Valdez Marine Terminal

Tank 5

Alleged Integrity Concerns
Preliminary Investigation

Report Requested by:
the Prince William Regional Citizens’ Advisory Council

Prepared by:
Harvey Consulting, LLC.

December 17, 2006
Revision No. 1

March 13, 2007
Revision No. 2
Executive Summary

Prince William Sound Regional Citizens Advisory Council (PWSRCAC) requested Harvey Consulting, LLC’s assistance to investigate the alleged tank integrity issues for Valdez Marine Terminal (VMT) Tank Number 5 (Tank 5). PWSRCAC received letters from Chuck Hamel in May, 2006, requesting the council investigate tank integrity issues on Tank 5, which along with other tanks were inspected and repaired in 2002. Dr. Kuckertz (P.E., PWSRCAC) completed the Tank 5 record review at Alyeska Pipeline Service’s (APSC’s) offices. In addition to the notes provided by Dr. Kuckertz, PWSRCAC requested that Harvey Consulting, LLC review agency records and meet with concerned individuals to better understand the scope of the allegations, and make a recommendation for further action by PWSRCAC. This report summarizes the work completed by Harvey Consulting, LLC, in the course of completing a preliminary investigation on the alleged Tank 5 integrity concerns.

Tank 5 is a 535,000 barrel crude oil storage tank. It was constructed in 1976 and received an internal inspected in 1991 and 2002. Tank 5 is located in secondary containment capable of storing the entire contents of the tank.

Employees working at the VMT during the 2002 Tank 5 inspection and repair work allege that materials and repair procedures (especially welding procedures) were substandard and the tank shell and roof were not properly inspected. ADEC started investigating the twelve Tank 5 allegations in October 2002. Tank 5 was returned to service in November 2002, prior to ADEC reaching a finding on whether the allegations were substantiated. ADEC did not reach a finding on the allegations until April of 2003. All twelve allegations were dismissed by the agency.

Requests made for meetings with APSC staff, and APSC contractors, to discuss the Tank 5 allegations and review additional records were denied.

Requests made for meetings with ADEC staff, and former ADEC staff, to discuss the Tank 5 records were denied. However, Ms. Lewis (ADEC) did confirm:

There is an on-going ADEC investigation into this matter, and until we are informed that the investigation has been completed, we will decline further conversations concerning past technical evaluations and/or decisions made by ADEC.¹

¹ August 30, 2006 e-mail from Ms. Lewis (ADEC) to Ms. Harvey (PWSRCAC) copying this memo to ADEC Management and the ADEC Environmental Crimes Investigator Mr. Moses.
One of the twelve allegations was not substantiated based on the records available for this review. It was alleged that the annular plate did not receive 100% Ultrasonic Testing (UT); the testing was completed.

Five of the twelve allegations were substantiated based on the records available for this including: API 653 Inspector’s finding of incomplete roof and support column inspection; lack of construction and inspection records available for inspectors; API 653 Inspector’s finding of incomplete shell inspection; and lack of tank nameplate.

Additional records and expert review would be required to make a finding on the remaining six allegations including: floor material quality; floor quality testing; annular plate inspection after back-gouging; welding of floor to annular ring; heat treatment of metal on access door area; and joint design on access door area.

**Information Available For This Report**

PWSRCAC requested records from ADEC and JPO. ADEC and JPO provided physical copies of letters via U.S. Mail; however, these records essentially denied any Tank 5 welding concerns from the 2002 timeframe. In May 2006, PWSRCAC requested an opportunity to review APSC Tank 5 records from the 2002 timeframe. In June 2006, PWSRCAC was provided two opportunities to visit APSC’s Anchorage office to read and take notes, but not photocopy, information from the Tank 5 files. Dr. Kuckertz (P.E., PWSRCAC staff) completed the APSC record review for Tank 5. In September 2006, APSC provided a copy of their July 3, 2006, report entitled 2002 Valdez Tank Project Review. Attempts to set up additional meetings with APSC Engineering and ADEC to obtain additional information were denied. A written request for additional agency records was prepared by Harvey Consulting, LLC, for PWSRCAC in June 2006, but was not sent by PWSRCAC.

It is recommended that PWSRCAC obtain and review several key reports which were mentioned in APSC and agency documentation, but not provided to PWSRCAC, including:

1. Original APSC inspection reports for Tank 5 which documented inspectors findings;
2. APSC President Wight October 2002 report to JPO on Tank 5 investigation;
3. Engineering Report commissioned by David Wight (APSC) and carried out by Dan Hisey in late 2002; and
4. JPO findings on Tank 5.

On November 26, 2002 Tank No. 5 was returned to service. There is no written record of ADEC or JPO approving this tank to be returned to service, nor were there any agency findings.

__2 June 14, 2006 and June 20, 2006__
issued on or before this date. PWSRCAC should request agency records which approved this tank to be returned to service.

**Allegations**

Employees working at the VMT during the 2002 Tank 5 inspection and repair work allege that material used to replace the tank floor was substandard, there was faulty welding and an incomplete inspection of the shell and tank roof.

In late 2002, ADEC started an investigation into the allegations raised during the 2002 VMT Tank Inspection and Repair Program. On April 25, 2003, ADEC issued a findings document summarizing the results of their investigation.³ This report shows twelve Tank 5 allegations were reported to ADEC and investigated.

Dr. Kuckertz (P.E., PWSRCAC) reviewed the Tank 5 records at the APSC offices on June 14, 2006, and June 20, 2006. Dr. Kuckertz (P.E., PWSRCAC) examined each of the unsatisfactory inspection findings to ensure that there was documentation showing that the inspection finding was closed out. Dr. Kuckertz (P.E., PWSRCAC) concluded that each of the unsatisfactory inspection findings identified by the inspectors was determined to be satisfactory by another inspector prior to returning the tank to crude oil service.

During the interviews conducted by Harvey Consulting, LLC, several people continued to be most concerned about the quality of material used to replace the floor in Tank 5, the welding procedures and incomplete inspection.

