considered as a backup RCM to review in the event that upon development of additional information, either of the first two selections would not provide a representative understanding of the VMT maintenance team's RCM program.
- 5) With regard to the selection of non-RCM based maintenance systems/facilities at the VMT from a list of systems covered by the VMT's maintenance strategy:
- A. It is the opinion of the Consultant, after consultation with PWSRCAC, that "Cathodic Protection Sys" and "Ballast Manifold (BWT)" would be two non-RCM based maintenance systems that ought to demonstrate the manner and methods in which the VMT handles the maintenance of systems/facilities, not readily adaptable to use of RCM principles and concepts. It was suggested that "West Crude Manifold" might also be considered as a backup for review in the event that the upon development of additional information, either of the first two selections would not provide a representative understanding of the way the VMT maintenance team handles such maintenance needs. (Note: The AMS-026 R.5 maintenance strategy process step 2.1.7 results in a determination of whether or not a need for a new or revised maintenance strategy is best satisfied with an RCM analysis or other proven maintenance strategy.)

6) With regard to the two day VMT Maintenance Survey Workshop held August 21-22, 2007 at the VMT:

A. It is the opinion of the Consultant that the Alyeska liaison representative and the VMT maintenance manager conducted the two day workshop in a manner which:

- 1) appropriately included participants from the JPO who were knowledgeable of both general requirements of and expectations for Alyeska in its role as the operator of the TAPS and VMT and the specific requirements of Alyeska to develop and implement a total maintenance program, largely based on RCM principles and concepts that would assure the long-term integrity of the TAPS and VMT operations in accordance with the ROW grants and leases that had been obtained from federal and State of Alaska government agencies;
- 2) appropriately included those Alyeska employees who were key members of the VMT maintenance team and who have direct responsibilities for the development of the Maintenance Strategy Process as set forth in Alyeska Management System document AMS-026, development of the Maintenance Work Management Process as set forth in Alyeska Management System document AMS-027, and the development of Passport Work Process Flow as set forth in Alyeska Management System document AMS-027-005;
- 3) appropriately organized and presented technical details and information on the following series of workshop topics:
  - a. the evolution of an Alyeska workplace culture from senior management to workers in the field that tends to encourage and support more open communication, positive interactive cooperation between maintenance, operations, and pipeline integrity staff in a manner that encourages and rewards teamwork, provides manpower, training, materials, and competent management and funding necessary to accomplish the operational objectives of the VMT;
  - b. a history of and the vision for the VMT maintenance program from 2002 to the present and beyond in a manner that demonstrated how use of RCM based principles and concepts, in conjunction with work management control tools to measure progress, have changed the VMT maintenance program from being “reactive” with a large backlog of maintenance work orders, to “planned” maintenance with a greatly reduced backlog of maintenance work orders, to a program that can be described as one of “Improved Precision”, and finally to a future goal of being a “World Class” maintenance program;

- c. a presentation of and discussion about Maintenance Strategy Process as set forth in Alyeska Management System document AMS-026;
  - d. a presentation of and discussion about Maintenance Work Management Process as set forth in Alyeska Management System document AMS-027;
  - e. a presentation of and discussion about the Passport Work Process Flow and sub-processes as set forth in Alyeska Management System document AMS-027-005, including interactions with Operations, Engineering, and Projects staff to assure coordinated, timely and efficient work actions;
  - f. a series of presentations that included a technical overview of RCM-VMT-030 “VMT Power Generation”, RCM-VMT-038 “VMT Ballast Water Recovered Crude Skimmers Z429”, and “Cathodic Protection Sys”, “Ballast Manifold System”, “RCM Review Cycles and Action Plans”, the “Informal Maintenance Strategy”, and how the VMT maintenance team uses both the formal RCM and informal maintenance strategies to address the unique maintenance needs of each facility or piece of equipment;
  - g. an on-site tour of VMT maintenance facilities (see photo) including observing the design of the current “Recovered Crude Skimmer” and a demonstration of why the changing composition of North Slope Crude affects the maintenance of skimmers and dictates the need for redesign of the equipment;
  - h. an on-site tour of the VMT Power Generation facility (see attached photo) to get a visual understanding of specific maintenance task activities set forth in RCM-VMT 030;
  - i. an in-depth presentation on how Alyeska’s VMT Maintenance Team has developed a comprehensive system of metrics (measurements) that accurately measures and tracks trends in a variety of key indicators related to work order task management, scoring of “System Health” for each of several major operating systems in the VMT Maintenance Program.
- 7) With regard to the performance of a detailed review of the application of RCM principles and concepts associated with the preparation of and continued revising of the RCM’s for the selected facilities/systems (of RCM-VMT-030 “VMT Power Generation”, RCM-VMT-038 “VMT Ballast Water Recovered Crude Skimmers Z429”) and the presentations on the “Cathodic Protection System” and the “Informal Maintenance Strategy”:

- A. It is the opinion of the Consultant that RCM, as used in the VMT maintenance program, is a comprehensive and scientifically based technique for developing a unique, cost-effective, risk-based maintenance program (preventive, predictive, or run-to-failure) for a particular asset or group of assets that must work simultaneously and cooperatively to achieve a specific purpose. To be a successful technique, RCM relies on a reasonable presumption that the inherent reliability of an asset or piece of equipment is a function of both the adequacy of the technical design of and the quality of materials used to construct that piece of equipment or combinations of pieces of equipment. A properly designed RCM program ensures that the inherent reliability of an asset is realized in its specific operation/functional application.
  
- B. It is, therefore, in this context that the Consultant is of the opinion that the Alyeska VMT maintenance team has demonstrated a good understanding of how the RCM's are to be written, how they are to be systematically reviewed and revised. Further, there are strong indicators that the Alyeska VMT maintenance team knows how the use of work management tools like Passport and a comprehensive metrics system that measures the proper indicators of effective management of maintenance work tasks associated with all aspects of the VMT total maintenance program. This ability can identify and has identified where maintenance problems or issues are occurring and gives analytical tools that help show how to best correct the problems or issues in a timely manner.
  
- C. It is the opinion of the Consultant that the VMT Maintenance Team has demonstrated that the current work environment or culture at the VMT has resulted in a motivated and well trained work force that supports the mission of Alyeska to "Safely and efficiently transport crude oil from the North Slope to the Gulf of Alaska".
  
- D. It is the opinion of the Consultant that the facilities, people and processes associated with the VMT Maintenance Team is effectively leveraging technology, management processes like the Alyeska Management System and the RCM principles and concepts, management effectiveness measurement tools, and personnel policies that combine to create an effective work and management force that appears to be meeting the compliance requirements of the Alyeska quality assurance program required by the Federal Grant of Right-of-Way (ROW) and State ROW Lease.

- E. It is also the opinion of the Consultant that much of the achievements described above are the result of relatively recent management attitudes and the creation of a highly skilled management team in support of the VMT Maintenance Team. The current high level of “VMT Maintenance System Health” as measured by using the comprehensive metrics that have been developed can easily be lost if changes in approach to maintenance of the VMT systems are not maintained. There can be a hidden risk to the success of the total maintenance program if multiple significant personnel changes occur and insufficient effort is made to replace experienced key personnel with equally qualified staff.

## **Recommendations**

The Consultant recommends that the appropriate JPO RCM specialists continue to monitor the Alyeska VMT RCM maintenance management program and facilitate the emulation of the VMT’s RCM maintenance management program wherever it appears to apply in the rest of the TAPS operations.

The Consultant recommends that the PWSRCAC staff in Valdez continue to monitor the Alyeska VMT RCM maintenance management program through regular review of the maintenance trend analyses and other management tools to ascertain whether any negative trends develop in the timeliness of completion of work tasks or effectiveness of the Maintenance Strategy Process and its associated Maintenance Work Management Process. Additional reviews may be warranted following any significant change in key senior VMT management staff or key VMT maintenance managers if there are concomitant indicators that such personnel changes could affect the work culture at the VMT.

The Consultant recommends that to the degree possible, with due consideration of national infrastructure security concerns, the achievements of the VMT Maintenance Team be documented and recognized in professional journals through the presentation of technical papers for professional societies in both the Quality Control and Maintenance Management disciplines.

The Consultant recommends that JPO use their influence to assure that future personnel changes in the management of the Alyeska VMT and the VMT maintenance have the technical knowledge and expertise to maintain and even improve the current VMT Maintenance program so that the vision of the current VMT Maintenance Manager to achieve his goal of achieving the distinction of having the VMT total maintenance program being considered a innovative “World Class” marine terminal maintenance program.

## Attachment



Photo depicting Bill Amberg (VMT Maintenance Manager), Gary J. Green (Consultant, PetroTech Alaska), and Sharon Marchant (VMT Liaison Representative)