NEW TANK REPORTS.

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241-SY Tank Farm Construction Extent of Condition Review for Tank Integrity

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EXECUTIVE SUMMARY

The construction history of the 241-SY tank farm has been reviewed to identify any concerns for the long-term integrity of the tanks. This initial review was prompted by construction issues identified during the formal leak assessment for tank 241-AY-102 (AY-102), RPP-ASMT-53793, *Tank 241-AY-102 Leak Assessment Report.* In tank AY-102, bulges in the secondary liner, deterioration of refractory during post-weld stress relieving (post-weld heat treatment), and primary tank floor plate welding rework during construction left residual stresses in the tank that may have accelerated corrosion and contributed to the primary tank failure. The main purpose of this review was to determine whether the construction methods adopted after completion of the 241-AY Farm either improved the quality and integrity of the third double-shell tank farm built (241-SY tank farm) or produced similar reduced margins.

During construction of the 241-SY tank farm, weld rejection rates for the tanks were similar to the weld rejection rate in tank AY-102. The secondary liner bottom thickness was increased to 3/8 in. from 1/4 in. and the primary tank bottom was increased from 3/8 in. to 1/2 in. The plate material was also changed from American Society for Testing and Materials (ASTM) A515-65 carbon steel in the 241-AY tank farm to ASTM A516-72 carbon steel in the 241-SY tank farm.

The construction of 241-SY tank farm showed improvement in refractory placement and post-weld heat treatment. Minor issues were noted for refractory installation and weather protection, but no significant refractory repairs were required. The post-weld stress relieving process was more disciplined and effective in the 241-SY tank farm. All tanks were successfully post-weld stress relieved with no deficiencies noted.

The most significant deficiency found in the 241-SY tank farm was the presence of bulging in the primary and secondary bottoms. The maximum root to crown slope was found in tank SY-103 secondary bottom and had a slope of 1 in. per ft. Structural analysis and strain gauge testing of the bulge was conducted and results indicated the stresses in the tank to be less than the yield strength of the material. Bulging in tank SY-101 was similar in size, shape, and location to the bulge in SY-103. However, it was decided to grout the area underneath two bulges to support the primary tank in those locations.

Various other issues related to difficulties in liner fabrication were noted. All of these issues were evaluated and accepted "as-is" with no stated impact on structural tank integrity.

The 241-SY tank farm had improved construction practices in some areas as compared to tank AY-102, yet many of the construction issues experienced by tank AY-102 re-emerged. Overall, the condition of the tank liners in the 241-SY tank farm are considered to be similar to tank AY-102. Factors thought to have caused unsupported areas in the primary tank bottom and the potential for areas of high residual stress in tank AY-102 are also present in all of the 241-SY tank farm tanks.

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241-AZ Tank Farm Construction Extent of Condition Review for Tank Integrity

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EXECUTIVE SUMMARY

The construction history of the 241-AZ tank farm has been reviewed to identify any concerns for the long-term integrity of the tanks. This initial review was prompted by construction issues identified during the formal leak assessment for tank 241-AY-102 (AY-102), RPP-ASMT-53793, *Tank 241-AY-102 Leak Assessment Report.* In AY-102, bulges in the secondary liner, deterioration of refractory during post-weld stress relieving (post-weld heat treatment), and primary tank floor plate welding rework during construction left residual stresses in the tank that may have accelerated corrosion and contributed to the primary tank failure. The main purpose of this review was to determine whether the construction methods adopted after completion of the 241-AY tank farm either improved the quality and integrity of the second double-shell tank farm built (241-AZ tank farm) or produced similar reduced margins.

During construction of the 241-AZ tank farm, fewer welding problems of the secondary liner and primary tank bottoms were noted compared to the 241-AY tank farm. The secondary liner bottom thickness in the 241-AZ tank farm was increased to 3/8 in. (from 1/4 in. in 241-AY tank farm) and only a minor mention of secondary liner irregularities was noted, requiring the refractory thickness to be increased to ensure a thickness of at least 8 inches in all locations. The thickness of the primary tank bottom was also increased from 3/8 in. in the 241-AY tank farm to 1/2" in the 241-AZ tank farm. The overall primary liner weld rejection rates were much lower in the 241-AZ tank farm. Refractory installation and weather protection were improved and although issues with this protection were noted, no significant refractory repairs were required. The post-weld stress relieving process required modifications, but the changes allowed for more efficient and effective heat treatment in tanks 241-AZ-101 (AZ-101) and 241-AZ-102 (AZ-102) compared to the tanks in the 241-AY tank farm.

The most significant deficiency found was the presence of plate laminations. Some surface grinding on the bottom plate of the primary tank occurred. In tank AZ-102, six plates in the upper shell ring were found to have laminations, with four of them severe enough to require replacement prior to heat treatment. Other minor issues, unique to the 241-AZ tank farm were noted. Both primary tanks had leaks found during the hydrostatic test. They were above the normal waste level and repaired without additional stress relieving. A square groove was discovered to have been ground into one weld in the lower knuckle in the tank AZ-101 primary side wall after heat treatment, but this condition was evaluated and accepted as-is. Fires occurred during construction in the annulus of tank AZ-102 and in the bottom of the primary tank in tank AZ-102 but the job logs did not indicate that any significant damage was caused by these two fires. These issues are not expected to significantly affect the tank integrity.

Following completion of the 241-AY tank farm, design evaluations and lesson learned meetings occurred to remedy issues encountered during construction and resulting changes were incorporated into the 241-AZ tank farm. Although there were improvements in the construction of 241-AZ tank farm, issues were still noted, some unique to tanks AZ-101 and AZ-102. Tanks AZ-101 and AZ-102 should remain in a category subject to enhanced inspection.

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241-AY-101 Tank Construction Extent of Condition Review for Tank Integrity

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The construction history of the 241-AY-101 (AY-101) tank has been reviewed to identify any concerns for the long-term integrity of the tank. This initial review was prompted by construction issues identified during the formal leak assessment for tank 241-AY-102 (AY-102), RPP-ASMT-53793, *Tank 241-AY-102 Leak Assessment Report.* In tank AY-102, bulges in the secondary liner, deterioration of refractory during post-weld stress relieving (post-weld heat treatment), and primary tank floor plate welding rework during construction left residual stresses in the tank that may have accelerated corrosion and contributed to the primary tank failure. The main purpose of this review was to determine whether construction modifications made between tanks AY-102 and AY-101 either improved the integrity of tank AY-101 or produced similar reduced margins.

During construction of the 241-AY tank farm, the most significant deficiency found in the review was the degradation and repair of the refractory in tanks AY-101 and AY-102. Both refractories were exposed to similar conditions of moisture and freezing temperatures during the curing stage, which is believed to have contributed to the friable nature and reduced vertical compressive strength. The refractory repairs required the outer 21 in. of the periphery refractory to be chipped out all the way around the tank and replaced with reinforced structural concrete.

Significant problems arose with welding of the secondary liner and primary tank bottoms of tank AY-102 with a weld rejection rate of 33.8%. Welding improved with fabrication of tank AY-101 with a weld rejection of 10.2%. Regarding tank bottom flatness, tank AY-101 had a total of six instances of secondary liner bottom bulging as compared to tank AY-102 with 22 instances. No QA inspections indicated that bulging of the primary tank bottom occurred in tank AY-101 and the information discovered substantiates that it met specification. Despite this documentation, photos from refractory repair after stress relief indicate that voids existed between the primary tank and refractory surface. These voids could be attributed to primary tank bottom bulges, which would indicate unsupported areas of the primary tank exist in tank AY-101. This lack of support was identified a contributing factor to primary tank failure in tank AY-102.

The post-weld stress relieving of tank AY-101 was more successful when compared to tank AY-102. Tank AY-101 was stress relieved at 1000°F for 4 hours, which did not meet the specification of 1100°F ± 50°F for 1 hour. This reduced temperature, longer duration, stress relief method was deemed to be an acceptable alternative per provisions of the ASME Boiler and Pressure Vessel Code, which indicated that it would still produce a suitable stress relief and resistance to stress corrosion cracking.

Although some improvement was seen in the construction of tank AY-101 following tank AY-102, many of the same issues found in tank AY-102 also exist in tank AY-101 and it should therefore remain in a category subject to enhanced inspection.

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241-AW Tank Farm Construction Extent of Condition Review for Tank Integrity

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The construction history of the 241-AW tank farm has been reviewed to identify any concerns for the long-term integrity of the tanks. This initial review was prompted by construction issues identified during the formal leak assessment for tank 241-AY-102 (AY-102), RPP-ASMT-53793, *Tank 241-AY-102 Leak Assessment Report.* In tank AY-102, bulges in the secondary liner, deterioration of insulating refractory (refractory) during post-weld stress relieving (post-weld heat treatment), and primary tank floor plate welding rework during construction left residual stresses in the tank that may have accelerated corrosion and contributed to the primary tank failure. The main purpose of this review was to determine whether the construction methods utilized after completion of the 241-AY tank farm either improved the quality and integrity of the fourth double-shell tank farm built (241-AW tank farm) or produced similar reduced margins.

The secondary liner bottom thickness was increased to 3/8 in. from 1/4 in. and the primary tank bottom thickness was increased from 3/8 in. to 1/2 in. The American Society for Testing and Materials (ASTM) A537-74a carbon steel plate material utilized in the 241-AW tank farm also varied from the ASTM A515-65 carbon steel utilized in the 241-AY tank farm.

During construction of the 241-AW tank farm, weld rejection rates for the tanks were similar to those for tank AY-102. High weld rejection rates and subsequent repairs are thought to be a contributor to out-of-tolerance distortions, or bulges. Tanks AW-102 and AW-106 had bulging in the secondary liner bottom that was similar to the bulging noted in RPP-ASMT-53793 for tank AY-102. In the 241-AW tank farm, each secondary liner was accepted as is, following engineering evaluation to determine any risk to tank structural integrity. No indication of bulging in any of the primary tank bottoms was found. All 241-AW tanks were accepted as successfully post-weld stress relieved. No post-weld stress relieving deficiencies similar to those that occurred during construction of the 241-AY tank farm were noted.

While Lite Wate 50 (LW50) was initially chosen as the castable refractory product to be used in the 241-AW tank farm, extensive out-of-specification low compressive strength tests of the first several refractory pads led to a material change to Lite Wate 70 (LW70). Tank AW-101 is the only tank in the 241-AW tank farm that utilized LW50 refractory material, with only Section D being composed of an enriched LW50, containing one additional bag of calcium aluminate binder. No issues were noted with refractory following the change to LW70.

As a result of refractory removal and replacement, scratches and gouges were inflicted upon the secondary liner bottom of several tanks. The construction specification provided direction for repair of such defects and it was applied satisfactorily in the discovered documented instances.

While tank bottom bulging, refractory material quality and post-weld stress relieving were improved, primary tank bottom weld rejection in the 241-AW tank farm experienced similar challenges when compared to tank AY-102. While these issues, along with others that were judged to be minor (e.g. surface defects and pitting), leave room for uncertainty of long-term tank integrity, the overall condition of the 241-AW tank farm following construction is judged to be better than that of tank AY-102.

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241-AN Tank Farm Construction Extent of Condition Review for Tank Integrity

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The construction history of the 241-AN tank farm has been reviewed to identify any concerns for the long-term integrity of the tanks. This initial review was prompted by construction issues identified during the formal leak assessment for tank 241-AY-102 (AY-102), RPP-ASMT-53793, *Tank 241-AY-102 Leak Assessment Report.* In tank AY-102, bulges in the secondary liner, deterioration of castable refractory (refractory) during post-weld stress relieving (post-weld heat treatment), and primary tank floor plate welding rework during construction left residual stresses in the tank that may have accelerated corrosion and contributed to the primary tank failure. The main purpose of this review was to determine whether the construction methods utilized after completion of the 241-AY tank farm either improved the quality and integrity of the fifth double-shell tank farm built (241-AN tank farm) or produced similar reduced margins.

The secondary liner bottom thickness was increased from 1/4 in. in the 241-AY tank farm to 3/8 in. in the 241-AN tank farm and the primary tank bottom thickness was increased from 3/8 in. to 1/2 in. The American Society for Testing and Materials (ASTM) A537-75 carbon steel plate material utilized in the 241-AN tank farm also varied from the ASTM A515-65 carbon steel used in the 241-AY tank farm. ASTM A537-75 represents a higher yield strength.

During construction of the 241-AN tank farm, there was approximately 50% less weld rejection when compared to tank AY-102. However, 9% to 20% weld rejection rates leave cause for concern. While high weld rejection rates and subsequent repairs are thought to be a contributor to out-of-tolerance distortions, or bulges, there were no out-of-specification bulges found in the 241-AN tank farm primary tank or secondary liner bottoms. All 241-AN tank stress relief processes were completed successfully using the alternate requirement of 1000° F for three hours per inch and were accepted. No post-weld stress relieving deficiencies similar to those that occurred during construction of the 241-AY tank farm were noted.

Lite Wate 70 (LW70) was the refractory material utilized in the 241-AN tank farm tanks. A void between the secondary liner bottom and refractory was found near the center of tank AN-104. Holes were drilled in the refractory and pourable grout was used to fill the void. The holes were then filled with LW70, and the refractory was accepted.

Tank bottom bulging, refractory material quality, post-weld stress relieving, and primary tank bottom weld rejection in the 241-AN tank farm were improved when compared to tank AY-102. While these issues, along with others that were judged to be minor (e.g., tank dome deformations and pitting), leave room for uncertainty of long-term tank integrity, the overall condition of the 241-AN tank farm following construction is judged to be better than that of tank AY-102.