**Background**

According to industry standard API No. 653, tanks are typically internally inspected at least once every decade, unless tank integrity history or risk indicate a different interval. In 2002, Tank 5 was due for an internal tank inspection.

During 2002, Tank 5 was cleaned, inspected, repaired, and returned to service.

**Chronology of Events**

This section provides a brief chronology of events associated with the inspection and repair work completed on Tank 5 and the subsequent investigation into employee(s) allegations.

³ April 25, 2003 letter from Bonnie Friedman (ADEC) to Robert Shoaf (APSC), Review of Employee Concerns, Inspection of Tanks 5, 55, and 93, Valdez Marine Terminal.
February 1, 2002
A letter from APSC to ADEC outlined the problems with the cathodic protection (CP) system installed under Tank 5 in 1991. The Tank 5 CP system was the first design attempted at the VMT and used a serpentine system which was later determined to be ineffective, and in 2002 APSC planned to remove the 1991 CP system and install a new CP system, and tank floor.4

May 14, 2002
A letter from APSC notified ADEC and JPO that APSC planned to remove the 1991 CP system and install a new CP system, and tank floor.5

Summer and Fall 2002
Tank 5 was cleaned, inspected, repaired. A new tank floor and CP system was installed.

ADEC’s letter to PWSRCAC dated June 19, 2006, stated that from June 2002 through September 2002 various APSC employees and contractors provided ADEC with copies of emails relating to Tank 5. Interviews with Mr. Harrison (JPO) in August 2006 confirmed that Tank 5 integrity allegations were reported to JPO and ADEC during the summer and fall of 2002.

September 20, 2002
A letter was sent from APSC President David Wight to JPO and Commissioner Brown (ADEC) about the Tank Floor Repair.6 The letter says the technical issues involved the floor plate material that was used and the associated welding processes. APSC President Wight states that Dan Hisey has undertaken an additional review of the project and that the “technical interpretation issues associated with the floor plate material and the welding also included some people issues where we intervened earlier with an ECP process.” Mr. Wight commits to investigating the matter and providing JPO with a report summarizing the status of APSC’s investigation in mid-October 2002.

October 1, 2002
Mr. Harrison (JPO) and Ms. Friedman (ADEC) met with a concerned employee. The employee was working at the VMT and was concerned about repairs being made to Tank 5. The main concerns were the quality of the material used to replace the tank floor and the welding procedures.

October 2, 2002
ADEC conducted a VMT Tank Inspection on July 18, 2002 and issued a report on October 2, 2002. The agency report only mentions minor issues with the Tank 5 chime area, which is confusing since by October 2002, APSC’s President and senior officials at ADEC and JPO were investigating over a dozen employee concerns relating to Tank 5.

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4 February 1, 2002 Letter from Tom Stokes (APSC) to Becky Lewis (ADEC), Cathodic Protection Questions on Tank 5
5 May 14, 2002 Letter from Rod Hanson (APSC) to Bonnie Friedman (ADEC) and John Kerrigan (JPO) and Jerry Brossia (JPO), Crude Tank Inspections – West Tank Farm, Valdez Marine Terminal
6 September 20, 2002 letter from David Wight (APSC) to Jerry Brossia and John Kerrigan (JPO) and Michele Brown (ADEC Commissioner), Tank 5 Floor Repair.
October 16, 2002
ADEC requested information on the inspection and repair of Tank 5. ADEC’s letter states that:

The Department is aware that these tanks will not be returned to service until such time that certain issues have been resolved.

October 16, 2002
APSC responds to ADEC, that APSC is “confident that the work on these tanks was appropriate and consistent with applicable codes…On Monday, October 21, 2002, we will release tank 5 for return to normal service.”

November 19, 2002
APSC responds to JPO with a detailed list of all unsatisfactory findings documented by the inspectors on the 2002 VMT Tank Program. This letter documents 11 unsatisfactory findings for Tank 5. APSC provided information describing how each problem was addressed.

Author’s Note: APSC responds to JPO listing 11 unsatisfactory findings for Tank 5; however, a total of 12 allegations surface during the course of the investigation into employee concerns on Tank 5.

November 23, 2002
Tank 5 was returned to service.

December 20, 2002
APSC informs ADEC Tank 5 was internally inspected, repaired and returned to service.

January 13, 2003
APSC provides ADEC with a copy of Tank 5 Inspection Report. The report summary was prepared by APSC; the original inspector reports were not provided.

April 25, 2003
ADEC sent APSC a letter closing out the twelve (12) Tank 5 allegations. ADEC did not substantiate any of the allegations.

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7 October 16, 2002 letter from Bill Hutmacher (ADEC) to Robert Shoaf (APSC), Request for information on inspection and repairs of Tanks 5, 55, and 93.
8 October 16, 2002 letter from Robert Shoaf (APSC) to Bill Hutmacher (ADEC), Request for information and repairs of Tanks 5, 55, and 93.
9 November 19, 2002 letter from Rod Hanson (APSC) to Willie Harrison (JPO), VMT Tank Program – Inspection Documented Unsatisfactory Conditions.
10 June 21, 2006 e-mail from Sharon Marchant (APSC) to Susan Harvey (Harvey Consulting, LLC.), TK-5 and TK-55 Recommissioning Dates.
11 December 20, 2002 letter from Mr. Hanson (APSC) to Ms. Friedman (ADEC), Planned internal crude tank inspection cycle.
12 January 13, 2003 letter from Rod Hoffman (APSC) to Ms. Friedman (ADEC), Final Crude Tank Inspection Summaries.
13 April 25, 2003 letter from Ms. Friedman (ADEC), to Mr. Shoaf (APSC), Review of Employee Concerns, Inspections of Tanks 5, 55, and 93, Valdez Marine Terminal.
Author’s Note: ADEC’s letter only lists 12 unsatisfactory findings for Tank 5; however, please note ADEC has an error in the numbering scheme (missing number 11) and inadvertently lists 13 allegations, rather than 12.

**July 2, 2003**
APSC submits an annual report for Year 2002 to JPO which included a new cathodic protection system and tank bottom in Tank 5 as one of APSC’s accomplishments for 2002. This report stated Tank 5 roof and shell showed no substantial corrosion during the 2002 inspection.

