WATER TANK INSPECTION REPORT

Prepared for the

Marina Coast Water District
Marina, CA

Steel Reservoir #2

October 26, 2005

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MCWD

INTRODUCTION

On October 26, 2005 EXTECH representatives, Joe and Vince Benoit performed corrosion and structural assessment of the exterior and interior of a potable water storage tank for the Marina Coast Water District in Marina, California. The inspection was conducted to establish the current condition of the tank's coatings and steel substrate. The tank inspected included:

2 MG Steel Reservoir #2

The tank was inspected in accordance with the latest version of AWWA D101-53 (86R) standard for water tank inspections and the M42 AWWA Tank Guidance Manual.

The interior of the reservoir was inspected with the TankRover remotely operated vehicle, while full. The TankRover is the only piece of equipment like it in the United States and was developed by Extech. By using the TankRover the interior of the tank was inspected with no special preparation, no additional disinfection and no downtime.

The TankRover is equipped with a surface-cleaning tool used to remove loose rust or debris in order to view the potential metal loss under the coating. The unit has high-powered thrusters, which are used to maneuver throughout the tank and are used to wash away bottom sediment for observations.

The TankRover was prepared for the inspection by disinfecting in accordance with AWWA C652.

The exterior portions of the tanks were inspected by walking the roof and shell portions that were accessible from the vertical ladder, and portions that could be inspected from each tank's base. The objectives of the assessment were to;

1. Perform field inspections and tests to assess the structural and coating integrity of the tank.
2. Review the safety compliance of tank ladders and access.
3. Review sanitary conditions and protection
4. Provide recommendations for rehabilitation.
5. Provide seismic evaluation and recommendations.

EXECUTIVE SUMMARY

The conditions and recommendations for the tank are briefly summarized in this section. For detailed information regarding tank conditions and the specific recommendations please refer to the designated section for each tank.

The coating systems are performing well after many years of service. The original interior coating application is a thick coal tar type coating that is showing signs that it has reached the end of its service life.

Corrosion on the interior of the reservoir is present on 35% of all shell courses. The shell coating is cracking and the steel substrate has been exposed in numerous areas. There is active corrosion on the edges of the roof plates and roof rafters on 15% of the surfaces.

The exterior coating is in poor condition on the roof with coating failure and active corrosion in numerous areas. The shell coating is chalking and there are areas of rock damage and active corrosion.

The floor of the tank had a layer of sediment 2 to 3 inches thick. The sediment was not removed after the inspection

Based on the tank's current condition the interior coating should be replaced in 2 to 3 years. The exterior coating should be repaired as well during this same period.

The tank vent screen is corroded and has holes it needs to be replaced immediately.

There are small openings in the roof around the inlet pipe these areas need to be repaired.

OBSERVATIONS

Photographs provided in the report were created from a digital camera and interior pictures were captured in digital format from the interior videotape. The interior images are as clear as our printed technology will allow. The copies in the report provide a reference for our comments. Keep in mind that for underwater video snaps, the videotape provides the greatest detail and should be viewed as part of the report.

A Posi-Tector 6000 was used to gather dry film thickness measurements on the exterior roof and shell surfaces.

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The reservoir is a welded steel structure, 80 feet in diameter and 56 feet high. The tank was built in 1979. There is no record of the tank being previously inspected or cleaned.

The tank has one 24-inch circular roof hatch and two 30-inch round bolted ground level man-ways. The roof hatch is equipped with the required sanitary curb. See DP# 6.

The following paint systems are present:

Interior- Heavy coal tar enamel coating.
Exterior-Two coat alkyd.

INTERIOR

The interior of the tank was accessed through the existing 24-inch circular perimeter hatch, which was locked at the time of the inspection. The cover was properly installed with a 4-inch sanitary curb. The water level during the inspection was consistently 10 feet below the overflow.

Roof (ceiling)

The roof is a flat cone structure with a central support column and radial “C” section rafters. The beams and stiffeners were in good condition with areas coating failure and edge corrosion. These conditions can be viewed in DP#8, DP#3, and DP10.

The roof plates are in good condition with minor areas of coating failure and localized active corrosion on the edges of beams and plates. There is no significant metal loss on the above water surfaces.

Ladders

There is no internal ladder on this reservoir.

Shell

The shell coating is in poor condition and has reached the end of its service life. Eighty-five (85%) of the coating on all of the shell courses is cracking and failing down to the steel substrate. Active corrosion can be seen extending out through the shell coating cracks. There are several areas on the lower shell where the coating has completely failed and the steel substrate is exposed.

