REQUEST FOR PROPOSALS
(Date of Issuance: May 6, 2020)

YAP STATE PUBLIC SERVICE CORPORATION (YSPSC)
WATER TANKS ENGINEERING DESIGN CONSULTANT SERVICES
YAP STATE, FEDERATED STATES OF MICRONESIA
RFP NO. 2020- 001

On behalf of the Yap State Government, Federated States of Micronesia, the Office of Planning and Budget/**Project Management Office (PMO)** invites proposals for the provision of professional consultant services to perform Engineering Design for the repairs and refurbishment of existing two atmospheric one million gallons (MG) potable water steel tanks and Engineering Design for a new two hundred fifty thousand gallons epoxy coated carbon steel potable water tank located in Colonia, Yap State, FSM.

Respondent may request a clarification or inquiry on any of the Request for Proposals (RFP) documents in writing addressed to: Samuel E. Luzano, PMO Manager, Project Management Office, YCA Complex, P.O. Box 970, Colonia, Yap FM 96943 at (691) 350- 2324 or emailed to seluzano@yapstategov.org

All Proposals are to be submitted in a sealed envelope marked "**RFP No. 2020 - 001, YSPSC Water Tanks Engineering Design**" and must incorporate the name and address of the Respondent on the outside of the envelope addressed to:

The PMO Manager
Project Management Office
YCA Complex, P.O. Box 970
Colonia, Yap FM 96943

Proposals must be submitted to the above address **no later than July 7, 2020 at 3:00 p.m., YAP local time** to be eligible for consideration. Proposals received after the deadline shall be rejected.

Whenever Proposals will be sent via FedEx, UPS or other mail carrier, Respondent must ensure that the outside mailing package is also clearly marked "**RFP- YSPSC Water Tanks Engineering Design**" with the name and address of the Respondent. Packages and envelopes not marked with the name of the proposal may be misidentified and will be rejected.

Proposals can also be submitted in electronic copies by E-mail. Electronic copies of proposals sent through E-mail shall be in PDF and submitted to:

Samuel E. Luzano
PMO Manager
seluzano@yapstategov.org
seluzano@gmail.com

Proposals thus received will be publicly opened and read by the PMO Manager or the designated Authorized Representative at the Project Management Office (PMO) in Yap State at **10:00 A.M. YAP local time, on July 8, 2020**.

The selected proposal will be formally awarded and announced publicly as soon as a complete review, evaluation and comparison of the proposals had been made by the Evaluation Committee. Formal notification of award to all respondents will occur immediately thereafter. Award of Consultant Services Contract is subject to the availability of funds and budget appropriation from the Yap State Legislature.

Proposals must remain valid for a period of ninety (90) days from opening date of the proposals and are to remain firm and unchanged once the proposal is awarded to the successful Respondent.

The PMO reserves the right to accept or reject any and all Proposals or parts thereof, to accept the Proposal which the PMO deems to be in the best interest of the Yap State Government, to waive any informality in the Proposals, and to negotiate further with the selected Respondent.

General Description of the Existing Water Tanks

The two potable water atmospheric steel tanks are both 1 MG tanks, 80 feet in diameter and 29 feet in height (see Appendix 1). The existing water tanks were constructed in Yap State, Federated State of Micronesia in 1971. Tank No. 1 is located in Dololeb while Tank No. 2 is located in Nimar. The tanks and its gravity water distribution network are being operated and maintained by YSPSC, the Owner. The two steel tanks are currently operational and impounding drinking water for the day-to-day consumption of Yap State consumers.

Engineering Assessment and Testing for both existing water tanks have been performed by Central Pacific Tanks in October 2019. The final inspection reports are included in Appendix 2 and Appendix 3.

General Description of the Additional Water Tank No. 3

The additional 250,000 gallons epoxy coated carbon steel potable Water Tank No. 3 is approximately 40 feet in diameter and 31.76 feet in height. The location will be in the vicinity of the existing Water Tank No. 2 in Nimar, Yap. See attached site development plan in Appendix 4 and original drawings in Appendix 5. The ground level pad is approximately 30 feet higher than the ground elevation of existing Water Tank No. 2.

Water Tank No. 3 is essential and incidental to the refurbishment of the existing water tanks. This must be built and operational prior to de-commissioning any of the two water tanks for repairs and refurbishment.

Technical information and design criteria:

- Site Class: D
- Wind Rating: 150 mph
- Seismic Use Group: III

- Materials: Carbon Steel – ASTM 36
- Coating: Interior basecoat thickness: 7 mils DFT average
  Exterior basecoat thickness: 5 mils DFT average
  Exterior polyester thickness: 3 mils DFT average
- Floor type – Flat Steel Floor
- Deck Type – 2:12 Roof (Center Supported)
- Construction Type – Bolted on Type-1 ring-wall concrete mat foundation
- Design according to AWWA D103
- Accessories to include guardrail, center vent, 6" flange, 12" overflow, 24" manway, 24" roof access hatch, 12" weir cone, 4" web truss, exterior ladder with safety climb system (OSHA compliant)
- Water connection to the existing service line at Water Tank No.2 is an 8-inch diameter cast iron pipe with isolation valves

Consultant Services Scope of Work

1. Close coordination with representatives of YSPSC, the Project Management Office and other relevant Yap State government agencies.
2. Prepare engineering design, specifications, detailed cost estimates and work plan schedule for the repairs and refurbishment of the two existing water tanks as well as the proposed new water tank.
3. Basis of design will include the facts, figures, findings and recommendations of the Engineering Assessment and Testing Reports done by Central Pacific Tanks Inc. and Powers Engineering and Inspection Inc. for the two existing water tanks. Tanks repair and refurbishment work is in accordance with AWWA D101- 53 (R1986), "Inspection and Repairing Steel Water Tanks, Standpipes, Reservoirs and Elevated Tanks for Water Storage".
4. Basis of Design for the additional Water Tank No. 3 is mentioned in the General Description section of this RFP. This water tank shall be connected to the main water distribution system at existing Water Tank No. 2. The water service line feeding the water tanks is an 8-inch diameter cast iron pipe.
5. Consultant shall perform geotechnical soil investigation at the additional Water Tank No. 3 site location.
6. Site development work to include site drainage and perimeter security chain link fence with lockable gate for both sites.
7. Design Phase Schedule. The projected turn-around time to completion of the design works and subsequent handover of information to PMO.
   Preliminary Design – 3 Months and Final Design – 2 Months.

General Requirements

Include as part of the Proposal references from work performed of a similar scope;

Present any applicable certificates or licenses held by the Respondent and its technical team members;

Any lobbying by or on behalf of the Respondent shall result in the rejection or disqualification of said Proposal;

All information submitted shall be relevant to the RFP, practical and concise. Emphasis should be on completeness and clarity of content, and not on volume or elaborate presentation materials;

The Fee Proposal should present detailed costs for the services to be provided. Itemized cost breakdown for all pay items including any reimbursable expenses shall be part of the Proposal.

Respondent shall be responsible to examine and fully inform themselves in relation to all aspects of the RFP including the existing project site conditions before submitting their proposal. It is expected that each Respondent had read and understood the RFP and its specifications with earnest. Failure to do so will be at the Respondent's own risk and shall not be allowed to secure relief on a plea of error of omission or commission;

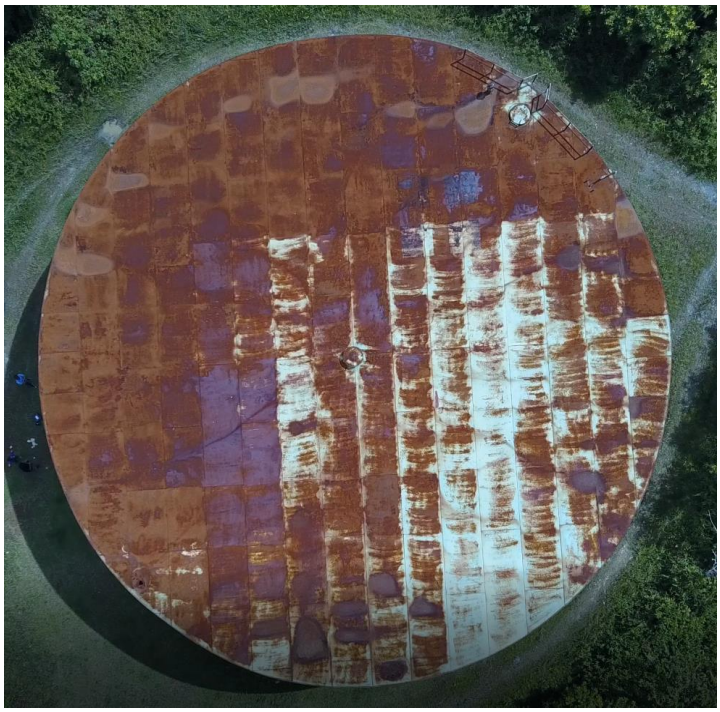
Indemnification Clause

To the fullest extent permitted by law, the selected Respondent or Professional Service Provider shall protect, indemnify, save, defend and hold harmless the PMO, Yap State Government and YSPSC including its officers, representatives and employees ("Indemnified Parties") from and against any and all liabilities, obligations, claims, damages, penalties, causes of action, costs, interest and expenses, including but not limited to reasonable attorney and paralegal fees, which Indemnified Parties may become obligated or suffer by reason of any accident, bodily injury, death of person, or loss of or damage to property, arising indirectly or directly under, out of, in connection with, or as a result of this Contract or the activities of the Service Provider or its agents, employees, sub-contractors, and even if caused in whole or in part by any negligent or intentional act or omission of Indemnified Parties.

The PMO, Yap State Government and YSPSC shall not be required to defend or indemnify the Professional Service Provider or its agents, employees, and sub-contractors.

Appendix 1

Tank No. 1



Description: Atmospheric Steel Tank (For potable water)

Volume:	1,000,000 gallons
Diameter:	80 feet
Height:	29 feet
Overflow Elevation:	252 feet Year
Constructed:	1971
Location:	Dololeb, Yap State (near YSPSC power plant)

Tank No. 2

Description:	Atmospheric Steel Tank
Volume:	1,000,000 gallons
Diameter:	80 feet
Height:	29 feet Overflow
Elevation:	199 feet Year
Constructed:	1971 Location:
	Nimar, Yap State

Appendix 2

TANK 1 AWWA D101-53 INTERNAL/OUT-OF-SERVICE TANK INSPECTION

Yap State Public Service Corporation (YSPSC), Colonia, Yap

Report Prepared for:
Project Management Office
Yap State, Federated States of Micronesia

Yap State Public Service Corporation
Yap State, Federated States of Micronesia

Contract/Task Order Number:
Contract: C 231202 2019-192

Report Prepared by:
Powers Engineering and Inspection, Inc. (PEI)
under subcontract to:
Central Pacific Tanks, Inc.
P.O. Box 5213
Kaneohe, Hawaii 96744 USA

Inspected on:
October 10, 2019

Construction and Inspection History:

Constructed	Bottom	External Inspection	Internal Inspection	UT Inspection
1971	**1971**	**October 2019**	**October 2019**	**October 2019**
Next Inspection:		**See Report**	**See Report**	**See Report**

Report Revisions:

Rev 0	October 29, 2019	Original Report
Rev 1	November 5, 2019	Minor Revision
Rev 2	November 8, 2019	Revised Executive Summary Item 4.d.
Rev 3	December 27, 2019	Revised per Customer Comments

Reporting:

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EXECUTIVE SUMMARY

Powers Engineering and Inspection Inc. was contracted by Central Pacific Tank (CPT) to provide AWWA D101-53 Internal Inspection services for Tank 1 at the Yap State Public Service Corporation in Colonia, Yap.

Tank 1 was originally engineered and designed in 1971 by Sunn, Low, Tom & Hara Inc. The tank is an 80-ft diameter x 29-ft tall tank with a supported steel cone roof, butt-welded shell, and a 1/4-in butt-welded bottom. The tank was most recently in Potable Water service.

The report and executive summary are based on field inspection and evaluation in accordance with AWWA D101-53 and API 653 Standards. Before the tank is returned to service all the requirements of AWWA D101-53 should be met.

Inspection Goal	Methods Employed	Results
1. Identify any current leak paths resulting from corrosion, internal or external.	◦ 100% Visual Inspection (VT) of corner weld and all bottom welds for defects or corrosion ◦ 100% Visual Inspection (VT) of base of tank, bottom extension and shell for corrosion, product stains or other signs of product seepage. ◦ Document with Digital Camera	a. Utilizing the AWWA D101-53 and Manual M42 Chapter 9 guidelines for periodic inspections along with API 653 MRT method for calculation of period to next inspection, the next formal AWWA Internal Inspection can be extended 3 to 5 years or as required by state regulatory agencies. The following Executive Summary and Action Items lists repairs that should be performed during the next planned outage. b. The coatings on the 1/4-in thick bottom plates and internal shell were noted to be ending or have surpassed it's intended lifespan with the most notable degraded locations being the lower 8-ft of the internal shell plate, internal corner weld, and bottom plate butt-welds. c. An MFL scan of the tank bottom was not performed during the inspection. Due to the extent of coating failure, disconnection of the cathodic protection system, and unknown extent of soil side corrosion, the 1/4-in bottom should be replaced. d. As internal coating is an important factor in protecting interior surfaces from corrosion in water storage tanks, the new bottom plates, shell plates, and roof structure should have a new internal coating installed that meets AWWA D102 and NSF/ANSI 61 requirements. e. The current cathodic protection system consists of (6) sacrifice anodes with only one anode currently connected to the tank. This system was installed during the initial tank construction in 1971 and has not been properly maintained. The cathodic protection system should be replaced with an API 651 compliant CP system, and a reference anode pipe should be installed underneath the bottom while the bottom plate is being replaced. f. The internal shell plate is experiencing widespread carbuncle corrosion and scaling due to the coating failure. During the time of inspection, no identifiable pitting requiring repair was identified. It is the Inspector's opinion that during the time of sandblasting to remove the existing coating, more extensive pitting will be identified and should be evaluated at that time. g. Extensive carbuncle corrosion was identified on the entirety of the center column. Due to the extent of the pitting was well as unidentifiable internal pipe corrosion of the center column, a "clam shell" should be installed around existing center column. The clam shell shall consist of two halves of pipe that are seal welded on both sides in order to provide additional support to the corroded center while also protecting it from further corrosion.

		h. API 653 minimum shell thickness calculations were performed and determined that the maximum height of product for the 1/4-in first shell course is 26-ft. As the bell-mouth of the 8-in overflow is located 28-ft above the bottom, special consideration should be made to limit the maximum fill height to 26-ft or lower the opening of the overflow to a maximum height of 26-ft. i. Consideration should also be made to lowering the fill heights to reduce the risk of sloshing damage during a strong seismic event.
2. Identify any risk areas for future leak path development	◦ Utilize Ultrasonic Testing (UT) to find areas of potential thinning or corrosion loss from internal corrosion. ◦ Documentation of any brittle fracture concerns including nozzle weld spacing.	a. A wear plate is currently not installed underneath the center column's base structure (crow's foot). As this creates an area of the bottom plate that is not able to be inspected, install a 1/4-in thick wear plate underneath the crow's foot that is lap-welded to the bottom plate, after the bottom plate is replaced. Do not weld the crow's foot to the new wear plate. Install four (4) angle iron clips around the crow's foot to limit horizontal movement. b. There is currently an abandoned and corroded automated tank gauge bottom attachment welded directly to the bottom plate. After the bottom replacement is completed and a new level gauge is installed Photo D, install a 1/4-in repad underneath the new level gaugetank bottom bracket. c. The tank bottom to foundation currently does not have a caulking installed, allowing for water intrusion underneath the bottom as well as increasing the risk of knife edge corrosion to occur on the bottom extension. After the bottom is replaced, install a flexible caulking system around 100% of the bottom extension to foundation interface. d. The current anchoring system is an anchor bolt going through the bottom extension. Consider installing API 650 compliant anchor chairs on the shell in order to adequately distribute seismic loading to the shell rather than the bottom extension in the event of seismic activity. e. There is currently an anchor missing on the tank opposite of the 24-in manway. Replace the missing anchor bolt like-in-kind and use an anchoring adhesive engineered for the calculated pull-out strength of the anchors. f. The shell reinforcing pads on the (2) 8-in nozzles and 24-in manway do not have "tell-tales" installed in order to adequately detect a leak in the shell behind the repads. Consider installing API 650 compliant tell-tales in the repads in order to detect the presence leaks. g. Isolated nozzle, bottom repad, and shell repad geometry, spacings, and thickness were found to be below API 650 requirements. As these components, have been operating in-service at max capacity, no corrective action is required, and brittle fracture risk is minimal. Monitor nozzles for signs of stress induced damages along the shell to determine if corrective action is needed in the future. h. UT scrubs were performed in (8) radial lines around the tank from the shell to the center column. The lowest remaining thickness measured with this technique on the 0.25-in thick bottom plates was 0.232-in. i. Visual inspection of the shell plate was performed to identify product side corrosion with no required repairs of pitting being identified. UT scrubs were performed along the top two courses via manlift with no identifiable corrosion being present.
3. Foundation settlement	◦ Survey of the shell for settlement. ◦ VT shell for bulges,	a. The maximum out-of-plane settlement was approximately 3.25-in, which is within acceptable limits of API 653 Appendix B calculations for differential settlement. See survey results. b. The shell was inspected for verticality and distortion. No significant distortion was identified.

	distortion, or other verticality issues.	c. The seismic loads were calculated utilizing the latest API 650 Appendix E (ASCE 7/ IBC 2009 methods). The risk of damage from a seismic event is minimal for all fill heights.
4. Access structures	◦ Through visual examination (VT) of access structure to determine its condition.	a. The internal vertical ladder is corroded beyond use and repair. Photo B. Replace with a permanent fall arrest system compliant with OSHA Subpart D installed on the ladder or an anchor point for a portable fall arrest system installed on or above the existing 24-in roof manway. b. The cone roof is accessed via vertical ladder on the tank shell. The vertical ladder is currently in good condition with minor coating failure. The vertical ladder is also over 24-ft tall without a fall arrest system installed. Photo C. Install an OSHA Subpart D compliantfall arrest system on the external vertical ladder. c. The roof handrails near the vertical ladder appear to be in good condition with minor corrosion and coating failure. d. The tank currently does not have system in place such as a fence and locked gate to limit access to the tank.
5. Cone Roof	◦ VT of steel roof deck and coating ◦ UT of components and roof deck	a. Three (3) areas of through-hole corrosion was identified on the cone roof plate (see RLO) caused by coating failure and localized stagnant water. Install 1/4-in x 3-ft x 3-ft lap-welded patch plates over these areas of corrosion. Photo F b. The center column crow's foot is experiencing corrosion throughout its W-beam support members and bearing plate. Replace the corroded center column crow's foot with like-in-kind materials as well as like-in-kind welding techniques. c. During inspection it was noted that the roof rafters are experiencing minor bowing most likely due to seismic activity with the most significant bow being measured at 6-in. The roof rafters are currently not twisting indicating that rafters are not experiencing lateral torsional buckling. Monitor the condition of the roof rafters during the next formal internal inspection to determine if the rafter conditions have worsened. Photo E d. The 3/16-in roof deck appears to be in generally good condition with no significant corrosion being identified visually or with UT scrubs performed on the roof plate. e. There are indications of a significant amount of localized water collection areas depressions, known as "bird baths." If the roof coating is not replaced, these bird baths will eventually lead to additional through-hole corrosion areas once the roof's bare steel is exposed.
6. Venting	◦ VT of existing venting system	a. The tank is vented with an 18-in open center vent while the tank is serviced with 8-in nozzles. API 2000 venting calculations indicate that the venting configuration is adequate. b. Coating failure and minor corrosion is present on the center vent
7. Coatings	◦ VT of coatings	a. As mentioned in the beginning of the Executive Summary, the internal linings appear to have surpassed their intended lifespan and are now experiencing flaking and general wear leading to exposed steel. The new bottom plates, shell plates, and roof structure should have a new internal coating installed that meets AWWA D102 and NSF/ANSI 61 requirements after all repairs are complete. b. The external shell plate, shell appurtenances, vertical ladder, and cone roof plate coatings are all experiencing coating failure in the form of worn and flaking coatings. Due to the tropical climate, corrosion of exposed steel will be higher than normal for these tanks. It is strongly recommended that all external coatings should be replaced to prevent further corrosion.

AWWA D101-53 COMPLIANCE

It is the best opinion of the Inspector that Tank 1 complies with the AWWA D101-53 and Manual M42 standard if the following Action Items are properly addressed:

ACTION ITEMS

1. Utilizing the AWWA D101-53 and Manual M42 Chapter 9 guidelines for periodic inspections along with API 653 MRT method for calculation of period to next inspection, the next formal AWWA Internal Inspection can be extended 3 to 5 years or as required by state regulatory agencies.

   Note: The action item repairs listed below can be performed at that time.

2. Replace the existing ¼-in butt-welded bottom with a new ¼-in lap-welded bottom.

3. API 653 Minimum Shell Thickness calculations indicate that the maximum allowable height of product for the tank is 26-ft. Limit the maximum fill height of water to 26-ft or modify the overflow piping to have a maximum height of 26-ft.

4. Restore or replace the cathodic protection system with an API 651 compliant cathodic protection system. The current system is a “1970’s era anode bed sacrificial cathodic protection system that has not been properly maintained with only one anode connected to the tank. Photo A

5. Install new internal coatings including bottom, shell, roof column and crow’s foot, and internal shell stiffeners to prevent further internal corrosion. Preliminary coating tests identified that the existing coatings do not contain lead or chromate, but a formal testing of the coatings should be complete prior to sandblasting.

6. Install a “clam shell” around the existing 8-in center column. The clam shell shall consist of two halves of a pipe that are seal welded on both sides in order to provide additional support to the corroded center column while also protecting it from further corrosion.

7. Replace the corroded center column base structure (crows’ foot) like-in-kind.

8. Install a wear plate underneath the center column crows’ foot with seismic clips to allow for slight vertical movement of the center column while restraining from lateral movement. Do not weld the crows’ foot to the wear plate.

9. Install (3) 1/4” x 3-ft x 3-ft lap-welded patch plates over the areas of through hole corrosion on the cone roof plate (see RLO).

10. Replace the missing anchor bolt.

11. Replace or remove the corroded internal vertical ladder.

12. The vertical ladder providing access to the cone roof is over 24-ft tall with no fall arrest system. Install an OSHA compliant fall arrest system on the vertical ladder.

13. Install a new automatic tank level gauge on the tank with a 1/4-in thick repad installed underneath the new tank bottom bracket.

In addition to the above required Action Items, the following are listed for Consideration and Monitoring:

CONSIDER ITEMS

1. Consider lowering the shell fill height to reduce the risk of sloshing damage during a strong seismic event.

2. Consider installing API 650 compliant anchor chairs on the shell in order to adequately distribute seismic loading to the shell rather than the bottom extension in the event of seismic activity.

3. Consider recoating the external shell and roof.

4. Consider installing API 650 compliant “tell-tales” on the shell appurtenance repads in order to detect the presence of leaks.

5. Consider installing sealant around the bottom extension to foundation interface to mitigate water intrusion underneath the bottom which could lead to soil side corrosion.

6. Consider adding fenced enclosure to the tank area for security.

MONITOR ITEMS

1. Visually, monitor the tank shell, exposed foundation and bottom extension for leaks on a periodic basis.

2. Monitor the coatings and apply touch-up as needed.

3. The roof rafters are experiencing minor bowing likely due to center column settlement, wind or seismic activity. The roof rafters are currently not twisting indicating the rafters are not experiencing lateral torsional bowing. Monitor the condition of the roof rafters during the next internal inspection to determine if the rafter conditions have worsened.

BASIC TANK INFORMATION

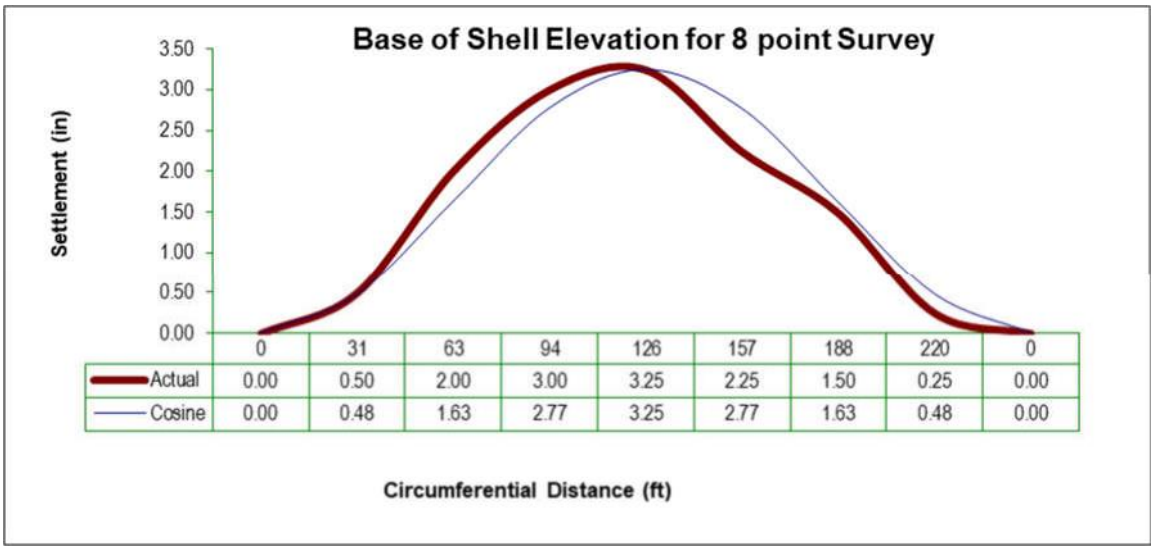
Tank Number:	Owner:	Location:	Unit/Zone/Area:
TANK 1	YAP STATE PUBLIC SERVICE CORPORATION	COLONIA, YAP, FEDERATED STATES OF MICRONESIA	--
Product:	**Diameter (ft):**	**Height (ft):**	**Capacity (gal):**
POTABLE WATER	80	29	733,950

Type Tank:	Year Built:	Design Standard:	Engineer/Designer:
BUTT-WELDED W/CONE ROOF	1971	AWWA	SUNN, LOW, TOM & HARA INC.

Type Shell:	Type Roof:	Type Foundation:	Type Bottom:
BUTT-WELDED	SUPPORTED CONE ROOF	CONCRETE RINGWALL	1/4-IN BUTT-WELDED
Cone Roof Access:	**Floating Roof Access:**	**Roof Vents:**	**Roof Manways:**
UNCAGED VERTICAL LADDER	NA	1: 18-IN OPEN VENT	1: 24-IN
Pumping Rate:	**Suction Line:**	**Receipt:**	**Shell Manways:**
UNKNOWN	1: 8-IN	1: 8-IN	1: 24-IN
Leak Detection:	**Secondary Containment:**	**Cathodic Protection:**	**Insulation:**
NONE	N/A	SACRIFICIAL ANODE	NONE

Shell Coatings:	Floating Roof Coatings:	Bottom Coating:
YES	NA	YES

SHELL SETTLEMENT SURVEY



	0	31	63	94	126	157	188	220	0
Actual	0.00	0.50	2.00	3.00	3.25	2.25	1.50	0.25	0.00
Cosine	0.00	0.48	1.63	2.77	3.25	2.77	1.63	0.48	0.00

- The settlement for the tank is planer or roughly approximates the shape of a cosine curve.
- The evaluation of this "out-of-levelness" or settlement, utilizing the criterion for "out-of-plane distortion" as described in API 653 Appendix B.3.2, indicates that the settlement **is well** within the acceptable limits.

Applicable Standards:

Shell settlement surveys were conducted in accordance with the requirements of API 653 Figure B-1. These surveys were evaluated in accordance with the API 653 Appendix B.2.2 and compared with the acceptance criteria outlined in API 653 Appendix B.3.2.

Note:

Calculation of maximum permissible S or out-of-plane distortion per API 653 Appendix B.3.2 was made using:

Shell Settlement API 653 5th Appendix B

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Find: Shell Settement API 653 5th edition Addendum 1 Appendix B Methodology

Given:

Tank Number	1		Circumference	251.3	(ft)
Tank Diameter	80.0	(ft)	Req'd Stations	251 / 32 = 8	ref API 653 12.5.1.2
Fit Cosine to Data	1		Actual Stations	8	
Sum of Sqr. Diff.	0.534				
Spacing Between (ft)	31.4	*L*	< 32-ft OK		
Allowable Stress (psi)	30,000	*Y*	Survey Max	0.271	(ft)
Modulas of Elasticity (ksi)	29,000	*E*		3.25	(in)
Tank Height (ft)	29.0	*H*	Curve Fit R^2	0.9997	

Results:	*Allowable*	>	*Actual*	
Differential (ft)	0.194	>	0.044	Pass
(in)	2.324	>	0.524	

$$|S| \le \frac{(L^2 \times Y \times 11)}{2[(E \times H)]}$$

Curve Fit to Cosine is OK R^2>=90%

SHELL THICKNESS CALCULATION

Shell Thickness Calculations per API 653 4.3.3.1

Find: Minimum shell thickness (t min) for each shell course utilizing the API 653 standard for tanks less than 200 ft dia.