**May 10, 2006**
Chuck Hamel submits a letter to PWSRCAC alleging unsafe conditions of Tank 5.

**May 12, 2006**
APSC responds to PWSRCAC’s inquiry about Tank 5 allegations. APSC confirms inspectors raised concerns on Tank 5 during 2002, but reports these concerns were all addressed by APSC engineers prior to returning the tank to service.

**May 16 & 18, 2006**
Mr. Hamel was not satisfied with APSC’s May 12, 2006 response, and encouraged PWSRCAC to complete a Tank 5 investigation.

**May 23, 2006**
PWSRCAC submitted a public records request to ADEC requiring all the tank inspection and repair records on Tank 5 since 2000.

**June 14, 2006**
Dr. Kuckertz (P.E., PWSRCAC) reviewed tank inspection and repair records at APSC’s Anchorage Office.

**June 19, 2006**
ADEC responds to PWSRCAC’s Tank 5 record request. ADEC reports Tank 5 inspection, welding and repair issues were investigated by ADEC in 2002-2003. ADEC did not substantiate Tank 5 concerns raised by employees working at the VMT. ADEC withheld many important documents from PWSRCAC citing confidentiality based on attorney client communication or deliberative process.

**June 20, 2006**
Dr. Kuckertz (P.E., PWSRCAC) reviewed tank inspection and repair records at APSC’s Anchorage Office.

**July 3, 2006**
In response to concerns raised by Mr. Hamel on Tank 5, APSC reviewed the Tank 5 records for APSC President, Mr. Hostler. APSC’s July 3, 2006, report to Mr. Hostler concludes: The APSC

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14 July 2, 2003, letter from Mr. Monthei (APSC) to Mr. Brossia (JPO), 2002 MP-166 Integrity Management Monitoring Program Annual Reports.
report concludes that all Tank 5 concerns raised by inspectors were addressed by APSC and fixed, if necessary, before returning the tank to service.

August 2006 (various dates)
Ms. Harvey (Harvey Consulting, LLC) interviewed Mr. Harrison (JPO). Mr. Harrison confirmed employee concerns were reported to JPO and ADEC on Tank 5. The main concerns included the quality of the material used to replace the floor and welding processes.

Ms. Harvey interviewed employee(s) that worked on VMT 2002 tank inspection and repair work who alleged the quality of the Tank 5 floor material was a significant issue, along with use of inappropriate welding procedures. Confidentiality was requested due to fears of retaliation for speaking about what happened on Tank 5 in 2002.

Ms. Harvey requested to meet with APSC Engineer (Tony Balowski) and KAM Inspector (Mike Stevens) to discuss Tank 5 and review engineering records on the allegations. Requests for meetings were denied by APSC.

Ms. Harvey made a request to meet Bonnie Friedman (previous ADEC employee), Sam Sangsudam (ADEC) and Becky Lewis (ADEC). Requests for meetings were denied.

August 30, 2006
On August 30, 2006, Ms. Lewis wrote to Ms. Harvey, copying this memo to ADEC Management and the ADEC Environmental Crimes Investigator Mr. Moses:

This email is in response to your request this afternoon that Sam Saengsudham and I meet with you on Friday, September 1, 2006 to discuss PWSRCAC’s investigation into the Chuck Hamel allegations made in May of 2006 concerning several tanks at the Valdez Marine Terminal (VMT). We have decided not to meet with you at this time. There is an on-going ADEC investigation into this matter, and until we are informed that the investigation has been completed, we will decline further conversations concerning past technical evaluations and/or decisions made by ADEC.

Analysis of Allegations
ADEC’s April 25, 2003 Findings Document lists twelve (12) employee concerns raised on Tank 5 during the 2002 Tank Project. Each of the twelve concerns raised is directly quoted from the ADEC April 25, 2003, finding document in quotations below, with a summary of ADEC’s findings, and a brief recommendation for how PWSRCAC might proceed.

ADEC investigated Twelve (12) Tank 5 concerns

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16 April 25, 2003 letter from Bonnie Friedman (ADEC) to Robert Shoaf (APSC), Review of Employee Concerns, Inspection of Tanks 5, 55, and 93, Valdez Marine Terminal.
Allegation No. 1 – Internal Roof Inspection Quality

Concern: “Roof Rafters were only visually inspected although there was evidence of corrosion. Visual inspection does not satisfy API 653.”

ADEC Finding: “API 653 does not specify the inspecting method. However, it calls for inspection and a structural integrity assessment of the roof support system. The "Responsible Inspector" decides how to inspect the rafter.”

Analysis: API 653, Section 4.2 Tank Roof Evaluation, allows fixed roofs to be inspected by a method acceptable to the responsible inspector. In this case, KAM Inspector Mr. Lane,17 recommended a rigorous inspection of the roof (internal) and roof support structure. Inspector Lane’s API 653 inspection report documented his inability to inspect the roof and roof support structure.

Inspector Lane’s August 24, 2002 Tank 5 inspection report states:18

Roof Internal: Project Specification XO52-T-500 (Section 8.5.2) mandated for the roof to be inspected visually by use of spotlight and binoculars. The roof was looked at and all rafters and support beams were in place. It is unknown the extent of corrosion pertaining to the rafters and support structures as no access to roof was available for close inspection of roof structure.

Roof Structural Members: No thickness readings were taken on rafters or support beam due to the fact that no access was available however random thickness readings were taken on the roof support columns in areas accessible from the floor only.

Conclusions: There was no access to underside of roof for inspection purposes and no means of obtaining shell thickness readings as suggested above. It would be this inspector’s conclusion that since no previous inspection records were available, and taking into account the age of the tank (approx. 26 years), a full comprehensive inspection should have been in order. This comprehensive inspection should have included, in addition to T-500 requirements the following...visually inspect (by way of manlift or scaffolding) underside of roof, rafters for thinning, roof girders and top portion of roof support columns. Also obtain metal thickness readings and visually inspect welded areas. (Ref. API 653 Sec. 4.2.2) and a comprehensive thickness assessment of the roof plates...

While API 653 Inspector Mr. Lane documented concerns about the inability to access the inside of the tank roof to perform a complete internal inspection, roof plate thickness readings were taken from the outside on top of the roof. The 2002 report does show that automated ultrasonic thickness (AUT) inspections were performed on a variety of areas of the tank roof (external).

17 API 653 certified inspector No. 1264
18 August 24, 2002, API 653 Inspection Report, X052 Storage Tank 54-TK-5, prepared by Lead KAM Inspector, Lynn Lane, API 653 certified inspector No. 1264 for APSC.
Corrosion and roof plate thinning was found on eight plates, five were corroded beyond design allowance

Thickness scanning of roof around the vapor inlet, vapor outlet and pressure vacuum vent showed lowest thickness reading (after calculations for paint velocity to be .285. "The nominal thickness of the roof is .375". AUT (Automated Ultrasonic Testing) was done on the roof per X052-T-500.

The original nominal roof plate thickness was 0.375” with a 0.125” corrosion allowance, for a minimum design plate thickness of 0.250.” The API 653 report shows five roof plates below the minimum design plate thickness of 0.250,” including roof plates numbers: 110, 111, 008, 018, and 023.

APSC produced two versions of the API 653 Tank 5 inspection report: (1) the actual inspection report prepared by the API 653 inspector on August 24, 2002, and (2) a January 29, 2003 summary report prepared for ADEC and provided to PWSRCAC upon request. The January 29, 2003 summary report provided to ADEC shows the roof thinning problem, with roof thickness readings below the design allowance for corrosion, but does not show the API inspector’s concern about the internal roof inspection.

It appears that ADEC relied on a summary report developed by APSC, rather than reviewing the original inspection report in developing their finding. Additionally, the agency did not address the more important concern raised by the inspector, which was evidence of roof corrosion.

Findings: API 653, Section 4.2 Tank Roof Evaluation, does allow for fixed roofs to be inspected by a method acceptable to the responsible inspector. In this case the responsible inspector determined the appropriate method for inspecting the roof was to complete an internal and external inspection of the roof. The internal inspection could not be completed, since the inspector was not provided the equipment to access the inside of the tank roof. External corrosion measurements found eight roof plates with corrosion. Five roof plates were corroded beyond the design corrosion allowance. Roof structural supports were not completely inspected. A review of the roof inspection records for Tank 5, and an engineering review of the roof thinning concern, would have resolved this issue in 2002. This concern was substantiated because API 653 provides the Authorized Inspector to decide the roof inspection method and state regulation at 18 AAC 75 requires a complete API 653 inspection.

Allegation No. 2 – Lack of Construction and Repair Records

Concern: “Construction and repair records not available for the AI [Authorized Inspector] to review.”

ADEC Finding: “Construction: there is no requirement for tanks constructed before state regulations took effect. Repairs: after State regulation took effect, (May 92), all repair records
must be kept for the operational life of the tank. If there has been no repair, this item is not applicable.”

**Analysis:** API 653 does require construction and repair records to be maintained by the owner/operator.  
API 653, Section 6.8 Records states: “[t]he owner/operator shall maintain a complete record file consisting of three types of records, namely: construction records, inspection history, and repair/alteration history.”

**Summary of Findings:** The agency’s finding is not consistent with API 653. If construction, inspection and repair records are not available to the inspector, he is required to verify additional items during the inspection that may not otherwise have been required. This concern was substantiated; however, it does not pose an environmental or safety concern requiring further PWSRCAC action at this time.

**Allegation No. 3 – Floor Material Quality**

**Concern:** “Plate lamination.” Many of the plates used for the floor had lamination. No NDE [nondestructive examination] was done to determine the extent of the flaw. No assessment was done. The areas were just "ground out." This does not satisfy API 653-2.3.6.”

**ADEC Finding:** “API 653-2.3.6 is only for shell course lamination. No section of API 653 can be found relating to *floor* plates lamination.”

**Analysis:** ADEC restricts their analysis to the specific language of API 653, Section 2.3.6, but does not answer the more important questions: (1) were there defects in the material used to repair the tank floors, and (2) could the use of poor quality material increase the oil spill risk? Several people interviewed for this report are still concerned poor quality metal was used to replace the Tank 5 floor. It is alleged that laminations in the floor plates were found and ground out. Some amount of “patch” welding was completed to repair the more serious laminations. It is alleged that repaired areas of the new floor were not tested to ensure adequate thickness and integrity prior to returning Tank 5 to service; however, APSC disputes this claim.

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19 A lamination is a metal defect with separation or weakness generally aligned parallel to the worked surface of the metal. A lamination may be the result of pipe blisters, seams, inclusions, or other manufacturing defects.
**Interview with JPO:** Mr. Harrison (JPO) explained that JPO and ADEC received a complaint about laminations in the metal used to repair the tank floors. The complaint alleged the laminations were shaved out of the metal surface and nondestructive testing was not completed to ensure adequate metal thickness before using the material to repair/replace the tank floors. Mr. Harrison said laminations were found in the metal that was used to repair the Tank 5 and 93’s floors. He explained that when the metal is rolled out at the factory, sometimes marks and irregularities are left in the top of the sheet. He said the metal used to repair the tank floors must be a certain thickness. When a lamination is removed by grinding and sanding, after the floor is laid down, this reduces the thickness of the floor and there is no way of ensuring the final remaining thickness is adequate without completing UT. By the time Mr. Harrison went into Tank 5, the laminations were ground out. Mr. Harrison said ADEC had their engineer, Saengsudham, review the allegation. Mr. Saengsudham concluded nondestructive testing was not required for the tank floor laminations. Mr. Harrison was concerned about this conclusion because significant lamination repair can result in a thinner metal.

**Confidential Source:** One person said the metal that was used to repair the tank floors was the poorest they had ever seen in decades of experience repairing tank floors. The metal surface had hundreds of imperfections/laminations. This source alleges APSC told the welders to weld metal over the laminations to cover them up, and the defects were never integrity tested after the repairs were made.

Photos shown were brought to ADEC by a concerned employee. The employee took the photos, labeled them and provided them to ADEC to document the laminations. Labels were not altered for this report; except to enlarge them slightly for better readability. The photos are shown as part of the historical record. This report does not affirm that these photos actually depict plate delamination.

**Records:** API Inspector Lane’s August 24, 2002 API 653 report concluded:

> A total of 84 plates showed areas of delaminations. Sketches of floor plates in question were drawn up and submitted to engineering for follow up.

Yet, a November 19, 2002 letter from APSC
to JPO\textsuperscript{20} reported delamination on nine (9) floor plates; not 84.

An internal APSC engineering report dated October 14, 2002 states:

\begin{quote}
Visual inspection noted laminations in nine bottom plates in Tank 5. Indications were approximately 1” to 2” long by ¼” wide by 1/32” deep and occurred along the edges of the plates. Two additional laminations were observed on the annular plate of Tank 5.
These were uncovered during abrasive blasting operations conducted in preparation for coating. They were located in the middle of the plate, were circular in shape, and roughly 1” in diameter.
\end{quote}

\textit{Per Section 3.4, API 650 requires all bottom plate[s] [to] have a minimum thickness of ¼-inch and comply with the requirements of Section 2.2.1.2.}

The design documents and technical specifications included in the X052 Issued for Construction engineering package reference the API 650 standard and list material requirements that mirror those contained in the standard. The materials used in the repairs of Tanks 5 and 55 conform to the requirements of Section 2, Materials, of API 650.

Material test reports (MTRs) are included with each order of steel. Receipt inspection, conducted by the third party inspection company, Kakivik Asset Management, ensures that the steel received meets the requirements of the project design documents. Documentation of the conformance of tank repair materials to the project technical requirements is maintained in the project file.

Author’s note: APSC’s 2002 report concludes that the steel was determined to be fit for use by a Kakivik Asset Management Inspector; however, it was a KAM Inspector that raised the concern about the floor delamination.

The internal APSC engineering report dated October 14, 2002 goes on to state:

\begin{quote}
Following engineering disposition of the laminations, concerns were raised regarding other surface marks in Tank 5. A total of 83 plates were catalogued by the API 653 inspector as containing these surface marks which the inspector characterized as laminations. Subsequent evaluation by the Project Engineer, the Alyeska Welding Engineer, the Tank Implementation Lead, the API 653 Inspector, the Project Manager, and the Certified Welding Inspector determined that these indications were not laminations. Rather, they were surface marks associated with the rolling process by which plate is formed. The results of this evaluation were documented in an engineering report that resides in the project file.

AWS [American Welding Society] A3.0:2001 defines a lamination as, “a type of discontinuity with separation or weakness generally aligned parallel with the worked surface of a metal.” The steel for the tank bottom plate in tanks 5, 55 and 93 was specified under the American Society for Testing and Materials (ASTM) Standard A36,
\end{quote}

\textsuperscript{20} November 19, letter from Rod Hanson (APSC) to Willie Harrison (Joint Pipeline Office), 2002 VMT Tank Program, Inspection Documented Unsatisfactory Conditions
Carbon Structural Steel. This specification draws upon ASTM A6, General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling, for the general requirements, material constraints, dimensional constraints, and finish of the plate steel. In Section 9, Quality, ASTM A6 states, “The material shall be free of injurious defects and shall have a workmanlike finish.” Note 4 under this section states, “Unless otherwise specified, structural quality steels are normally furnished in the as-rolled condition and subjected to visual inspection by the manufacturer, Non-injurious surface or internal imperfections or both may be present in the steel as delivered and may require conditioning by the purchaser to improve the appearance of the steel or in preparation for welding, coating, or other further processing.”

Based on these requirements, the laminations discovered in the steel were within the tolerances of the ASTM standards governing the plate manufacture. Given that over 106,000 ft² of steel bottom plate was installed in Tanks 5, 55 and 93, the extent of laminations was very minimal.

Summary of Findings: The allegation that defective materials were used to replace Tank 5’s floor could not be substantiated based on the records provided for PWSRCAC review. Mr. Dr. Kuckertz (P.E., PWSRCAC) reviewed the Tank 5 records and does not remember seeing an engineering report in the project file, authored by the Project Engineer, the Alyeska Welding Engineer, the Tank Implementation Lead, the API 653 Inspector, the Project Manager, and the Certified Welding Inspector, which allegedly ruled out this concern. Ms. Harvey requested an opportunity to meet with APSC Engineering staff to review the engineering reports and discuss this concern further to bring it to resolution. Ms. Harvey was denied the opportunity to meet with the APSC engineer that worked on this tank floor replacement, and was denied further access to the APSC engineering records which were requested. Therefore, this issue could not be resolved. It is recommended that the engineering specifications for the tank floor material quality be reviewed and compared to the material delivery and quality control records. It is also recommended that PWSRCAC obtain and review the engineering report in the project file, authored by the Project Engineer, the Alyeska Welding Engineer, the Tank Implementation Lead, the API 653 Inspector, the Project Manager, and the Certified Welding Inspector, which allegedly ruled out this concern.

Allegation No. 4 – Floor Quality Testing

Concern: “Just vacuum box testing of bottom plates is not adequate.”

ADEC Finding: “This inspection method satisfies API 653-12.1.7 for welding. Since the floor was replaced, the latest edition of 650 and 653 should be applied. API 650, 5.3.3, and API 653, 12.1.7.1, allow just visual inspection and vacuum box testing for floor welding.”

Analysis: While API 653 Section 12.1.7.1 does allow vacuum box testing as an approved method, the 2003 amendment to API Section 12.1.7.3 requires repaired sections of the floor be examined by magnetic particle method or the liquid penetrant method, in addition to vacuum box
and solution or a tracer gas and detector method. While section API Section 12.1.7.3 was not contained within the API standard when the tanks were inspected in 2002, it is currently industry practice to require magnetic particle method or the liquid penetrant method as an important quality control procedure for floor repairs. The inspector was aware of this improved technique and recommended it to APSC for implementation in 2002.

Inspectors Concerns: Inspector Lane’s API 653 report states:

All areas showing floor delaminations should have been examined and tested both visually and by an NDT method to ensure no delaminations remain in the new floor plate.

APSC’s Response: An internal APSC engineering report dated October 14, 2002 explained the testing that was completed to repair these nine areas of delamination:

All significant laminations were repaired by adding low hydrogen weld metal to the affected area and then grinding the area smooth. No special examinations were performed on these areas as they fell within the area encompassed by the vacuum box and received a leak test application.

Author’s note: APSC Engineering only recognized nine (9) significant areas that they label “delaminations.” The Kakivik Asset Management Inspectors document eighty four (84) areas of delamination. Although the APSC report concludes the nine (9) laminations were fixed and tested, this does not satisfy the inspector, because not all the laminations are addressed. APSC documentation made available to PWSRCAC, states that APSC engineers confirmed only 9 of the 84 areas were “true” laminations. However, this report was not available for PWSRCAC. APSC’s lamination report should be made available to confirm this important discontinuity in the records.

The October 14, 2002 APSC engineering report goes on to say:

Visual inspection and leak testing using a vacuum box formed the basis on the NDE applies to the laminations. All laminations were visually inspected. All bottom plate laminations were, or will be, leak tested...Magnetic particle testing (MT) was used to evaluate the deepest lamination and was applied randomly to check the remaining laminations.

All methods of examination are not necessarily the best for all indications. With respect to the laminations found on the bottom plate, all were within the examination area encompassed by the vacuum box testing. Taking all factors into consideration, examination based upon visual testing and leak testing and coupled with good welding practice, is effective and sufficient for the indications found.

All bottom plate laminations discovered and presented to engineering were superficial. All were within the examination areas of the vacuum box method of examination (or in close proximity) and the type of indication to which vacuum box examination applies. All were visually examined by a qualified and certified individual. All laminations that required welding were repaired using a low-hydrogen welding procedure. The chemical and mechanical characteristics of the floor plate and/or annular plate base metal and the design conditions of the floor plate do not constitute a need for extraordinary techniques or an over abundance of different examination methods. None of the laminations were in the critical zone and the material of choice (i.e., A36 carbon steel) is not susceptible to cracking. The essential attributes that the floor plate must have to achieve its design
requirements are 1) that it contain the project and 2) that it not have an area deficient by any means that would provide a leak path for the product. The application of the vacuum box technique coupled with visual examination and sound welding practice provide the level of attention needed to ensure a quality product.

A more recent report by APSC (July 3, 2006) concludes:

Inspections identified what they considered to be floor plate laminations. The condition was brought to the attention of the X052 Project Management Team, which included two welding engineers. Some areas referred to as de-laminations were identified, corrected and accepted by inspections. Others were inspected through nondestructive examination and determined to be plate milling marks that are acceptable (the difference being, laminations have depth, milling marks do not; milling marks are cosmetic features).

Findings: The API 653 inspection standard in place during the 2002 Tank 5 repair allowed for vacuum box testing as an approved method. APSC’s report to JPO states that vacuum box testing was completed for the nine (9) laminations. Test results of the vacuum box testing of the nine (9) laminations were not available to PWSRCAC.

APSC Engineering concluded that the other 75 areas (84 laminations identified by the API 653 inspector vs. the nine (9) repaired and vacuum box testing) were determined not to be laminations. The remaining 75 areas did not receive vacuum box testing, according to the records available to PWSRCAC.

In 2003, API upgraded its method for floor inspection to include Section 12.1.7.3 which requires repaired sections of the floor to be examined by magnetic particle method or the liquid penetrant method, in addition to vacuum box and solution or a tracer gas and detector method. While the 2003 method was not an API 653 requirement in 2002, the API 653 Inspector did specifically recommendation this additional testing. APSC states there is an engineering report in the project file which allegedly ruled out this concern in the Tank 5 records; this report was not available to PWSRCAC. Requests to meet with APSC engineering were denied.

Allegation No. 5 – Annular Plate Inspection

Concern: “Annular plate\textsuperscript{21} was not 100% inspected.”

\textsuperscript{21} The annular ring sits at the bottom of the storage tank and connects the tank shell plates to the tank bottom. The annular plate typically rests on a crushed stone or concrete ring wall, and joins the shell of the tank to the bottom plates. The bottom plates are set on the tank pad or foundation. The annular ring takes most of the tank bottom stress. The annular plate-to-shell junction is subjected to high stresses, because the annular plate tends restrains the radial changes in the tank shell dimensions due to both hydrostatic pressure loads and temperature. The annular plate rests on a rigid foundation restraining the rotation of the shell subjecting the annular plate and junction weld to high bending stresses. The rigidity of the foundation determines, for the most part, the restraint to rotation at the junction.
**ADEC Finding:** “API 653 does not specifically call for an entire plate scan. However, records indicated that a 100% inspection was done.”

**Finding:** The 2002 API 653 report for Tank 5\(^{22}\) shows the Annular Ring was 100% inspected using manual ultrasonic testing (MUT). This concern was not substantiated.

### Allegation No. 6 – Annular Plate Inspection After Back-Gouging

**Concern:** “Annular plate was not being NDE [nondestructive examination] after "back-gouging."\(^{23}\)

**ADEC Finding:** “API 653-12.1.5 has provisions for back-gouged of shell-to-shell welding, not bottom plates.”

**Analysis:** The 2002 API 653 report for Tank 5\(^{24}\) shows an unsatisfactory finding for the lack of magnetic particle examination of annular ring back-gouging:

> Tank 5 floor removal involved gouging off old floor from annular ring. X052-T-411 Sec. 3.7.2 required magnetic particle examination of all back-gouging. This examination was not performed.

A July 16, 2002 inspection finding by KAM Inspector Mr. Isensee\(^{25}\) states:

> TK-5 NDE not performed after old floor removal by arc-gouging. Refer to T-411 3.7.2.1.

In response to an inquiry from ADEC about whether or not back-gouging occurred on Tank 5, APSC responded:

> With regards to tank bottoms (i.e., bottom plate-to-bottom plate welds and bottom plate-to-annular plate welds) no back-gouging was performed.

**Findings:** Further investigation is required. While Section 12.1.5 does refer to shell plate to plate welds, it does specify that for plate thicknesses greater than 1 inch, the back-gouged surface of the root pass and final pass (each side) should be examined for its complete length by magnetic particle or liquid penetrant methods. It is not clear why this would be an appropriate method for shell back-gouging and

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\(^{22}\) August 24, 2002, API 653 Inspection Report, X052 Storage Tank 54-TK-5, prepared by Lead KAM Inspector, Lynn Lane, API 653 certified inspector No. 1264 for APSC.

\(^{23}\) Back gouging is defined as the removal of weld metal and base metal from the weld root side of a welded joint to facilitate complete fusion and complete joint penetration upon subsequent welding from that side.

\(^{24}\) August 24, 2002, API 653 Inspection Report, X052 Storage Tank 54-TK-5, prepared by Lead KAM Inspector, Lynn Lane, API 653 certified inspector No. 1264 for APSC.

\(^{25}\) November 19, letter from Rod Hanson (APSC) to Willie Harrison (Joint Pipeline Office), 2002 VMT Tank Program, Inspection Documented Unsatisfactory Conditions
It is not clear why two API 653 Inspectors concluded that Tank 5 floor removal involved back-gouging and APSC reports just the opposite.

More importantly, the inspectors documented the requirement to test back-gouged areas with magnetic particle or liquid penetrant methods was required in APSC’s own procedures for the 2002 Tank Repair Project, Manual X052-T-411 Sec. 3.7.2. A welding expert’s opinion and additional data is needed to resolve this allegation.

**Allegation No. 7 – Tank Shell Testing Requirements**

**Concern:** “API 653 requires UT [ultrasonic testing] (internally and externally) of all shell course quadrants during an internal inspection.”

**ADEC Finding:** “API 653 does not mandate an UT [ultrasonic testing] inspection during an internal inspection. Regarding the shell courses, the intent on an internal inspection is to ensure that there is no significant general wall loss and to gather enough information and to perform shell integrity assessments, if needed.”

**Analysis:** API 653 requires UT readings to be obtained from the outside of the tank shell during the external tank inspection. External tank inspections are required every five years by the VMT C-plan. Internal tank inspections are required every ten years by the VMT C-plan. Therefore, both an internal and external inspection of Tank 5 was due in 2002.

For efficiency, the internal and external tank inspections are typically completed at the same time once every ten years. API Section 6.3.3.3 allows an internal inspection of the tank shell to be substituted for a program of external ultrasonic thickness measurement if the internal inspection is completed at or before the next external inspection is due.

In the case of Tank 5, the Authorized Inspector report documents his inability to conduct a complete internal tank shell inspection, due to the lack of equipment and oil remaining on the tank walls.

*Only the first shell course was clean enough for visual inspection as the remaining shell courses were not clean enough for inspection as they showed and contained remains of product that has not been removed for inspection purposes. Also, it should be noted that there was no access available to inspect the upper shell course other than the 1st shell course.*

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26 The term shell refers to the tank wall. A shell course is a tank wall layer. Tank 5 has eight shell courses starting from No. 1 on the ground to No. 8 at the roof line. Tank 5 is 250’ in diameter and 62’ 3” tall. Typically each shell course for very large storage tanks is divided into at least four quadrants (north, south, east and west), and a minimum of corrosion measurements are taken to look for problem areas and to identify if any additional testing is needed.
The shell was externally inspected to the extent as to what could be visually inspected while walking around the tank from the ground...thickness readings were taken on each shell course only in the area that could be reached from external stairway.

**Conclusion:** Tank cleaning and inspector access should have been afforded to improve the inspection quality for this tank’s shell, especially since roof corrosion was indicated by external UT readings; indicating upper shell course corrosion may be present. While API 653 inspection does not mandate UT inspection of the shell during an internal tank inspection, this is a discretionary call which can be made by the Authorized Inspector to ensure an adequate inspection. Alternatively, and at a minimum, the inspector should have been provided a clean tank and equipment to complete his inspection. Additionally, external UT readings only at one point outside the shell (made as the inspector is climbing the tank stairs) may not be a sufficient set of data for a tank this size. Tank 5 is 250’ in diameter and 62’ 3” tall. Typically each shell course for very large storage tanks is divided into at least four quadrants (north, south, east and west), and a minimum of corrosion measurements are taken at each quadrant. Although quadrant measurements are not required by API 653, the number of data collection points is a discretionary call made by the inspector. It is reasonable for an inspection to find one data point per shell course to be insufficient for this size tank.

The Authorized Inspector’s report provided critical data to enhance the inspector’s concern and understanding of why the recommendation was made to obtain UT data. This situation highlights the need for PWSRCAC to review the original API 653 tank inspection report signed by the Authorized Inspector, rather than a summary of the reports prepared by APSC, since much of the critical data identified from the AI report was excluded from the summary report provided to PWSRCAC.

UT data on the tank shell can be obtained from outside the tank without having to take the tank out of service. An external tank inspection for Tank 5 is due in 2007. Close attention should be paid to the shell corrosion rate data collected in light of the concerns raised during this last inspection.

**Allegation No. 8 – Welding of Floor to Annular Ring**

**Concern:** “Lapping of floor plates ("3 plate rule").”

**ADEC Finding:** “Not an issue. DEC agrees with APSC regarding their interpretation.”

**Analysis:** On July 13, 2002, KAM Inspector, Mr. Isensee, writes Mr. Marchesani (APSC):
This AM it has come to our attention that at 5 separate locations on the completed bottom plate to annular welds the 12” three plate overlap rule requirement has not been complied with.

Bottom plates 2 & 3 intersecting with annulars A-32 & A-33
Bottom plates 41 & 42 intersecting with annulars A-5 & A-6
Bottom plates 60 & 61 intersecting with annulars A-6 & A-7
Bottom plates 198 & 199 intersecting with annulars A-13 & A-14
Bottom plates 213 & 214 intersecting with annulars A-15 & A-16

One day later, on July 14, 2002, Mr. Marchesani (APSC) writes back:

Alyeska addresses this issue with the following interpretation of the API 653 three plate overlap rule: the reference to 3-plate laps, and tolerance with them, reside in figure 3 and section 3.3.1(2) of specification X052-T-411. Figure 3 is lifted from API 653. In either case (API 653 or X052-T-411), the reference for tolerances to a 3-plate lap are associated with patching of an existing tank floor. The specification and code are written to prevent additional welding (such as patches) close to the intersection of three floor plates (i.e., a 3-plate lap) as such a condition would create areas of high stiffness (and thus stress) within the floor.

We are not installing any patches in Tank 5. Rather we are installing an entirely new floor (please also note that X052-T-411, API 653, and API 650 differentiate between ¼-in floor plate and annular plate). As such, the sections of X052-T-411 and API 653 referencing 3-plate laps do not apply to the situation you present below. API 653 does suggest that when performing a complete replacement of the tank floor plate, that the installation of tank floor plate conform to API 650. API 650 contains no limitations for the distance between the intersection of sketch plate-to-sketch plate fillet welds and an annular plate-to-annular plate butt weld.

Apparently KAM Inspector, Mr. Isensee, did not agree with APSC’s interpretation of the API 650 3-plate rule because on July 16, 2002, Mr. Isensee logged an unsatisfactory finding, citing the API 650 standard:

TK-5, 3 Plate overlap 12” rule –bottom to annular- refer to API-650 Section 3.1.5.4.

Another KAM Inspector also concluded that APSC’s interpretation of the 3-plate rule was incorrect. An August 24, 2006 API 653 tank inspection report prepared by API 653 inspector, Mr. Lane, concluded that welds made in the floor plates do not conform to the API 650, Section 3.1.5.4, 3 plate rule.

Tank 5, (3 plate rule) five individual
locations were found where the floor plates were welded either directly over butt welds in the annular ring or within the 12” restricted area.

Photos showing the 3-plate lap concerns were brought to ADEC by a concerned employee. The employee took the photos, labeled them and provided them to ADEC to document the laminations. Labels were not altered for this report; except to enlarge them slightly for better readability.

Finding: Dr. Kuckertz (P.E., PWSRCAC Staff)27 reviewed this issue with APSC, and concluded the 3 plate rule did not apply to the situation in Tank 5’s floor. However, it may be prudent to refer this recommendation to a welding expert for confirmation.

Allegation No. 9 – Tank Nameplate

Concern: “No nameplate on Tank 5.”

ADEC Finding: “New construction standards should only be applied to the new tank bottom, and not shell. Therefore, API 653 does not require a new name plate for an existing tank (shells).”

Analysis: Safety, security and operating procedures rely on the appropriate labeling of facility components.

Finding: A name plate for each tank is a minimum professional standard for a storage terminal. While API 653 may not require a name plate on an old tank, it is just common sense.

Allegation No. 10 – Heat Treatment of Metal on Access Door Area

Concern: “Post weld heat treatment on access door. API 653 requires that anything over 1" should be heat treated - or at the approval of the engineer.”

ADEC Finding: “There is no relevant reference regarding post weld heat treatment in API 653. This is dependent upon whether a heat treatment is required under the WPS qualified per ASME Section IX. APSC records indicate that no post weld heat treatment is required (verified by an APSC welding engineer).”

Analysis: Post Weld Heat Treatment is a heat treatment done after welding to improve the chemical mechanical properties of weld surfaces. There are many post weld treatment methods, however, for steel the most common use is to relieve stress after welding a large section. A company that provides Post Weld Heat Treatment Services summarizes the need for post weld treatment:28

The base material near the weld metal and the heat-affected zones transform through various metallurgical phases. Depending upon the chemistry of the metals in their areas,

27 Ms. Harvey did not complete an independent assessment of the floor plate lapping concern.

28 Post Weld Heat Treatment Services; http://www.industrial-inspection.in/pwht.htm
hardening occurs in various degrees, depending mainly upon the carbon content. This is particularly very true in the heat-affected zone adjacent to the weld metal deposit. The resultant stresses are highest due to melting and solidification. Stress, due to welding is of magnitude roughly equal to the yield strength of the base material.

Stress Relieving is done by uniformly heating-fabricated equipment or the vessel or vessel part to a sufficiently high temperature, but below the lower transformation temperature range, then subjecting it to a thermal retardation for a sufficient time depending upon the material thickness and then finally uniformly cooling it which is also of utmost importance.

Advantages of Post Weld Heat Treatment - Stress Relieving
- A much greater dimensional stability is obtained and maintained
- The potential of stress induce cracking is reduced.
- Metallurgical structure is improved.
- Strength of the Material and Life of the equipment is Enhanced.

Finding: This concern should be reviewed by a welding expert.

Allegation No. 11 – Joint Design on Access Door Area
Concern: “Change of joint design on access door was not appropriately approved by a qualified engineer. (Assume this is UNSAT #17)”

ADEC Finding: “There is no explicit requirement in API 653. ASME Section IX, Table QW-253 lists joint groove design change as NONESSENTIAL (e.g. changes are OK). The change was reviewed by a licensed PE and an APSC welding engineer.”

Finding: There is insufficient information available to PWSRCAC to review the joint design and draw a conclusion. Additional information is required. This allegation should be reviewed by the welding expert.

Allegation No. 12 – Roof Support Column Inspection
Concern: “Minimal UTing of roof support columns (This issue was identified during the investigation of the original concern)”

ADEC Finding: “Not an issue.”
Analysis: The analysis of this concern is described in Allegation No. 7, Section 4.8 of this Report.

This concern was substantiated. API 653 Inspector required internal roof support column inspection; it was not completed.
Finding: The API 653 inspector recommended that the roof column supports be inspected, and reports he was not provided equipment or access to the upper sections of the roof supports to complete this inspection.