Typical coating conditions can be viewed in DP#7, VS#1, VS#2, VS#3, VS#4, VS#5, VS#6, VS#7, VS#8, and VS#9.

No extensive pitting was found in the areas where the coating was missing.

Floor

The floor of the tank had a heavy sediment layer 2 to 3inches thick. This condition can be viewed in VS#10, VS#11, and VS#12. The floor coating could not be inspected due to the heavy layer of sediment. In general CTE coatings are applied thicker on the floor and as such retard moisture intrusion. The thick sediment layer will prevent oxygen from reaching any exposed steel on the floor and therefore any corrosion would be less advanced than seen on the walls.

Inlet/ Outlet

The tank has an inlet pipe that discharges through the roof of the reservoir. This pipe is located on the opposite side of the roof from the roof access hatch. There is a small gap around this pipe on the roof that needs to be repaired. DP#3, DP#4, and DP#12.

There is one outlet pipe in the lower shell course.

EXTERIOR

Roof

The roof coating is in poor condition with coating failure and active corrosion in several areas. DP#5, and DP#11. UV exposure has chalked the topcoat and rain erosion has exposed 50-70% of the primer.

The dry film thickness of the coating averaged 9.14 mils and ranged from a low of 7.40 to a high of 12.10 mils.

Vent

The tank is equipped with a (20) inch diameter central finial vent. See DP# 1, and DP#2. The vent does not have a bug screen installed and the existing screen is badly corroded and brittle with large gaps.

Ladders and Railings

The shell has a vertical ladder located at ground level. The ladder is equipped with a locking anti-climb device and safety cage.

Shell

The tank shell coating is in fair to good condition with chalking and a few localized rock damage sites.

The coating thickness measured from a minimum of 5.20 mils to a maximum of 15.50 mils. The average paint thickness was 10.14 mils.

Adhesion of the shell coating was fair between the topcoat and primer and very good between the primer and steel.

Overflow

The over flow consists of an internal funnel and external pipe with a flapper attached seen in DP # 13.

Foundation

The tank rests on a concrete ring wall that is in good condition with no spalling and only minor cracking.

RECOMMENDATIONS

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The top vent screen needs to be repaired or replaced as soon as possible

The external roof coating needs to be repaired. The area should be abrasive blasted and fully coated. The shell coating is generally in good condition and will probably last for another 5-7 years before it is unsightly.

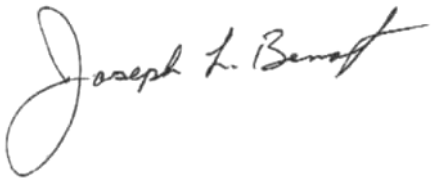
The internal coating system should be replaced in 2 to 3 years to prevent the formation of internal pitting. The coal tar coating currently in the tank is not ANSI/NSF-61 approved and would be replaced with a modern epoxy system. It should be noted that the coal tar is extremely difficult and costly to remove.

The opening around the inlet pipe on the roof should be repaired immediately to prevent entry of contaminates.

The shell ladder should be equipped with a sheet metal shield on the lower cage to prevent someone from climbing the exterior of the ladder cage. These sheet metal guards generally extend up 10-12 feet.

Estimated Costs:

Internal complete blast and repaint	$250,000
Exterior roof blast and repaint	$ 25,000
Ladder cage shield	$ 3,000



NACE Certified Coating Inspector #1381

GLOSSARY OF TERMS

Cathodic Protection - The use of a sacrificial metal or energized substance to polarize the structures surfaces and prevents corrosion.

Chalking - The degradation of a paint system when exposed to ultra-violet light which creates a loose residue on the surface.

Corrosion Cell - A concentrated localized site of accelerated corrosion that creates pitting.

Dry Film Thickness - Total thickness of a paint film when complete cured.

Finial Vent - The central roof vent on top of a water tank.

Holiday - A hole in a protective coating that may be invisible to the unaided eye that extends to the substrate.

Lead Abatement - The removal and a lead bearing paint system.

Lead Encapsulation - The covering over of a lead based paint by applying a compatible topcoat.

Osmotic Blister- Raised coating area created by build up of fluid under the coating. Fluid moves through coating in response to water/solvent concentrations between coating and tank water.

ROV- Remotely operated vehicle, underwater inspection device "TankRover"

Silt - Material that accumulates in the bottom of a water tank originating from treatment by products and distribution system debris.

Tubercle- Domed shaped build up of corrosion products over an active corrosion site. Promotes metal loss through pitting due to differential oxygen concentrations.

Ultrasonic Measurement - The use of high frequency sound waves passed through a material to measure the time required to return. The time required to pass through the material is correlated to the speed of sound in the substrate to yield an actual thickness at a specific location.