Given:

Variable Identifier		Description	Value	Reference
H		Fill height (ft)	26.00	Measured from the base of each shell course (see column H in the table below)
D		Tank Diameter (ft)	80.00	
G		Specific Gravity	1.00	
S		Allow stress (psi)	Varies	Reference API 653 Table 4-1
E		Joint Efficiency	Varies	Reference API 653 table 4.2 for Welded and 4.3 for Riveted construction
M	1.00	Temp Modifier	Varies	Reference API 650 Appendix M Elevated temperature modifier

Solution: 1st Course Stress(psi)=(g*2.6(D(H-1)/t)=20,800(psi)

Table for Calculating minimum shell thickness (t min) for each shell course

			H		E		S	API 653 Required Calculation		Actual	Solution
Course	Height of each Course		Product Height Above Course	Type of Joint for each Course	Joint Eff API 653 Tbl 4.2 and 4.3	Material Type or Unknown Welded or Riveted	Maximum Allowable Stress	$t\ min = \frac{2.6\,(H-1)\,DG}{SEM}$	Req'd t min	Minimum Thickness for Course	Actual Vs Req'd
	(in)	(ft)	(ft)		%		(psi)	API 653 4.3.3.1	(in)	(in)	OK?
1	60.00	5	26.00	85% Butt Weld	0.85	A 36	24,882	2.6 x (26.00 - 1) x 80.00 x 1.00 / (24,882 x 0.85 x 1.00)	0.2459	0.2500	Ok
2	60.00	5	21.00	85% Butt Weld	0.85	A 36	24,882	2.6 x (21.00 - 1) x 80.00 x 1.00 / (24,882 x 0.85 x 1.00)	0.1967	0.2500	Ok
3	60.00	5	16.00	85% Butt Weld	0.85	A 36	27,376	2.6 x (16.00 - 1) x 80.00 x 1.00 / (27,376 x 0.85 x 1.00)	0.1341	0.2500	Ok
4	60.00	5	11.00	85% Butt Weld	0.85	A 36	27,376	2.6 x (11.00 - 1) x 80.00 x 1.00 / (27,376 x 0.85 x 1.00)	0.1000	0.2500	Ok
5	60.00	5	6.00	85% Butt Weld	0.85	A 36	27,376	2.6 x (6.00 - 1) x 80.00 x 1.00 / (27,376 x 0.85 x 1.00)	0.1000	0.2500	Ok
6	45.00	3.75	1.00	85% Butt Weld	0.85	A 36	27,376	2.6 x (1.00 - 1) x 80.00 x 1.00 / (27,376 x 0.85 x 1.00)	0.1000	0.2500	Ok

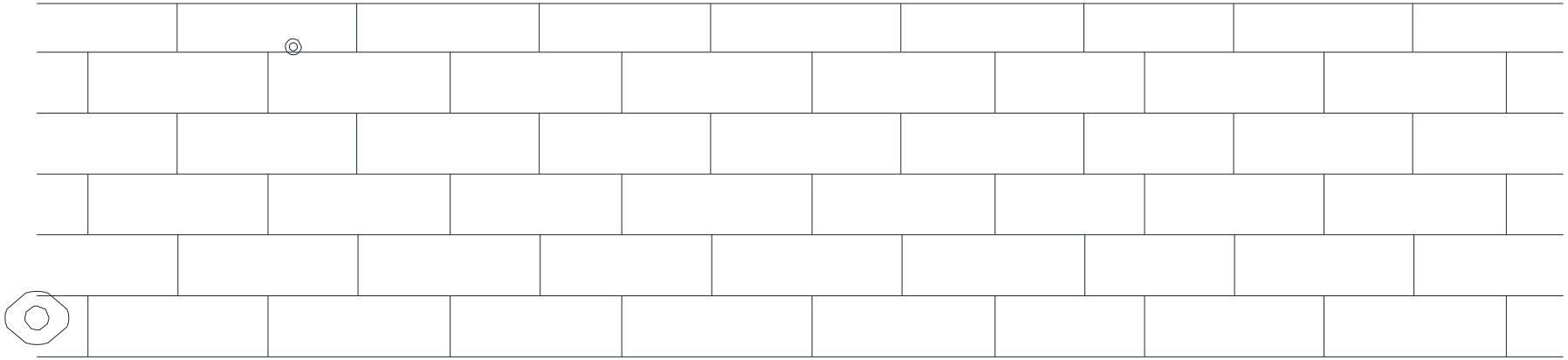
SHELL CORROSION RATE CALCULATION

Shell Corrosion Rate Calculations API 653 6.3, Widely Scattered Pits

Course	Date(s)			Thickness			A	B	Corrosion Rate(s)		N	RCA	RCA/ 4N Next External
	Year Built or Replaced	Inspection Year			Measured			Calculated				API 653 6.3.2.1 (A-B)	API 653 6.3.2
		Prev	Current	As Built	Prev	Current		t min	Previous	Current			
	(yr)	(yr)	(yr)	(in)	(in)	(in)		(in)	(in/ yr)	(in/ yr)		(in)	(yr)
1	1971	1971	2019	0.250	0.250	0.242		0.123	N/A	0.0002		0.1191	5.00
2	1971	1971	2019	0.250	0.250	0.244		0.098	N/A	0.0001		0.1457	5.00
3	1971	1971	2019	0.250	0.250	0.241		0.067	N/A	0.0002		0.1740	5.00
4	1971	1971	2019	0.250	0.250	0.248		0.050	N/A	0.0000		0.1980	5.00
5	1971	1971	2019	0.250	0.250	0.245		0.050	N/A	0.0001		0.1950	5.00
6	1971	1971	2019	0.250	0.250	0.245		0.050	N/A	0.0001		0.1950	5.00
											minimum:		5.00

RCA = The difference between the measured thickness and the minimum required thickness (in per year are used in this calculation) ref API 653 6.3.2.1
Per API 653 Section 4.3.2.2 a), no pit depth results in the remaining shell thickness being less than one-half the minimum acceptable tank shell thickness exclusive of the corrosion allowance

SHELL ROLLOUT



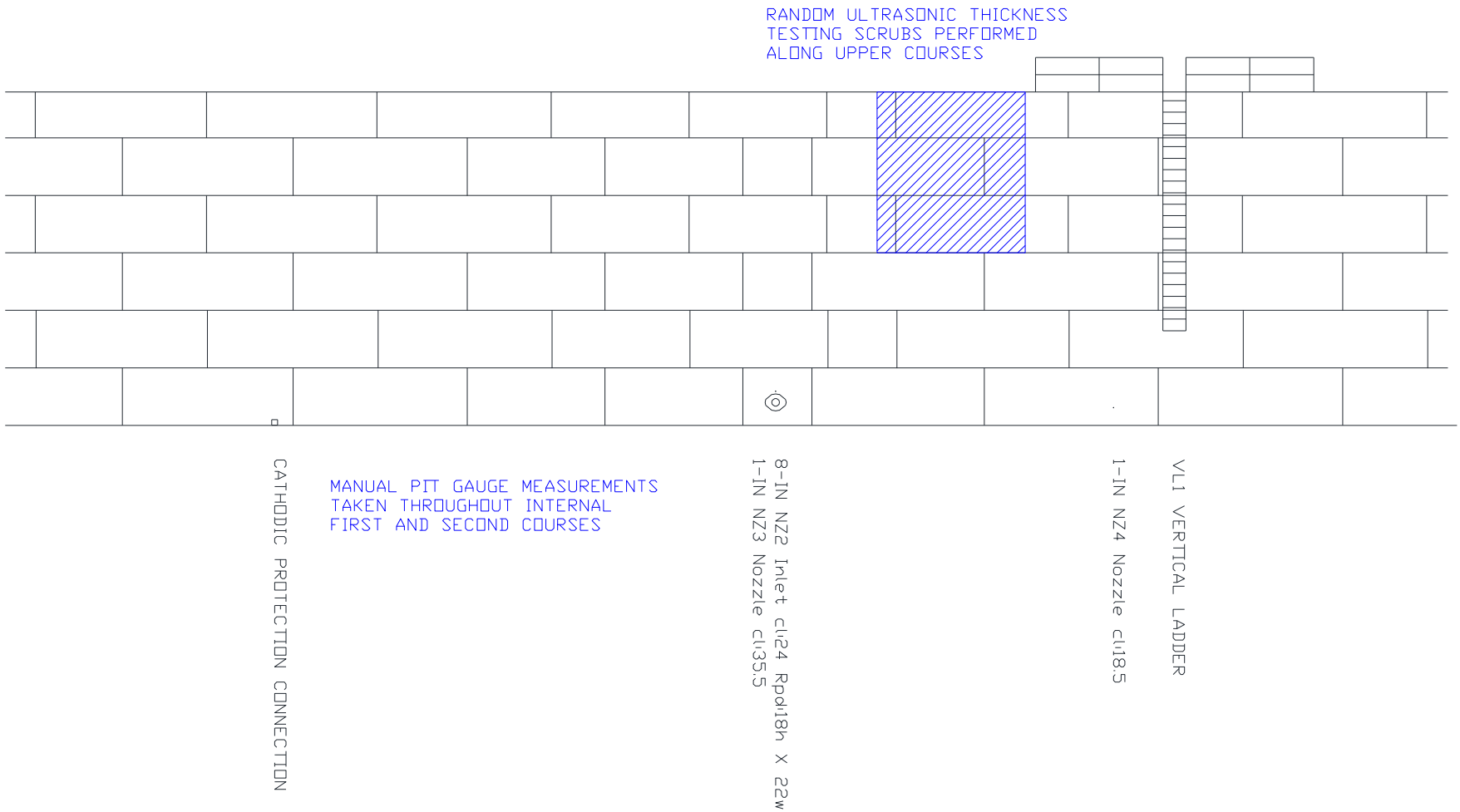
24-IN MW1 cl:38 Rpd:53h X 63w

8-IN NZ1 Nozzle cl:302 Rpd:16h X 16w

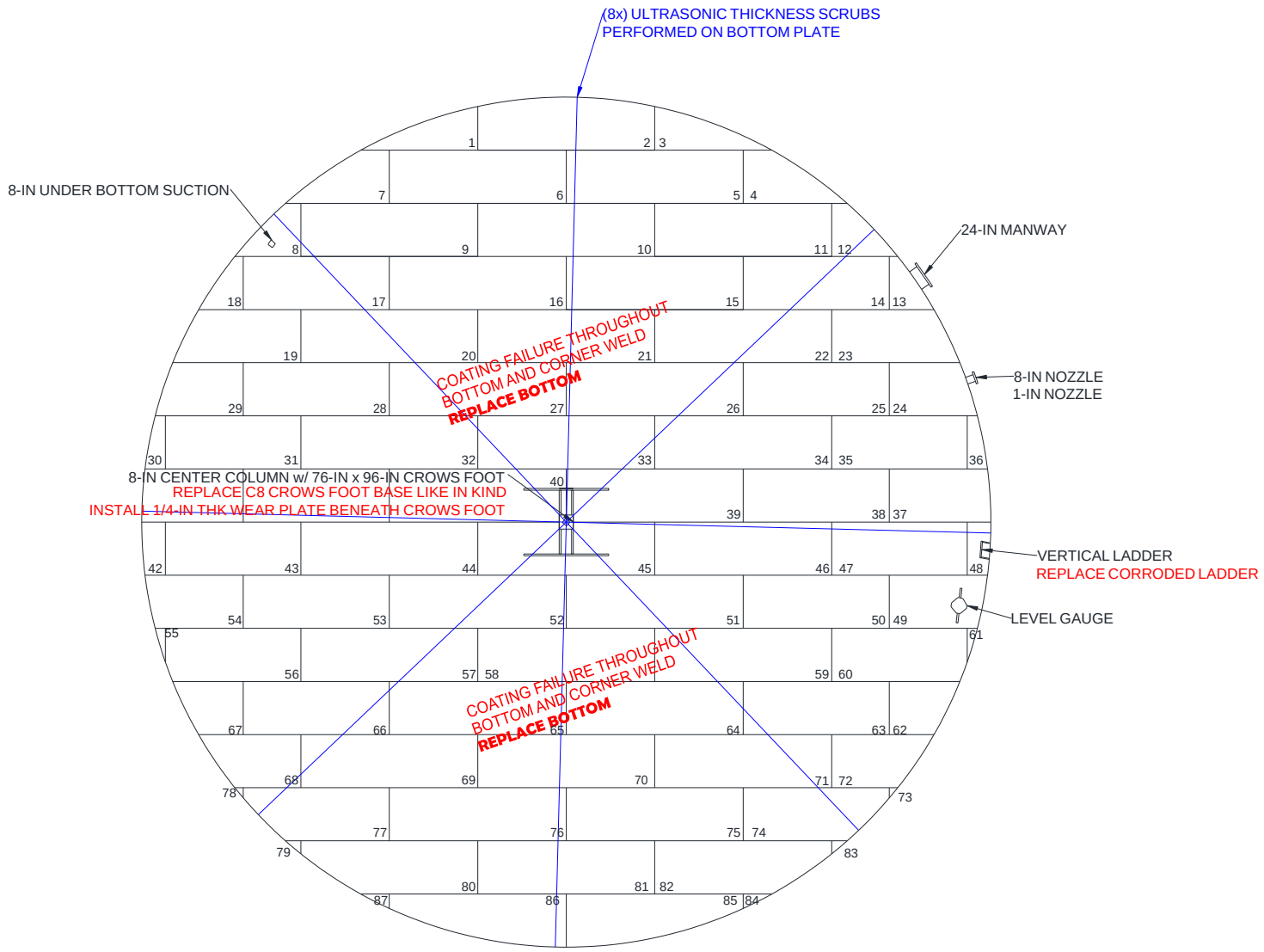
MANUAL PIT GAUGE MEASUREMENTS TAKEN THROUGHOUT
INTERNAL FIRST AND SECOND COURSES

MISSING ANCHOR BOLT

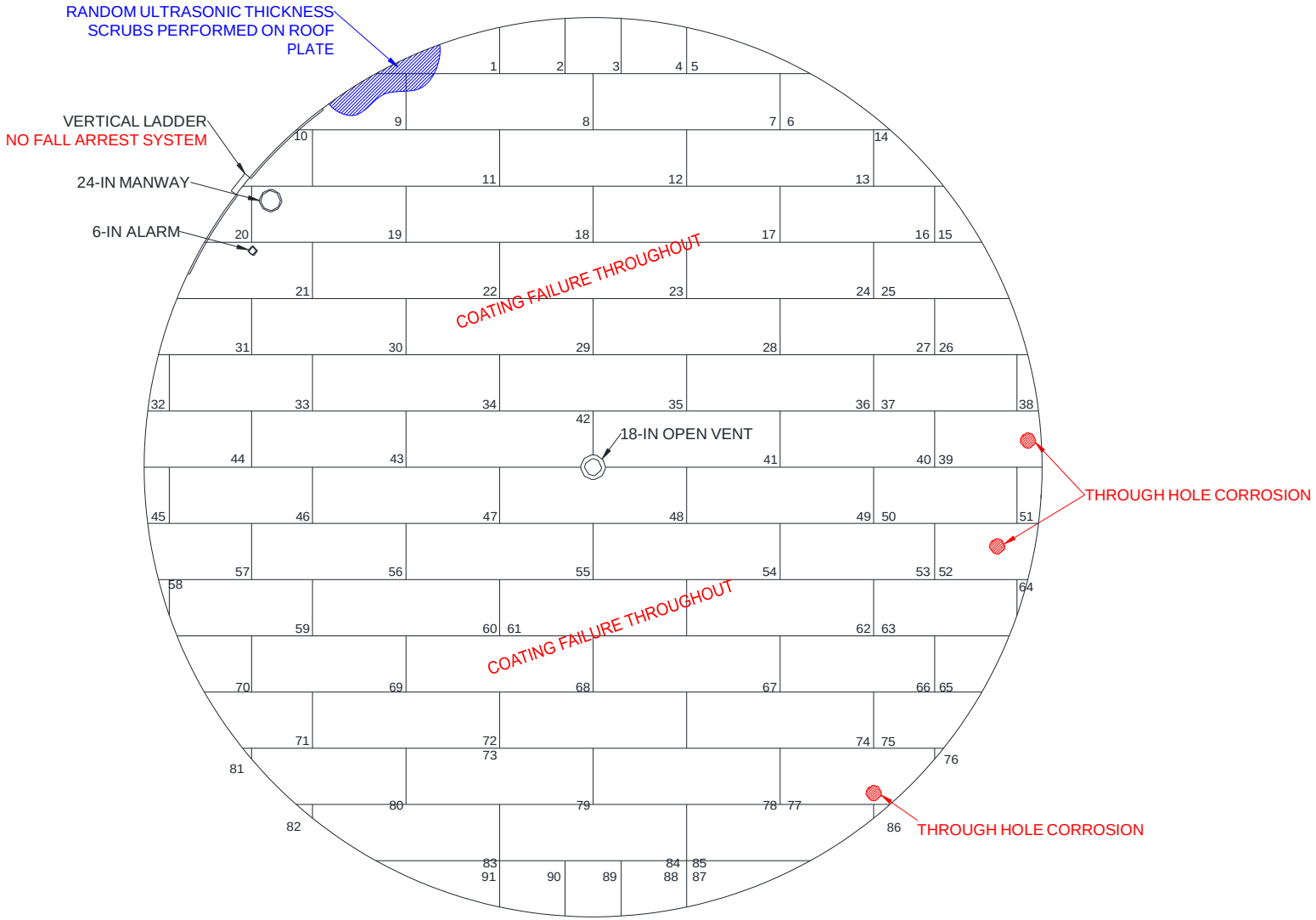
SHELL ROLLOUT (CONT.)



BOTTOM LAYOUT



CONE ROOF LAYOUT



NEXT INSPECTION CALCULATION

The tank bottom will be replaced. It is the best opinion of the Inspector that the bottom has a remaining life of 2-3 years until a leak occurs. Periodic monitoring of the tank bottom for a leak should be performed until the bottom is replaced.

SEISMIC CALCULATION

Seismic Design per API 650 11th Appendix E

Find: Product fill height for seismic loading utilizing API 650 12th edition Appendix E Methodology

Given:

Tank Number:		1		
Type Roof		3 Cone Roof with no Internal Floating Roof		
Tank (D)iameter (ft)		80.00		
Tank (H)eight or length for Horizontal Tank (ft)		29.00		
Seismic Product fill Height (ft)		26.00	Hfill	26 (ft) Operational
Specific (G)ravity		1.00		
Elevation of tank bottom above grade (ft)		0.66667		
Location:	Latitude (deg)	9.514400		
	Longitude (deg)	138.129400		
Spectral Response Factors	Ss	0.79	78.60%	USGS or UFC 3-101 -1 tbl F-2
	S1	0.31	31.40%	USGS or UFC 3-101 -1 tbl F-2
	So	0.314	= Ss*0.4 for Mapped Methods	
Site Coefficients	Fa	1.186	API 650 Table E-1	
	Fv	1.77	API 650 Table E-2	
Regional-dependant transition period	TL	-	ASCE 7 maps	*Varies from 4 to 16*
Sm1=Fv*S1		0.5564		
Use Group Importance Factor (API 650 Tbl E-5)		1		
Site Soil Classification		D Stiff Soil	Table E-3 API 650	IBC 2009 table 1613.5.2
Seismic Use Group		I	SUI or I	Use: group IV Military III essential, II public risk, or I
Thickness of Bottom under the shell (in)		0.2500	*tb*	
Min Req'd Thickness of Bottom under shell (in)		0.1000		API 653
Calc'd 23.43 Width of Annular Plate (in)		1.95	L	API 650 Appendix E.6.2.1.1.1
API 650 Appendix M Temeprature Modifier		1.00	Tm	
Yield of Bottom Under Shell (psi)		30,000	Fby	
Yield of 1st shell course (psi)		36,000	Fyield 1st Course	
(psi)		24,882	Sd	
Modulus of Elasticity (psi)		29,000,000	E	
Weight per Cubic ft of Material (pcf)		Steel	490 pcf	
Snow Load (psf)		10		IBC 1608.4 or UFC 3-101 -1 tbl F-1
3-sec Gust Design Wind Velocity (mph)		100	V	IBC 2009 fig 1609 or UFC 3-101 -1 tbl F-1

Solution:

API 650 12th Appendix E Calculations for Lat 9.51440 and Long 138.12940

Seismic Overturning or Uplift Risk w/o Anchors?	No Seismic uplift is expected for fill heights < 26.00 (ft)
Compressive Shell Stress from Seismic Loads ?	Good ! Calculated Seismic Compressive Stress is less than Allowable
Height of sloshing wave per API 650 Appendix E ?	The calculated height of the sloshing wave is 1.64 (ft); recommended freeboard 1.15 (ft)
Wind Overturning for 100 mph wind?	Wind Overturning OK for API 650. No anchors are required to resist wind overturning

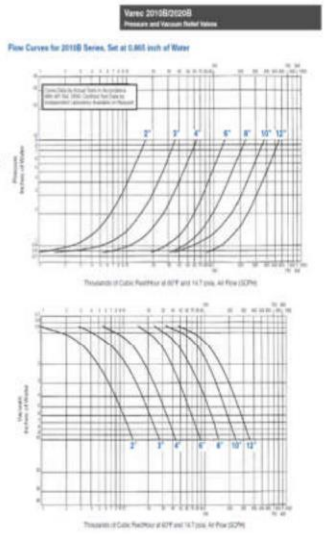
API 2000 VENTING CALCULATIONS

Venting Calculations for Atmospheric and Low Pressure Tanks per API 2000

Find: Normal Out-Breathing and In-Breathing for non-frangible roof design utilizing the API 2000 methodology

Given:

Variable Identifier	Description	Value		Reference or Formula	
D	Tank Diameter (ft)	80			
H	Shell height (ft)	29			
Hfill	Fill height (ft)	29.00			
	Type Product	Water			
	Specific Gravity	1			
	Vapor Pressure (mm Hg at 20°C)	0		IERA-RS-BR-SR-2001-002 SwRI 03.40.50.03148.001	
	Vapor Pressure (Fuel Oil, Diesel, Jet, Crude)			Vapor pressure of Hexane is 130 mm Hg at 20 °C	
	Flash Point (deg F)	200	93.33 (deg C)	UFC 3-460-01, Table 2-2	
	Operating Temperature (deg F)	100	37.78 (deg C)		
Tv	Simple Tank Volume (ft^3)	145,770		=0.25*H*pi*D^2	
	Type of Venting	3. Fixed Roof with Open Vent		Pressure Capacity	Vacuum Capacity
	Number of Vents on Roof	1			
Calculations:	Size of Vent 1 on Roof (in)	18		0	0
	Size of Vent 2 on Roof (in)	0		0	0
	Size of Vent 3 on Roof (in)	0		0	0
	Size of Vent 4 on Roof (in)	0		0	0
	Size of Largest Product In/Out Nozzle (in)	8			



Pressure

	Product In Flow Rate (bph)	2,286		
Pifr	(gpm)	1,600		
C	Hexane to product conversion factor	4.00	API 2000 Table 2	
Ri	Insulation Factor (1 for un-insulated tanks)	1.00	API 2000 Table 9	
Vop	Out breathing due to liquid movement (CFH Air)	12,832	= 8.02*Pfr	
Vit	Normal Out breathing due to Thermal (CFH Air)	13,406	= 3.08*C*Simple Tank Volume^(0.7)*Ri	
	Total Out breathing (CFH Air)	26,238		
	Per vent out Breathing (CFH Air)	26,238	Total/Number of Vents	OK Venting area >= 90% In/Out Per NFPA 30 21.4.3.3 sizing using API 2000 is acceptable or sizing vents at least as large as the largest inlet/outlet nozzle.
	API 2000 Pressure Sizing with Varec PVV:			
	Existing Venting Capacity (CFH Air):	0		
	Existing Vent Ok?:	Venting capacity insufficient.		
	Option 1	1 : 6-in		

Vacuum

	Product Pump Out Flow Rate (bph)	2,286	
Pofr	(gpm)	1,600	
Y	Latitude Factor	0.20	API 2000 Table 1
Vip	In breathing due to liquid movement (CFH Air)	12,832	if Temp < 104 deg F use 8.02 * Pofr else 8.02 * 1.005 * Pofr
Vot	Normal In breathing due to Thermal (CFH Air)	50,720	= 1.51*Y*Simple Tank Volume^(0.9)*Ri
	Total In breathing (CFH Air)	63,552	
	Per vent In Breathing (CFH Air)	63,552	
	API 2000 Vacuum Sizing with Varec PVV:		
	Existing Venting Capacity (CFH Air):	0	
	Existing Vent Ok?:	Existing venting capacity insufficient.	
	Option 1:	1 : 12-in	
	Option 2:	1 : 12-in	

Solution: Vent size 1 : 18-in Open Vent Total/Number of Vents

APPENDIX A: API 653 CHECKLIST

EXTERNAL

1.1 FOUNDATION		
ALL		
C.1.1	Measure foundation levelness and bottom elevations	See Report 'Shell Settlement Survey'
CONCRETE RING WALL		
C.1.1.1 a	Inspect for broken concrete, spalling, and cracks, particularly under backup bars used in welding butt welded annular rings under the shell.	See report
C.1.1.1 b	Inspect drain openings in ring, back of water draw basins and top surface of ring for indications of bottom leakage.	OK
C.1.1.1 c	Inspect for cavities under foundation and vegetation against bottom of tank.	OK
C.1.1.1 d	Check that runoff rainwater from the shell drains away from tank.	OK
C.1.1.1 e	Check for settlement around perimeter of tank.	OK
ASPHALT		
C.1.1.2. a	Check for settling of tank into asphalt base which would direct runoff rain water under the tank instead of away from it.	NA Concrete Ringwall
C.1.1.2. b	Look for areas where leaching of oil has left rock filler exposed, which indicates hydrocarbon leakage.	NA Concrete Ringwall
OILED DIRT OR SAND		
C.1.1.3 a	Check for settlement into the base which would direct runoff rain water under the tank rather than away from it.	NA Concrete Ringwall
ROCK		
C.1.1.4 a	Presence of crushed rock under the steel bottom usually results in severe underside corrosion. Make a note to do additional bottom plate examination (ultrasonic, hammer testing, or turning of coupons) when the tank is out of service.	NA Concrete Ringwall
SITE DRAINAGE		
C.1.1.5 a	Check site for drainage away from the tank and associated piping and manifolds.	Drainage is away from tank
C.1.1.5 b	Check operating condition of the dike drains.	Not Performed
HOUSEKEEPING		
C.1.1.6. a	Inspect the area for buildup of trash, vegetation, and other inflammables buildup.	None present
1.2 SHELLS		
EXTERNAL VISUAL INSPECTION		
C.1.2.1. a	Visually inspect for paint failures, pitting, and corrosion.	See Report
C.1.2.1. b	Clean off the bottom angle area and inspect for corrosion and thinning on plate and weld.	See Report
C.1.2.1. c.	Inspect the bottom-to-foundation seal, if any	None Present
INTERNAL (FLOATING ROOF TANK)		
C.1.2.2.a	Visually inspect for grooving, corrosion, pitting, and coating failures.	NA

RIVETED SHELL INSPECTION		
C.1.2.3. a	Inspect external surface for rivet and seam leaks	Shell Not Riveted
C.1.2.3. b	Locate leaks by sketch or photo (location will be lost when shell is abrasive cleaned for painting).	Shell Not Riveted
C.1.2.3. c	Inspect rivets for corrosion loss and wear	Shell Not Riveted
C.1.2.3. d	Inspect vertical seams to see if they have been full fillet lap welded to increase joint efficiency	Shell Not Riveted
C.1.2.3. e	If no record exists of vertical riveted seams, dimension and sketch (or photograph) the rivet pattern: number of rows, rivet size, pitch length, and note whether the joint is butt riveted or lap riveted.	Shell Not Riveted
WIND GIRDER (FLOATING ROOF TANKS)		
C.1.2.4. a	Inspect wind girder and handrail for corrosion damage (paint failure, pitting, corrosion product buildup), especially where it occurs at tack welded junction, and for broken welds.	No Wind Girder
C.1.2.4. b	Check support welds to shell for pitting, especially on shell plates.	No Wind Girder
C.1.2.4. c	Note whether supports have reinforcing pads welded to shell.	No Wind Girder
1.3 SHELL APPURTENANCES		
MANWAYS AND NOZZLES		
C.1.3.1. a	Inspect for cracks or signs of leakage on weld joint at nozzles, manways, and reinforcing plates.	No seeps present
C.1.3.1. b	Inspect for shell plate dimpling around nozzles, caused by excessive pipe deflection.	No distortion
C.1.3.1. c	Inspect for flange leaks and leaks around bolting.	No seeps present
C.1.3.1. d	Inspect sealing of insulation around manways and nozzles.	N/A Tank Not Insulated
C.1.3.1. e	Check for inadequate manway flange and cover thickness on mixer manways.	No Mixer
TANK PIPING MANIFOLDS		
C.1.3.2. a	Inspect manifold piping, flanges, and valves for leaks.	No leaks observed
C.1.3.2. b	Inspect firefighting system components	NA
C.1.3.2. c	Check for anchored piping which would be hazardous to the tank shell or bottom connections during earth movement.	NA
C.1.3.2. d	Check for adequate thermal pressure relief of piping to the tank.	NA
C.1.3.2. e	Check operation of regulators for tanks with purge gas systems.	Not Performed
C.1.3.2. f	Check sample connections for leaks and for proper valve operation	NA
C.1.3.2. g	Check for damage and test the accuracy of temperature indicators.	NA
C.1.3.2. h	Check welds on shell-mounted davit clips above valves 6 inches and larger.	No davit clips present
AUTO GAUGE SYSTEM		
C.1.3.3. a	Inspect auto gauge tape guide and lower sheave housing (floating swings) for leaks	NA
C.1.3.3. b	Inspect auto gauge head for damage	NA
C.1.3.3. c	Bump the checker on auto gauge head for proper movement of tape.	NA
C.1.3.3. d	Identify size and construction material of auto gauge tape guide (floating roof tanks).	NA

C.1.3.3. e	Ask operator if tape tends to hang up during tank roof movement (floating roof tanks).	NA
C.1.3.3. f	Compare actual product level to the reading on the auto gauge (maximum variation is 2 inches).	NA
C.1.3.3. g	On floating roof tanks, when the roof is in the lowest position, check that no more than two feet of tape are exposed at the end of the tape guide.	NA
C.1.3.3. h	Inspect condition of board and legibility of board-type auto gauges.	NA
C.1.3.3. i	Test freedom of movement of marker and float.	NA
SHELL MOUNTED SAMPLE STATION		
C.1.3.4. a	Inspect sample lines for function of valves and plugging of lines, including drain or return-to-tank line.	NA
C.1.3.4. b	Check circulation pump for leaks and operating problems.	NA
C.1.3.4. c	Test bracing and supports for sample lines and equipment.	NA
HEATER (SHELL MANWAY MOUNTED)		
C.1.3.5. a	Inspect condensate drain for presence of oil indicating leakage	NA
MIXER		
C.1.3.6. a	Inspect for proper mounting flange and support.	NA
C.1.3.6. b	Inspect for leakage.	NA
C.1.3.6. c	Inspect condition of power lines and connections to mixer.	NA
SWING LINES: WINCH OPERATION		
C.1.3.7. a	Non-floating. Raise, then lower the swing line with the winch, and check for cable tightness to confirm that swing line lowered properly.	NA
C.1.3.7. b	Floating. With tank half full or more, lower the swing line, then let out cable and check if swing has pulled cable tight, indicating that the winch is operating properly.	NA
C.1.3.7. c	Indicator. Check that the indicator moves in the proper direction: Floating swing line indicators show a lower level as cable is wound up on the winch. Non-floating swing line indicators show the opposite.	NA
SWING LINES: EXTERNAL GUIDE SYSTEM		
C.1.3.8. a	Check for leaks at threaded and flanged joints.	NA
SWING LINES: IDENTIFY BALLAST VARYING NEED		
C.1.3.9. a	Check for significant difference in stock specific gravity.	NA
SWING LINES: CABLE MATERIAL AND CONDITION		
C.1.3.9.1. a	For non-stainless-steel cable, check for corrosion over entire length.	NA
C.1.3.9.1. b	All cable: check for wear or fraying.	NA
SWING LINES: PRODUCT SAMPLE COMPARISON		
C.1.3.9.1. a	Check for water or gravity differences that would indicate a leaking swing joint.	NA
SWING LINES: TARGET		
C.1.3.9.1. d	Target should indicate direction of swing opening (up or down) and height above bottom where suction will be lost with swing on bottom support.	NA

1.4 ROOFS

DECK PLATE INTERNAL CORROSION		
C.1.4.1 a	For safety, before accessing the roof, check with ultrasonic instrument or lightly use a ball peen hammer to test the deck plate near the edge of the	UT 3/16-in Nominal Thickness

	roof for thinning. (Corrosion normally attacks the deck plate at the edge of a fixed roof and at the raft	
DECK PLATE EXTERNAL CORROSION		
C.1.4.2. a	Visually inspect for paint failure, holes, pitting, and corrosion product on the roof deck.	See Report
ROOF DECK DRAINAGE		
C.1.4.3. a	Look for indication of standing water. (Significant sagging of fixed roof deck indicates potential rafter failure. Large standing water areas on a floating roof indicate inadequate drainage design or, if to one side, a non-level roof with possible leaking	See report
LEVEL OF FLOATING ROOF		
C.1.4.4. a	At several locations, measure distance from roof rim to a horizontal weld seam above the roof. A variance in the readings indicates a non-level roof with possible shell out-of-round, out-of-plumb, leaking pontoons, or hang-up.	N/A
INTERNAL FLOATING ROOF		
C.1.4.5. a	Test for explosive gas on top of the internal floating roof. Readings could indicate a leaking roof, leaking seal system, or inadequate ventilation of the area above the internal floating roof.	N/A
ROOF INSULATION		
C.1.4.6. a	Visually inspect for cracks or leaks in the insulation weather coat where runoff rainwater could penetrate the insulation.	N/A No Roof Insulation
C.1.4.6. b	Inspect for wet insulation under the weather coat.	N/A No Roof Insulation
C.1.4.6. c	Remove small test sections of insulation and check roof deck for corrosion and holes near the edge of the insulated area.	N/A No Roof Insulation
FLOATING ROOF SEAL SYSTEMS		
C.1.4.6. a	Measure and record maximum seal-to-shell gaps at: 1. Low pump out. 2. Mid-shell. 3.High liquid level.	N/A
C.1.4.6. b	Measure and record annular space at 30-foot spacing (minimum of four quadrants) around roof and record. Measurements should be taken in directly opposite pairs. 1.Opposite pair. 2. Opposite pair.	N/A
C.1.4.6. c	Check if seal fabric on primary shoe seals is pulling shoes away from shell (fabric not wide enough).	N/A
C.1.4.6. d	Inspect fabric for deterioration, holes, tears, and cracks.	N/A
C.1.4.6. e	Inspect visible metallic parts for corrosion and wear.	N/A
C.1.4.6. f	Inspect for openings in seals that would permit vapor emissions.	N/A
C.1.4.6. g	Inspect for protruding bolt or rivet heads against the shell.	N/A
C.1.4.6. h	Pull both primary and secondary seal systems back all around the shell to check their operation.	N/A
C.1.4.6. i	Inspect secondary seals for signs of buckling or indications that their angle with the shell is too shallow.	N/A
C.1.4.6. j	Inspect wedge-type wiper seals for flexibility, resilience, cracks, and tears.	N/A
1.5 ROOF APPURTENANCES		
SAMPLE HATCH		
C.1.5.1. a	Inspect condition and functioning of sample hatch cover.	N/A

