Valdez Marine Terminal
Maintenance Assessment Advisory Audit

Prince William Sound Regional Citizens' Advisory Council

FINAL REPORT

PWSRCAC Contract No.: 504.11.01
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Bellingham, WA

List of Acronyms

AMS	Alyeska Management System
APSC	Alyeska Pipeline Service Company
CI	Continuous Improvement
CMMS	Computerized Maintenance Management System (Alyeska uses Passport)
CMP	Comprehensive Monitoring Program
FQ	Frequency
IMS	Informal Maintenance Strategy (Analysis)
IT	Information Technology
JPO	Joint Pipeline Office
KPI	Key Performance Indicator
KPM	Key Performance Measure
MAC	Management Action Commitment (tracking system)
MOC	Management of Change
OLE	Object Linking and Embedding
PDSA	Plan-Do-Study-Act
PI	Plant Intelligence (software)
PM	Preventative Maintenance (task or procedure)
PWR	Project Work Request
RCM	Reliability Centered Maintenance
SAE	Society of Automotive Engineers
SME	Subject Matter Expert
SMP	Safety Maintenance Practice
SOP	Standard Operating Procedure
ROW	Right-of-Way
TAPS	Trans-Alaska Pipeline System
TDDI	TAPS Drawing and Documentation Information (system)
VMT	Valdez Marine Terminal
WO	Work Order
WOM	Work Order Model (Model Work Order)

1. Introduction

Prince William Sound Regional Citizens Advisory Council (PWSRCAC) contracted with Hisey and Associates, LLC in late 2010 to develop a scope and work plan to perform an audit of Alyeska Pipeline Service Co.'s (Alyeska) Valdez Marine Terminal (VMT) Reliability Centered Maintenance (RCM) processes, procedures and results. The audit was performed between January 2011 and August 2011 by Dan Hisey and Darryl Hammond under PWSRCAC contract 504.11.01.

2. Acknowledgements

We wish to acknowledge the open, candid, and professional interaction exhibited by the numerous Alyeska employees we met with and interviewed throughout the audit process. We want to specifically thank Tom Kuckertz, PWSRCAC Project Manager and Barry Roberts, Alyeska Liaison, for their support and cooperation throughout the audit. Additionally, we want to recognize the extraordinary support and cooperation we received from Robert Roundtree and Mark Stevens, the RCM Facilitators/Coordinators at the VMT. They provided valuable insights and worked tirelessly to accommodate our requests for thousands of documents needed to conduct the audit.

3. Executive Summary

This audit report summarizes the results of an assessment of Alyeska's application of Reliability Centered Maintenance (RCM) at Alyeska's Valdez Marine Terminal. The report describes the history and Alyeska's commitments to RCM over the past decade and the current status of RCM-based maintenance through the review of a statistically significant sampling of RCM Analyses performed at VMT. The findings presented are summarized into 5 major categories:

1) Process and System Complexity

2) Use of Reliability Centered Maintenance (RCM)

3) Use of Informal Maintenance Strategy Analysis (IMS)

4) Implementing Maintenance Strategy Recommendations

5) Maintenance Performance Monitoring

Based on the results of the audit, it is the Consultants' opinion that, although no maintenance rose to the level of "imminent threat," on the 5 RCM's reviewed, Alyeska is struggling with overly complex processes and poorly integrated IT systems which are adversely impacting their ability to effectively apply Reliability Centered Maintenance.

It is the Consultants' opinion that Alyeska is not effectively implementing RCM at the Valdez Marine Terminal to develop consistent, efficient and appropriate maintenance strategies. In addition, their management systems do not provide adequate monitoring of overall maintenance performance to insure they are meeting their stated goals, objectives and commitments to RCM.

RCM's do not appear to have been completed on all the critical systems listed in the original JPO commitment letter. We are therefore, unable to verify Alyeska met the spirit of the 2002 JPO commitments. There may be subsequent agreements between the parties which modify these original commitments which we did not review.

4. Audit Objectives

The primary objectives of the audit were to:

1) Determine if the results of Alyeska's Maintenance Strategy Process meet their commitments to Federal and State Agencies and the public to ensure safe, environmentally sound, and long-term operations of TAPS.

2) Determine if Alyeska's maintenance procedures and processes as described in "Maintenance Strategy Process," (AMS-026) and "Maintenance Work Management Process" (AMS-027) and their referenced documents:

- Effectively establish appropriate and effective Reliability Centered Maintenance (RCM) requirements for VMT assets,
- Effectively establish appropriate and effective maintenance strategies for non-RCM systems and equipment,
- Effectively establish appropriate and effective maintenance strategies for corrosion monitoring and mitigation programs, and
- Are being effectively and consistently implemented at the VMT.

5. Scope of Work[1]

The original scope of work consisted of:

1) Selecting two (2) RCM based systems and two (2) non-RCM based systems. Consultant will recommend systems to be audited to Council Project Manager for approval;
2) Determining if VMT facilities and systems maintenance requirements have effectively been established by methods equivalent to Reliability Centered Maintenance (RCM) per AMS-026 and AMS-027;

[1] PWSRCAC Contract No. 504.11.01

3) Determining if all systems and subsystems have appropriate and effective maintenance procedures defined and established per AMS-026 and AMS-027 and their referenced documents;
4) Verifying that maintenance is being completed in accordance with the established processes and procedures for the selected system(s) and individual system components;
5) Determining if Alyeska's Maintenance Strategy and implementation adequately addresses maintenance issues related to safety, environmental protection, regulatory compliance and long-term operations; and
6) Determining if Alyeska's corrosion monitoring and mitigation "programs" adequately address and manage corrosion related risks of failure to systems and their individual components, and to understand how RCM and IMS integrate with corrosion management programs and systems.

Revised Scope of Work

RCM and IMS documents were made available by Alyeska on-site at the VMT on six (6) select RCM's. After document searches for relevant VMT Informal Maintenance Strategy (IMS) packages, it was evident that very few IMS document packages had been entered into TAPS Drawing and Documentation Information system (TDDI). Therefore, it was determined that five (5) RCM analyses would be reviewed, including, "Crude Distribution System Corrosion Control"[2] and IMS documents would be reviewed in total. The focus on IMS then became to determine if the process was being used regularly and effectively, and if the packages were retrievable from Alyeska documentation systems. See Attachment 1, for a list of IMS packages Alyeska entered into TDDI database for both Pipeline and the VMT.

Audit Limitations

Although the Consultants both have extensive experience in operations and maintenance mostly specific to Alyeska Pipeline, the audit did not attempt to investigate technical validity of the maintenance strategies or specific recommended actions resulting from any of the RCMs or IMS analyses. Recognizing Alyeska typically utilizes both internal and external subject matter experts when performing RCM analyses, the audit did not attempt to "second-guess" or reevaluate their recommendations. The Consultants did however, review the RCM recommendations for consistency in relation to the failure mode to test relevancy. The audit focused primarily on Alyeska's follow-through with their recommendations and if the processes and procedures Alyeska applies to RCM are working and sustainable. Since Alyeska has made commitments to both State and Federal Regulators requiring the application of RCM, this audit assesses Alyeska meeting those commitments as they apply to VMT maintenance.

[2] TAPS Crude Distribution System, Crude Distribution System, Crude Distribution Corrosion Control System, RCM2 Analysis, Final Report, May 2002, REF-RCM-VMT-017r0

The audit also did not evaluate the effectiveness or implementation of Alyeska projects or programs into which RCM recommendations were "absorbed". For example, some of the recommendations from the Crude Distribution Piping Corrosion RCM were input into Alyeska's overall Corrosion Monitoring Programs. In this case, the audit did not evaluate the implementation or overall effectiveness of the Corrosion Monitoring Programs.

Audit findings are those issues which the Consultant determined related specifically to the scope of this audit. Findings can reflect deficiencies or gaps in the processes or procedures, or may reflect specific evidence of successful implementation which meet the intent of the processes and procedures. Observations, where appropriate, are included and intended to provide additional insight into issues the Consultant observed during this audit process which do not relate specifically to the scope of the audit and may not contain sufficient detailed evidence to be stated as an audit finding.

6. Alyeska 2010 Internal Audit

Dan Hisey met with Alyeska's Audit Manager, Bill Polley, and Lead Auditor, Leo Ramirez in early February to review the findings of Alyeska's 2010 Maintenance Program Audit. Although the Consultant was not provided a copy of the Audit, a summary of the findings was discussed. (See Attachment 2) Alyeska's audit included Maintenance Processes, AMS-026 and AMS-027 for Pipeline, VMT, Right-of-Way and Fleet Maintenance. Although Alyeska's findings include references to all four areas, there was only minor indication that the findings varied between the Pipeline, VMT and ROW maintenance programs or processes. PWSRCAC requested the Consultant attempt to validate Alyeska's own internal audit findings to the extent there was overlap in scope of the efforts. A summary of comments correlating Alyeska's findings to this audit can be found in Attachment 3. Generally, as Alyeska's audit relates to RCM at VMT, we found Alyeska's audit findings to be accurate.

One notable exception is that we disagree with their finding that managers use Key Performance Indicators (KPI) well in tracking work order aging and deferrals. It is the Contractors opinion that the overall "Satisfactory" evaluation offered in the 2010 Maintenance Audit may have undercut the importance of the audit's principal findings. Other than an internal Alyeska effort to rewrite AMS-026 and AMS-027, which began in 1Q11 we found little knowledge of Alyeska's audit, or specific efforts underway to address its' findings.

7. Background

Alyeska Commitments to RCM

In the time leading up to the 2004 Right-of-Way (ROW) Renewal of the TAPS Grant and Lease, Alyeska negotiated and signed various agreements with the JPO on the use of RCM as a basis to, "…ensure the functionality of critical systems and subsystems."[3] The various agreements between JPO and Alyeska involving maintenance and RCM are captured in the JPO 2001-2002 Annual Report.[4] TAPS Maintenance Baseline Assessments began in November 2000, initially consisting of a criticality analysis of TAPS systems, and training of JPO and Alyeska personnel to the RCM process. Alyeska formally agreed in a written Memorandum of Agreement (MOA), signed January 9, 2001, to support the implementation of the AMM (Asset Maintenance Management) and RCM analyses.

Under the January 2001 agreement, Alyeska and JPO agreed to a list of "Critical Systems" that would be subject to RCM. These include:

1) Valdez Marine Terminal
2) Back Pressure Control
3) Pressure Relief
4) Ballast Water Treatment (BWT)
5) Control System (Operations Control Center)
6) Leak Detection System
7) Fire Protection System
8) Combustible Gas Detection
9) Hazardous Gas Detection
10) Tanks

The June 2002 Agreement updated the January 2001 agreement including: "Alyeska agreed to determine maintenance activities for newly installed or existing systems and equipment in TAPS in accordance with a structured, comprehensive and industry recognized methodology, such as Reliability Centered Maintenance."[5] Although Alyeska's original commitment to use RCM as a method of establishing maintenance requirements was for 10 specific systems, it was expanded under the June 2002 agreement and addressed in the TAPS Renewal Environmental Impact Statement (EIS) Report as being applied to all TAPS maintenance, regardless of system criticality.

It is of interest that during the audit interviews, only one person specifically knew the impetus or commitment to the RCM process between Alyeska and the JPO. Some indicated

[3] JPO 2001-2002 Annual Report, BLM-AK/AE-03/007+2800-990, pg. 13
[4] Ibid, pg. 19
[5] JPO 2001-2002 Annual Report, BLM-AK/AE-03/007+2800-990, pg. 20

they believed there was a requirement to do RCM analyses, but did not know from where it came. Although clearly not critical, it seems that knowledge of the regulatory commitment for Alyeska to use RCM by employees ultimately responsible for RCM implementation would be relevant and useful.

8. Discussion of RCM

Reliability Centered Maintenance, often known as RCM is a specific process used to identify the policies which must be implemented to manage the failure modes of a physical asset which could cause the functional failure of that asset in a given operating context. The late John Moubray, in his industry leading book Reliability-centered Maintenance[6], characterized Reliability-Centered Maintenance as a "process used to determine what must be done to ensure that any physical asset continues to do what its users want it to do in its present operating context." The first step in the RCM process is to define the functions of each asset in its operating context, together with the associated desired standards of performance. Asset functions can be split into two categories:

1) Primary Functions summarize why the asset was acquired in the first place. This category of functions covers issues such as speed, output, carrying or storage capacity, product quality, and customer service.

2) Secondary Functions recognize that every asset is expected to do more than simply fulfill its primary function. Users also have expectations in areas such as safety, control, containment, comfort, structural integrity, economy, protection, operational efficiency, and even the appearance of the asset.

John Moubray and Society of Automotive Engineers (SAE) technical standard SAE JA1011 both utilize the same basic evaluation criteria for RCM processes, which set out the minimum criteria that any process should meet before it can be called RCM. This starts with the 7 basic questions:

1. What is the item supposed to do and what are its associated performance standards?
2. In what ways can it fail to provide the required functions?
3. What are the events that cause each failure?
4. What happens when each failure occurs?
5. In what way does each failure matter?
6. What systematic task can be performed proactively to prevent, or to diminish to a satisfactory degree, the consequences of the failure?
7. What must be done if a suitable preventive task cannot be found?

[6] Moubray, John *Reliability-Centered Maintenance*. New York: Industrial Press, Second Edition 1997

The RCM process is an industry standard generally used to achieve improvements in areas such as:

1. Establishing safe minimum levels of maintenance
2. Changes to operating procedures and strategies
3. Establishing capital maintenance regimes and plans

The successful implementation of RCM will lead to an increase in cost effectiveness, machine uptime, and a greater understanding of the level of risk that the organization is presently managing. It is important to know that an RCM is a "snap shot" in time and needs to be a living document and process to be fully effective. This requires the maintenance organization monitor the RCM's that have been performed and update the RCM each time the operating context changes. The RCM process also emphasizes the use of Predictive Maintenance (PdM) techniques in addition to traditional preventive measures on assets that would cause the most disruption if they were to fail.

Although not specifically defined in Alyeska's AMS Processes, the output of an RCM (or IMS) which is referred to as the "Maintenance Strategy" is simply the list or compilation of recommendations coming out of the RCM, typically maintenance or operating procedure tasks. This can be confusing if one thinks in the context of a strategy being, "an overall method or plan chosen to bring about a desired solution, goal or objective." Although the term, "Maintenance Strategy" is used continuously throughout AMS-026, in the end, the list of maintenance and operating procedures for a piece of equipment or physical system is what actually constitutes the maintenance strategy.

9. PWSRCAC History of RCM Audits

Petrotech 2002

PWSRCAC originally contracted with PetroTech Alaska in 2002[7] to review Alyeska's application of RCM at the VMT prior to ROW Renewal. A summary of the findings of the Petrotech 2002 review are found in Attachment 4. This audit focused primarily on how Alyeska was using RCM at the VMT. Findings of the audit addressed specific issues related to Alyeska's use of "Recommended Practice" in developing the RCM analysis. Although many of these same findings were evident during the 2011 Audit, (there was evidence of improved RCM methodology on some RCM's) the Consultants did not focus on Alyeska's analysis method. The 2011 Audit focused on Alyeska's follow through on implementing the recommendations of the RCM analysis.

Petrotech 2007

[7] PetroTech Alaska, Review of Reliability Centered Maintenance Documents Right-of-Way Renewals Project, Valdez Marine Terminal, PWSRCAC Contract No.: 552.02.01, Final Report, July 2002

PWSRCAC contracted with PetroTech again in 2007 to perform a more general (high-level) review of the VMT Maintenance Program. This review, admittedly budget constrained in scope, consisted primarily of a two-day "Survey Workshop" review of RCM programs to demonstrate the development, evolution, and maturation of the VMT RCM programs. Unlike the 2002 Audit, this Review did not include a review of any significant documents regarding Alyeska's implementation of the RCM's and IMS's being reviewed. Rather, the focus of the review was on the understanding of RCM principles and practices being used by VMT Maintenance. This review found a general understanding of RCM at VMT and supported Alyeska's application of RCM through the relevant AMS Processes. PWSRCAC recognized the limitations of this type of review in which a vertical audit of the follow-up recommendations and outputs of the RCM and IMS analyses were not conducted. For this reason, the 2011 VMT RCM Audit focused not only on the Management System(s) Processes and Procedures, but also on identifying evidence that actions, follow-up, and implementation of RCM and IMS analyses were completed as committed.

10. Audit Methodology

The Consultants made a total of three site visits to the Valdez Marine Terminal between March and June 2011. The first two visits consisted primarily of reviewing documents and information as well as interviewing selected individuals for the audit. See Attachment 7 for a list of people interviewed. Alyeska scheduled many of the interviews during the Consultants' first visit. Alyeska developed a schedule of remaining interviews based on the availability of PWSRCAC staff, the Consultants, and the Alyeska employees. The third visit consisted of following up on document requests and site inspection of some of the physical assets involved in the audit. While at VMT, the Consultants reviewed the following documents, processes and databases:

- Alyeska Management System Documents
- RCM's and Informal Maintenance Strategies (IMS)
- Transmittal forms
- Engineering checklist
- Passport documentation of implemented RCM's
- TDDI documentation of IMS

As each RCM was reviewed, the supporting documents related to the RCM Analysis Recommendations were identified and requested from Alyeska. The specific findings, observations and Consultants' opinions are contained in this report and attachments.

11. Confidentiality of Documents

Alyeska provided to the Consultant copies of all reference documents required to conduct this audit. These were provided under mutual agreement between Alyeska, PWSRCAC and the Consultant that these source documents would only be used in conjunction with performing this audit/evaluation. The documents provided are included by reference, but the originals of these documents remain under the control of Alyeska. Access to the original source documents named in this report is only available through Alyeska. Any person or organization interested in reviewing these original source documents should contact Alyeska directly to request access. PWSRCAC does not have access to the original source documents used by the Consultant in conducting this audit.

A complete list of the documents reviewed under this audit is contained in Attachment 5.

12. RCM's Reviewed

The following VMT RCM's were evaluated:

- V5 Skimmers – RCM-VMT-038r1, March 2008
- Power Vapor Compressor – RCM-VMT-025, October 2002
- Main Line Relief Valves – RCM-VMT-018, May 2002
- Back Flow Preventer – RCM-VMT-010, 2007
- Crude Distribution Piping Corrosion Control – RCM-VMT-017, May 2002

13. Discussion of Alyeska's Management System (AMS)

Alyeska, like many other organizations, use what is referred to as a "Plan-Do-Check-Adjust (or Act)" cycle model to establish and define their management system(s). Also known as PDSA (Plan, Do, Study, Act), Deming, or Shewart cycle, a basic element of this model is that it is designed to create a "closed-loop" to ensure that required actions are taken. AMS and any effective "closed-loop" model ensures that there is documentation and an assurance process to verify that actions have been taken, or the loop has been closed. The American Society for Quality identifies when to use the PDSA Model[8] :

- As a model for continuous improvement.
- When starting a new improvement project.
- When developing a new or improved design of a process, product or service.
- When defining a repetitive work process.
- When planning data collection and analysis in order to verify and prioritize problems or root causes.

[8] American Society for Quality, http://asq.org/learn-about-quality/project-planning-tools/overview/pdca-cycle.html

- When implementing any change.

In effect, this RCM Audit was designed and conducted to evaluate Alyeska's effectiveness in applying the PDSA Model to RCM as described in their AMS documents, primarily AMS-026 and AMS-027 by testing to determine if Alyeska is, "closing the loop" with respect to RCM commitments and recommended actions (maintenance strategies).

14. Alyeska Employee Interviews

Most, but not all, of the interviews were conducted in person. Due to conflicting schedules a few interviews were conducted via teleconference. All of the office staff interviewees were asked a standard set of questions to establish a baseline understanding and knowledge of Alyeska's AMS processes and commitments, and to evaluate how well key individuals involved in the processes understood and could manage their work through the processes and procedures prescribed by Alyeska. Individuals in leadership and Subject Matter Expert (SME) positions were asked additional questions applicable to their role in the processes. Depending on the interviewee's position and role with respect to maintenance and the RCM/IMS processes, some questions were skipped where they appeared as not relevant to the individual. The complete list of interview questions is included in Attachment 6.

15. Summary of RCM and IMS Reviews

A spreadsheet was developed to capture the documents and data considered as part of the review of each RCM under this audit. These spreadsheets entitled "Summary of Audit Findings," are found in the Appendices to this report. Information was entered into the spreadsheet directly from the RCM Final Report (where available). The process was to next trace each action through the Alyeska maintenance and document systems to determine the final disposition of each specific recommendation. Obviously, not all elements in the spreadsheet were available or applicable for every RCM Recommended Action. The spreadsheet ultimately provided the "road map" for tracking each recommendation through the various processes. Specific comments are provided relevant to each recommendation and evidence trail where applicable.

Since the RCM Recommendations did not follow a consistent format or detail, each spreadsheet was provided to the VMT RCM Facilitators to determine the appropriate reference documents to be used in tracking each recommendation. As discussed in the findings, since the maintenance and documentation systems do not provide a clear trail of evidence, a review of each document provided determined if another document and related action was available to follow the recommendation to conclusion. Again, in most cases, the auditors requested the next referenced document in the trail be provided for review, until the final implemented recommendation was identified and confirmed, or the trail of subsequent documents was exhausted.

Data fields captured in the individual RCM Summary Spreadsheets include (where available):

1. Reference No. (RCM Reference)
2. RCM Tag No.
3. WOM (Work Order Model) Tag No.
4. Title (Recommendation)
5. Job Type
6. W-R# (Work Request)
7. WOM No. (Work Order Model)
8. Procedure
9. FQ (Frequency)
10. Discipline
11. PG (Page number)
12. Action Tracking
13. MAC No.
14. Modifications
15. TDDI No.
16. SOP (Standard Operating Procedure)
17. MP No. (Maintenance Practice)
18. SMP (Safety Maintenance Practice)

Since there was no consistent method of capturing action items resulting from RCM recommendations, not all data fields are used in every summary spreadsheet or for recommendations in the same RCM analysis. The data available relevant to each RCM recommendation varied greatly making it very difficult to track specific recommendations to final resolution.

The review of IMS packages demonstrated that those completed by the RCM Facilitator/Coordinators at VMT were performed effectively and in accordance with the intent of the RCM process. Most IMS packages are completed by Project Engineers and are not retrievable through Alyeska's documentation systems as discussed in Section 17.11-13. The RCM Facilitators in VMT have adopted the use of the RCM toolkit (software package) to document the IMS Analysis. Although this is a more rigorous and in-depth review than the process prescribed by AMS-026 (Form 10410), the Consultants would characterize this is a "best practice" in the application of Alyeska's IMS Analysis process. Due to the very limited documentation of rationale and few specific maintenance strategies being developed through the use of Form 10410 (IMS Analysis Worksheet), other than the process being used to cause an engineer to "consider maintenance" in a PWR it is not clear that this process is delivering much value. There is no evidence to suggest that the recommendations and action items resulting from IMS analyses are tracked and implemented with any more or less success than actions coming out of a complete RCM Analysis.

16. Preliminary Review of Findings with Alyeska, ADEC and BLM

A preliminary review of the audit findings was conducted in Anchorage on August 15 with Alyeska management. The Consultants reviewed the significant findings and observations with several operations and maintenance managers. Similar separate reviews were later conducted with ADEC and BLM representatives. Alyeska management was also sent a draft of this report summary. Although the Summary Finding spreadsheets (appendices to the main report) were used with Alyeska as a means of identifying and capturing referenced documents throughout the audit, the final version of these spreadsheets were not completed until Sept. 14, 2011. Accordingly, it is acknowledged that Alyeska has not had the opportunity to do a final review of the Summary Finding spreadsheets prior to the issuance of this report. However, the general findings of the report were reviewed with Alyeska in August. Alyeska noted no exceptions at that time to the Findings or Observations. It is therefore expected that any corrections to these spreadsheets if indicated would be minor and of an editorial nature and not result in different findings or observations.

17. Summary of Audit Findings by Category

The following list represents some of the significant systematic findings of the audit. They have been grouped by category. More detailed explanations of the finding, including a discussion of the issue and implications follow. Findings specific to individual RCM recommendations can be found in the "Summary Notes" column of the Audit Findings Summary Spreadsheets.

PROCESS COMPLEXITY

1) RCM, maintenance and documentation processes are overly complex and complicated
2) System is over reliant upon a few key individuals
3) Document access is difficult and inconsistent
4) Maintenance work is being performed outside Alyeska's Computerized Maintenance Management System (CMMS) (Passport)

USE OF RCM PROCESS

5) No clear criteria exists establishing when to complete an RCM and/or IMS Analysis
6) Risk and Prioritization ranking is too open to interpretation
7) Management of Change (MOC) is not adequately controlled
8) The RCM Process does not manage Continuous Improvement (CI)
9) RCM performed without appropriate Subject Matter Expert (SME) involvement
10) No proposed action resulting from a significant failure mode and effect

USE OF IMS PROCESS

11) IMS Analyses are not consistently developed
12) IMS documentation is not entered into TDDI
13) IMS Analysis are not effectively reviewed or approved

IMPLEMENTING MAINTENANCE STRATEGY RECOMMENDATIONS

14) RCM recommendations do not consistently address failure mode
15) RCM actions not traceable back to RCM recommendation
16) Compulsory Redesign timelines are extended without justification
17) Action Items lack adequate follow-through
18) RCM recommendations not consistently implemented

MAINTENANCE PERFORMANCE MONITORING

19) Maintenance processes lack leadership and coordination
20) Alyeska executives are not notified of "Risk Rank Priority" 2 items
21) Key Performance Indicators (KPI) are ineffective at monitoring maintenance performance
22) Self-Assessments are not effectively evaluating AMS process performance
23) No evidence that maintenance data or trends are being collected and analyzed

PROCESS COMPLEXITY

17.1. RCM, Maintenance and Documentation Processes are Overly Complex and Complicated

Alyeska Management System AMS-026 and AMS-027 and related maintenance management processes have become overly complex and unwieldy for employees to manage and utilize effectively. Most interviewees: (1) demonstrated some level of frustration with Alyeska processes and procedures; (2) see someone else as accountable for major components of the processes; (3) were unable to retrieve documents or information related to RCM's or IMS's, or; (4) did not understand significant elements of RCM, IMS, or maintenance and documentation processes especially as they relate to AMS-026 and AMS-027.

The Alyeska Management System (AMS) was initially developed in the early 2000's as part of Alyeska's "Systems Renewal Program," and was generally modeled after ExxonMobil's "Operations Integrity Management System" (OIMS) comprising of 11 key business processes.[9] Under this audit, the Contractor had access to 42 AMS entitled documents, but it is evident by the numbering that many more AMS documents exist. It is the Consultants' opinion that Alyeska has lost connection to the original intent of AMS, and in developing and expanding the AMS documents, has created a disjointed document hierarchy that adds to the confusion around AMS documents.

AMS-000, Alyeska Management System Governance Manual, 2.2, defines a business process as, "… a series of activities that describe an input, its transformation to add value, and the outputs. Business processes are management level documents, written at a summary level of detail intended to define management's expectations. Processes give enough details to achieve consistent, accurate, and reliable results without being overly prescriptive. A business procedure provides detailed, prescriptive information, expanding on an activity described in a business process. The business process describes what needs to be done while the procedure describes how to do something." Alyeska's list of AMS titles now consists of documents entitled: processes, procedures, manuals, permit requirements, programs, and guides. Unlike ExxonMobil's OIMS, AMS has become a collection of numerous levels of policies, processes, guidelines, procedures and instructions which do not hold much relevance to individual workers and are not clearly integrated or structured to effectively manage Alyeska processes. It appears the original hierarchy intentionally designed into the AMS structure has been overcomplicated by the addition of a multitude of documents which should exist at levels other than the AMS itself.

[9] ExxonMobil, Operations Integrity Management System, http://www.exxonmobil.com/Corporate/Files/OIMS_Framework_Brochure.pdf

While it should be recognized that complex or complicated processes should allow for some managed degree of deviation on occasion, evidence suggests that in the case of managing and monitoring maintenance at the VMT, with the exception of a few key individuals as described below, employees either do not know the processes and procedures, or the processes and procedures are simply too disjointed for them to support the work. This complexity results in increased likelihood of errors and inefficient use of employees' time.

17.2. System is Over Reliant upon a few Key Individuals

Alyeska depends on a very few key individuals to retain enough knowledge of their maintenance management systems and processes to keep them working. In spite of the complex processes and procedures Alyeska applies to managing maintenance at the VMT and the related but disconnected processes, the auditors found the individual contributor level employees to be knowledgeable of what it takes to operate and maintain VMT assets, although not necessarily guided or assisted by established maintenance strategies or processes. Alyeska workers are forced to rely on their personal knowledge of the assets and their casual network of co-workers to find information they need to do their job.

Alyeska continues to depend on their knowledgeable and experienced workforce to know what needs to be done to maintain their equipment and operations. It is the opinion of the Consultants that the real work to maintain and operate the VMT is being done by dedicated workers, not through efficient or effective processes, but in spite of burdensome systems, processes, and procedures. It is the Consultants' opinion that Alyeska could significantly reduce the confusion created by overly complex systems and processes, and improve maintenance effectiveness through major process simplification. Alyeska should consider replacing Passport as their Maintenance Management system. Passport has become an impediment to getting work done, rather than an enabler. It is also evident that Passport is not being utilized in the same way on the Pipeline as it is at the Valdez Marine Terminal.

17.3. Document Access is Difficult and Inconsistent

Alyeska's various IT systems do not effectively integrate maintenance data, making analysis and workflow management difficult. This makes it extremely difficult for workers or management to have a clear understanding of the results or status of their maintenance programs and the condition of the equipment. Many people interviewed seemed to know where they thought information and data should be stored, but often referred to someone else as being responsible for entering data and knowing how to access it. In numerous cases, the Consultants followed a "name trail" given by several people of someone else to talk to, only to find that at the end of the trail, that person did not have the answer or know how to retrieve the data.

It is extremely difficult to access data from within the Alyeska IT systems. Much of the data that is available is not effectively cross-referenced to related data, so it is extremely difficult

to follow a trail of action between systems. Employees are challenged to know where to retrieve information and data when requests are made. Much of it is dependent on the individual's knowledge of the systems and where the data exists. Due to the difficulty in accessing historical maintenance analyses, such as RCM and IMS documentation, valuable information is being lost, which can be costly in terms of project efficiency and management of change. This also increases the risk of loss of institutional knowledge as key employees and contractors leave Alyeska.

Additionally, since specific actions related to an RCM recommendation are not "linked back" to the RCM through the multiple systems, there are cases where recommendations lead to implementing actions which are included in a related document and the related document is either changed or deleted, which can in effect cancel the recommendation. One example of this was found in AMS-017 where recommendations ended in an implementing action to be included in PM2001 (Engineering Process Manual). PM2001 was replaced by AMS-003 and 004 in the early 2000's. This problem is compounded by the length of time some action items are open, increasing the likelihood that the recommended action is lost, cancelled or overtaken by other changes prior to implementation with no clear link back to the RCM that initiated the action.

17.4. Maintenance Work is being performed outside Alyeska's Computerized Maintenance Management System (CMMS) Passport

When processes and procedures become too complex or overly prescriptive, employees simply create "workarounds" to manage the work that they know needs to get done. Additionally, ad-hoc systems are created to work outside of established processes, like Passport. One example of this is the infra-red monitoring "program" of switchgear and breakers being managed through a process outside of Passport. As discussed in section 18.4, "Maintenance Backlog," maintenance work done outside Passport cannot be forecast, tracked or managed in the context of the overall maintenance workload at VMT.

USE OF RCM PROCESS

17.5. No clear criteria exists establishing when to complete an RCM and/or IMS Analysis

A key and probably the most important element to effective application of RCM is to fully understand and accurately assess the "Operating Context" of systems and equipment to be maintained. In every case, the Operating Context drives the entire RCM process. A change in Operating Context should also be the primary driver for reviewing or redoing an RCM. Of the people interviewed, only two recognized that a "change in operating context" should be a trigger for reviewing an existing RCM. Without this basic understanding of operating context with respect to the RCM process, it is unlikely that proper judgment and assessment will be made regarding revising an RCM to reevaluate the maintenance strategy for a system or specific equipment.

17.6. Risk and Prioritization ranking is too open to interpretation

AMS-026 (2.1) states, "The risk ranking, coupled with engineering judgment, is used to determine if a formal RCM analyses should be performed." Based on interviews with responsible engineers, there is no established guideline for determining when an RCM should be performed, other than the "Failure Risk Ranking" guidance stated in AMS-026, (2.1.7):

> "Assets with a failure risk priority level of "1" (High Priority risk) or "2" (Medium Priority risk) are typically candidates for an RCM analysis. Assets with a failure risk priority level of "3" (Low Priority risk) or "4" (Tolerable risk) are typically candidates for an IMS Analysis. The maintenance strategy analyst is expected to use good judgment in making the final decision to either proceed with completing the IMS Analysis or to recommend an RCM Analysis."

Failure Risk Ranking is established through a process described in AMS-017. Since the vast majority of all risk reviews result in a low or tolerable risk priority, specifically level 3 or 4, with very little analysis, it is unclear what other elements the maintenance strategy analyst (or responsible engineer) is supposed to consider when making the determination of whether to complete an IMS or move to the RCM analysis. Since very few new RCM analyses have been conducted at the VMT since the mid-2000's, it appears that nearly all risk reviews result in a low or tolerable risk priority with little or no documented justification.

The risk ranking prioritization determines whether an IMS or RCM is required. This prioritization does not follow through to the recommendations coming out of the RCM which create the action item. Therefore, the rationale for assessing the risk as medium or high to develop an RCM does not apply to the recommendations the RCM generates. Nearly all RCM recommendations are low priority even though by definition, the risk prioritization process recommending the RCM resulted in either a medium or high risk ranking. This can be confusing when following through the various processes and systems that rank risk or priority differently.

17.7. Management of Change is Not Adequately Controlled

Management of Change (MOC) control of maintenance strategies is not adequate. There is no evidence that effective MOC controls exist for managing maintenance strategies established through RCM or IMS processes. The PMCR process does not require appropriate review or approval in connection to the RCM that generated the original PM. Therefore, PM's can be changed without considering the failure mechanism or modes that were originally considered in the RCM for the equipment or system. This can lead to completely losing the benefit the rigorous RCM process offers and unintentionally change the maintenance strategy without appropriate consideration, review and approval.

17.8. The RCM Process does not manage Continuous Improvement

One required attribute of an RCM Process is Continuous Improvement. Both SAE JA1011 and Alyeska's commitments to JPO require a continuous improvement element. An excerpt from a JPO Comprehensive Monitoring Report (CMP) from 2002 includes a commentary on Continuous Improvement (underlines added for emphasis):

> *"A Word on RCM and Maintenance Process Improvement*
>
> *The application of RCM leads to a much more precise understanding of the functions of the assets which have been reviewed, and a much more scientific view of what must be done to cause them to fulfill their intended functions.*
>
> *However, the analysis will not be perfect – for two reasons:*
>
> *• Numerous decisions have to be made on the basis of incomplete or nonexistent hard data, especially about the relationships between age and failure*
>
> *• The assets and their associated operating contexts may be changing continuously. This means that even parts of the analyses, which are wholly valid, may become invalid due to change.*
>
> *The people involved in the analysis will also change. This is partly because the perspectives and priorities of those who take part in the original analysis inevitably change over time; and partly because people simply forget things. In other cases, people leave and their places are taken by others who need to learn why things are as they are.*
>
> *All these factors mean that both the validity of the RCM database and people's attitudes towards it will inevitably deteriorate if no attempt is made to prevent this from happening.*
>
> *To ensure that the RCM databases remain current, asset managers should consider bringing the original review group together on an annual basis to validate the original analysis. Such a review need not last longer than one afternoon. This is a continuous improvement effort."*

The Consultants agree with JPO's 2002 assessment and believe Alyeska's application of RCM has deteriorated significantly, due in part to their failure to review and revise their original analysis and the lack of maintenance leadership. A failure to commit to and implement a continuous improvement process has diminished the intended and potential value of RCM to Alyeska.

17.9. RCM performed without appropriate Subject Matter Expert (SME) Involvement

It is a requirement of the RCM process that the necessary and appropriate experts are involved with the RCM analysis to ensure that an accurate and insightful evaluation can be

performed. For example, a number of the recommendations from RCM-VMT-017, (Crude Distribution Piping Corrosion Control) were rejected by the SME Corrosion Engineers responsible for monitoring the subject system; it is evident that the individuals conducting the RCM were not fully aware of the existing corrosion management procedures being implemented. Failure to involve the appropriate SME's significantly limits the value of performing a rigorous RCM Analysis.

17.10. No Proposed Action resulting from a Significant Failure Mode and Effect

RCM-017, Crude Distribution Corrosion Control, identified failure to provide adequate cathodic protection as a failure description, which relates to a failure mode of external corrosion resulting in a crude leak. This failure mode resulted in a recommended action of "No Scheduled Maintenance." (See Fig. 17.19) Although cathodic protection is likely managed under Alyeska's larger Corrosion Control Program(s), the RCM should clearly identify what method is in place, or needs to be put in place, to mitigate a failure mode as significant as a below ground crude leak.

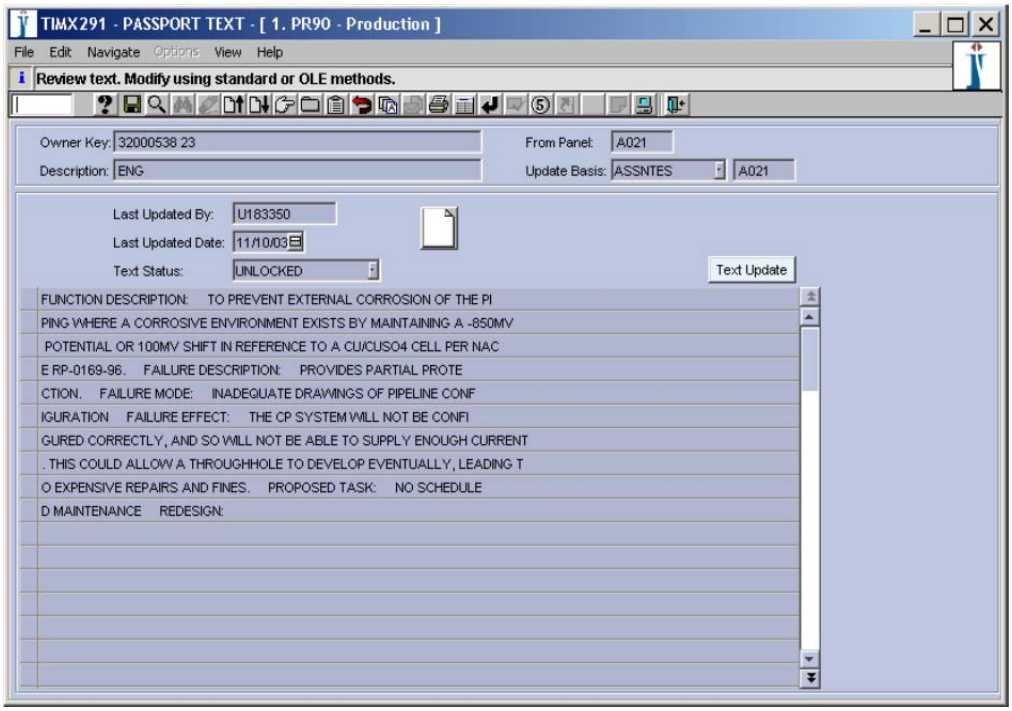


Fig. 17.10 - Significant Failure Mode resulting in no recommended action

USE OF INFORMAL MAINTENANCE STRATEGY PROCESS

17.11. IMS Analyses are not Consistently Developed

IMS packages are not consistently prepared as required in AMS-026 and are not retrievable within Alyeska document systems. The initial search for IMS packages in TDDI identified only 22 IMS's as having been performed at VMT. (See Attachment 1) Although Form 10410 is the referenced document to use when performing Informal Maintenance Strategy

Analysis, a variety of documents and methods have been used to perform IMS analysis. Some IMS's consist of a complete RCM Analysis. Many IMS forms reviewed from Project Work Packages were incomplete and did not effectively establish maintenance strategies.

17.12. IMS Documentation is not entered into TDDI

Although most individuals responsible for completing IMS packages knew that the IMS worksheets were supposed to be entered into TDDI, they all believed that a complete work package submitted to the Documentation Group would initiate the step of entering the IMS into TDDI. Since completed IMS packages are not being entered into TDDI, they are not retrievable through the established documentation processes and procedures. Most interviewees were familiar with the IMS form and understood it to be on the engineering checklist as a requirement.

The engineers responsible for completing the IMS Form 10410 generally believed they had met the requirement of completing the IMS and included it in their engineering package turnover to Documentation, but the 10410 is not being entered into TDDI. Of the total of 22 VMT IMS packages included within TDDI, all but one of them reference participation by the VMT RCM Facilitator or Coordinator. It appears that the RCM Facilitator and Coordinator are the only two individuals who recognize that IMS packages should be entered into TDDI. IMS Analysis packages that are not entered into TDDI are not retrievable, and are therefore of no value in documenting the process or rationale for the maintenance strategy they have established.

17.13. IMS Analysis are not effectively reviewed or approved

The IMS Analysis process, which was developed to provide a very simplified process to assess and develop a maintenance strategy in lieu of the more formal, time-consuming and expensive RCM Analysis is not being used effectively at VMT. AMS-026 (2.2.3) states that, "If the IMS Analysis is performed in conjunction with a modification, maintenance strategy review and approval is part of the design review and approval process," and, "If the IMS Analysis is not associated with a modification or design change, the Maintenance Manager, or designee, reviews and approves the IMS analysis and the implementing recommendation." The IMS Analysis is performed using form 10410, which does not include an area for review and approval. None of the IMS documents reviewed under this audit indicated any review or approval as required by AMS-026.

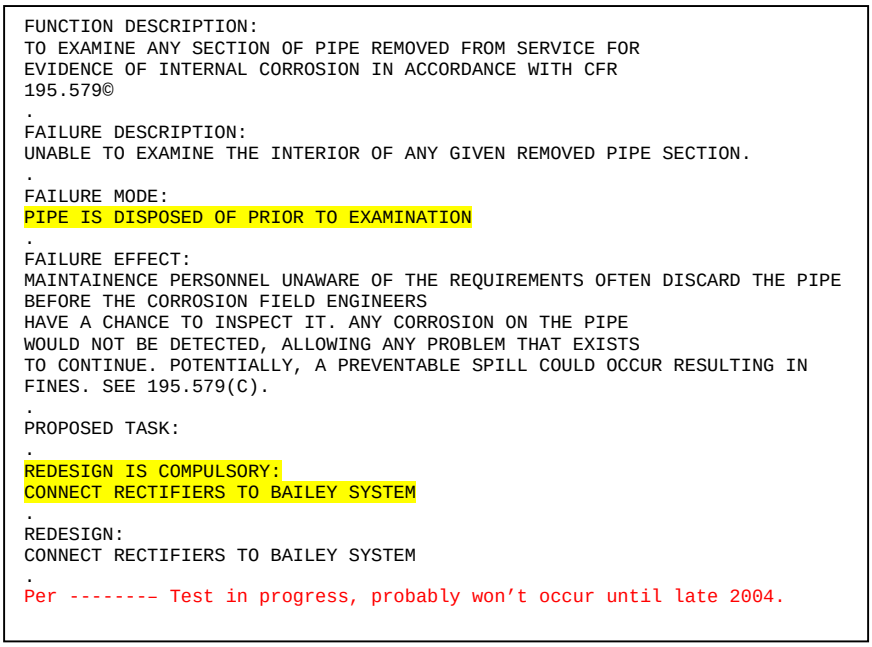
Since RCM and IMS recommendations also include Operations action items, it seems illogical that the Maintenance Manager would be the responsible individual for reviewing and approving operational recommendations.

17.14. RCM Recommendations do not consistently address failure mode

In the case of RCM-017, Crude Distribution Corrosion Control Piping, some of the specific actions initiated from the RCM recommended actions do not relate to the recommendation or failure mode identified in the RCM. These are addressed specifically in the Summary spreadsheet for the RCM, but as an example, a review of a specific action coming out of the RCM indicates the following function, failure, effect and proposed compulsory redesign action: (see Fig. 17.14)

- Function: Examine any section of pipe removed from service for evidence of internal corrosion.
- Failure mode: Pipe is disposed of prior to examination
- Proposed task: Redesign is Compulsory. Connect Rectifiers to Bailey System.

Clearly, no relationship exists between inspecting pipe that is removed from service for internal corrosion and connecting cathodic protection rectifiers to the Bailey system. The Corrosion Control RCM in particular was rife with errors, illogical references and recommendations, yet the actions generated were entered into Alyeska's Action Tracking management system without review.



```
FUNCTION DESCRIPTION:
TO EXAMINE ANY SECTION OF PIPE REMOVED FROM SERVICE FOR
EVIDENCE OF INTERNAL CORROSION IN ACCORDANCE WITH CFR
195.579©
.
FAILURE DESCRIPTION:
UNABLE TO EXAMINE THE INTERIOR OF ANY GIVEN REMOVED PIPE SECTION.
.
FAILURE MODE:
PIPE IS DISPOSED OF PRIOR TO EXAMINATION
.
FAILURE EFFECT:
MAINTAINENCE PERSONNEL UNAWARE OF THE REQUIREMENTS OFTEN DISCARD THE PIPE
BEFORE THE CORROSION FIELD ENGINEERS
HAVE A CHANCE TO INSPECT IT. ANY CORROSION ON THE PIPE
WOULD NOT BE DETECTED, ALLOWING ANY PROBLEM THAT EXISTS
TO CONTINUE. POTENTIALLY, A PREVENTABLE SPILL COULD OCCUR RESULTING IN
FINES. SEE 195.579(C).
.
PROPOSED TASK:
.
REDESIGN IS COMPULSORY:
CONNECT RECTIFIERS TO BAILEY SYSTEM
.
REDESIGN:
CONNECT RECTIFIERS TO BAILEY SYSTEM
.
Per --------– Test in progress, probably won't occur until late 2004.
```

Fig. 17.14: Example of recommended action not addressing failure mode

As shown in the Audit Finding Summary Spreadsheet for RCM-017 attached, the recommended actions from the RCM are inconsistent with the failure mode and in many cases were rejected by Engineering.

17.15. RCM actions not traceable back to RCM recommendation

There is no consistent reference or traceability of recommendations back to the RCM that generated them. There is no way to know if recommendations were rejected, cancelled or for some other reason not implement

17.16. Compulsory Redesign timelines are Extended without Justification

RCM's cannot be considered implemented until MAC Action Items generated by the RCM are closed. Typically, MAC issue due dates change due to work load, prioritization, or lack of funding. Project Engineers looking at new system modifications and reviewing existing RCM's would be forced to check multiple databases to determine if recommendations had been implemented. No process exists to end continuance of low priority RCM recommendations.

An RCM "Best Practice" is to address "compulsory redesign" recommendations within 14 days of issue. Alyeska has compulsory redesign recommendations from the V5 Crude Skimmers RCM which have remained open since 2007. There is no evidence that Due Date extensions were considered in the context of the significance of a compulsory redesign recommendation from the RCM Analysis.

17.17. Action Items Lack Adequate follow-through

MAC actions are only tracked and reported on RCM recommendations at a high level. There is no visibility of specific tasks or resources required to accomplish the recommendations. The management reports Alyeska provided use almost exclusively the over-simplified metric of "Open" or "Closed" MAC Action items to measure the effectiveness of RCM. A review of the MAC action item status report for VMT RCM related Action Items, as of March 24, 2011 showed a total of 13 open action items related to VMT RCM recommendations. Of the 13 open action items, seven indicated they had slipped past their assigned due dates. The other six action items all have an assigned due date of December 2011. It appears a common practice to adjust due dates to December of the current year.

17.18. RCM Recommendations not consistently implemented

Recommendations resulting from RCM and IMS analysis that are not implemented are not documented within the RCM or IMS Analysis Form per AMS-026, 2.3.6. Since no effective means of associating RCM recommendations with final implementing procedures exist, some recommendations which are rejected by the assigned responsible party are not documented back to the RCM or IMS. AMS-017, Crude Distribution Piping Corrosion Control is a good example of this finding. Corrosion Engineering rejected a number of RCM recommendations, but the RCM Analysis Form did not reflect the rejection or rationale.

MAINTENANCE PERFORMANCE MONITORING

17.19. Maintenance Processes Lack Leadership and Coordination

AMS-026 defines the Maintenance Strategy Board as "A group of managers accountable for providing clear direction and consistent application of the Maintenance Strategy Process and for coordinating and championing implementation of maintenance strategy recommendations with cross-area applicability. The Board consists of a company-wide cross section of Managers with an interest and/or accountability in maintenance."[10]

The Maintenance Strategy Board has not met since December 2008. Maintenance management lacks overall direction, lessons learned, shared best practices, and coordinated process improvement. The VMT based RCM Facilitator and Coordinator provide excellent technical support to the RCM process of developing maintenance strategies, but are not in a position to provide the management leadership and direction the overall process requires. AMS-026 assigns this responsibility to the Process Owner and the Maintenance Strategy Board.

One specific role of the Strategy Board defined in AMS-026 is to consider and approve maintenance strategies or recommended work activity applicability to other areas (Pipeline, Marine Terminal, SERVS, Right-of-Way, or Fleet).[11] These common strategies are established in AMS-026 as, "Standard Maintenance Strategies."[12] As of revision 9 of AMS-026, there are only four (4) Standard Maintenance Strategies that apply to all of TAPS, relating only to meggering (electrical insulation testing) of motors over 250hp, molded case circuit breakers, lube oil analysis, and vibration analysis. These are the same 4 standard strategies that appeared in revision 1 of AMS-026. The Consultant agrees with some interviewees' observation, that these standard strategies seem trivial in the context of TAPS assets and maintenance efforts. One would expect to see standard maintenance strategies for a broad range of critical common equipment on TAPS, e.g. valves, transmitters, batteries, generators, pumps, switchgear, etc.

17.20. Alyeska executives are not notified of Risk Rank Priority 2 items

AM-017-01, Risk Assessment Procedure, (pg. 7) states, "The appropriate member of the Executive Team is notified of Level 2 Medium Priority risks." Risk Rank 2 functional failures identified by IMS Analysis[13] are not generating a complete RCM, as recommended in AMS-026, (2.1.7) and there is no evidence to suggest that the appropriate member of the Executive Team was notified.

[10] AMS-026, rev. 9, Maintenance Strategy Process, pg. 4
[11] Ibid. 2.2.3, pg. 8
[12] Ibid. Attachment 9, pg. 23
[13] IMS-500002, Maintenance Strategy for the Sequential Batch Reactor, and IMS re: 35024714 PV, Evaluate Transformer Oil Samples and Make Recommendation

17.21. Key Performance Indicators (KPI) are Ineffective at Monitoring Maintenance Performance

VMT KPI's do not adequately measure or monitor the effectiveness of the RCM/IMS processes to ensure maintenance strategies are being implemented or optimized. Few management controls were identified to monitor consistent application of maintenance processes, procedures and documentation. The KPI's that management uses to ostensibly track maintenance performance at the VMT consist almost exclusively of numerical count of actions (MAC Action Items, PMs and Work Orders) and the organization's ability to close the particular action item. This does not however, give any indication of the proper handling, disposition, or documentation of the Action Item. As discussed elsewhere in this report, it is also evident that a large number of work items can be combined under one action item, therefore masking the significance and potential amount of work involved in a specific Action Item.

17.22. Self-Assessments are not effectively evaluating AMS Process Performance

Alyeska AMS-000, Alyeska Management System Governance Manual, paragraph 4.1 indicates requirements for periodic assessment by process stewards with respect to operation of the AMS processes and an annual report of such assessments to Alyeska management.

> "Process Stewards are accountable for reporting performance metrics that illustrate the performance of the process on at least a quarterly basis. These metrics are developed by the Process Steward in accordance with AMS-021, Performance Measurement and Monitoring Process. The Process Steward will also perform an analysis of the metrics and rate the effectiveness of the process based on their analysis. The performance metrics, analysis, and effectiveness rating for all AMS Processes are submitted via the AMS Integrated Reporting Tool..."

Paragraph, 4.2.1 indicates a requirement for an annual self-assessment of the workings of the process and subsequent reporting of the assessment to management. "All AMS Process Stewards are required to complete an annual self-assessment of their process. This assessment is completed in accordance with AMS-019, Assessment Process, and is designed to measure the suitability, status, effectiveness, and efficiency of the process. Collectively these assessments determine if design principles are being met, if processes reflect good business practice and serve the process users, and add value to TAPS. AMS Self Assessments are completed using the standard template provided the AMS Integrated Reporting Tool..."

The auditors reviewed copies of these self-assessment reports from 2008 to 2011. The KPM (Key Performance Measure) Description in the Quarterly "Periodic Performance Measures for AMS-026: Equipment Maintenance Strategy Process" states, "Maintenance data is monitored, categorized by type, and evaluated with respect to historical performance and

indications of trends. (QA Criteria A11)." Over the time period these reports were reviewed, (4Q08 – 2Q11) the only "KPM Detail" provided is the number of RCMs completed and the number of RCM associated actions open in MAC. Of the 5 of 11 quarterly reports that include a table of "Overall Effectiveness", (added 2Q10) the only "Analysis of Performance Metrics" provided are:

1) *"MAC action items are not being actively worked due to other priorities"*
2) *"The process is not actively supported by support groups"*
3) *"Only 4 of 28 MAC actions were closed this quarter"*
4) *"The MAC items have been open since 2007 and are still not complete, they need actions to be completed by Operations or Support Groups (Engineering) before they can be completed"*
5) *"Engineering project packages are not requiring any RCMs"*

This evidence strongly suggests that the only KPM being considered, evaluated, or reported regarding Alyeska's entire Equipment Maintenance Strategy is MAC action item closures, which by their own assessments were not being closed in a timely manner. The auditors do not believe these self-assessments or the metrics they report provide any insight into the requirement to, "…perform an analysis of the metrics and rate the effectiveness of the process based on their analysis."

17.23. No Evidence that Maintenance Data or Trends are being collected and analyzed

Per AMS-026 and AMS-027, trending and data analysis is a key input component to maintenance management and RCM Analysis. None of the RCMs or IMS documents reviewed indicated any trending analysis data was used to establish maintenance strategies.

18. Additional Observations

In addition to the Audit Findings discussed above, the Consultants made observations, which although they may not relate specifically to the scope of the audit or issues specific to Alyeska's use of RCM at the VMT, may provide useful insight to both PWSRCAC and Alyeska management. Similarly, the Consultants were also asked to provide opinions of the significance and potential impact of the Findings and Observations.

18.1. Complex Management Systems and Procedures increase Operational Risk

Operational risk is typically defined as "the risk of loss resulting from inadequate or failed processes, people, or systems, or from external events." This audit reflects a number of failed processes and management systems which increase Alyeska's operational risk. Although the audit did not uncover any specific maintenance issue which could be characterized as an "imminent threat," in the RCM systems reviewed, the complexity of the

processes and number of procedural disconnects, significantly increases Alyeska's risk and hampers their ability to manage it. Further contributing to this risk is the finding that only a very few key individuals understand the RCM and Maintenance Strategy processes. Failure to effectively understand and manage changing operating conditions (operating context) in relation to asset configuration management are often contributing factors to Industrial Process facility accidents and incidents.

18.2. Configuration Management

Although a number of relatively insignificant errors and references were identified in a review of the RCM and IMS Analyses and referenced documents, one error in the analysis of the V5 Crude Skimmers stood out as potentially significant. The RCM referenced Pressure Safety Valves (PSVs) in the analysis, that when researched, could not be identified by tag number on the P&ID's as PSVs. Further research determined that these were actually Pressure Control Valves (PCVs) and not in fact PSVs. Obviously, PSVs and PCVs perform significantly different functions and have very different safety and regulatory issues.

Field walk-down of some equipment associated with the V5 Skimmer RCM also identified some missing equipment tags and discrepancies in skid package tag numbers versus individual components.

18.3. Maintenance Backlog

VMT Maintenance backlog appears unmanageable in terms of backlog hours versus available resources. A review of the April 2011 VMT Maintenance backlog report indicated approximately 810,000 hours of work in Passport. The largest volume of work forecast in Passport is project related, so it has been removed from consideration of this analysis. Of the remaining, approximately 126,000 hours are direct Alyeska maintenance hours. Assuming a 2,000 hour man-year, these backlogs represent 400 total man-years for all backlog, and 63 man-years for non-project backlog. A review of a single week (May 31 – June 6, 2011) indicated approximately 1,000 logged maintenance hours were captured in Passport. Assuming this is a reasonable estimate of an average week, the maintenance backlog would represent approximately 2-1/2 years of maintenance backlog. Considering not all maintenance work is captured and tracked in Passport, the actual backlog is likely considerably higher than this simple estimate. The Consultants did not identify a realistic understanding of the magnitude of backlog maintenance by VMT management. It is also evident that during an "average week," approximately 40-50% of "planned maintenance" is not completed, but this does not appear to create a "wave front" of increased backlog the following week. Although we did not fully investigate this with VMT management, it is not clear how the maintenance backlog report is generated, or how it can be used to assist in understanding maintenance priorities, resources required, or maintenance performance. Alyeska management acknowledged "challenges" with maintenance metrics, including KPI's and backlog management.

18.4. Maintenance Prioritization

Although within Passport work orders are assigned a priority rank of 1 through 4, these priorities are not directly related to planning and scheduling of backlog. One interviewee referenced the existence of a "Maintenance Work Prioritization Process" at VMT. We did not identify any reference to such a process within the systems or process documents we reviewed. AMS-026 indicates that AMS-017 (Risk Management) will be used to evaluate risk to be used in performing an RCM analysis, and presumably establish priorities associated with maintenance tasks. No other work prioritization process or procedure is referenced within AMS-026 or 027, other than AMS-017. If a formal work prioritization process exists for VMT maintenance, it is not referenced in AMS documents or captured in Passport.

18.5. RCM Resources

It is the Consultants' opinion that Alyeska does not dedicate adequate resources or provide sufficient management support to ensure the RCM process is effectively applied at the VMT.

18.6. Computerized Maintenance Management System (CMMS)

The Indus Passport Suite was implemented at Alyeska in the mid 1990's to streamline the maintenance and materials management functions. At that point in time there were multiple software solutions and data bases being utilized across Alyeska's organization to support their core company processes.

The ability to access and report against these data base systems as an aggregated whole was virtually impossible. While the initial deployment of Passport at Alyeska reduced the overall data bases and software solutions, Passport did not evolve over time and today remains too complex for most users.

Additionally, technology obsolescence is creating a need for adopting specialized technical solutions that deal with software incompatibilities caused by mixing old and new software architectures. Similarly, business process challenges are driving the need for the creation of "work around" systems leading to fragmentation of data and business workflows. This in turn results in inefficiencies, increased support requirements, and increased operational risk.

It is the opinion of the Consultant that Passport fails to deliver the desired results Alyeska needs to adequately plan, schedule, query, track, link relationship and dependencies, or generate meaningful Key Performance Indicators.

It is the opinion of the Consultant that Alyeska needs to implement a different CMMS system to address the problems that seem to plague Alyeska Maintenance. Passport suffers the following limitations:

1) Passport Functionality

- Passport lacks the basic flexibility to fit the organization's business and work flow needs.
- Passport has limited ability to manage specialty resources, which can result in the execution of unplanned work, sometimes causing duplications of the same work in the system.
- Passport lacks basic cross reference search capabilities.
- Passport does not navigate well between its own modules.
- Passport does not have the ability to research cost of repairs and labor very well.
- Passport does not work well with other platforms.
- Work order close out in work management is very time consuming and cumbersome.
- "Silo" architecture and business processes limit integration and sharing

2) Passport Integration

- Passport is not an Open Source software suite that allows easy integration of other data sources. This limitation forces organization to maintain multiple data bases for documentations, drawings, management tracking, etc.
- Passport does not allow for easy OPC (OLE for Process Control) interfacing. This is a standard business practice today that allows for better work management and historical tracking from data historians, and keeps all real-time data from data historians in the CMMS suite.
- Passport does not provide visibility and accurate real time data management.

3) Passport Support

- Passport version 9C is rapidly approaching the end of its life cycle. Some Modules within Passport are outdated and very costly to maintain.
- The current version of Passport is no longer supported by the software manufacturer.

19. Recommendations

Based on the findings and observations of this audit, the Consultants recommend Alyeska consider the following:

1) Review Industry Best Practices with respect to Facility Maintenance and RCM.

2) For Alyeska to make RCM an effective method of establishing maintenance strategies, they should:
    a. Dedicate the resources and management attention necessary to support and implement RCM.
    b. Redesign Alyeska's Maintenance Strategy Process to more simply and practically support the use of RCM and/or IMS Analysis.
    c. Establish criteria and standards to update an RCM.
    d. Establish criteria and standards for input into an RCM.
    e. Establish criteria and standards for output of an RCM. Include standards for recommendations, determining actions and implementation tracking.
    f. If an RCM recommendation changes due to feedback or response, it should be captured and documented within the RCM toolkit.
    g. Review current employee training status and establish minimum requirements for performing an RCM.

3) Independent of the recommendations regarding RCM, Alyeska should replace Passport with a new fit-for-purpose Maintenance Work Management suite. Selection should be driven by an objective assessment of its ability to effectively manage maintenance work flow and provide open source integration as discussed above. Integration with financial systems should not be a major factor in system selection or design. Any new CMMS should be capable of managing the RCMs and their recommendations directly.

4) Rewriting AMS documents to be more reflective of their commitments and objectives, which may entail a complete, rewrite and restructure of many of the existing AMS documents.

5) Alyeska should augment its maintenance strategies by leveraging more data from its' own PI (Plant Intelligence Software) data historian by doing more condition based monitoring and predictive maintenance. This is a highly effective way of doing non-intrusive maintenance that mitigates shut downs and process up sets.

Attachments:

1. TDDI List of IMS Packages - VMT
2. Summary of Alyeska 2010 Maintenance Audit Findings
3. Comparison of Audit Findings to Alyeska 2010 Maintenance Audit
4. Summary of PetroTech 2002 Audit Findings
5. Documents Reviewed under this Audit
6. Audit Interview Questions
7. Interview List

Appendices:

8. V5 Skimmers – RCM-VMT-038r1, March 2008 - Summary of Audit Findings
9. Power Vapor Compressor – RCM-VMT-025, October 2002 - Summary of Audit Findings
10. Main Line Relief Valves – RCM-VMT-018, May 2002 - Summary of Audit Findings
11. Back Flow Preventer – RCM-VMT-010, 2007 - Summary of Audit Findings
12. Crude Distribution Piping Corrosion Control – RCM-VMT-017, May 2002 - Summary of Audit Findings

Attachment 1

VMT Informal Maintenance Strategy Analysis Packages

(Available through TDDI)

1.	IMS-500001	IMS Medium Voltage Switchgear
2.	IMS-500002	IMS STP
3.	IMS-500003	IMS Firewater Control Panel
4.	IMS-500004	IMS VRLA UPS
5.	IMS-500005	IMS Flooded Cell UPS
6.	IMS-500006	IMS G&W Gas Filled Switches
7.	IMS-500007	IMS BWT Air Handling Units
8.	IMS-500008	IMS Roadway Lighting
9.	IMS-500009	IMS Oil Filled Transformers
10.	IMS-500010	IMS Limitorque Actuators
11.	IMS-500011	IMS Sump 58-SU-15
12.	IMS-500012	IMS Panametric Flow Meters
13.	IMS-500013	IMS 480V Switchgear
14.	IMS-500014	IMS Berth Robo-Monitors
15.	IMS-500015	IMS BWT Sludge
16.	IMS-500016	IMS Sump 58-SU-96
17.	IMS-500017-01	IMS Root Vine PI-5203A
18.	IMS-500017-02	IMS Root Vine PI-5203B
19.	IMS-500017-03	IMS Root Vine PI-5203C
20.	IMS-500018	IMS Evacuation Sirens
21.	IMS-500019	IMS Level Sensor
22.	IMS-500020	IMS 53-PIT-8254

Attachment 2

Summary of Alyeska's findings of their 2010 Maintenance Program Audit

1) Apparent drop in the number of RCM's written over time. No clear rationale for reduction.
2) Maintenance Strategy Board has not met in over 2 years. Lack of maintenance leadership.
3) RCM resources reduced over time. (VMT better focused than Pipeline)
4) No clear criteria for when to "revisit" RCM's on systems previously reviewed.
5) Difficult to monitor and track Informal Reviews
6) Informal Reviews not consistently getting in to TDDI
7) Recommendations coming out of RCM's /IMS do not have KPI's under Action Items and Tasks by which to measure and monitor progress of implementation of recommendations.
8) Multiple actions sometimes roll up to one single MAC Action item, making it difficult to see the extent of the actions pending and their completion.
9) Some Action Items are significantly old and incomplete.
10) Lack of specific frequency for updating RCM's. (see item #4 above) No clear and specific "trigger" upon which to review/revise RCM's.
11) Subject Matter Experts (SMEs) are only "encouraged" to be involved with RCM's, making it difficult to ensure their involvement due to other pressing priorities.
12) Management of Change (MOC) controls, checks and balances appear weak with respect to RCM's.
13) PM changes are being well documented.
14) SMP changes poorly documented. Controls appear too casual.
15) PM changes are supposed to be reviewed as they relate to RCM's recommendations and analysis. Unclear conformity.
16) Recommendations from RCM's appear to default to "Low Risk". Not clear enough guidance for engineers in categorizing risk. Risk matrix leaves too much to engineering judgment.
17) Managers use KPI's with respect to Passport well in tracking aging/deferrals for work tasks entered into Passport.

Attachment 3

Comparison of Findings to Alyeska 2010 Maintenance Audit	
Alyeska Internal 2010 Maintenance Audit	**2011 RCAC Maintenance Advisory Audit**
1. Apparent drop in the number of RCM's written over time. No clear rationale for reduction.	Agree. No investigation performed.
2. Maintenance Strategy Board has not met in over 2 years. Lack of Maintenance Leadership.	Agree.
3. RCM resources reduced over time. (VMT better focused than Pipeline)	Did not investigate.
4. No clear criteria for when to "revisit" RCM's on systems previously reviewed.	Agree. Significant finding with respect to effectiveness of RCM process.
5. Difficult to monitor and track Informal Reviews	Agree. Very few IMS packages are entered into TDDI.
6. Informal Reviews not consistently getting in to TDDI	Agree. Very few IMS packages are entered into TDDI.
7. Recommendations coming out of RCM's /IMS do not have KPI's under Action Items and Tasks which to measure and monitor progress of implementation of recommendations. a. Multiple actions sometimes roll up to one single MAC Action item, making it difficult to see the extent of the actions pending and their completion. b. Creates a problem with MAC AI aging issues. Some Action Items are significantly old and incomplete. c. VMT is better than Pipeline in this area.	Agree. KPI's do not adequately track RCM/IMS recommendations.
8. Lack of specific frequency for updating RCM's. (see item #4 above) No clear and specific "trigger" upon which to review/revise RCM's.	Agree. Very few RCMs have ever been revised. IMSs are not retrievable, so review/revisions are extremely unlikely within current system.

Alyeska Internal 2010 Maintenance Audit	2011 RCAC Maintenance Advisory Audit
9. SME's are only "encouraged" to be involved with RCM's, making it difficult to ensure their involvement due to pressing priorities.	Agree. Evidence of appropriate SME's not being involved in RCM Analysis, resulting in recommendations being rejected by SME's after RCM is published.
10. MOC controls, checks and balances appear weak with respect to RCM's.	Agree. No evidence of MOC controls for RCMs exist.
11. PM changes are being well documented.	PM changes are documented, but the method of initiating a PMCR is not adequately controlled.
12. SMP changes poorly documented. Controls appear too casual.	Did not investigate.
13. PM changes are supposed to be reviewed as they relate to RCM's recommendations and analysis.	Agree. No evidence of any review related to RCM.
14. Recommendations from RCM's appear to default to low Risk. Not clear enough guidance for engineers in categorizing risk. Risk matrix leaves too much to engineering judgment.	Agree. Risk evaluations appear to default to Low, and even some Risk Rank 2 elements are not being reviewed and approved as required by AMS-017.
15. Managers use KPI's with respect to PassPort well in tracking aging/deferrals for work tasks entered into PassPort.	Do not Agree. No evidence that managers have any metric available in KPI's other than total number of WO's opened and closed, and deferred WO's do not appear to receive any higher attention. KPI's do track PassPort assigned Priorities, but KPI's do not provide any insight into specific items being deferred, only that they are open, closed, or late.

Attachment 4

Summary of Findings from Petrotech Alaska
Review of RCM Documents, ROW Renewal Projects VMT, July 2002[14]

1. Analyses of the specific applications do not adequately follow Recommended Practice (RP) in RCM methodology.
2. Major deficiency in lack of performance standards and expectations in areas of safety, environmental integrity, useful life integrity and operational effectiveness.
3. Methodology and guidelines for performance of the analysis are sound, although the actual analyses do not adequately use them.
4. Does not follow the RP for RCM Analyses method from the standpoint of system functions.
5. Do not follow the RP for establishing the appropriate operating context addressing:
    a. Historical failure frequency
    b. Expected operating performance criteria
    c. Why the system is judged critical
    d. Useful life requirements
    e. Economic impact of system failure
6. Primary and secondary functions listed in the analyses do not follow RP
7. System Boundary assessments do not follow RP
8. Identification of failure modes do not follow RP
9. No evidence to indicate that a sub-system function criticality analysis was performed
10. Many failure modes are not analyzed as prescribed in the RP
11. Pre-analysis documentation does not follow RP (inaccurate system configuration data was used)
12. Analysis performed on different basis than installed equipment
13. Failure mode details are incomplete
14. Task selection does not follow RP
15. Absence of failure data in analyses reviewed
16. Failures recommending redesign do not follow RP
17. Failures requiring compulsory redesign do not follow RP
18. Different application on Pipeline vs. VMT ("streamlined" RCM on the pipeline and RCM II for VMT). Potential exists for the more detailed (VMT) program to be degraded over time because it requires more time and effort to execute properly.

[14] "Review of Reliability Centered Maintenance Documents Right-of-Way Renewals Project, Valdez Marine Terminal", RCAC Contract No: 552.02.01, PetroTech Alaska, July 2002

Attachment 5

Alyeska Reference Documents

1. Alyeska Management System Documents

1.1.	AMS-000	Alyeska Management System Governance Manual
1.2.	AMS-001-01	Publishing Documents in TAPS Document System
1.3.	AMS-001	Documents Process
1.4.	AMS-002	Regulatory Compliance Process
1.5.	AMS-003	Project Management Process
1.6.	AMS-004-01	TAPS Engineering Guidance Manual
1.7.	AMS-004-02	Seismic Design Control
1.8.	AMS-004-04	Fabricator and Repair Facility Evaluation and Approval Procedure
1.9.	AMS-004-05	Engineering Work Management Procedure for Non-Project Activities
1.10.	AMS-004-06	Alyeska Equipment Tag Philosophy and Update Procedure
1.11.	AMS-004	Engineering Process
1.12.	AMS-005	Long Range Strategic and Business Planning Process
1.13.	AMS-006	Agency Interaction Process
1.14.	AMS-007	Performance Expectations and Review Process
1.15.	AMS-008-01	Electronic AFE Desktop Guide
1.16.	AMS-008-02	AFE Control Manual
1.17.	AMS-008	Authorization for Expenditure (AFE) Process
1.18.	AMS-009-01	Drawing Services Guidance Manual
1.19.	AMS-009	Alyeska Master Drawing Update Process
1.20.	AMS-010-01	Contracting Guide
1.21.	AMS-010-02	Contractor Qualification Procedure
1.22.	AMS-010	Contract Administration Process
1.23.	AMS-011-01	Oil Spill Response Training Management Program
1.24.	AMS-011	Training and Qualification Process
1.25.	AMS-012-01	Management Identified Issues Procedure
1.26.	AMS-012-03	MAC Trending and Analysis Procedure
1.27.	AMS-012	Management Action and Commitments (MAC) Process
1.28.	AMS-017-01	Risk Assessment Procedure
1.29.	AMS-017-02	Project Risk Management Procedure
1.30.	AMS-017	Enterprise Risk Management Process
1.31.	AMS-026-001	Preventative Maintenance (PM) Change New PM Procedure
1.32.	AMS-026-002	BOM Development Procedure
1.33.	AMS-026-003	Maintenance Tag List and Physical Tagging Procedure
1.34.	AMS-026	Equipment Maintenance Strategy Process
1.35.	AMS-027-001	Replacement-in-Kind
1.36.	AMS-027-002	Certificate of Fitness
1.37.	AMS-027-003	Permit Requirements for Working on Fire and Gas Systems

1.38. AMS-027-004 Electronic Maintenance Records
1.39. AMS-027-005 PassPort Work Process Flow
1.40. AMS-027-006 ROW Maintenance Work Management
1.41. AMS-027-007 Fleet Work Process Flow
1.42. AMS-027 Maintenance Work Management Process

2. TD-219 Technical Document and Drawing Index

3. DB-180 Design Basis Update

4. QA-36 Quality Assurance Program Manual, Ed. 2, Rev. 2, Feb. 25, 2010

5. Forms
   5.1. 0228 Engineering Document Release
   5.2. 0245 Materials Catalog Request, Inventory Control FBU
   5.3. 10016 Pre-startup Safety Review (PSSR) Checklist
   5.4. 10085 OCC Change Controller Form
   5.5. 10192 FSIH Review Checklist
   5.6. 10195 Environmental Review Checklist
   5.7. 10276 Scope of Work Form
   5.8. 10362 Replacement in Kind Evaluation
   5.9. 10410 Informal Maintenance Strategy Analysis Form
   5.10. 10481 Project Completion Punchlist
   5.11. 10563 Engineering Checklist
   5.12. 10565 Modification Specific Design Basis
   5.13. 10568 Scope Document
   5.14. 1241 Preventative Maintenance Change Request
   5.15. 3105 Equipment Tag Request Change Workbook
   5.16. 3110 Mechanical Catalog Record Transmittal Instructions
   5.17. 3119 Mechanical Catalog Record Transmittal Instructions
   5.18. 3440 Design Change Verification Request Log
   5.19. 7248 Bill of Materials Data Sheet

6. VMT RCM's Reviewed
   6.1. RCM-VMT-010 VMT Mainline Back Pressure Control Review RCM, 2007
   6.2. RCM-VMT-017 VMT Crude Distribution Piping Corrosion Control RCM, May 2002
   6.3. RCM-VMT-018 VMT Mainline Relief RCM, May 2002
   6.4. RCM-VMT-021 VMT Berth 4 Firewater System RCM, September 2002
   6.5. RCM-VMT-025 VMT Vapor Recovery Tank Farm Compressor RCM, October 2002
   6.6. RCM-VMT-030 VMT Power Generation Overview RCM, December 2002
   6.7. RCM-VMT-031 VMT P/V Boiler Drum Level Controls RCM, March 2003
   6.8. RCM-VMT-038 VMT Ballast Water Recovered Crude Skimmer Version 5 RCM, March 2008

6.9. RCM-VMT-041 VMT Marine Crude Arms, Vapor Arms, and Chiksan Hydraulic Skid RCM Review, June 2005

6.10. RCM-VMT-042 VMT P/V Gas Compressor Seal Leak Control System Z466 RCM, June 2005

6.11. Tanks 7 & 8 Secondary Containment System RCM2 Analysis – Final Report, Sept. 2008

7. VMT IMS's Reviewed (available through TDDI)

7.1. IMS-500001 IMS Medium Voltage Switchgear

7.2. IMS-500002 IMS STP

7.3. IMS-500003 IMS Firewater Control Panel

7.4. IMS-500004 IMS VRLA UPS

7.5. IMS-500005 IMS Flooded Cell UPS

7.6. IMS-500006 IMS G&W Gas Filled Switches

7.7. IMS-500007 IMS BWT Air Handling Units

7.8. IMS-500008 IMS Roadway Lighting

7.9. IMS-500009 IMS Oil Filled Transformers

7.10. IMS-500010 IMS Limitorque Actuators

7.11. IMS-500011 IMS Sump 58-SU-15

7.12. IMS-500012 IMS Panametric Flow Meters

7.13. IMS-500013 IMS 480V Switchgear

7.14. IMS-500014 IMS Berth Robo Monitors

7.15. IMS-500015 IMS BWT Sludge

7.16. IMS-500016 IMS Sump 58-SU-96

7.17. IMS-500017-01 IMS Root Vine PI-5203A

7.18. IMS-500017-02 IMS Root Vine PI-5203B

7.19. IMS-500017-03 IMS Root Vine PI-5203C

7.20. IMS-500018 IMS Evacuation Sirens

7.21. IMS-500019 IMS Level Sensor

7.22. IMS-500020 IMS 53-PIT-8254

8. VMT IMS's Reviewed (not available through TDDI)

8.1. Z533, VMT Power Generation Upgrades

9. Joint Pipeline Office Documents

9.1. Comprehensive Monitoring Program, TAPS Maintenance and Sustained Useful Life, CMP-02-C-002, Report #12, May 2002,http://www.jpo.doi.gov/Publications/CMPs/CMP12/RCMReport.pdf

9.2. Joint Pipeline Office, 2003 Annual Report, BLM-AK/AE-04/011+2800-990, http://www.jpo.doi.gov/Publications/Annual/2003-2004%20report.pdf

9.3. Agreement between Joint Pipeline Office and Alyeska Pipeline Service Company, February 28, 2002.

9.4. Agreement Between Joint Pipeline Office and Alyeska Pipeline Service Company, June 27, 2002

9.5. Joint Pipeline Office, Executive Summary, April 30, 2002

10. Alyeska Management Reports
    - 10.1. 2008 (Q4) through 2011 (Q2) Periodic Performance Measures for AMS-026: Equipment Maintenance Strategy Process
    - 10.2. 2008 Annual Self-Assessment for AMS-026: Equipment Maintenance Strategy Process
    - 10.3. MAC Action Item Summary Tracking Report, "Maintenance Strategy Recommendations" Core Business Source sort, dated: March 24, 2011
    - 10.4. VMT Maintenance Organization Chart

11. Maintenance and Operating Procedures
    - 11.1. MEC-0118, Mainline Relief Valve Coupling Installation
    - 11.2. OMS-4.60, East Metering Operator Duties
    - 11.3. MIE-0102, Calibration of the Inlet Relief Valves
    - 11.4. BWT-9.10, Ballast Water Treatment Facility Operator Routine Checklist-Normal Operations
    - 11.5. OMS-3.85, Isolation Procedure for Relief Valves: 58-PSV-004, -005, -006, and -007 – Normal Operations

Attachment 6

Interview Questions

The standard questions asked of interviewees were:

1. What change initiates an Informal Maintenance Strategy (IMS) or revision to an existing IMS or RCM at VMT?
2. Do minor modifications or modifications covered by a work order require an IMS or RCM review?
3. Is an IMS always conducted prior to an RCM as specified in AMS-026 to determine risk per AMS-017?
4. When is an RCM analysis appropriate as described in AMS-026 and AMS-017?
5. How do project managers and Engineers know if an IMS or RCM has been done in the past?
6. Where are IMS and RCM documented and stored for review?
7. Who must attend an IMS or RCM as participants and how does the IMS or RCM document who participated?
8. What is the feedback loop for RCM's that ensures sustainability of the process over time?
9. When the IMS is completed does it require maintenance, operations or owner acceptance prior to Maintenance Manager Sign off?
10. What method is used to ensure appropriate individuals are assigned implementation tasks and to confirm assignments are completed?
11. When compulsory redesigns are indicated, what method of tracking is used to assure implementation?
12. How are IMS and RCM implementation responsibilities identified and documented?
13. Who is responsible for ensuring an IMS or RCM is implemented?
14. How are "employee concerns" on an, IMS or RCM system handled?
    a. Does it trigger an IMS or RCM review?
    b. Have there ever been any employee concerns over an IMS or RCM?
    c. Have they been resolved?
15. Have any MAC items been generated on an IMS or RCM?
    a. Have they all been resolved?
    b. Does the MAC item trigger a review of the RCM?
16. What is engineering's role in the IMS or RCM?
    a. Where is that documented?
    b. Can an IMS or RCM be completed without an engineer?
17. What are the Project Manager and Construction Superintendent roles in the IMS or RCM?
18. What is the customer's role in the IMS or RCM?
19. Have all Engineers, Project Managers, Construction Superintendents and Customers with acceptance authority been formally trained in AMS003/004/017/026/027?

20. Have all Engineers, Project Managers, Construction Superintendents and Customers with acceptance authority been formally trained in Maintenance Strategy (analysis and implementation)
21. When was the last Maintenance Strategy Board meeting?
    a. What were their findings?
    b. Was there any meeting minutes
    c. Was anything implemented
22. What training is provided to accountable individuals in AMS documents?
23. Who is the Risk Programs Manager?
24. Who is the Risk and Crisis Programs Manager?
25. Who is the MAC Process Administrator?
26. What MAC reports are generated and used by management to track completion of Action Items entered as the result of an RCM?
27. Are all members of an RCM Review Team trained and documented as having attended MAM-041?
28. Who determines Operator Qualifications for actions recommended in an RCM:
    a. Maintenance related tasks
    b. Operations related tasks
29. Do you believe there are sufficient resources, controls and leadership to maintain the integrity of the RCM process?

Attachment 7

Alyeska Employees Interviewed (or met with) during Audit:

1.	Chuck Strub	Senior Project Manager
2.	Greg Coombs	Project Engineer
3.	John Hobson	Project Engineer
4.	Lester Green	Valdez Maintenance Manager (Acting)
5.	Scott James	VMT Engineering Manager
6.	Bob Rountree	Senior Discipline Engineer
7.	Mark Stephens	Maintenance Programs Coordinator
8.	Jenni Smith	Technical Information Specialist
9.	Jeff Woods	Maintenance Supervisor
10.	Weston Branshaw	Utilities Operations Coordinator
11.	Tammy Mond	Passport Analyst
12.	Steve Goudreau	BWT Supervisor
13.	Bob Smith	Operations Coordinator
14.	Dennis Allen	Instrument Technician
15.	Dennis White	BWT SPOC
16.	Roger Milionta	PM Specialist
17.	Dale Merrill	Maintenance Planner
18.	Megan Woods	Maintenance Planner
19.	Dave Towne	Instrument Technician
20.	Todd Nibler	Instrument Technician
21.	Joe Kuchin	Sr. Director VDZ Operations (Acting)
22.	Patricia Miller	Project Engineering Supervisor
23.	Rob Annett	Engineering Design Services Supervisor
24.	Ron Robinson	Documentation Supervisor
25.	Andres Morales	Acting SERVS Manager, Recent VMT Maintenance Manager
26.	Bill Polley	Audit Manager
27.	Leo Ramirez	Lead Auditor
28.	Mike Joynor	VP Operations
29.	Kathy Zinn	VMT Manager

Appendices 8 -- 13

V5 Skimmers – RCM-VMT-038r1, March 2008 - Summary of Audit Findings

Power Vapor Compressor – RCM-VMT-025, October 2002 - Summary of Audit Findings

Main Line Relief Valves – RCM-VMT-018, May 2002 - Summary of Audit Findings

Back Flow Preventer – RCM-VMT-010, 2007 - Summary of Audit Findings

Crude Distribution Piping Corrosion Control – RCM-VMT-017, May 2002 - Summary of Audit Findings

Alyeska provided many documents and large quantities of information to the authors of this report under an agreement of confidentiality. The documents and information covered by the confidentiality agreement are not now nor ever in the possession of PWSRCAC. The referenced spreadsheet appendices were created from documents covered by the confidentiality agreement and they contain many verbatim excerpts from the documents.

Although the appendices are referenced in the body of the report, it was determined during the PWSRCAC Board Meeting of September 15-16, 2011 that the appendices are not essential to understanding the findings and recommendations of this report. Additionally, the verbatim excerpts in spreadsheets contain the names of Alyeska personnel.

For these reasons, the appendices are not being distributed with this report. Distribution of the appendices is controlled by Alyeska and requests for the appendices should be directed to Alyeska. PWSRCAC will respond in detail to specific inquiries pertaining to analyses wherein a consultation with the appendices is needed.