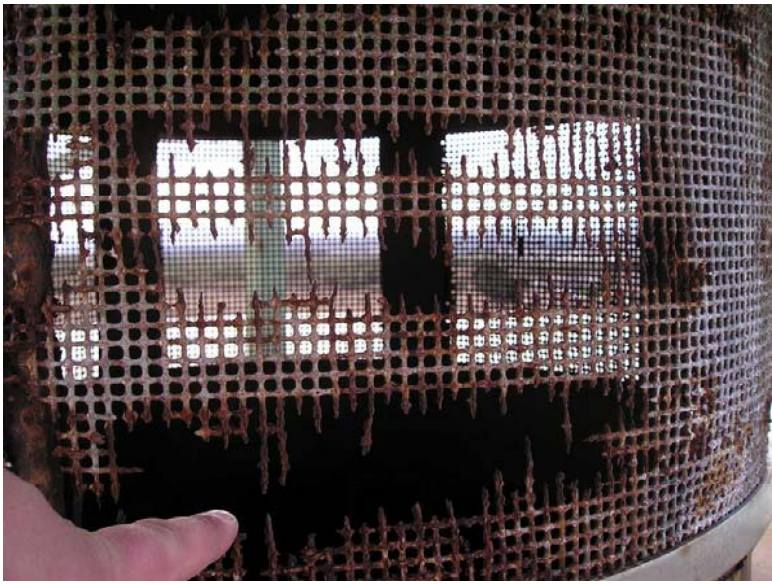
APPENDIX A

PHOTOGRAPHS

2MG
Steel
GROUND RESERVOIR #2

DP#01.JPG

Roof vent screen badly corroded and crumbling.



DP#02.JPG

Hole in vent screen

DP#03.JPG

Inlet pipe coating failure and active corrosion

DP#04.JPG

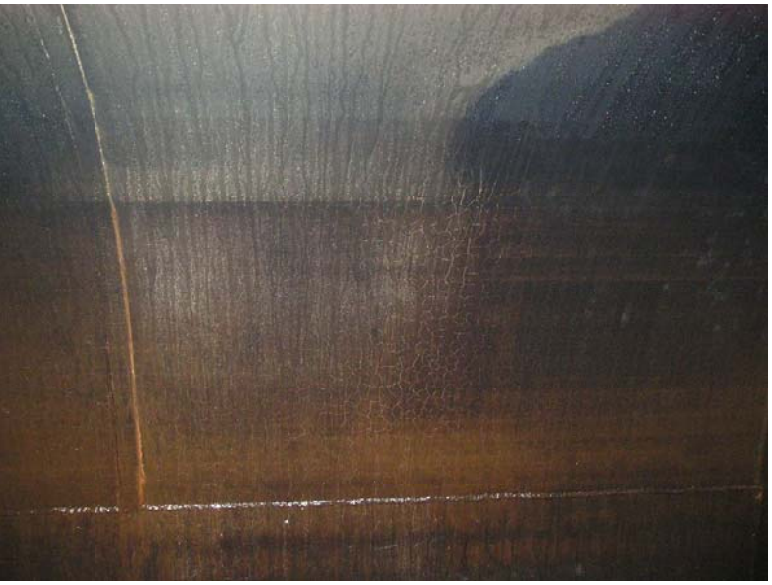
Inlet pipe - bad picture - opening in inlet pipe