C.1.5.1. b	On tanks governed by Air Quality Monitoring District rules, check for the condition of seal inside hatch cover.	N/A
C.1.5.1. c	Check for corrosion and plugging on thief and gauge hatch cover.	N/A
C.1.5.1. d	Where sample hatch is used to reel gauge stock level, check for marker and tab stating hold off distance.	N/A
C.1.5.1. e	Check for reinforcing pad where sample hatch pipe penetrates the roof deck.	N/A
C.1.5.1. f	On floating roof sample hatch and recoil systems, inspect operation of recoil reel and condition of rope.	N/A
C.1.5.1. g	Test operation of system.	N/A
C.1.5.1. h	On ultra clean stocks such as JP4, check for presence and condition of protective coating or liner inside sample hatch (preventing rust from pipe getting into sample).	N/A
GAUGE WELL		
C.1.5.2. a	Inspect visible portion of the gauge well for thinning, size of slots, and cover condition	N/A
C.1.5.2. b	Check for a hold off distance marker and tab with hold off distance (legible).	N/A
C.1.5.2. c	On floating roofs, inspect condition of roof guide for gauge well, particularly the condition of the rollers for grooving.	N/A
C.1.5.2. d	If accessible, check the distance from the gauge well pipe to the tank shell at different levels.	N/A
C.1.5.2. e	If tank has a gauge-well washer, check valve for leakage and for presence of a bull plug or blind flange.	N/A
FIXED ROOF SCAFFOLD SUPPORT		
C.1.5.3. a	Inspect scaffold support for corrosion, wear, and structural soundness.	N/A
AUTOGAUGE: INSPECTION HATCH AND GUIDES (FIXED ROOF)		
C.1.5.4. a	Check the hatch for corrosion and missing bolts.	N/A
C.1.5.4. b	Look for corrosion on the tape guide's and float guides wire anchors.	N/A
AUTOGAUGE: FLOAT WELL COVER		
C.1.5.5. a	Inspect for corrosion.	N/A
C.1.5.5. b	Check tape cable for wear or fraying caused by rubbing on the cover.	N/A
SAMPLE HATCH (INTERNAL FLOATING ROOF)		
C.1.5.6. a	Check overall conditions.	N/A
C.1.5.6. b	When equipped with a fabric seal, check for automatic sealing after sampling.	N/A
C.1.5.6. c	When equipped with a recoil reel opening device, check for proper operations	N/A
ROOF-MOUNTED VENTS (INTERNAL FLOATING ROOF)		
C.1.5.7. a	Check condition of screens, locking and pivot pins.	N/A
GAUGING PLATFORM DRIP RING		
C.1.5.8. a	On fixed roof tanks with drip rings under the gauging platform or sampling area, inspect for plugged drain return to the tank	N/A
EMERGENCY ROOF DRAINS		
C.1.5.9. a	Inspect vapor plugs for emergency drain: that seal fabric discs are slightly smaller than the pipe ID and that fabric seal is above the liquid level.	N/A

REMOVABLE ROOF LEG RACKS		
C.1.5.9.1. a	Check for leg racks on roof.	N/A
VACUUM BREAKERS		
C.1.5.9.2. b	Report size, number, and type of vacuum breakers. Inspect vacuum breakers. If high legs are set, check for setting of mechanical breakers in high leg position.	NA
RIM VENTS		
C.1.5.9.3. a	Check condition of the screen on the rim vent cover.	NA
C.1.5.9.3. b	Check for plating off or removal of rim vents where jurisdictional rules do not permit removal.	NA
PONTOON INSPECTION HATCHES		
C.1.5.9.4. a	Open pontoon inspection hatch covers and visually check inside for pontoon leakage.	NA
C.1.5.9.4. b	Test for explosive gas (an indicator of vapor space leaks).	NA
C.1.5.9.4. c	If pontoon hatches are equipped with locked down coves, check for vent tubes. Check that vent tubes are not plugged up. Inspect lock down devices for condition and operation	NA
ACCESS STRUCTURES		
HANDRAILS		
C.1.6.1. a	Identify and report type (steel pipe, galvanized pipe, square tube, angle) and size of handrails.	OSHA Compliant
C.1.6.1. b	Inspect for pitting and holes, paint failure.	Thinning Paint
C.1.6.1. c	Inspect attachment welds.	Attachment welds in good condition
C.1.6.1. d	Identify cold joints and sharp edges. Inspect the handrails and mid-rails	Handrails free from cold joints and sharp edges.
C.1.6.1. e	Inspect safety drop bar (or safety chain) for corrosion, functioning, and length.	Not Present
C.1.6.1. f	Inspect the handrail between the rolling ladder and the gaging platform for a hazardous opening when the floating roof is at its lowest level.	NA
PLATFORM FRAME		
C.1.6.2. a	Inspect frame for corrosion and paint failure.	N/A
C.1.6.2. b	Inspect the attachment of frame to supports and supports to tank for corrosion and weld failure.	N/A
C.1.6.2. c	Check reinforcing pads where supports are attached to shell or roof.	N/A
C.1.6.2. d	Inspect the surface that deck plate or grating rests on, for thinning and holes.	N/A
C.1.6.2. e	Check that flat-surface to flat-surface junctures reseal welded.	N/A
DECK PLATE AND GRATING		
C.1.6.3. a	Inspect deck plate for corrosion-caused thinning or holes (not drain holes) and paint failure.	N/A
C.1.6.3. b	Inspect plate-to-frame weld for rust scale buildup.	N/A
C.1.6.3. c	Inspect grating for corrosion-caused thinning of bars and failure of welds	N/A
C.1.6.3. d	Check grating tie down clips. Where grating has been retrofitted to replace plate.	N/A

STAIRWAY STRINGERS		
C.1.6.4. a	Inspect spiral stairway stringers for corrosion, paint failure, and weld failure. Inspect attachment of stairway treads to stringer.	N/A
C.1.6.4. b	Inspect stairway supports to shell welds and reinforcing pads.	N/A
C.1.6.4. c	Inspect steel support attachment to concrete base for corrosion.	N/A
ROLLING LADDER		
C.1.6.5. a	Inspect rolling ladder stringers for corrosion.	NA
C.1.6.5. b	Identify and inspect ladder fixed rungs (square bar, round bar, angles) for weld attachment to stringers and corrosion, particularly where angle rungs are welded to stringers	NA
C.1.6.5. c	Check for wear and corrosion where rolling ladder attaches to gauging platform.	NA
C.1.6.5. d	Inspect pivot bar for wear and secureness.	NA
C.1.6.5. e	Inspect operation of self-leveling stairway treads.	NA
C.1.6.5. f	Inspect for corrosion and wear on moving parts.	NA
C.1.6.5. g	Inspect rolling ladder wheels for freedom of movement, flat spots, and wear on axle.	NA
C.1.6.5. h	Inspect alignment of rolling ladder with roof rack.	NA
C.1.6.5. i	Inspect top surface of rolling ladder track for wear by wheels to assure at least 18 inches of unworn track (track long enough).	NA
C.1.6.5. j	Inspect rolling ladder track welds for corrosion.	NA
C.1.6.5. k	Inspect track supports on roof for reinforcing pads seal welded to deck plate.	NA
C.1.6.5. l	Check by dimensioning, the maximum angle of the rolling ladder when the roof is on low legs.	NA
C.1.6.5. m	If rolling ladder track extends to within five feet of the edge of the roof on the far side, check for a handrail on the top of the shell on that side. Max. angle	NA

INTERNAL

2.10 OVERVIEW		
SAFETY		
C.2.1. a	Check that tank has been cleaned, is gas free, and safe for entry.	Acceptable
C.2.1. b	Check that the tank is completely isolated from product lines, all electrical power, and steam lines.	Acceptable
C.2.1. c	Check that roof is adequately supported, including fixed roof structure and floating roof legs	See Report
C.2.1. d	Check for presence of failing object hazards, such as corroded-through roof rafters, asphalt stalactites, and trapped hydrocarbons in unopened or plugged equipment or appurtenances, ledges, etc.	Acceptable
C.2.1. e	Inspect for slipping hazards on the bottom and roof decks.	Tank bottom is clean
C.2.1. f	Inspect structural welds on access ways and clips	Acceptable
C.2.1. g	Check surfaces needing inspection for a heavy-scale buildup and check weld seams and oily surfaces where welding is to be done. Note areas needing more cleaning, including blasting.	Good
2.2 TANK EXTERIOR		
INSPECTION		
C.2.2. a	Inspect appurtenances opened during cleaning such as lower floating swing sheave assemblies, nozzle interiors (after removal of valves)	OK
C.2.2. b	Hammer test or ultrasonically test the roof.	OK
C.2.2. c	Enter and inspect the floating roof pontoon compartments.	NA
2.3 BOTTOM INTERIOR SURFACE		
INSPECTION		
C.2.3. a	Using a flashlight held close to and parallel to the bottom plates, and using the bottom plate layout as a guide, visually inspect and hammer test the entire bottom.	See Report
C.2.3. b	Measure the depth of pitting and describe the pitting appearance (sharp edged, lake type, dense, scattered, etc.)	See Report.
C.2.3. c	Mark areas requiring patching or further inspection.	See Report
C.2.3. d	Mark locations for turning coupons for inspection.	OK
C.2.3. e	Inspect all welds for corrosion and leaks, particularly the shell-to-bottom weld.	See Report
C.2.3. f	Inspect sketch plates for corrosion.	See Report
C.2.3. g	Locate and mark voids under the bottom.	OK
C.2.3. h	Record bottom data on a layout sketch using the existing bottom plates as a grid. List the number and sizes of patches required.	See report
C.2.3. i	Vacuum test the bottom lap welds.	Not Performed
C.2.3. j	Hammer test or ultrasonically examine any slightly discolored spots or damp areas.	OK
C.2.3. k	Check for reinforcing pads under all bottom attached clips, brackets, and supports	See report
C.2.3. l	Inspect floating roof leg pads for pitting or cutting, and excessive dimpling (indicating excessive loading).	No Floating Roof

C.2.3. m	Check the column bases of fixed roof supports for adequate pads and restraining clips.	See report
C.2.3. n	In earthquake zones 3 and 4, check that roof supports are not welded down to the tank bottom, but are only restrained from horizontal movement.	See Report
C.2.3. o	Check area beneath swing line cable for indications of cable cutting or dragging.	N/A No Swing Line
C.2.3. p	Mark old oil and air test connection for removal and patching.	OK
C.2.3. q	Identify and report low areas on the bottom that do not drain adequately.	OK
C.2.3. r	Inspect coating for holes, disbanding, deterioration, and discoloration.	OK
2.4 SHELL SEAMS AND PLATE		
INSPECTION		
C.2.4. a	On cone up bottoms, closely inspect and gauge the depth of metal loss on the lower 2 to 4 inches of the shell (area of standing water).	See Report
C.2.4. b	Measure the depth of pitting on each course.	See Report
C.2.4.c	Inspect and estimate the amount of metal loss on the heads of rivets and bolts	NA
C.2.4. d	Inspect shell-to-bottom riveted lap joints.	NA
C.2.4. e	Inspect for vertical grooving damage from seal assembly protrusions.	No Floating Roof
C.2.4. f	Inspect existing protective coatings for damage, deterioration, and disbanding	See Report
C.2.4. g	Check for areas of rubbing (indicating too much pressure by the seal assembly shoes or inadequate annular space).	No Floating Roof
C.2.4.h	Visually inspect the shell plates and seams for indications of leakage. If the shell has riveted or bolted seams, record the leak locations by film or chart in case the locations are lost during surface preparation for painting	No shell leakage idenified
C.2.4. i	Measure annular space at 40-foot intervals.	NA
C.2.4. j	Survey the shell to check for roundness and plumb.	Visually Acceptable
2.5 SHELL MOUNTED OVERFLOWS		
INSPECTION		
C.2.5. a	Inspect overflow for corrosion and adequate screening.	OK
C.2.5. b	Check location of overflow that it is not above any tank valves or equipment.	OK
2.6 ROOF INTERIOR SURFACE		
GENERAL		
C.2.6.1. a	Visually inspect the underside surface of the roof plates for holes, scale buildup, and pitting.	Visually Acceptable
C.2.6.1. b	Hammer test or ultrasonically examine to check for thin areas, particularly in the vapor space of floating roofs and at edge of roof on cone roof tank.	UT Acceptable
C.2.6.1. c	Check all clips, brackets, braces, etc., welded to the roof deck plate for welded reinforcing pads and see that they have not broken free.	Visually Acceptable
C.2.6.1. d	If no pad is present, penetrant test for cracking of the weld or deck plate.	OK
C.2.6.1. e	Inspect for protective coating for breaks, disbandment, and deterioration	See Report
C.2.6.1. f	Spark test the interior surface coating if recoating is not planned.	NA

FIXED ROOF SUPPORT STRUCTURE		
C.2.6.2. a	Inspect the support columns for thinning in the upper two feet.	NA
C.2.6.2. b	On API columns (two channels welded together) check for corrosion scale breaking the tack welds, unless the joint between the channels is completely seal welded.	NA
C.2.6.2. c	Check that the reinforcing pad on the bottom is seal welded to the tank bottom with horizontal movement restraining clips welded to the pad.	See report.
C.2.6.2. d	Determine if pipe column supports are concrete filled or open pipe. If open pipe, check for a drain opening in the bottom of the pipe	OK
C.2.6.2. e	Inspect and gauge rafters for thinning, particularly near the center of the roof. Report metal loss.	OK
C.2.6.2. f	Check for loose or twisted rafters.	OK
C.2.6.2. g	Inspect girders for thinning and check that they are attached securely to the top of the columns.	NA
C.2.6.2. h	Report if the columns have cross bracing in the area between the low pump out of the top of the shell (for future internal floating roof installation).	OK
C.2.6.2. i	Inspect and report presence of any roof-mounted swing line bumpers.	NA
C.2.6.2. j	Photograph the roof structure if no rafter layout drawing exists.	See Report/Photos
2.7 FIXED ROOF APPURTENANCES		
INSPECTION AND LIGHT HATCHES		
C.2.7.1. a	Inspect the hatches for corrosion, paint and coating failures, holes, and cover sealing.	N/A No Light Hatches
C.2.7.1. b	On loose covers, check for a safety chain in good condition.	N/A No Light Hatches
C.2.7.1. c	On light hatches over 30 inches across, check for safety rods	N/A No Light Hatches
C.2.7.1. d	Inspect the condition of the gaskets on bold or latched down hatch covers.	N/A No Light Hatches
STAGING SUPPORT CONNECTION		
C.2.7.2. a	Inspect the condition of the staging support for corrosion.	NA
BREATHERS AND VENTS		
C.2.7.3. a	Inspect and service the breather.	NA
C.2.7.3. b	Inspect screens on vents and breathers.	NA
EMERGENCY PV HATCHES		
C.2.7.4. a	Inspect and service pressure/vacuum hatches. (Setting should be high enough to prevent chattering of breather during normal operation. See breather manufacturer's guide,)	NA
C.2.7.4. b	Inspect liquid seal hatches for corrosion and proper liquid level in the seal.	NA
SAMPLE HATCH		
C.2.7.5. a	Inspect sample hatch for corrosion.	NA
C.2.7.5. b	Check that the cover operates properly	NA
C.2.7.5. c	If the tank has no gauge well, check for a hold off distance marker and check measurement.	NA
2.8 FLOATING ROOF		

ROOF DECK		
C.2.8.1. a	Hammer test the area between roof rim and shell. (If access for hammer testing is inadequate, measure the distance from the bottom edge of the roof to the corroded area and then hammer test from inside the pontoon.)	No Floating Roof
C.2.8.1. b	In sour water service, clean and test all deck plate weld seams for cracking unless the lower laps have been seal welded.	No Floating Roof
C.2.8.1. c	Check that either the roof drain is open, or the drain plug in the roof is open in case of unexpected rain	No Floating Roof
C.2.8.1. d	On flat bottomed and cone bottom roof decks, check for a vapor dam around the periphery of the roof. The dam should be continuous without break to prevent escape of vapors to the seal area from under the center of the roof.	No Floating Roof
FLOATING ROOF PONTOONS		
C.2.8.2. a	Visually inspect each pontoon for liquid leakage.	No Floating Roof
C.2.8.2. b	Run a light wire through the goose neck vents on locked down inspection hatch covers to make sure they are open.	No Floating Roof
C.2.8.2. c	Inspect lockdown latches on each cover.	No Floating Roof
C.2.8.2. d	Check and report if each pontoon is:1. Vapor tight (bulkhead seal welded on one side on bottom, sides, and top), 2. Liquid tight seal welded on bottom and sides only), or 3. Unacceptable (minimum acceptable condition is liquid tight).	No Floating Roof
FLOATING ROOF CUTOUTS		
C.2.8.3. a	Inspect underside of cutouts for mechanical damage.	No Floating Roof
C.2.8.3. b	Inspect welds for cracks.	No Floating Roof
C.2.8.3. c	Inspect plate for thinning, pitting, and erosion.	No Floating Roof
C.2.8.3. d	Measure mixer cutouts and record plate thickness for future mixer installation or replacement. Plate thickness	No Floating Roof
FLOATING ROOF SUPPORTS		
C.2.8.4. a	Inspect fixed low and removable high floating roof legs for thinning.	No Floating Roof
C.2.8.4. b	Inspect for notching at bottom of legs for drainage	No Floating Roof
C.2.8.4. c	Inspect for leg buckling or felling at bottom.	No Floating Roof
C.2.8.4. d	Inspect pin hole in roof guide for tears.	No Floating Roof
C.2.8.4. e	Check plumb of all legs.	No Floating Roof
C.2.8.4. f	Inspect for adequate reinforcing gussets on all legs through a single portion of the roof.	No Floating Roof
C.2.8.4. g	Inspect the area around the roof legs for cracking if there is no internal reinforcing pad or if the topside pad is not welded to the deck plate on the underside.	No Floating Roof
C.2.8.4. h	Inspect the sealing system on the two-position legs and the vapor plugs in the fixed low leg for deterioration of the gaskets.	No Floating Roof
C.2.8.4. i	On shell mounted roof supports, check for adequate clearance based on the maximum floating roof movement as determined by the position of the roof relative to the gauge well and/or counter rotational device.	No Floating Roof

2.9 FLOATING ROOF SEAL ASSEMBLIES

PRIMARY SHOE ASSEMBLY

C.2.9.1. a	Remove four sections of foam log (foam filled seals) for inspection on 90' locations.	No Floating Roof
C.2.9.1. b	Inspect hanger attachment to roof rim for thinning, bending, broken welds, and wear of pin holes.	No Floating Roof
C.2.9.1. c	Inspect clips welded to roof rim for thinning.	No Floating Roof
C.2.9.1. d	Shoes-inspect for thinning and holes in shoes.	No Floating Roof
C.2.9.1. e	Inspect for bit-metal bolts, clips, and attachments.	No Floating Roof
C.2.9.1. f	Seal fabric-inspect for deterioration, stiffening, holes, and tears in fabric.	No Floating Roof
C.2.9.1. g	Measure length of fabric from top of shoe to roof rim, and check against maximum anticipated annular space as roof operates.	No Floating Roof
C.2.9.1. h	Inspect any modification of shoes over shell nozzles, mixers, etc., for clearance.	No Floating Roof
C.2.9.1. i	Inspect shoes for damage caused by striking shell nozzles, mixers, etc.	No Floating Roof
PRIMARY TOROIDAL ASSEMBLY		
C.2.9.2. a	Inspect seal fabric for wear, deterioration, holes, and tears	No Floating Roof
C.2.9.2. b	Inspect hold down system for buckling or bending.	No Floating Roof
C.2.9.2. c	Inspect foam for liquid absorption and deterioration.	No Floating Roof
RIM MOUNTED SECONDARIES		
C.2.9.3. a	Inspect the rim-mounted bolting bar for corrosion and broken welds.	N/A No Secondary Seal
C.2.9.3. b	Measure and chart seal-to-shell gaps.	N/A No Secondary Seal
C.2.9.3. c	Visually inspect seal from below, looking for holes as evident by light.	N/A No Secondary Seal
C.2.9.3. d	Inspect fabric for deterioration and stiffness.	N/A Wiper
C.2.9.3. e	Inspect for mechanical damage, corrosion, and wear on tip in contact with shell	N/A No Secondary Seal
C.2.9.3. f	Inspect for contact with obstructions above top of shell.	N/A No Secondary Seal

2.10 FLOATING ROOF APPURTENANCES

ROOF MANWAYS		
C.2.10.1. a	Inspect walls of manways for pitting and thinning.	No Floating Roof
C.2.10.1. b	On tanks with interface autogauges, check seal around gauge tape cable and guide wires through manway cover.	No Floating Roof
C.2.10.1. c	Inspect cover gasket and bolts.	No Floating Roof
RIM VENT		
C.2.10.1. a	Check rim vent for pitting and holes	No Floating Roof
C.2.10.2. b	Check vent for condition of screen.	No Floating Roof
C.2.10.2. c	On floating roof tanks where the environmental rules require closing off the vent, check the vent pipe for corrosion at the pipe-to-rim joint and check that the blinding is adequate.	No Floating Roof
VACUUM BREAKER, BREATHER TYPE		
C.2.10.3. a	Service and check operation of breather valve.	No Floating Roof
C.2.10.3. b	Check that nozzle pipe projects no more than 1/2 inch below roof deck	No Floating Roof

VACUUM BREAKER, MECHANICAL TYPE		
C.2.10.4.	Inspect the stem for thinning. Measure how far the vacuum breaker cover riser is off the pipe when the roof is resting on high or low legs.	No Floating Roof
ROOF DRAINS: OPEN SYSTEMS, INCLUDING EMERGENCY DRAINS		
C.2.10.5.	Check liquid level inside open roof drains for adequate freeboard. Report if there is insufficient distance between liquid level and top of drain.	No Floating Roof
C.2.10.5. b	If tank comes under Air Quality Monitoring District rules, inspect the roof drain vapor plug	No Floating Roof
C.2.10.5. c	If emergency drain is not at the center of the roof, check that there are at least three emergency drains.	No Floating Roof
CLOSED DRAIN SYSTEMS: DRAIN BASINS		
C.2.10.6. a	Inspect for thinning and pitting	No Floating Roof
C.2.10.6. b	Inspect protective coating (topside).	No Floating Roof
C.2.10.6. c	Inspect basin cover or screen for corrosion.	No Floating Roof
C.2.10.6. d	Test operation of check valve.	No Floating Roof
C.2.10.6. e	Check for presence of check valve where bottom of basin is below product level.	No Floating Roof
C.2.10.6. f	Inspect drain basin(s) to roof deck welds for cracking.	No Floating Roof
C.2.10.6. g	Check drain basin(s) outlet pipe for adequate reinforcement to roof deck (including reinforcing pad).	No Floating Roof
CLOSED DRAIN SYSTEMS: FIXED DRAIN LINE ON TANK BOTTOM		
C.2.10.7. a	Hammer test fixed drain line on tank bottom for thinning and scale/debris plugging.	No Floating Roof
C.2.10.7. b	Inspect supports and reinforcing pads for weld failures and corrosion.	No Floating Roof
C.2.10.7. c	Check that pipe is guided, not rigidly locked to support, to avoid tearing of tank bottom plate.	No Floating Roof
CLOSED DRAIN SYSTEMS: FLEXIBLE PIPE DRAIN		
C.2.10.8. a	Inspect for damage to exterior of pipe	No Floating Roof
C.2.10.8. b	Check for obstructions that pipe could catch on.	No Floating Roof
C.2.10.8. c	Inspect shields to protect pipe from snagging.	No Floating Roof
C.2.10.8. d	Inspect results of hydro-test on flexible roof drain system.	No Floating Roof
CLOSED DRAIN SYSTEMS: ARTICULATED JOINT DRAIN		
C.2.10.9. a	Hammer test rigid pipe inflexible joint systems for thinning and scale/debris plugging.	No Floating Roof
C.2.10.9. b	Inspect system for signs of bending or strain.	No Floating Roof
C.2.10.9. c	Inspect results of system hydro test.	No Floating Roof
C.2.10.9. d	Inspect landing leg and pad.	No Floating Roof
AUTOGAUGE SYSTEM AND ALARMS		
C.2.10.10. a	Check freedom of movement of tape through autogauge tape guide	No Floating Roof
C.2.10.10. b	Inspect sheaves for freedom of movement.	No Floating Roof
C.2.10.10. c	Test operation checker.	No Floating Roof
C.2.10.10. d	Inspect tape and tape cable for twisting and fraying.	No Floating Roof

C.2.10.10. e	Test the tape's freedom of movement through guide sheaves and tape guide pipe.	No Floating Roof
C.2.10.10. f	On open-top tanks, check that gate tapes with cables have no more than one foot of tape exposed with float at lowest point.	No Floating Roof
C.2.10.10. g	Check float for leakage.	No Floating Roof
C.2.10.10. h	Test float guide wire anchors for spring action by pulling on wire and releasing	No Floating Roof
C.2.10.10. i	Inspect float wells in floating roofs for thinning and pitting of walls just above the liquid level.	No Floating Roof
C.2.10.10. j	Check that the autogauge tape is firmly attached to the float.	No Floating Roof
C.2.10.10. k	Inspect the tape cable and float guide wire fabric seals through the float well cover.	No Floating Roof
C.2.10.10. l	Inspect the bottom guide wire attachment clip: inspect for a temporary weighted bar instead of a permanent welded down clip.	No Floating Roof
C.2.10.10. m	Inspect board-type autogauge indicators for legibility and freedom of movement of indicator.	No Floating Roof
C.2.10.10. n	Measure and record these distances to determine if seal damage will occur if tank is run over from: 1. Shell top angle to underside of tape guide system. 2.Liquid level on floating top to top of secondary seal.	No Floating Roof
C.2.10.10. o	Identify floating roots where the tape is connected directly to the roof.	No Floating Roof
C.2.10.10. p	Overfill alarm: Inspect tank overfill prevention alarm switches for proper operation.	No Floating Roof

2.11 COMMON TANK APPURTENANCES

GAUGE WELL

C.2.11.1. a	Inspect gauge well pipe for thinning at about two-thirds distance above the bottom: look for thinning at the edge of the slots.	N/A No Gauge Well
C.2.11.1. b	Check for corrosion on the pipe joint. Check that sample cords, weights, thermometers, etc., have been removed from the pipe.	N/A No Gauge Well
C.2.11.1. c	Check for cone at bottom end of pipe about one foot above the bottom.	N/A No Gauge Well
C.2.11.1. d	Check condition of well washer pipe and that its flared end is directed at the near side of the hold off pad.	N/A No Gauge Well
C.2.11.1. e	Check that supports for gauge well are welded to pad or to shell and not directly to bottom plate,	N/A No Gauge Well
C.2.11.1. f	Check operation of gauge well cover.	N/A No Gauge Well
C.2.11.1. g	Check presence of a hold-off distance marker in well pipe and record hold-off distance.	N/A No Gauge Well
C.2.11.1. h	Identify and report size and pipe schedule, and whether pipe is solid or slotted. Report slot size.	N/A No Gauge Well
C.2.11.1. i	Check that the hold-off distance plate is seal welded to the bottom and that any gauge well supports are welded to the plate and not directly to the bottom.	N/A No Gauge Well
C.2.11.1. j	Inspect vapor control float and cable.	N/A No Gauge Well
C.2.11.1. k	Check for presence and condition of gauge well washer.	N/A No Gauge Well

C.2.11.1. l	Check for bull plug or plate blind on gauge well washer valve.	N/A No Gauge Well
C.2.11.1. m	Inspect gauge well guide in floating roof for pitting and thinning.	N/A No Gauge Well
C.2.11.1. n	Inspect the guide rollers and sliding plates for freedom of movement.	N/A No Gauge Well
C.2.11.1. o	Inspect condition of gauge well pipe seal system.	N/A No Gauge Well
C.2.11.1. p	On black oil and diesel services: if gauge well is also used for sampling, check for presence of a thief- and gauge-type hatch to avoid spillage.	N/A No Gauge Well
C.2.11.1. q	Visually inspect inside of pipe for pipe weld protrusions which could catch or damage vapor control float.	N/A No Gauge Well
SAMPLING SYSTEMS: ROOF SAMPLE HATCHES		
C.2.11.2. a	Inspect roof mounted sample hatches for reinforcing pads and cracking.	N/A
C.2.11.2. b	Inspect cover for operation.	N/A
C.2.11.2. c	For tanks complying with Air Quality Monitoring District rules, inspect sample hatch covers for adequate sealing	N/A
C.2.11.2. d	Check horizontal alignment of internal floating roof sample hatches under fixed roof hatches.	No Floating Roof
C.2.11.2. e	Inspect the sealing system on the internal floating roof sample hatch cover.	No Floating Roof
C.2.11.2. f	Inspect floating roof sample hatch cover recoil reel and rope.	No Floating Roof
SHELL NOZZLES		
C.2.11.3. a	Inspect shell nozzles for thinning and pitting.	See Report
C.2.11.3. b	Inspect hot tap nozzles for trimming of holes.	NA
C.2.11.3. c	Identify type of shell nozzles.	See Report
C.2.11.3. d	Identify and describe internal piping, including elbow up and elbow down types.	Good
NOZZLES EXTENDED INTO THE TANK		
C.2.11.4. a	Inspect pipe support pads welded to tank bottom.	None
C.2.11.4. b	Inspect to see that pipe is free to move along support without strain or tearing action on bottom plate.	NA
C.2.11.4. c	Inspect nozzle valves for packing leaks and damaged flange faces.	NA
C.2.11.4. d	Inspect heater stream nozzle flanges and valves for wire cutting.	NA
C.2.11.4. e	Report which nozzles have thermal pressure relief bosses and valves.	None
C.2.11.4. f	In internal elbow-down fill line nozzles, inspect the wear plate on the tank bottom.	NA
C.2.11.4. g	On elbow-up fill lines in floating roof tanks, check that opening is directed against underside of roof, not against vapor space. Inspect impact are for erosion.	NA
DIFFUSERS AND AIR ROLLING SYSTEMS		
C.2.11.5. a	Inspect diffuser pipe for erosion and thinning.	N/A No Diffuser
C.2.11.5. b	Check holes in diffuser for excessive wear and enlargement.	N/A No Diffuser
C.2.11.5. c	Inspect diffuser supports for damage and corrosion.	N/A No Diffuser

C.2.11.5. d	Check that diffuser supports restrain, not anchor, longitudinal line movement.	N/A No Diffuser
C.2.11.5. e	Inspect air spiders on bottom of lube oil tanks for plugging and damaged or broken threaded joints	N/A No Diffuser
SWING LINES		
C.2.11.6. a	Inspect flexible joint for cracks and leaks.	No Swing Line Present
C.2.11.6. b	Scribe the flexible joint across the two moving faces and raise end of swing line to check the joint's freedom of movement, indicated by separation of scribe marks.	No Swing Line Present
C.2.11.6. c	Check that flexible joints over six inches are supported.	No Swing Line Present
C.2.11.6. d	Inspect the swing pipe for deep pitting and weld corrosion.	No Swing Line Present
C.2.11.6. e	Loosen the vent plugs in the pontoons and listen for a vacuum. Lack of a vacuum indicates a leaking pontoon.	No Swing Line Present
C.2.11.6. f	Check the results of air test on pontoons during repairs.	No Swing Line Present
C.2.11.6. g	Inspect the pontoons for pitting.	No Swing Line Present
C.2.11.6. h	Inspect the pull-down cable connections to the swing	No Swing Line Present
C.2.11.6. i	Inspect the condition of the bottom-mounted support, fixed roof limiting bumper, or shell mounted limiting bumper for wood condition, weld and bolt corrosion, and seal welding to bottom or shell.	No Swing Line Present
C.2.11.6. j	Inspect safety hold-down chain for corrosion and weak links.	No Swing Line Present
C.2.11.6. k	Check that there is a welded reinforcing pad where the chain connects to the bottom.	No Swing Line Present
C.2.11.6. l	If the floating swing in a floating or internal floating roof tank does not have a limiting device preventing the swing from exceeding 60 degrees, measure and calculate the maximum angle possible with the roof on overflow. Max. angle on overflow (If the c	No Swing Line Present
C.2.11.6. m	Inspect pull down cable for fraying.	No Swing Line Present
C.2.11.6. n	Inspect for three cable clamps where cable attaches to end of swing line (single reeved) or to roof assembly (double-reeved). Inspect sheaves for freedom of movement.	No Swing Line Present
C.2.11.6. o	Inspect winch operation and check the height indicator for legibility and accuracy.	No Swing Line Present
C.2.11.6. p	Inspect bottom-mounted sheave assembly at end of pontoon for freedom of rotation of sheave.	No Swing Line Present
C.2.11.6. q	Inspect shell-mounted lower sheave assembly for freedom of rotation of sheave, corrosion thinning, and pitting of sheave housing.	No Swing Line Present
C.2.11.6. r	Inspect upper sheave assembly for freedom of movement of sheave.	No Swing Line Present
C.2.11.6. s	Inspect the cable counterbalance assembly for corrosion and freedom of operation.	No Swing Line Present
MANWAY HEATER RACKS		

C.2.11.7. a	Inspect the manway heater racks for broken welds and bending of the sliding rails.	No Floating Roof
C.2.11.7. b	Measure and record the length of the heater and length of the track.	No Floating Roof
MIXER WEAR PLATES AND DEFLECTOR STANDS		
C.2.11.8. a	Inspect bottom and shell plates and deflector stands.	N/A No Mixer
C.2.11.8. b	Inspect for erosion and corrosion on the wear plates. Inspect for rigidity, structural soundness, corrosion, and erosion of deck plates and reinforcing pads that are seal welded to the bottom under the deflector stand legs.	N/A No Mixer
C.2.11.8. c	Measure for propeller clearance between the bottom of deflector stand and roof when the roof is on low legs.	N/A No Mixer

SIGNIFICANT PHOTOS

Photo A Disconnected Cathodic Protection

Photo B Corroded Internal Vertical Ladder

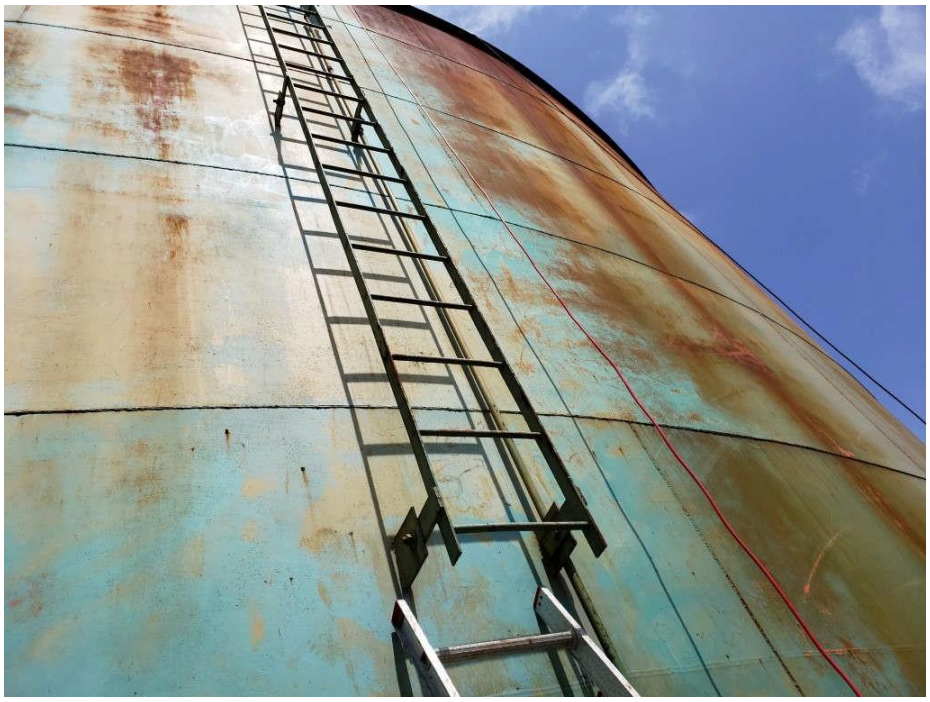


Photo C
No Fall Arrest System on External Vertical Ladder

Photo D
Damaged Level Gauge

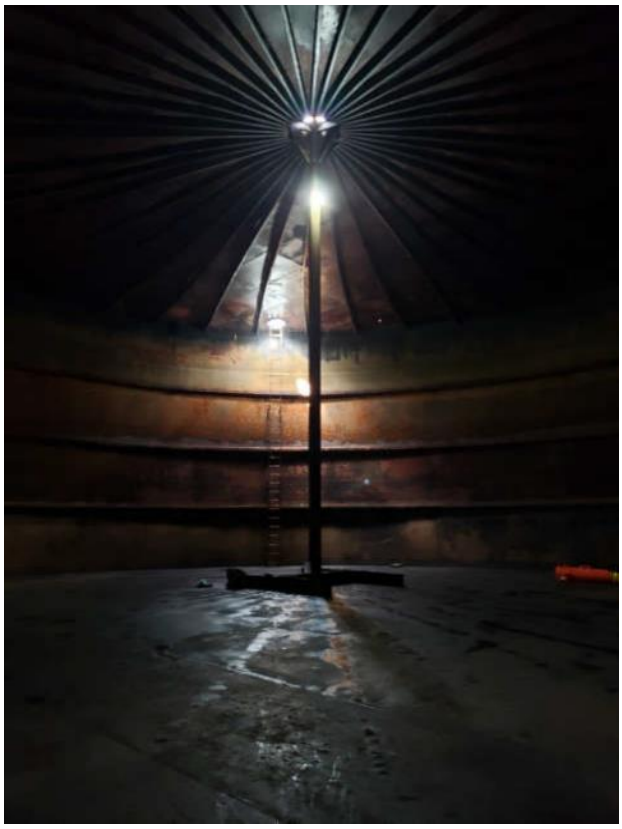


Photo E
Bowing in Roof Rafters

Photo F Through-Hole Corrosion on Roof

GENERAL PHOTOS

ALL






ACCESS_STRUCTURE


Corroded Internal Vertical Ladder


No Fall Arrest System on External Vertical Ladder













APPURTENANCES





























BOTTOM
















FOUNDATION






Disconnected Cathodic Protection












Missing Anchor Bolt

So Sealant Present on Bottom to Foundation Interface



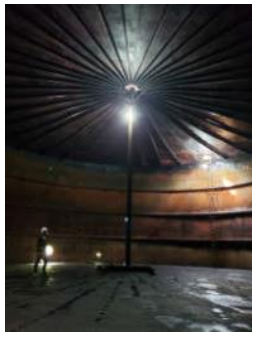


GENERAL



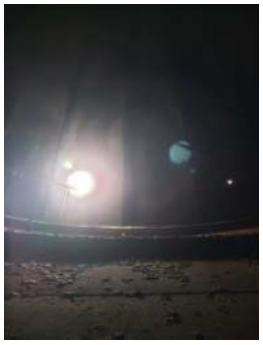































PIPING







ROOF

























Damaged Level Gauge

















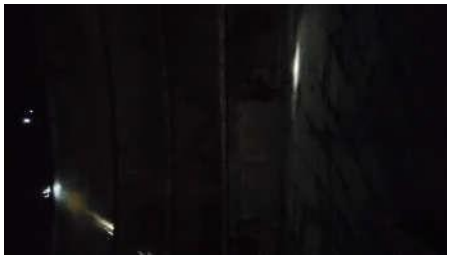






Bowing in Roof Rafters







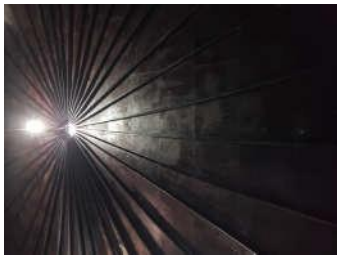




























Through-Hole Corrosion on Roof




SHELL





































Appendix C

NDE or UT Report

Report Prepared For
PROJECT MANAGEMENT OFFICE

YAP STATE PUBLIC SERVICE CORPORATION

YAP STATE, FEDERATED STATES OF MICRONESIA

WATER

Tank Number
1

NDE Conducted on
OCTOBER 10, 2019

Appendix C

Shell Thickness UT Table 3
Bottom Thickness UT Table 4
Roof Thickness UT Table 5
Nozzle Thickness UT Table 6
Equipment Calibration 7

POWERS Engineering and Inspection, Inc. was contracted by Central Pacific Tank (CPT) to provide Non-Destructive Examination (NDE) services for Tank 1 at the Yap State Public Service Corporation in Colonia, Yap. The services include, Ultrasonic Testing (UT), Visual Examination.

The following equipment was utilized:

- Panametrics DL-36 Plus Thickness Gauge *sn:992097204*
- Panametrics DL-36 Plus Thickness Gauge *sn:992157166*
- Panametrics EPOCH III *sn:94085612*
- Standard UT couplant suitable for temp to 300 deg F.
- UT thickness probe Panametrics D790 5Mhz *sn:602600*
- UT thickness probe Panametrics D790 5Mhz *sn:603918*
- UT thickness probe FH2E-WR *sn:00W6XP*
- Calibration Block Panametrics 2214E *sn:6182*
- B&W Gas Alert Max XT II Multi-Gas Detector with Pump

SHELL THICKNESS UT TABLE.

UT thickness readings of the butt-welded shell plate were conducted through the coatings utilizing the Panametrics DL-36 Thickness Gauge in 'echo to echo' mode to compensate for the sound path through the coatings. UT readings were performed along to circumference of the lower two courses in twelve vertical locations, see Shell Rollout drawing for location of upper course readings.

Shell Course	Location	Drop 1	2	3	4	Drop 5	6	7	8	Drop 9	10	11	12
2	Top	0.256	0.247	0.248	0.249	0.249	0.249	0.249	0.247	0.247	0.252	0.248	0.248
	Upper	0.247	0.247	0.247	0.247	0.247	0.247	0.247	0.247	0.247	0.247	0.247	0.247
	Lower	0.248	0.247	0.247	0.247	0.247	0.247	0.248	0.248	0.248	0.247	0.247	0.248
	Bottom	0.249	0.247	0.250	0.247	0.248	0.248	0.247	0.248	0.247	0.247	0.247	0.249
1	Top	0.248	0.253	0.248	0.252	0.250	0.250	0.255	0.251	0.248	0.247	0.248	0.252
	Upper	0.248	0.248	0.248	0.247	0.248	0.247	0.248	0.247	0.248	0.248	0.248	0.247
	Lower	0.247	0.249	0.248	0.248	0.247	0.249	0.251	0.247	0.249	0.248	0.252	0.248
	Bottom	0.250	0.249	0.250	0.248	0.248	0.250	0.248	0.250	0.248	0.249	0.249	0.248

Course 5 Shell UT Readings Top to Bottom				Course 4 Shell UT Readings Top to Bottom				Course 3 Shell UT Readings Top to Bottom			
Location				Location				Location			
Reading	Course	Distance (in)	UT (in)	Reading	Course	Distance (in)	UT (in)	Reading	Course	Distance (in)	UT (in)
1	5	59	0.247	1	4	59	0.249	1	3	59	0.250
2	5	53	0.250	2	4	53	0.251	2	3	53	0.251
3	5	47	0.247	3	4	47	0.249	3	3	47	0.249
4	5	41	0.250	4	4	41	0.247	4	3	41	0.248
5	5	35	0.248	5	4	35	0.252	5	3	35	0.253
6	5	29	0.247	6	4	29	0.249	6	3	29	0.247
7	5	23	0.248	7	4	23	0.247	7	3	23	0.250
8	5	17	0.248	8	4	17	0.249	8	3	17	0.248
9	5	11	0.248	9	4	11	0.251	9	3	11	0.250
10	5	5	0.249	10	4	5	0.258	10	3	5	0.255

Course 6 Shell UT Readings Top to Bottom			
Location			
Reading	Course	Distance (in)	UT (in)
1	6	44	0.247
2	6	38	0.252
3	6	32	0.248
4	6	26	0.248
5	6	20	0.255
6	6	14	0.249
7	6	8	0.247
8	6	2	0.252

BOTTOM THICKNESS UT TABLE

Systematic bottom UT measurements were difficult to obtain through the rough surface of the bottom coatings. UT readings were conducted in a formation of eight radial lines (see Bottom Layout) with 10 measurements recorded per radial line.

Bottom UT Thickness Readings (in)								
Reading	Radial Station							
	1	2	3	4	5	6	7	8
1	0.243	0.242	0.247	0.244	0.246	0.241	0.249	0.241
2	0.248	0.248	0.249	0.241	0.247	0.243	0.245	0.247
3	0.241	0.246	0.245	0.244	0.244	0.245	0.246	0.244
4	0.246	0.245	0.248	0.249	0.243	0.241	0.243	0.248
5	0.244	0.241	0.243	0.241	0.246	0.243	0.243	0.247
6	0.247	0.244	0.242	0.245	0.244	0.244	0.249	0.249
7	0.241	0.241	0.242	0.243	0.248	0.243	0.246	0.242
8	0.246	0.243	0.242	0.249	0.244	0.241	0.248	0.245
9	0.247	0.241	0.241	0.243	0.245	0.247	0.248	0.248
10	0.245	0.244	0.246	0.248	0.241	0.247	0.241	0.246

ROOF THICKNESS UT TABLE

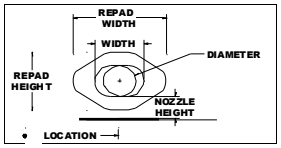
Random UT thickness readings of the 3/16-in nominal lap-welded cone roof plates were conducted utilizing the Panametrics DL-36 Thickness Gauge in 'echo to echo' mode to compensate for the sound path through the coatings. Due to limited safe access at the time of inspection UT reading were conducted from a manlift near the roof manway (see Cone Roof Layout).

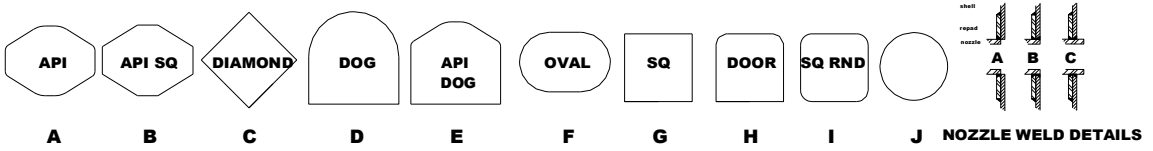
Roof UT Thickness Reading (in)					
Plate	**1**	**2**	**3**	**4**	**5**
1	0.180	0.176	0.186	0.184	0.186
9	0.180	0.180	0.180	0.180	0.180
8	0.177	0.182	-	-	-

NOZZLE THICKNESS UT TABLE

Tank Shell Nozzle & Appurtenances Table with Geometry API 650 and Weld Spacing Check API 653

Item	Description	Diameter (in)	Shell	Nozzle Height (in)		Nozzle Thickness (in)		Repad						Comments
			Course Thickness (in)	Bottom of Nozzle to Bottom	Nozzle Centerline to Bottom	Field UT Data top, bottom, left and right	Min, API 650, OK?	Shape	Width (in)	Height (in)	Repad Thickness (in)	Weld Detail nozzle neck to shell and repad	Does Repad meet requirements of API 650 5.7.2?	
A	**Manway**	**24**	**0.247**	**26**	**38.00** **>=** **29** ***Ok***	**0.750** **0.754** **0.751** **0.751**	**0.750** **>=** **0.1875** ***Ok***	**A**	**63** **>=** **60** **Ok**	**53** **>=** **49.5** **Ok**	**0.25** **>=** **0.247** **Ok**	**A**	**OK**	Ok
B	**Nozzle**	**8**	**0.247**	**20**	**24.00** **<** **13.75** **Ok**	**0.313** **0.318** **0.325** **0.326**	**0.313** **<** **0.5** **Not Ok**	**A**	**22** **<** **23.25** **Not Ok**	**18** **<** **19** **Not Ok**	**0.25** **>=** **0.247** **Ok**	**A**	**OK**	Some of the repad geometry or weld spacings is less than required. Because, these items have most likely been in service during a hydro test, or in low temp service, API 653 would consider the brittle fracture risk low and therefore, no action is req'd.
					ref API 650 tbl 5-6b						**API6505.7.2**			





EQUIPMENT CALIBRATION

Date	Equipment	Calibration Tool	Calibrated By
October 10, 2019 (Daily Calibration)	Panametrics DL-36 Plus Thickness Gauge	Calibration using 5-step block (0.1, 0.2, 0.3, 0.4, 0.5-in) in accordance with ASTM E 797-05. Calibration performed in accordance with PEI NDE Manual.	GP
October 10, 2019 (Daily Calibration)	B&W Gas Alert Max XT II Multi-Gas Detector	Bump tested prior to each use. Calibration performed using CH4 Calibration Gas BW CG-Q34-4	GP

Appendix 3

TANK 2 AWWA D101-53 INTERNAL/OUT-OF-SERVICE TANK INSPECTION

Yap State Public Service Corporation (YSPSC), Colonia, Yap

Report Prepared for:
Project Management Office
Yap State, Federated States of Micronesia

Yap State Public Service Corporation
Yap State, Federated States of Micronesia

Contract/Task Order Number:
Contract: C 231202 2019-192

Report Prepared by:
Powers Engineering and Inspection, Inc. (PEI)
under subcontract to:
Central Pacific Tanks, Inc.
P.O. Box 5213
Kaneohe, Hawaii 96744 USA

Inspected on:
October 2, 2019

Construction and Inspection History:

Constructed	Bottom	External Inspection	Internal Inspection	UT Inspection
1971	**1971**	**October 2019**	**October 2019**	**October 2019**
Next Inspection:		**See Report**	**See Report**	**See Report**

Report Revisions:

Rev 1	October 29, 2019	Revised Executive Summary Item 1.g.
Rev 2	November 5, 2019	Minor Revision
Rev 3	November 8, 2019	Revised Executive Summary Item 4.d.
Rev 4	December 27, 2019	Revised per Customer Comments

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STI SP001 AST-T10391
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ASNT Corporate Level III UT, PT, MT and VT
California Civil PE 60589

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  API 653 Inspection APP C Checklists

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  Non-Destructive Examination (NDE) UT Report

EXECUTIVE SUMMARY

Powers Engineering and Inspection Inc. was contracted by Central Pacific Tank (CPT) to provide AWWA D101-53 Internal Inspection services for Tank 2 at the Yap State Public Service Corporation in Colonia, Yap.

Tank 2 was originally engineered and designed in 1971 by Sunn, Low, Tom & Hara Inc. The tank is an 80-ft diameter x 29-ft tall tank with a supported steel cone roof, butt-welded shell, and a 1/4-in butt-welded bottom. The tank was most recently in Potable Water service.

The report and executive summary are based on field inspection and evaluation in accordance with AWWA D101-53 and API 653 Standards. Before the tank is returned to service all the requirements of AWWA D101-53 should be met.

Inspection Goal	Methods Employed	Results
1. Identify any current leak paths resulting from corrosion, internal or external.	◦ 100% Visual Inspection (VT) of corner weld and all bottom welds for defects or corrosion ◦ 100% Visual Inspection (VT) of base of tank, bottom extension and shell for corrosion, product stains or other signs of product seepage. ◦ Utilize Ultrasonic Testing (UT) to find areas of potential thinning or corrosion loss from internal corrosion. ◦ Document with Digital Camera	a. Utilizing the AWWA D101-53 and Manual M42 Chapter 9 guidelines for periodic inspections along with API 653 MRT method for calculation of period to next inspection, the next formal AWWA Internal Inspection can be extended 3 to 5 years or as required by state regulatory agencies. The following Executive Summary and Action Items lists repairs that should be performed during the next planned outage. b. The coatings on the 1/4-in thick bottom plates and internal shell were noted to be ending or have surpassed it's intended lifespan with the most notable degraded locations being the lower 9-ft of the internal shell plate, internal corner weld, and bottom plate butt-welds. Photo A Photo J c. An MFL scan of the tank bottom was not performed during the inspection. Due to the extent of coating failure, disconnection of the cathodic protection system Photo G, and unknown extent of soil sidecorrosion, the 1/4-in bottom should be replaced. d. As internal coating is an important factor in protecting interior surfaces from corrosion in water storage tanks, the new bottom plates, shell plates, and roof structure should have a new internal coating installed that meets AWWA D102 and NSF/ANSI 61 requirements. e. The current cathodic protection system consists of (6) sacrifice anodes with only one anode currently connected to the tank. This system was installed during the initial tank construction in 1971 and has not been properly maintained. The cathodic protection system should be replaced with an API 651 compliant CP system, and a reference anode pipe should be installed underneath the bottom while the bottom plate is being replaced. f. The lower 9-ft of internal shell and lowest internal stiffening ring is experiencing widespread pitting corrosion with the deepest pit on the 0.25-in shell plate being 0.16-in deep. A total of thirty-six (36) areas on the shell that have been marked for repair. The pits in these marked areas should be repaired by puddle welding and ground flush with the shell plate after welding. If additional pitting is identified during sandblasting, further evaluation of the pitting should be performed. Photo C Photo D Photo J2 g. In addition to the shell plate, the center column was also experiencing pitting corrosion with deepest pit of the 0.325-in wall being measured at 0.13-in deep. Due to the extent of the pitting was well as unidentifiable internal pipe corrosion of the center column, a "clam shell" should be installed around existing center column. The clam shell shall consist of two halves of pipe that are

		seal welded on both sides in order to provide additional support to the corroded center while also protecting it from further corrosion. Photo K h. Extensive pitting corrosion was also identified in the internal neck of the 24-in manway. During the time of bottom replacement, the doorsheet should be cut into the shell at the existing 24-in manway's location. This section of the shell should be replaced with new shell plate after bottom repairs are complete and a new 30-in shell manway should be installed. Photo H i. API 653 minimum shell thickness calculations were performed and determined that the maximum height of product for the 1/4-in first shell course is 26-ft. As the bell-mouth of the 8-in overflow is located 28-ft above the bottom, special consideration should be made to limit the maximum fill height to 26-ft or lower the opening of the overflow to a maximum height of 26-ft. j. Consideration should also be made to lowering the fill heights to reduce the risk of sloshing damage during a strong seismic event.
2. Identify any risk areas for future leak path development	◦ Utilize Ultrasonic Testing (UT) to find areas of potential thinning or corrosion loss from internal corrosion. ◦ Documentation of any brittle fracture concerns including nozzle weld spacing.	a. Wear plate is currently not installed underneath the center column base structure (crow's foot). This creates an area ofthe bottom plate that is not able to be inspected. Install a 1/4-in thick wear plate underneath the crow's foot that is lap-welded to the bottom plate, after the bottom plate is replaced. Do not weld crow's foot to the new wear plate. Install four (4) angle iron clips around crow's foot to limit horizontal movement. Photo E b. There is currently an abandoned and corroded automated tank gauge bottom attachment welded directly to the bottom plate. After the bottom replacement is completed and a new level gauge is installed, install a 1/4-in repad underneath the new level gauge tank bottom bracket. Photo M c. The tank bottom to foundation currently does not have a caulking installed, allowing for water intrusion underneath the bottom as well as increasing the risk of knife edge corrosion to occur on the bottom extension. After the bottom is replaced, install a flexible caulking system around 100% of the bottom extension to foundation interface. d. The current anchoring system is an anchor bolt going through the bottom extension. Consider installing API 650 compliant anchor chairs on the shell in order to adequately distribute seismic loading to the shell rather than the bottom extension in the event of seismic activity. e. There is currently an anchor missing on the tank opposite of the 24-in manway. Replace the missing anchor bolt like-in-kind and use an anchoring adhesive engineered for the calculated pull-out strength of the anchors. Photo N f. The shell reinforcing pads on the (2) 8-in nozzles and 24-in manway do not have "tell-tales" installed in order to adequately detect a leak in the shell behind the repads. Consider installing API 650 compliant tell-tales in the repads in order to detect the presence leaks. g. Isolated nozzle, bottom repad, and shell repad geometry, spacings, and thickness were found to be below API 650 requirements. As these components, have been operating in-service at max capacity, no corrective action is required, and brittle fracture risk is minimal. Monitor nozzles for signs of stress induced damages along the shell to determine if corrective action is needed in the future. h. UT scrubs were performed in (8) radial lines around the tank from the shell to the center column. The lowest remaining thickness measured with this technique on the 0.25-in thick bottom plates was 0.228-in.

		i. Visual inspection of the shell plate was performed to identify product side corrosion with the only areas of corrosion being the lower 9-ft of the shell as discussed earlier. UT scrubs were performed along the top two courses via manlift with no identifiable corrosion being present.
3. Foundation settlement	◦ Survey of the shell for settlement. ◦ VT shell for bulges, distortion, or other verticality issues.	a. The maximum out-of-plane settlement was approximately 4-in, which is within acceptable limits of API 653 Appendix B calculations for differential settlement. See survey results. b. The shell was inspected for verticality and distortion. No significant distortion was identified. c. The seismic loads were calculated utilizing the latest API 650 Appendix E (ASCE 7/ IBC 2009 methods). The risk of damage from a seismic event is minimal for all fill heights.
4. Access structures	◦ Through visual examination (VT) of access structure to determine its condition.	a. The internal vertical ladder is corroded beyond use and repair. Replace the internal vertical ladder with a permanent fall arrest system compliant with OSHA Subpart D installed on the ladder or an anchor point for a portable fall arrest system installed on or above the existing 24-in roof manway. Photo I b. The cone roof is accessed via vertical ladder on the tank shell. The vertical ladder is currently in good condition with minor coating failure. The vertical ladder is also over 24-ft tall without a fall arrest system installed. Install an OSHA Subpart D compliant fall arrest system on the external vertical ladder. Photo L c. The roof handrails near the vertical ladder appear to be in good condition with minor corrosion and coating failure. d. The tank currently does not have system in place such as a fence and locked gate to limit access to the tank.
5. Cone Roof	◦ VT of steel roof deck and coating ◦ UT of components and roof deck	a. The center column crow's foot is experiencing corrosion throughout its W-beam support members and bearing plate. Replace the corroded center column crow's foot with like-in-kind materials as well as like-in-kind welding techniques. Photo F b. During inspection it was noted that the roof rafters are experiencing minor bowing most likely due to seismic activity. The roof rafters are currently not twisting indicating that rafters are not experiencing lateral torsional buckling. Monitor rafter condition during the next formal internalinspection to determine if the rafter conditions have worsened. Photo B c. The 3/16-in roof deck appears to be in generally good condition with no significant corrosion being identified visually or with UT scrubs performed on the roof plate. d. There are indications of a significant amount of localized water collection areas depressions, known as "bird baths." If the roof coating is not replaced, these bird baths will eventually lead to through-hole corrosion once the roof's bare steel is exposed.
6. Venting	◦ VT of existing venting system	a. The tank is vented with an 18-in open center vent while the tank is serviced with 8-in nozzles. API 2000 venting calculations indicate that the venting configuration is adequate. b. Coating failure and minor corrosion is present on the center vent.
7. Coatings	◦ VT of coatings	a. As mentioned in the beginning of the Executive Summary, the internal linings appear to have surpassed their intended lifespan and are now experiencing flaking and general wear leading to exposed steel. The new bottom plates, shell plates, and roof structure should have a new internal coating installed that meets AWWA D102 and NSF/ANSI 61 requirements after all repairs are complete. b. The external shell plate, shell appurtenances, vertical ladder, and cone roof plate coatings are all experiencing coating failure in the form of worn and flaking coatings. Due to the tropical climate, corrosion of exposed steel will be higher than normal for these

		tanks. It is strongly recommended that all external coatings should be replaced.

AWWA D101-53 COMPLIANCE

It is the best opinion of the Inspector that Tank 2 complies with the AWWA D101-53 and Manual M42 standard if the following Action Items are properly addressed:

ACTION ITEMS

1. Utilizing the AWWA D101-53 and Manual M42 Chapter 9 guidelines for periodic inspections along with API 653 MRT method for calculation of period to next inspection, the next formal AWWA Internal Inspection can be extended 3 to 5 years or as required by state regulatory agencies.

   Note: The action item repairs listed below can be performed at that time.

2. Replace the existing 1/4-in butt-welded bottom with a new 1/4-in lap-welded bottom.
3. API 653 Minimum Shell Thickness calculations indicate that the maximum allowable height of product for the tank is 26-ft. Limit the maximum fill height of water to 26-ft or modify the overflow piping to have a maximum height of 26-ft.
4. Restore or replace the cathodic protection system with an API 651 compliant cathodic protection system. The current system is a “1970’s era anode bed sacrificial cathodic protection system that has not been properly maintained with only one anode connected to the tank.
5. Install new internal coatings including bottom, shell, roof column and crow’s foot, and internal shell stiffeners to prevent further internal corrosion. Preliminary coating tests identified that the existing coatings do not contain lead or chromate, but a formal testing of the coatings should be complete prior to sandblasting.
6. The lower 9-ft of shell plate and shell plate butt-welds are experiencing product side pitting with the deepest pit measured of 0.16-in. Perform thirty-six (36) puddle weld and butt-weld repairs on the marked areas of shell plate and shell plate butt-weld pitting with a pit depth greater than 0.09-in.
7. Remove the existing 24-in shell manway during the bottom replacement process and install a new 30-in shell manway after the repairs are complete.
8. Install a “clam shell” around the existing 8-in center column. The clam shell shall consist of two halves of a pipe that are seal welded on both sides in order to provide additional support to the corroded center column while also protecting it from further corrosion.
9. Replace the corroded center column base structure (crows’ foot) like-in-kind.
10. Install a wear plate underneath the center column crows’ foot with seismic clips to allow for slight vertical movement of the center column while restraining from lateral movement. Do not weld the crows’ foot to the wear plate.
11. Replace the missing anchor bolt on the opposite side of the tank from the existing 24-in shell manway.
12. Replace or remove the corroded internal vertical ladder.

13. The vertical ladder providing access to the cone roof is over 24-ft tall with no fall arrest system. Install an OSHA compliant fall arrest system on the vertical ladder.

14. Install a new automatic tank level gauge on the tank with a 1/4-in thick repad installed underneath the new tank bottom bracket.

In addition to the above required Action Items, the following are listed for Consideration and Monitoring:

CONSIDER ITEMS

1. Consider lowering the fill height to reduce the risk of sloshing damage during a strong seismic event.
2. Consider installing API 650 compliant anchor chairs on the shell in order to adequately distribute seismic loading to the shell rather than the bottom extension in the event of seismic activity.
3. Consider recoating the external shell and roof.
4. Consider installing API 650 compliant “tell-tales” on the shell appurtenance repads in order to detect the presence of leaks.
5. Consider installing sealant around the bottom extension to foundation interface to mitigate water intrusion underneath the bottom which could lead to soil side corrosion.
6. Consider adding fenced enclosure to the tank area for security.

MONITOR ITEMS

1. Monitor the coatings and apply touch-up as needed.
2. The roof rafters are experiencing minor bowing most likely due to seismic activity. The roof rafters are currently not twisting indicating the rafters are not experiencing lateral torsional buckling. Monitor the condition of the roof rafters during the next internal inspection to determine if the rafter conditions have worsened.

BASIC TANK INFORMATION

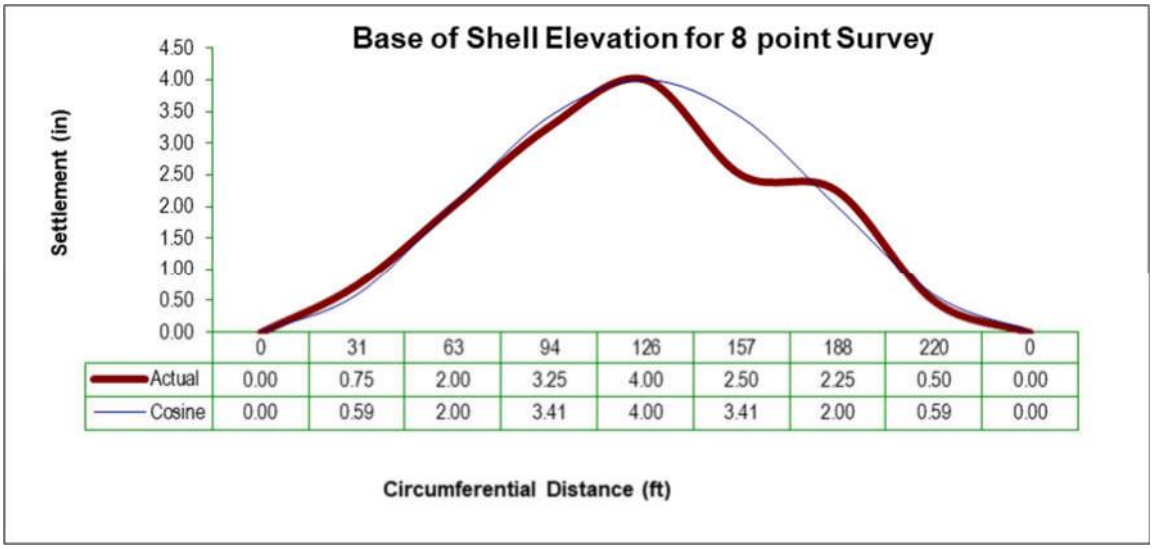
Tank Number:	Owner:	Location:	Unit/Zone/Area:
TANK 2	YAP STATE PUBLIC SERVICE CORPORATION	COLONIA, YAP, FEDERATED STATES OF MICRONESIA	--
Product:	**Diameter (ft):**	**Height (ft):**	**Capacity (gal):**
POTABLE WATER	80	29	733,950

Type Tank:	Year Built:	Design Standard:	Engineer/Designer:
BUTT-WELDED W/CONE ROOF	1971	AWWA	SUNN, LOW, TOM & HARA INC.

Type Shell:	Type Roof:	Type Foundation:	Type Bottom:
BUTT-WELDED	SUPPORTED CONE ROOF	CONCRETE RINGWALL	1/4-IN BUTT-WELDED
Cone Roof Access:	**Floating Roof Access:**	**Roof Vents:**	**Roof Manways:**
UNCAGED VERTICAL LADDER	NA	1: 18-IN OPEN VENT	1: 24-IN
Pumping Rate:	**Suction Line:**	**Receipt:**	**Shell Manways:**
UNKNOWN	1: 8-IN	1: 8-IN	1: 24-IN
Leak Detection:	**Secondary Containment:**	**Cathodic Protection:**	**Insulation:**
NONE	N/A	SACRIFICIAL ANODE	NONE

Shell Coatings:	Floating Roof Coatings:	Bottom Coating:
YES	NA	YES

SHELL SETTLEMENT SURVEY



	0	31	63	94	126	157	188	220	0
Actual	0.00	0.75	2.00	3.25	4.00	2.50	2.25	0.50	0.00
Cosine	0.00	0.59	2.00	3.41	4.00	3.41	2.00	0.59	0.00

- The settlement for the tank is planer or roughly approximates the shape of a cosine curve.
- The evaluation of this "out-of-levelness" or settlement, utilizing the criterion for "out-of-plane distortion" as described in API 653 Appendix B.3.2, indicates that the settlement **is well** within the acceptable limits.

Applicable Standards:

Shell settlement surveys were conducted in accordance with the requirements of API 653 Figure B-1. These surveys were evaluated in accordance with the API 653 Appendix B.2.2 and compared with the acceptance criteria outlined in API 653 Appendix B.3.2.

Note:

Calculation of maximum permissible S or out-of-plane distortion per API 653 Appendix B.3.2 was made using:

Shell Settlement API 653 5th Appendix B

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Find: Shell Settement API 653 5th edition Addendum 1 Appendix B Methodology

Given:

Tank Number	2		Circumference	251.3	(ft)
Tank Diameter	80.0	(ft)	Req'd Stations	251 / 32 = 8	ref API 653 12.5.1.2
Fit Cosine to Data	1		Actual Stations	8	
Sum of Sqr. Diff.	0.960				
Spacing Between (ft)	31.4	*L*	< 32-ft OK		
Allowable Stress (psi)	30,000	*Y*	Survey Max	0.333	(ft)
Modulas of Elasticity (ksi)	29,000	*E*		4	(in)
Tank Height (ft)	29.0	*H*	Curve Fit R^2	0.9996	

Results:	*Allowable*	>	*Actual*	
Differential (ft)	0.194	>	0.087	Pass
(in)	2.324	>	1.039	

$$|S| \le \frac{(L^2 \times Y \times 11)}{2[(E \times H)]}$$

Curve Fit to Cosine is OK R^2>=90%

SHELL THICKNESS CALCULATION

Shell Thickness Calculations per API 653 4.3.3.1

Find: Minimum shell thickness (t min) for each shell course utilizing the API 653 standard for tanks less than 200 ft dia.

Given:

Variable Identifier		Description	Value	Reference
H		Fill height (ft)	26.00	Measured from the base of each shell course (see column H in the table below)
D		Tank Diameter (ft)	80.00	
G		Specific Gravity	1.00	
S		Allow stress (psi)	Varies	Reference API 653 Table 4-1
E		Joint Efficiency	Varies	Reference API 653 table 4.2 for Welded and 4.3 for Riveted construction
M	1.00	Temp Modifier	Varies	Reference API 650 Appendix M Elevated temperature modifier

Solution: 1st Course Stress(psi)=(g*2.6(D(H-1)/t)=20,800(psi)

Table for Calculating minimum shell thickness (t min) for each shell course

			H		E		S	API 653 Required Calculation		Actual	Solution
Course	Height of each Course		Product Height Above Course	Type of Joint for each Course	Joint Eff API 653 Tbl 4.2 and 4.3	Material Type or Unknown Welded or Riveted	Maximum Allowable Stress	$t\ min = \frac{2.6\,(H-1)\,DG}{SEM}$	Req'd t min	Minimum Thickness for Course	Actual Vs Req'd
	(in)	(ft)	(ft)		%		(psi)	API 653 4.3.3.1	(in)	(in)	OK?
1	60.00	5	26.00	85% Butt Weld	0.85	A 36	24,882	2.6 x (26.00 - 1) x 80.00 x 1.00 / (24,882 x 0.85 x 1.00)	0.2459	0.2500	Ok
2	60.00	5	21.00	85% Butt Weld	0.85	A 36	24,882	2.6 x (21.00 - 1) x 80.00 x 1.00 / (24,882 x 0.85 x 1.00)	0.1967	0.2500	Ok
3	60.00	5	16.00	85% Butt Weld	0.85	A 36	27,376	2.6 x (16.00 - 1) x 80.00 x 1.00 / (27,376 x 0.85 x 1.00)	0.1341	0.2500	Ok
4	60.00	5	11.00	85% Butt Weld	0.85	A 36	27,376	2.6 x (11.00 - 1) x 80.00 x 1.00 / (27,376 x 0.85 x 1.00)	0.1000	0.2500	Ok
5	60.00	5	6.00	85% Butt Weld	0.85	A 36	27,376	2.6 x (6.00 - 1) x 80.00 x 1.00 / (27,376 x 0.85 x 1.00)	0.1000	0.2500	Ok
6	45.00	3.75	1.00	85% Butt Weld	0.85	A 36	27,376	2.6 x (1.00 - 1) x 80.00 x 1.00 / (27,376 x 0.85 x 1.00)	0.1000	0.2500	Ok

SHELL CORROSION RATE CALCULATION

Shell Corrosion Rate Calculations API 653 6.3; Widely Scattered Pits

Course	Date(s)					A	B		N	RCA	RCA/ 4N
		Inspection Year		Thickness				Corrosion Rate(s)		API 653 6.3.2.1 (A-B)	Next External API 653 6.3.2
	Year Built or Replaced				Measured		Calculated				
		Prev	Current	As Built	Prev	Current	t min	Previous	Current		
	(yr)	(yr)	(yr)	(in)	(in)	(in)	(in)	(in/ yr)	(in/ yr)	(in)	(yr)
1	1971	1971	2019	0.250	0.250	0.070	0.123	N/A	0.0038	(0.0529)	-3.53*
2	1971	1971	2019	0.250	0.250	0.110	0.098	N/A	0.0029	0.0117	1.00*
3	1971	1971	2019	0.250	0.250	0.242	0.067	N/A	0.0002	0.1750	5.00
4	1971	1971	2019	0.250	0.250	0.240	0.050	N/A	0.0002	0.1900	5.00
5	1971	1971	2019	0.250	0.250	0.244	0.050	N/A	0.0001	0.1940	5.00
6	1971	1971	2019	0.250	0.250	0.243	0.050	N/A	0.0001	0.1930	5.00
										minimum:	5.00

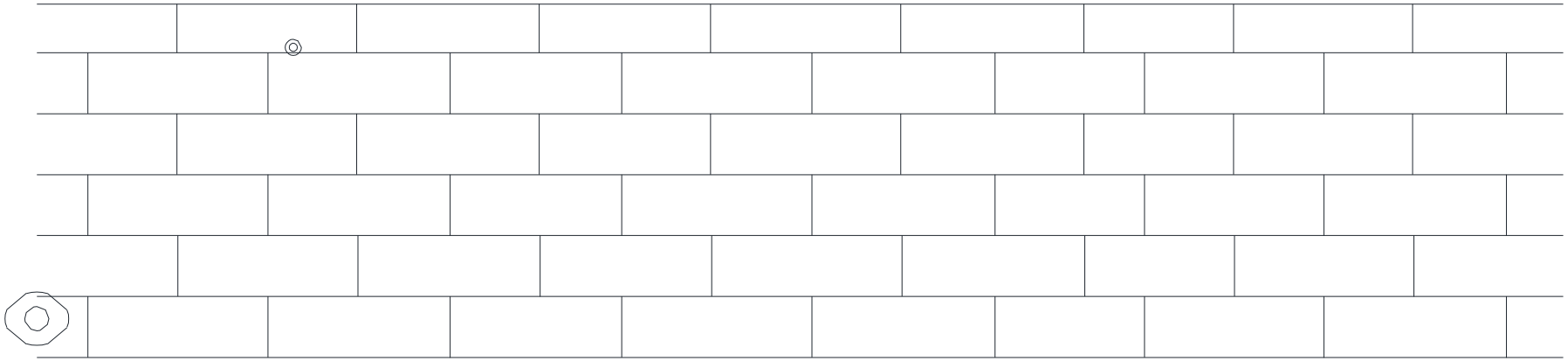
RCA = The difference between the measured thickness and the minimum required thickness (in per year are used in this calculation) ref API 653 6.3.2.1

Per API 653 Section 4.3.2.2 a), no pit depth results in the remaining shell thickness being less than one-half the minimum acceptable tank shell thickness exclusive of the corrosion allowance

*Note: Next External API 653 and UT Inspection calculation(s) not applicable because the tank will be coated inside reducing the corrosion rate to 0.

Tank 2

Shell Rollout



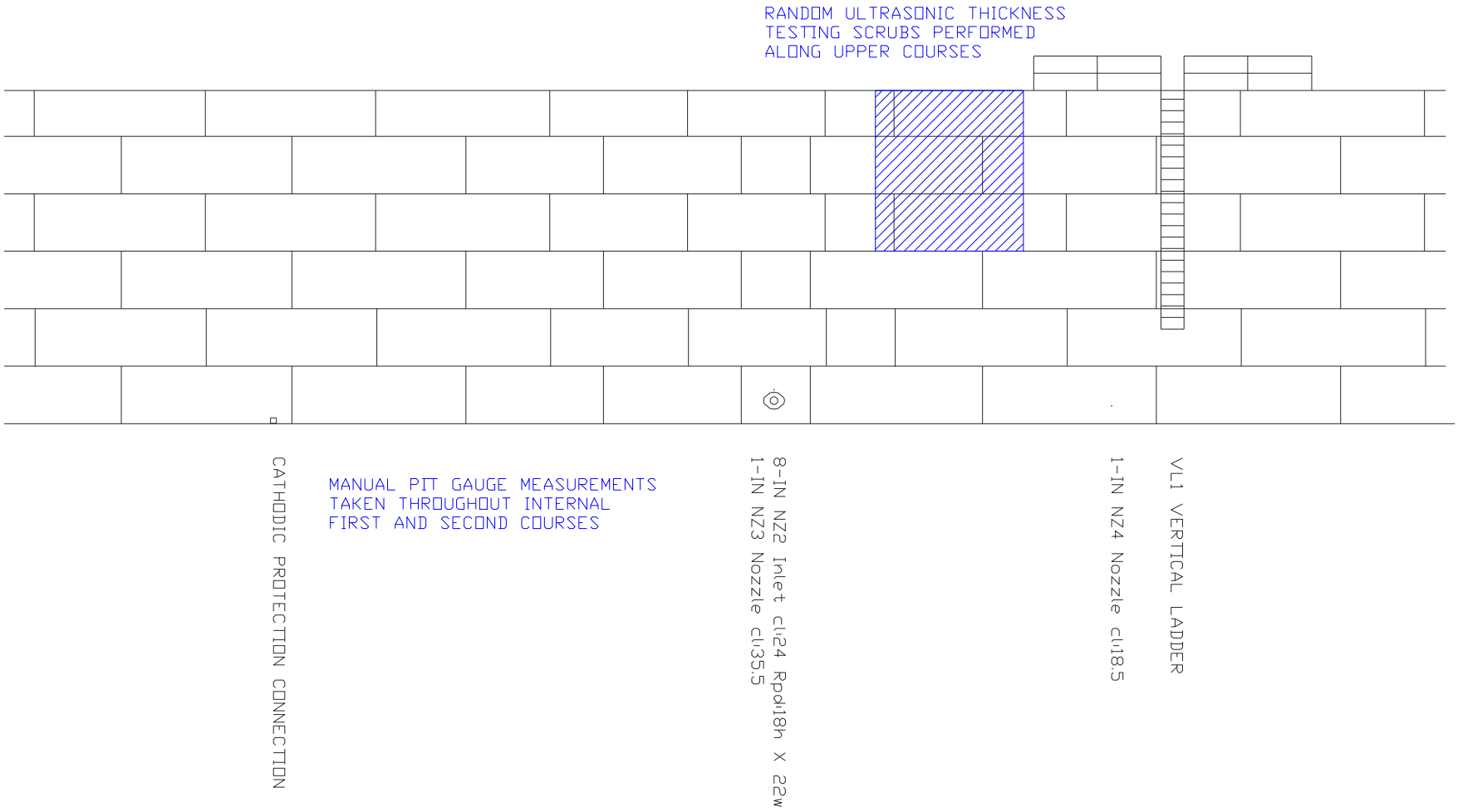
24-IN MW1 cl38 Rpd53h X 63w

8-IN NZ1 Nozzle cl302 Rpd16h X 16w

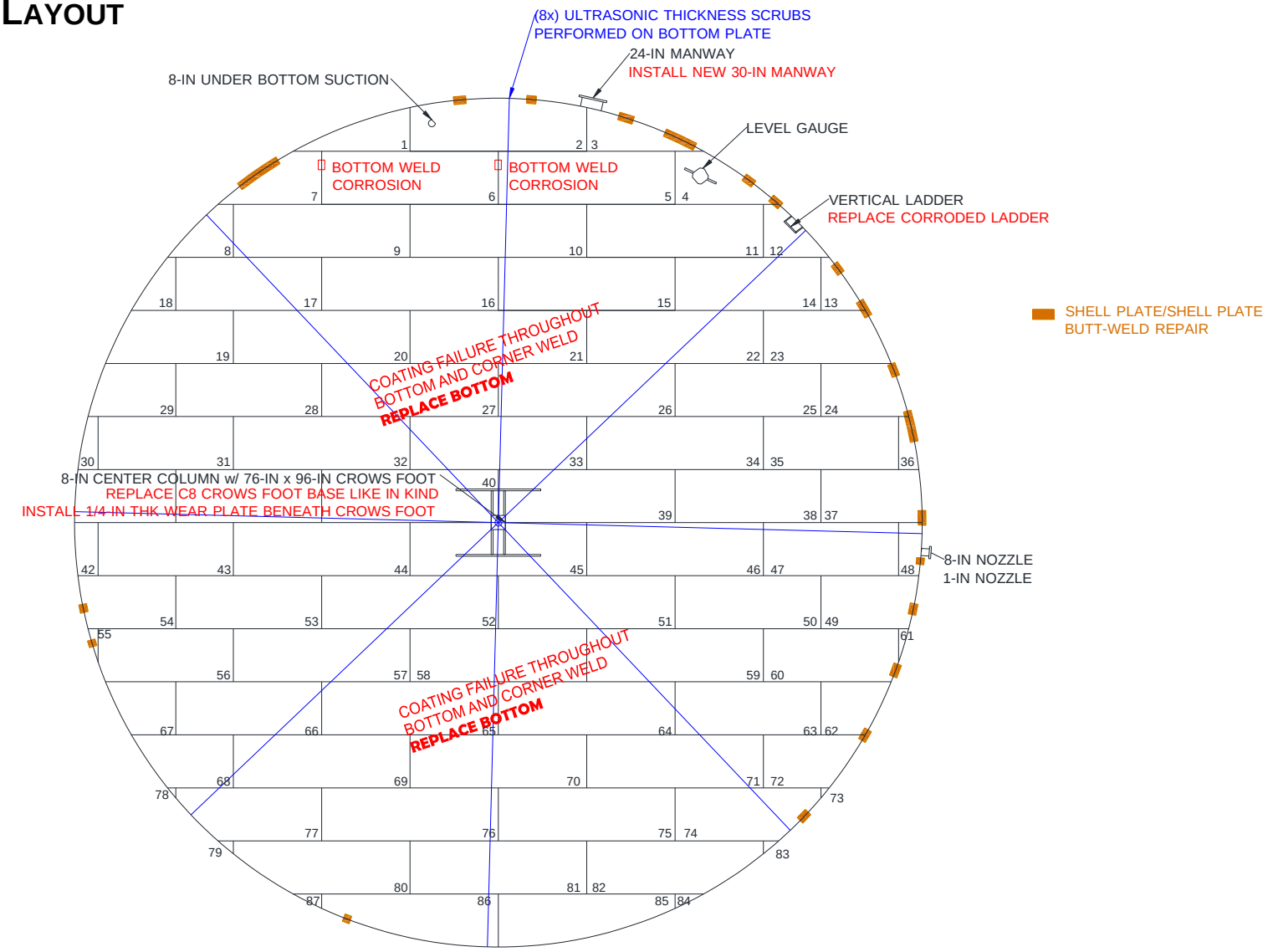
MANUAL PIT GAUGE MEASUREMENTS TAKEN THROUGHOUT
INTERNAL FIRST AND SECOND COURSES

MISSING ANCHOR BOLT

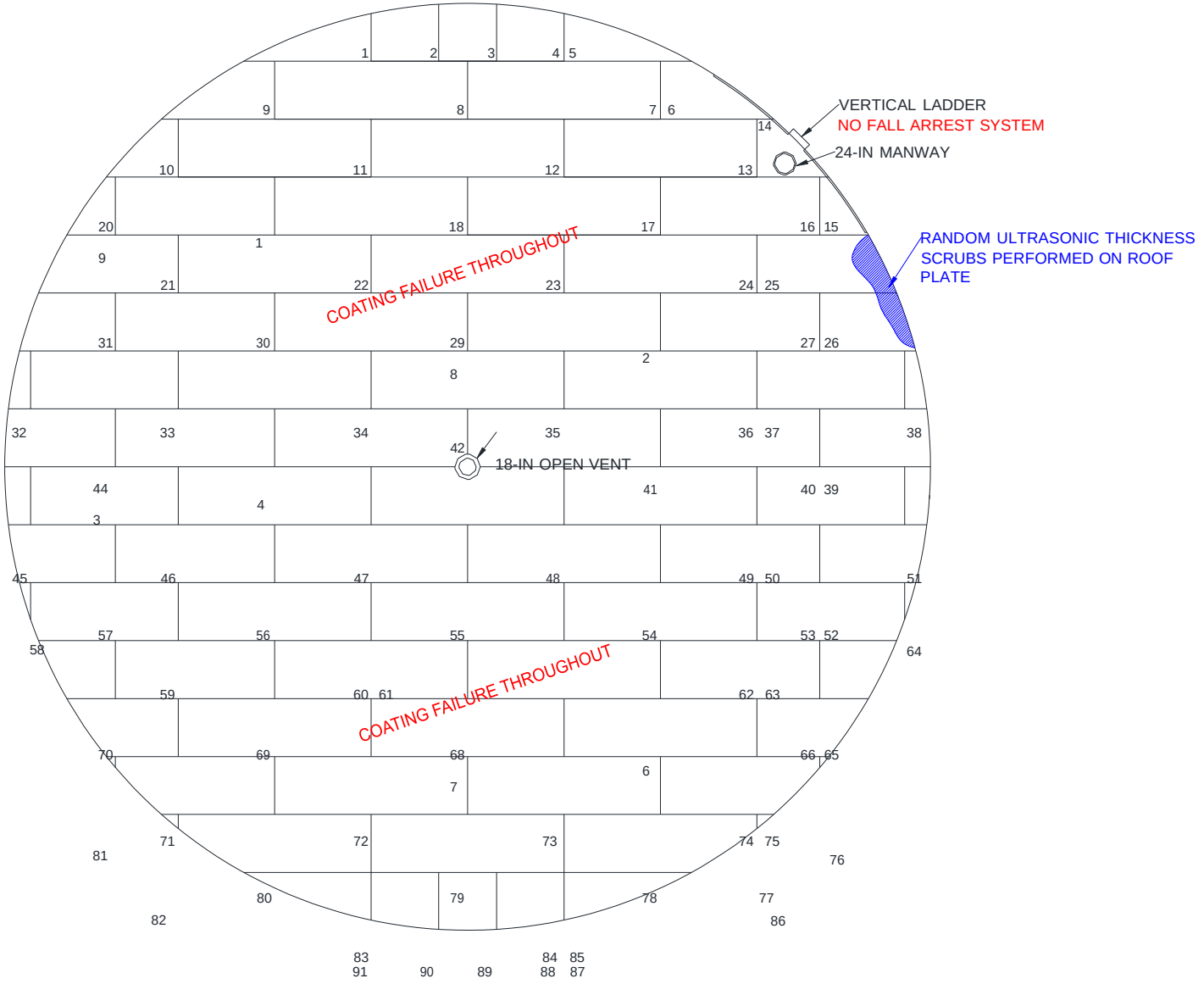
SHELL ROLLOUT (CONT.)



BOTTOM LAYOUT



CONE ROOF LAYOUT



NEXT INSPECTION CALCULATION

The tank bottom will be replaced. It is the best opinion of the Inspector that the bottom has a remaining life of 2-3 years until a leak occurs. Periodic monitoring of the tank bottom for a leak should be performed until the bottom is replaced.

SEISMIC CALCULATION

Seismic Design per API 650 11th Appendix E

Find: Product fill height for seismic loading utilizing API 650 12th edition Appendix E Methodology

Given:

Tank Number:		2		
Type Roof		3 Cone Roof with no Internal Floating Roof		
Tank (D)iameter (ft)		80.00		
Tank (H)eight or length for Horizontal Tank (ft)		29.00		
Seismic Product fill Height (ft)		26.00	Hfill	26 (ft) Operational
Specific (G)ravity		1.00		
Elevation of tank bottom above grade (ft)		0.66667		
Location:	Latitude (deg)	9.514400		
	Longitude (deg)	138.129400		
Spectral Response Factors	Ss	0.79	78.60%	USGS or UFC 3-101 -1 tbl F-2
	S1	0.31	31.40%	USGS or UFC 3-101 -1 tbl F-2
	So	0.314	= Ss*0.4 for Mapped Methods	
Site Coefficients	Fa	1.186	API 650 Table E-1	
	Fv	1.77	API 650 Table E-2	
Regional-dependant transition period	TL	-	ASCE 7 maps	*Varies from 4 to 16*
Sm1=Fv*S1		0.5564		
Use Group Importance Factor (API 650 Tbl E-5)		1		
Site Soil Classification		D Stiff Soil	Table E-3 API 650	IBC 2009 table 1613.5.2
Seismic Use Group		I	SUI or I	Use: group IV Military III essential, II public risk, or I
Thickness of Bottom under the shell (in)		0.2500	*tb*	
Min Req'd Thickness of Bottom under shell (in)		0.1000		API 653
Calc'd 23.43 Width of Annular Plate (in)		1.95	L	API 650 Appendix E.6.2.1.1.1
API 650 Appendix M Temeprature Modifier		1.00	Tm	
Yield of Bottom Under Shell (psi)		30,000	Fby	
Yield of 1st shell course (psi)		36,000	Fyield 1st Course	
(psi)		24,882	Sd	
Modulus of Elasticity (psi)		29,000,000	E	
Weight per Cubic ft of Material (pcf)		Steel	490	pcf
Snow Load (psf)		10		IBC 1608.4 or UFC 3-101 -1 tbl F-1
3-sec Gust Design Wind Velocity (mph)		100	V	IBC 2009 fig 1609 or UFC 3-101 -1 tbl F-1

Solution:

API 650 12th Appendix E Calculations for Lat 9.51440 and Long 138.12940

Seismic Overturning or Uplift Risk w/o Anchors?	No Seismic uplift is expected for fill heights < 26.00 (ft)
Compressive Shell Stress from Seismic Loads ?	Good ! Calculated Seismic Compressive Stress is less than Allowable
Height of sloshing wave per API 650 Appendix E ?	The calculated height of the sloshing wave is 1.64 (ft); recommended freeboard 1.15 (ft)
Wind Overturning for 100 mph wind?	Wind Overturning OK for API 650. No anchors are required to resist wind overturning

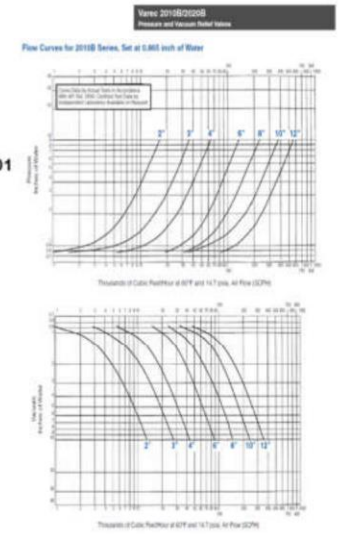
API 2000 VENTING CALCULATIONS

Venting Calculations for Atmospheric and Low Pressure Tanks per API 2000

Find: Normal Out-Breathing and In-Breathing for non-frangible roof design utilizing the API 2000 methodology

Given:

Variable Identifier	Description	Value		Reference or Formula	
D	Tank Diameter (ft)	80			
H	Shell height (ft)	29			
Hfill	Fill height (ft)	29.00			
	Type Product	Water			
	Specific Gravity	1			
	Vapor Pressure (mm Hg at 20°C)	0		IERA-RS-BR-SR-2001-002 SwRI 03.40.50.03148.001	
	Vapor Pressure (Fuel Oil, Diesel, Jet, Crude)			Vapor pressure of Hexane is 130 mm Hg at 20 °C	
	Flash Point (deg F)	200	93.33 (deg C)	UFC 3-460-01, Table 2-2	
	Operating Temperature (deg F)	100	37.78 (deg C)		
Tv	Simple Tank Volume (ft^3)	145,770		=0.25*H*pi*D^2	
	Type of Venting	3. Fixed Roof with Open Vent		Pressure Capacity	Vacuum Capacity
	Number of Vents on Roof	1			
Calculations:	Size of Vent 1 on Roof (in)	18		0	0
	Size of Vent 2 on Roof (in)	0		0	0
	Size of Vent 3 on Roof (in)	0		0	0
	Size of Vent 4 on Roof (in)	0		0	0
	Size of Largest Product In/Out Nozzle (in)	8			



Pressure

	Product In Flow Rate (bph)	2,286		
Pifr	(gpm)	1,600		
C	Hexane to product conversion factor	4.00	API 2000 Table 2	
Ri	Insulation Factor (1 for un-insulated tanks)	1.00	API 2000 Table 9	
Vop	Out breathing due to liquid movement (CFH Air)	12,832	= 8.02*Pfr	
Vit	Normal Out breathing due to Thermal (CFH Air)	13,406	= 3.08*C*Simple Tank Volume^(0.7)*Ri	
	Total Out breathing (CFH Air)	26,238		
	Per vent out Breathing (CFH Air)	26,238	Total/Number of Vents	OK Venting area >= 90% In/Out Per NFPA 30 21.4.3.3 sizing using API 2000 is acceptable or sizing vents at least as large as the largest inlet/outlet nozzle.
	API 2000 Pressure Sizing with Varec PVV:			
	Existing Venting Capacity (CFH Air):	0		
	Existing Vent Ok?:	Venting capacity insufficient.		
	Option 1	1 : 6-in		

Vacuum

	Product Pump Out Flow Rate (bph)	2,286	
Pofr	(gpm)	1,600	
Y	Latitude Factor	0.20	API 2000 Table 1
Vip	In breathing due to liquid movement (CFH Air)	12,832	if Temp < 104 deg F use 8.02 * Pofr else 8.02 * 1.005 * Pofr
Vot	Normal In breathing due to Thermal (CFH Air)	50,720	= 1.51*Y*Simple Tank Volume^(0.9)*Ri
	Total In breathing (CFH Air)	63,552	
	Per vent In Breathing (CFH Air)	63,552	
	API 2000 Vacuum Sizing with Varec PVV:		
	Existing Venting Capacity (CFH Air):	0	
	Existing Vent Ok?:	Existing venting capacity insufficient.	
	Option 1:	1 : 12-in	
	Option 2:	1 : 12-in	

Solution: Vent size 1 : 18-in Open Vent Total/Number of Vents

APPENDIX A: API 653 CHECKLIST

EXTERNAL

1.1 FOUNDATION		
ALL		
C.1.1	Measure foundation levelness and bottom elevations	See Report 'Shell Settlement Survey'
CONCRETE RING WALL		
C.1.1.1 a	Inspect for broken concrete, spalling, and cracks, particularly under backup bars used in welding butt welded annular rings under the shell.	See report
C.1.1.1 b	Inspect drain openings in ring, back of water draw basins and top surface of ring for indications of bottom leakage.	OK
C.1.1.1 c	Inspect for cavities under foundation and vegetation against bottom of tank.	OK
C.1.1.1 d	Check that runoff rainwater from the shell drains away from tank.	OK
C.1.1.1 e	Check for settlement around perimeter of tank.	OK
ASPHALT		
C.1.1.2. a	Check for settling of tank into asphalt base which would direct runoff rain water under the tank instead of away from it.	NA Concrete Ringwall
C.1.1.2. b	Look for areas where leaching of oil has left rock filler exposed, which indicates hydrocarbon leakage.	NA Concrete Ringwall
OILED DIRT OR SAND		
C.1.1.3 a	Check for settlement into the base which would direct runoff rain water under the tank rather than away from it.	NA Concrete Ringwall
ROCK		
C.1.1.4 a	Presence of crushed rock under the steel bottom usually results in severe underside corrosion. Make a note to do additional bottom plate examination (ultrasonic, hammer testing, or turning of coupons) when the tank is out of service.	NA Concrete Ringwall
SITE DRAINAGE		
C.1.1.5 a	Check site for drainage away from the tank and associated piping and manifolds.	Drainage is away from tank
C.1.1.5 b	Check operating condition of the dike drains.	Not Performed
HOUSEKEEPING		
C.1.1.6. a	Inspect the area for buildup of trash, vegetation, and other inflammables buildup.	None present
1.2 SHELLS		
EXTERNAL VISUAL INSPECTION		
C.1.2.1. a	Visually inspect for paint failures, pitting, and corrosion.	See Report
C.1.2.1. b	Clean off the bottom angle area and inspect for corrosion and thinning on plate and weld.	See Report
C.1.2.1. c.	Inspect the bottom-to-foundation seal, if any	None Present
INTERNAL (FLOATING ROOF TANK)		
C.1.2.2.a	Visually inspect for grooving, corrosion, pitting, and coating failures.	NA

RIVETED SHELL INSPECTION		
C.1.2.3. a	Inspect external surface for rivet and seam leaks	Shell Not Riveted
C.1.2.3. b	Locate leaks by sketch or photo (location will be lost when shell is abrasive cleaned for painting).	Shell Not Riveted
C.1.2.3. c	Inspect rivets for corrosion loss and wear	Shell Not Riveted
C.1.2.3. d	Inspect vertical seams to see if they have been full fillet lap welded to increase joint efficiency	Shell Not Riveted
C.1.2.3. e	If no record exists of vertical riveted seams, dimension and sketch (or photograph) the rivet pattern: number of rows, rivet size, pitch length, and note whether the joint is butt riveted or lap riveted.	Shell Not Riveted
WIND GIRDER (FLOATING ROOF TANKS)		
C.1.2.4. a	Inspect wind girder and handrail for corrosion damage (paint failure, pitting, corrosion product buildup), especially where it occurs at tack welded junction, and for broken welds.	No Wind Girder
C.1.2.4. b	Check support welds to shell for pitting, especially on shell plates.	No Wind Girder
C.1.2.4. c	Note whether supports have reinforcing pads welded to shell.	No Wind Girder
1.3 SHELL APPURTENANCES		
MANWAYS AND NOZZLES		
C.1.3.1. a	Inspect for cracks or signs of leakage on weld joint at nozzles, manways, and reinforcing plates.	No seeps present
C.1.3.1. b	Inspect for shell plate dimpling around nozzles, caused by excessive pipe deflection.	No distortion
C.1.3.1. c	Inspect for flange leaks and leaks around bolting.	No seeps present
C.1.3.1. d	Inspect sealing of insulation around manways and nozzles.	N/A Tank Not Insulated
C.1.3.1. e	Check for inadequate manway flange and cover thickness on mixer manways.	No Mixer
TANK PIPING MANIFOLDS		
C.1.3.2. a	Inspect manifold piping, flanges, and valves for leaks.	No leaks observed
C.1.3.2. b	Inspect firefighting system components	NA
C.1.3.2. c	Check for anchored piping which would be hazardous to the tank shell or bottom connections during earth movement.	NA
C.1.3.2. d	Check for adequate thermal pressure relief of piping to the tank.	NA
C.1.3.2. e	Check operation of regulators for tanks with purge gas systems.	Not Performed
C.1.3.2. f	Check sample connections for leaks and for proper valve operation	NA
C.1.3.2. g	Check for damage and test the accuracy of temperature indicators.	NA
C.1.3.2. h	Check welds on shell-mounted davit clips above valves 6 inches and larger.	No davit clips present
AUTO GAUGE SYSTEM		
C.1.3.3. a	Inspect auto gauge tape guide and lower sheave housing (floating swings) for leaks	NA
C.1.3.3. b	Inspect auto gauge head for damage	NA
C.1.3.3. c	Bump the checker on auto gauge head for proper movement of tape.	NA
C.1.3.3. d	Identify size and construction material of auto gauge tape guide (floating roof tanks).	NA

C.1.3.3. e	Ask operator if tape tends to hang up during tank roof movement (floating roof tanks).	NA
C.1.3.3. f	Compare actual product level to the reading on the auto gauge (maximum variation is 2 inches).	NA
C.1.3.3. g	On floating roof tanks, when the roof is in the lowest position, check that no more than two feet of tape are exposed at the end of the tape guide.	NA
C.1.3.3. h	Inspect condition of board and legibility of board-type auto gauges.	NA
C.1.3.3. i	Test freedom of movement of marker and float.	NA
SHELL MOUNTED SAMPLE STATION		
C.1.3.4. a	Inspect sample lines for function of valves and plugging of lines, including drain or return-to-tank line.	NA
C.1.3.4. b	Check circulation pump for leaks and operating problems.	NA
C.1.3.4. c	Test bracing and supports for sample lines and equipment.	NA
HEATER (SHELL MANWAY MOUNTED)		
C.1.3.5. a	Inspect condensate drain for presence of oil indicating leakage	NA
MIXER		
C.1.3.6. a	Inspect for proper mounting flange and support.	NA
C.1.3.6. b	Inspect for leakage.	NA
C.1.3.6. c	Inspect condition of power lines and connections to mixer.	NA
SWING LINES: WINCH OPERATION		
C.1.3.7. a	Non-floating. Raise, then lower the swing line with the winch, and check for cable tightness to confirm that swing line lowered properly.	NA
C.1.3.7. b	Floating. With tank half full or more, lower the swing line, then let out cable and check if swing has pulled cable tight, indicating that the winch is operating properly.	NA
C.1.3.7. c	Indicator. Check that the indicator moves in the proper direction: Floating swing line indicators show a lower level as cable is wound up on the winch. Non-floating swing line indicators show the opposite.	NA
SWING LINES: EXTERNAL GUIDE SYSTEM		
C.1.3.8. a	Check for leaks at threaded and flanged joints.	NA
SWING LINES: IDENTIFY BALLAST VARYING NEED		
C.1.3.9. a	Check for significant difference in stock specific gravity.	NA
SWING LINES: CABLE MATERIAL AND CONDITION		
C.1.3.9.1. a	For non-stainless-steel cable, check for corrosion over entire length.	
C.1.3.9.1. b	All cable: check for wear or fraying.	
SWING LINES: PRODUCT SAMPLE COMPARISON		
C.1.3.9.1. c	Check for water or gravity differences that would indicate a leaking swing joint.	NA
SWING LINES: TARGET		
C.1.3.9.1. d	Target should indicate direction of swing opening (up or down) and height above bottom where suction will be lost with swing on bottom support.	NA
1.4 ROOFS		
DECK PLATE INTERNAL CORROSION		
C.1.4.1 a	For safety, before accessing the roof, check with ultrasonic instrument or lightly use a ball peen hammer to test the deck plate near the edge of the	UT 3/16-in Nominal Thickness

	roof for thinning. (Corrosion normally attacks the deck plate at the edge of a fixed roof and at the raft	
DECK PLATE EXTERNAL CORROSION		
C.1.4.2. a	Visually inspect for paint failure, holes, pitting, and corrosion product on the roof deck.	See Report
ROOF DECK DRAINAGE		
C.1.4.3. a	Look for indication of standing water. (Significant sagging of fixed roof deck indicates potential rafter failure. Large standing water areas on a floating roof indicate inadequate drainage design or, if to one side, a non-level roof with possible leaking	See report
LEVEL OF FLOATING ROOF		
C.1.4.4. a	At several locations, measure distance from roof rim to a horizontal weld seam above the roof. A variance in the readings indicates a non-level roof with possible shell out-of-round, out-of-plumb, leaking pontoons, or hang-up.	N/A
INTERNAL FLOATING ROOF		
C.1.4.5. a	Test for explosive gas on top of the internal floating roof. Readings could indicate a leaking roof, leaking seal system, or inadequate ventilation of the area above the internal floating roof.	N/A
ROOF INSULATION		
C.1.4.6. a	Visually inspect for cracks or leaks in the insulation weather coat where runoff rain water could penetrate the insulation.	N/A No Roof Insulation
C.1.4.6. b	Inspect for wet insulation under the weather coat.	N/A No Roof Insulation
C.1.4.6. c	Remove small test sections of insulation and check roof deck for corrosion and holes near the edge of the insulated area.	N/A No Roof Insulation
FLOATING ROOF SEAL SYSTEMS		
C.1.4.6. a	Measure and record maximum seal-to-shell gaps at: 1. Low pump out. 2. Mid-shell. 3.High liquid level.	N/A
C.1.4.6. b	Measure and record annular space at 30-foot spacing (minimum of four quadrants) around roof and record. Measurements should be taken in directly opposite pairs. 1.Opposite pair. 2. Opposite pair.	N/A
C.1.4.6. c	Check if seal fabric on primary shoe seals is pulling shoes away from shell (fabric not wide enough).	N/A
C.1.4.6. d	Inspect fabric for deterioration, holes, tears, and cracks.	N/A
C.1.4.6. e	Inspect visible metallic parts for corrosion and wear.	N/A
C.1.4.6. f	Inspect for openings in seals that would permit vapor emissions.	N/A
C.1.4.6. g	Inspect for protruding bolt or rivet heads against the shell.	N/A
C.1.4.6. h	Pull both primary and secondary seal systems back all around the shell to check their operation.	N/A
C.1.4.6. i	Inspect secondary seals for signs of buckling or indications that their angle with the shell is too shallow.	N/A
C.1.4.6. j	Inspect wedge-type wiper seals for flexibility, resilience, cracks, and tears.	N/A
1.5 ROOF APPURTENANCES		
SAMPLE HATCH		
C.1.5.1. a	Inspect condition and functioning of sample hatch cover.	N/A

C.1.5.1. b	On tanks governed by Air Quality Monitoring District rules, check for the condition of seal inside hatch cover.	N/A
C.1.5.1. c	Check for corrosion and plugging on thief and gauge hatch cover.	N/A
C.1.5.1. d	Where sample hatch is used to reel gauge stock level, check for marker and tab stating hold off distance.	N/A
C.1.5.1. e	Check for reinforcing pad where sample hatch pipe penetrates the roof deck.	N/A
C.1.5.1. f	On floating roof sample hatch and recoil systems, inspect operation of recoil reel and condition of rope.	N/A
C.1.5.1. g	Test operation of system.	N/A
C.1.5.1. h	On ultra clean stocks such as JP4, check for presence and condition of protective coating or liner inside sample hatch (preventing rust from pipe getting into sample).	N/A
GAUGE WELL		
C.1.5.2. a	Inspect visible portion of the gauge well for thinning, size of slots, and cover condition	N/A
C.1.5.2. b	Check for a hold off distance marker and tab with hold off distance (legible).	N/A
C.1.5.2. c	On floating roofs, inspect condition of roof guide for gauge well, particularly the condition of the rollers for grooving.	N/A
C.1.5.2. d	If accessible, check the distance from the gauge well pipe to the tank shell at different levels.	N/A
C.1.5.2. e	If tank has a gauge-well washer, check valve for leakage and for presence of a bull plug or blind flange.	N/A
FIXED ROOF SCAFFOLD SUPPORT		
C.1.5.3. a	Inspect scaffold support for corrosion, wear, and structural soundness.	N/A
AUTOGAUGE: INSPECTION HATCH AND GUIDES (FIXED ROOF)		
C.1.5.4. a	Check the hatch for corrosion and missing bolts.	N/A
C.1.5.4. b	Look for corrosion on the tape guide's and float guides wire anchors.	N/A
AUTOGAUGE: FLOAT WELL COVER		
C.1.5.5. a	Inspect for corrosion.	N/A
C.1.5.5. b	Check tape cable for wear or fraying caused by rubbing on the cover.	N/A
SAMPLE HATCH (INTERNAL FLOATING ROOF)		
C.1.5.6. a	Check overall conditions.	N/A
C.1.5.6. b	When equipped with a fabric seal, check for automatic sealing after sampling.	N/A
C.1.5.6. c	When equipped with a recoil reel opening device, check for proper operations	N/A
ROOF-MOUNTED VENTS (INTERNAL FLOATING ROOF)		
C.1.5.7. a	Check condition of screens, locking and pivot pins.	N/A
GAUGING PLATFORM DRIP RING		
C.1.5.8. a	On fixed roof tanks with drip rings under the gauging platform or sampling area, inspect for plugged drain return to the tank	N/A
EMERGENCY ROOF DRAINS		
C.1.5.9. a	Inspect vapor plugs for emergency drain: that seal fabric discs are slightly smaller than the pipe ID and that fabric seal is above the liquid level.	N/A

REMOVABLE ROOF LEG RACKS		
C.1.5.9.1. a	Check for leg racks on roof.	N/A
VACUUM BREAKERS		
C.1.5.9.2. a	Report size, number, and type of vacuum breakers. Inspect vacuum breakers. If high legs are set, check for setting of mechanical breakers in high leg position.	NA
RIM VENTS		
C.1.5.9.3. a	Check condition of the screen on the rim vent cover.	NA
C.1.5.9.3. b	Check for plating off or removal of rim vents where jurisdictional rules do not permit removal.	NA
PONTOON INSPECTION HATCHES		
C.1.5.9.4. a	Open pontoon inspection hatch covers and visually check inside for pontoon leakage.	NA
C.1.5.9.4. b	Test for explosive gas (an indicator of vapor space leaks).	NA
C.1.5.9.4. c	If pontoon hatches are equipped with locked down coves, check for vent tubes. Check that vent tubes are not plugged up. Inspect lock down devices for condition and operation	NA
ACCESS STRUCTURES		
HANDRAILS		
C.1.6.1. a	Identify and report type (steel pipe, galvanized pipe, square tube, angle) and size of handrails.	OSHA Compliant
C.1.6.1. b	Inspect for pitting and holes, paint failure.	Thinning Paint
C.1.6.1. c	Inspect attachment welds.	Attachment welds in good condition
C.1.6.1. d	Identify cold joints and sharp edges. Inspect the handrails and mid-rails	Hand rails free from cold joints and sharp edges.
C.1.6.1. e	Inspect safety drop bar (or safety chain) for corrosion, functioning, and length.	Not Present
C.1.6.1. f	Inspect the handrail between the rolling ladder and the gaging platform for a hazardous opening when the floating roof is at its lowest level.	NA
PLATFORM FRAME		
C.1.6.2. a	Inspect frame for corrosion and paint failure.	N/A
C.1.6.2. b	Inspect the attachment of frame to supports and supports to tank for corrosion and weld failure.	N/A
C.1.6.2. c	Check reinforcing pads where supports are attached to shell or roof.	N/A
C.1.6.2. d	Inspect the surface that deck plate or grating rests on, for thinning and holes.	N/A
C.1.6.2. e	Check that flat-surface to flat-surface junctures reseal welded.	N/A
DECK PLATE AND GRATING		
C.1.6.3. a	Inspect deck plate for corrosion-caused thinning or holes (not drain holes) and paint failure.	N/A
C.1.6.3. b	Inspect plate-to-frame weld for rust scale buildup.	N/A
C.1.6.3. c	Inspect grating for corrosion-caused thinning of bars and failure of welds	N/A
C.1.6.3. d	Check grating tie down clips. Where grating has been retrofitted to replace plate.	N/A

STAIRWAY STRINGERS		
C.1.6.4. a	Inspect spiral stairway stringers for corrosion, paint failure, and weld failure. Inspect attachment of stairway treads to stringer.	N/A
C.1.6.4. b	Inspect stairway supports to shell welds and reinforcing pads.	N/A
C.1.6.4. c	Inspect steel support attachment to concrete base for corrosion.	N/A
ROLLING LADDER		
C.1.6.5. a	Inspect rolling ladder stringers for corrosion.	NA
C.1.6.5. b	Identify and inspect ladder fixed rungs (square bar, round bar, angles) for weld attachment to stringers and corrosion, particularly where angle rungs are welded to stringers	NA
C.1.6.5. c	Check for wear and corrosion where rolling ladder attaches to gauging platform.	NA
C.1.6.5. d	Inspect pivot bar for wear and secureness.	NA
C.1.6.5. e	Inspect operation of self-leveling stairway treads.	NA
C.1.6.5. f	Inspect for corrosion and wear on moving parts.	NA
C.1.6.5. g	Inspect rolling ladder wheels for freedom of movement, flat spots, and wear on axle.	NA
C.1.6.5. h	Inspect alignment of rolling ladder with roof rack.	NA
C.1.6.5. i	Inspect top surface of rolling ladder track for wear by wheels to assure at least 18 inches of unworn track (track long enough).	NA
C.1.6.5. j	Inspect rolling ladder track welds for corrosion.	NA
C.1.6.5. k	Inspect track supports on roof for reinforcing pads seal welded to deck plate.	NA
C.1.6.5. l	Check by dimensioning, the maximum angle of the rolling ladder when the roof is on low legs.	NA
C.1.6.5. m	If rolling ladder track extends to within five feet of the edge of the roof on the far side, check for a handrail on the top of the shell on that side. Max. angle	NA

INTERNAL

2.10 OVERVIEW		
SAFETY		
C.2.1. a	Check that tank has been cleaned, is gas free, and safe for entry.	Acceptable
C.2.1. b	Check that the tank is completely isolated from product lines, all electrical power, and steam lines.	Acceptable
C.2.1. c	Check that roof is adequately supported, including fixed roof structure and floating roof legs	See Report
C.2.1. d	Check for presence of failing object hazards, such as corroded-through roof rafters, asphalt stalactites, and trapped hydrocarbons in unopened or plugged equipment or appurtenances, ledges, etc.	Acceptable
C.2.1. e	Inspect for slipping hazards on the bottom and roof decks.	Tank bottom is clean
C.2.1. f	Inspect structural welds on access ways and clips	Acceptable
C.2.1. g	Check surfaces needing inspection for a heavy-scale buildup and check weld seams and oily surfaces where welding is to be done. Note areas needing more cleaning, including blasting.	Good
2.2 TANK EXTERIOR		
INSPECTION		
C.2.2. a	Inspect appurtenances opened during cleaning such as lower floating swing sheave assemblies, nozzle interiors (after removal of valves)	OK
C.2.2. b	Hammer test or ultrasonically test the roof.	OK
C.2.2. c	Enter and inspect the floating roof pontoon compartments.	NA
2.3 BOTTOM INTERIOR SURFACE		
INSPECTION		
C.2.3. a	Using a flashlight held close to and parallel to the bottom plates, and using the bottom plate layout as a guide, visually inspect and hammer test the entire bottom.	See Report
C.2.3. b	Measure the depth of pitting and describe the pitting appearance (sharp edged, lake type, dense, scattered, etc.)	See Report.
C.2.3. c	Mark areas requiring patching or further inspection.	See Report
C.2.3. d	Mark locations for turning coupons for inspection.	OK
C.2.3. e	Inspect all welds for corrosion and leaks, particularly the shell-to-bottom weld.	See Report
C.2.3. f	Inspect sketch plates for corrosion.	See Report
C.2.3. g	Locate and mark voids under the bottom.	OK
C.2.3. h	Record bottom data on a layout sketch using the existing bottom plates as a grid. List the number and sizes of patches required.	See report
C.2.3. i	Vacuum test the bottom lap welds.	Not Performed
C.2.3. j	Hammer test or ultrasonically examine any slightly discolored spots or damp areas.	OK
C.2.3. k	Check for reinforcing pads under all bottom attached clips, brackets, and supports	See report
C.2.3. l	Inspect floating roof leg pads for pitting or cutting, and excessive dimpling (indicating excessive loading).	No Floating Roof

C.2.3. m	Check the column bases of fixed roof supports for adequate pads and restraining clips.	See report
C.2.3. n	In earthquake zones 3 and 4, check that roof supports are not welded down to the tank bottom, but are only restrained from horizontal movement.	See Report
C.2.3. o	Check area beneath swing line cable for indications of cable cutting or dragging.	N/A No Swing Line
C.2.3. p	Mark old oil and air test connection for removal and patching.	OK
C.2.3. q	Identify and report low areas on the bottom that do not drain adequately.	OK
C.2.3. r	Inspect coating for holes, disbanding, deterioration, and discoloration.	OK
2.4 SHELL SEAMS AND PLATE		
INSPECTION		
C.2.4. a	On cone up bottoms, closely inspect and gauge the depth of metal loss on the lower 2 to 4 inches of the shell (area of standing water).	See Report
C.2.4. b	Measure the depth of pitting on each course.	See Report
C.2.4.c	Inspect and estimate the amount of metal loss on the heads of rivets and bolts	NA
C.2.4. d	Inspect shell-to-bottom riveted lap joints.	NA
C.2.4. e	Inspect for vertical grooving damage from seal assembly protrusions.	No Floating Roof
C.2.4. f	Inspect existing protective coatings for damage, deterioration, and disbanding	See Report
C.2.4. g	Check for areas of rubbing (indicating too much pressure by the seal assembly shoes or inadequate annular space).	No Floating Roof
C.2.4.h	Visually inspect the shell plates and seams for indications of leakage. If the shell has riveted or bolted seams, record the leak locations by film or chart in case the locations are lost during surface preparation for painting	No shell leakage idenified
C.2.4. i	Measure annular space at 40-foot intervals.	NA
C.2.4. j	Survey the shell to check for roundness and plumb.	Visually Acceptable
2.5 SHELL MOUNTED OVERFLOWS		
INSPECTION		
C.2.5. a	Inspect overflow for corrosion and adequate screening.	OK
C.2.5. b	Check location of overflow that it is not above any tank valves or equipment.	OK
2.6 ROOF INTERIOR SURFACE		
GENERAL		
C.2.6.1. a	Visually inspect the underside surface of the roof plates for holes, scale buildup, and pitting.	Visually Acceptable
C.2.6.1. b	Hammer test or ultrasonically examine to check for thin areas, particularly in the vapor space of floating roofs and at edge of roof on cone roof tank.	UT Acceptable
C.2.6.1. c	Check all clips, brackets, braces, etc., welded to the roof deck plate for welded reinforcing pads and see that they have not broken free.	Visually Acceptable
C.2.6.1. d	If no pad is present, penetrant test for cracking of the weld or deck plate.	OK
C.2.6.1. e	Inspect for protective coating for breaks, disbandment, and deterioration	See Report
C.2.6.1. f	Spark test the interior surface coating if recoating is not planned.	NA

FIXED ROOF SUPPORT STRUCTURE		
C.2.6.2. a	Inspect the support columns for thinning in the upper two feet.	NA
C.2.6.2. b	On API columns (two channels welded together) check for corrosion scale breaking the tack welds, unless the joint between the channels is completely seal welded.	NA
C.2.6.2. c	Check that the reinforcing pad on the bottom is seal welded to the tank bottom with horizontal movement restraining clips welded to the pad.	See report.
C.2.6.2. d	Determine if pipe column supports are concrete filled or open pipe. If open pipe, check for a drain opening in the bottom of the pipe	OK
C.2.6.2. e	Inspect and gauge rafters for thinning, particularly near the center of the roof. Report metal loss.	OK
C.2.6.2. f	Check for loose or twisted rafters.	OK
C.2.6.2. g	Inspect girders for thinning and check that they are attached securely to the top of the columns.	NA
C.2.6.2. h	Report if the columns have cross bracing in the area between the low pump out of the top of the shell (for future internal floating roof installation).	OK
C.2.6.2. i	Inspect and report presence of any roof-mounted swing line bumpers.	NA
C.2.6.2. j	Photograph the roof structure if no rafter layout drawing exists.	See Report/Photos
2.7 FIXED ROOF APPURTENANCES		
INSPECTION AND LIGHT HATCHES		
C.2.7.1. a	Inspect the hatches for corrosion, paint and coating failures, holes, and cover sealing.	N/A No Light Hatches
C.2.7.1. b	On loose covers, check for a safety chain in good condition.	N/A No Light Hatches
C.2.7.1. c	On light hatches over 30 inches across, check for safety rods	N/A No Light Hatches
C.2.7.1. d	Inspect the condition of the gaskets on bold or latched down hatch covers.	N/A No Light Hatches
STAGING SUPPORT CONNECTION		
C.2.7.2. a	Inspect the condition of the staging support for corrosion.	NA
BREATHERS AND VENTS		
C.2.7.3. a	Inspect and service the breather.	NA
C.2.7.3. b	Inspect screens on vents and breathers.	NA
EMERGENCY PV HATCHES		
C.2.7.4. a	Inspect and service pressure/vacuum hatches. (Setting should be high enough to prevent chattering of breather during normal operation. See breather manufacturer's guide,)	NA
C.2.7.4. b	Inspect liquid seal hatches for corrosion and proper liquid level in the seal.	NA
SAMPLE HATCH		
C.2.7.5. a	Inspect sample hatch for corrosion.	NA
C.2.7.5. b	Check that the cover operates properly	NA
C.2.7.5. c	If the tank has no gauge well, check for a hold off distance marker and check measurement.	NA
2.8 FLOATING ROOF		

ROOF DECK		
C.2.8.1. a	Hammer test the area between roof rim and shell. (If access for hammer testing is inadequate, measure the distance from the bottom edge of the roof to the corroded area and then hammer test from inside the pontoon.)	No Floating Roof
C.2.8.1. b	In sour water service, clean and test all deck plate weld seams for cracking unless the lower laps have been seal welded.	No Floating Roof
C.2.8.1. c	Check that either the roof drain is open, or the drain plug in the roof is open in case of unexpected rain	No Floating Roof
C.2.8.1. d	On flat bottomed and cone bottom roof decks, check for a vapor dam around the periphery of the roof. The dam should be continuous without break to prevent escape of vapors to the seal area from under the center of the roof.	No Floating Roof
FLOATING ROOF PONTOONS		
C.2.8.2. a	Visually inspect each pontoon for liquid leakage.	No Floating Roof
C.2.8.2. b	Run a light wire through the goose neck vents on locked down inspection hatch covers to make sure they are open.	No Floating Roof
C.2.8.2. c	Inspect lockdown latches on each cover.	No Floating Roof
C.2.8.2. d	Check and report if each pontoon is:1. Vapor tight (bulkhead seal welded on one side on bottom, sides, and top), 2. Liquid tight seal welded on bottom and sides only), or 3. Unacceptable (minimum acceptable condition is liquid tight).	No Floating Roof
FLOATING ROOF CUTOUTS		
C.2.8.3. a	Inspect underside of cutouts for mechanical damage.	No Floating Roof
C.2.8.3. b	Inspect welds for cracks.	No Floating Roof
C.2.8.3. c	Inspect plate for thinning, pitting, and erosion.	No Floating Roof
C.2.8.3. d	Measure mixer cutouts and record plate thickness for future mixer installation or replacement. Plate thickness	No Floating Roof
FLOATING ROOF SUPPORTS		
C.2.8.4. a	Inspect fixed low and removable high floating roof legs for thinning.	No Floating Roof
C.2.8.4. b	Inspect for notching at bottom of legs for drainage	No Floating Roof
C.2.8.4. c	Inspect for leg buckling or felling at bottom.	No Floating Roof
C.2.8.4. d	Inspect pin hole in roof guide for tears.	No Floating Roof
C.2.8.4. e	Check plumb of all legs.	No Floating Roof
C.2.8.4. f	Inspect for adequate reinforcing gussets on all legs through a single portion of the roof.	No Floating Roof
C.2.8.4. g	Inspect the area around the roof legs for cracking if there is no internal reinforcing pad or if the topside pad is not welded to the deck plate on the underside.	No Floating Roof
C.2.8.4. g	Inspect the sealing system on the two-position legs and the vapor plugs in the fixed low leg for deterioration of the gaskets.	No Floating Roof
C.2.8.4. h	On shell mounted roof supports, check for adequate clearance based on the maximum floating roof movement as determined by the position of the roof relative to the gauge well and/or counter rotational device.	No Floating Roof

2.9 FLOATING ROOF SEAL ASSEMBLIES

PRIMARY SHOE ASSEMBLY

C.2.9.1. a	Remove four sections of foam log (foam filled seals) for inspection on 90' locations.	No Floating Roof
C.2.9.1. b	Inspect hanger attachment to roof rim for thinning, bending, broken welds, and wear of pin holes.	No Floating Roof
C.2.9.1. c	Inspect clips welded to roof rim for thinning.	No Floating Roof
C.2.9.1. d	Shoes-inspect for thinning and holes in shoes.	No Floating Roof
C.2.9.1. e	Inspect for bit-metal bolts, clips, and attachments.	No Floating Roof
C.2.9.1. f	Seal fabric-inspect for deterioration, stiffening, holes, and tears in fabric.	No Floating Roof
C.2.9.1. g	Measure length of fabric from top of shoe to roof rim, and check against maximum anticipated annular space as roof operates.	No Floating Roof
C.2.9.1. h	Inspect any modification of shoes over shell nozzles, mixers, etc., for clearance.	No Floating Roof
C.2.9.1. i	Inspect shoes for damage caused by striking shell nozzles, mixers, etc.	No Floating Roof
PRIMARY TOROIDAL ASSEMBLY		
C.2.9.2. a	Inspect seal fabric for wear, deterioration, holes, and tears	No Floating Roof
C.2.9.2. b	Inspect hold down system for buckling or bending.	No Floating Roof
C.2.9.2. c	Inspect foam for liquid absorption and deterioration.	No Floating Roof
RIM MOUNTED SECONDARIES		
C.2.9.3. a	Inspect the rim-mounted bolting bar for corrosion and broken welds.	N/A No Secondary Seal
C.2.9.3. b	Measure and chart seal-to-shell gaps.	N/A No Secondary Seal
C.2.9.3. c	Visually inspect seal from below, looking for holes as evident by light.	N/A No Secondary Seal
C.2.9.3. d	Inspect fabric for deterioration and stiffness.	N/A Wiper
C.2.9.3. e	Inspect for mechanical damage, corrosion, and wear on tip in contact with shell	N/A No Secondary Seal
C.2.9.3. f	Inspect for contact with obstructions above top of shell.	N/A No Secondary Seal

2.10 FLOATING ROOF APPURTENANCES

ROOF MANWAYS		
C.2.10.1. a	Inspect walls of manways for pitting and thinning.	No Floating Roof
C.2.10.1. b	On tanks with interface autogauges, check seal around gauge tape cable and guide wires through manway cover.	No Floating Roof
C.2.10.1. c	Inspect cover gasket and bolts.	No Floating Roof
RIM VENT		
C.2.10.2. a	Check rim vent for pitting and holes	No Floating Roof
C.2.10.2. b	Check vent for condition of screen.	No Floating Roof
C.2.10.2. c	On floating roof tanks where the environmental rules require closing off the vent, check the vent pipe for corrosion at the pipe-to-rim joint and check that the blinding is adequate.	No Floating Roof
VACUUM BREAKER, BREATHER TYPE		
C.2.10.3. a	Service and check operation of breather valve.	No Floating Roof
C.2.10.3. b	Check that nozzle pipe projects no more than 1/2 inch below roof deck	No Floating Roof

VACUUM BREAKER, MECHANICAL TYPE		
C.2.10.4. a	Inspect the stem for thinning. Measure how far the vacuum breaker cover riser is off the pipe when the roof is resting on high or low legs.	No Floating Roof
ROOF DRAINS: OPEN SYSTEMS, INCLUDING EMERGENCY DRAINS		
C.2.10.5. a	Check liquid level inside open roof drains for adequate freeboard. Report if there is insufficient distance between liquid level and top of drain.	No Floating Roof
C.2.10.5. b	If tank comes under Air Quality Monitoring District rules, inspect the roof drain vapor plug	No Floating Roof
C.2.10.5. c	If emergency drain is not at the center of the roof, check that there are at least three emergency drains.	No Floating Roof
CLOSED DRAIN SYSTEMS: DRAIN BASINS		
C.2.10.6. a	Inspect for thinning and pitting	No Floating Roof
C.2.10.6. b	Inspect protective coating (topside).	No Floating Roof
C.2.10.6. c	Inspect basin cover or screen for corrosion.	No Floating Roof
C.2.10.6. d	Test operation of check valve.	No Floating Roof
C.2.10.6. e	Check for presence of check valve where bottom of basin is below product level.	No Floating Roof
C.2.10.6. f	Inspect drain basin(s) to roof deck welds for cracking.	No Floating Roof
C.2.10.6. g	Check drain basin(s) outlet pipe for adequate reinforcement to roof deck (including reinforcing pad).	No Floating Roof
CLOSED DRAIN SYSTEMS: FIXED DRAIN LINE ON TANK BOTTOM		
C.2.10.7. a	Hammer test fixed drain line on tank bottom for thinning and scale/debris plugging.	No Floating Roof
C.2.10.7. b	Inspect supports and reinforcing pads for weld failures and corrosion.	No Floating Roof
C.2.10.7. c	Check that pipe is guided, not rigidly locked to support, to avoid tearing of tank bottom plate.	No Floating Roof
CLOSED DRAIN SYSTEMS: FLEXIBLE PIPE DRAIN		
C.2.10.8. a	Inspect for damage to exterior of pipe	No Floating Roof
C.2.10.8. b	Check for obstructions that pipe could catch on.	No Floating Roof
C.2.10.8. c	Inspect shields to protect pipe from snagging.	No Floating Roof
C.2.10.8. d	Inspect results of hydro-test on flexible roof drain system.	No Floating Roof
CLOSED DRAIN SYSTEMS: ARTICULATED JOINT DRAIN		
C.2.10.9. a	Hammer test rigid pipe inflexible joint systems for thinning and scale/debris plugging.	No Floating Roof
C.2.10.9. b	Inspect system for signs of bending or strain.	No Floating Roof
C.2.10.9. c	Inspect results of system hydro test.	No Floating Roof
C.2.10.9. d	Inspect landing leg and pad.	No Floating Roof
AUTOGAUGE SYSTEM AND ALARMS		
C.2.10.10. a	Check freedom of movement of tape through autogauge tape guide	No Floating Roof
C.2.10.10. b	Inspect sheaves for freedom of movement.	No Floating Roof
C.2.10.10. c	Test operation checker.	No Floating Roof
C.2.10.10. d	Inspect tape and tape cable for twisting and fraying.	No Floating Roof

C.2.10.10. e	Test the tape's freedom of movement through guide sheaves and tape guide pipe.	No Floating Roof
C.2.10.10. f	On open-top tanks, check that gate tapes with cables have no more than one foot of tape exposed with float at lowest point.	No Floating Roof
C.2.10.10. g	Check float for leakage.	No Floating Roof
C.2.10.10. h	Test float guide wire anchors for spring action by pulling on wire and releasing	No Floating Roof
C.2.10.10. i	Inspect float wells in floating roofs for thinning and pitting of walls just above the liquid level.	No Floating Roof
C.2.10.10. j	Check that the autogauge tape is firmly attached to the float.	No Floating Roof
C.2.10.10. k	Inspect the tape cable and float guide wire fabric seals through the float well cover.	No Floating Roof
C.2.10.10. l	Inspect the bottom guide wire attachment clip: inspect for a temporary weighted bar instead of a permanent welded down clip.	No Floating Roof
C.2.10.10. m	Inspect board-type autogauge indicators for legibility and freedom of movement of indicator.	No Floating Roof
C.2.10.10. n	Measure and record these distances to determine if seal damage will occur if tank is run over from: 1. Shell top angle to underside of tape guide system. 2.Liquid level on floating top to top of secondary seal.	No Floating Roof
C.2.10.10. o	Identify floating roots where the tape is connected directly to the roof.	No Floating Roof
C.2.10.10. p	Overfill alarm: Inspect tank overfill prevention alarm switches for proper operation.	No Floating Roof

2.11 COMMON TANK APPURTENANCES

GAUGE WELL

C.2.11.1. a	Inspect gauge well pipe for thinning at about two-thirds distance above the bottom: look for thinning at the edge of the slots.	N/A No Gauge Well
C.2.11.1. b	Check for corrosion on the pipe joint. Check that sample cords, weights, thermometers, etc., have been removed from the pipe.	N/A No Gauge Well
C.2.11.1. c	Check for cone at bottom end of pipe about one foot above the bottom.	N/A No Gauge Well
C.2.11.1. d	Check condition of well washer pipe and that its flared end is directed at the near side of the hold off pad.	N/A No Gauge Well
C.2.11.1. e	Check that supports for gauge well are welded to pad or to shell and not directly to bottom plate,	N/A No Gauge Well
C.2.11.1. f	Check operation of gauge well cover.	N/A No Gauge Well
C.2.11.1. g	Check presence of a hold-off distance marker in well pipe and record hold-off distance.	N/A No Gauge Well
C.2.11.1. h	Identify and report size and pipe schedule, and whether pipe is solid or slotted. Report slot size.	N/A No Gauge Well
C.2.11.1. i	Check that the hold-off distance plate is seal welded to the bottom and that any gauge well supports are welded to the plate and not directly to the bottom.	N/A No Gauge Well
C.2.11.1. j	Inspect vapor control float and cable.	N/A No Gauge Well
C.2.11.1. k	Check for presence and condition of gauge well washer.	N/A No Gauge Well

C.2.11.1. l	Check for bull plug or plate blind on gauge well washer valve.	N/A No Gauge Well
C.2.11.1. m	Inspect gauge well guide in floating roof for pitting and thinning.	N/A No Gauge Well
C.2.11.1. n	Inspect the guide rollers and sliding plates for freedom of movement.	N/A No Gauge Well
C.2.11.1. o	Inspect condition of gauge well pipe seal system.	N/A No Gauge Well
C.2.11.1. p	On black oil and diesel services: if gauge well is also used for sampling, check for presence of a thief- and gauge-type hatch to avoid spillage.	N/A No Gauge Well
C.2.11.1. q	Visually inspect inside of pipe for pipe weld protrusions which could catch or damage vapor control float.	N/A No Gauge Well
SAMPLING SYSTEMS: ROOF SAMPLE HATCHES		
C.2.11.2. a	Inspect roof mounted sample hatches for reinforcing pads and cracking.	N/A
C.2.11.2. b	Inspect cover for operation.	N/A
C.2.11.2. c	For tanks complying with Air Quality Monitoring District rules, inspect sample hatch covers for adequate sealing	N/A
C.2.11.2. d	Check horizontal alignment of internal floating roof sample hatches under fixed roof hatches.	No Floating Roof
C.2.11.2. e	Inspect the sealing system on the internal floating roof sample hatch cover.	No Floating Roof
C.2.11.2. f	Inspect floating roof sample hatch cover recoil reel and rope.	No Floating Roof
SHELL NOZZLES		
C.2.11.3. a	Inspect shell nozzles for thinning and pitting.	See Report
C.2.11.3. b	Inspect hot tap nozzles for trimming of holes.	NA
C.2.11.3. c	Identify type of shell nozzles.	See Report
C.2.11.3. d	Identify and describe internal piping, including elbow up and elbow down types.	Good
NOZZLES EXTENDED INTO THE TANK		
C.2.11.4. a	Inspect pipe support pads welded to tank bottom.	None
C.2.11.4. b	Inspect to see that pipe is free to move along support without strain or tearing action on bottom plate.	NA
C.2.11.4. c	Inspect nozzle valves for packing leaks and damaged flange faces.	NA
C.2.11.4. d	Inspect heater stream nozzle flanges and valves for wire cutting.	NA
C.2.11.4. e	Report which nozzles have thermal pressure relief bosses and valves.	None
C.2.11.4. f	In internal elbow-down fill line nozzles, inspect the wear plate on the tank bottom.	NA
C.2.11.4. g	On elbow-up fill lines in floating roof tanks, check that opening is directed against underside of roof, not against vapor space. Inspect impact are for erosion.	NA
DIFFUSERS AND AIR ROLLING SYSTEMS		
C.2.11.5. a	Inspect diffuser pipe for erosion and thinning.	N/A No Diffuser
C.2.11.5. b	Check holes in diffuser for excessive wear and enlargement.	N/A No Diffuser
C.2.11.5. c	Inspect diffuser supports for damage and corrosion.	N/A No Diffuser

C.2.11.5. d	Check that diffuser supports restrain, not anchor, longitudinal line movement.	N/A No Diffuser
C.2.11.5. e	Inspect air spiders on bottom of lube oil tanks for plugging and damaged or broken threaded joints	N/A No Diffuser
SWING LINES		
C.2.11.6. a	Inspect flexible joint for cracks and leaks.	No Swing Line Present
C.2.11.6. b	Scribe the flexible joint across the two moving faces and raise end of swing line to check the joint's freedom of movement, indicated by separation of scribe marks.	No Swing Line Present
C.2.11.6. c	Check that flexible joints over six inches are supported.	No Swing Line Present
C.2.11.6. d	Inspect the swing pipe for deep pitting and weld corrosion.	No Swing Line Present
C.2.11.6. e	Loosen the vent plugs in the pontoons and listen for a vacuum. Lack of a vacuum indicates a leaking pontoon.	No Swing Line Present
C.2.11.6. f	Check the results of air test on pontoons during repairs.	No Swing Line Present
C.2.11.6. g	Inspect the pontoons for pitting.	No Swing Line Present
C.2.11.6. h	Inspect the pull-down cable connections to the swing	No Swing Line Present
C.2.11.6. i	Inspect the condition of the bottom-mounted support, fixed roof limiting bumper, or shell mounted limiting bumper for wood condition, weld and bolt corrosion, and seal welding to bottom or shell.	No Swing Line Present
C.2.11.6. j	Inspect safety hold-down chain for corrosion and weak links.	No Swing Line Present
C.2.11.6. k	Check that there is a welded reinforcing pad where the chain connects to the bottom.	No Swing Line Present
C.2.11.6. l	If the floating swing in a floating or internal floating roof tank does not have a limiting device preventing the swing from exceeding 60 degrees, measure and calculate the maximum angle possible with the roof on overflow. Max. angle on overflow (If the c	No Swing Line Present
C.2.11.6. m	Inspect pull down cable for fraying.	No Swing Line Present
C.2.11.6. n	Inspect for three cable clamps where cable attaches to end of swing line (single reeved) or to roof assembly (double-reeved). Inspect sheaves for freedom of movement.	No Swing Line Present
C.2.11.6. o	Inspect winch operation and check the height indicator for legibility and accuracy.	No Swing Line Present
C.2.11.6. p	Inspect bottom-mounted sheave assembly at end of pontoon for freedom of rotation of sheave.	No Swing Line Present
C.2.11.6. q	Inspect shell-mounted lower sheave assembly for freedom of rotation of sheave, corrosion thinning, and pitting of sheave housing.	No Swing Line Present
C.2.11.6. r	Inspect upper sheave assembly for freedom of movement of sheave.	No Swing Line Present
C.2.11.6. s	Inspect the cable counterbalance assembly for corrosion and freedom of operation.	No Swing Line Present
MANWAY HEATER RACKS		

C.2.11.7. a	Inspect the manway heater racks for broken welds and bending of the sliding rails.	No Floating Roof
C.2.11.7. b	Measure and record the length of the heater and length of the track.	No Floating Roof
MIXER WEAR PLATES AND DEFLECTOR STANDS		
C.2.11.8. a	Inspect bottom and shell plates and deflector stands.	N/A No Mixer
C.2.11.8. b	Inspect for erosion and corrosion on the wear plates. Inspect for rigidity, structural soundness, corrosion, and erosion of deck plates and reinforcing pads that are seal welded to the bottom under the deflector stand legs.	N/A No Mixer
C.2.11.8. c	Measure for propeller clearance between the bottom of deflector stand and roof when the roof is on low legs.	N/A No Mixer

SIGNIFICANT PHOTOS

Photo A
Typical Failed Coating on Bottom Welds

Photo B
Slight Bow in Roof Rafters

Photo C
Typical Vertical Weld Pitting

Photo D
Typical Shell Plate Pitting

Photo E
No Wear Plate Present

Photo F
General Thinning of Crow's Foot

Photo G
Typical Cathodic Protection Disconnection

Photo H
Pitting on Manway Neck

Photo I
Corroded Internal Ladder

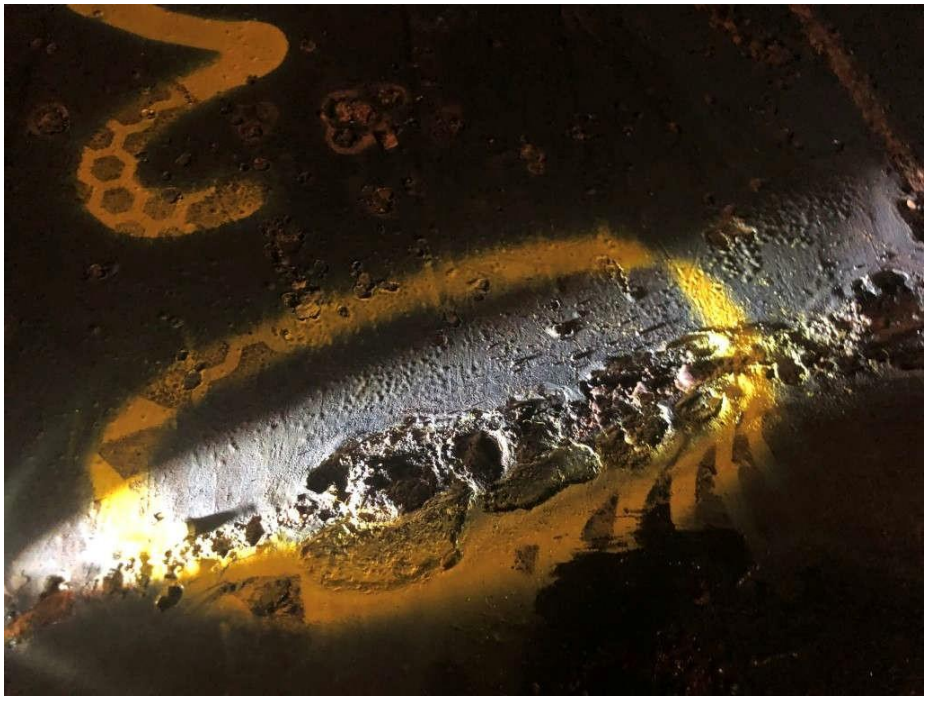


Photo J
Bottom Butt-Weld Corrosion

Photo J2
Under Bottom Suction Weld Corrosion

Photo K
Center Column Pitting

Photo L
No Fall Restrain System on Vertical Ladder

Photo M
Level Float Disconnected

Photo N
Missing Anchor Bolt

GENERAL PHOTOS

ALL




ACCESS STRUCTURE



Corroded Internal Ladder



No Fall Restrain System on Vertical Ladder

APPURTENANCES



Pitting on Manway Neck

Under Bottom Suction Weld Corrosion














Level Float Disconnected

BOTTOM



Typical Failed Coating on Bottom Welds

Typical Cathodic Protection Disconnection

Bottom Butt-Weld Corrosion




CORNER WELD







FOUNDATION

Missing Anchor Bolt

GENERAL

PIPING







ROOF



Slight Bow in Roof Rafters



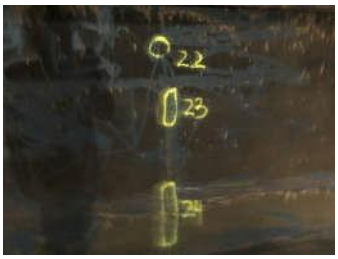

No Wear Plate Present

General Thinning of Crow's Foot

Center Column Pitting



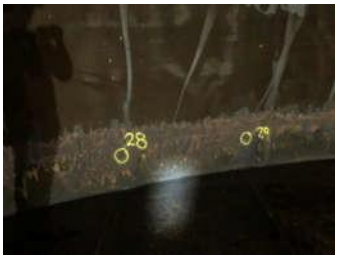
SHELL







Typical Vertical Weld Pitting




Typical Shell Plate Pitting















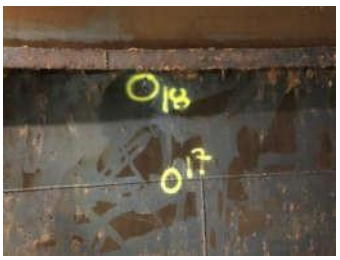



















Appendix C

NDE or UT Report

Report Prepared For
PROJECT MANAGEMENT OFFICE

YAP STATE PUBLIC SERVICE CORPORATION

YAP STATE, FEDERATED STATES OF MICRONESIA

WATER

Tank Number
2

NDE Conducted on
OCTOBER 2, 2019

Appendix C

Shell Thickness UT Table 3
Bottom Thickness UT Table 4
Roof Thickness UT Table 5
Nozzle Thickness UT Table 6
Equipment Calibration 7

POWERS Engineering and Inspection, Inc. was contracted by Central Pacific Tank (CPT) to provide Non-Destructive Examination (NDE) services for Tank 2 at the Yap State Public Service Corporation in Colonia, Yap. The services include, Ultrasonic Testing (UT), Visual Examination.

The following equipment was utilized:

- Panametrics DL-36 Plus Thickness Gauge *sn:992097204*
- Panametrics DL-36 Plus Thickness Gauge *sn:992157166*
- Panametrics EPOCH III *sn:94085612*
- Standard UT couplant suitable for temp to 300 deg F.
- UT thickness probe Panametrics D790 5Mhz *sn:602600*
- UT thickness probe Panametrics D790 5Mhz *sn:603918*
- UT thickness probe FH2E-WR *sn:00W6XP*
- Calibration Block Panametrics 2214E *sn:6182*
- B&W Gas Alert Max XT II Multi-Gas Detector with Pump

SHELL THICKNESS UT TABLE.

UT thickness readings of the butt-welded shell plate were conducted through the coatings utilizing the Panametrics DL-36 Thickness Gauge in 'echo to echo' mode to compensate for the sound path through the coatings. UT readings were performed along to circumference of the lower two courses in twelve vertical locations, see Shell Rollout drawing for location of upper course readings.

Shell Course	Location	Drop 1	2	3	4	Drop 5	6	7	8	Drop 9	10	11	12
2	Top	0.259	0.247	0.255	0.247	0.251	0.247	0.258	0.257	0.250	0.251	0.248	0.247
	Upper	0.251	0.247	0.248	0.247	0.249	0.248	0.249	0.248	0.247	0.247	0.248	0.250
	Lower	0.249	0.249	0.247	0.249	0.248	0.247	0.248	0.250	0.251	0.248	0.256	0.249
	Bottom	0.255	0.247	0.249	0.253	0.248	0.247	0.251	0.249	0.250	0.248	0.250	0.247
1	Top	0.261	0.248	0.251	0.255	0.261	0.257	0.248	0.247	0.247	0.250	0.254	0.252
	Upper	0.249	0.247	0.249	0.249	0.247	0.247	0.248	0.249	0.247	0.248	0.248	0.247
	Lower	0.248	0.247	0.248	0.248	0.248	0.248	0.247	0.248	0.247	0.248	0.247	0.249
	Bottom	0.257	0.253	0.255	0.249	0.248	0.249	0.254	0.247	0.248	0.247	0.247	0.249

Course 5 Shell UT Readings Top to Bottom				Course 4 Shell UT Readings Top to Bottom				Course 3 Shell UT Readings Top to Bottom			
Location				Location				Location			
Reading	Course	Distance (in)	UT (in)	Reading	Course	Distance (in)	UT (in)	Reading	Course	Distance (in)	UT (in)
1	5	59	0.248	1	4	59	0.247	1	3	59	0.248
2	5	53	0.256	2	4	53	0.249	2	3	53	0.248
3	5	47	0.256	3	4	47	0.247	3	3	47	0.249
4	5	41	0.247	4	4	41	0.259	4	3	41	0.247
5	5	35	0.253	5	4	35	0.249	5	3	35	0.251
6	5	29	0.250	6	4	29	0.255	6	3	29	0.247
7	5	23	0.247	7	4	23	0.248	7	3	23	0.252
8	5	17	0.250	8	4	17	0.249	8	3	17	0.251
9	5	11	0.249	9	4	11	0.248	9	3	11	0.249
10	5	5	0.261	10	4	5	0.247	10	3	5	0.255

Course 6 Shell UT Readings Top to Bottom			
Location			
Reading	Course	Distance (in)	UT (in)
1	6	44	0.247
2	6	38	0.249
3	6	32	0.248
4	6	26	0.254
5	6	20	0.251
6	6	14	0.248
7	6	8	0.248
8	6	2	0.259

BOTTOM THICKNESS UT TABLE

Systematic bottom UT measurements were difficult to obtain through the rough surface of the bottom coatings. UT readings were conducted in a formation of eight radial lines (see Bottom Layout) with 10 measurements recorded per radial line.

Bottom UT Thickness Readings (in)								
Reading	Radial Station							
	1	2	3	4	5	6	7	8
1	0.246	0.248	0.249	0.249	0.248	0.248	0.248	0.249
2	0.247	0.243	0.244	0.243	0.247	0.244	0.244	0.246
3	0.249	0.248	0.241	0.246	0.244	0.247	0.244	0.243
4	0.244	0.245	0.246	0.245	0.247	0.245	0.246	0.241
5	0.242	0.248	0.242	0.241	0.241	0.245	0.241	0.246
6	0.249	0.243	0.243	0.242	0.243	0.241	0.242	0.247
7	0.241	0.245	0.245	0.245	0.248	0.243	0.241	0.246
8	0.243	0.241	0.242	0.246	0.242	0.243	0.242	0.245
9	0.241	0.242	0.241	0.244	0.248	0.241	0.247	0.246
10	0.247	0.246	0.247	0.241	0.245	0.244	0.249	0.245

ROOF THICKNESS UT TABLE

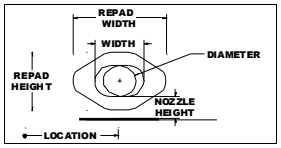
Random UT thickness readings of the 3/16-in nominal lap-welded cone roof plates were conducted utilizing the Panametrics DL-36 Thickness Gauge in 'echo to echo' mode to compensate for the sound path through the coatings. Due to limited safe access at the time of inspection UT reading were conducted from a manlift near the roof manway (see Cone Roof Layout).

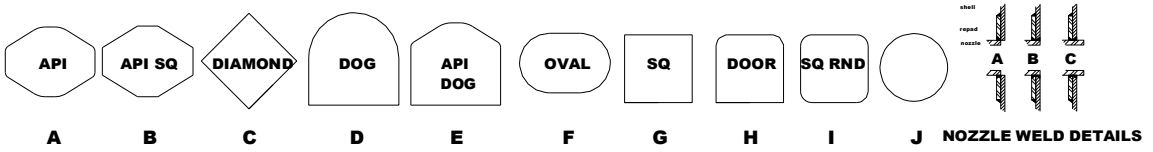
Roof UT Thickness Reading (in)					
Plate	**1**	**2**	**3**	**4**	**5**
25	0.185	0.176	0.186	0.181	0.185
26	0.181	0.180	0.179	0.180	0.180

NOZZLE THICKNESS UT TABLE

Tank Shell Nozzle & Appurtenances Table with Geometry API 650 and Weld Spacing Check API 653

Item	Description	Diameter (in)	Shell	Nozzle Height (in)		Nozzle Thickness (in)		Repad						Comments
			Course Thickness (in)	Bottom of Nozzle to Bottom	Nozzle Centerline to Bottom	Field UT Data top, bottom, left and right	Min, API 650, OK?	Shape	Width (in)	Height (in)	Repad Thickness (in)	Weld Detail nozzle neck to shell and repad	Does Repad meet requirements of API 650 5.7.2?	
A	**Manway**	**24**	**0.247**	**26**	**38.00** **>=** **29** ***Ok***	**0.732** **0.733** **0.741** **0.748**	**0.732** **>=** **0.1875** ***Ok***	**A**	**63** **>=** **60** **Ok**	**53** **>=** **49.5** **Ok**	**0.25** **>=** **0.247** **Ok**	**A**	**OK**	Ok
B	**Nozzle**	**8**	**0.247**	**20**	**24.00** **<** **13.75** **Ok**	**0.321** **0.322** **0.322** **0.323**	**0.321** **<** **0.5** **Not Ok**	**A**	**22** **<** **23.25** **Not Ok**	**18** **<** **19** **Not Ok**	**0.25** **>=** **0.247** **Ok**	**A**	**OK**	Some of the repad geometry or weld spacings is less than required. Because, these items have most likely been in service during a hydro test, or in low temp service, API 653 would consider the brittle fracture risk low and therefore, no action is req'd.
					ref API 650 tbl 5-6b						**API6505.7.2**			

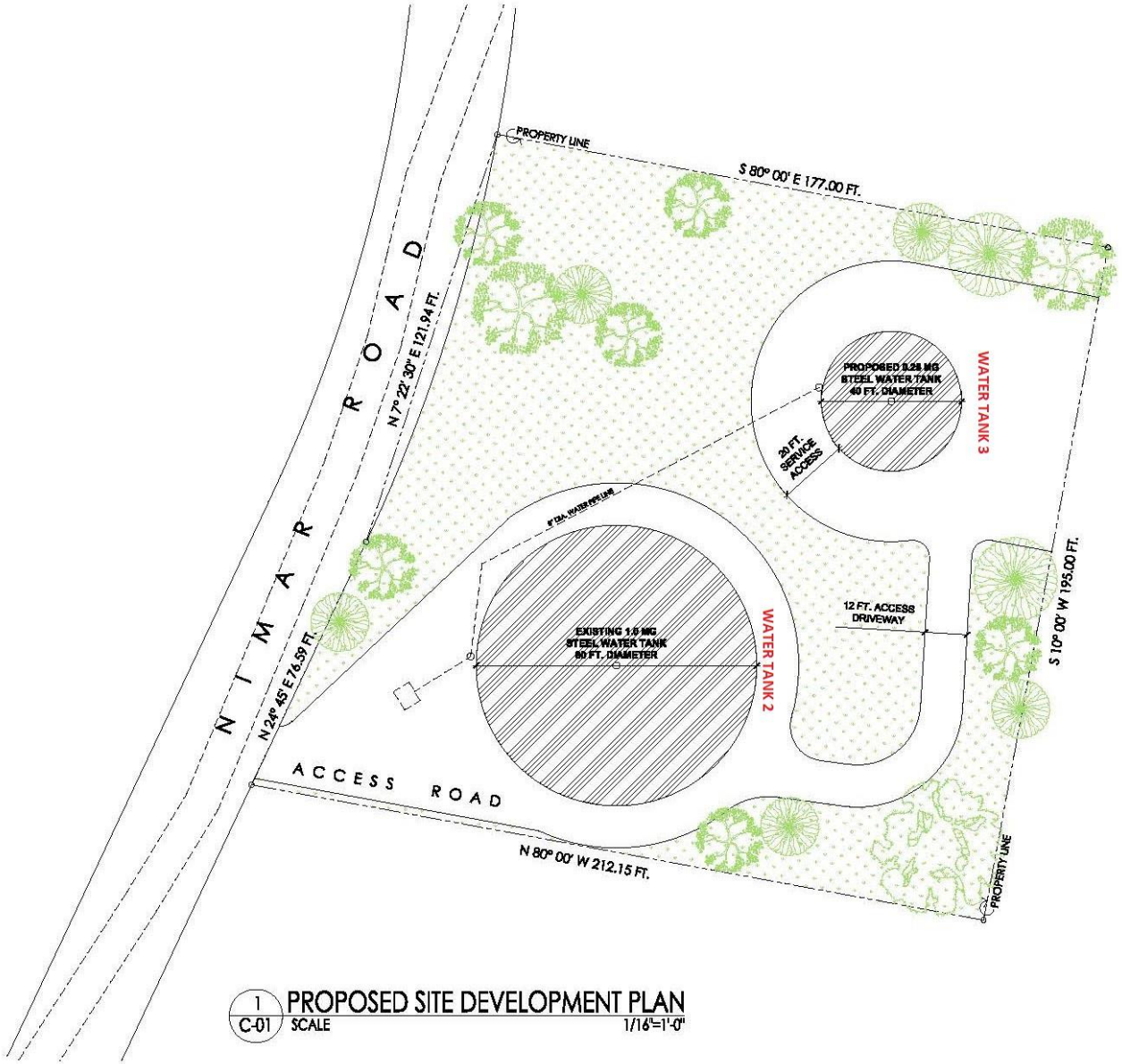




EQUIPMENT CALIBRATION

Date	Equipment	Calibration Tool	Calibrated By
October 2, 2019 (Daily Calibration)	Panametrics DL-36 Plus Thickness Gauge	Calibration using 5-step block (0.1, 0.2, 0.3, 0.4, 0.5-in) in accordance with ASTM E 797-05. Calibration performed in accordance with PEI NDE Manual.	DM
October 2, 2019 (Daily Calibration)	B&W Gas Alert Max XT II Multi-Gas Detector	Bump tested prior to each use. Calibration performed using CH4 Calibration Gas BW CG-Q34-4	DM

Appendix 4



1 C-01 PROPOSED SITE DEVELOPMENT PLAN
SCALE 1/16"=1'-0"

STATE OF YAP
PROJECT MANAGEMENT OFFICE

SAMUEL E. LUZAND
CERTIFICATE
No. 420
EXP. 04/30/20
CNMI
REGISTERED ARCHITECT

I HEREBY CERTIFY THAT THIS PLAN WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION

PROJECT NUMBER
2020-PMO-YSPSC-001

PROJECT TITLE
PROPOSED WATER TANK 3

STATE OF YAP
FEDERATED STATES OF MICRONESIA

SHEET CONTENTS
SITE PLAN

REV	DATE	DESCRIPTION	BY
0			

DRAWN BY:	RLV
DESIGNED BY:	RLV
CHECKED BY:	SL
DATE:	02/28/2020

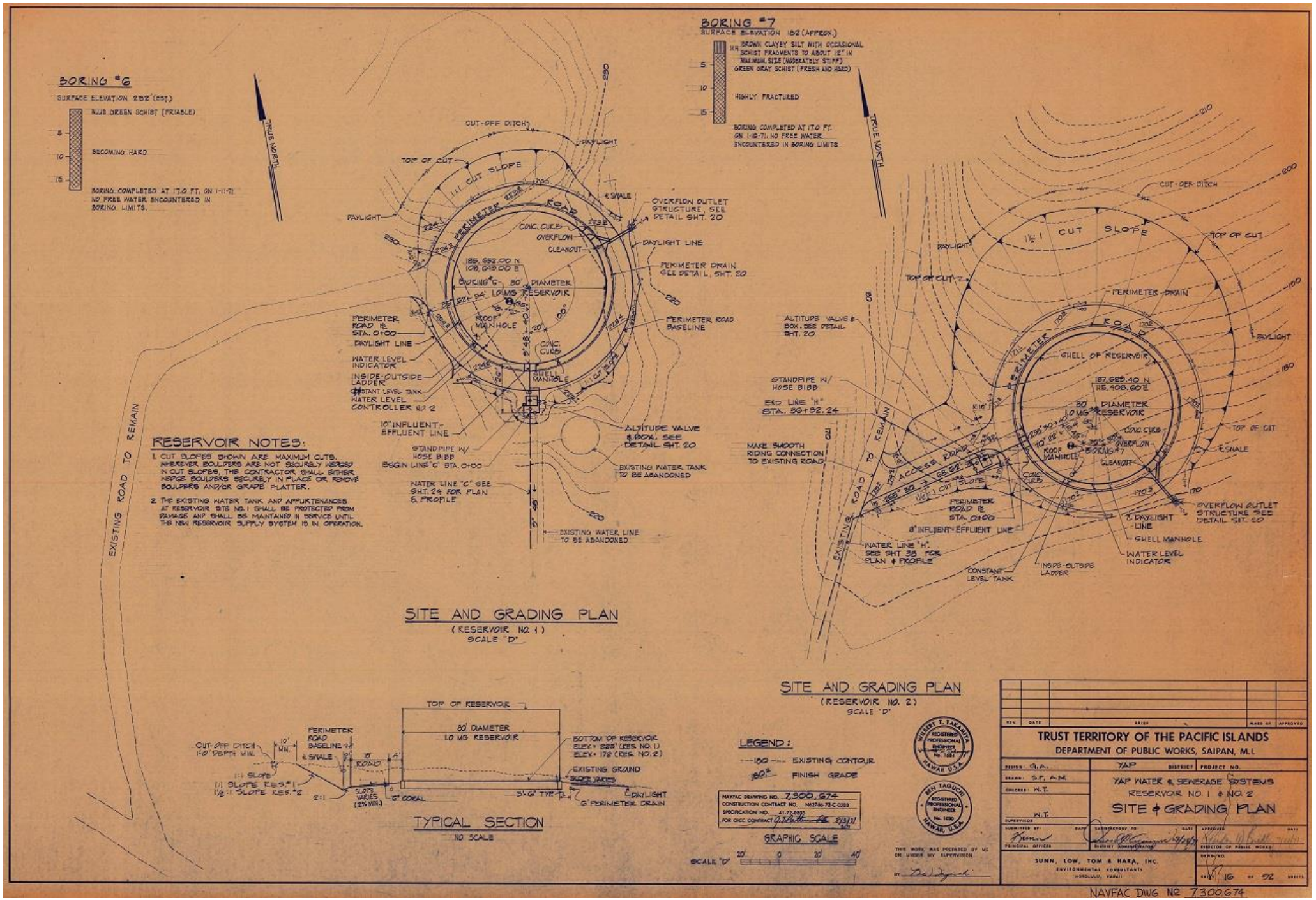
SHEET TITLE
CIVIL WORKS

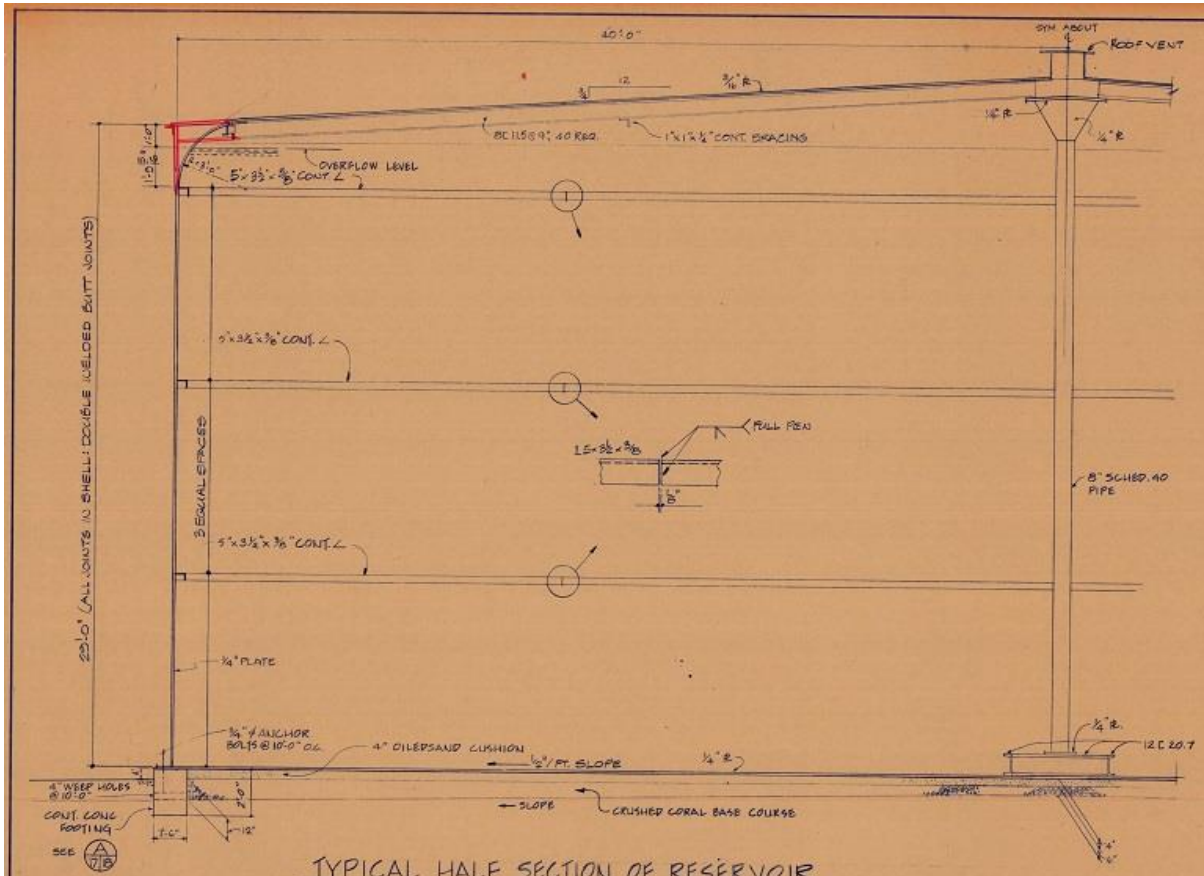
SHEET NUMBER
C-01

SHEET 01 OF 01

Tank 2 Site Photo *(Aerial View)*

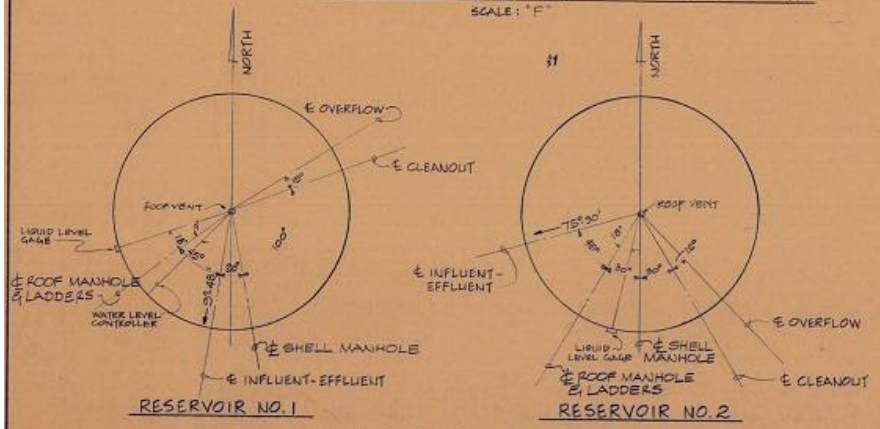
Appendix 5


BORING #6
SURFACE ELEVATION 232' (EST.)
BLUE GREEN SCHIST (FRIABLE)
BECOMING HARD
BORING COMPLETED AT 17.0 FT. ON 1-11-71. NO FREE WATER ENCOUNTERED IN BORING LIMITS.
BORING #7
SURFACE ELEVATION 182 (APPROX.)
BROWN CLAYEY SILT WITH OCCASIONAL SCHIST FRAGMENTS TO ABOUT 12" IN MAXIMUM SIZE (MODERATELY STIFF)
GREEN GRAY SCHIST (FRESH AND HARD)
HIGHLY FRACTURED
BORING COMPLETED AT 17.0 FT. ON 1-12-71. NO FREE WATER ENCOUNTERED IN BORING LIMITS
TRUE NORTH
CUT-OFF DITCH
DAYLIGHT
TOP OF CUT
1:1 CUT SLOPE
PERIMETER ROAD
SWALE
OVERFLOW OUTLET STRUCTURE, SEE DETAIL SHT. 20
CONC. CURB
OVERFLOW
CLEANOUT
DAYLIGHT LINE
185,652.00 N
108,649.00 E
BORING "G"
80' DIAMETER 1.0 MG RESERVOIR
PERIMETER DRAIN SEE DETAIL, SHT. 20
PERIMETER ROAD BASELINE
PERIMETER ROAD @ STA. 0+00
ROOF MANHOLE
SHELL MANHOLE
WATER LEVEL INDICATOR
INSIDE-OUTSIDE LADDER
CONSTANT LEVEL TANK WATER LEVEL CONTROLLER NO 2
10" INFLUENT-EFFLUENT LINE
STANDPIPE W/ HOSE BIBB
BEGIN LINE "G" STA. 0+00
ALTITUDE VALVE & BOX, SEE DETAIL SHT. 20
EXISTING WATER TANK TO BE ABANDONED
WATER LINE "G" SEE SHT. 24 FOR PLAN & PROFILE
EXISTING WATER LINE TO BE ABANDONED
EXISTING ROAD TO REMAIN
RESERVOIR NOTES:
1. CUT SLOPES SHOWN ARE MAXIMUM CUTS. WHEREVER BOULDERS ARE NOT SECURELY KEYED IN CUT SLOPES, THE CONTRACTOR SHALL EITHER KEYDE BOULDERS SECURELY IN PLACE OR REMOVE BOULDERS AND/OR GRADE FLATTER.
2. THE EXISTING WATER TANK AND APPURTENANCES AT RESERVOIR SITE NO. 1 SHALL BE PROTECTED FROM DAMAGE AND SHALL BE MAINTAINED IN SERVICE UNTIL THE NEW RESERVOIR SUPPLY SYSTEM IS IN OPERATION.
SITE AND GRADING PLAN
(RESERVOIR NO. 1)
SCALE "D"
CUT-OFF DITCH
TOP OF CUT
1½:1 CUT SLOPE
PERIMETER ROAD
SWALE
PERIMETER DRAIN
SHELL OF RESERVOIR
187,669.40 N
115,908.60 E
80' DIAMETER 1.0 MG RESERVOIR
ROOF MANHOLE
OVERFLOW
CLEANOUT
CONC. CURB
ACCESS ROAD
ALTITUDE VALVE & BOX, SEE DETAIL SHT. 20
STANDPIPE W/ HOSE BIBB
END LINE "H" STA. 30+92.24
MAKE SMOOTH RIDING CONNECTION TO EXISTING ROAD
EXISTING ROAD TO REMAIN
PERIMETER ROAD @ STA. 0+00
8" INFLUENT-EFFLUENT LINE
WATER LINE "H" SEE SHT 38 FOR PLAN & PROFILE
CONSTANT LEVEL TANK
INSIDE-OUTSIDE LADDER
WATER LEVEL INDICATOR
DAYLIGHT LINE
SHELL MANHOLE
OVERFLOW OUTLET STRUCTURE SEE DETAIL SHT. 20
SITE AND GRADING PLAN
(RESERVOIR NO. 2)
SCALE "D"
TOP OF RESERVOIR
80' DIAMETER 1.0 MG RESERVOIR
CUT-OFF DITCH 1:0" DEPTH MIN.
PERIMETER ROAD BASELINE
SWALE
1:1 SLOPE
1½:1 SLOPE RES. #1
2:1 SLOPE RES. #2
SLOPE VARIES (2% MIN.)
6" CORAL
BOTTOM OF RESERVOIR ELEV. = 225' (RES. NO. 1) ELEV. = 172 (RES. NO. 2)
EXISTING GROUND
SLOPE VARIES
DAYLIGHT
6" PERIMETER DRAIN
TYPICAL SECTION
NO SCALE
LEGEND:
EXISTING CONTOUR
FINISH GRADE
NAVFAC DRAWING NO. 7,300,674
CONSTRUCTION CONTRACT NO. N43786-73-C-0203
SPECIFICATION NO. 41-72-0003
FOR OICC CONTRACT
GRAPHIC SCALE
SCALE "D" 20' 0 20' 40'
THIS WORK WAS PREPARED BY ME OR UNDER MY SUPERVISION
TRUST TERRITORY OF THE PACIFIC ISLANDS
DEPARTMENT OF PUBLIC WORKS, SAIPAN, M.I.
DESIGN: G.A.
DRAWN: S.F., A.M.
CHECKED: M.T.
SUPERVISED: M.T.
YAP DISTRICT
PROJECT NO.
YAP WATER & SEWERAGE SYSTEMS
RESERVOIR NO. 1 & NO. 2
SITE & GRADING PLAN
SUBMITTED BY: PRINCIPAL OFFICER
SATISFACTORY TO: DISTRICT ADMINISTRATOR
APPROVED: DIRECTOR OF PUBLIC WORKS
SUNN, LOW, TOM & HARA, INC.
ENVIRONMENTAL CONSULTANTS
HONOLULU, HAWAII
DRAWING NO.
SHEET 16 OF 52 SHEETS
NAVFAC DWG NO 7300674



TYPICAL HALF SECTION OF RESERVOIR

SCALE: "F"



LAYOUT PLANS

SCALE: "D"

GENERAL NOTES ON STEEL RESERVOIRS

1. LOADS:
   A. ROOF LIVE LOAD: 20 PSF
   B. DESIGN WIND VELOCITY: 125 MPH
   C. DESIGN EARTHQUAKE INTENSITY: ZONE II
2. DESIGN CODE: AWWA D100-67, APPENDIX C.
3. MAXIMUM SOIL PRESSURE: 2000 PSF
4. MATERIALS:
   A. CONC: f'_c = 2,500 PSI
   B. REINFORCING STEEL: INTERMEDIATE GRADE: f_y = 40,000 PSI
   C. STRUCTURAL STEEL INCLUDING BARS, PLATES & ROLLED SECTIONS: ASTM A-242
   D. PIPE RAILING: ASTM A-120
   E. STEEL WATER PIPE & PIPE COLUMNS: ASTM A53-B
   F. STEEL FLANGES: ASTM A-181-I
   G. C.I. ELBOWS: CLASS 125 FLANGED
   H. C.I. PIPE: CLASS 150
   I. BOLTS: ASTM A-307
5. SEE SHEET 5B FOR GENERAL STRUCTURAL NOTES.

NOTE:
SEE APPROVED SUBMITAL FOR STEEL RESERVOIR

NAVFAC DRAWING NO. 7300,675
CONSTRUCTION CONTRACT NO. 96378-72-C-0203
SPECIFICATION NO. 41-72-0203
FOR OICC CONTRACT

GRAPHIC SCALES
SCALE "F" 1' 0 1' 3' 5' 7'
SCALE "D" 20' 0 20' 40'

THIS WORK WAS PREPARED BY ME OR UNDER MY SUPERVISION.

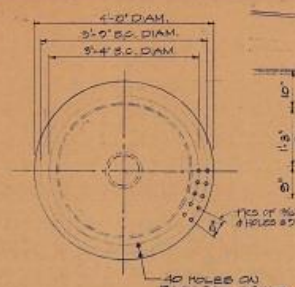
TRUST TERRITORY OF THE PACIFIC ISLANDS
DEPARTMENT OF PUBLIC WORKS, SAIPAN, M.I.

DESIGN: FTT	YAP DISTRICT	PROJECT NO.	
DRAWN: C	YAP WATER & SEWERAGE SYSTEMS		
CHECKED: FTT	RESERVOIR NO. 1 & NO. 2		
SUPERVISION	TYPICAL HALF SECTION		
SUBMITTED BY: PRINCIPAL ENGINEER	DATE	RECOMMENDED TO: DISTRICT ADMINISTRATOR	DATE 7/5/72
APPROVED	DATE	DIRECTOR OF PUBLIC WORKS	

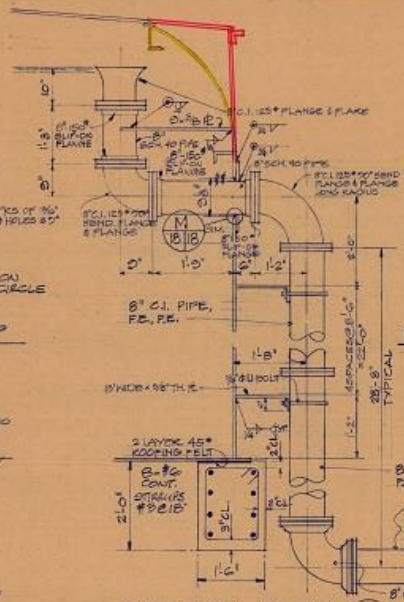
SUNN, LOW, TOM & NARA, INC.
ENVIRONMENTAL CONSULTANTS
HONOLULU, HAWAII

DWG. NO.
SHEET 17 OF 52 SHEETS

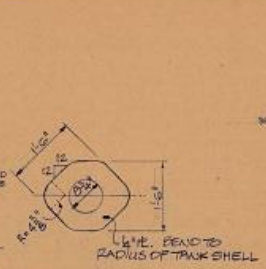
NAVFAC DWG NO 7300,675



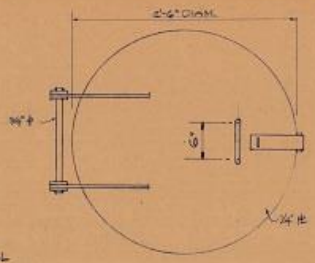
PLAN OF COLUMN CAP
SCALE: H



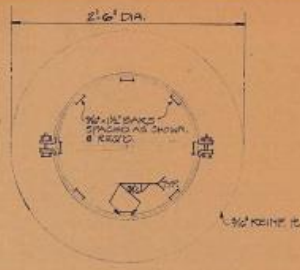
OVERFLOW DETAIL (A 17/8)
SCALE: H



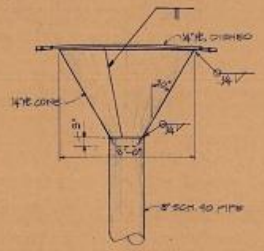
KEINF. PLATE DET (B 18/8)
SCALE: H

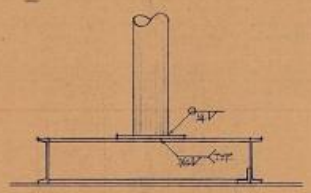


PLAN OF ROOF MANHOLE (G 18/8)
SCALE: K

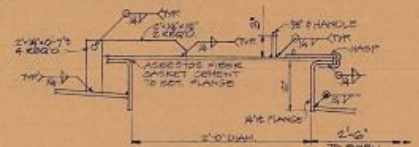


PLAN OF ROOF VENT (J 18/8)
SCALE: K

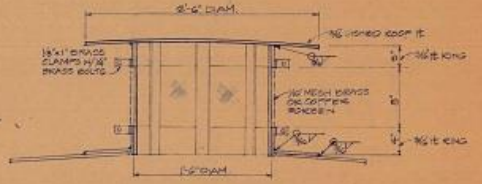




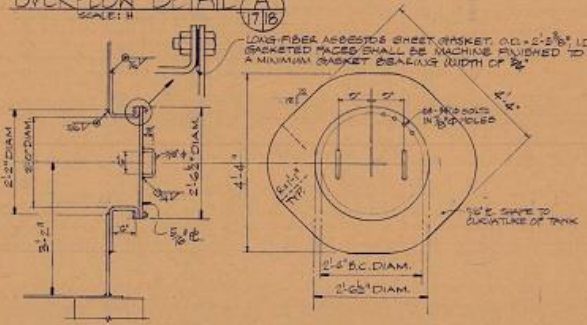
ELEVATION OF COLUMN
SCALE: H



SECTION (H 18/8)
SCALE: K

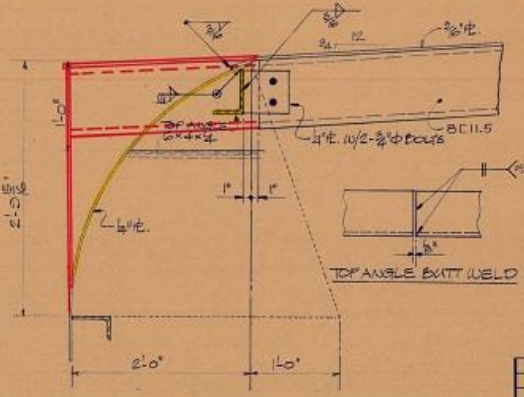


SECTION (K 18/8)
SCALE: K



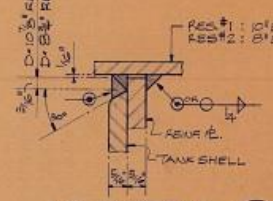
SHELL MANHOLE DET. (C 18/8)
SCALE: H

KEINF. PLATE DET (D 18/8)
SCALE: H

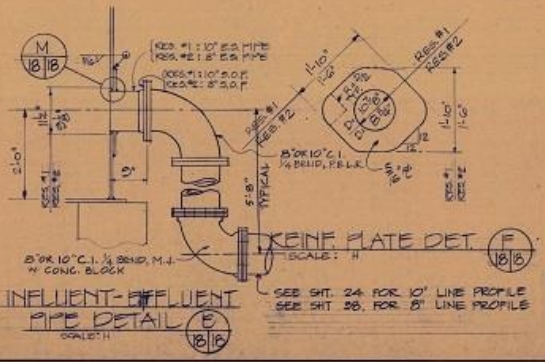


PLAN OF COLUMN BASE
SCALE: H

DETAIL OF KNUCKLE (L 18/8)
SCALE: K



WELD DETAIL (M 18/8)
FULL SCALE



INFLUENT-EFFLUENT PIPE DETAIL (E 18/8)
SCALE: H

KEINF. PLATE DET. (F 18/8)
SCALE: H

NAVFAC DRAWING NO. Z-300,676
CONSTRUCTION CONTRACT NO. N62760-72-C-0333
SPECIFICATION NO. 41-72(877)
FOR OICC CONTRACT 9/7/71 DATE

GRAPHIC SCALES

SCALE "H" 1' 0 1' 2' 3'

SCALE "K" 1' 0 1'

THIS WORK WAS PREPARED BY ME OR UNDER MY SUPERVISION.

TRUST TERRITORY OF THE PACIFIC ISLANDS
DEPARTMENT OF PUBLIC WORKS, SAIPAN, M.I.

DESIGN: PTT | YAP DISTRICT | PROJECT NO.
DRAWN: IC
CHECKED: PTT
SUPERVISOR

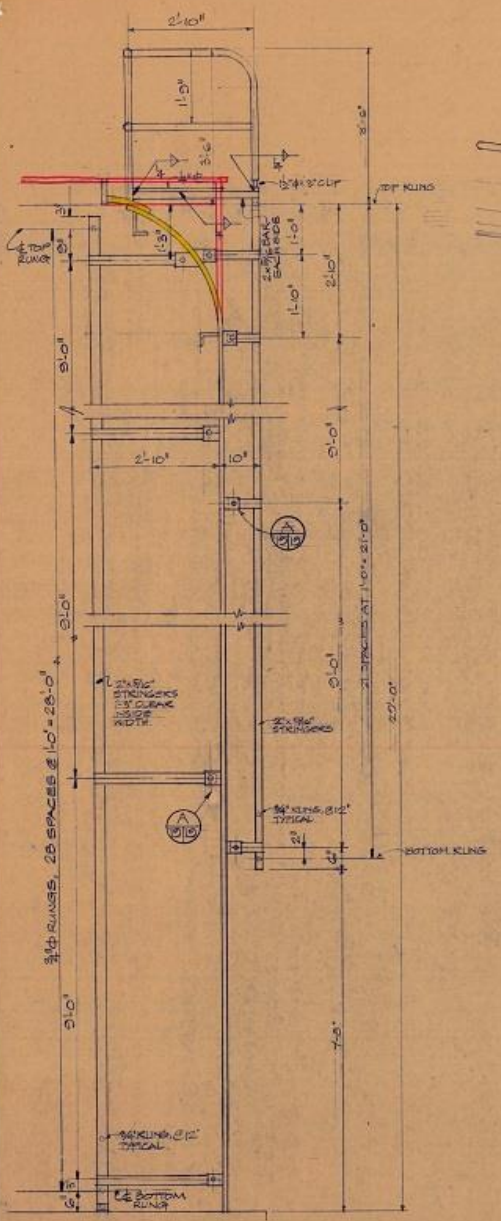
YAP WATER & SEWERAGE SYSTEMS
RESERVOIR NO. 1 & NO. 2
DETAILS

SUBMITTED BY: PRINCIPAL OFFICER
SATISFACTORY TO: DISTRICT ADMINISTRATOR
APPROVED: DIRECTOR OF PUBLIC WORKS

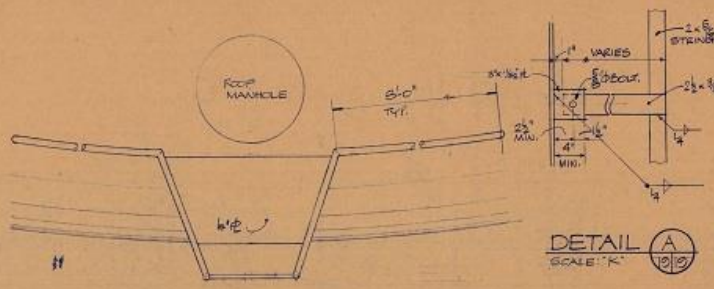
SUNN, LOW, TOM & HARA, INC.
ENVIRONMENTAL CONSULTANTS
HONOLULU, HAWAII

DRWG. NO.
SHEET 18 OF 92 SHEETS

NAVFAC DWG NO Z300676

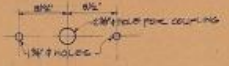


INTERIOR & EXTERIOR LADDER DET. B 10/19
SCALE: H

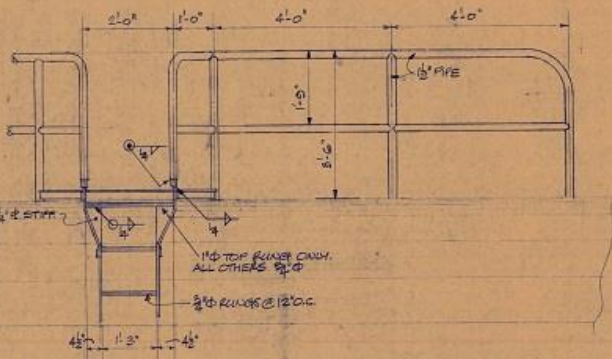


PLAN OF EXTERIOR LADDER
SCALE: "H"

DETAIL A 10/19
SCALE: "K"

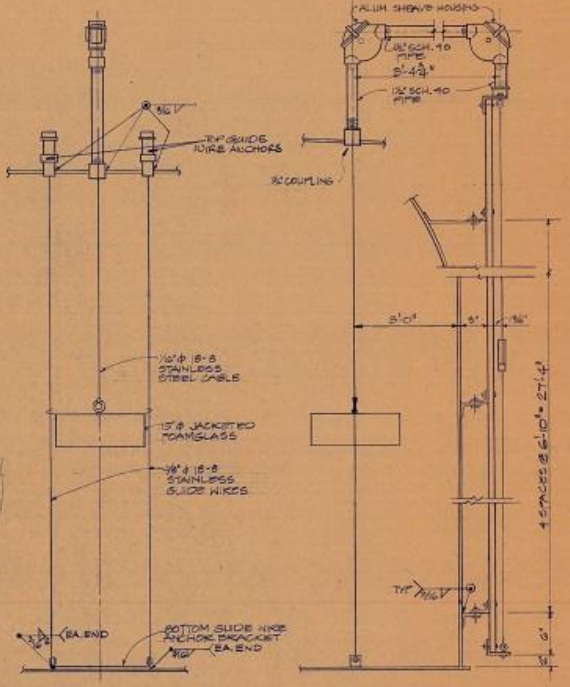


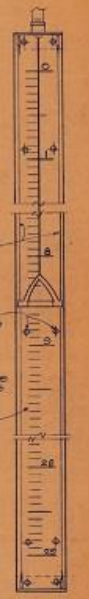
PLAN OF HOLES IN TANK ROOF



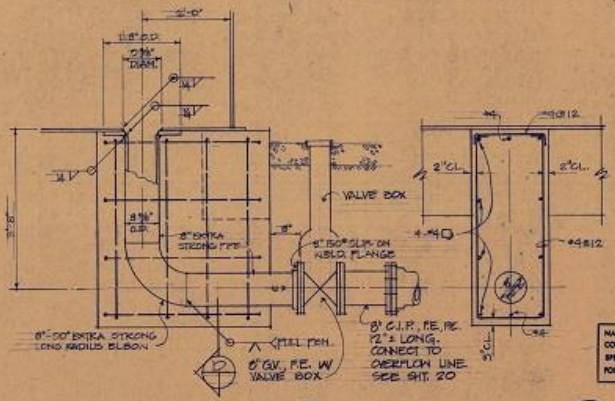
ELEVATION OF LADDER
SCALE: "H"

PARTIAL ELEVATION OF RAILING
SCALE: "H"





LIQUID LEVEL GAGE DETAIL F 10/19
NO SCALE



CLEANOUT DETAIL C 10/19
SCALE: "H"

SECTION D 10/19
SCALE: "H"

GRAPHIC SCALES

SCALE "H" 1' 0 1' 2' 3'

SCALE "K" 1' 0 1'

NAVFAC DRAWING NO. 7300677
CONSTRUCTION CONTRACT NO. N62706-72-C-0203
SPECIFICATION NO. 41-72-0202
FOR OICC CONTRACT 9/1971

THIS WORK WAS PREPARED BY ME OR UNDER MY SUPERVISION.
Paul T. Tanigawa

TRUST TERRITORY OF THE PACIFIC ISLANDS
DEPARTMENT OF PUBLIC WORKS, SAIPAN, M.I.

DESIGN: TT
DRAWN: IC
CHECKED: TT
SUPERVISOR
SUBMITTED BY: DATE
PRINCIPAL OFFICER

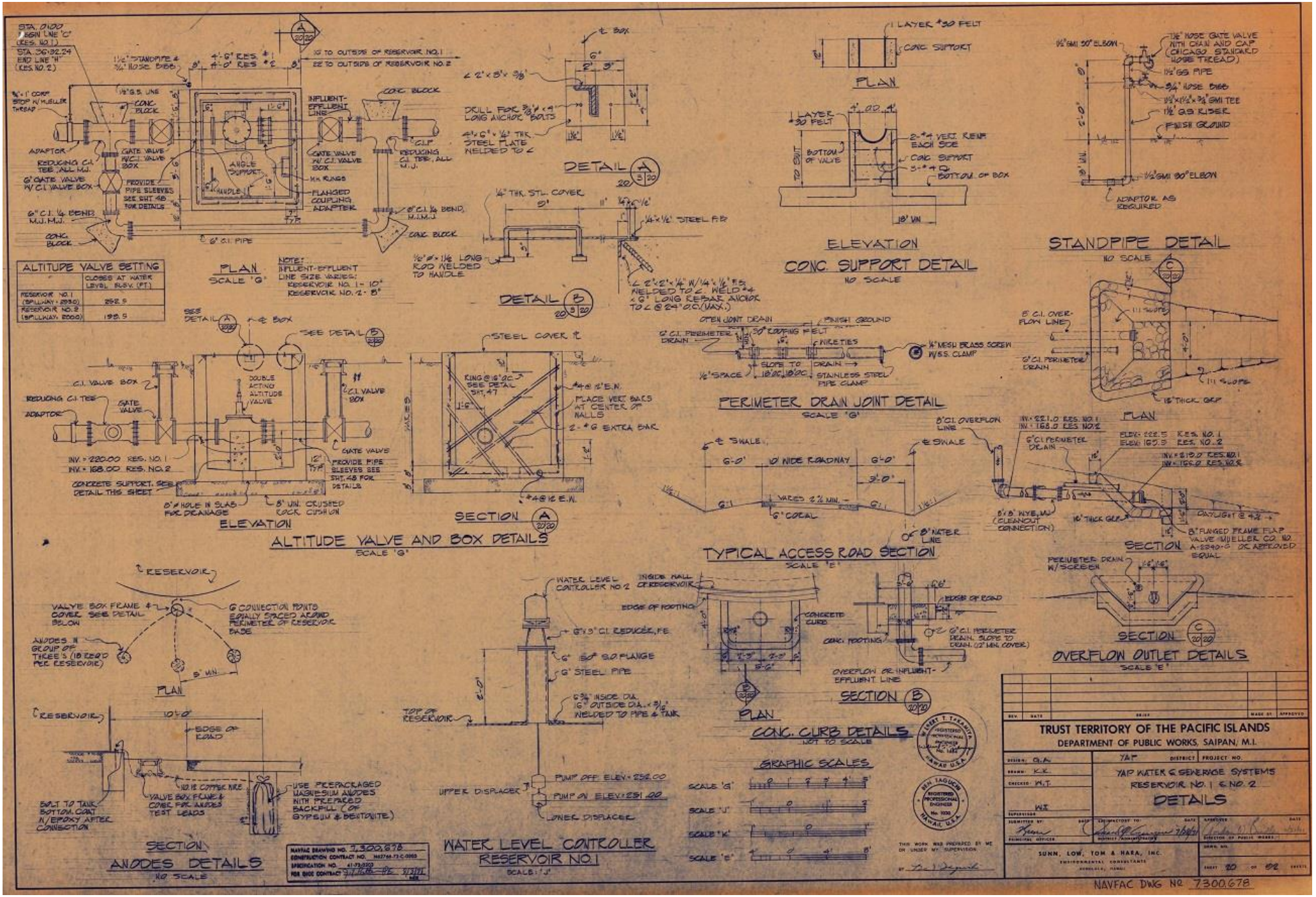
"YAP" DISTRICT PROJECT NO.
YAP WATER & SEWERAGE SYSTEMS
RESERVOIR NO. 1 & NO. 2
DETAILS

SUBMITTED TO: DATE
DISTRICT ADMINISTRATOR
APPROVED DATE
DIRECTOR OF PUBLIC WORKS

SUHN, LOW, TOM & HARA, INC.
ENVIRONMENTAL CONSULTANTS
HONOLULU, HAWAII

DRWG. NO.
SHEET 10 OF 92 SHEETS

NAVFAC DWG Nº 7300677


PLAN
SCALE '6'
ALTITUDE VALVE SETTING
CLOSES AT WATER LEVEL ELEV. (FT.)
RESERVOIR NO. 1 (SPILLWAY = 259.0)
252.5
RESERVOIR NO. 2 (SPILLWAY = 200.0)
195.5
NOTE: INFLUENT-EFFLUENT LINE SIZE VARIES: RESERVOIR NO. 1 - 10" RESERVOIR NO. 2 - 8"
DETAIL
SCALE '6'
ELEVATION
SECTION
ALTITUDE VALVE AND BOX DETAILS
SCALE '6'
ELEVATION
CONC. SUPPORT DETAIL
NO SCALE
STANDPIPE DETAIL
NO SCALE
PERIMETER DRAIN JOINT DETAIL
SCALE '6'
PLAN
TYPICAL ACCESS ROAD SECTION
SCALE 'E'
SECTION
PLAN
CONC. CURB DETAILS
NOT TO SCALE
SECTION
OVERFLOW OUTLET DETAILS
SCALE 'E'
PLAN
SECTION
ANODES DETAILS
NO SCALE
WATER LEVEL CONTROLLER RESERVOIR NO. 1
SCALE: 'J'
GRAPHIC SCALES
SCALE '6'
SCALE 'J'
SCALE 'K'
SCALE 'E'
NAVFAC DRAWING NO. 7300,678
CONSTRUCTION CONTRACT NO. N62744-73-C-0303
SPECIFICATION NO. 41-73-0303
FOR BIDS CONTRACT
TRUST TERRITORY OF THE PACIFIC ISLANDS
DEPARTMENT OF PUBLIC WORKS, SAIPAN, M.I.
YAP
YAP WATER & SEWERAGE SYSTEMS
RESERVOIR NO. 1 & NO. 2
DETAILS
SUNN, LOW, TOM & HARA, INC.
ENVIRONMENTAL CONSULTANTS
HONOLULU, HAWAII
NAVFAC DWG NO 7300,678