DP#05.JPG

Top coat failure on roof plate

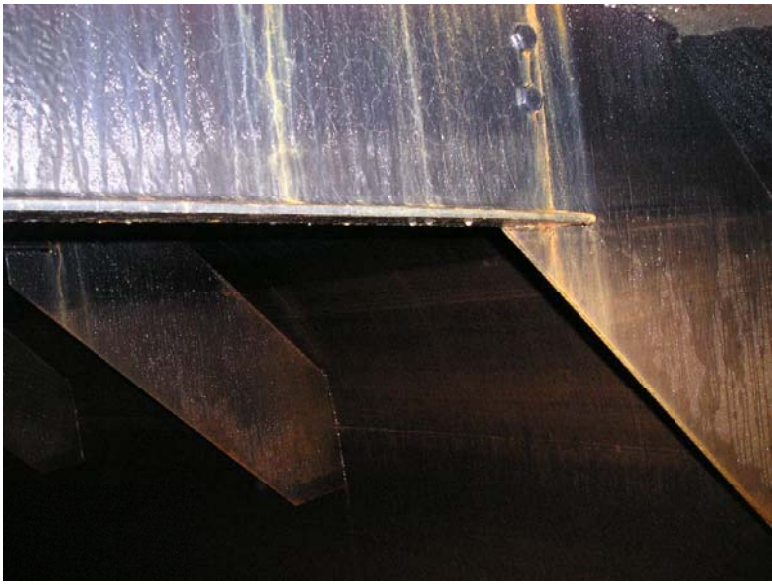
DP#06.JPG

Roof hatch with corrosion on edges



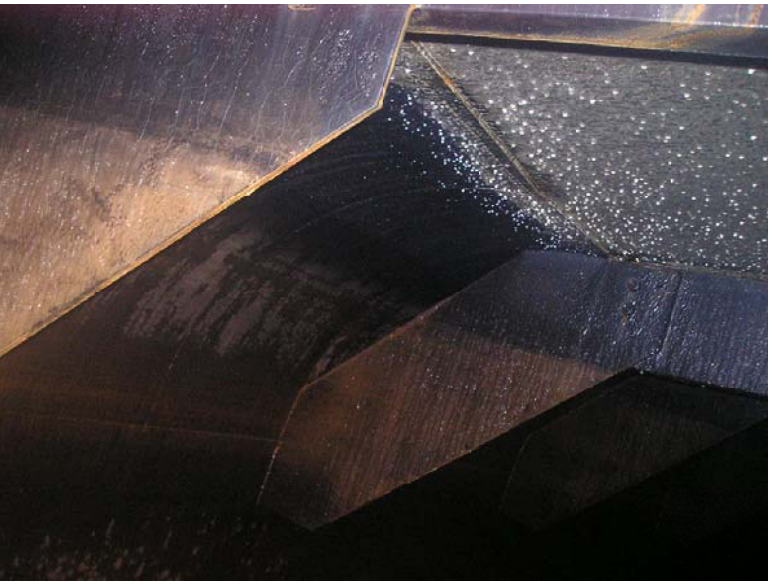
DP#07.JPG

Internal shell - cracks in coating



DP#08.JPG

Roof rafter with edge corrosion



DP#09.JPG

Roof rafters with edge corrosion

DP#10.JPG

Roof rafter with edge corrosion

DP#11.JPG

Roof plate and hand rail active corrosion

DP#12.JPG

Inlet pipe with active corrosion

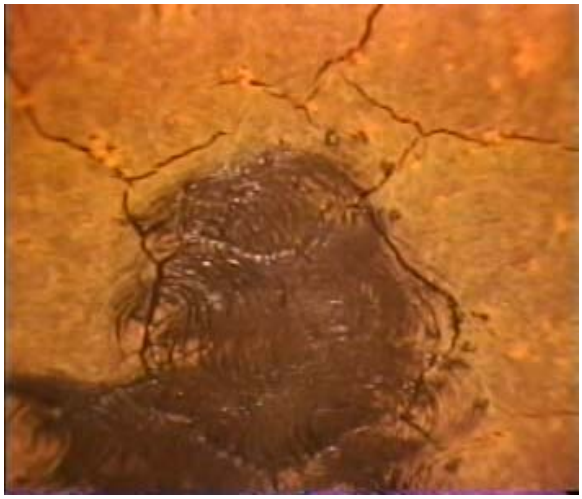
DP#13.JPG

Overflow pipe with flapper

DP#14.JPG

Marina Coast Water District **Steel Reservoir #2**

VS #1. Heavy iron buildup and cracks in coating. (Time: 2:09)



VS #2. Cracks in internal coating. (Time: 4:28)

VS #3. Coating has failed, active corrosion, exposed steel upper shell at 8'oclock position. (Time: 6:57)

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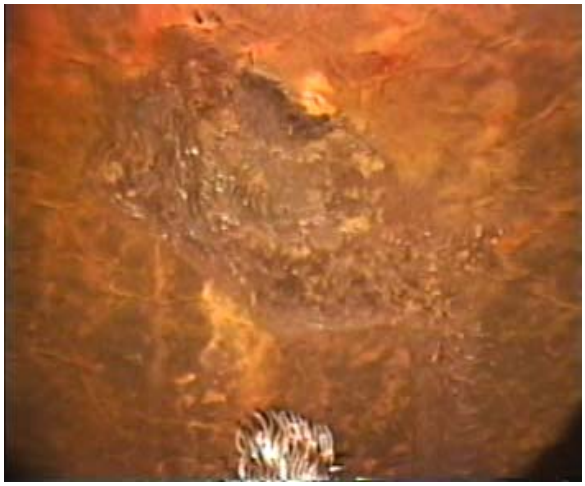
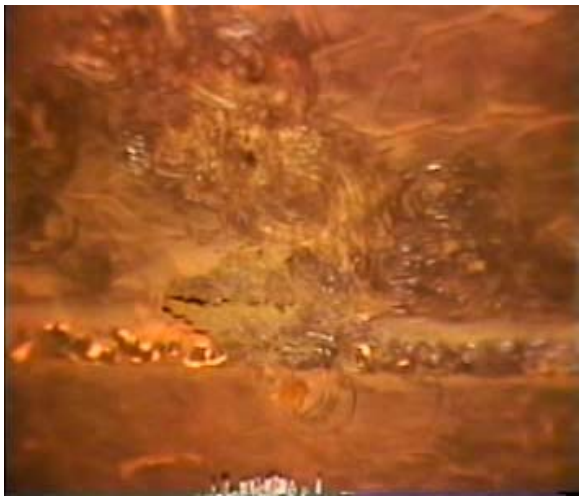


VS #4. Coating has failed to steel substrate 2nd shell 6'oclock position. (Time: 10:20)

VS #5. Cracked coating and active corrosion. (Time: 10:46)



VS #6. Coating failure on horizontal weld. (Time: 15:47)

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VS #7. Exposed steel substrate mid-shell corrosion. (Time: 21:35)

VS #8. Micro blisters in coating. (Time: 26:12)

VS #9. Coating failure bare steel – upper section when shell at 9'oclock position. (Time: 33:48)

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VS #10. 1 ½ -inch sediment. (Time: 36:14)

VS #11. 2-inches sediment. (Time: 41:50)

VS #12. 3-inches sediment at center of tank. (Time: 47:41)

APPENDIX B

DRY FILM THICKNESS READINGS

Reservoir #2 Roof

6000_0_Nov 14 05 15:00:50
Batch Readings

Reading,,	Coat 1,
1, ,	10.4,
2, ,	11.2,
3, ,	10.6,
4, ,	8.4,
5, ,	8.3,
6, ,	5.2,
7, ,	8.1,
8, ,	7.8,
9, ,	8.3,
10, ,	11.2,
11, ,	10.5,
12, ,	8.7,
13, ,	10.5,
14, ,	10.4,
15, ,	10.6,
16, ,	15.5,
17, ,	15.1,
18, ,	14.2,
19, ,	7.6,
20, ,	6.6,
21, ,	7.8,
22, ,	12.4,
23, ,	13.5,
24, ,	13.3,
25, ,	8.2,
26, ,	7.9,
27, ,	8.2,
28, ,	9.5,
29, ,	9.2,
30, ,	9.2,
31, ,	10.0,
32, ,	9.7,
33, ,	8.8,
34, ,	7.7,
35, ,	7.2,
36, ,	8.1,
37, ,	13.2,
38, ,	12.3,
39, ,	13.7,
40, ,	9.9,
41, ,	9.6,
42, ,	9.7,
43, ,	13.4,
44, ,	12.6,
45, ,	11.8,

Batch Summary

Mean,,	10.14,
StdDev,,	2.39,
Min,,	5.20,
Max,,	15.50,

Batch Annotations
Gage Model: 6000
Probe Model: P6000FE
Probe s/n:
User:
Part:
Substrate:

Reservoir #2 Shell

6000_1_Nov 14 05 15:00:51
Batch Readings

Reading,,	Coat 1,
1, ,	7.6,
2, ,	7.6,
3, ,	7.8,
4, ,	8.8,
5, ,	7.9,
6, ,	8.1,
7, ,	9.6,
8, ,	8.5,
9, ,	9.0,
10, ,	10.0,
11, ,	10.1,
12, ,	8.8,
13, ,	11.4,
14, ,	12.1,
15, ,	11.9,
16, ,	9.5,
17, ,	9.7,
18, ,	9.6,
19, ,	9.7,
20, ,	8.8,
21, ,	9.4,
22, ,	9.9,
23, ,	8.8,
24, ,	8.3,
25, ,	8.7,
26, ,	8.3,
27, ,	7.4,
28, ,	11.4,
29, ,	11.9,
30, ,	11.4,
31, ,	8.2,
32, ,	8.5,
33, ,	9.7,
34, ,	7.6,
35, ,	8.0,
36, ,	9.2,
37, ,	7.5,
38, ,	8.7,
39, ,	8.4,
40, ,	9.1,
41, ,	8.7,
42, ,	8.1,
43, ,	8.5,
44, ,	9.6,
45, ,	9.6,

Batch Summary

Mean,,	9.14,
StdDev,,	1.25,
Min,,	7.40,
Max,,	12.10,

Batch Annotations
Gage Model: 6000
Probe Model: P6000FE
Probe s/n:
User:
Part:
Substrate: