PHIBRO-TECH, INC.

December 18, 2015

Mr. Steve Lavinger
Branch Chief, Chatsworth Office
Department of Toxic Substances Control
9211 Oakdale Avenue
Chatsworth, CA 91311
E-mail: Steve.Lavinger@DTSC.CA.gov

Subject: Phibro-Tech, Inc.; 8851 Dice Road, Santa Fe Springs, CA CAD008488025 - Permit No. 91-3-TS-002; Request for Determination of Class 2 Permit Modification for Wastewater Tank Replacements

Dear Mr. Lavinger,

Phibro-Tech, Inc. is submitting the enclosed information requesting that the Department of Toxic Substances Control approve the proposed modifications as a Class 2 permit modification to Permit No. 91-3-TS-002. These modifications are necessary to allow access to the former Pond 1 surface impoundment so that closure activities may commence while still allowing Phibro-Tech, Inc. to operate the facility safely and efficiently. As explained in prior correspondence, it would be arbitrary and capricious for the Department to implement the Pond 1 closure plan prior to implementing the facility modifications sought in this application.

The attached, prepared by our consultant Yorke Engineering, LLC, describes the requested change and provides justification the additional information requested by the Department in a letter dated November 17, 2015 to Mr. David Thaete of Phibro-Tech, Inc.

We would appreciate an expedited review of this request.

For questions or additional information, please contact David Thaete of Phibro-Tech Inc. at 562.273.0170 or David.Thaete@pahc.com or Michael Dudasko of Yorke Engineering LLC at 415.897.6203, Ext. 10 or MDudasko@YorkeEngr.com.

Sincerely,

W D Glover

W. D. Glover
President
Phibro-Tech, Inc.
Dwight.glover@pahc.com
(201) 329-7315

cc:

Phil Blum (letter only)
Facility Permitting Branch
Department of Toxic Substances Control
9211 Oakdale Ave.
Chatsworth, CA 91311

Stephen Baxter
Facility Permitting Branch
Department of Toxic Substances Control
9211 Oakdale Ave.
Chatsworth, CA 91311

David Thaete (four copies)
EHS Manager
Phibro-Tech Inc.
8851 Dice Road
Santa Fe Springs, CA 90670

Zachary Walton, Esq. (letter only)
SSL Law Firm LLP
575 Market Street, Suite 2700
San Francisco, CA 94105

Michael Dudasko
Principal Engineer 1
Yorke Engineering, LLC
7665 Redwood Blvd., Suite 210
Novato, CA 94945

Yorke
ENGINEERING, LLC
www.YorkeEngr.com

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Mr. Steve Lavinger
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Department of Toxic Substances Control
9211 Oakdale Avenue
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E-mail: Steve.Lavinger@DTSC.CA.gov

Subject: Phibro-Tech, Inc.; 8851 Dice Road, Santa Fe Springs, CA
CAD008488025
Class 2 Permit Modification – Permit No. 91-3-TS-002

Dear Mr. Lavinger:

Phibro-Tech, Inc. (PTI) is submitting the enclosed application for a Class 2 permit modification to the 1991 Part B permit 91-3-TS-002, which is still in effect. As you know, under a separate action the Department of Toxic Substances Control (DTSC or Department) is reviewing the Pond 1 Closure Plan and Interim Measures Work Plan for the facility. Quarterly groundwater monitoring consistently demonstrates that constituents of concern are at or below background concentrations at the facility's point of compliance and boundary wells and that there is no immediate threat to the environment. Nevertheless, the closure of Pond 1 is required and, in conjunction with the Interim Measures, will further remove near surface contaminants and further fixate hexavalent chromium in deeper soils. The modifications described in this permit modification submittal are necessary to allow for the ongoing operation of the facility during the closure of Pond 1, which the Department has identified as a priority item, and also to accommodate the Department's recently stated preference for 30" aisle spaces in the two permitted container storage areas.

The specific modifications are described below:

1. Replacement of Tanks W-1 and W-2

The permitted wastewater treatment tanks W-1 and W-2 must be replaced and relocated before Pond 1 can be closed without shutting down the facility. The new tanks will be named W-7 and W-8 and will be of the same nominal capacity as tanks W-1 and W-2. To make the location available for the new W-7 and W-8 wastewater treatment tanks, it is necessary to replace an operating filter press (FP-#2) that is subject to a variance along with tanks W-3 and W-4 with a new, similarly designed filter press, designated FP-#2A. Design details for Tanks W-7 and W-8, the new tank containment area, container pumping station, and filter press FP-#2A are provided as part of this permit modification request. In addition, these changes are also included in the current revision of the Part B Operations Plan dated September 2015 that is being reviewed by the Department.

2. Replacement of Variance Tanks W-3 and W-4

Tanks W-3 and W-4 currently operate under a 1988 variance issued from the Department of Health Services. As shown in Attachment 2, Unit Drawing C9, they are located adjacent

to the Pond 1 containment area currently used for W-1 and W-2. When Pond 1 closure commences, soil will be excavated up to about 12 feet below the base of tanks W-3 and W-4. Removing these tanks prior to the excavation associated with Pond 1 closure will increase safety during excavation and associated closure activities. In addition, removing W-3 and W-4 will allow the 1988 variance to expire, another stated priority for the Department. Prior to removal of Tanks W-3 and W-4, new tanks J-6 and J-7, each with the same capacity (12,500 gallons) as tanks W-3 and W-4, will be installed in a new J-containment area. Design details for Tanks J-6 and J-7 and the containment area are provided as part of this permit modification request. In addition, these changes are also included in the current revision of the Part B Operations Plan dated September 2015 that is being reviewed by the Department. Once Tanks J-6 and J-7, along with tanks W-7 and W-8, are operational, the facility will be able to initiate Pond 1 closure.

3. Expansion of Two Current Containment Areas to Allow Increased Aisle Space

Modifications are also requested for increasing the physical size of two existing container storage areas, ERS-1 and ERS-2, without changing the currently authorized storage capacity in Permit No. 91-3-TS-002. These are renamed Container Storage Areas #1 and #2 (CS-1 and CS-2) in the current Part B Operations Plan dated September 2015, currently being reviewed by the Department. This is requested due to current discussions with DTSC permitting staff who have indicated a minimum of 30-inch aisle space will be required, rather than the current 24 inches. In addition, the expanded CS-1 area is adjacent to the new J-area (see #2 above), and it would be preferable to modify CS-1 concurrently with the new J-area construction for replacing Tanks W-3 and W-4 (see Modification #2 above in details following). Without these modifications, the facility cannot accommodate the Department's preference for 30" aisle space. As the closure of Pond 1 is a priority, work to expand the surface area of the containment areas will be scheduled so as not to delay the implementation of installing new tanks and associated tank containment areas for W-7, W-8, J-6, and J-7 and for initiating Pond 1 closure.

In a letter dated November 17, 2015, to Mr. David Thaete of PTI, the Department concluded that with submittal of additional requested information, the modifications described above would constitute a Class 2 Permit Modification subject to final review after public notice and review of public comments by the DTSC.

This transmittal includes:

- Description of the requested change;
- Description of why the requested change is necessary;
- Discussion of why we believe it is a Class 2 permit modification;
- Supporting information including, but not limited to:
  - Revised Part A application;
  - Closure procedures for new equipment; and
  - Soil sampling procedures for proposed new locations and discussion of how the characterization will be conducted and determination made that new units and equipment will not be placed in locations where existing contamination exceeds the

corrective action cleanup goals, unless PTI demonstrates that implementation of the facility-wide corrective action would not be compromised by the construction of the new units and equipment; and

- Schedule; and
- Updated closure cost estimate for the new equipment installed as a result of the permit modifications.

MODIFICATION #1 – REPLACEMENT OF TANKS W-1 AND W-2

1. Description of Change and Statement of Need

Permit No. 91-3-TS-002, effective July 29, 1991, identifies tanks W-1 and W-2 as wastewater treatment tanks that are each identified in the permit as 30,000 gallons (nominal capacity), but are identified as having a 30,457 gallon capacity in the engineering certifications. The effective or operating capacity is less than 30,000 gallons. Other wastewater tanks and a filter press are identified as subject to the 1988 variance. Because tanks W-1 and W-2 were installed in the concrete-lined area that formerly served as Pond 1, which was identified under the 1981 Interim Status Document, tanks W-1 and W-2 must be relocated to allow access to execute the planned closure of Pond 1. The closure of Pond 1 will be authorized under separate approval.

In order to allow the processing of site wastewater during and after the closure of Pond 1, PTI requests authorization via a Class 2 Permit Modification to install two new tanks W-7 and W-8 (see description in Attachment 1, Section 1), each 30,500 gallons, to replace W-1 and W-2. W-7 and W-8 will be placed in a newly constructed secondary containment area (see Unit Drawing C19 in Attachment 2) that is sized to contain the release of one tank, plus the rainfall from a 25-year/24-hour storm event.

Before the containment area for W-7 and W-8 can be constructed, the filter press currently identified as filter press FP-#2 must be removed and replaced. FP-#2 will be replaced with a new filter press FP-#2A (see discussion below for replacement of Tanks W-3 and W-4). When the installation of FP-#2A is complete, FP-#2 will be disassembled and closed, as described in the Part B closure plan (Volume 2) submitted to the DTSC in September 2015. This will be considered a partial closure for the filter press and tanks W-1 and W-2. Closure records will be maintained and submitted to the DTSC in the Pond 1 closure report.

Table 1-1 below provides a comparison of the current wastewater tanks versus the replacement units.

Table 1-1: Comparison of Wastewater Tank System Tanks and Filter Press

Characteristic	Tanks W-1/W-2	Tanks W-7/W-8
Process Used In	Wastewater treatment	Wastewater treatment
Status	Existing tanks	Planned replacement tanks
Material of Construction	Fiberglass construction throughout; Structural Layer: Filament-wound E-glass and ATLAC 382-4010 resin	Constructed in accordance with ASTM D3299 – 10; "Standard Specification for Filament-Wound Glass-Fiber-Reinforced Thermoset Resin Corrosion-Resistant Tanks"

Characteristic	Tanks W-1/W-2	Tanks W-7/W-8
Tank Type	Cylindrical vertical tank with flat bottom	Cylindrical vertical tank with flat bottom
Max. Spec. Gravity	1.44	1.1
Thickness (in.)	0.375	0.375
Diam. (ft.)	18	14
Height (ft.)	15.5	27
Maximum Volume (gals.)	30,457	30,500
Design Temp. (°F)	Ambient	Ambient
Design Pressure [pounds per square inch gauge (psig)]	Atmospheric	Atmospheric
Tank Fabrication Date	1985	New
Tank Controls	Level control, pH meter, mixer	Level control, pH meter, mixer
Secondary Containment Design	1,266 square foot containment area with 58" high walls and floors made of reinforced concrete and coated with an epoxy coating	925 sq. foot concrete containment area with fiberglass coating and 6 ft. high containment walls
Secondary Containment Capacity	4,751 cubic feet	4,357 cubic feet
Required Secondary Containment Capacity(1)	4,072 cubic feet	4,078 cubic feet
Adequate Containment	Yes	Yes
Characteristic	**Filter Press FP-#2**	**Filter Press FP-#2A**
Plate Size	42" x 42"	47.25" x 47.25"
Number of Plates	77	59
Plate Surface Area	943 square feet	914 square feet

Note:

1. After allowing for volume of 25-year, 24-hour rain event, and capacity excluded by shell of other tank(s) in area.

The same types of wastewater streams that are managed in the existing tanks will be managed in the replacement tanks, and in the same manner. Treated wastewater suitable for discharge to the Los Angeles County Sanitation Department will continue to be routed to the final wastewater holding tanks, W-5 and W-6.

The proposed changes include a permanent container pumping station where waste containers are placed to be pumped into tanks W-7 or W-8. This will be provided in lieu of using portable plastic containment pallets, as is being used currently.

2. Analysis of Permit Modification Class

Table 1-2 below lists the potentially applicable permit modification classification descriptions from Appendix I to Title 22 California Code of Regulations, Division 4.5, Chapter 20 (22 CCR 66270) and provides a discussion.

Table 1-2: Review of Modification Class – Tank W-1 and W-2 Replacements

Citation	Description	Class	Discussion
G.2	Modification of a tank unit or secondary containment system without increasing the capacity of the unit.	2	The facility will remain subject to the same overall throughput and increase in actual capacity of 43 gallons per tank (0.14%); or 500 gallons per tank above nominal capacity listed in the Permit (1.67%). The new secondary containment system will be similarly sized.
G.3	Replacement of a tank with a tank that meets the same design standards and has a capacity within +/-10% of the replaced tank provided: ▪ The capacity difference is no more than 1,500 gals; ▪ The facility's permitted tank capacity is not increased; and ▪ The replacement tank meets the same conditions in the permit.	1	Increase in actual capacity of 43 gallons per tank (0.14%); or 500 gallons per tank above nominal capacity listed in the Permit (1.67%).

In addition, 22 CCR 66270.42(d)(2)(B), states:

> *"Class 2 modifications apply to changes that are necessary to enable a permittee to respond, in a timely manner, to:*
>
> 1. *…*
> 2. *…, and*
> 3. *Changes necessary to comply with new regulations, where these changes can be implemented without substantially changing design specifications or management practices in the permit."*

Replacement of the Tanks W-1 and W-2 with Tanks W-7 and W-8 will allow compliance with the requirement to close Pond 1. Therefore, this most closely meets a Class 2 permit modification.

3. Additional Information

Since the replacements for tanks W-1 and W-2 are identically sized, there is no change in tank storage capacity contemplated by the modification. The replacements for tanks W-1/W-2 will meet the same permit conditions as tanks W-1 and W-2, i.e. 30,000 gallons and handling the same type of wastewater streams. Tanks W-7 and W-8 will meet all applicable conditions identified in Permit No. 91-3-TS-002.

Specific Changes to Permit No. 91-3-TS-002

Page 18 Replace W-7 for W-1; and

Replace W-8 for W-2.

Under 22 CCR 66270.42(b)(1)(D), the applicable information identified is required.

Table 1-3: Supporting Information

22 CCR Regulatory Reference	Summary	Discussion
66270.10	Part A and Part B Information	This section primarily discusses Part A and Part B submittal requirements for facilities prior to or after receiving Interim Status, but before they receive a Part B permit. Therefore, this information is not applicable.
66270.13	Contents of Part A Application	There will be no change in the hazardous waste amounts stored and/or treated in the new tanks or the allowable hazardous waste codes. Names of tanks will change and locations will be slightly changed within the site. See revised Part A form included as Attachment 3.
66270.14b	Contents of Part B: General Requirements	The described modifications do not require changes to the Waste Analysis Plan, waste codes and types of wastes managed, or contingency procedures, except that W-7 and W-8 will replace any reference to W-1 and W-2. In Inspection schedules, W-7 and W-8 will replace any reference to W-1 and W-2. Closure procedures for Tanks W-7 and W-8 are included in Attachment 9. Closure procedures for existing tanks W-1 and W-2 and Tank Containment Area are discussed in the Pond 1 Closure Plan submitted on September 30, 2015, and are currently subject to a separate public comment and approval process.
66270.15	Containers	Not applicable to replacement of Tanks W-1 and W-2.
66270.16	Tank Information and Assessment	See Tank W-7/W-8 Tank Containment Area – Data Sheet and description in Attachment 1 (Section 1.1 through 1.3) and Tank Layout in Drawing C19 (Attachment 2). The professional engineer's (PE's) certification for tanks W-7 and W-8 is provided in Attachment 4. Tank containment area descriptions, including drawings showing adequate secondary containment sized for the largest tank in the containment system and a 25-year, 24-hour rainfall, are also provided in Section 1 of Attachment 1 and Drawing C19 in Attachment 2. Also see Additional Information below.
66270.17	Surface Impoundments	Not Applicable
66270.18	Waste Piles	Not Applicable

22 CCR Regulatory Reference	Summary	Discussion
66270.19	Incinerators	Not Applicable
66270.20	Land Treatment Facilities	Not Applicable
66270.21	Landfill	Not Applicable
66270.22	Boilers and Industrial Furnaces Burning Hazardous Wastes	Not Applicable
66270.23	Miscellaneous Units	Filter Press FP-#2A is assumed to be subject to standards for miscellaneous units. See the FP-#2A data sheet in Attachment 1, Section 3.
66270.62	Hazardous Waste Incinerator Permits	Not Applicable
66270.63	Land Treatment Demonstrations Using Field Test or Laboratory Analyses	Not Applicable

4. Tank Construction Sequence

The tank construction sequence required to provide access to Pond 1 is provided in Attachment 5, along with an estimated timeline. This includes soil sampling procedures for the area where the new containment area will be located.

Once the new tanks W-7 and W-8 are constructed and installed, the tank installation will be inspected and the tanks will be tightness tested by an independent PE registered in California as required by 22 CCR 66264.192(c) and (e). Tanks W-7 and W-8 will then be tested as part of a system, along with pumps, piping, and level controls, by using raw water or non-hazardous wastewater. Once PTI determines that Tanks W-7 and W-8 are suitable for handling hazardous waste (PE certification is on file) and the system passes initial tests, Tanks W-1 and W-2 will be emptied of liquid to the extent possible by pumping. Then the waste feed piping into Tanks W-1 and W-2 will be physically disconnected either by blinding the line or closing a valve and blinding the outlet. This process may be performed individually for Tanks W-1 and W-7 and for W-2 and W-8. At no time will both tanks of the pair (existing and replacement tank) be in simultaneous use. After Tanks W-7 and W-8 are operational, Tanks W-1 and W-2 will be cleaned and demolished in accordance with the procedures in the final Pond 1 Closure Plan.

Similarly, filter press FP-#2A will be constructed prior to the removal of FP-#2. Upon completion of FP-#2A, the system will be tested. During the test efforts, the existing FP-#2 will be locked out so both filter presses (FP-#2 and FP-#2A) will not be operating at the same time to process wastewater treatment tank solids. Upon verification that FP-#2A is fully functional, the piping to filter press FP-#2 will be disconnected and FP-#2A will be placed into full service. Once FP-#2A is operational, FP-#2 will be cleaned and demolished in accordance with the procedures in the final Pond 1 Closure Plan.

5. Tank and Filter Press Closure

Closure of tanks W-1 and W-2 and the existing Filter Press FP-#2 will be performed in accordance with the procedures in the September 30, 2015, Pond 1 Closure Plan that is currently under separate review by the DTSC. Closure procedures for Tanks W-7 and W-8, their containment area, and FP-#2A will be as described in the attached closure procedures (Attachment 9).

MODIFICATION #2 - REPLACEMENT OF TANKS W-3 AND W-4

1. Description of Change and Reasons for Request

Permit No. 91-3-TS-002, effective July 29, 1991, identifies tanks W-3 and W-4 as wastewater treatment tanks that are each identified as having a 12,500 gallon capacity, but are identified as subject to the February 23, 1988, Hazardous Waste Unit Permit Variance (1988 Variance) issued to Southern California Chemical Company by the California Department of Health Services, Toxic Substances Control Division.

Tanks W-3 and W-4 and the containment area are located adjacent to the Pond 1 containment area currently used for W-1 and W-2. When Pond 1 closure commences, soil will be excavated to about 12 feet below the base of tanks W-3 and W-4. The proximity of the excavation to Tanks W-3 and W-4, if they remain in place, presents a significant risk to their stability, and therefore presents a risk of release and a risk to the safety of the facility's employees. Removing these tanks prior to the excavation associated with Pond 1 closure will increase safety during excavation and associated closure activities. In addition, removing W-3 and W-4 will allow the 1988 Variance to expire, which is another stated priority for the Department. Prior to removal of Tanks W-3 and W-4, new tanks J-6 and J-7, each with the same capacity (12,500 gallons) as tanks W-3 and W-4, will be installed in a new J-containment area. Design details for Tanks J-6 and J-7 and the containment area are provided as part of this permit modification request. In addition, these changes are also included in the current revision of the Part B Operations Plan dated September 2015, which is being reviewed by the Department. Once Tanks J-6 and J-7, along with tanks W-7 and W-8, are operational, the facility will be able to remove Tanks W-1, W-2, W-3, and W-4 and initiate Pond 1 closure. In order to allow processing of site wastewater during and after the closure of Pond 1, PTI requests authorization via a Class 2 Permit Modification to install two new tanks, J-6 and J-7 (see description in Attachment 1, Section 2), each 12,500 gallons, that will replace W-3 and W-4. Tanks J-6 and J-7 will be placed in a newly constructed secondary containment area (see Unit Drawing C19 in Attachment 2) that is sized to contain the release of one tank, plus the rainfall from a 25-year/24-hour storm event.

Table 2-1 below provides a comparison of the current wastewater tanks and filter press versus the replacement units.

Table 2-1: Comparison of Wastewater Tanks W-3/W-4 with J-6/J-7

Characteristic	Tanks W-3/W-4	Tanks J-6/J-7
Process Used In	Wastewater treatment	Wastewater treatment
Status	Existing tanks subject to 1988 Variance	Planned replacement tanks
Material of Construction	Fiber-reinforced plastic	Fiber-reinforced plastic with epoxy vinyl ester resin corrosion barrier

Characteristic	Tanks W-3/W-4	Tanks J-6/J-7
Tank Type	Cylindrical vertical tank with flat bottom	Cylindrical vertical tank with domed bottom
Max. Spec. Gravity	1.2	1.2
Thickness (in.)	0.376	0.375
Diam. (ft.)	12	12
Height (ft.)	16	14.17 (straight side)
Maximum Volume (gals.)	12,500	12,500
Design Temp. (°F)	Ambient	150°F
Design Pressure (psig)	Atmospheric	Atmospheric
Tank Fabrication Date	Pre-1988	New
Tank Controls	Level control, pH meter	Level control, pH meter, mixer
Secondary Containment Design	721.6 square feet area, made of concrete and concrete blocks (uncoated)	720 square feet area with walls and floors made of reinforced concrete and coated with an impervious fiberglass coating
Secondary Containment Capacity	3,415.7 cubic feet	2,230 cubic feet
Wall Height	74 inches	42 inches
Required Secondary Containment Capacity(1)	1,671.1 cubic feet	1,671.1 cubic feet
Adequate Containment	Yes	Yes

Note:
1. After allowing for volume of 25-year, 24-hour rain event, and capacity excluded by shell of other tank(s) in area.

The same types of wastewater streams that are managed in the existing tanks will be managed in the replacement tanks, and in the same manner. Treated wastewater suitable for discharge to Los Angeles County Sanitation Department will continue to be routed to the final wastewater holding tanks W-5 and W-6. The residual water exiting the filter press (the filtrate) will be recirculated back to the replacement wastewater tanks as it is from the exiting wastewater tanks. Filter solids will be emptied into bins or directly into super sacks for the new press as they have been for the older press FP-#2.

2. Analysis of Permit Modification Class

Table 2-2 below lists the potentially applicable permit modification classification descriptions from Appendix I to CCR Title 22, Division 4.5, Chapter 20 (22 CCR 66270) and provides a discussion.

Table 2-2: Review of Modification Class – Tank W-3 and W-4 Replacement

Citation	Description	Class	Discussion
G.2	Modification of a tank unit or secondary containment system without increasing the capacity of the unit.	2	There is no increase in tank size and facility will remain subject to the same overall throughput. The new secondary containment system will be similarly sized.
G.3	Replacement of a tank with a tank that meets the same design standards and has a capacity within +/-10% of the replaced tank provided: ▪ The capacity difference is no more than 1,500 gals; ▪ The facility's permitted tank capacity is not increased; and ▪ The replacement tank meets the same conditions in the permit.	1	There is no increase in tank size.

In addition, 22 CCR 66270.42(d)(2)(B), states:

> *"Class 2 modifications apply to changes that are necessary to enable a permittee to respond, in a timely manner, to:*
>
> *4. …*
>
> *5. …, and*
>
> *6. Changes necessary to comply with new regulations, where these changes can be implemented without substantially changing design specifications or management practices in the permit."*

Since the replacement for tanks W-3 and W-4 are identically sized, there is no change in tank storage capacity contemplated by the modification. The replacements for tanks W-3 and W-4 will meet the same permit conditions as tanks W-1 and W-2, i.e. 12,500 gallons and handling the same type of wastewater streams. In addition, since replacement Tanks J-6 and J-7 will no longer be under variance, they will be subject to all applicable requirements in Title 22, Chapter 14, Article 10 (Tank Standards), including certifications, daily inspections, etc. Therefore, this most closely meets a Class 2 permit modification.

3. Additional Information

Since the replacements for tanks W-3 and W-4 are identically sized, there is no change in tank storage capacity contemplated by the modification. Since tanks W-3 and W-4 are variance tanks, they do not have specific conditions in the permit. The replacement for tanks W-3 and W-4 will have the same volume, i.e. 12,500 gallons each, and will be handling the same type of wastewater streams. Tanks J-6 and J-7 will meet any generally applicable conditions for tanks identified in Permit No. 91-3-TS-002.

Specific Changes to Permit No. 91-3-TS-002

Page 18 Replace J-6 for W-3; and

Replace J-7 for W-4.

Strikeout/remove the following sentence:

"W-3, W-4 tanks, the filter press, and the three stage clarifier operate under a hazardous waste permit variance issued by the Department on February 23, 1988."

Under 22 CCR 66270.42(b)(1)(D), the applicable information identified is required.

Table 2-3: Supporting Information

22 CCR Regulatory Reference	Summary	Discussion
66270.10	Part A and Part B Information	This section primarily discusses Part A and Part B submittal requirements for facilities prior to or after receiving Interim Status, but before they receive a Part B permit. Therefore, this section is not applicable.
66270.13	Contents of Part A Application	There will be no change in the hazardous waste amounts stored and/or treated in the new tanks or the allowable hazardous waste codes. Names of tanks will change and locations will be slightly changed within the site. See revised Part A form included as Attachment 3.
66270.14b	Contents of Part B: General Requirements	The described modifications do not require changes to the Waste Analysis Plan, waste codes and types of wastes managed, or contingency procedures, except that J-6 and J-7 will replace any reference to W-3 and W-4. In Inspection schedules, J-6 and J-7 will be added to be the same as new tanks W-7 and W-8. Closure procedures for Filter Press FP-#2A and Tanks J-6 and J-7 are included in Attachment 9. Closure procedures for existing tanks W-3 and W-4, Tank Containment Area, and Filter Press #2 are discussed in the Pond 1 Closure Plan submitted September 30, 2015, and currently subject to separate public comment and approval process.
66270.15	Containers	Not applicable to replacement of Tanks W-3 and W-4.

22 CCR Regulatory Reference	Summary	Discussion
66270.16	Tank Information and Assessment	See Tank J-6 and J-7 Tank Containment Area – Data Sheet and description in Attachment 1, Section 2 and Tank Layout in Drawing C19. The PE's certification for tanks J-6 and J-7 is provided in Attachment 6. Tank containment area descriptions, including drawings showing adequate secondary containment sized for the largest tank in the containment system and a 25-year, 24-hour rainfall, are also provided in Attachment 1, Section 2, and in Drawing C19 in Attachment 2. Also see Additional Information below.
66270.17	Surface Impoundments	Not Applicable
66270.18	Waste Piles	Not Applicable
66270.19	Incinerators	Not Applicable
66270.20	Land Treatment Facilities	Not Applicable
66270.21	Landfill	Not Applicable
66270.22	Boilers and Industrial Furnaces Burning Hazardous Wastes	Not Applicable
66270.23	Miscellaneous Units	Filter Press FP-#2A is discussed above in Table 1-3.
66270.62	Hazardous Waste Incinerator Permits	Not Applicable
66270.63	Land Treatment Demonstrations Using Field Test or Laboratory Analyses	Not Applicable

4. Tank Construction Sequence

The tank construction sequence required to provide access to Pond 1 is provided in Attachment 5, along with an estimated timeline. This includes soil sampling procedures for the area where the new containment area will be located.

Once the new tanks J-6 and J-7 are constructed and installed, the tank installation will be inspected and the tanks' tightness tested by an independent PE registered in California as required by 22 CCR 66264.192(c) and (e). Tanks J-6 and J-7 will then be tested as part of a system, along with pumps, piping, and level controls, by using raw water or non-hazardous wastewater. Once PTI determines Tanks J-6 and J-7 are suitable for handling hazardous waste (PE certification is on file) and the system passes initial testing, Tanks W-3 and W-4 will be emptied of liquid to the extent possible by pumping. Then the waste feed piping into Tanks W-3 and W-4 will be physically disconnected either by blinding the line or closing a valve and blinding the outlet. This process may be performed individually for Tanks W-3 and J-6 and for W-4 and J-7. At no time will both tanks of the pair (existing and replacement tank) be in simultaneous use. After Tanks J-6 and J-7

are operational, Tanks W-3 and W-4 will be cleaned and demolished in accordance with the procedures in the final Pond 1 Closure Plan.

5. Tank and Filter Press Closure

Closure of tanks W-3 and W-4 will be performed in accordance with the procedures in the September 30, 2015 Pond 1 Closure Plan currently under separate review by the DTSC. Closure procedures for Tanks J-6 and J-7 and their containment area will be as described in the attached closure procedures (Attachment 9).

MODIFICATION #3 - EXPANSION OF TWO CURRENT CONTAINMENT AREAS TO ALLOW INCREASED AISLE SPACE

1. Description of Change and Reasons for Request

The PTI facility currently has two permitted container storage areas for hazardous waste, ERS-1 and ERS-2. These have historically been used with 24-inch aisle space between rows of stored containers.

DTSC permitting staff have indicated a preference for 30-inch aisle space, rather than the current 24 inches. As a result, a modification is requested for increasing the physical size of the two existing container storage areas, ERS-1 and ERS-2, without changing the currently authorized storage capacity in Permit No. 91-3-TS-002. These storage areas are also referred to as Container Storage Areas #1 and #2 (CS-1 and CS-2) in the current Part B Operations Plan dated September 2015, currently being reviewed by the Department. Since the expanded CS-1 area is adjacent to the new J-area (see Modification #2 above), it would be preferable to modify CS-1 (ERS-1) concurrently with the new J-area construction. Without these modifications, the facility cannot accommodate the Department's preference for 30" aisle space.

Tables 3-1A and 3-1B below provide a comparison of the container storage areas before and after the proposed modifications. The proposed changes for CS-1 are:

A. Expansion of the containment area in the southeast corner of CS-1 by a net of 1,733 square feet to a new total surface area of 5,550 square feet; and

B. Addition of a partial shade structure to the new expanded area (CS-1 ex.).

Refer to Unit Drawing C20 and descriptive write up in Attachment 1, Section 4.

The proposed changes for CS-2 are increasing the containment surface area by 1,885 square feet to a total of 4,098 square feet. Refer to Unit Drawing C34 (See Attachment 2) and descriptive write up in Attachment 1, Section 5.

Table 3-1A: Comparison of Existing and Modified CS-1 Area

Characteristic	Container Storage Area CS-1	Container Storage Area CS-1ex
Process Used In	Container storage; drum cutting/cleaning; container pumping station.	Container storage; drum cutting/cleaning; container pumping station.
Status	Existing containment area	Existing containment area with additional contiguous area added to the southeast and connected.

Material of Construction	Floor and berms are concrete coated with a 100% solids Novalac epoxy lining system with a flexible joint seal.	Floor and berms are concrete coated with a 100% solids Novalac epoxy lining system with a flexible joint seal.
Containment Area Surface Area (Useable)	3,817 square feet	5,550 square feet (net increase of 1,733 square feet)
Container Storage Limit	69,000 gallons	69,000 gallons
Available Containment Capacity(1)	For 89,045 gallons	Per engineering certification TI&CS Report No. 15-10-24 (see Attachment 7), the expanded CS-1 area will allow for containment of 199,870 gallons, which exceeds the combined permitted storage capacity for the site.
Adequate Containment	Yes	Yes

Note:
1. After allowing for volume of 25-year, 24-hour rain event.

Table 3-1B: Comparison of Existing and Modified CS-2 Area

Characteristic	Container Storage Area CS-2	Container Storage Area CS-2ex
Process Used In	Container storage	Container storage
Status	Existing containment area	Existing containment area with additional contiguous area added to the south and west and connected.
Material of Construction	Floor and berms are concrete coated with a chemical-resistant coating comprised of a 100% solid epoxy with a flexible joint seal.	Floor and berms are concrete coated with a chemical-resistant coating comprised of a 100% solid epoxy with a flexible joint seal.
Containment Area Surface Area (Useable)	2,212 square feet(3)	About 1,885 square feet additional (4,098 gross square feet)
Container Storage Limit	46,900 gallons	46,900 gallons
Available Containment Capacity(1)	For 89,045 gallons	Per engineering certification TI&CS Report No. 15-10-9 (see Attachment 8), the expanded CS-area will allow for containment of 94,610 gallons, which exceeds the permitted storage capacity for the area (89,045 gallons).
Adequate Containment	Yes	Yes

Note:
1. After allowing for volume of 25-year, 24-hour rain event.

There is no change in the types of containers, waste codes, or volume of containers to be managed in the CS-1 (ERS-1) and CS-2 (ERS-2) container storage areas.

2. Analysis of Permit Modification Class

Table 3-2 below lists the potentially applicable permit modification classification descriptions from Appendix I to CCR Title 22, Division 4.5, Chapter 20 (22 CCR 66270) and provides a discussion.

Table 3-2: Review of Modification Class

Citation	Description	Class	Discussion
F.1.b	Modification or addition of container units resulting in up to 25% increase in the facility's container storage capacity, except as provided in F(1)(c) and F(4)(a) below. [F(1)(c) and F(4)(a) refer to Class 1* and Class 1 changes, respectively, that are necessary to treat wastes that are restricted from land disposal to meet some or all of the applicable treatment standards. These are not germane to the requested modification.]	2	There is no increase in container storage capacity. The facility is solely requesting to increase the regulated storage surface area to allow the facility to accommodate the wider 30" aisle spacing.
F.2.a	Modification of a container unit without increasing the capacity of the unit.	2	There is no increase in container storage capacity. The facility is solely requesting to increase the regulated storage surface area to allow the facility to accommodate the wider 30" aisle spacing.

In addition, 22 CCR 66270.42(d)(2)(B), states:

> *"Class 2 modifications apply to changes that are necessary to enable a permittee to respond, in a timely manner, to:*
>
> 1. *Common variations in the types and quantities of the wastes managed under the facility permit,*
> 2. *Technological advancements, and*
> 3. *Changes necessary to comply with new regulations, where these changes can be implemented without substantially changing design specifications or management practices in the permit."*

Since there is no increase in the requested volume of containers to be allowed in the modified CS-1 and CS-2 containment areas, and that these measures only enhance the ability of PTI to comply with DTSC requirements for managing containers (larger aisle space), this meets the Class 2 Permit Modification standard.

2. Additional Information

The expanded container storage areas will meet all applicable conditions identified in Permit No. 91-3-TS-002.

Specific Changes to Permit No. 91-3-TS-002

Page 15 Edit the following paragraph

2. Storage in Containers

The two existing drum storage areas occupy a total of 6,727 square feet of the facility. Both of these storage areas are padded with concrete and are surrounded by a combination of a 10" curb and berms to prevent run-on to or run-off from the storage areas. Up to a total of approximately 3,146 55-gallon containers (equivalent to 174,000 gallons) can be stored in both of these areas. The base and curb of both of these container storage areas are coated with an impervious epoxy type paint. Secondary containment for these areas are designed to hold a total of 17,400 gallons, which is 10% of the total storage capacity of the facility.

To read as,

The two existing drum storage areas occupy a total of 9,648 square feet of the facility. Both of these storage areas are padded with concrete and are surrounded by a combination of a 10" curb and berms to prevent run-on to or run-off from the storage areas. Up to a total of approximately 3,146 55-gallon containers (equivalent to 174,000 gallons) can be stored in both of these areas. The base and curb of both of these container storage areas are coated with an impervious epoxy type paint. Secondary containment for these areas is designed to hold at least 17,400 gallons, which is 10% of the total storage capacity of the facility after the allowance of precipitation from a 25-year/24-hour storm event.

Page 34 Edit the following paragraph

"Q. Required Aisle Space

The owner or operator shall maintain aisle space as needed to allow the unobstructed movement of personnel, fire protection equipment, spill control equipment, and decontamination equipment."

To read as,

"Q. Required Aisle Space

Upon completion of the expansion of ERS-1 or ERS-2, the owner or operator shall maintain 30-inch aisle space in the expanded area to allow the unobstructed movement of personnel, fire protection equipment, spill control equipment, and decontamination equipment."

Under 22 CCR 66270.42(b)(1)(D), the applicable information identified is required.

Table 3-3: Supporting Information

22 CCR Regulatory Reference	Summary	Discussion
66270.10	Part A and Part B Information	This section primarily discusses Part A and Part B submittal requirements for facilities prior to or after receiving Interim Status, but before they receive a Part B permit. Therefore, this section is not applicable.
66270.13.	Contents of Part A Application	There will be no change in the hazardous waste amounts stored in the expanded container storage areas. See revised Part A form included as Attachment 3.
66270.14b.	Contents of Part B: General Requirements	The described modifications do not require changes to the Waste Analysis Plan, waste codes and types of wastes managed, or contingency procedures. Closure procedures for the expanded Container Storage Areas #1 and #2 are included in Attachment 9.
66270.15	Containers	See Container Storage Area 1 Expanded and Container Storage Area 2 Expanded Data Sheets and description in Attachment 1, Sections 4 and 5. See containment area certifications in Attachment 7 (CS-1ex) and Attachment 8 (CS-2ex). Refer to Layout in Drawing C20 (CS-1ex) and C34 (CS-2ex). The containment area descriptions, including drawings and certifications, demonstrate that these areas have adequate secondary containment for 10% of the aggregate container capacity, plus a 25-year, 24-hour rainfall.
66270.16	Tank Information and Assessment	Not Applicable to Containers.
66270.17	Surface Impoundments	Not Applicable
66270.18	Waste Piles	Not Applicable
66270.19	Incinerators	Not Applicable
66270.20	Land Treatment Facilities	Not Applicable
66270.21	Landfill	Not Applicable
66270.22	Boilers and Industrial Furnaces Burning Hazardous Wastes	Not Applicable
66270.23	Miscellaneous Units	Not Applicable
66270.62	Hazardous Waste Incinerator Permits	Not Applicable

22 CCR Regulatory Reference	Summary	Discussion
66270.63	Land Treatment Demonstrations Using Field Test or Laboratory Analyses	Not Applicable

Containment Area Construction

The containment area construction will be scheduled to occur at a time and in a manner that will not prevent or interfere with the replacement of wastewater Tanks W-1, W-2, W-3, and W-4, or interfere or delay Pond 1 closure. Specific construction procedures are discussed in Attachment 1, Section 4 and Section 5. This includes soil sampling procedures for the area where the new containment area will be located. It is expected that these construction activities will be coordinated to make efficient use of construction equipment on-site. However, no specific timeline for the modifications has been established.

Containment Area Closure

Closure procedures for expanded Container Storage Areas #1 and #2 are included in Attachment 9.

CONCLUSIONS

Based on the above analysis of Class 1 and Class 2 permit modification standards, PTI respectfully requests that the DTSC approve the following requested changes as Class 2 permit modifications to Permit No. 91-3-TS-002:

1. Replacement of Tanks W-1 and W-2 with Tanks W-7 and W-8 in a new containment area after Filter Press FP-#2 is replaced by Filter Press FP-#2A, and replacement of the plastic pallets used as a container pumping station with a new permanent container pumping station;
2. Replacement of Variance Tanks W-3 and W-4 with Tanks J-6 and J-7 in a new containment area; and
3. Expansion of Container Storage Area #1 and Container Storage Area #2 without increasing the allowable container storage limits in each area.

PTI understands that the following are required for a Class 2 Permit Modification in accordance with 22 CCR 66270.42(b):

- *"The permittee shall send a notice of the modification request to all persons on the facility mailing list maintained by the Department and to the appropriate units of State and local government as specified in section 66271.9(c)(1)(E) and shall publish this notice in a major local newspaper of general circulation. This notice shall be mailed and published within 7 days before or after the date of submission of the modification request, and the permittee shall provide to the Department evidence of the mailing and publication. The notice shall include:*
    - *Announcement of a 60-day comment period, in accordance with section 66270.42(b)(5), and the name and address of a Department contact to whom comments shall be sent;*
    - *Announcement of the date, time, and place for a public meeting held in accordance with section 66270.42(b)(4);*
    - *Name and telephone number of the permittee's contact person;*
    - *Name and telephone number of a Department contact person;*
    - *Location where copies of the modification request and any supporting documents can be viewed and copied;*
    - *The following statement: 'The permittee's compliance history during the life of the permit being modified is available from the Department contact person; and*
    - *A description of the proposed changes at the facility.*
- *The permittee shall place a copy of the permit modification request and supporting documents in a location accessible to the public in the vicinity of the permitted facility.*
- *The permittee shall hold a public meeting no earlier than 15 days after the publication of the notice required in subsection (b)(2) of this section and no later than 15 days before the close of the 60-day comment period. The meeting shall be held to the extent practicable in the vicinity of the permitted facility.*

- *The public shall be provided 60 days to comment on the modification request. The comment period shall begin on the date the permittee publishes the notice in the local newspaper. Comments shall be submitted to the Department contact identified in the public notice."*

PTI will provide the DTSC a copy of relevant public notice information.

If you have any questions regarding this report, please contact Michael Dudasko at (415) 897-6203 x10 or at the e-mail below, or David Thaete of PTI at (562) 273-0170 or David.Thaete@PAHC.com.

Sincerely,

Michal Dudasko, CPEA
Principal Engineer
Yorke Engineering, LLC
MDudasko@YorkeEngr.com

Enclosures:

1. Attachment 1 – Description of Modified Equipment
2. Attachment 2 – Unit Drawings
   - C-2 Site Plan – Current Operations
   - C-9 Unit W – Current Tank and Containment Details
   - C-10 CS1 – Current Details
   - C-11 CS2 – Current Details
   - C-16 Unit J – Future Tank and Containment Details
   - C-19 Unit W – Future Tank and Containment Details
   - C-20 CS1ex – Future Detail
   - C-33 Unit W – Future Pumping Station
   - C-34 CS2ex – Future Details
3. Attachment 3 – Part A Form
4. Attachment 4 – Tank Certification – Tanks W-7 and W-8
5. Attachment 5 – Tank Construction Sequence
6. Attachment 6 – Tank Certification – Tanks J-6 and J-7
7. Attachment 7 – Certification Report CS-1 Ex (TI&CS Report No. 15-10-24)
8. Attachment 8 – Certification Report CS-2 Ex (TI&CS Report No. 15-10-9)
9. Attachment 9 – Closure Procedures for Newly Added Equipment
10. Attachment 10 – Closure Cost Estimates for Newly Added Equipment
11. Attachment 11 – Soil Sampling Procedures

ATTACHMENT 1 – DESCRIPTION OF MODIFIED EQUIPMENT

Equipment Description for Class 2 Permit Modification

1 TANKS W-7 AND W-8

1.1 Tank Containment Area – Data Sheet

NAME	W-7/W-8 Tank Containment Area (Containment Area W Subarea W4)	
STATUS	New unit to be constructed	
LOCATION	West portion of facility, west of Pond 1; see Unit Drawing C19	
UNIT TYPE/ACTIVITY	Tank containment area for storage and treatment tanks	
PHYSICAL DESCRIPTION	925-square-foot concrete containment area with fiberglass coating and 6-foot-high containment walls	
HAZARDOUS WASTE MANAGEMENT UNIT (HWMU) STORAGE AND TREATMENT TANKS WITHIN AREA	W-7	FRP, sloped bottom; 30,500 gallons; 14' diam. x 27' tall
	W-8	FRP, sloped bottom; 30,500 gallons; 14' diam. x 27' tall
OTHER HWMU EQUIPMENT WITHIN CONTAINMENT	None	
NON-HWMU EQUIPMENT WITHIN CONTAINMENT	None	
APPURTENANCES USED	Centrifugal and air diaphragm pumps with filters to protect pumps	
SECONDARY CONTAINMENT	As shown in Unit Drawing C19, Containment Area W Subarea W4 has adequate secondary containment capacity. This is determined by multiplying the containment surface area by the containment wall height to yield a gross containment volume. The gross containment volume is then reduced by the volume of a maximum 25-year, 24-hour rain event (4.5 inches) and then by the volume of all tank shells other than the largest tank (which is assumed to be leaking). The volume is further reduced by any concrete pads that extend above the floor level and occupy additional containment capacity. This provides the net or available containment capacity to contain the volume of a waste release. The resulting available containment capacity is 4,357 cubic feet versus a required containment for W-7 or W-8 of 4,078 cubic feet.	
REMOVAL OF ACCUMULATED LIQUIDS	Any liquids, rainfall or wastes, accumulating within the containment area will be manually pumped within 24 hours to either another waste tank on-site or, if solely rainwater, to rainwater storage tanks R-1, R-2, R-3, T-3, or to wastewater treatment tanks.	

ALLOWABLE RCRA AND CALIFORNIA WASTE CODES	Wastes managed in this area may carry any currently approved waste codes in Permit No. 91-3-TS-002, with the exceptions described below. RCRA – except F006, F019, F039, K062, U134, U151, U219, and D018 through D043 California Waste Codes (CWC) – except 221, 222, 223, 331, 342, 343, and 352

1.2 New W-7 and W-8 Containment Area

1.2.1 DESCRIPTION

The new W-7/W-8 Containment Area is a new containment area that will be placed just north of the existing Pond 1 (see Unit Drawing C19). As discussed in the Permit Modification package, this containment area will first require the removal and relocation of Filter Press #2. See Unit Drawing C19 for details. Two 30,500-gallon wastewater storage/treatment tanks (W-7 and W-8) will be placed in this containment area to provide a direct replacement for the two 30,500-gallon tanks currently located in Pond 1. The containment area will be roughly a trapezoid, but will have six sides as shown in Unit Drawing C19.

The total surface area of the containment basin (see Unit Drawing C19 Subarea W4) is 925 square feet. The outer perimeter wall will have a height of 72 inches. The walls and floors of the new W-7/W-8 Containment Area will be made of reinforced concrete and coated with an impervious fiberglass coating that is chemically resistant to the types of wastes and materials anticipated to be handled in the wastewater treatment area. No Resource Conservation and Recovery Act (RCRA) listed wastes will be processed in these tanks.

1.2.2 CONTAINMENT CAPACITY

As shown in Unit Drawing C19, Containment Area W Subarea W4 has adequate secondary containment capacity. This is determined by multiplying the containment surface area by the containment wall height to yield a gross containment volume. The gross containment volume is then reduced by the volume of a maximum 25-year, 24-hour rain event (4.5 inches) and then by the volume of all tank shells other than the largest tank (which is assumed to be leaking). The volume is further reduced by any concrete pads that extend above the floor level and occupy additional containment capacity. This provides the net or available containment capacity to contain the volume of a waste release. The resulting available containment capacity is 4,357 cubic feet, versus a required containment for W-7 or W-8 of 4,078 cubic feet.

1.2.3 CONSTRUCTION PLAN – W-7/W-8 AREA

The following is a description of the installation of two new tanks (W-7 and W-8) and a containment structure north of existing tanks W-1 and W-2. The tanks will each be 30,500 gallons and contained by a wall 6 feet tall. The containment area will have an irregular shape, but will have 934 square feet of surface area. The area where the new tanks and containment system will be installed is currently occupied by a 75-cubic-foot filter press, which will be removed as the first step in construction. See Unit Drawing C19.

Core samples will be obtained to determine the characteristics of soil and disposal and/or treatment methods. Soil samples will be collected following the methodology in the Soil Sampling Plan in Attachment 11 to the Class 2 Permit Modification package. Samples in this area are not expected to be collected more than 5 feet below ground surface (bgs) and would be collected using a hydraulically driven direct push rig mounted to a heavy-duty pickup truck or small work truck.

Existing asphalt and concrete covering in the area of the new tanks and tank walls will be removed. Concrete or asphalt debris and excavated soil will be assumed to be hazardous waste or separately characterized in accordance with California regulations to determine if it is hazardous waste. Assuming an excavation of up to 5 feet, about 200 cubic yards of soil will be removed in this area. Equipment used will include a gasoline-powered concrete/asphalt saw, diesel-powered off-road backhoe/loader (such as a Caterpillar 416) with a demolition ram attachment, diesel-powered off-road skidsteer loader with buckets, diesel-powered off-road mini-excavator with buckets, and diesel-powered end dump trucks.

After the tank and containment area is cleared, about 120 cubic yards of clean fill will be brought on-site by diesel-powered end dump trucks and compacted. Construction of the containment area would involve fabricating wood and/or cardboard forms and installing a rebar mesh. Concrete and concrete reinforcement details will be according to the engineering plans to meet local codes. The concrete will contain #4 rebar or greater and be 20 inches thick. Tank pads will be elevated 12 inches above surrounding grade to minimize soil removal. The concrete will be poured directly from the concrete truck or by using a concrete pumping truck. The tank pads for W-7 and W-8 will have radial grooves to allow for inspection and identification of possible leaks at the bottoms of the tanks. Equipment used for this work will be diesel-powered off-road reach forklifts, diesel-powered concrete truck, diesel-powered concrete pumps (on-road), and concrete vibrators.

Concrete walls will be poured. The walls will be 8 inches thick and contain #4 rebar or greater. Water stops will be installed between the walls and containment pad. The equipment used for this work will be the same as used in pouring the tank foundation described above.

After the concrete has cured for at least 7 days, the floor and interior walls will be coated with a 100% solids Novalac epoxy lining system (or equal) that is chemically resistant to the types of wastes handled by the facility.

New fiberglass reinforced plastic (FRP) tanks will be placed on their designated tank pads using a 17 or 23-ton diesel-powered boom truck. Seismic restraints will be installed on the tanks. Penetrations into the coated tank pad will be repaired and sealed as needed.

Tank installation and seismic restraints will be certified by a Professional Engineer.

Tank piping and instrumentation (e.g., level indicators, mixers, etc.) will be installed.

1.3 New W-7/W-8 Container Pumping Station

NAME	W-7/W-8 Container Pumping Station (Area 1)
STATUS	To be constructed (see Construction Plan below)
LOCATION	Placed on asphalt surface outside west wall of Tank W-7/W-8 containment area; see Unit Drawing C33
ACTIVITY	Temporary placement of containers (drums or tote bins) while the contents are being pumped to tanks; container rinsing with water and transfer into storage tank (see Section E9)

PHYSICAL DESCRIPTION	A new two-compartment 30-foot-by-7-foot concrete area with 12.5-inch curbs as shown in Unit Drawing C33 will be created west of the new Tank W-7/W-8 containment area. One area will be 20.0 feet wide (Area A) and the other will be 9.75 feet wide (Area B), which allows for the 3-inch inner berm. Fiberglass grating will be secured permanently over the curbs to support the drums or totes to be pumped. Containers will be placed in one row.
MAXIMUM CAPACITY	Area A – five tote bins (300 gallons average, 330 gallons maximum) or 18 drums or combination thereof Area B – two tote bins (300 gallons average, 330 gallons maximum) or eight drums or combination thereof
SECONDARY CONTAINMENT	The containment systems, after allowing for the maximum 25-year/24-hour storm event of 4.5 inches, are capable of containing: Area A – 698 gallons, which is larger than both 10% of the aggregate capacity (1,650 gallons) and the contents of the largest container (330-gallon tote bin) Area B – 340 gallons, which is larger than both 10% of the aggregate capacity (660 gallons) and the contents of the largest container (330-gallon tote bin)
SPECIFIC TANKS THAT RECEIVE MATERIAL PUMPED	Tanks that will receive contents of the containers managed at this pumping station are W-7 and W-8.
ALLOWABLE RCRA AND CALIFORNIA WASTE CODES	Wastes managed in this area may carry any currently approved waste codes in Permit No. 91-3-TS-002, with the exceptions described below. RCRA – except F006, F019, F039, K062, U134, U151, U219, and D018 through D043 CWC – except 221, 222, 223, 331, 342, 343, and 352

1.3.1 CONSTRUCTION PLAN – NEW CPS W-7/W-8 CONTAINER PUMPING STATION

After the new W-7/W-8 Containment Area is constructed, a new two-compartment 30-foot-by-7-foot concrete area with 12-inch curbs as shown in Unit Drawing C33 will be constructed.

Core samples will be obtained in the construction area to determine the characteristics of soil and disposal and/or treatment methods. Soil samples will be collected following the methodology in the November 22, 2006, "Revised Draft Pond 1 Soil Sampling and Analysis Plan."

Existing covering in the area of the new curbs will be removed. Disposal of concrete/soil asphalt will be according to regulations depending on the analysis of soil. It is assumed that soil will be removed to a depth of 5 feet, resulting in about 25 cubic yards of soil removal. Equipment used will include a concrete/asphalt saw (off-road), backhoe with a breaker and buckets (off-road), skidsteer with buckets (off-road), mini-excavator with buckets (off-road), and dump trucks (on-road).

The containment pad and curb will be poured as a monolithic structure. Concrete and concrete reinforcement details will be according to the engineering plans to meet local codes. The concrete will contain #4 rebar or greater. Equipment used for this work will be reach forklifts (off-road), concrete truck (on-road), concrete pumps (on-road), and concrete vibrators (off-road).

The floor and interior curbs will be coated with a 100% solids Novalac epoxy lining system (or equal) that is chemically resistant to the types of wastes handled by the facility. The area will be given the required amount of cure time.

2 TANKS J-6 AND J-7

2.1 Tank Containment Area – Data Sheet

NAME	New J-Tank Containment Area (J-6 and J-7)	
STATUS	New unit to be constructed	
LOCATION	Southern area of facility south of CS-1; see Unit Drawing C16	
UNIT TYPE/ACTIVITY	Tank containment area for storage and treatment tanks	
PHYSICAL DESCRIPTION	720-square-foot concrete containment area, 3.5 feet high, with fiberglass coating	
HWMU STORAGE AND TREATMENT TANKS WITHIN AREA	J-6	FRP, domed bottom; 12,500 gallons; 12' diam. x 14.17' tall
	J-7	FRP, domed bottom; 12,500 gallons; 12' diam. x 14.17' tall
OTHER NON-HWMU EQUIPMENT WITHIN CONTAINMENT	Sodium sulfide reagent vessel about 5 feet by 5 feet (square)	
APPURTENANCES USED	Air diaphragm pumps with filters to protect pump	
SECONDARY CONTAINMENT	As shown in Unit Drawing C16, the New J Containment Area will have adequate secondary containment capacity. This is determined by multiplying the containment surface area by the containment wall height of 3.5 feet to yield a gross containment volume. The gross containment volume is then reduced by the volume of a maximum 25-year, 24-hour rain event (4.5 inches) and then by the volume of all tank shells other than the largest tank (which is assumed to be leaking). The volume is further reduced by any concrete pads that extend above the floor level and occupy additional containment capacity. This provides the net or available containment capacity to contain the volume of a waste release. The resulting available containment capacity (see Unit Drawing C16) is 2,230 cubic feet, versus a required containment for the largest tank (12,500 gallons each for J-6 or J-7) of 1,671.1 cubic feet.	

REMOVAL OF ACCUMULATED LIQUIDS	Any liquids, rainfall or wastes, accumulating within the containment area will be manually pumped within 24 hours to either another waste tank on-site or, if solely rainwater, to rainwater storage tanks R-1, R-2, R-3, T-3, or to wastewater treatment tanks.
ALLOWABLE RCRA AND CALIFORNIA WASTE CODES	Wastes managed in this area may carry any currently approved waste codes in Permit No. 91-3-TS-002, with the exceptions described below. RCRA – except F006, F019, F039, K062, U134, U151, U219, and D018 through D043 CWC – except 221, 222, 223, 331, 342, 343, and 352

2.2 New J-6 and J-7 Containment Area

2.2.1 DESCRIPTION

The new J Containment Area will contain Tanks J-6 and J-7 and will be placed south of Container Storage Area #1 (CS-1) near the existing J-Containment and process area. See Unit Drawing C16 for details. The J-6/J-7 area will be designed to hold two 12,500-gallon treatment/storage tanks (J-6 and J-7). Tanks J-6 and J-7 are identically sized as Variance Tanks W-3/W-4, and two tanks will initially be used as their replacement. The containment area is 720 square feet (22.5 feet by 35.19 feet). The outer perimeter wall will have a height of 42 inches (3.5 feet).

The walls and floors of the new J Containment Area will be made of reinforced concrete and coated with an impervious fiberglass coating. Epoxy may be used to repair cracks or gaps in the containment area coating. This chemically resistant fiberglass coating has been effective in the existing J-Area and proven to be resistant to the types of wastes and materials anticipated to be handled in the wastewater treatment area. No RCRA listed wastes will be processed in these tanks.

2.2.2 CONTAINMENT CAPACITY

As shown in Unit Drawing C16, the New J Containment Area will have adequate secondary containment capacity. This is determined by multiplying the containment surface area by the containment wall height to yield a gross containment volume. The gross containment volume is then reduced by the volume of a maximum 25-year, 24-hour rain event (4.5 inches) and then by the volume of all tank shells or other equipment within the containment area other than the largest tank (which is assumed to be leaking). The volume is further reduced by any concrete pads that extend above the floor level and occupy additional containment capacity. This provides the net or available containment capacity to contain the volume of a waste release. The resulting available containment capacity for the J-6/J-7 Area (see Unit Drawing C16) is 2,230 cubic feet, versus a required containment for the largest tank (12,500 gallons each for J-6 or J-7) of 1,671.1 cubic feet.

2.2.3 CONSTRUCTION PLAN – NEW J AREA

The following is a description of the installation of a containment area for two new tanks (J-6 and J-7) southwest of Containment Storage Area #1. Tanks J-6 and J-7 will each be 12,500 gallons and contained in a tank containment area. The area where the new J-6 and J-7 tanks and containment system will be installed is an asphalt pad that is mostly unused, except for storage of miscellaneous spare parts and materials for the plant, such as motors, piping, steam heating coils, etc.

Core samples will be obtained to determine the characteristics of soil and disposal and/or treatment methods. Soil samples will be collected following the methodology in the Soil Sampling Plan in Attachment 11 to the Class 2 Permit Modification package. Samples in this area are not expected to be collected more than 5 feet bgs and would be collected using a hydraulically driven direct push rig mounted to a heavy-duty pickup truck or small work truck.

Existing asphalt and concrete covering in the area of the new tanks and tank walls will be removed. Concrete or asphalt debris and excavated soil will be assumed to be hazardous waste or separately characterized in accordance with California regulations to determine if it is hazardous waste. Assuming an excavation of up to 5 feet, about 180 cubic yards of soil will be removed in this area. Equipment used will include a gasoline-powered concrete/asphalt saw, diesel-powered off-road backhoe/loader (such as a Caterpillar 416) with a demolition ram attachment, diesel-powered off-road skidsteer loader with buckets, diesel-powered off-road mini-excavator with buckets, and diesel-powered end dump trucks.

After the tank and containment areas are cleared, about 90 cubic yards of clean fill will be brought on-site by diesel-powered end dump trucks and compacted for the J-6/J-7 area. Construction of the containment area would involve fabricating wood and/or cardboard forms and installing a rebar mesh. Concrete and concrete reinforcement details will be according to the engineering plans to meet local codes. The concrete will contain #4 rebar or greater and be 17 inches thick. The concrete will be poured directly from the concrete truck or by using a concrete pumping truck. The tank pads for Tanks J-6 and J-7 will have radial grooves to allow for inspection and identification of possible leaks at the bottoms of the tanks. Equipment used for this work will be diesel-powered off-road reach forklifts, diesel-powered concrete truck, diesel-powered concrete pumps (on-road), and concrete vibrators.

Concrete walls will be poured. The walls will be 8 inches thick and contain #4 rebar or greater. Water stops will be installed between the walls and containment pad. The equipment used for this work will be the same as used in pouring the tank foundation described above.

After the concrete has cured for at least 7 days, the floor and interior walls will be coated with a 100% solids Novalac epoxy lining system (or equal) that is chemically resistant to the types of wastes handled by the facility.

New FRP tanks will be placed on their designated tank pads using a diesel-powered boom truck. Seismic restraints will be installed on the tanks. Penetrations into the coated tank pad will be repaired and sealed as needed.

Tank installation and seismic restraints will be certified by a Professional Engineer.

Tank piping and instrumentation (e.g., level indicators, mixers, etc.) will be installed.

3 WASTEWATER FILTER PRESS FP #2A

NAME	Wastewater Filter Press FP #2A
STATUS	To be constructed
LOCATION	North of Tank W-5; see Unit Drawing C19

UNIT TYPE/ACTIVITY	Filter press processing potentially recyclable metal solids from W-1/W-2 (to be replaced with W-7/W-8) and other wastewater treatment tanks, but also interchangeable with Filter Press #1 (fed from J Tanks). This filter press will be replaced by Filter Press #2A.
PHYSICAL DESCRIPTION	Filter press, replacement for FP #2. 59 plates, 47" x 47"; U.S. Filter Model #1200N32-59-755YLC; overall dimensions 225" H x 372" L x 153" D.
APPURTENANCES USED	Centrifugal pumps; air diaphragm pumps
COMPLIANCE WITH TITLE 22 REQUIREMENTS	Filter press is permanently installed in a fixed location on concrete foundation in accordance with applicable building codes at the time of installation. The filter press is designed to not leak during normal operation when material is flowing through it. The concrete pad under the filter press is curbed on three sides and sloped to provide containment for incidental liquid and solids releases. The filter press is operated in batch mode, and when the batch is complete, the press is opened and the solids are dropped into super sacks. No air emissions arise from the filter press.
DISCUSSION OF USAGE	Filtering metal bearing solids from wastewater streams
MANAGEMENT OF RESIDUALS	Filter cake solids are placed into super sacks to be sold off-site as Excluded Recyclable Material subject to demonstration to the Department of Toxic Substances Control under Health and Safety Code 25143.2(f). Alternatively, or based on the characteristics of certain batches of filter cake, some may be sent off-site as a hazardous waste for further processing or disposal.
	Filter press water (filtrate), whether hazardous or not, will be sent to wastewater tanks W-1, W-2, W-3, or W-4 until the replacement tanks are installed (W-7, W-8, J-6, and J-7) for treatment prior to discharge to the Los Angeles County Sanitation District.

4 CONTAINER STORAGE AREA CS-1 EX

4.1 Container Storage Area CS-1 Ex Data Sheet

NAME	Container Storage Area 1 Expansion (CS-1 Ex)
STATUS	Proposed modifications to CS-1
LOCATION	Eastern portion of facility, south of main plant roadway; see Unit Drawing C20

UNIT TYPE/ACTIVITY	Container storage area; container cutting/cleaning; container pumping station (for J-Area and new J-Area); location of tote bin for tanker truck to tote transfer. Location of reagent tote bins used in the J-Area and new J-Area (typically sodium sulfide, ferrous sulfate, and sulfuric acid).
PHYSICAL DESCRIPTION	The proposed changes are: A. Expansion of the containment area by the addition of a new pad in the southeast corner of CS-1; and B. Addition of a partial shade structure to CS-1 Ex. CS-1 Ex adds a net 1,733 square feet to a new total surface area of 5,550 square feet.
CONTAINER STORAGE LIMIT	No change from CS-1; 69,000 gallons of waste in containers (drums or tote bins)
SECONDARY CONTAINMENT	The capacity determination for CS-1 Ex is described below based on double-stacking. In accordance with California Code of Regulations (CCR) Title 22 Section 66264.175, this containment area must be capable of holding 10% of the combined capacity of the containers, plus the maximum 25-year, 24-hour rainfall amount. For 230 tote bins or 69,000 gallons maximum, the required containment volume is 6,900 gallons. As described in the Certification Report from Testing, Inspection & Certification Services (TI&CS) Report No. 15-10-24, the available containment capacity for CS-1 is 199,870 gallons, which exceeds the combined permitted storage capacity for the site.
REMOVAL OF ACCUMULATED LIQUIDS	Any liquids, rainfall or wastes, accumulating within the containment area will be manually pumped within 24 hours to either another waste tank on-site or, if solely rainwater, to rainwater storage tanks R-1, R-2, R-3, T-3, or to wastewater treatment tanks.
RUN-ON CONTROL	The facility perimeter is bermed to prevent rainfall run-on from off-site. The facility is not in the 100-year floodplain, so run-on from floods will not impact the facility. Perimeter berms for the containment area prevent rainfall falling outside the containment area from running into this area.
ALLOWABLE RCRA AND CALIFORNIA WASTE CODES	Wastes managed in this area may carry any currently approved waste codes in Permit No. 91-3-TS-002.

4.2 Container Storage Area 1 Ex (CS-1 Ex) Containment Area

4.2.1 DESCRIPTION – PROPOSED CS-1 MODIFICATIONS

The facility is planning to make several modifications to the CS-1 container storage area. For the purposes of this application, the modified area will be referred to as CS-1 Expanded (or CS-1 Ex). Although there will be a net gain in storage area, the planned storage capacity of 69,000 gallons will remain the same. The proposed changes are:

A. Expansion of the containment area by the addition of a new pad in the southeast corner of CS-1; and

B. Addition of a partial shade structure to CS-1 Ex.

The major change of increasing the containment storage area is possible since the replacements for wastewater tanks W-1 and W-2 will now be located near the existing tanks and not south of CS-1, as originally conceived. This will allow shorter rows of drums to be placed that will improve operational efficiency for selecting drums to add into the on-site processes or to respond to damaged or leaking containers. These changes are further described below and are shown in Unit Diagram Sheet C20.

Modification A – A new 1,733-square-foot pad will be added to the southeast corner of the existing CS-1. A berm will be provided to the southeast corner of CS-1 extending south 34.66 feet, then west about 50.77 feet until it intersects with the new J-Containment Area. The total containment area will be 5,550 square feet. The perimeter containment wall in the expanded area will be 10 inches.

Modification B – A 22-foot-by-15-foot roof structure will be installed at a height of about 12 feet in the southeast corner of the CS-1 Ex area so that waste materials that may be affected by heat can be shaded from the sun. The roof support will not be attached directly through the CS-1 containment floor or walls.

The CS-1 Ex containment area will be coated with a 100% solids Novalac epoxy lining system with a flexible joint seal similar to CS-1, which uses materials supplied by Plasite Protective Coatings of Green Bay Wisconsin that are chemically resistant to the types of wastes handled by the facility. See Coating specifications in Volume III, Appendix A. Alternative coatings equal to or better than Novalac may be used.

It is assumed that any of the facility's approved waste codes in Permit No. 91-3-TS-002 can be managed in this area provided wastes are not incompatible with one another. If a waste is received that is incompatible with other waste in CS-1, it will be placed in a different container management area.

Containers received at the facility will be United Nations (UN) and Department of Transportation (DOT)-approved shipping containers. Of the container types described, 55-gallon plastic containers (placed three or four drums to a pallet) and intermediate bulk container (IBCs) are expected to be the most common. PTI will single or double-stack the pallets or IBCs.

4.2.2 CONTAINMENT CAPACITY – CS-1 EX AREA

The capacity determination for the expanded area CS-1 Ex is described below based on double-stacking. A minimum aisle space of 30 inches between rows is provided to allow for routine inspections, safe handling, and emergency response. For IBCs with a standard 48-inch-by-42-inch pallet, the maximum container storage limit is 230 IBCs or 69,000 gallons, which is unchanged from CS-1.

In accordance with 22 CCR 66264.175, this containment area must be capable of holding 10% of the combined capacity of the containers, plus the maximum 25-year, 24-hour rainfall amount. For 230 tote bins or 69,000 gallons maximum, the minimum required containment volume is 6,900 gallons. As described in TI&CS Report No. 15-10-24 (see Attachment 7 of the Permit Modification package), the expanded CS-1 area will allow for containment of 199,870 gallons, which exceeds the combined permitted storage capacity for the site.

4.2.3 PRECIPITATION AND RUN-ON CONTROL – CS-1 EX AREA

Similar to CS-1, CS-1 Ex is located outside and is exposed to rainfall, exposed for the atrial roof structure. The maximum 25-year, 24-hour rainfall amount is 4.5 inches (see Operating Plan Section

B5.3) and is accounted for in the containment volume calculations described above. The facility perimeter is bermed to prevent rainfall run-off, as well as run-on from off-site. The facility is not in the 100-year floodplain, so run-on from floods will not impact the facility. The access ramp in the center of the north containment wall of CS-1 Ex is equal to the height of the containment wall in that area, which assures the proper containment volume will be maintained since no spilled contents and/or rainwater can exit the containment system, and rainfall falling outside the containment area is prevented from running into this area.

4.2.4 CS-1 EX CONSTRUCTION PLAN

The CS-1 container storage area will be expanded to the south, adding 1,733 square feet to the existing area. The expanded area will have a 12-inch concrete curb. The area where the expansion will take place is currently a storage area for non-hazardous maintenance and production supplies. The expanded area will be at the same elevation as the existing containment. A 15-foot-by-22-foot roof structure, about 12 feet high, will be added to the southeast side of the new area for the purpose of providing shade to some containers that may be more sensitive to heat.

During the construction of the CS-1 Ex modifications, there will be short periods of time when containment berms will be disturbed. Along the southeastern corner of the existing CS-1, the containment berm will be removed so the new expansion containment area can be connected into the existing area and the junction made smooth and level and the floor coated as described above. Waste drums will remain in CS-1. During this time, a temporary secondary containment berm will be created by using sandbags and polyethylene sheeting to create a berm of at least the same height as the former containment area wall when waste remains in CS-1. The temporary berm will remain in place during any time the containment wall is disturbed until construction of the new additional area is completed with the containment wall and the coating is installed and ready for use.

Core samples will be obtained to determine the characteristics of soil and disposal and/or treatment methods for any soil that is exposed and/or removed. Soil samples will be collected following the methodology in the November 22, 2006, "Revised Draft Pond 1 Soil Sampling and Analysis Plan," which was submitted and approved as part of the 2006 Tank Relocation Plan. Samples in this area are not expected to be collected more than 5 feet bgs and would be collected using a hydraulically driven direct push rig mounted to a heavy-duty pickup truck or small work truck.

Existing asphalt and concrete covering in the new expanded area and the existing south curb of CS-1 will be removed. Concrete or asphalt debris and excavated soil will be assumed to be hazardous waste or separately characterized in accordance with California regulations to determine if it is hazardous waste. About 17 cubic yards of soil will be removed in this area. Equipment used will include a gasoline-powered concrete/asphalt saw, diesel-powered off-road backhoe/loader (such as a Caterpillar 416) with a demolition ram attachment, diesel-powered off-road skidsteer loader with buckets, diesel-powered off-road mini-excavator with buckets, and diesel-powered end dump trucks.

After the containment area is cleared, about 17 cubic yards of clean fill will be brought on-site by diesel-powered end dump trucks and compacted. About 6 cubic yards of clean fill will be brought on-site for construction of the rollover berm at the new entrance. About 6 cubic yards of soil will be removed when the old rollover berm is removed. Construction of the containment area would involve fabricating wood and/or cardboard forms and installing a rebar mesh. Concrete and concrete reinforcement details will be according to the engineering plans to meet local codes. The concrete will contain #4 rebar or greater. The new concrete will be 8 inches thick. The concrete will be poured directly from the concrete truck or

by using a concrete pumping truck. The existing south containment curb of CS-1 will remain intact as long as possible during construction to maintain containment of the area. At the time that construction requires this curb to be breached, adequate temporary containment structures will be put in place to contain contents stored in the area. Equipment used for this work will be diesel-powered off-road reach forklifts, diesel-powered concrete truck, diesel-powered concrete pumps (on-road), and concrete vibrators.

Concrete curbs will be poured. The curbs will contain #4 rebar or greater and be doweled with rebar to the concrete foundation. The equipment used for this work will be the same as used in pouring the foundation described above.

After the concrete has cured for at least 7 days, the floor and interior walls will be coated with a 100% solids Novalac epoxy lining system (or equal) that is chemically resistant to the types of wastes handled by the facility. A 15-foot-by-22-foot roof structure, 12 feet high, will be added to the southeast side of the new area for the purpose of providing shade to some containers that are more sensitive to heat. The supports of the roof structure will be anchored to pads that are within the containment area, but raised above the liquid containment height. This will eliminate the need to penetrate any containment surfaces with anchors.

5 CONTAINER STORAGE AREA CS-2 EX

5.1 Container Storage Area CS-2 Ex Data Sheet

NAME	Container Storage Area 2 Expansion (CS-2 Ex)
STATUS	Existing
LOCATION	Northern boundary of facility; see Unit Drawing C34
UNIT TYPE/ACTIVITY	Container storage area
PHYSICAL DESCRIPTION	About 1,885 square feet of additional surface area will be provided for a total area of 4,098 square feet. The area will be bermed and made of reinforced concrete coated with a chemical-resistant coating comprised of a 100% solids epoxy with a flexible joint seal.
CONTAINER STORAGE LIMIT	46,900 gallons of waste in containers (drums or tote bins)
SECONDARY CONTAINMENT	The capacity determination for CS-2 is described below based on double-stacking. In accordance with 22 CCR 66264.175, this containment area must be capable of holding 10% of the combined capacity of the containers, plus the maximum 25-year, 24-hour rainfall amount. For 156 tote bins or 46,900 gallons maximum, the required containment volume is 4,690 gallons. TI&CS Report 15-10-9 in Volume III, Appendix A shows that the available containment capacity is 9,461 gallons for IBCs and, therefore, the containment capacity meets the minimum required.

REMOVAL OF ACCUMULATED LIQUIDS	Any liquids, rainfall or wastes, accumulating within the containment area will be manually pumped within 24 hours to either another waste tank on-site or, if solely rainwater, to rainwater storage tanks R-1, R-2, R-3, T-3, or to wastewater treatment tanks.
RUN-ON CONTROL	The facility perimeter is bermed to prevent rainfall run-on from off-site. The facility is not in the 100-year floodplain, so run-on from floods will not impact the facility. Perimeter berms for the containment area prevent rainfall falling outside the containment area from running into this area.
ALLOWABLE RCRA AND CALIFORNIA WASTE CODES	Wastes managed in this area may carry any currently approved waste codes in Permit No. 91-3-TS-002, except D001 wastes (which must be 50 feet from the property boundary).

5.2 Container Storage Area 1 Ex (CS-2 Ex) Containment Area

5.2.1 DESCRIPTION – PROPOSED CS-2 EX MODIFICATIONS

The facility is planning to extend the area of CS-2 to the south and west to accommodate 30-inch aisle spacing. This describes the area after it is expanded. For the purposes of this application, the modified area will be referred to as CS-2 Expanded (or CS-2 Ex). About 1,885 square feet of additional surface area will be provided to 4,098 gross square feet. Although there will be a net gain in storage surface area, the planned storage capacity of 46,900 gallons will remain the same. See Unit Drawing C34 and TI&CS Report #15-10-9 (Attachment 8).

The CS-2 Ex containment area will be coated with a chemical-resistant coating comprised of a 100% solids epoxy with a flexible joint seal. Alternative coatings equal to or better than Novalac may be used.

It is assumed that any of the facility's currently approved waste codes in Permit No. 91-3-TS-002 can be managed in this area, provided wastes are not incompatible with one another and provided they are not D001 ignitable characteristic wastes (which must be 50 feet from the property boundary).

Containers received at the facility will be UN and DOT-approved shipping containers. Of the container types described, 55-gallon plastic containers (placed three or four drums to a pallet) and IBCs are expected to be the most common. PTI will single or double-stack the pallets or IBCs.

5.2.2 CONTAINMENT CAPACITY – CS-2 EX AREA

The capacity determination for the expanded area CS-2 Ex is described below based on double-stacking. A minimum aisle space of 30 inches between rows is provided to allow for routine inspections, safe handling, and emergency response. For IBCs with a standard 48-inch-by-42-inch pallet, the container storage capacity is 156 IBCs or 46,900 gallons.

In accordance with 22 CCR 66264.175, this containment area must be capable of holding 10% of the combined capacity of the containers, plus the maximum 25-year, 24-hour rainfall amount. For 156 tote bins or 46,900 gallons maximum, the required containment volume is 4,690 gallons. TI&CS Report 15-10-9 (see Attachment 8) shows that the available containment capacity is 9,461 gallons for IBCs and, therefore, the containment capacity meets the minimum required.

5.2.3 PRECIPITATION AND RUN-ON CONTROL

CS-2 Ex is located outside and is exposed to rainfall. The maximum 25-year, 24-hour rainfall amount is 4.5 inches (see Operating Plan Section B5.3) and is accounted for in the containment volume calculations described above. The facility perimeter is bermed to prevent rainfall run-off, as well as run-on from off-site. The facility is not in the 100-year floodplain, so run-on from floods will not impact the facility. A new 69.8-foot rollover ramp will be added to the south side and will be 14.4 inches high at the peak. The access ramp at the open south side of CS-2 Ex is greater than the height of the containment wall in that area, which assures the proper containment volume will be maintained since no spilled contents and/or rainwater can exit the containment system, and rainfall falling outside the containment area is prevented from running into this area. The grade outside CS-2 slopes from north-northeast to south-southwest, further directing rainwater away from the CS-2 containment berm.

5.2.4 CS-2 EX CONSTRUCTION PLAN

The CS-2 container storage area will be expanded to the west and south to 4,098 square feet by adding 1,885 square feet to the existing area. The expanded area will have a 13.25-inch curb on the east and west sides and a ramp down from level grade on the south side. The ramp will change elevation by 13.35 inches over 12 feet. The area where the expansion will take place is currently an asphalt driveway used for receiving containers of incoming waste.

During the construction of the CS-2 Ex modifications, there will be short periods of time when containment berms will be disturbed. During this time, a temporary secondary containment berm will be created by using sandbags and polyethylene sheeting to create a berm of at least the same height as the former containment area wall when waste remains in CS-2. The temporary berm will remain in place during any time the containment wall is disturbed until construction of the new additional area is completed with the containment wall and the coating is installed and ready for use.

Core samples will be obtained to determine the characteristics of soil and disposal and/or treatment methods for any soil that is exposed and/or removed. Soil samples will be collected following the methodology in the November 22, 2006, "Revised Draft Pond 1 Soil Sampling and Analysis Plan," which was submitted and approved as part of the 2006 Tank Relocation Plan. Samples in this area are not expected to be collected more than 5 feet bgs and would be collected using a hydraulically driven direct push rig mounted to a heavy-duty pickup truck or small work truck.

Existing asphalt and concrete covering in the new expanded area for CS-2 will be removed. Concrete or asphalt debris and excavated soil will be assumed to be hazardous waste or separately characterized in accordance with California regulations to determine if it is hazardous waste. About 90 cubic yards of soil will be removed in this area. Equipment used will include a gasoline-powered concrete/asphalt saw, diesel-powered off-road backhoe/loader (such as a Caterpillar 416) with a demolition ram attachment, diesel-powered off-road skidsteer loader with buckets, diesel-powered off-road mini-excavator with buckets, and diesel-powered end dump trucks.

After the containment area is cleared, about 30 cubic yards of clean fill will be brought on-site by diesel-powered end dump trucks and compacted. Construction of the containment area would involve fabricating wood and/or cardboard forms and installing a rebar mesh. Concrete and concrete reinforcement details will be according to the engineering plans to meet local codes. The concrete will contain #4 rebar or greater. The new concrete will be at least 8 inches thick. The concrete will be poured directly from the concrete truck or by using a concrete pumping truck. The existing south containment curb of CS-2 and existing ramp on the west side will remain intact as long as possible during construction

to maintain containment of the area. At the time that construction requires this curb to be breached, adequate temporary containment structures will be put in place to contain contents stored in the area. Equipment used for this work will be diesel-powered off-road reach forklifts, diesel-powered concrete truck, diesel-powered concrete pumps (on-road), and concrete vibrators.

Concrete curbs will be poured. The curbs will contain #4 rebar or greater and be doweled with rebar to the concrete foundation. The equipment used for this work will be the same as used in pouring the foundation described above.

After the concrete has cured for at least 7 days, the floor and interior walls will be coated with a 100% solids Novalac epoxy lining system (or equal) that is chemically resistant to the types of wastes handled by the facility.

ATTACHMENT 2 – UNIT DRAWINGS

C-2 Site Plan – Current Operations

C-9 Unit W – Current Tank and Containment Details

C-10 CS1 – Current Details

C-11 CS2 – Current Details

C-16 Unit J – Future Tank and Containment Details

C-19 Unit W – Future Tank and Containment Details

C-20 CS1ex – Future Detail

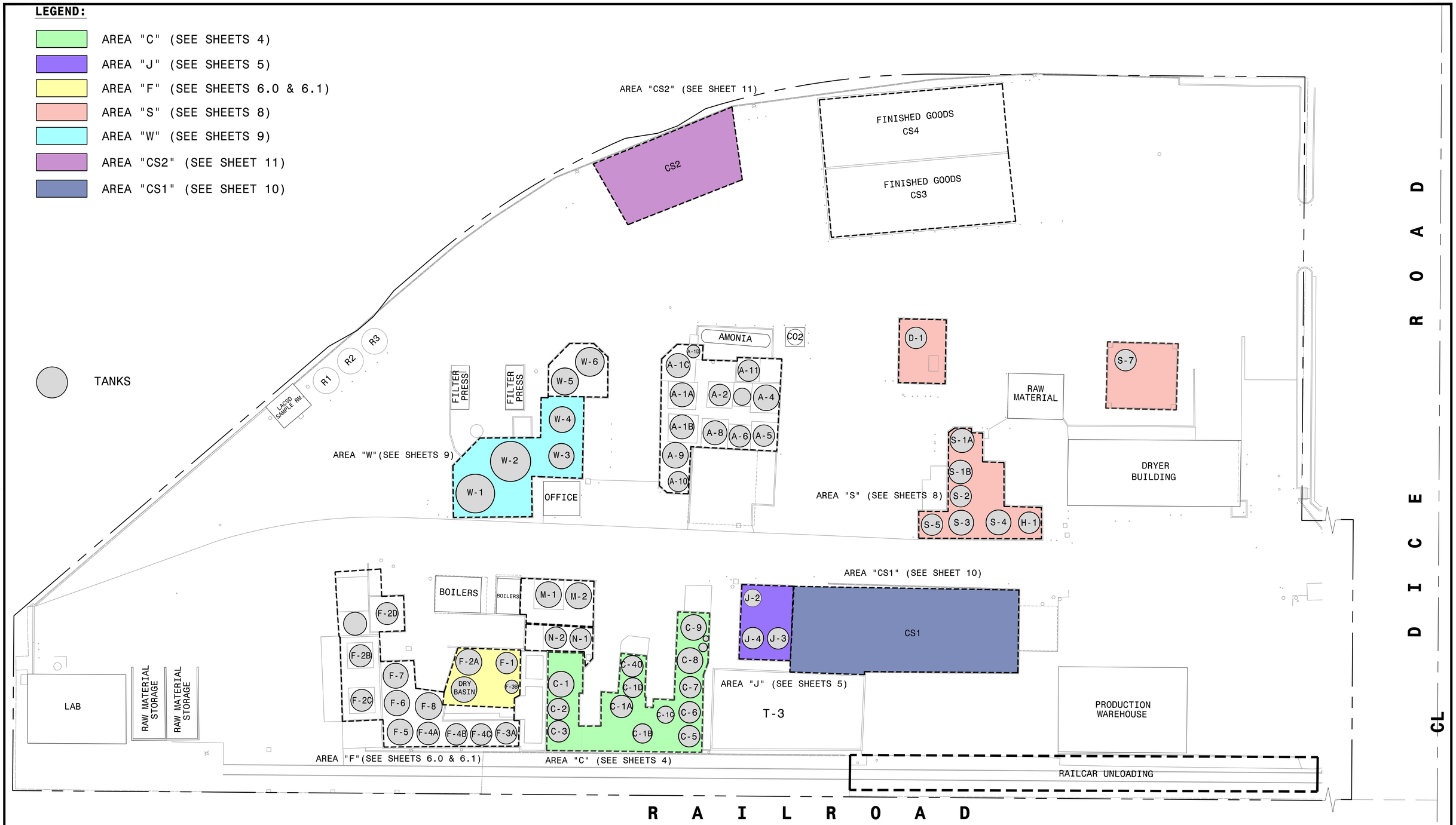
C-33 Unit W – Future Pumping Station

C-34 CS2ex – Future Details

LEGEND:

- AREA "C" (SEE SHEETS 4)
- AREA "J" (SEE SHEETS 5)
- AREA "F" (SEE SHEETS 6.0 & 6.1)
- AREA "S" (SEE SHEETS 8)
- AREA "W" (SEE SHEETS 9)
- AREA "CS2" (SEE SHEET 11)
- AREA "CS1" (SEE SHEET 10)

TANKS



OVERALL SITE MAP

SCALE: 1" = 20'

30' 0 30' 60' 90'

SCALE: 1" = 30'

NO.	DATE	REVISION DESCRIPTION	APP'D	DATE

PLUMP ENGINEERING INC.
CONSULTING ENGINEERS IN CIVIL / STRUCTURAL ENGINEERING & SURVEYING
914 E. KATELLA AVENUE
ANAHEIM, CALIFORNIA 92805
(714) 385-1835, FAX (714) 385-1834

REGISTERED PROFESSIONAL ENGINEER TRYFON P. TRYFONOPOULOS NO. 65859 EXP.12/31/15 CIVIL STATE OF CALIFORNIA

12 / 3 / 2015

TRYFON TRYFONOPOULOS DATE

SITE PLAN-CURRENT OPERATIONS

PHIBRO-TECH, INC.
PHIBRO-TECH
8851 DICE ROAD, SANTA FE SPRINGS, CALIFORNIA 90670
(562) 698-8036

JOB NO. 131131.CS

DATE: 12 / 3 / 2015

SHEET **C2**

2 OF 40 SHEETS

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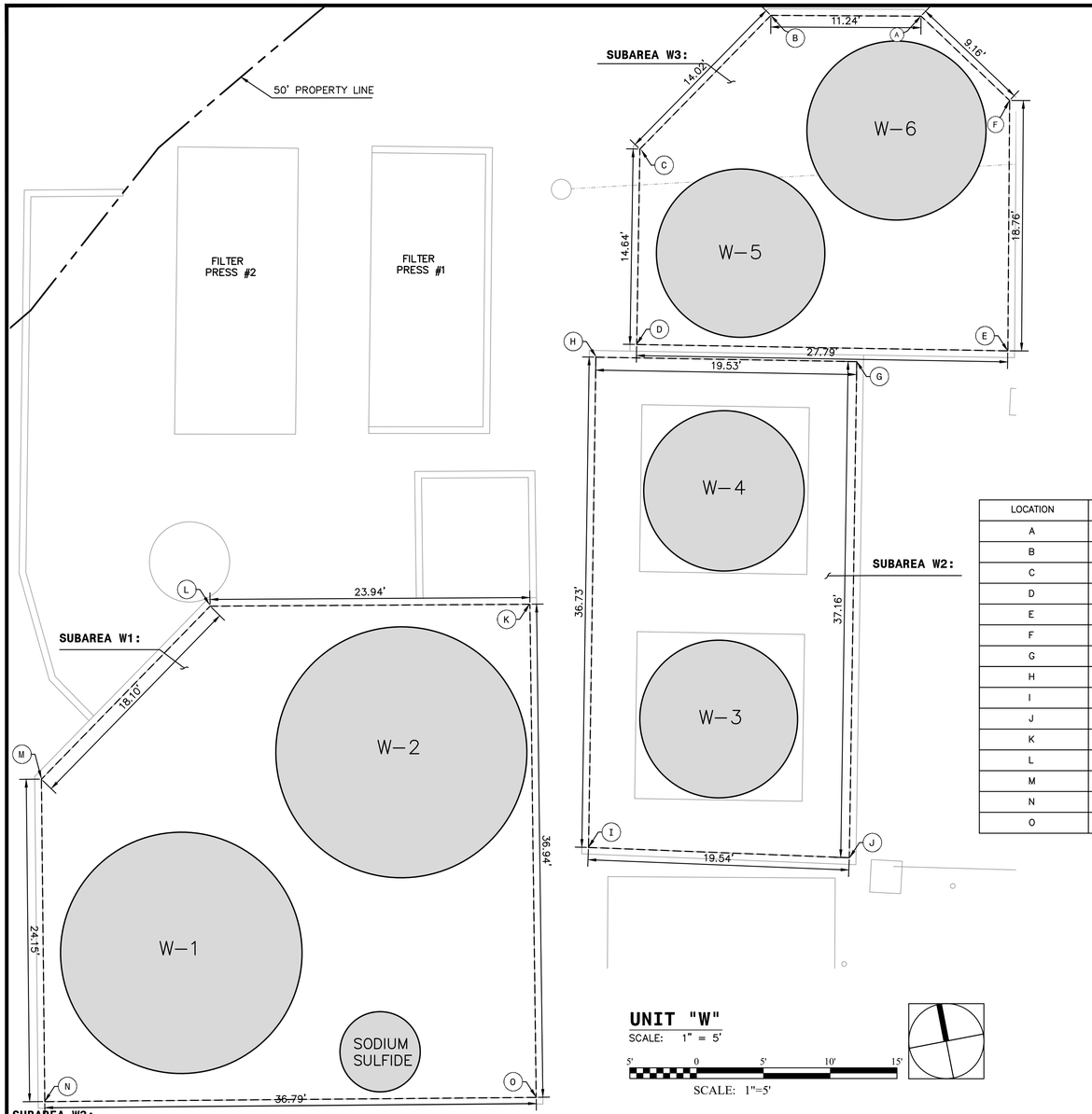


LOCATION	CONTAINMENT HEIGHT	WALL THICKNESS
A	47"	6"
B	48"	6"
C	47"	6"
D	48"	6"
E	48"	6"
F	47"	6"
G	74"	8"
H	74"	8"
I	77"	8"
J	74"	8"
K	58"	8"
L	60"	8"
M	58"	8"
N	58"	8"
O	58"	8"

UNIT "W"

SCALE: 1" = 5'

5' 0 5' 10' 15'

SCALE: 1"=5'

SUBAREA W1:

Containment Area W1 (Existing)

Tank Identification	Volume (gal)	Volume (cf)	Diameter (ft)	Footprint (ft^2)	Location	Shell Hgt (in.) w/in containment	Shell vol (ft^3)
W-1	30,457.00	4,071.79	18	254.34	Base	40	847.8
W-2	30,457.00	4,071.79	18	254.34	Base	40	847.8
Sodium Sulfide	1,057.45	141.37	6	28.26	Base	40	94.2
Totals	61,971.45	8,143.58		508.68		This is the area of the tank that would occupy containment vol. and must be excluded.	1789.8

Pads Internal to Containment Area

Description	mesions (width)(ft	Length (ft.)	Depth (ft.)	Vol. (ft^3)
Base	0	0	0	0.00
Total				0.00

Required Containment Volume

Ref.	Item	value	Comments
A.	Volume of largest Tank (Gal)	30,457.00	Tank W-2
B.	10% of Total Tank Volume(Gal)	6,197.14	
C.	Required Containment Volume (Gal)	30,457.00	Greater of (A) or (B)
D.	**Required Containment Volume (ft^3)**	**4,071.79**	

Available Containment Volume

E.	Containment Area (ft^2)	1,276.98	Irregular
F.	Berm Height (in.)	58.00	overall height
G.	Gross Volume Total (ft^3)	6,172.07	Area (E.) x Height (F)/12
H.	Volume Rainfall (ft^3)	478.87	Rainfall at 25 yr-24hr max: 4.5 inches
K.	Volume of other Tank Shells (ft^3)	942.00	Volume of other shells(area of each tank x [dike height - pad height]
L.	Volume of Pads (ft^3)	-	
M.	**Available Containment Volume (ft^3)**	4,751.20	Gross Vol. (G) - Rain Vol (H) -Tank Shells (K) -Pad (L)
N.	**Meets Volume Requirments?**	Yes	If Line (M) > Line (D)

SUBAREA W2:

Containment Sub Area W2 (Existing)

Tank Identification	Volume (gal)	Volume (cf)	Diameter (ft)	Footprint (ft^2)	Location	Shell Hgt (in.) w/in containment	Shell vol (ft^3)
W-3	12,500.00	1,671.12	12	113.04	Npad	70	659.40
W-4	12,500.00	1,671.12	12	113.04	Spad	70	659.40
Totals	25,000.00	3,342.25		226.08		This is the area of the tank that would occupy containment vol. and must be excluded.	1318.80

Pads Internal to Containment Area

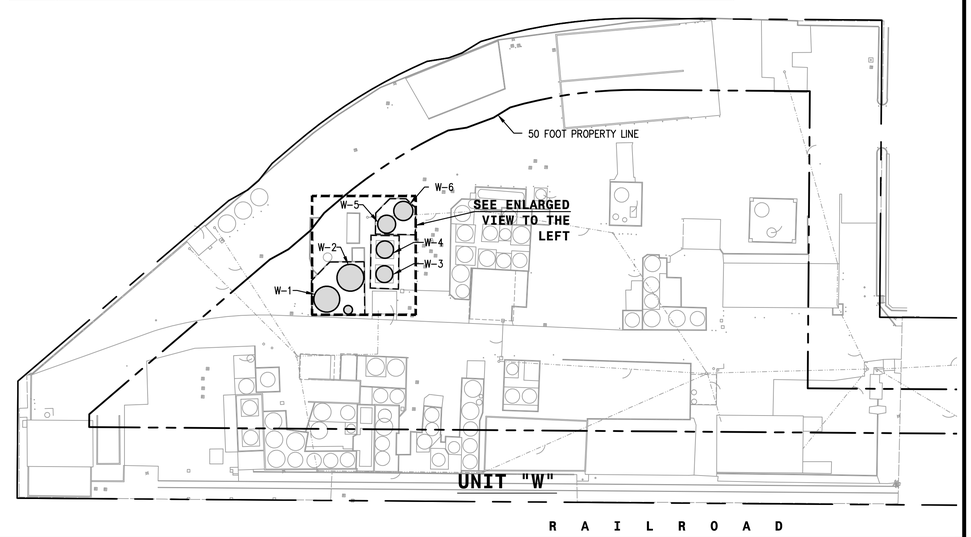
Description	Dimesions (width)(ft.)	Length (ft.)	Depth (in.)	Vol. (ft^3)
North Pad of Subarea W	12.5	12.5	4	52.08
South Pad of Subarea W	12.5	12.5	4	52.08
Total				104.17

Required Containment Volume

Ref.	Item	value	Comments
A.	Volume of largest Tank (Gal)	12,500.00	Tank W-4
B.	10% of Total Tank Volume(Gal)	2,500.00	
C.	Required Containment Volume (Gal)	12,500.00	Greater of (A) or (B)
D.	**Required Containment Volume (ft^3)**	**1,671.12**	

Available Containment Volume

E.	Containment Area (ft^2)	721.60	Rectangle
F.	Berm Height (in.)	74.00	overall height
G.	Gross Volume Total (ft^3)	4,449.87	Area (E.) x Height (F)/12
H.	Volume Rainfall (ft^3)	270.60	Rainfall at 25 yr-24hr max: 4.5 inches
K.	Volume of other Tank Shells (ft^3)	659.40	Volume of other shells(area of each tank x [dike height - pad height]
L.	Volume of Pads (ft^3)	104.17	
M.	**Available Containment Volume (ft^3)**	3,415.70	Gross Vol. (G) - Rain Vol (H) -Tank Shells (K) -Pad (L)
N.	**Meets Volume Requirments?**	yes	If Line (M) > Line (D)



SUBAREA W3:

Containment Sub Area W3 (Existing)

Tank Identification	Volume (gal)	Volume (cf)	Diameter (ft)	Footprint (ft^2)	Location	Shell Hgt (in.) w/in containment	Shell vol (ft^3)
W-5	22,400.00	2,994.65	13	132.67	Base	47	519.60
W-6	22,400.00	2,994.65	13	132.67	Base	47	519.60
Totals	44,800.00	5,989.30		265.33		This is the area of the tank that would occupy containment vol. and must be excluded.	1,039.21

Pads Internal to Containment Area

Description	Dimesions (width)(ft.)	Length (ft.)	Depth (ft.)	Vol. (ft^3)
Base	0	0	0	0.00
Total				0.00

Required Containment Volume

Ref.	Item	value	Comments
A.	Volume of largest Tank (Gal)	22,400.00	Tank W-6
B.	10% of Total Tank Volume(Gal)	4,480.00	
C.	Required Containment Volume (Gal)	22,400.00	Greater of (A) or (B)
D.	**Required Containment Volume (ft^3)**	**2,994.65**	

Available Containment Volume

E.	Containment Area (ft^2)	618.81	Irregular
F.	Berm Height (in)	47.00	overall height
G.	Gross Volume Total (ft^3)	2,423.67	Area (E.) x Height (F)/12
H.	Volume Rainfall (ft^3)	232.05	Rainfall at 25 yr-24hr max: 4.5 inches
K.	Volume of other Tank Shells (ft^3)	519.60	Volume of other shells(area of each tank x [dike height - pad height]
L.	Volume of Pads (ft^3)	-	
M.	**Available Containment Volume (ft^3)**	1,672.01	Gross Vol. (G) - Rain Vol (H) -Tank Shells (K) -Pad (L)
N.	**Meets Volume Requirments?**	no	If Line (M) > Line (D)

KEY MAP

SCALE: 1" = 50'

50' 0 50' 100' 150'

SCALE: 1"=50'

NO.	DATE	REVISION DESCRIPTION	APP'D	DATE

PLUMP ENGINEERING INC.
CONSULTING ENGINEERS IN CIVIL / STRUCTURAL ENGINEERING & SURVEYING
914 E. KATELLA AVENUE
ANAHEIM, CALIFORNIA 92805
(714) 385-1835, FAX (714) 385-1834

REGISTERED PROFESSIONAL ENGINEER TRYFON P. TRYFONOPOULOS NO. 65859 EXP.12/31/15 CIVIL STATE OF CALIFORNIA

12 / 3 / 2015

TRYFON TRYFONOPOULOS DATE

UNIT W-CURRENT TANK AND CONTAINMENT DETAILS

PHIBRO-TECH, INC.
PHIBRO-TECH
8851 DICE ROAD, SANTA FE SPRINGS, CALIFORNIA 90670
(562) 698-8036

JOB NO. 131131.CS

DATE: 12 / 3 / 2015

SHEET **C09**

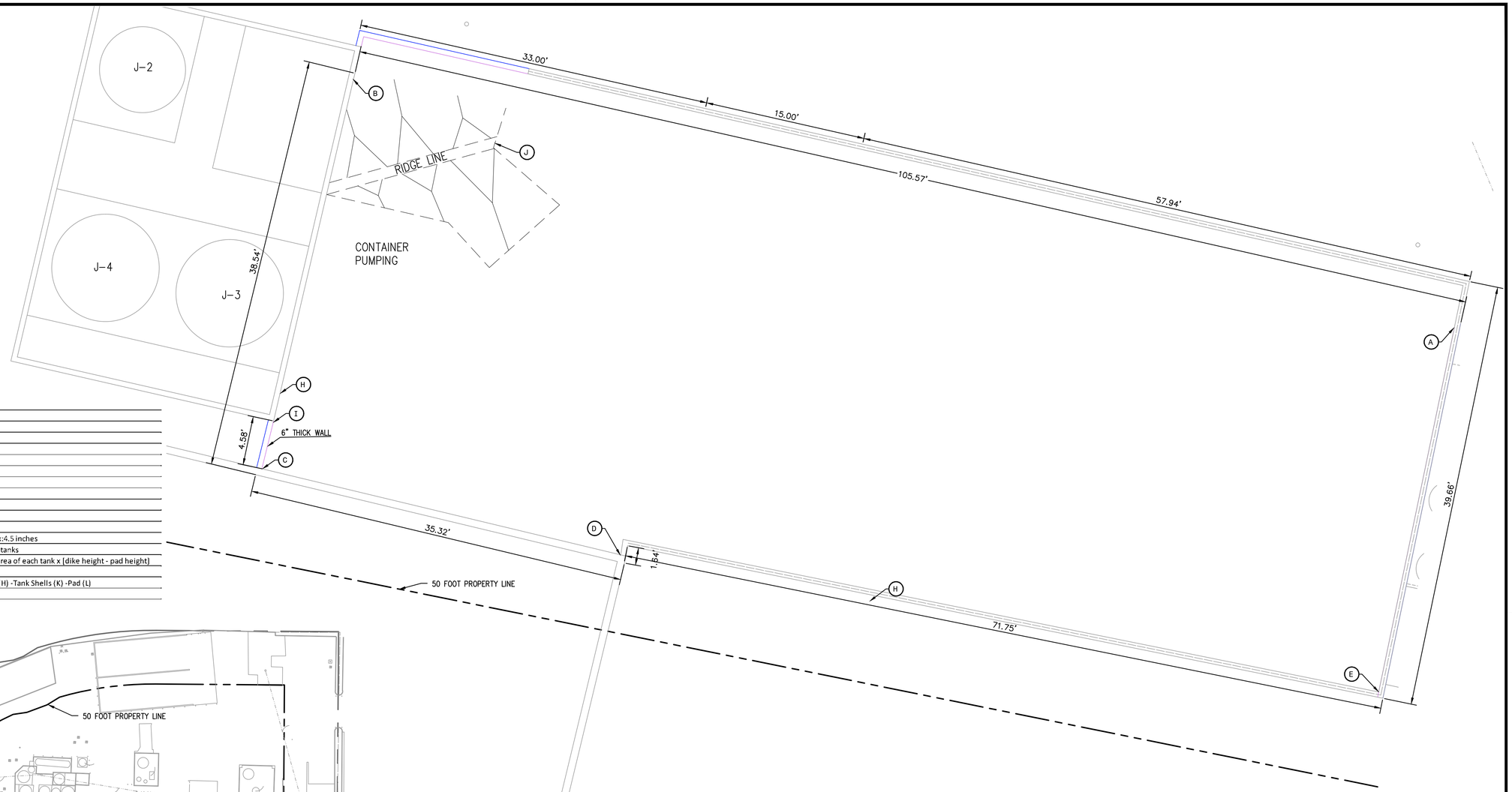
9 OF 40 SHEETS

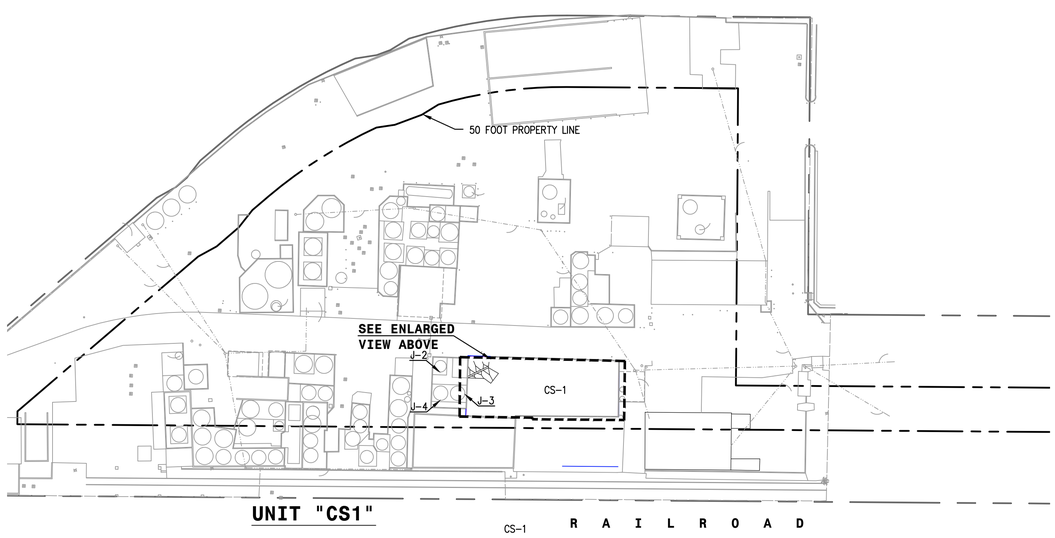
P:\Civil & Surveying\Projects\131131 Santa Fe Springs Topo\dwg\131131C09- AREA W.1&2.dwg Dec 03, 2015 - 1:37pm

LOCATION	CONTAINMENT HEIGHT	WALL THICKNESS
A	11"	6"
B	0"	6"
C	17"	6"
D	10"	6"
E	10"	6"
I	17"	6"
G	10"	6"
H	28"	6"
J	10"	—

Required Containment Volume			
Ref.	**Item**	**value**	**Comments**
A.	Volume of largest Tank (Gal)	6,900.00	
B.	10% of Total Tank Volume(Gal)	690.00	
C.	Required Containment Volume (Gal)	690.00	
D.	**Required Containment Volume (ft^3)**	**922.46**	

Available Containment Volume			
E.	Containment Area (ft^2)	3,817.54	Irregular
F.	Berm Height (in.)	10.00	overall height
G.	Gross Volume Total (ft^3)	3,181.28	Area (E.) x Height (F)/12
H.	Volume Rainfall (ft^3)	1,431.58	Rainfall at 25 yr-24hr max:4.5 inches
J.	Footprint of other Tank Shells (ft^2)	-	Subtract out footprint of tanks
K.	Volume of other Tank Shells (ft^3)	-	Volume of other shells(area of each tank x [dike height - pad height]
L.	Volume of Pads (ft^3)	-	
M.	**Available Containment Volume (ft^3)**	1,749.71	Gross Vol. (G) - Rain Vol (H) -Tank Shells (K) -Pad (L)
N.	**Meets Volume Requirments?**	Yes	If Line (M) > Line (D)





UNIT "CS1"

KEY MAP

SCALE: 1" = 50'

50' 0 50' 100' 150'

SCALE: 1"=50'

UNIT "CS1"

SCALE: 1" = 5'

5' 0 5' 10' 15'

SCALE: 1"=5'

NO.	DATE	REVISION DESCRIPTION	APP'D	DATE

PLUMP ENGINEERING INC.
CONSULTING ENGINEERS IN
CIVIL / STRUCTURAL
ENGINEERING & SURVEYING
914 E. KATELLA AVENUE
ANAHEIM, CALIFORNIA 92805
(714) 385-1835, FAX (714) 385-1834

REGISTERED PROFESSIONAL ENGINEER
TRYFON P. TRYFONOPOULOS
NO. 65859
EXP.12/31/15
CIVIL
STATE OF CALIFORNIA

12 / 3 / 2015
TRYFON TRYFONOPOULOS DATE

CS1-CURRENT DETAILS

PHIBRO-TECH, INC.
PHIBRO-TECH
8851 DICE ROAD, SANTA FE SPRINGS, CALIFORNIA 90670
(562) 698-8036

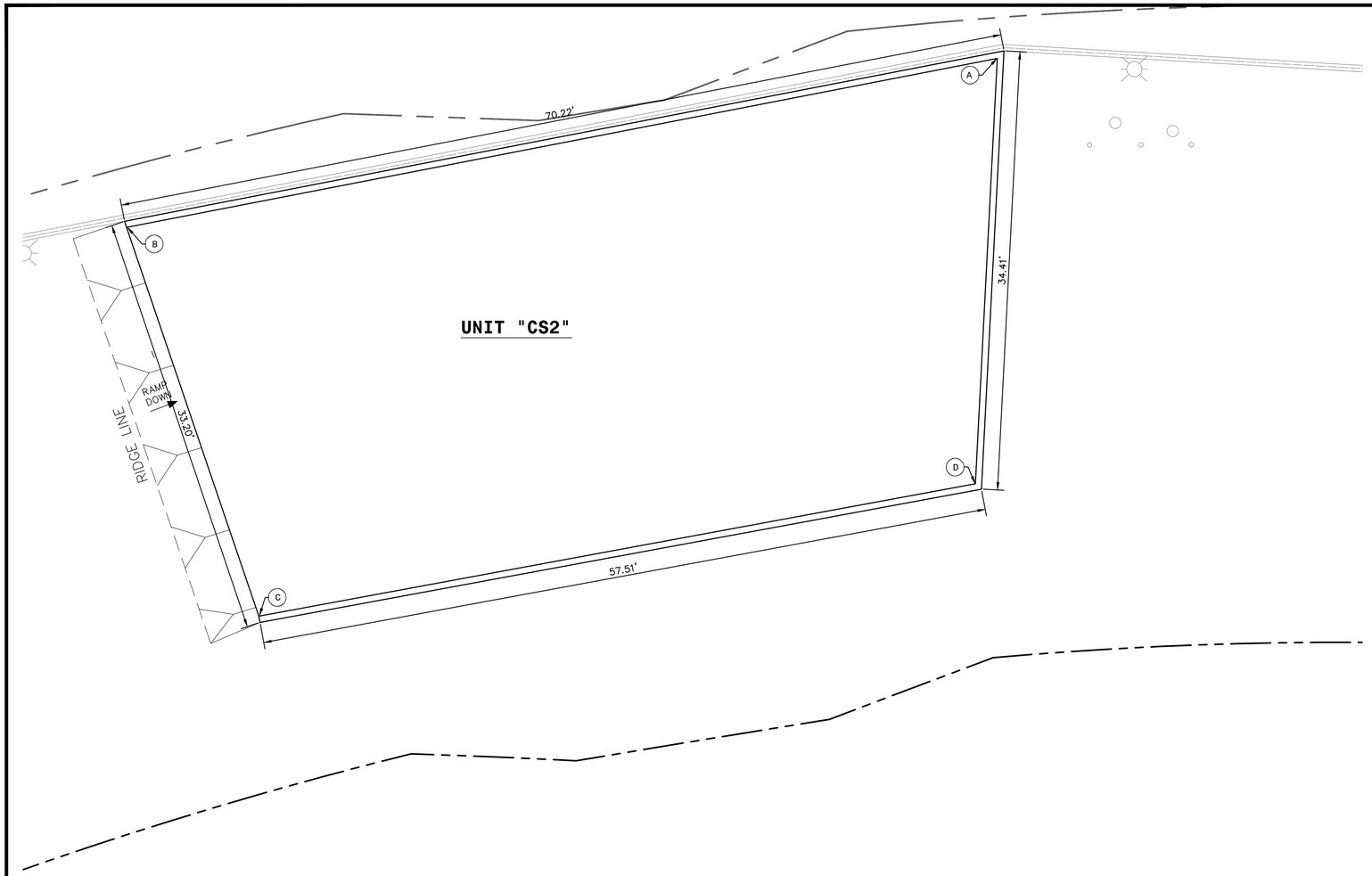
JOB NO. 131131.CS

DATE: 12 / 3 / 2015

SHEET **C10**

10 OF 40 SHEETS

P:\Civil & Surveying\Projects\131131 Santa Fe Springs Topo\dwg\131131C10 - CS1 CURRENT DETAILS.dwg Dec 03, 2015 - 1:37pm



UNIT "CS2"

Required Containment Volume			
Ref.	Item	value	Comments
A.	Gross Volume (Gallons)	12723	
B.	Volume Rainfall (Gallons)	6206	
C.	Displacement Volume of Containers (Gallons)	827	
D.	**Available Containment Volume (Gallons)**	**4690**	A-B-C
E.	Maximum Storage Capacity	46900	D. multiplied by 10

✳ NOTE: FOR DETAILS OF CALCULATIONS SEE REPORT "DESIGN OF CONTAINMENT FOR STORAGE AREA CS-2 LOCATED AT THE NORTH END OF THE PHIBOTECH FACILITY IN SANTA FE SPRINGS, CA"

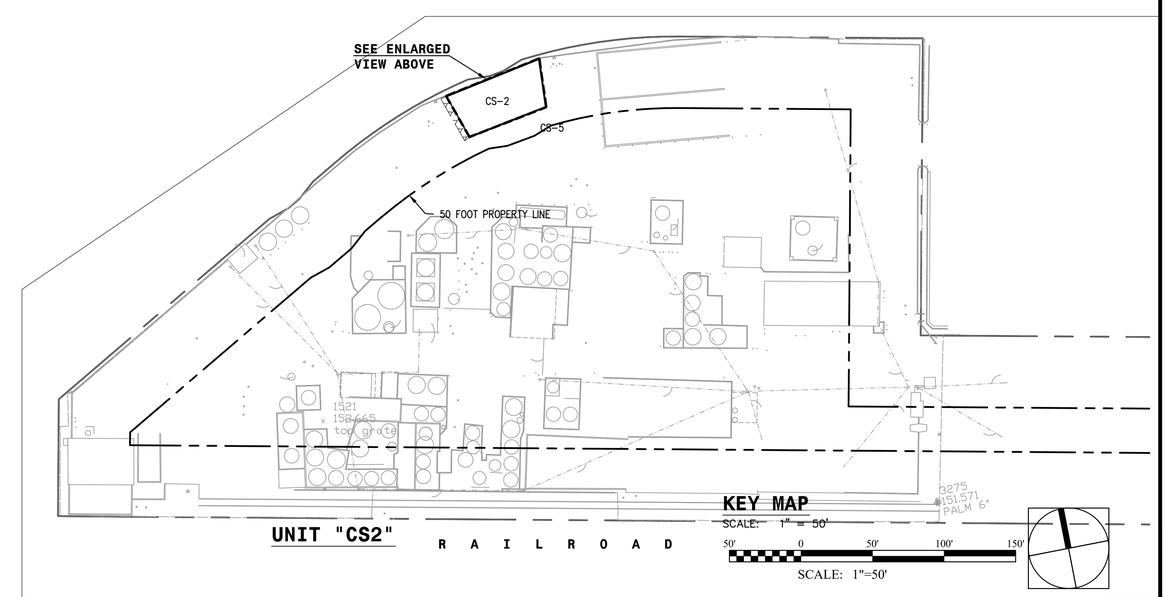
LOCATION	CONTAINMENT HEIGHT	WALL THICKNESS
A	7"	6"
B	5"	6"
C	9"	6"
D	13"	6"

UNIT "CS2"

SCALE: 1" = 5'

5' 0 5' 10' 15'

SCALE: 1"=5'



KEY MAP

SCALE: 1" = 50'

50' 0 50' 100' 150'

SCALE: 1"=50'

NO.	DATE	REVISION DESCRIPTION	APP'D	DATE

PLUMP ENGINEERING INC.
CONSULTING ENGINEERS IN CIVIL / STRUCTURAL ENGINEERING & SURVEYING
914 E. KATELLA AVENUE
ANAHEIM, CALIFORNIA 92805
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REGISTERED PROFESSIONAL ENGINEER TRYFON P. TRYFONOPOULOS NO. 65859 EXP.12/31/15 CIVIL STATE OF CALIFORNIA

TRYFON TRYFONOPOULOS 12 / 3 / 2015 DATE

CS2-CURRENT DETAILS

PHIBRO-TECH, INC.

PHIBRO-TECH

8851 DICE ROAD, SANTA FE SPRINGS, CALIFORNIA 90670
(562) 698-8036

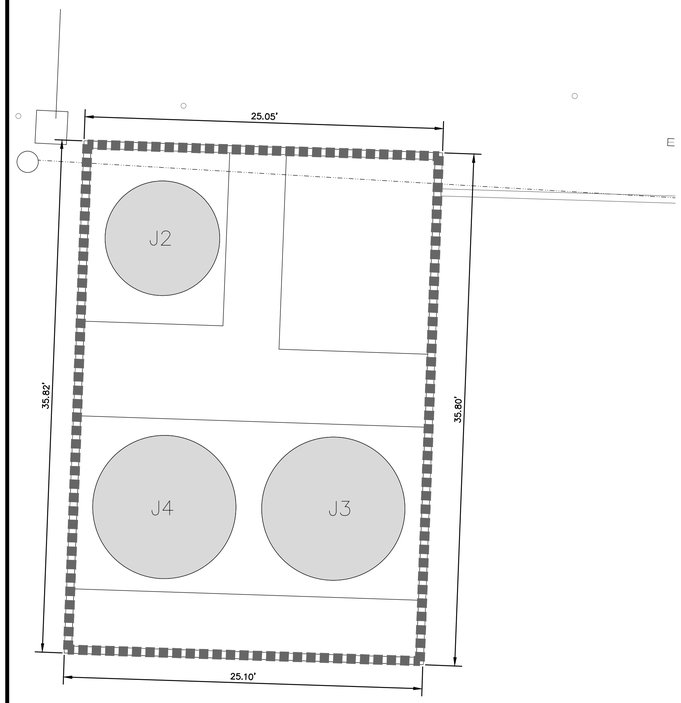
JOB NO. 131131.CS

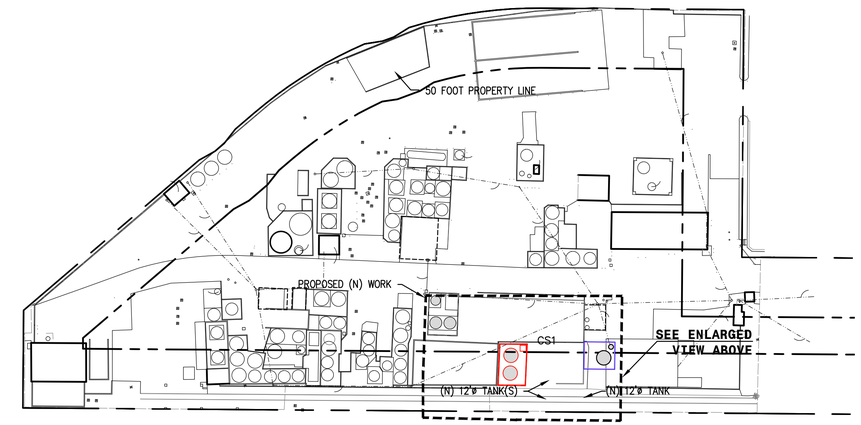
DATE: 12 / 3 / 2015

SHEET **C11**

11 OF 40 SHEETS

P:\Civil & Surveying\Projects\131131 Santa Fe Springs Topo\dwg\131131C11 - AREA CS2.dwg Dec 03, 2015 - 1:37pm



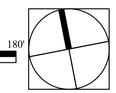


UNIT "J"

R A I L R O A D

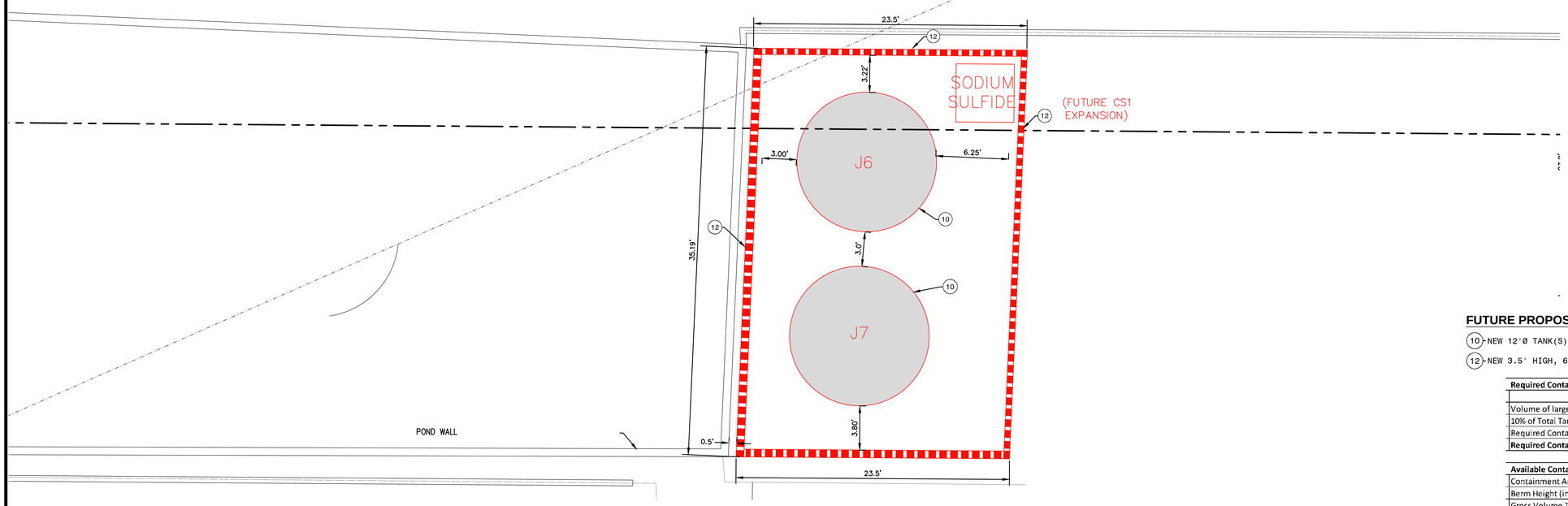
60' 0 60' 120' 180'

SCALE: 1"=60'



KEY MAP

SCALE: 1" = 60'



AREA "J"

SCALE: 1" = 10'

5' 0 5' 10' 15'

SCALE: 1"=5'

FUTURE PROPOSED CONSTRUCTION NOTES:

(10) - NEW 12'Ø TANK(S).(COLOR ——)

(12) - NEW 3.5' HIGH, 6" THICK POURED CONCRETE WALL.(COLOR ——)

Required Containment Volume		
Item	**value**	**Comments**
Volume of largest Tank (Gal)	12,500.00	Containment of J7
10% of Total Tank Volume(Gal)	1,250.00	
Required Containment Volume (Gal)	1,250.00	
Required Containment Volume (ft^3)	**1,671.12**	

Available Containment Volume		
Containment Area (ft^2)	760.00	Irregular
Berm Height (in.)	42.00	overall height
Gross Volume Total (ft^3)	2,660.00	Area (E.) x Height (F)/12
Volume Rainfall (ft^3)	285.00	Rainfall at 25 yr-24hr max:4.5 inches
Footprint of other Tank Shells (ft^2)	-	Subtract out footprint of tanks
Volume of other Tank Shells (ft^3)	145.00	Volume of other shells(area of each tank x [dike height - pad height]
Volume of Pads (ft^3)	-	
Available Containment Volume (ft^3)	2,230.00	Gross Vol. (G) - Rain Vol (H) -Tank Shells (K) -Pad (L)
Meets Volume Requirments?	yes	If Line (M) > Line (D)

NO.	DATE	REVISION DESCRIPTION	APP'D	DATE

PLUMP ENGINEERING INC.
CONSULTING ENGINEERS IN CIVIL / STRUCTURAL ENGINEERING & SURVEYING
914 E. KATELLA AVENUE
ANAHEIM, CALIFORNIA 92805
(714) 385-1835, FAX (714) 385-1834

REGISTERED PROFESSIONAL ENGINEER TRYFON P. TRYFONOPOULOS NO. 65859 EXP.12/31/15 CIVIL STATE OF CALIFORNIA

12 / 3 / 2015
TRYFON TRYFONOPOULOS DATE

UNIT J-FUTURE TANK AND CONTAINMENT DETAILS

PHIBRO-TECH, INC.
8851 DICE ROAD, SANTA FE SPRINGS, CALIFORNIA 90670
(562) 698-8036

JOB NO. 131131.CS

DATE: 12 / 3 / 2015

SHEET C16

16 OF 40 SHEETS

P:\Civil & Surveying\Projects\131131 Santa Fe Springs Topo\dwg\131131C16-UNIT J Future Work.dwg Dec 03, 2015 - 1:39pm

FUTURE PROPOSED CONSTRUCTION NOTES:

(3) - NEW 14' DIA. TANK. (COLOR ——)

(14) - NEW 6' (HEIGHT OF THE CONTAINMENT WALL), 6" THICK WALL. (COLOR ——)

(16) - NEW FILTER PRESS.(COLOR ——)

(17) - NEW 72" HIGH, 6" THICK WALL. (COLOR ——)

FUTURE PROPOSED DEMOLITION NOTES:

[3] - REMOVE AND DISPOSE OF EXISTING CMU WALL.(COLOR ——)

SUBAREA W4: Containment Sub Area W4 (Proposed)

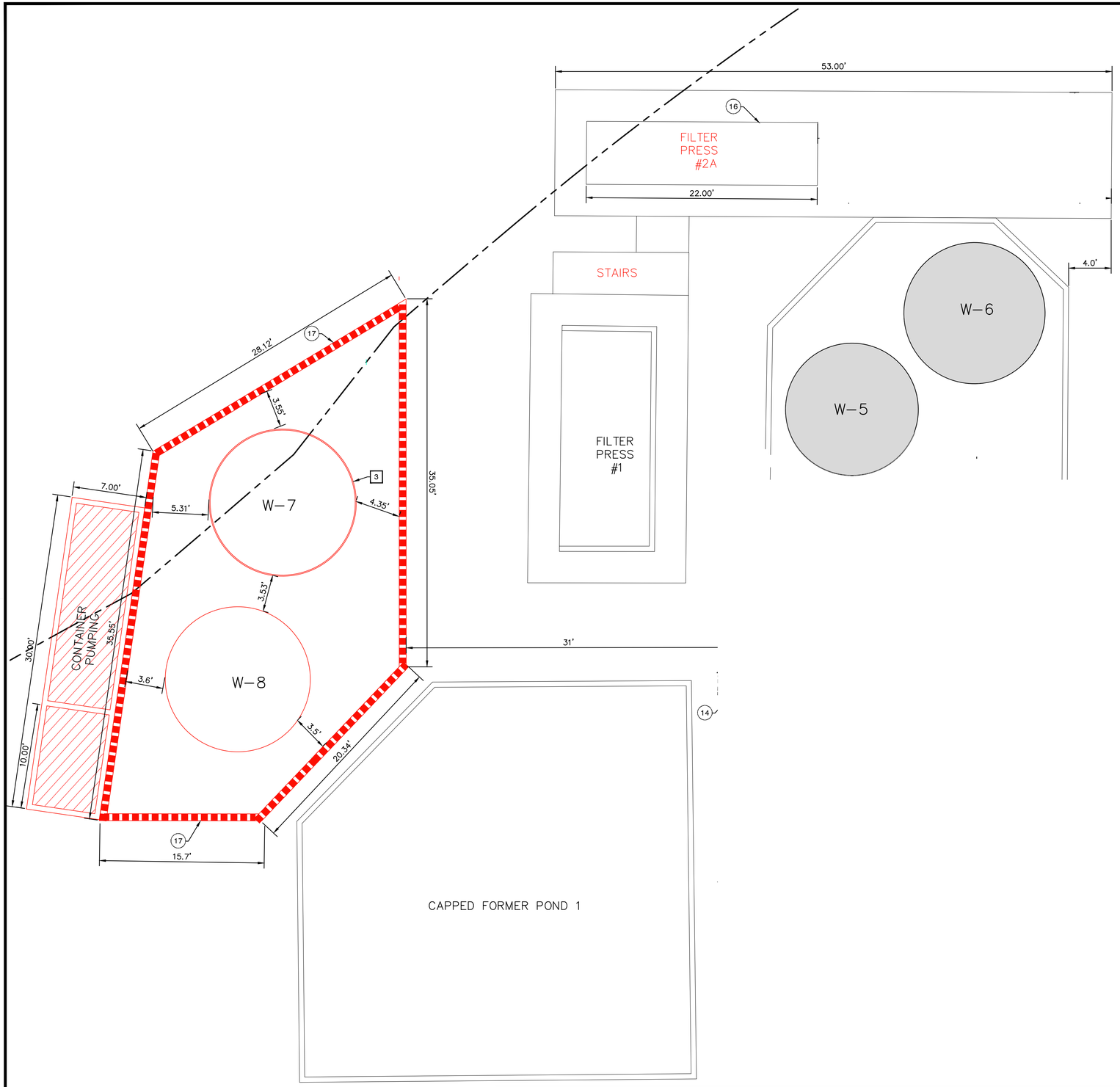
Tank Identification	Volume (gal)	Volume (cf)	Diameter (ft)	Footprint (ft^2)	Location	Shell Hgt (in.) w/in containment	Shell vol (ft^3)
W-7	30,500.00	4,077.54	14	153.86	New Pad	66	846.23
W-8	30,500.00	4,077.54	14	153.86	New Pad	66	846.23
Totals	61,000.00	8,155.08		307.72		This is the area of the tank that would occupy containment vol. and must be excluded.	1692.46

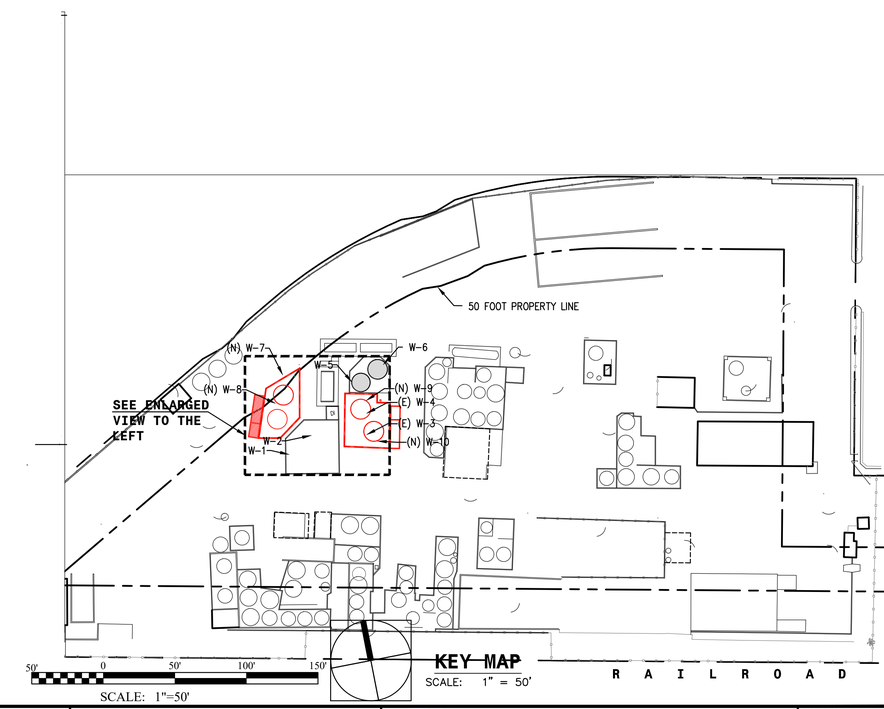
Pads Internal to Containment Area

Description	Dimesions (width)(ft.)	Length (ft.)	Depth (in.)	Vol. (ft^3)
New Pad	0	0	0	0.00
Total				0.00

	Required Containment Volume		
Ref.	**Item**	**value**	**Comments**
A.	Volume of largest Tank (Gal)	30,500.00	Tank W-7
B.	10% of Total Tank Volume(Gal)	4,000.00	
C.	Required Containment Volume (Gal)	30,500.00	Greater of (A) or (B)
D.	**Required Containment Volume (ft^3)**	**4,077.54**	

	Available Containment Volume		
E.	Containment Area (ft^2)	925.00	irregular
F.	Berm Height (in.)	72.00	overall height
G.	Gross Volume Total (ft^3)	5,550.00	Area (E.) x Height (F)/12
H.	Volume Rainfall (ft^3)	346.88	Rainfall at 25 yr-24hr max: 4.5 inches
J.	Footprint of other Tank Shells (ft^2)	846.23	Subtract out footprint of tank W-8
K.	Volume of other Tank Shells (ft^3)	846.23	Volume of other shells(area of each tank x [dike height - pad height]
L.	Volume of Pads (ft^3)	-	
M.	**Available Containment Volume (ft^3)**	4,356.90	Gross Vol. (G) - Rain Vol (H) -Tank Shells (K) -Pad (L)
N.	**Meets Volume Requirments?**	yes	If Line (M) > Line (D)





AREA "W"
SCALE: 1" = 5'

5' 0 5' 10' 15'
SCALE: 1"=5'

NO.	DATE	REVISION DESCRIPTION	APP'D	DATE

PLUMP ENGINEERING INC.
CONSULTING ENGINEERS IN CIVIL / STRUCTURAL ENGINEERING & SURVEYING
914 E. KATELLA AVENUE
ANAHEIM, CALIFORNIA 92805
(714) 385-1835, FAX (714) 385-1834

REGISTERED PROFESSIONAL ENGINEER TRYFON P. TRYFONOPOULOS NO. 65859 EXP.12/31/15 CIVIL STATE OF CALIFORNIA

12 / 3 / 2015
TRYFON TRYFONOPOULOS — DATE

UNIT W-FUTURE TANK AND CONTAINMENT DETAILS

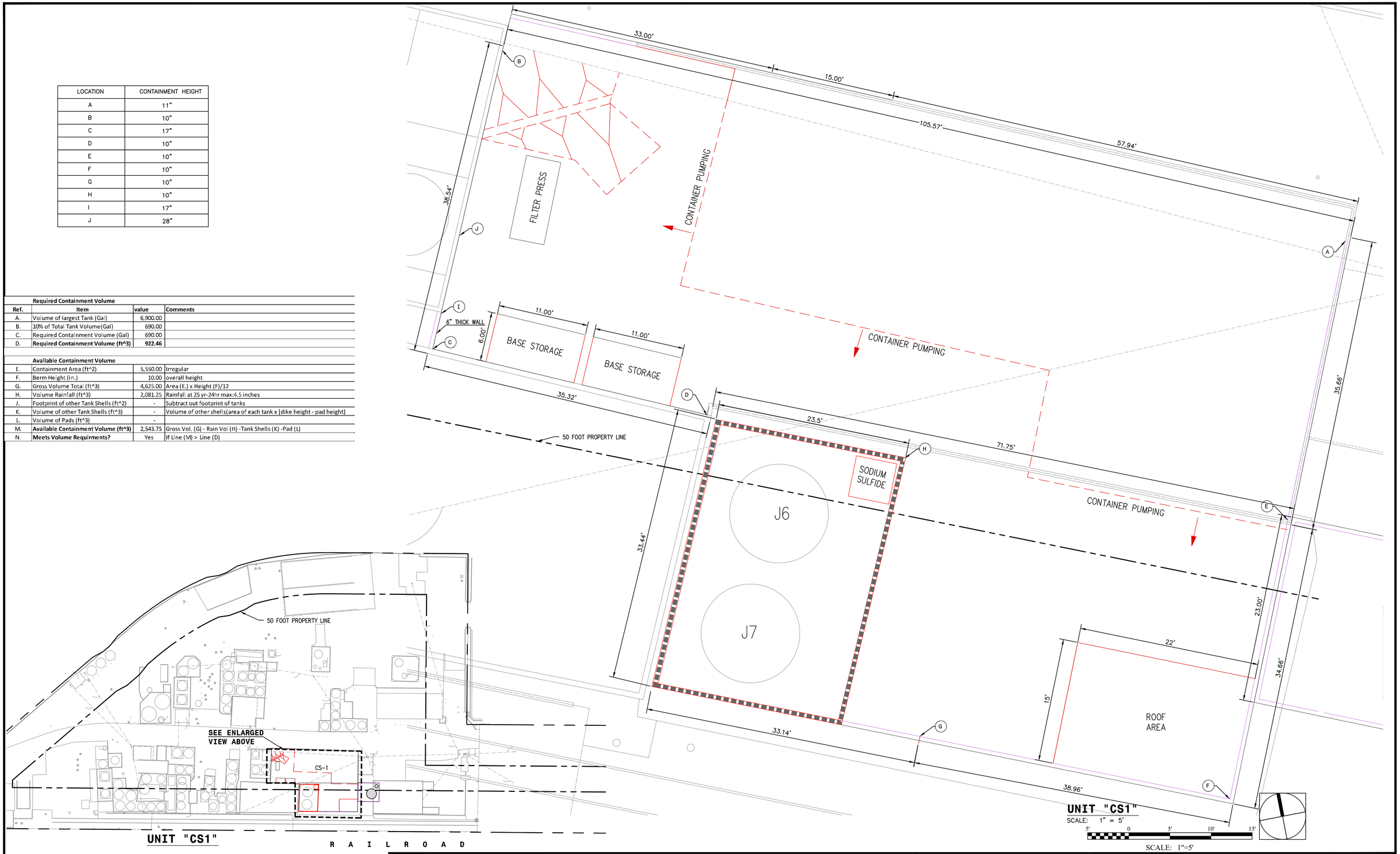
PHIBRO-TECH, INC.
8851 DICE ROAD, SANTA FE SPRINGS, CALIFORNIA 90670
(562) 698-8036

JOB NO. 131131.CS
DATE: 12 / 3 / 2015
SHEET C19
19 OF 40 SHEETS

P:\Civil & Surveying\Projects\131131 Santa Fe Springs Topo\dwg\131131C19 -UNIT W Future Work.dwg Dec 03, 2015 - 2:06pm

LOCATION	CONTAINMENT HEIGHT
A	11"
B	10"
C	17"
D	10"
E	10"
F	10"
G	10"
H	10"
I	17"
J	28"

Ref.	Item	value	Comments
	Required Containment Volume		
A.	Volume of largest Tank (Gal)	6,900.00	
B.	10% of Total Tank Volume(Gal)	690.00	
C.	Required Containment Volume (Gal)	690.00	
D.	**Required Containment Volume (ft^3)**	**922.46**	
	Available Containment Volume		
E.	Containment Area (ft^2)	5,550.00	Irregular
F.	Berm Height (in.)	10.00	overall height
G.	Gross Volume Total (ft^3)	4,625.00	Area (E.) x Height (F)/12
H.	Volume Rainfall (ft^3)	2,081.25	Rainfall at 25 yr-24hr max:4.5 inches
J.	Footprint of other Tank Shells (ft^2)	-	Subtract out footprint of tanks
K.	Volume of other Tank Shells (ft^3)	-	Volume of other shells(area of each tank x [dike height - pad height]
L.	Volume of Pads (ft^3)	-	
M.	**Available Containment Volume (ft^3)**	2,543.75	Gross Vol. (G) - Rain Vol (H) -Tank Shells (K) -Pad (L)
N.	**Meets Volume Requirments?**	Yes	If Line (M) > Line (D)



KEY MAP

SCALE: 1" = 50'

50' 0 50' 100' 150'

SCALE: 1"=50'

NO.	DATE	REVISION DESCRIPTION	APP'D	DATE

PLUMP ENGINEERING INC.
CONSULTING ENGINEERS IN
CIVIL / STRUCTURAL
ENGINEERING & SURVEYING
914 E. KATELLA AVENUE
ANAHEIM, CALIFORNIA 92805
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REGISTERED PROFESSIONAL ENGINEER TRYFON P. TRYFONOPOULOS NO. 65859 EXP.12/31/15 CIVIL STATE OF CALIFORNIA

12 / 3 / 2015

TRYFON TRYFONOPOULOS DATE

CS1-FUTURE DETAILS

PHIBRO-TECH, INC.
8851 DICE ROAD, SANTA FE SPRINGS, CALIFORNIA 90670
(562) 698-8036

JOB NO. 131131.CS

DATE: 12 / 3 / 2015

SHEET C20

20 OF 40 SHEETS

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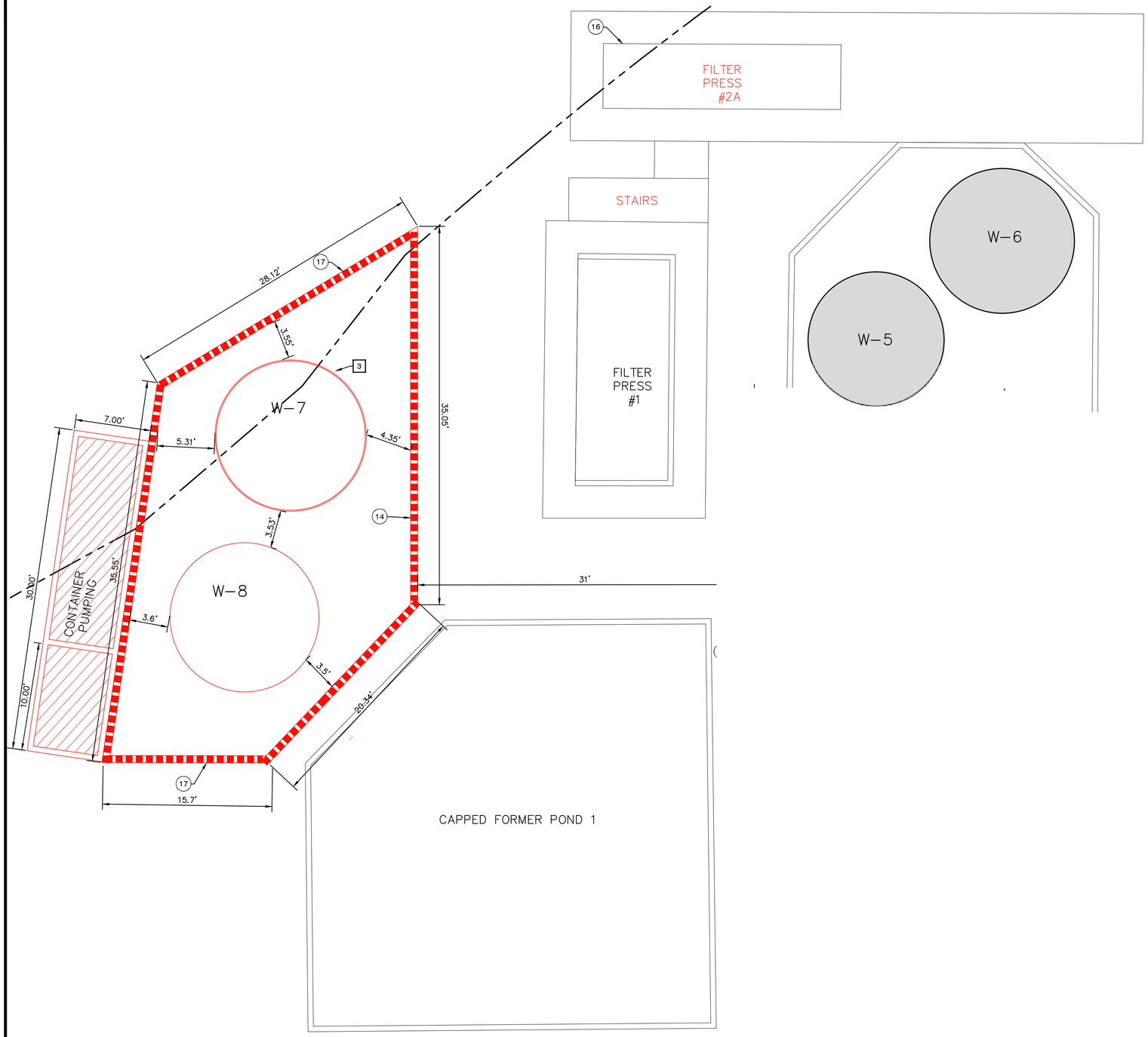


FUTURE PROPOSED CONSTRUCTION NOTES:

14 - NEW 6' (HEIGHT OF THE CONTAINMENT WALLS) POURED CONCRETE WALL.(COLOR ——)

15 - NEW 15'Ø TANK(S).(COLOR ——)

16 - NEW FILTER PRESS.(COLOR ——)

17 - NEW 72" HIGH POURED CONCRETE WALL.(COLOR ——)

FUTURE PROPOSED DEMOLITION NOTES:

3 REMOVE AND DISPOSE OF EXISTING CMU WALL.(COLOR ——)

SUBAREA W4: Containment Sub Area W4 (Proposed)

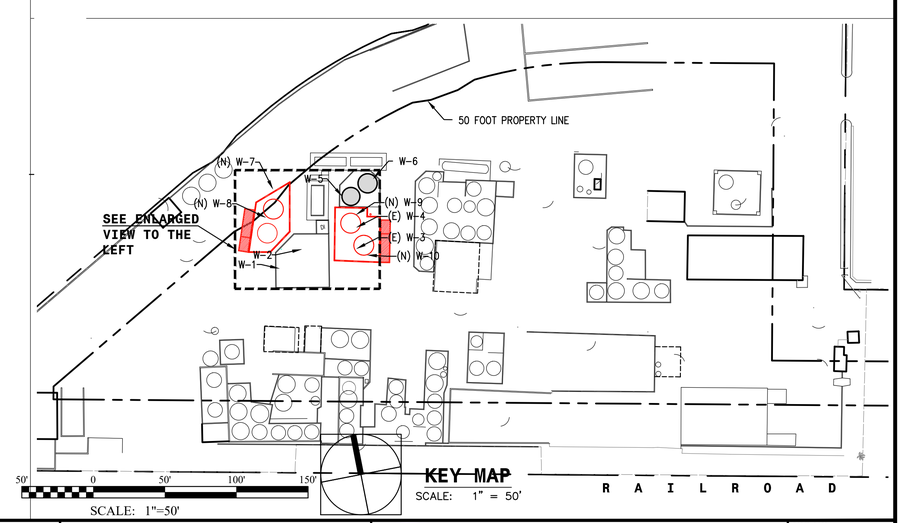
Tank Identification	Volume (gal)	Volume (cf)	Diameter (ft)	Footprint (ft^2)	Location	Shell Hgt (in.) w/in containment	Shell vol (ft^3)
W-7	30,500.00	4,077.54	14	153.86	New Pad	66	846.23
W-8	30,500.00	4,077.54	14	153.86	New Pad	66	846.23
Totals	61,000.00	8,155.08		307.72		This is the area of the tank that would occupy containment vol. and must be excluded.	1692.46

Pads Internal to Containment Area

Description	Dimesions (width)(ft.)	Length (ft.)	Depth (in.)	Vol. (ft^3)
New Pad	0	0	0	0.00
Total				0.00

	Required Containment Volume		
Ref.	**Item**	**value**	**Comments**
A.	Volume of largest Tank (Gal)	30,500.00	Tank W-7
B.	10% of Total Tank Volume(Gal)	4,000.00	
C.	Required Containment Volume (Gal)	30,500.00	Greater of (A) or (B)
D.	**Required Containment Volume (ft^3)**	**4,077.54**	

	Available Containment Volume		
E.	Containment Area (ft^2)	925.00	irregular
F.	Berm Height (in.)	72.00	overall height
G.	Gross Volume Total (ft^3)	5,550.00	Area (E.) x Height (F)/12
H.	Volume Rainfall (ft^3)	346.88	Rainfall at 25 yr-24hr max: 4.5 inches
J.	Footprint of other Tank Shells (ft^2)	846.23	Subtract out footprint of tank W-8
K.	Volume of other Tank Shells (ft^3)	846.23	Volume of other shells(area of each tank x [dike height - pad height]
L.	Volume of Pads (ft^3)	-	
M.	**Available Containment Volume (ft^3)**	4,356.90	Gross Vol. (G) - Rain Vol (H) -Tank Shells (K) -Pad (L)
N.	**Meets Volume Requirments?**	yes	If Line (M) > Line (D)



AREA "W"
SCALE: 1" = 5'

5' 0 5' 10' 15'
SCALE: 1"=5'

NO.	DATE	REVISION DESCRIPTION	APP'D	DATE

PLUMP ENGINEERING INC.
CONSULTING ENGINEERS IN CIVIL / STRUCTURAL ENGINEERING & SURVEYING
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ANAHEIM, CALIFORNIA 92805
(714) 385-1835, FAX (714) 385-1834

REGISTERED PROFESSIONAL ENGINEER TRYFON P. TRYFONOPOULOS NO. 65859 EXP.12/31/15 CIVIL STATE OF CALIFORNIA

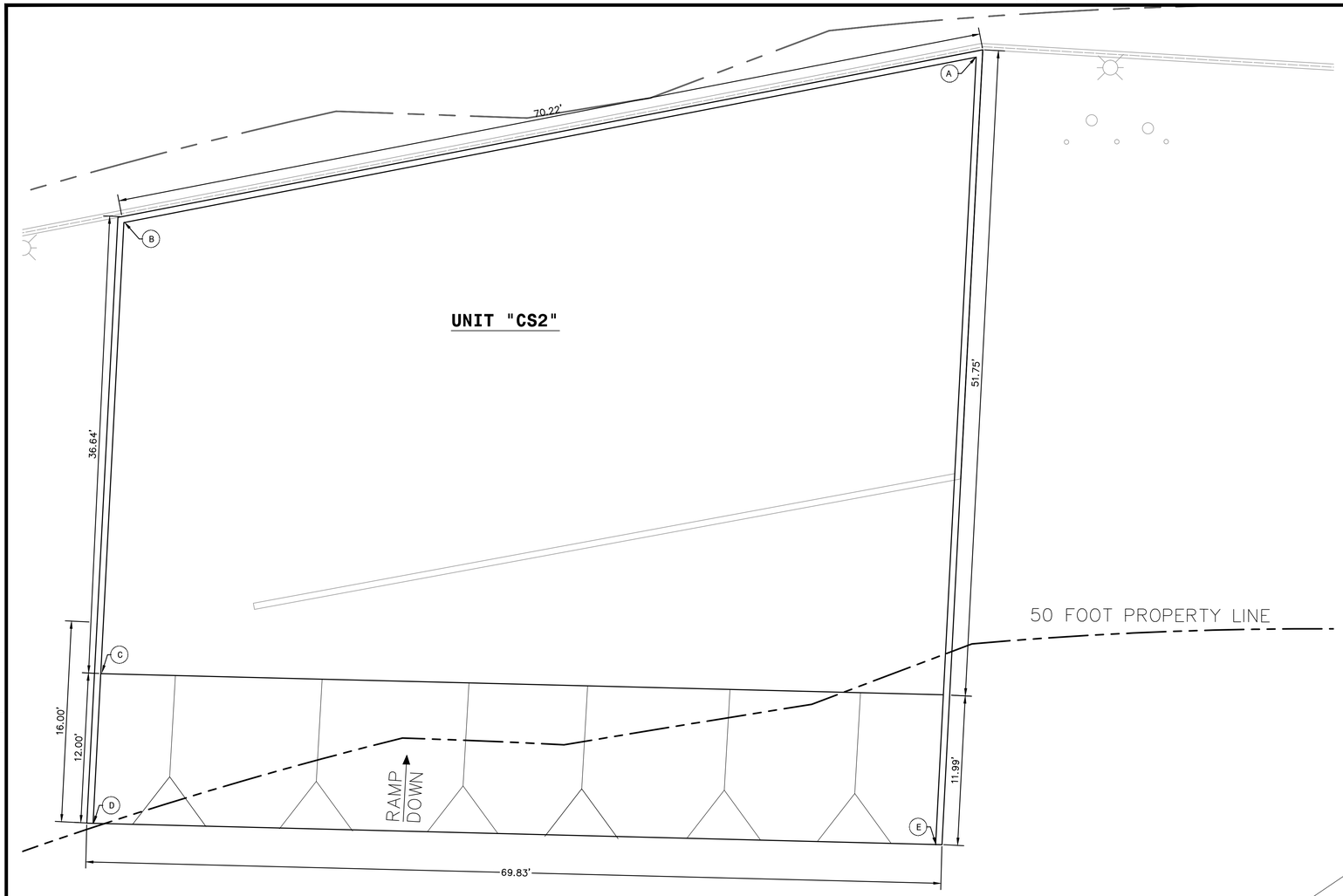
12 / 3 / 2015
TRYFON TRYFONOPOULOS DATE

UNIT W-FUTURE PUMPING STATIONS

PHIBRO-TECH, INC.
PHIBRO-TECH
8851 DICE ROAD, SANTA FE SPRINGS, CALIFORNIA 90670
(562) 698-8036

JOB NO. 131131.CS
DATE: 12 / 3 / 2015
SHEET **C33**
33 OF 40 SHEETS

P:\Civil & Surveying\Projects\131131 Santa Fe Springs Topo\dwg\131131C33 -UNIT W FUTURE PUMPING STA.dwg Dec 03, 2015 - 1:44pm



UNIT "CS2"

Required Containment Volume			
Ref.	**Item**	**value**	**Comments**
A.	Gross Volume (Gallons)	23321	
B.	Volume Rainfall (Gallons)	11494	
C.	Displacement Volume of Containers (Gallons)	3498	
D.	**Available Containment Volume (Gallons)**	**8329**	A-B-C
E.	Maximum Storage Capacity	83290	D. multiplied by 10

✳ NOTE: FOR DETAILS OF CALCULATIONS SEE REPORT "DESIGN OF PROPOSED EXPANSION FOR ERS 2 STORAGE AREA AT PHIBRO TECH FACILITY IN SANTA FE SPRINGS, CA."

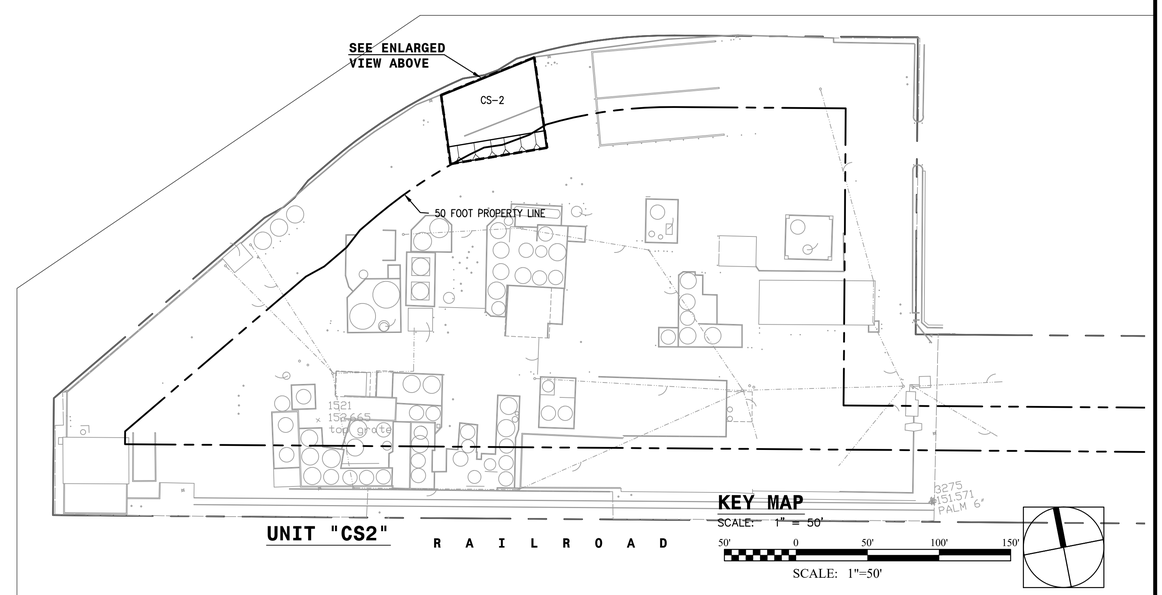
LOCATION	CONTAINMENT HEIGHT	WALL THICKNESS
A	7"	6"
B	5"	6"
C	13.25"	6"
D	0"	6"
E	0"	6"

UNIT "CS2"

SCALE: 1" = 5'

5' 0 5' 10' 15'

SCALE: 1"=5'



KEY MAP

SCALE: 1" = 50'

50' 0 50' 100' 150'

SCALE: 1"=50'

NO.	DATE	REVISION DESCRIPTION	APP'D	DATE

PLUMP ENGINEERING INC.
CONSULTING ENGINEERS IN CIVIL / STRUCTURAL ENGINEERING & SURVEYING
914 E. KATELLA AVENUE
ANAHEIM, CALIFORNIA 92805
(714) 385-1835, FAX (714) 385-1834

REGISTERED PROFESSIONAL ENGINEER TRYFON P. TRYFONOPOULOS NO. 65859 EXP. 12/31/15 CIVIL STATE OF CALIFORNIA

12 / 3 / 2015
TRYFON TRYFONOPOULOS — DATE

CS2-FUTURE DETAILS

PHIBRO-TECH, INC.
8851 DICE ROAD, SANTA FE SPRINGS, CALIFORNIA 90670
(562) 698-8036

JOB NO. 131131.CS
DATE: 12 / 3 / 2015
SHEET C34
34 OF 40 SHEETS

P:\Civil & Surveying\Projects\131131 Santa Fe Springs Topo\dwg\131131C34 - AREA CS2 future details.dwg Dec 03, 2015 - 1:44pm

ATTACHMENT 3 – PART A FORM

OMB# 2050-0024; Expires 01/31/2017

SEND COMPLETED FORM TO: The Appropriate State or Regional Office.	United States Environmental Protection Agency **RCRA SUBTITLE C SITE IDENTIFICATION FORM**

1. Reason for Submittal MARK ALL BOX(ES) THAT APPLY	**Reason for Submittal:** ☐ To provide an Initial Notification (first time submitting site identification information / to obtain an EPA ID number for this location) ☐ To provide a Subsequent Notification (to update site identification information for this location) ☐ As a component of a First RCRA Hazardous Waste Part A Permit Application ☒ As a component of a Revised RCRA Hazardous Waste Part A Permit Application (Amendment #_____) ☐ As a component of the Hazardous Waste Report (If marked, see sub-bullet below) ☐ Site was a TSD facility and/or generator of >1,000 kg of hazardous waste, >1 kg of acute hazardous waste, or >100 kg of acute hazardous waste spill cleanup in one or more months of the report year (or State equivalent LQG regulations)
2. Site EPA ID Number	**EPA ID Number** C A D 0 0 8 4 8 8 0 2 5
3. Site Name	**Name:** Phibro-Tech, Inc.
4. Site Location Information	**Street Address:** 8851 Dice Road **City, Town, or Village:** Santa Fe Springs — **County:** Los Angeles **State:** California — **Country:** USA — **Zip Code:** 90670
5. Site Land Type	☑ Private ☐ County ☐ District ☐ Federal ☐ Tribal ☐ Municipal ☐ State ☐ Other
6. NAICS Code(s) for the Site (at least 5-digit codes)	A. 3 2 5 1 8 8 — C. _____ B. 5 6 2 2 1 1 — D. _____
7. Site Mailing Address	**Street or P.O. Box:** 8851 Dice Road **City, Town, or Village:** Santa Fe Springs **State:** CA — **Country:** USA — **Zip Code:** 90670
8. Site Contact Person	**First Name:** David — **MI:** — **Last:** Thaete **Title:** EHS Manager **Street or P.O. Box:** 8851 Dice Road **City, Town or Village:** Santa Fe Springs **State:** CA — **Country:** USA — **Zip Code:** 90670 **Email:** David.Thaete@pahc.com **Phone:** 562-273-0170 — **Ext.:** — **Fax:** 562-698-1921
9. Legal Owner and Operator of the Site	**A. Name of Site's Legal Owner:** First Dice Road Company, A California Limited Partnership — **Date Became Owner:** 1/1/1984 **Owner Type:** ☑ Private ☐ County ☐ District ☐ Federal ☐ Tribal ☐ Municipal ☐ State ☐ Other **Street or P.O. Box:** 300 Frank W. Burr Blvd., Ste. 21 **City, Town, or Village:** Teaneck — **Phone:** 201-329-7300 **State:** NJ — **Country:** USA — **Zip Code:** 07666 **B. Name of Site's Operator:** Phibro-Tech, Inc. — **Date Became Operator:** 1/1/1984 **Operator Type:** ☑ Private ☐ County ☐ District ☐ Federal ☐ Tribal ☐ Municipal ☐ State ☐ Other

10. Type of Regulated Waste Activity (at your site)
Mark "Yes" or "No" for all current activities (as of the date submitting the form); complete any additional boxes as instructed.

A. Hazardous Waste Activities; Complete all parts 1-10.

Y ☑ N ☐ **1. Generator of Hazardous Waste**
If "Yes," mark only one of the following – a, b, or c.

- ☑ a. LQG: Generates, in any calendar month, 1,000 kg/mo (2,200 lbs/mo.) or more of hazardous waste; **or** Generates, in any calendar month, or accumulates at any time, more than 1 kg/mo (2.2 lbs/mo) of acute hazardous waste; **or** Generates, in any calendar month, **or** accumulates at any time, more than 100 kg/mo (220 lbs/mo) of acute hazardous spill cleanup material.
- ☐ b. SQG: 100 to 1,000 kg/mo (220 – 2,200 lbs/mo) of non-acute hazardous waste.
- ☐ c. CESQG: Less than 100 kg/mo (220 lbs/mo) of non-acute hazardous waste.

If "Yes" above, indicate other generator activities in 2-10.

Y ☐ N ☑ **2. Short-Term Generator** (generate from a short-term or one-time event and not from on-going processes). If "Yes," provide an explanation in the Comments section.

Y ☑ N ☐ **3. United States Importer of Hazardous Waste**

Y ☐ N ☑ **4. Mixed Waste (hazardous and radioactive) Generator**

Y ☑ N ☐ **5. Transporter of Hazardous Waste**
If "Yes," mark all that apply.

- ☑ a. Transporter
- ☑ b. Transfer Facility (at your site)

Y ☑ N ☐ **6. Treater, Storer, or Disposer of Hazardous Waste** Note: A hazardous waste Part B permit is required for these activities.

Y ☑ N ☐ **7. Recycler of Hazardous Waste**

Y ☐ N ☑ **8. Exempt Boiler and/or Industrial Furnace**
If "Yes," mark all that apply.

- ☐ a. Small Quantity On-site Burner Exemption
- ☐ b. Smelting, Melting, and Refining Furnace Exemption

Y ☐ N ☑ **9. Underground Injection Control**

Y ☑ N ☐ **10. Receives Hazardous Waste from Off-site**

B. Universal Waste Activities; Complete all parts 1-2.

Y ☐ N ☑ **1. Large Quantity Handler of Universal Waste (you accumulate 5,000 kg or more) [refer to your State regulations to determine what is regulated]. Indicate types of universal waste managed at your site. If "Yes," mark all that apply.**

- a. Batteries ☐
- b. Pesticides ☐
- c. Mercury containing equipment ☐
- d. Lamps ☐
- e. Other (specify) _____ ☐
- f. Other (specify) _____ ☐
- g. Other (specify) _____ ☐

Y ☐ N ☑ **2. Destination Facility for Universal Waste**
Note: A hazardous waste permit may be required for this activity.

C. Used Oil Activities; Complete all parts 1-4.

Y ☐ N ☑ **1. Used Oil Transporter**
If "Yes," mark all that apply.

- ☐ a. Transporter
- ☐ b. Transfer Facility (at your site)

Y ☐ N ☑ **2. Used Oil Processor and/or Re-refiner**
If "Yes," mark all that apply.

- ☐ a. Processor
- ☐ b. Re-refiner

Y ☐ N ☑ **3. Off-Specification Used Oil Burner**

Y ☐ N ☑ **4. Used Oil Fuel Marketer**
If "Yes," mark all that apply.

- ☐ a. Marketer Who Directs Shipment of Off-Specification Used Oil to Off-Specification Used Oil Burner
- ☐ b. Marketer Who First Claims the Used Oil Meets the Specifications

D. Eligible Academic Entities with Laboratories—Notification for opting into or withdrawing from managing laboratory hazardous wastes pursuant to 40 CFR Part 262 Subpart K

- You can ONLY Opt into Subpart K if:
  - you are at least one of the following: a college or university; a teaching hospital that is owned by or has a formal affiliation agreement with a college or university; or a non-profit research institute that is owned by or has a formal affiliation agreement with a college or university; AND
  - you have checked with your State to determine if 40 CFR Part 262 Subpart K is effective in your state

Y☐ N☑ 1. Opting into or currently operating under 40 CFR Part 262 Subpart K for the management of hazardous wastes in laboratories **See the item-by-item instructions for definitions of types of eligible academic entities. Mark all that apply:**

☐ **a. College or University**

☐ **b. Teaching Hospital that is owned by or has a formal written affiliation agreement with a college or university**

☐ **c. Non-profit Institute that is owned by or has a formal written affiliation agreement with a college or university**

Y☐ N☐ 2. Withdrawing from 40 CFR Part 262 Subpart K for the management of hazardous wastes in laboratories

11. Description of Hazardous Waste

A. Waste Codes for Federally Regulated Hazardous Wastes. Please list the waste codes of the Federal hazardous wastes handled at your site. List them in the order they are presented in the regulations (e.g., D001, D003, F007, U112). Use an additional page if more spaces are needed.

D001	D002	D004	D005	D006	D007	D008
D009	D010	D011	F006	F019	F039	K062
U134	U151	U219				

B. Waste Codes for State-Regulated (i.e., non-Federal) Hazardous Wastes. Please list the waste codes of the State-Regulated hazardous wastes handled at your site. List them in the order they are presented in the regulations. Use an additional page if more spaces are needed.

121	122	123	131	132	133	134
135	141	162	171	172	181	221
222	223	241	331	342	343	352
421	491	541	551	721	722	723
724	726	727	791	792		

12. Notification of Hazardous Secondary Material (HSM) Activity

Y ☐ N ☑ Are you notifying under 40 CFR 260.42 that you will begin managing, are managing, or will stop managing hazardous secondary material under 40 CFR 261.2(a)(2)(ii), 40 CFR 261.4(a)(23), (24), or (25)?

If "Yes," you must fill out the Addendum to the Site Identification Form: Notification for Managing Hazardous Secondary Material.

13. Comments

11. A1. D001 waste code limited to DOT Class 5.1 oxidizers

11. B1. See Part B Permit Application, Section C, Table C-3 for description of waste types accepted by the Facility and corresponding state and federal waste codes. See Part B, Section C, Appendix C-1 for waste acceptance limits.

12. The PTI facility is a hazardous waste treatment, storage and transfer facility accepting off-site generated inorganic hazardous waste (e.g. copper bearing etchants used for printed circuit board manufacturing) for the purpose of reclaiming metals. Materials produced from the reclaiming processing of off-site generated hazardous waste (e.g. copper sulfate, copper oxide, copper carbonate, and ferrous chloride) are sold to off-site customers. Note, California has not adopted Hazardous Secondary Material Rules.

14. Certification. I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fines and imprisonment for knowing violations. For the RCRA Hazardous Waste Part A Permit Application, all owner(s) and operator(s) must sign (see 40 CFR 270.10(b) and 270.11).

Signature of legal owner, operator, or an authorized representative	Name and Official Title (type or print)	Date Signed (mm/dd/yyyy)
W D Glover	William Dwight Glover / President	12/14/2015

EPA ID Number | C | A | D | 0 | 0 | 8 | 4 | 8 | 8 | 0 | 2 | 5 |

OMB#: 2050-0024; Expires 01/31/2017

United States Environmental Protection Agency

HAZARDOUS WASTE PERMIT INFORMATION FORM

1. Facility Permit Contact	**First Name:** David	**MI:**	**Last Name:** Thaete
	Contact Title: EHS Manager		
	Phone: 562-273-0170	**Ext.:**	**Email:** David.Thaete@Pahc.com
2. Facility Permit Contact Mailing Address	**Street or P.O. Box:** 8851 Dice Road		
	City, Town, or Village: Santa Fe Springs		
	State: California		
	Country: USA	**Zip Code:** 90670	
3. Operator Mailing Address and Telephone Number	**Street or P.O. Box:** Same		
	City, Town, or Village:		
	State:	**Phone:**	
	Country:	**Zip Code:**	
4. Facility Existence Date	**Facility Existence Date (mm/dd/yyyy):** 01/01/1958		

5. Other Environmental Permits

A. Facility Type *(Enter code)*	B. Permit Number													C. Description
R	C	A	D	0	0	8	4	8	8	0	2	5		RCRA Part B Hazardous Waste Treatment Permit
C	9	1	-	3	-	T	S	-	0	0	2			California Hazardous Waste Treatment Permit
E	0	2	1	4	9	8								LA County Sanitation Industrial Wastewater Discharge
E	6	0	0	2	6	7								Santa Fe Springs Fire Dept. Hazardous Materials Storage
E	4	4	1											City of Santa Fe Springs Conditional Use Permit
E	4	4	2	8	7									South Coast Air Quality Mgmt. District Air Permits

6. Nature of Business: Production of inorganic Chemicals (such as copper carbonate, copper oxide, and copper sulfate) from recycling federal and state inorganic hazardous waste and processing inorganic and oily wastewaters from off-site sources.

7. Process Codes and Design Capacities – Enter information in the Section on Form Page 3

A. PROCESS CODE – Enter the code from the list of process codes below that best describes each process to be used at the facility. If more lines are needed, attach a separate sheet of paper with the additional information. For "other" processes (i.e., D99, S99, T04 and X99), describe the process (including its design capacity) in the space provided in Item 8.

B. PROCESS DESIGN CAPACITY – For each code entered in Item 7.A; enter the capacity of the process.

1. **AMOUNT – Enter the amount. In a case where design capacity is not applicable (such as in a closure/post-closure or enforcement action) enter the total amount of waste for that process.**
2. **UNIT OF MEASURE – For each amount entered in Item 7.B(1), enter the code in Item 7.B(2) from the list of unit of measure codes below that describes the unit of measure used. Select only from the units of measure in this list.**

C. PROCESS TOTAL NUMBER OF UNITS – Enter the total number of units for each corresponding process code.

Process Code	Process	Appropriate Unit of Measure for Process Design Capacity
	Disposal	
D79	Underground Injection Well Disposal	Gallons; Liters; Gallons Per Day; or Liters Per Day
D80	Landfill	Acre-feet; Hectares-meter; Acres; Cubic Meters; Hectares; Cubic Yards
D81	Land Treatment	Acres or Hectares
D82	Ocean Disposal	Gallons Per Day or Liters Per Day
D83	Surface Impoundment Disposal	Gallons; Liters; Cubic Meters; or Cubic Yards
D99	Other Disposal	Any Unit of Measure Listed Below
	Storage	
S01	Container	Gallons; Liters; Cubic Meters; or Cubic Yards
S02	Tank Storage	Gallons; Liters; Cubic Meters; or Cubic Yards
S03	Waste Pile	Cubic Yards or Cubic Meters
S04	Surface Impoundment	Gallons; Liters; Cubic Meters; or Cubic Yards
S05	Drip Pad	Gallons; Liters; Cubic Meters; Hectares; or Cubic Yards
S06	Containment Building Storage	Cubic Yards or Cubic Meters
S99	Other Storage	Any Unit of Measure Listed Below
	Treatment	
T01	Tank Treatment	Gallons Per Day; Liters Per Day
T02	Surface Impoundment	Gallons Per Day; Liters Per Day
T03	Incinerator	Short Tons Per Hour; Metric Tons Per Hour; Gallons Per Hour; Liters Per Hour; BTUs Per Hour; Pounds Per Hour; Short Tons Per Day; Kilograms Per Hour; Gallons Per Day; Metric Tons Per Hour; or Million BTU Per Hour
T04	Other Treatment	Gallons Per Day; Liters Per Day; Pounds Per Hour; Short Tons Per Hour; Kilograms Per Hour; Metric Tons Per Day; Short Tons Per Day; BTUs Per Hour; Gallons Per Day; Liters Per Hour; or Million BTU Per Hour
T80	Boiler	Gallons; Liters; Gallons Per Hour; Liters Per Hour; BTUs Per Hour; or Million BTU Per Hour

Process Code	Process	Appropriate Unit of Measure for Process Design Capacity
	Treatment (Continued)	**(for T81 – T94)**
T81	Cement Kiln	Gallons Per Day; Liters Per Day; Pounds Per Hour; Short Tons Per Hour; Kilograms Per Hour; Metric Tons Per Day; Metric Tons Per Hour; Short Tons Per Day; BTU Per Hour; Liters Per Hour; Kilograms Per Hour; or Million BTU Per Hour
T82	Lime Kiln	
T83	Aggregate Kiln	
T84	Phosphate Kiln	
T85	Coke Oven	
T86	Blast Furnace	
T87	Smelting, Melting, or Refining Furnace	
T88	Titanium Dioxide Chloride Oxidation Reactor	
T89	Methane Reforming Furnace	
T90	Pulping Liquor Recovery Furnace	
T91	Combustion Device Used in the Recovery of Sulfur Values from Spent Sulfuric Acid	
T92	Halogen Acid Furnaces	
T93	Other Industrial Furnaces Listed in 40 CFR 260.10	
T94	Containment Building Treatment	Cubic Yards; Cubic Meters; Short Tons Per Hour; Gallons Per Hour; Liters Per Hour; BTU Per Hour; Pounds Per Hour; Short Tons Per Day; Kilograms Per Hour; Metric Tons Per Day; Gallons Per Day; Liters Per Day; Metric Tons Per Hour; or Million BTU Per Hour
	Miscellaneous (Subpart X)	
X01	Open Burning/Open Detonation	Any Unit of Measure Listed Below
X02	Mechanical Processing	Short Tons Per Hour; Metric Tons Per Hour; Short Tons Per Day; Metric Tons Per Day; Pounds Per Hour; Kilograms Per Hour; Gallons Per Hour; Liters Per Hour; or Gallons Per Day
X03	Thermal Unit	Gallons Per Day; Liters Per Day; Pounds Per Hour; Short Tons Per Hour; Kilograms Per Hour; Metric Tons Per Day; Metric Tons Per Hour; Short Tons Per Day; BTU Per Hour; or Million BTU Per Hour
X04	Geologic Repository	Cubic Yards; Cubic Meters; Acre-feet; Hectare-meter; Gallons; or Liters
X99	Other Subpart X	Any Unit of Measure Listed Below

Unit of Measure	Unit of Measure Code	Unit of Measure	Unit of Measure Code	Unit of Measure	Unit of Measure Code
Gallons	**G**	**Short Tons Per Hour**	**D**	**Cubic Yards**	**Y**
Gallons Per Hour	**E**	**Short Tons Per Day**	**N**	**Cubic Meters**	**C**
Gallons Per Day	**U**	**Metric Tons Per Hour**	**W**	**Acres**	**B**
Liters	**L**	**Metric Tons Per Day**	**S**	**Acre-feet**	**A**
Liters Per Hour	**H**	**Pounds Per Hour**	**J**	**Hectares**	**Q**
Liters Per Day	**V**	**Kilograms Per Hour**	**X**	**Hectare-meter**	**F**
		Million BTU Per Hour	**X**	**BTU Per Hour**	**I**

7. Process Codes and Design Capacities (Continued)

EXAMPLE FOR COMPLETING Item 7 (shown in line number X-1 below): A facility has a storage tank, which can hold 533.788 gallons.

Line Number		A. Process Code (From list above)			B. PROCESS DESIGN CAPACITY (1) Amount (Specify)	(2) Unit of Measure	C. Process Total Number of Units	For Official Use Only					
X	1	S	0	2	533.788	G	001						
	1	S	0	1	174,000	G	002						
	2	S	0	2	262,500	G	025						
	3	T	0	1	137,200	U	006						
	4												
	5												
	6												
	7												
	8												
	9												
1	0												
1	1												
1	2												
1	3												

Note: If you need to list more than 13 process codes, attach an additional sheet(s) with the information in the same format as above. Number the line sequentially, taking into account any lines that will be used for "other" process (i.e., D99, S99, T04, and X99) in Item 8.

8. Other Processes (Follow instructions from Item 7 for D99, S99, T04, and X99 process codes)

Line Number (Enter #s in sequence with Item 7)		A. Process Code (From list above)			B. PROCESS DESIGN CAPACITY (1) Amount (Specify)	(2) Unit of Measure	C. Process Total Number of Units	For Official Use Only					
X	2	T	0	4	100.00	U	001						

9. Description of Hazardous Wastes - Enter Information in the Sections on Form Page 5

A. **EPA HAZARDOUS WASTE NUMBER – Enter the four-digit number from 40 CFR, Part 261 Subpart D of each listed hazardous waste you will handle. For hazardous wastes which are not listed in 40 CFR, Part 261 Subpart D, enter the four-digit number(s) from 40 CFR Part 261, Subpart C that describes the characteristics and/or the toxic contaminants of those hazardous wastes.**

B. **ESTIMATED ANNUAL QUANTITY – For each listed waste entered in Item 9.A, estimate the quantity of that waste that will be handled on an annual basis. For each characteristic or toxic contaminant entered in Item 9.A, estimate the total annual quantity of all the non-listed waste(s) that will be handled which possess that characteristic or contaminant.**

C. **UNIT OF MEASURE – For each quantity entered in Item 9.B, enter the unit of measure code. Units of measure which must be used and the appropriate codes are:**

ENGLISH UNIT OF MEASURE	CODE	METRIC UNIT OF MEASURE	CODE
POUNDS	P	KILOGRAMS	K
TONS	T	METRIC TONS	M

If facility records use any other unit of measure for quantity, the units of measure must be converted into one of the required units of measure, taking into account the appropriate density or specific gravity of the waste.

D. **PROCESSES**

1. **PROCESS CODES:**

For listed hazardous waste: For each listed hazardous waste entered in Item 9.A, select the code(s) from the list of process codes contained in Items 7.A and 8.A on page 3 to indicate all the processes that will be used to store, treat, and/or dispose of all listed hazardous wastes.

For non-listed waste: For each characteristic or toxic contaminant entered in Item 9.A, select the code(s) from the list of process codes contained in Items 7.A and 8.A on page 3 to indicate all the processes that will be used to store, treat, and/or dispose of all the non-listed hazardous wastes that possess that characteristic or toxic contaminant.

NOTE: THREE SPACES ARE PROVIDED FOR ENTERING PROCESS CODES. IF MORE ARE NEEDED:

1. **Enter the first two as described above.**
2. **Enter "000" in the extreme right box of Item 9.D(1).**
3. **Use additional sheet, enter line number from previous sheet, and enter additional code(s) in Item 9.E.**

2. **PROCESS DESCRIPTION: If code is not listed for a process that will be used, describe the process in Item 9.D(2) or in Item 9.E(2).**

NOTE: HAZARDOUS WASTES DESCRIBED BY MORE THAN ONE EPA HAZARDOUS WASTE NUMBER – Hazardous wastes that can be described by more than one EPA Hazardous Waste Number shall be described on the form as follows:

1. **Select one of the EPA Hazardous Waste Numbers and enter it in Item 9.A. On the same line complete Items 9.B, 9.C, and 9.D by estimating the total annual quantity of the waste and describing all the processes to be used to store, treat, and/or dispose of the waste.**
2. **In Item 9.A of the next line enter the other EPA Hazardous Waste Number that can be used to describe the waste. In Item 9.D.2 on that line enter "included with above" and make no other entries on that line.**
3. **Repeat step 2 for each EPA Hazardous Waste Number that can be used to describe the hazardous waste.**

EXAMPLE FOR COMPLETING Item 9 (shown in line numbers X-1, X-2, X-3, and X-4 below) – A facility will treat and dispose of an estimated 900 pounds per year of chrome shavings from leather tanning and finishing operations. In addition, the facility will treat and dispose of three non-listed wastes. Two wastes are corrosive only and there will be an estimated 200 pounds per year of each waste. The other waste is corrosive and ignitable and there will be an estimated 100 pounds per year of that waste. Treatment will be in an incinerator and disposal will be in a landfill.

Line Number		A. EPA Hazardous Waste No. (Enter code)				B. Estimated Annual Qty of Waste	C. Unit of Measure (Enter code)	D. PROCESSES									
								(1) PROCESS CODES (Enter Code)									(2) PROCESS DESCRIPTION (If code is not entered in 9.D(1))
X	1	K	0	5	4	900	P	T	0	3	D	8	0				
X	2	D	0	0	2	400	P	T	0	3	D	8	0				
X	3	D	0	0	1	100	P	T	0	3	D	8	0				
X	4	D	0	0	2												Included With Above

9. Description of Hazardous Wastes ***(Continued. Use additional sheet(s) as necessary; number pages as 5a, etc.)***

Line Number		A. EPA Hazardous Waste No. (Enter code)				B. Estimated Annual Qty of Waste	C. Unit of Measure (Enter code)	D. PROCESSES (1) PROCESS CODES (Enter Code)									(2) PROCESS DESCRIPTION (If code is not entered in 9.D(1))
	1	D	0	0	2	130,000	T	S	0	1	S	0	2	T	0	1	
	2	D	0	0	4												INCLUDED IN ABOVE
	3	D	0	0	5												INCLUDED IN ABOVE
	4	D	0	0	6												INCLUDED IN ABOVE
	5	D	0	0	7												INCLUDED IN ABOVE
	6	D	0	0	8												INCLUDED IN ABOVE
	7	D	0	0	9												INCLUDED IN ABOVE
	8	D	0	1	0												INCLUDED IN ABOVE
	9	D	0	1	1												INCLUDED IN ABOVE
1	0	D	0	0	2	10,000	T	S	0	1	S	0	2	T	0	1	
1	1	D	0	0	1												INCLUDED IN ABOVE
1	2	D	0	0	4												INCLUDED IN ABOVE
1	3	D	0	0	5												INCLUDED IN ABOVE
1	4	D	0	0	6												INCLUDED IN ABOVE
1	5	D	0	0	7												INCLUDED IN ABOVE
1	6	D	0	0	8												INCLUDED IN ABOVE
1	7	D	0	0	9												INCLUDED IN ABOVE
1	8	D	0	1	0												INCLUDED IN ABOVE
1	9	D	0	1	1												INCLUDED IN ABOVE
2	0	D	0	0	2	50	T	S	0	1	T	0	1				
2	1	D	0	0	1												INCLUDED IN ABOVE
2	2	D	0	0	4												INCLUDED IN ABOVE
2	3	D	0	0	5												INCLUDED IN ABOVE
2	4	D	0	0	6												INCLUDED IN ABOVE
2	5	D	0	0	7												INCLUDED IN ABOVE
2	6	D	0	0	8												INCLUDED IN ABOVE
2	7	D	0	0	9												INCLUDED IN ABOVE
2	8	D	0	1	0												INCLUDED IN ABOVE
2	9	D	0	1	1												INCLUDED IN ABOVE
3	0	F	0	1	9	20	T	S	0	1							
3	1	F	0	3	9	20	T	S	0	1							
3	2	K	0	6	2	10	T	S	0	1							
3	3	U	1	3	4	10	T	S	0	1							
3	4	U	1	5	1	10	T	S	0	1							
3	5	U	2	1	9	10	T	S	0	1							
3	6	F	0	0	6	100	T	S	0	1							

10. Map

Attach to this application a topographical map, or other equivalent map, of the area extending to at least one mile beyond property boundaries. The map must show the outline of the facility, the location of each of its existing intake and discharge structures, each of its hazardous waste treatment, storage, or disposal facilities, and each well where it injects fluids underground. Include all spring, rivers, and other surface water bodies in this map area. See instructions for precise requirements.

11. Facility Drawing

All existing facilities must include a scale drawing of the facility (see instructions for more detail).

12. Photographs

All existing facilities must include photographs (aerial or ground-level) that clearly delineate all existing structures; existing storage, treatment, and disposal areas; and sites of future storage, treatment, or disposal areas (see instructions for more detail).

13. Comments

7. Line 1. See Part B Application, Volume 1, Section D for description of container storage areas at the facility. The maximum storage capacity of each containment areas based on the storage of all IBCs/tote bins. On this basis, the sum of the maximum container storage capacities of each of the five containment areas exceeds the maximum facility storage 174,000 gallons. However, when drums are stored the maximum storage capacity is reduced. The Facility will store no more than 174,000 gallons of off-site hazardous waste in containers within container areas combined at any one time.

7. Line 2. Tank Volume from 1991 Permit plus the Variance tanks: 12,500 gallons (W-3) and 12,500 gallons (W-4)

7. Line 3. Daily total for all hazardous waste transferred to treatment. Treatment process include: copper oxide (Area C); copper sulfate (Area S); ferric chloride (Area F); copper carbonate (Area S); neutralization (Area J); wastewater treatment (Area W)

9. Line 11. D001 waste code limited to DOT Class 5.1 oxidizers.

10. See Figure B-5 in Volume 1, Section B of the Part B Application for Topo map

11. See Figure B-2 in Volume I, Section B of the Part B Application for a facility Drawing (Plot Plan), and Figures in Section D for Detailed plot plans of hazardous waste treatment and storage areas.

12. See Photos tab in Part B Application Volume I for photos showing facility tanks, storage areas, and processing areas.

General Note- See Executive Summary in Part B Permit Application Volume 1 for a Narrative overview of the Phibro-Tech, Inc. facility and the equipment and activities covered by this Part and Part B Application Package.

ATTACHMENT 4 – TANK CERTIFICATION – TANKS W-7 AND W-8

TESTING, INSPECTION & CERTIFICATION SERVICES
www.frpengineer.com

CLIENT: Phibro Tech
Santa Fe Springs, CA

TI&CS Report Number: 14-11-2

Report Title: Design of Tanks W-7, W-8, W-9 and W-10
for the Phibro Tech Facility in Santa Fe Springs, CA

Tank Size: 14 ft. Diameter by 27 ft. Straight Shell
Flat Bottom, Dome Top
Seismic and Wind Loads per CBC 2013 and ASCE 7-10
Stored Liquid Specific Gravity: 1.10 Max.
Atmospheric Conditions: 0 Vacuum, 0 Internal Pressure

Author(s): Joseph M. Plecnik, Ph.D., P.E.
Joseph M. Plecnik Jr., BSCE
Christine Bosque, Ph.D., Chemistry
TI&CS
3562 Cerritos Ave.
Los Alamitos, CA 90720
(562) 900-3118

REGISTERED PROFESSIONAL ENGINEER
JOSEPH M. PLECNIK
No. C26354
3/2016
CIVIL
STATE OF CALIFORNIA

Date of Issue: November 4, 2014

NOTES:

TESTING, INSPECTION AND CERTIFICATION SERVICES
TI&CS
3562 CERRITOS AVE.
LOS ALAMITOS, CA 90720 (562) 493-7911

CHAPTER A: SUMMARY OF FRP TANK DESIGN: DIAMETER 14 FT. HEIGHT 27 FT.

I. WALL THICKNESS DESIGN

1. For tank dome, use 7/16 in. wall thickness. See Fig. A-2

2. For tank wall, use the following thicknesses starting from the tank bottom.

a) From 0 ft. to 6 ft., use 0.576 in. wall thick., LAMINAR COMB. CC-7

b) From 6 ft. to 12 ft., use 0.452 in. wall thick., LAMINAR COMB. CC-16

c) From 12 ft. to 18 ft., use 0.328 in. wall thick., LAMINAR COMB. AA-7

d) From 18 ft. to 27 ft., use 0.248 in. wall thick., LAMINAR COMB. AA-1

e) From _____ ft. to _____ ft., use _____ in. wall thick., LAMINAR COMB. _____

f) Knuckle Thickness See Fig. A-3

g. See Fig. A-6 for Lifting lug design.

II. LAMINAR CONSTRUCTION AND MATERIAL PROPERTIES ARE PROVIDED IN CHAPTER B

III. LUG DESIGN

1. Use 12 lugs uniformly spaced over tank circumference. Type D1

2. Use ONE bolt per lug with 1 1/2 in. diameter and See Fig A-4 type.

3. Fig. A-4 provides lug design details.

4. If extensive corrosion on the outside of the tank is probable, use stainless or other types of corrosion resistant lugs.

IV. SPECIFICATIONS

1. Seismic and Wind Loads per CBC 2013 & ASCE 7-10

2. Specific gravity of liquid contents; G = 1.10

3. ASTM D3299 used for filament winding and tank dome construction.

4. AISC - 13th edition is used for steel design.

5. A36 steel used for lugs (unless stated otherwise).

CHAPTER A : DESIGN OF 168 in. ϕ x 324 in. HIGH TANK USING THE API 650 METHOD, CBC 2013 AND ASCE 7-10

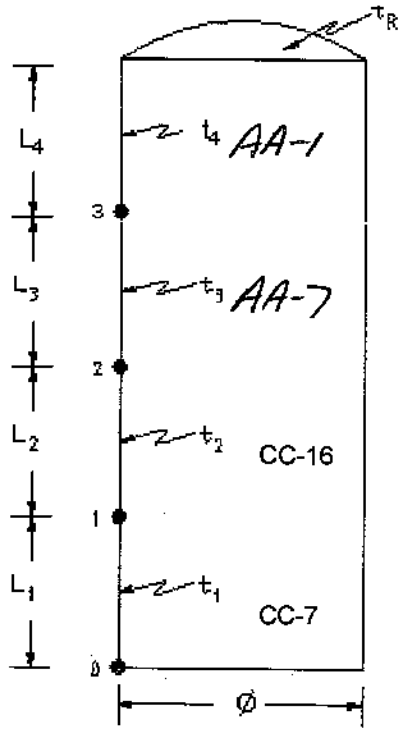


Fig. A-1: Tank Geometry

Min. Dome Thickness ; $t_R := 0.35$ (in.)

Type of Cover; Flat or Dish Type

Radius of Cover (∞ for Flat Cover);

Length 4 ; $L_4 := 108$ (in.)

Minimum Thickness for L4 ; $t_4 := 0.248$ (in.)

$E_{h4} := 3.50591 \cdot 10^6$ $E_{a4} := 0.93484 \cdot 10^6$

Length 3 ; $L_3 := 72$ (in.)

Minimum Thickness for L3 ; $t_3 := 0.328$ (in.)

$E_{h3} := 2.84810 \cdot 10^6$ $E_{a3} := 2.11254 \cdot 10^6$

Length 2 ; $L_2 := 72$ (in.)

Minimum Thickness for L2 ; $t_2 := 0.452$ (in.)

$E_{h2} := 3.00575 \cdot 10^6$ $E_{a2} := 2.20510 \cdot 10^6$

Length 1 ; $L_1 := 72$ (in.)

Minimum Thickness for L1 ; $t_1 := 0.576$ (in.)

$E_{h1} := 3.25535 \cdot 10^6$ $E_{a1} := 2.24859 \cdot 10^6$

I) Seismic Design Parameters (per CBC 2013 and ASCE 7-10)

For plant site, ASCE 7-10 gives the following seismic parameters:

Seismic Risk Category: III

Seismic Design Category: D

Site Class: D

Importance Factor: I $I := 1.25$

Response Modification Coefficient; $RR := 3$

Specific Gravity of Liquid ; $SGL := 1.1$

MATERIAL PROPERTIES AND LAMINATE CONSTRUCTIONS FOR SHELL

Total Height ; $HH := 324$ (in.)

Tank Diameter ; $D := 168$ (in.)

Tank Radius ; $R := \frac{D}{2}$ $R = 84$ (in.)

P_{app} = applied pressure (+) or vacuum (-) $P_{app} := 0$ (psi)

Specific Gravity of Shell Material; $SGS := 1.7$

Poisson Ratio (for shell); $v := 0.27$

Number of Anchor Lugs; $nn := 12$

Thickness of Corrosion Barrier $t_L := 0.02$ (in.) (Not used in structural)

Shell Weight Added Factor $SWAF := 1.05$

A-2

FB1 = Minimum Free Board $FB1 := 0$ (in.)

BWR = maximum width of flat bottom resisting overturning $BWR := 3$ (in.)

Seismic Response Spectral Acceleration Values:

$S_S := 2.16$

$S_1 := 0.766$

$F_a := 1.0$

$F_v := 1.5$

$S_{MS} := F_a \cdot S_S$

$S_{MS} = 2.16$

$S_{M1} := F_v \cdot S_1$

$S_{M1} = 1.149$

$S_{DS} := \frac{2}{3} \cdot S_{MS}$

$S_{DS} = 1.44$

$S_{D1} := \frac{2}{3} \cdot S_{M1}$

$S_{D1} = 0.766$

$T_s := \frac{S_{D1}}{S_{DS}}$

$T_s = 0.531944$ sec.

Since $T_s < T_c$:

$S_{ai} := S_{DS}$

$S_{ai} = 1.44$

W_i = impulsive weight component

$W_i = W_1$

ZC = resultant impulsive spectral acceleration

$ZC := S_{ai} \cdot I \div RR$

$ZC = 0.6$

$ZC_{1S} := ZC$

$ZC_{1R} := ZC$

$ZC_{11} := ZC$

A-3

A) Convective Component or Sloshing Seismic Coefficient

T_C = natural period for sloshing

$g := 32.2$ ft./sec. sec. = gravitational acceleration

$$T_C := 2 \cdot \pi \cdot \sqrt{\frac{D \div 12}{3.68 \cdot g \cdot \tanh\left(\frac{3.68 \cdot HH}{D}\right)}}$$

$T_C = 2.16$

Since $T_C < 4$ sec.

$$S_{ac} := \frac{1.5 \cdot S_{D1}}{T_c}$$

$S_{ac} = 0.532$

C_2 = sloshing spectral acceleration

$$C_2 := \frac{S_{ac} \cdot I}{1.5}$$

$C_2 = 0.443$

B) Height of Sloshing Wave Analysis (ASCE 7-05)

SWH = sloshing wave height

$SWH := 0.5 \cdot D \cdot I \cdot S_{ac}$

$SWH = 55.862$ (in.)

FB = Free Board

$FB := SWH + 0.005 \cdot D$

$FB = 56.702$ (in.)

$$FB2 := \begin{cases} FB & \text{if } FB < FB1 \\ FB1 & \text{otherwise} \end{cases}$$

$FB2 = 0$

H = design liquid height at base of tank

$H := HH - FB2$

$H = 324$ (in.)

A-4

VII) Calculation of Overturning Moments

A) AT TANK BOTTOM (POINT 0, FIG. A-1)

$M_0 = M_{0S} + M_{0R} + M_{01} + M_{02}$

Where,

M_{0S} = (1/1.4) ZC W_S X_S = overturning moment due to shell weight

M_{0R} = (1/1.4) ZC W_R H = overturning moment due to roof weight

M_{01} = (1/1.4) ZC W_1 X_1 = overturning moment due to liquid inertial force

M_{02} = (1/1.4) C_2 W_2 X_2 = overturning moment due to liquid sloshing

W_S = Total weight of shell

$W_s := \pi \cdot D \cdot (SGS) \cdot (0.0361) \cdot \left[L_1 \cdot (t_1 + t_L) + L_2 \cdot (t_2 + t_L) + L_3 \cdot (t_3 + t_L) + L_4 \cdot (t_4 + t_L) \right] \cdot SWAF$

$W_s = 4451.752$ lbs

X_S = Half tank height ; $X_s := \frac{H}{2}$

$X_s = 162$ in.

W_R = Weight of tank roof

$W_R := \pi \cdot R^2 \cdot t_R \cdot (SGS) \cdot 0.0361 \cdot SWAF$

$W_R = 499.945$ lbs

W_L = Weight of tank contents

$W_L := \pi \cdot R^2 \cdot H \cdot 0.0361 \cdot SGL$

$W_L = 285202.509$ lbs

$F_{A1} := \frac{0.866 \cdot D}{H}$ $\qquad F_{A1} = 0.449$

$F_{A2} := \frac{3.67 \cdot H}{D}$ $\qquad F_{A2} = 7.078$

$F_{A3} := \cosh(F_{A2}) - 1$ $\qquad F_{A3} = 591.713$

$AW_{1a} := \frac{\tanh(F_{A1}) \cdot W_L}{F_{A1}}$ $\qquad AW_{1a} = 267463.036$ lb.

$AW_{1b} := \left(1 - \frac{0.218 \cdot D}{H}\right) \cdot W_L$ $\qquad AW_{1b} = 252964.063$ lb.

$W_1 := \begin{cases} AW_{1a} & \text{if } \frac{D}{H} \geq 1.33 \\ AW_{1b} & \text{otherwise} \end{cases}$ $\qquad W_1 = 252964.063$ lb.

$W_2 := 0.230 \cdot \left(\frac{D}{H}\right) \cdot \tanh(F_{A2}) \cdot W_L$ $\qquad W_2 = 34012.992$ lb.

A-5

X_1 = moment arm for liquid seismic inertial force

X_2 = moment arm for sloshing seismic force

$X_{1a} := 0.375 \cdot H$ $\qquad X_{1a} = 121.5$ in.

$X_{1b} := \left(0.5 - 0.094 \cdot \frac{D}{H}\right) \cdot H$ $\qquad X_{1b} = 146.208$ in.

$$X_1 := \begin{cases} X_{1a} & \text{if } \frac{D}{H} \geq 1.33 \\ X_{1b} & \text{otherwise} \end{cases}$$ $\qquad X_1 = 146.208$ in.

$X_2 := \left(1 - \frac{F_{A3}}{F_{A2} \cdot \sinh(F_{A2})}\right) \cdot H$ $\qquad X_2 = 278.301$ in.

M_0 = overturning moment at Point "0"

$M_{0s} := \left(\frac{1}{1.4}\right) \cdot ZC \cdot W_s \cdot X_s$ $\qquad M_{0s} = 309078.774$

$M_{0R} := \left(\frac{1}{1.4}\right) \cdot ZC \cdot W_R \cdot H$ $\qquad M_{0R} = 69420.883$

$M_{01} := \left(\frac{1}{1.4}\right) \cdot ZC \cdot W_1 \cdot X_1$ $\qquad M_{01} = 15850872.713$

$M_{02} := \left(\frac{1}{1.4}\right) \cdot C_2 \cdot W_2 \cdot X_2$ $\qquad M_{02} = 2997625.561$

$M_0 := M_{0s} + M_{0R} + M_{01} + M_{02}$

$M_0 = 19226997.932$ (in - lbs.)

F_H = horizontal base shear

$F_H := M_{0s} \div X_s + M_{0R} \div H + M_{01} \div X_1 + M_{02} \div X_2$

$F_H = 121306.504$ (lbs.)

B) OVERTURNING MOMENT AT POINT 1 (SEE FIG. A-1)

A-6

$M_1 = M_{1S} + M_{1R} + M_{11} + M_{12}$

Where,

$M_{1S} = (1/1.4)\ ZC\ BW_S\ BX_S$

$M_{1R} = (1/1.4)\ ZC\ W_R\ (L_2 + L_3 + L_4)$

$M_{11} = (1/1.4)\ ZC\ BW_1\ BX_1$

$M_{12} = (1/1.4)\ C_2\ BW_2\ BX_2$

BWs = total weight of shell above point 1. (See Fig. A-1)

$BW_S := \pi \cdot D \cdot (SGS) \cdot (0.0361) \cdot \left[L_2 \cdot (t_2 + t_L) + L_3 \cdot (t_3 + t_L) + L_4 \cdot (t_4 + t_L)\right] \cdot SWAF$

$BW_S = 2992.322$ lbs.

$BX_S := \dfrac{L_2 + L_3 + L_4}{2}$

$BX_S = 126$ in.

W_R = weight of tank roof

$W_R = 499.945$ lbs.

For $\dfrac{D}{L_2 + L_3 + L_4} = 0.667$

BW_L = weight of tank contents above point 1.

$BW_L := \pi \cdot R^2 \cdot (0.0361) \cdot (SGL) \cdot (L_2 + L_3 + L_4)$

$BW_L = 221824.174$ lbs.

$F_{B1} := \dfrac{0.866 \cdot D}{(L_2 + L_3 + L_4)}$ $\qquad F_{B1} = 0.577$

$F_{B2} := \dfrac{3.67 \cdot (L_2 + L_3 + L_4)}{D}$ $\qquad F_{B2} = 5.505$

$F_{B3} := \cosh(F_{B2}) - 1$ $\qquad F_{B3} = 121.961$

$BW_{1a} := \dfrac{\tanh(F_{B1}) \cdot BW_L}{F_{B1}}$ $\qquad BW_{1a} = 200073.83$ lb.

$BW_{1b} := \left[1 - \dfrac{0.218 \cdot D}{(L_2 + L_3 + L_4)}\right] \cdot BW_L$ $\qquad BW_{1b} = 189585.727$ lb.

$BW_1 := \begin{cases} BW_{1a} & \text{if } \dfrac{D}{(L_2 + L_3 + L_4)} \geq 1.33 \\ BW_{1b} & \text{otherwise} \end{cases}$ $\qquad BW_1 = 189585.727$ lb.

$BW_2 := 0.230 \cdot \left[\dfrac{D}{(L_2 + L_3 + L_4)}\right] \cdot \tanh(F_{B2}) \cdot BW_L$ $\qquad BW_2 = 34011.915$ lb.

A-7

$BX_{1a} := 0.375 \cdot (L_2 + L_3 + L_4)$ $\qquad BX_{1a} = 94.5$ in.

$$BX_{1b} := \left[0.5 - 0.094 \cdot \frac{D}{(L_2 + L_3 + L_4)}\right] \cdot (L_2 + L_3 + L_4)$$ $\qquad BX_{1b} = 110.208$ in.

$$BX_1 := \begin{cases} BX_{1a} & \text{if } \dfrac{D}{(L_2 + L_3 + L_4)} \geq 1.33 \\ BX_{1b} & \text{otherwise} \end{cases}$$ $\qquad BX_1 = 110.208$ in.

$$BX_2 := \left(1 - \frac{F_{B3}}{F_{B2} \cdot \sinh(F_{B2})}\right) \cdot (L_2 + L_3 + L_4)$$ $\qquad BX_2 = 206.594$ in.

M_1 = overturning moment at Point "1"

$$M_{1s} := \left(\frac{1}{1.4}\right) \cdot ZC \cdot BW_s \cdot BX_s$$ $\qquad M_{1s} = 161585.371$

$$M_{1R} := \left(\frac{1}{1.4}\right) \cdot ZC \cdot W_R \cdot (L_2 + L_3 + L_4)$$ $\qquad M_{1R} = 53994.02$

$$M_{11} := \left(\frac{1}{1.4}\right) \cdot ZC \cdot BW_1 \cdot BX_1$$ $\qquad M_{11} = 8954513.068$

$$M_{12} := \left(\frac{1}{1.4}\right) \cdot C_2 \cdot BW_2 \cdot BX_2$$ $\qquad M_{12} = 2225192.843$

$M_1 := M_{1s} + M_{1R} + M_{11} + M_{12}$

$M_1 = 11395285.302$ (in - lbs.)

C) OVERTURNING MOMENT AT POINT 2 (SEE FIG. A-1)

$M_2 = M_{2S} + M_{2R} + M_{21} + M_{22}$

Where,

$M_{2S} = (1/1.4)\ ZC\ CW_S\ CX_S$

$M_{2R} = (1/1.4)\ ZC\ W_R\ CL$

$M_{21} = (1/1.4)\ ZC\ CW_1\ CX_1$

$M_{22} = (1/1.4)\ C_2\ CW_2\ CX_2$

CWs = total weight of shell above point 2. (See Fig. A-1)

$CW_s := \pi \cdot D \cdot (SGS) \cdot (0.0361) \cdot \left[L_3 \cdot (t_3 + t_L) + L_4 \cdot (t_4 + t_L) \right] \cdot SWAF$

$CW_s = 1836.531$ lbs.

$CL := L_3 + L_4$

$CL = 180$

$CX_s := \frac{CL}{2}$

$CX_s = 90$ in.

W_R = weight of tank roof

$W_R = 499.945$ lbs.

CW_L = weight of tank contents above point 2.

$CW_L := \pi \cdot R^2 \cdot (CL) \cdot (0.0361) \cdot (SGL)$

$CW_L = 158445.838$ lbs.

$F_{C1} := \frac{0.866 \cdot D}{(L_3 + L_4)}$ $\qquad F_{C1} = 0.808$

$F_{C2} := \frac{3.67 \cdot (L_3 + L_4)}{D}$ $\qquad F_{C2} = 3.932$

$F_{C3} := \cosh(F_{C2}) - 1$ $\qquad F_{C3} = 24.518$

$CW_{1a} := \frac{\tanh(F_{C1}) \cdot CW_L}{F_{C1}}$ $\qquad CW_{1a} = 131073.214$ lb.

$CW_{1b} := \left[1 - \frac{0.218 \cdot D}{(L_3 + L_4)} \right] \cdot CW_L$ $\qquad CW_{1b} = 126207.392$ lb.

$CW_1 := \begin{cases} CW_{1a} & \text{if } \frac{D}{(L_3 + L_4)} \geq 1.33 \\ CW_{1b} & \text{otherwise} \end{cases}$ $\qquad CW_1 = 126207.392$ lb.

$CW_2 := 0.230 \cdot \left[\frac{D}{(L_3 + L_4)} \right] \cdot \tanh(F_{C2}) \cdot CW_L$ $\qquad CW_2 = 33986.913$ lb.

$CX_{1a} := 0.375 \cdot (L_3 + L_4)$ $\qquad CX_{1a} = 67.5$ in.

$CX_{1b} := \left[0.5 - 0.094 \cdot \frac{D}{(L_3 + L_4)}\right] \cdot (L_3 + L_4)$ $\qquad CX_{1b} = 74.208$ in.

$CX_1 := \begin{cases} CX_{1a} & \text{if } \frac{D}{(L_3 + L_4)} \geq 1.33 \\ CX_{1b} & \text{otherwise} \end{cases}$ $\qquad CX_1 = 74.208$ in.

$CX_2 := \left(1 - \frac{F_{C3}}{F_{C2} \cdot \sinh(F_{C2})}\right) \cdot (L_3 + L_4)$ $\qquad CX_2 = 135.984$ in.

M_2 = overturning moment at Point "2"

$M_{2s} := \left(\frac{1}{1.4}\right) \cdot ZC \cdot CW_s \cdot CX_s$ $\qquad M_{2s} = 70837.636$

$M_{2R} := \left(\frac{1}{1.4}\right) \cdot ZC \cdot W_R \cdot (CL)$ $\qquad M_{2R} = 38567.157$

$M_{21} := \left(\frac{1}{1.4}\right) \cdot ZC \cdot CW_1 \cdot CX_1$ $\qquad M_{21} = 4013827.772$

$M_{22} := \left(\frac{1}{1.4}\right) \cdot C_2 \cdot CW_2 \cdot CX_2$ $\qquad M_{22} = 1463579.822$

$M_2 := M_{2s} + M_{2R} + M_{21} + M_{22}$

$M_2 = 5586812.388$ (in - lbs.)

D) OVERTURNING MOMENT AT POINT 3 (SEE FIG. A-1)

$M_3 = M_{3S} + M_{3R} + M_{31} + M_{32}$

Where,

$M_{3S} = (1/1.4)\ ZC\ DW_S\ DX_S$

$M_{3R} = (1/1.4)\ ZC\ W_R\ DL$

$M_{31} = (1/1.4)\ ZC\ DW_1\ DX_1$

$M_{32} = (1/1.4)\ C_2\ DW_2\ DX_2$

DWs = total weight of shell above point 3. (See Fig. A-1)

$DW_S := \pi \cdot D \cdot (SGS) \cdot (0.0361) \cdot \left[L_4 \cdot (t_4 + t_L)\right] \cdot SWAF$

$DW_S = 984.381$ lbs.

$DL := L_4$

$DL = 108$

$DX_S := \frac{DL}{2}$

$DX_S = 54$ in.

W_R = weight of tank roof

$W_R = 499.945$ lbs.

DW_i = weight of tank contents above point 3.

$DW_L := \pi \cdot R^2 \cdot (DL) \cdot (0.0361) \cdot (SGL)$

$DW_L = 95067.503$ lbs.

$F_{D1} := \frac{0.866 \cdot D}{L_4}$ $\qquad F_{D1} = 1.347$

$F_{D2} := \frac{3.67 \cdot (L_4)}{D}$ $\qquad F_{D2} = 2.359$

$F_{D3} := \cosh(F_{D2}) - 1$ $\qquad F_{D3} = 4.339$

$DW_{1a} := \frac{\tanh(F_{D1}) \cdot DW_L}{F_{D1}}$ $\qquad DW_{1a} = 61634.913$ lb.

$DW_{1b} := \left(1 - \frac{0.218 \cdot D}{L_4}\right) \cdot DW_L$ $\qquad DW_{1b} = 62829.056$ lb.

$DW_1 := \begin{cases} DW_{1a} & \text{if } \frac{D}{L_4} \geq 1.33 \\ DW_{1b} & \text{otherwise} \end{cases}$ $\qquad DW_1 = 61634.913$ lb.

$DW_2 := 0.230 \cdot \left(\frac{D}{L_4}\right) \cdot \tanh(F_{D2}) \cdot DW_L$ $\qquad DW_2 = 33411.083$ lb.

A-11

$DX_{1a} := 0.375 \cdot (L_4)$ $\qquad DX_{1a} = 40.5$ in.

$DX_{1b} := \left[0.5 - 0.094 \cdot \frac{D}{(L_4)} \right] \cdot (L_4)$ $\qquad DX_{1b} = 38.208$ in.

$DX_1 := \begin{cases} DX_{1a} & \text{if } \frac{D}{L_4} \geq 1.33 \\ DX_{1b} & \text{otherwise} \end{cases}$ $\qquad DX_1 = 40.5$ in.

$DX_2 := \left(1 - \frac{F_{D3}}{F_{D2} \cdot \sinh(F_{D2})} \right) \cdot (L_4)$ $\qquad DX_2 = 70.127$ in.

M_3 = overturning moment at Point "3"

$M_{3s} := \left(\frac{1}{1.4} \right) \cdot ZC \cdot DW_s \cdot DX_s$ $\qquad M_{3s} = 22781.384$

$M_{3R} := \left(\frac{1}{1.4} \right) \cdot ZC \cdot W_R \cdot (DL)$ $\qquad M_{3R} = 23140.294$

$M_{31} := \left(\frac{1}{1.4} \right) \cdot ZC \cdot DW_1 \cdot DX_1$ $\qquad M_{31} = 1069805.992$

$M_{32} := \left(\frac{1}{1.4} \right) \cdot C_2 \cdot DW_2 \cdot DX_2$ $\qquad M_{32} = 741986.227$

$M_3 := M_{3s} + M_{3R} + M_{31} + M_{32}$

$M_3 = 1857713.898$ (in - lbs.)

A-12

VIII) Calculation of Flexural Stresses

A) Flexural Stresses At Tank Bottom (Point 0)

1) S_1 = section modulus for t_1

R_{m1} = mean tank radius

$R_{m1} := R + .50 \cdot (t_1)$

$R_{m1} = 84.288$

$S_1 := \pi \cdot (R_{m1})^2 \cdot (t_1)$

$S_1 = 12855.941$ in.^{3}

$$\sigma_0 := \left(\frac{M_0}{S_1}\right)$$

$\sigma_0 = 1495.573$ psi

ε_0 = axial strain at tank bottom due to flexure

E_{a1} = axial modulus of elasticity

$$\varepsilon_0 := \frac{\sigma_0}{E_{a1}}$$

$\varepsilon_0 = 0.000665$ in./in.

where Ea_1 = axial modulus for t_1 thick lamina

ε_{allow} = allowable axial strain

= 0.00133 in./in. (ASTM D3299 with 33% increase for seismic)

= 0.002 in./in. (ASME RTP-1)

Hence,

$\varepsilon_0 = 0.000665$ in./in. $\leq$ εallow

Ref. 1: *Structural Analysis of Shells* by Baker, Kovalevsky and Rish.

2) Check for buckling at tank bottom

From Fig. 10-13 of Ref. 1

$M_{cr/0}$ = critical buckling moment at tank bottom

$M_{cr/0} = \pi R^2 t_1 \sigma_{cr/0}$

where,

$\sigma_{cr/0}$ = critical buckling axial stress at tank bottom.

$$\sigma_{cr/0} = \gamma_1 \cdot C_b \cdot \left(\frac{E_{e1} \cdot t_1}{R}\right)$$

A-13

$RAT1 := \frac{R}{t_1}$ $\quad RAT1 = 145.833$,From Fig.10-13 of Ref. 1: $\gamma_1 := 0.63$

$C_b := \left[\frac{1}{\sqrt{3\cdot\left(1-\nu^2\right)}}\right]$ $\quad C_b = 0.6$

E_{e1} = effective modulus for buckling for t_1 lamina.

$E_{e1} := \sqrt{E_{a1}\cdot E_{h1}}$ $\quad E_{e1} = 2.70554\times 10^6$ psi

$\sigma_{cr0} := \gamma_1\cdot C_b\cdot\left(\frac{E_{e1}\cdot t_1}{R}\right)$

$\sigma_{cr0} = 7008.318$ psi

$M_{cr0} := \pi\cdot R^2\cdot t_1\cdot\sigma_{cr0}$

$M_{cr0} = 89483866.039$ in. - lbs

SF_0 = Safety factor against buckling due to M_0

$SF_0 := \left(\frac{M_{cr0}}{M_0}\right)$ $\quad SF_0 = 4.654$

A minimum safety factor against buckling of 4.0 is recommended.

A-14

B) Flexural Stresses At Point 1

1) S_2 = section modulus for t_2

R_{m2} = mean tank radius

$R_{m2} := R + .50 \cdot (t_2)$

$R_{m2} = 84.226$

$S_2 := \pi \cdot (R_{m2})^2 \cdot (t_2)$

$S_2 = 10073.506$ in.^{3}

$$\sigma_1 := \left(\frac{M_1}{S_2}\right)$$

$\sigma_1 = 1131.213$ psi

ε_1 = strain at Point 1 in axial direction due to flexure

$$\varepsilon_1 := \frac{\sigma_1}{E_{a2}}$$

$\varepsilon_1 = 0.000513$ in./in.

where Ea_2 = axial modulus for t_2 thick lamina

ε_{allow} = allowable axial strain

= 0.00133 in./in. (ASTM D3299 with 33% increase for seismic)

= 0.002 in./in. (ASME RTP-1)

$\varepsilon_1 = 0.000513$ in./in. $\leq$ εallow

2) Check for buckling at Point 1

From Fig. 10-13 of Ref. 1

M_{cr1} = critical buckling moment at Point 1

$M_{cr1} = \pi R^2 t_2 \sigma_{cr/1}$

where,

$\sigma_{cr/1}$ = critical buckling axial stress at Point 1

$$\sigma_{cr/1} = \gamma \cdot C_b \cdot \left(\frac{E_{e2} \cdot t_2}{R}\right)$$

A-15

$RAT2 := \frac{R}{t_2}$ $\quad RAT2 = 185.841$,From Fig.10-13 of Ref. 1: $\gamma_2 := 0.59$

$C_b := \left[\frac{1}{\sqrt{3\cdot(1-\nu^2)}}\right]$ $\quad C_b = 0.6$

E_{e2} = effective modulus for buckling for t_2 lamina.

$E_{e2} := \sqrt{(E_{a2}\cdot E_{h2})}$ $\quad E_{e2} = 2.574486 \times 10^6$ psi

$\sigma_{cr1} := \gamma_2\cdot C_b\cdot\left(\frac{E_{e2}\cdot t_2}{R}\right)$

$\sigma_{cr1} = 4900.922$ psi

$M_{cr1} := \pi\cdot R^2\cdot t_2\cdot\sigma_{cr1}$

$M_{cr1} = 49104884.587$ in. - lbs

SF_1 = Safety factor against buckling due to M_1

$SF_1 := \left(\frac{M_{cr1}}{M_1}\right)$ $\quad SF_1 = 4.309$

A minimum safety factor against buckling of 4.0 is recommended.

C) Flexural Stresses At Point 2 (Section L3)

1) S_3 = section modulus for t_3

R_{m3} = mean tank radius

$R_{m3} := R + .50 \cdot (t_3)$

$R_{m3} = 84.164$

$S_3 := \pi \cdot (R_{m3})^2 \cdot (t_3)$

$S_3 = 7299.22$ in.^{3}

$$\sigma_2 := \left(\frac{M_2}{S_3}\right)$$

$\sigma_2 = 765.399$ psi

ε_2 = strain at Point 2 in axial direction due to flexure

$$\varepsilon_2 := \frac{\sigma_2}{E_{a3}}$$

$\varepsilon_2 = 0.000362$ in./in.

where Ea_3 = axial modulus for t_3 thick lamina

ε_{allow} = allowable axial strain

= 0.00133 in./in. (ASTM D3299 with 33% increase for seismic)

= 0.002 in./in. (ASME RTP-1)

$\varepsilon_2 = 0.000362$ in./in. $\leq$ εallow

2) Check for buckling above Point 2

From Fig. 10-13 of Ref. 1

M_{cr2} = critical buckling moment at Point 2

$M_{cr2} = \pi R^2 t_3 \sigma_{cr/2}$

where,

$\sigma_{cr/2}$ = critical buckling axial stress at Point 2

$$\sigma_{cr/2} = \gamma_3 \cdot C_b \cdot \left(\frac{E_{e3} \cdot t_3}{R}\right)$$

A-17

$RAT3 := \frac{R}{t_3}$ $\quad RAT3 = 256.098$,From Fig.10-13 of Ref. 1: $\gamma_3 := 0.54$

$$C_b := \left[\frac{1}{\sqrt{3\cdot\left(1-\nu^2\right)}}\right] \qquad C_b = 0.6$$

E_{e3} = effective modulus for buckling for t_3 lamina.

$$E_{e3} := \sqrt{E_{a3}\cdot E_{h3}} \qquad E_{e3} = 2.452901\times 10^6 \quad \text{psi}$$

$$\sigma_{cr2} := \gamma_3\cdot C_b\cdot\left(\frac{E_{e3}\cdot t_3}{R}\right)$$

$\sigma_{cr2} = 3101.305$ psi

$$M_{cr2} := \pi\cdot R^2\cdot t_3\cdot\sigma_{cr2}$$

$M_{cr2} = 22548973.46$ in. - lbs

SF_2 = Safety factor against buckling due to M_2

$$SF_2 := \left(\frac{M_{cr2}}{M_2}\right) \qquad SF_2 = 4.036$$

A minimum safety factor against buckling of 4.0 is recommended.

D) Flexural Stresses At Point 3 (Section L4)

1) S_4 = section modulus for t_4

R_{m4} = mean tank radius

$R_{m4} := R + .50 \cdot (t_4)$

$R_{m4} = 84.124$

$S_4 := \pi \cdot (R_{m4})^2 \cdot (t_4)$

$S_4 = 5513.678$ in.^{3}

$\sigma_3 := \left(\frac{M_3}{S_4}\right)$

$\sigma_3 = 336.928$ psi

ε_3 = strain at Point 3 in axial direction due to flexure.

$\varepsilon_3 := \frac{\sigma_3}{E_{a4}}$

$\varepsilon_3 = 0.00036$ in./in.

where E_{a4} = axial modulus for t_4 thick lamina

ε_{allow} = allowable axial strain

= 0.00133 in./in. (ASTM D3299 with 33% increase for seismic)

= 0.002 in./in. (ASME RTP-1)

$\varepsilon_3 = 0.00036$ in./in. $\leq$ εallow = 0.00133 in./in. OK

2) Check for buckling above Point 3

From Fig. 10-13 of Ref. 1

M_{cr3} = critical buckling moment above Point 3

$M_{cr3} = \pi R^2 t_4 \sigma_{cr/3}$

where,

$\sigma_{cr/3}$ = critical buckling axial stress at Point 3

$\sigma_{cr/3} = \gamma_4 \cdot C_b \cdot \left(\frac{E_{e4} \cdot t_4}{R}\right)$

A-19

$RAT4 := \frac{R}{t_4}$ $\quad RAT4 = 338.71$,From Fig.10-13 of Ref. 1: $\gamma_4 := 0.49$

$C_b := \left[\frac{1}{\sqrt{3\cdot(1-\nu^2)}}\right]$ $\quad C_b = 0.6$

E_{e4} = effective modulus for buckling for t_4 lamina.

$E_{e4} := \sqrt{(E_{a4}\cdot E_{h4})}$ $\quad E_{e4} = 1.810377\times 10^6$ psi

$\sigma_{cr3} := \gamma_4\cdot C_b\cdot\left(\frac{E_{e4}\cdot t_4}{R}\right)$

$\sigma_{cr3} = 1570.412$ psi

$M_{cr3} := \pi\cdot R^2\cdot t_4\cdot\sigma_{cr3}$

$M_{cr3} = 8633237.877$ in. - lbs

SF_3 = Safety factor against buckling due to M_3

$SF_3 := \frac{M_{cr3}}{M_3}$ $\quad SF_3 = 4.647$

A minimum safety factor against buckling of 4.0 is recommended.

IX) Calculation of Hoop and Resultant Stresses And Strains

A-20

A) Hoop and Resultant Stresses and Strains at Tank Bottom (Point 0)

σ_{h0} = hoop stress = $\left(\frac{P_0 \cdot R_{m1}}{t_1}\right)$

P_{app} = applied pressure (+) or vacuum (-), (psi)

P_0 = pressure at tank bottom + P_{app}

$P_0 := SGL \cdot 0.0361 \cdot H + (P_{app})$

$P_0 = 12.866$ psi

$\sigma_{h0} := \left(\frac{P_0 \cdot R_{m1}}{t_1}\right)$

$\sigma_{h0} = 1882.731$ psi

ε_{h0} = hoop strain at tank bottom

$\varepsilon_{h0} := \frac{\sigma_{h0}}{E_{h1}}$ $\varepsilon_{h0} = 0.000578$ in./in.

where E_{h1} = hoop modulus for t_1 thick lamina

$\varepsilon_{h0} = 0.000578$ in./in. $\leq$ 0.00100 in./in. (ASTM D3299 and RTP-1) OK

ε_{0T} = total axial strain due to bending and internal pressure (vacuum)

ε_{aappo} = axial strain due to P_{app}

$\varepsilon_{aappo} := \left(\frac{P_{app} \cdot R_{m1}}{2 \cdot t_1 \cdot E_{a1}}\right)$

$\varepsilon_{aappo} = 0$

$\varepsilon_{0T} := \varepsilon_0 + \varepsilon_{aappo}$

$\varepsilon_{0T} = 0.0006651$

ε_{res0} = resultant strain for t_1 thick laminate

$\varepsilon_{res0} := \sqrt{(\varepsilon_{h0})^2 + (\varepsilon_{0T})^2}$

$\varepsilon_{res0} = 0.000881$ in./in. $\leq$ ε_{allow}

ε_{allow} = allowable resultant strain

= 0.0015 in./in. (ASTM D3299 with 50% increase for seismic)

= 0.002 in./in. (ASME RTP-1)

A-21

B) Hoop and Resultant Stresses and Strains at Point 1

σ_{h1} = hoop stress = $\left(\frac{P_1 \cdot R_{m2}}{t_2}\right)$

P_{app} = applied pressure (+) or vacuum (-), (psi)

P_1 = pressure at Point 1 + P_{app}

$P_1 := SGL \cdot 0.0361 \cdot (L_2 + L_3 + L_4 - FB) + (P_{app})$

$P_1 = 7.755$ psi

$\sigma_{h1} := \left(\frac{P_1 \cdot R_{m2}}{t_2}\right)$

$\sigma_{h1} = 1445.125$ psi

ε_{h1} = hoop strain at Point 1

$\varepsilon_{h1} := \frac{\sigma_{h1}}{E_{h2}}$ $\varepsilon_{h1} = 0.000481$ in./in.

where E_{h2} = hoop modulus for t_2 thick lamina

$\varepsilon_{h1} = 0.000481$ in./in. $\leq$ 0.00100 in./in. (ASTM D3299 AND RTP-1) OK

ε_{1T} = total axial strain due to bending and internal pressure (vacuum)

ε_{aapp1} = axial strain due to P_{app}

$\varepsilon_{aapp1} := \left(\frac{P_{app} \cdot R_{m2}}{2 \cdot t_2 \cdot E_{a2}}\right)$

$\varepsilon_{aapp1} = 0$

$\varepsilon_{1T} := \varepsilon_1 + \varepsilon_{aapp1}$

$\varepsilon_{1T} = 0.000513$

ε_{res1} = resultant strain for t_2 thick laminate

$\varepsilon_{res1} := \sqrt{(\varepsilon_{h1})^2 + (\varepsilon_{1T})^2}$

$\varepsilon_{res1} = 0.000703$ in./in. $\leq$ ε_{allow}

ε_{allow} = allowable resultant strain

= 0.0015 in./in. (ASTM D3299 with 50% increase for seismic)

= 0.002 in./in. (ASME RTP-1)

A-22

C) Hoop and Resultant Stresses and Strains at Point 2 (Section L3)

σ_{h2} = hoop stress = $\left(\frac{P_2 \cdot R_{m3}}{t_3}\right)$

P_{app} = applied pressure (+) or vacuum (-), (psi)

P_2 = pressure at Point 2 + P_{app}

$P_2 := SGL \cdot 0.0361 \cdot (L_3 + L_4 - FB) + (P_{app})$

$P_2 = 4.896$ psi

$\sigma_{h2} := \left(\frac{P_2 \cdot R_{m3}}{t_3}\right)$

$\sigma_{h2} = 1256.343$ psi

ε_{h2} = hoop strain at Point 2

$\varepsilon_{h2} := \frac{\sigma_{h2}}{E_{h3}}$

$\varepsilon_{h2} = 0.000441$ in./in. $\leq$ 0.00100 in./in. (ASTM D3299 and RTP-1) OK

ε_{2T} = total axial strain due to bending and internal pressure (vacuum)

ε_{aapp2} = axial strain due to P_{app}

$\varepsilon_{aapp2} := \left(\frac{P_{app} \cdot R_{m3}}{2 \cdot t_3 \cdot E_{a3}}\right)$

$\varepsilon_{aapp2} = 0$

$\varepsilon_{2T} := \varepsilon_2 + \varepsilon_{aapp2}$

$\varepsilon_{2T} = 0.0003623$

ε_{res2} = resultant strain for t_3 thick laminate

$\varepsilon_{res2} := \sqrt{(\varepsilon_{h2})^2 + (\varepsilon_{2T})^2}$

$\varepsilon_{res2} = 0.000571$ in./in. $\leq$ ε_{allow}

ε_{allow} = allowable resultant strain

= 0.0015 in./in. (ASTM D3299 with 50% increase for seismic)

= 0.002 in./in. (ASME RTP-1)

A-23

D) Hoop and Resultant Stresses and Strains at Point 3 (Section L4)

σ_{h3} = hoop stress = $\left(\frac{P_3 \cdot R_{m4}}{t_4}\right)$

P_{app} = applied pressure (+) or vacuum (-), (psi)

P_3 = pressure at Point 3 + P_{app}

$P_3 := SGL \cdot 0.0361 \cdot (L_4 - FB) + (P_{app})$

$P_3 = 2.037$ psi

$\sigma_{h3} := \left(\frac{P_3 \cdot R_{m4}}{t_4}\right)$

$\sigma_{h3} = 690.984$ psi

ε_{h3} = hoop strain at Point 3

$\varepsilon_{h3} := \frac{\sigma_{h3}}{E_{h4}}$

$\varepsilon_{h3} = 0.000197$ in./in. $\leq$ 0.00100 in./in. (ASTM D3299 and RTP-1) OK

ε_{3T} = total axial strain due to bending and internal pressure (vacuum)

ε_{aapp3} = axial strain due to P_{app}

$\varepsilon_{aapp3} := \left(\frac{P_{app} \cdot R_{m4}}{2 \cdot t_4 \cdot E_{a4}}\right)$

$\varepsilon_{aapp3} = 0$

$\varepsilon_{3T} := \varepsilon_3 + \varepsilon_{aapp3}$

$\varepsilon_{3T} = 0.00036$

ε_{res3} = resultant strain for t_4 thick laminate

$\varepsilon_{res3} := \sqrt{(\varepsilon_{h3})^2 + (\varepsilon_{3T})^2}$

$\varepsilon_{res3} = 0.000411$ in./in. $\leq$ εallow

ε_{allow} = allowable resultant strain
= 0.0015 in./in. (ASTM D3299 with 50% increase for seismic)
= 0.002 in./in. (ASME RTP-1)

ANCHOR LUG DESIGN FOR SEISMIC LOADS

From page A-12

$\sigma_0 = 1495.573$ psi

$LS := \frac{\pi \cdot D}{nn}$

$LS = 43.982$ in. / lug (lug spacing around tank perimeter)

P_L = tension force per lug

$ZZ := \begin{cases} BWR & \text{if } BWR < 0.035 \cdot D \\ D \cdot 0.035 & \text{otherwise} \end{cases}$

$ZZ = 3$ in.

$P_L := (t_1) \cdot (LS) \cdot (\sigma_0) + \pi \cdot R^2 \cdot \left(\frac{P_{app}}{nn}\right) - ZZ \cdot LS \cdot H \cdot SGL \cdot 0.0361 - \frac{W_s}{nn} - \frac{W_R}{nn}$

$P_L = 35778.277$ lbs TENSION (ASD)

P_S = avg. shear force per lug

R=1.0

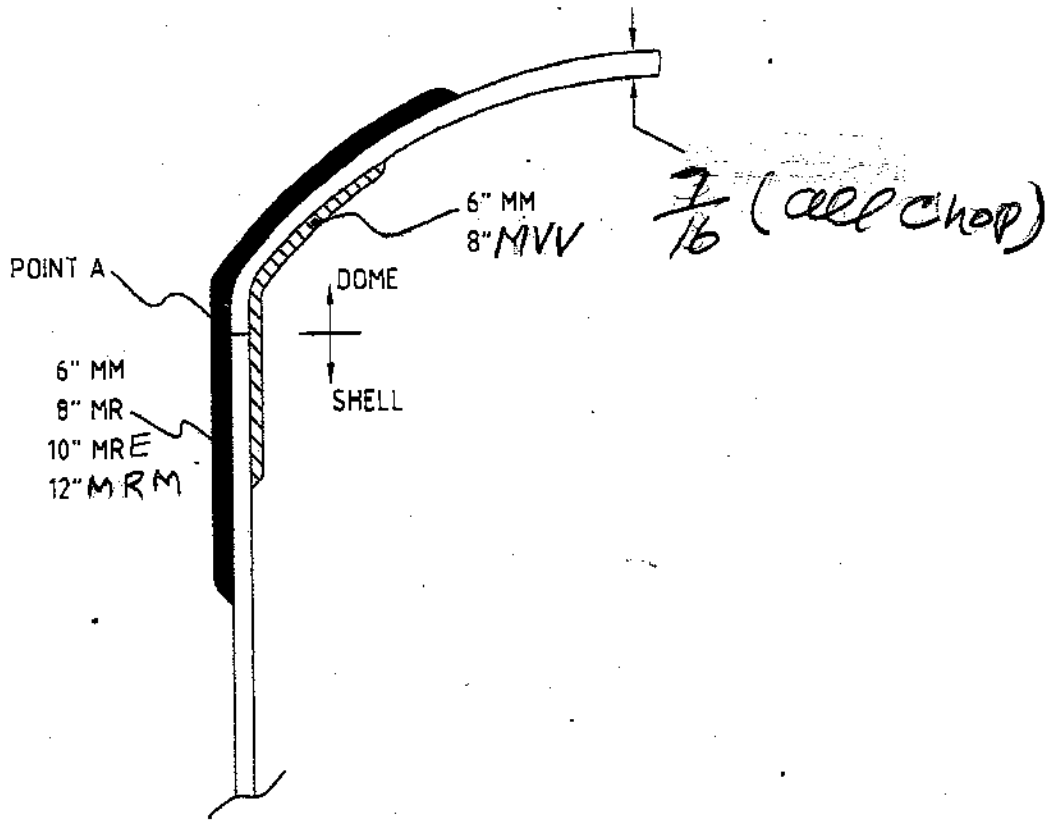
$P_S := \frac{F_H}{nn}$

$P_S = 10108.875$ lbs SHEAR (ASD)

ENG 2011

A-25

FIG. A-2: DOME TOP DESIGN AND BOND

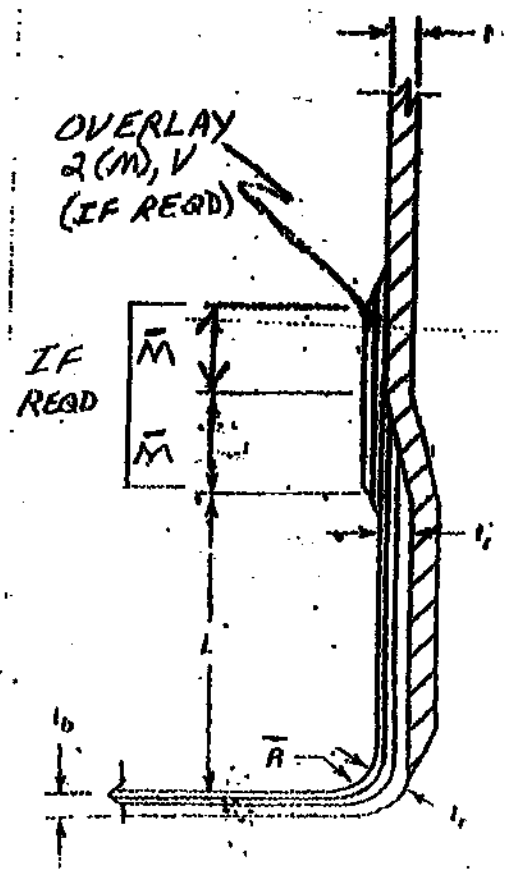


NOTE: CENTER BONDS ON POINT A

M = 1-1/2 OZ. MAT
R = 24 OZ. WOVEN ROVING
V = VEILS, AS REQUIRED BY SPECS.
E = exotherm = 1½ oz Mat.

FIG. A-3: KNUCKLE REGION DESIGN

Vessel Diameter ft. (m)	$\bar{R}$ min. in. (mm)	L min. in. (mm)	$\bar{M}$ min. in. (mm)
4(1.2) and under	1 (25.4)	8 (203)	3 (24)
Over 4(1.2)	1½ (38)	12 (305)	4 (102



t = shell thickness

t = 0.576"

t_r = total knuckle reinforcement [MAX($2t_b$, t_b + t)]

t_r = $t_b + \{[3(MR), E], MRM\}$

t_b = bottom thickness

t_b = 0.40" (TYPE II CSM)

$\bar{M}$ = overlay length (interior) (IF REQD)

$\bar{M}$ = 4"

L = 26"

$\bar{R}$ = KNUCKLE RADIUS

M = 1-1/2 oz. mat = E = exotherm

WR = 24 oz. woven roving

V = veils (as required by spec.)

A-3

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A-27

TYPE D1 LUG DESIGN

(CAPACITY OF LUG AS SHOWN IN FIG. BELOW IS 24000 - 40,000 LBS., ASD)

(FABRICATED WITH 3/8 IN. PLATES)

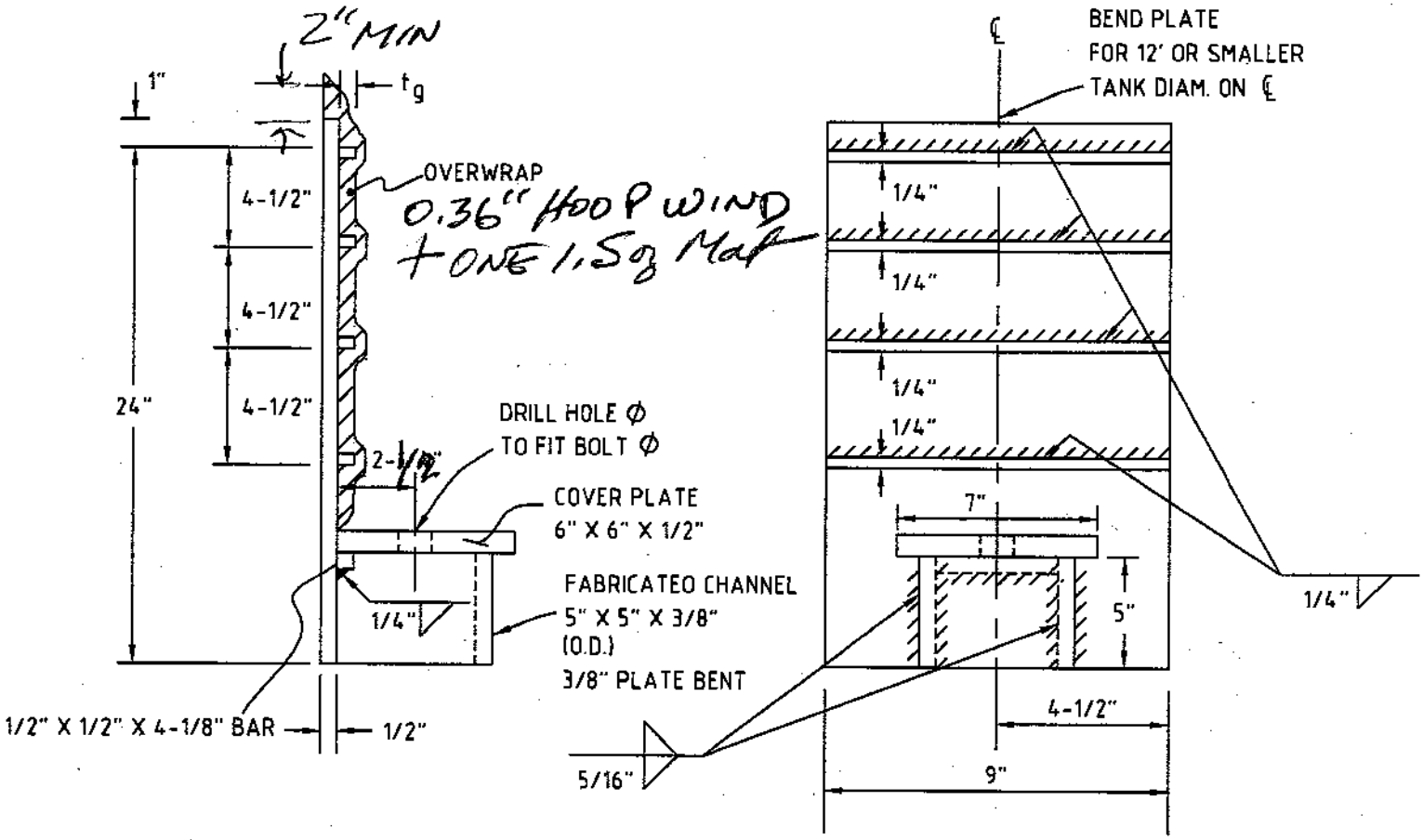


FIG. A-4: TYPE D1 LUG
(12 REQD)

1. THE LUG IS DESIGNED TO DEVELOP PLASTIC MOMENT IN 1/2 IN. COVER PLATE AT TOP OF FABRICATED CHANNEL, WITH THE REMAINING MOMENT TAKEN INTO TANK WALL.

2. THIS LUG IS DESIGNED TO DEVELOP DUCTILITY REQUIRED BY ACI 318-11 APPENDIX D AND ASCE 7-10 TO AVOID OVERSTRENGTH FACTORS.

NOTES: 1) All weld elctrodes; E70
2) Use 4000 psi = f' concrete for fill of structure tube.
3) All steel; A36
4) Bend lug plate to fit tank.

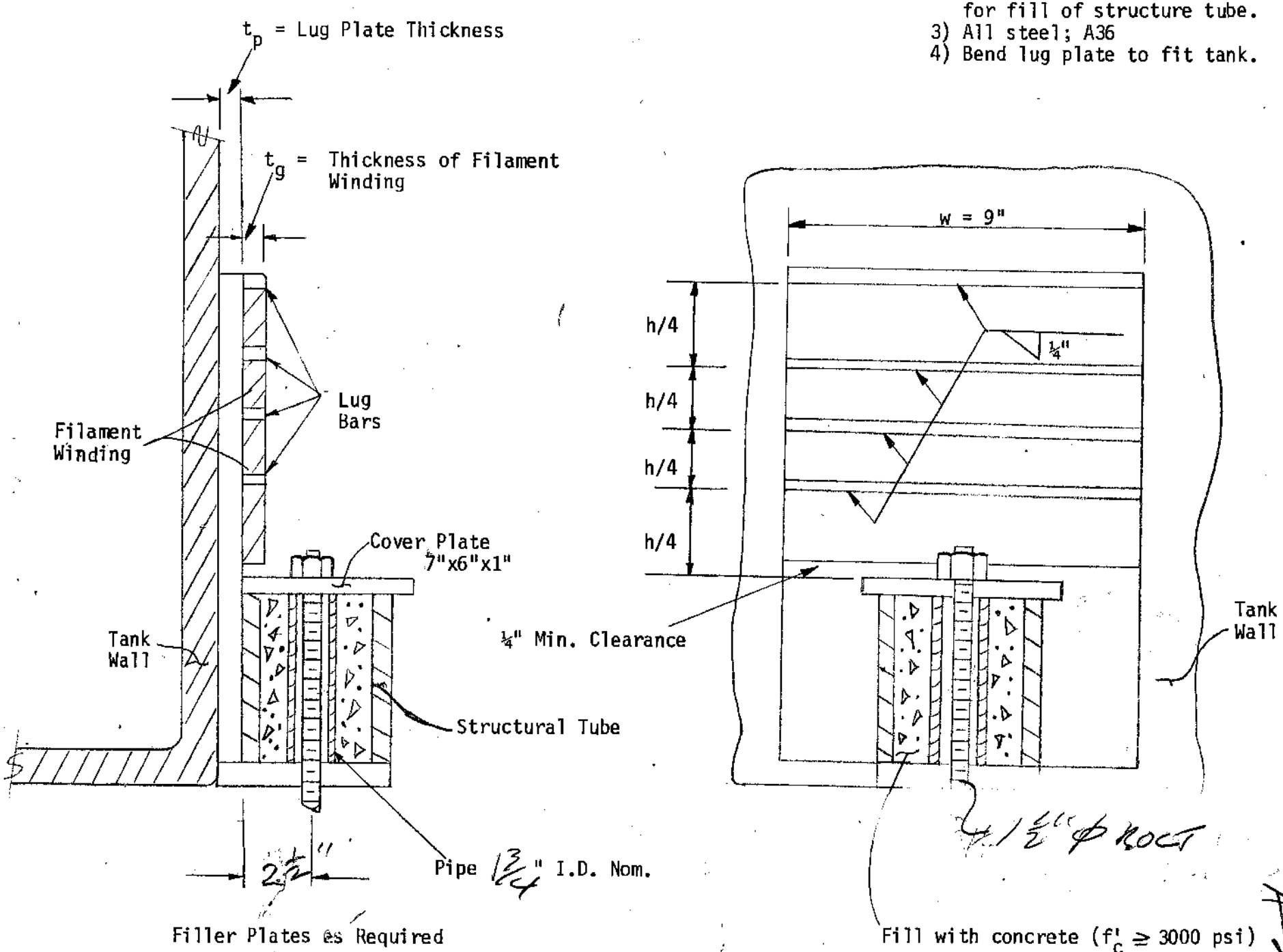
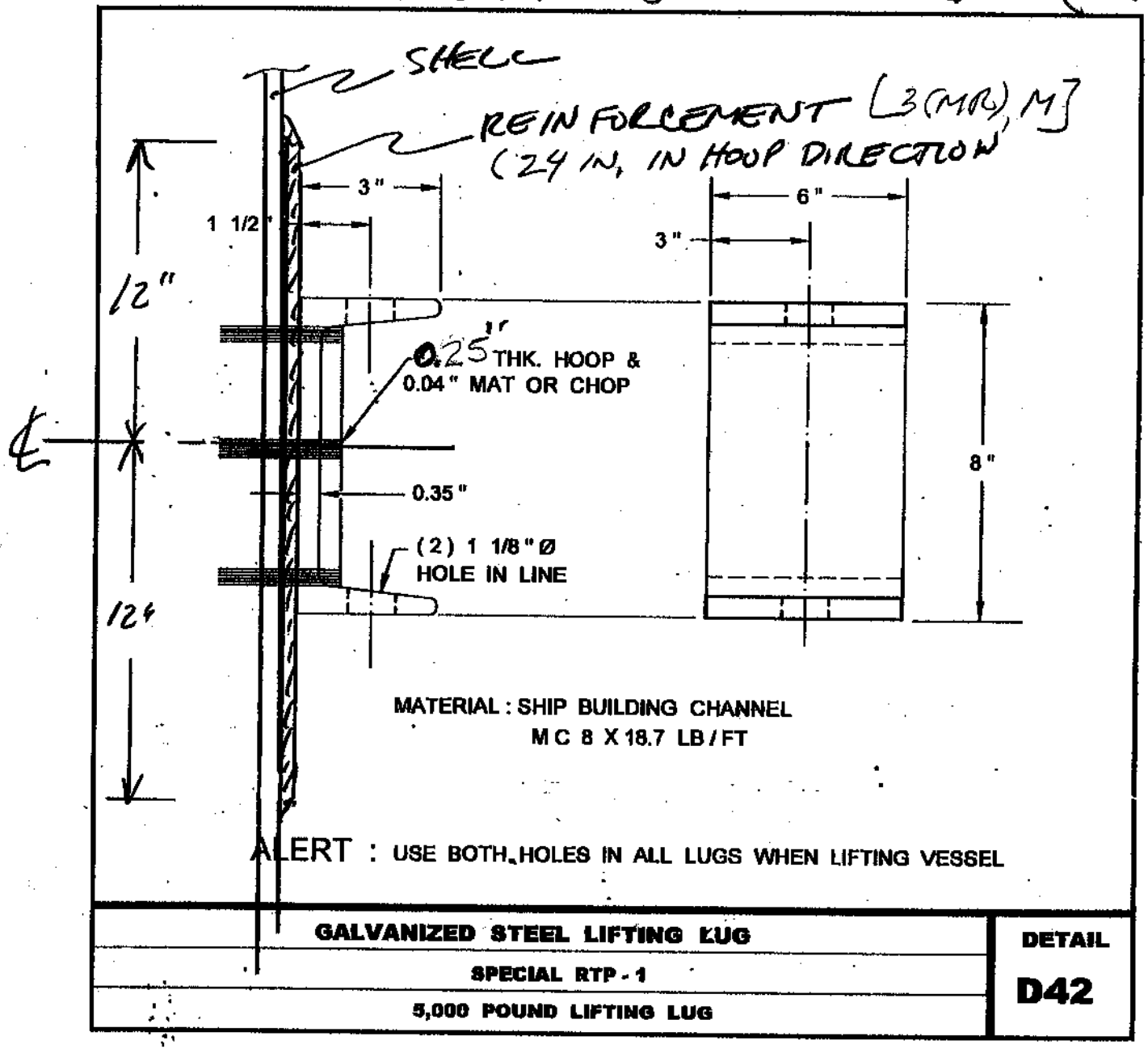


FIGURE A-5. LUG AND SHELL DETAILS (Lug Type)

A-8

FIG. A-6: LIFTING LUG DESIGN (4 REQD)



GALVANIZED STEEL LIFTING LUG	DETAIL
SPECIAL RTP - 1	D42
5,000 POUND LIFTING LUG	

B-1

CHAPTER B: SHELL CONST.

C.S.U.L.B. ULTRA FIBER S.C.L.
Laminate Model

DATE: 07-30-1993

TIME: 11:08:39
PAGE: 1

File Name :CC7 LAMINATE CC7

Material Properties for Laminate Model in L-T Coordinates (psi)

E1(Times E6)	Et(Times E6)	G(Times E6)	Poisson Ratio
5.7000	0.8000	0.2800	0.2800
1.0000	1.0000	0.4000	0.2500

Data for each Lamina (Theta(θ) measured clockwise from +Y axis)

Lamina#	Material #	Theta(θ) (deg)	Thickness (in.)	Graphical Layup
1	2	LINER	0.0800	
2	1	70	0.0210	<><><>
3	1	0	0.0200	
4	1	0	0.0200	
5	1	-70	0.0210	<><><>
6	1	70	0.0210	<><><>
7	1	0	0.0200	
8	1	0	0.0200	
9	1	-70	0.0210	<><><>
10	1	90	0.0210	======
11	1	90	0.0210	======
12	1	70	0.0210	<><><>
13	1	-70	0.0210	<><><>
14	1	-70	0.0210	<><><>
15	1	70	0.0210	<><><>
16	1	90	0.0210	======
17	1	90	0.0210	======
18	1	-70	0.0210	<><><>
19	1	0	0.0200	
20	1	0	0.0200	
21	1	70	0.0210	<><><>
22	1	-70	0.0210	<><><>
23	1	0	0.0200	
24	1	0	0.0200	
25	1	70	0.0210	<><><>

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ULTRA FIBER

C.S.U.L.B. S.C.L.

Laminate Model

DATE: 07-30-1993

TIME: 11:08:43
PAGE: 2

File Name :CC7

LAMINATE CC7

Data for each Lamina (Theta(θ) measured clockwise from +Y axis)

Lamina#	Material #	Theta(θ) (deg)	Thickness (in.)	Graphical Layup

	CORROSSION LINER HAS	1	LAYERS WITH	0.080	in. THICKNESS
<><><>	HELIX WINDING CONSISTS OF	12	LAYERS WITH	0.252	in. THICKNESS
	CHOPPED LAMINA CONSISTS OF	0	LAYERS WITH	0.000	in. THICKNESS
======	CERT WINDING CONSISTS OF	4	LAYERS WITH	0.084	in. THICKNESS
|||||||	UNI WINDING CONSISTS OF	8	LAYERS WITH	0.160	in. THICKNESS

The Total Thickness of the Composite Construction = 0.576 inches

ULTRA FIBER
C.S.U.L.B. S.C.L.
LAMINATE MATRIX DATA
Units are in in. lbs.

DATE: 07-30-1993 TIME: 11:08:45
PAGE: 3

File Name :CC7 LAMINATE CC7

Force-Moment Total Matrix (Times E6)

1.875082	0.263807	0.000000	0.050427	0.004408	0.000000
0.263807	1.295189	0.000000	0.004408	0.027232	0.000000
0.000000	0.000000	0.301013	0.000000	0.000000	0.002825
0.050427	0.004408	0.000000	0.037866	0.006660	0.002454
0.004408	0.027232	0.000000	0.006660	0.039061	0.000314
0.000000	0.000000	0.002825	0.002454	0.000314	0.007909

Inverse Force-Moment Total Matrix (Times E-6)

0.570600	-0.116700	-0.002200	-0.788100	0.149400	0.239400
-0.116700	0.807400	0.000300	0.164800	-0.577600	-0.028300
-0.002200	0.000300	3.333500	0.082500	-0.004200	-1.216000
-0.788100	0.164800	0.082500	28.867000	-4.877400	-8.791600
0.149400	-0.577600	-0.004200	-4.877400	26.814700	0.449500
0.239400	-0.028300	-1.216000	-8.791600	0.449500	129.586900

A Elasticity Matix (Times E6)

3.25535	0.45800	0.00000
0.45800	2.24859	0.00000
0.00000	0.00000	0.52259

AInv Elasticity Matrix (Times E-6)

0.31625	-0.06441	0.00000
-0.06441	0.45784	0.00000
0.00000	0.00000	1.91354

B Elasticity Matix (Times E6)

0.08755	0.00765	0.00000
0.00765	0.04728	0.00000
0.00000	0.00000	0.00490

BInv Elasticity Matrix (Times E-6)

11.58636	-1.87561	0.00000
-1.87561	21.45555	0.00000
0.00000	0.00000	203.92823

D Elasticity Matix (Times E6)

0.06574	0.01156	0.00426
0.01156	0.06782	0.00055
0.00426	0.00055	0.01373

DInv Elasticity Matrix (Times E-6)

15.99933	-2.68901	-4.85693
-2.68901	15.20273	0.23031
-4.85693	0.23031	74.32883

B-4

C.S.U.L.B. ULTRA FIBER S.C.L.
Laminate Model

DATE: 08-02-1993 TIME: 10:17:15
PAGE: 1

File Name :CC16 LAMINATE CC-16

Material Properties for Laminate Model in L-T Coordinates (psi)

El(Times E6)	Et(Times E6)	G(Times E6)	Poisson Ratio
5.7000	0.8000	0.2800	0.2800
1.0000	1.0000	0.4000	0.2500

Data for each Lamina (Theta(θ) measured clockwise from +Y axis)

Lamina#	Material #	Theta(θ) (deg)	Thickness (in.)	Graphical Layup
1	2	LINER	0.0800	
2	1	70	0.0210	<><><>
3	1	0	0.0200	
4	1	0	0.0200	
5	1	-70	0.0210	<><><>
6	1	70	0.0210	<><><>
7	1	0	0.0200	
8	1	-70	0.0210	<><><>
9	1	70	0.0210	<><><>
10	1	-70	0.0210	<><><>
11	1	-70	0.0210	<><><>
12	1	70	0.0210	<><><>
13	1	-70	0.0210	<><><>
14	1	0	0.0200	
15	1	70	0.0210	<><><>
16	1	-70	0.0210	<><><>
17	1	0	0.0200	
18	1	0	0.0200	
19	1	70	0.0210	<><><>

	CORROSSION LINER HAS	1	LAYERS WITH	0.080	in. THICKNESS
<><><>	HELIX WINDING CONSISTS OF	12	LAYERS WITH	0.252	in. THICKNESS
	CHOPPED LAMINA CONSISTS OF	0	LAYERS WITH	0.000	in. THICKNESS
======	CERT WINDING CONSISTS OF	0	LAYERS WITH	0.000	in. THICKNESS
	UNI WINDING CONSISTS OF	6	LAYERS WITH	0.120	in. THICKNESS

The Total Thickness of the Composite Construction = 0.452 inches

B-5

ULTRA FIBER

C.S.U.L.B. S.C.L.

LAMINATE MATRIX DATA

Units are in in. lbs.

DATE: 08-02-1993 TIME: 10:17:20

PAGE: 2

File Name :CC16 LAMINATE CC-16

Force-Moment Total Matrix (Times E6)

1.358598	0.235722	0.000000	0.035059	0.004608	0.000000
0.235722	0.996705	0.000000	0.004608	0.020583	0.000000
0.000000	0.000000	0.266293	0.000000	0.000000	0.003420
0.035059	0.004608	0.000000	0.017699	0.003295	0.001456
0.004608	0.020583	0.000000	0.003295	0.017526	0.000186
0.000000	0.000000	0.003420	0.001456	0.000186	0.003931

Inverse Force-Moment Total Matrix (Times E-6)

0.811100	-0.190700	-0.007800	-1.666100	0.317400	0.608900
-0.190700	1.073100	0.000900	0.340900	-1.273600	-0.066600
-0.007800	0.000900	3.799100	0.299800	-0.019000	-3.415400
-1.666100	0.340900	0.299800	63.811900	-11.709600	-23.342400
0.317400	-1.273600	-0.019000	-11.709600	60.657300	1.476900
0.608900	-0.066600	-3.415400	-23.342400	1.476900	265.959900

A Elasticity Matix (Times E6)

3.00575	0.52151	0.00000
0.52151	2.20510	0.00000
0.00000	0.00000	0.58914

AInv Elasticity Matrix (Times E-6)

0.34693	-0.08205	0.00000
-0.08205	0.47290	0.00000
0.00000	0.00000	1.69738

B Elasticity Matix (Times E6)

0.07756	0.01019	0.00000
0.01019	0.04554	0.00000
0.00000	0.00000	0.00757

BInv Elasticity Matrix (Times E-6)

13.28349	-2.97355	0.00000
-2.97355	22.62567	0.00000
0.00000	0.00000	132.17444

D Elasticity Matix (Times E6)

0.03916	0.00729	0.00322
0.00729	0.03877	0.00041
0.00322	0.00041	0.00870

DInv Elasticity Matrix (Times E-6)

27.28526	-5.02421	-9.86862
-5.02421	26.72905	0.59326
-9.86862	0.59326	118.62159

B-6

C.S.U.L.B. ULTRA FIBER S.C.L.
Laminate Model

DATE: 07-29-1993

TIME: 12:20:39
PAGE: 1

File Name :LMAA7

LAMINATE AA7

Material Properties for Laminate Model in L-T Coordinates (psi)

El(Times E6)	Et(Times E6)	G(Times E6)	Poisson Ratio
5.7000	0.8000	0.2800	0.2800
1.0000	1.0000	0.4000	0.2500

Data for each Lamina (Theta(θ) measured clockwise from +Y axis)

Lamina#	Material #	Theta(θ) (deg)	Thickness (in.)	Graphical Layup
1	2	LINER	0.0800	
2	1	70	0.0210	<><><>
3	1	0	0.0200	
4	1	0	0.0200	
5	1	-70	0.0210	<><><>
6	1	70	0.0210	<><><>
7	1	-70	0.0210	<><><>
8	1	-70	0.0210	<><><>
9	1	70	0.0210	<><><>
10	1	-70	0.0210	<><><>
11	1	0	0.0200	
12	1	0	0.0200	
13	1	70	0.0210	<><><>

	CORROSSION LINER HAS	1	LAYERS WITH	0.080	in. THICKNESS
<><><>	HELIX WINDING CONSISTS OF	8	LAYERS WITH	0.168	in. THICKNESS
	CHOPPED LAMINA CONSISTS OF	0	LAYERS WITH	0.000	in. THICKNESS
	CERT WINDING CONSISTS OF	0	LAYERS WITH	0.000	in. THICKNESS
	UNI WINDING CONSISTS OF	4	LAYERS WITH	0.080	in. THICKNESS

The Total Thickness of the Composite Construction = 0.328 inches

ULTRA FIBER

C.S.U.L.B. S.C.L.

LAMINATE MATRIX DATA

Units are in in. lbs.

DATE: 07-29-1993

TIME: 12:20:43

PAGE: 2

File Name :LMAA7

LAMINATE AA7

Force-Moment Total Matrix (Times E6)

0.934177	0.164259	0.000000	0.023372	0.003072	0.000000
0.164259	0.692914	0.000000	0.003072	0.013722	0.000000
0.000000	0.000000	0.188195	0.000000	0.000000	0.002280
0.023372	0.003072	0.000000	0.006481	0.001222	0.000653
0.003072	0.013722	0.000000	0.001222	0.006186	0.000084
0.000000	0.000000	0.002280	0.000653	0.000084	0.001481

Inverse Force-Moment Total Matrix (Times E-6)

1.236200	-0.290700	-0.024900	-4.703500	0.932400	2.058200
-0.290700	1.578000	0.002900	0.994100	-3.549000	-0.242300
-0.024900	0.002900	5.419900	0.985200	-0.070300	-8.772300
-4.703500	0.994100	0.985200	185.670700	-35.455800	-81.324700
0.932400	-3.549000	-0.070300	-35.455800	175.989300	5.801200
2.058200	-0.242300	-8.772300	-81.324700	5.801200	724.137600

A Elasticity Matix (Times E6)

2.84810	0.50079	0.00000
0.50079	2.11254	0.00000
0.00000	0.00000	0.57377

AInv Elasticity Matrix (Times E-6)

0.36638	-0.08685	0.00000
-0.08685	0.49395	0.00000
0.00000	0.00000	1.74287

B Elasticity Matix (Times E6)

0.07126	0.00937	0.00000
0.00937	0.04184	0.00000
0.00000	0.00000	0.00695

BInv Elasticity Matrix (Times E-6)

14.45902	-3.23669	0.00000
-3.23669	24.62794	0.00000
0.00000	0.00000	143.87129

D Elasticity Matix (Times E6)

0.01976	0.00373	0.00199
0.00373	0.01886	0.00026
0.00199	0.00026	0.00452

DInv Elasticity Matrix (Times E-6)

54.97927	-10.54362	-23.62967
-10.54362	55.06461	1.53780
-23.62967	1.53780	231.76748

B-8

4A

C.S.U.L.B. ULTRA FIBER S.C.L.
Laminate Model

DATE: 07-29-1993

TIME: 11:48:27
PAGE: 1

File Name :LMAA1

LAMINATE AA-1

Material Properties for Laminate Model in L-T Coordinates (psi)

El(Times E6)	Et(Times E6)	G(Times E6)	Poisson Ratio
5.7000	0.8000	0.2800	0.2800
1.0000	1.0000	0.4000	0.2500

Data for each Lamina (Theta(θ) measured clockwise from +Y axis)

Lamina#	Material #	Theta(θ) (deg)	Thickness (in.)	Graphical Layup
1	2	LINER	0.0800	
2	1	70	0.0210	<><><>
3	1	-70	0.0210	<><><>
4	1	70	0.0210	<><><>
5	1	-70	0.0210	<><><>
6	1	-70	0.0210	<><><>
7	1	70	0.0210	<><><>
8	1	-70	0.0210	<><><>
9	1	70	0.0210	<><><>

	CORROSSION LINER HAS	1 LAYERS WITH	0.080 in.	THICKNESS
<><><>	HELIX WINDING CONSISTS OF	8 LAYERS WITH	0.168 in.	THICKNESS
	CHOPPED LAMINA CONSISTS OF	0 LAYERS WITH	0.000 in.	THICKNESS
	CERT WINDING CONSISTS OF	0 LAYERS WITH	0.000 in.	THICKNESS
	UNI WINDING CONSISTS OF	0 LAYERS WITH	0.000 in.	THICKNESS

The Total Thickness of the Composite Construction = 0.248 inches

B-9

ULTRA FIBER

C.S.U.L.B. S.C.L.

LAMINATE MATRIX DATA

Units are in in. lbs.

DATE: 07-29-1993

TIME: 11:48:31

PAGE: 2

File Name :LMAA1

LAMINATE AA-1

Force-Moment Total Matrix (Times E6)

0.869465	0.146139	0.000000	0.024197	0.003200	0.000000
0.146139	0.231841	0.000000	0.003200	-0.001308	0.000000
0.000000	0.000000	0.165795	0.000000	0.000000	0.002664
0.024197	0.003200	0.000000	0.003747	0.000655	0.000209
0.003200	-0.001308	0.000000	0.000655	0.001227	0.000027
0.000000	0.000000	0.002664	0.000209	0.000027	0.000772

Inverse Force-Moment Total Matrix (Times E-6)

1.557000	-0.850200	-0.043700	-9.488400	0.039900	2.721600
-0.850200	4.890700	0.004500	0.031600	7.421400	-0.281800
-0.043700	0.004500	6.392900	1.574500	-0.231000	-22.488500
-9.488400	0.031600	1.574500	362.818100	-166.852900	-97.994200
0.039900	7.421400	-0.231000	-166.852900	911.858500	14.375700
2.721600	-0.281800	-22.488500	-97.994200	14.375700	1399.678400

A Elasticity Matix (Times E6)

3.50591	0.58927	0.00000
0.58927	0.93484 E_a	0.00000
0.00000	0.00000	0.66853

AInv Elasticity Matrix (Times E-6)

0.31903	-0.20110	0.00000
-0.20110	1.13646	0.00000
0.00000	0.00000	1.49582

B Elasticity Matix (Times E6)

0.09757	0.01290	0.00000
0.01290	-0.00527	0.00000
0.00000	0.00000	0.01074

BInv Elasticity Matrix (Times E-6)

7.74299	18.94884	0.00000
18.94884	-143.27346	0.00000
0.00000	0.00000	93.09954

D Elasticity Matix (Times E6)

0.01511	0.00264	0.00084
0.00264	0.00495	0.00011
0.00084	0.00011	0.00311

DInv Elasticity Matrix (Times E-6)

74.08839	-39.16185	-18.72406
-39.16185	223.03516	2.87408
-18.72406	2.87408	326.37838

CHAPTER C

C-1

DESIGN OF HOLD-DOWN LUGS FOR 168 in. ϕ X 324 in. HIGH TANK (HOOP WOUND)

P_{app} = Applied pressure over and above hydrostatic pressure

$P_{app} := 0$ psi

S_0= Section modulus of tank

$R_0 := 84$ in.

$t_0 := 0.576$ in.

$S_0 := \pi \cdot R_0^2 \cdot t_0$ $S_0 = 12768.237$ in.^{3} (S_0 = section modulus for t_0 thickness)

F_L = Tension force per lug

SGL = Specific gravity of the liquid $SGL := 1.1$

$D_0 := 2 \cdot R_0$ $D_0 = 168$ in.

H = Height of tank $H := 324$ in.

$Lugs := 12$

SSL = Lug spacing

$SSL := \pi \cdot D_0 \div Lugs$ $SSL = 43.982$ in.

$F_L := 35778$ lb.

W_{MAX} = Unit radial load on overwrap

e = load eccentricity on lug $e := 2.5$ in.

h = height of lug $h := 25$ in.

$W_{MAX} := 3 \cdot F_L \frac{e}{h^2}$ $W_{MAX} = 429.336$ lb. per in.

C-2

P = Radial load due to moment

$P := W_{MAX} \cdot \frac{h}{2}$ $\quad P = 5366.7$ lb.

T_{tot} = Hoop overwind load

R_m = Mean radius of overwind $\quad R_m := 84.8$ in.

w = Lug width $\quad w := 9$ in.

$T_{tot} := \frac{P \cdot R_m}{w}$ $\quad T_{tot} = 50566.24$

Try overwrap thickness, t_1 $\quad t_1 := 0.36$ in.

σ_T = Hoop overwind tensile stress

h_1 = Height of wound overwrap, in $\quad h_1 := 19$ in.

$\sigma_T := \frac{T_{tot}}{h_1 \cdot t_1}$ $\quad \sigma_T = 7392.725$ psi $< \frac{40000}{5} = 8000$ psi allowable ok

τ_b = shear across lug bond

$\tau_b := \frac{F_L}{2 \cdot h_1 \cdot t_1}$

$\tau_b = 2615.351 \quad \leq$ 3,000 psi

τ_w = Shear across vessel wall

t_b = Tank bottom thickness $\quad t_b := 0.40$ in.

t_r = Knuckle reinforcement thickness $\quad t_r := 0.795$ in.

t_k = Total thickness above knuckle radius

$t_k := 1.371$ in.

$\tau_w := \frac{P}{(t_k \cdot w)}$ $\quad \tau_w = 434.938$ psi $< \frac{3000}{2} = 1500$ psi allowable ok

β = Coefficient of bending in the vessel wall

$\beta := \frac{1.28}{(R_m \cdot t_k)^{\frac{1}{2}}}$ $\quad \beta = 0.119$ in.$^{-1}$

C-3

P* = Unit radial loading

$P^* := \frac{P}{w}$ $\quad P^* = 596.3$ lb. per in.

Axial and hoop bending loads

$M_{ax} := \frac{P^*}{4 \cdot \beta}$ $\quad M_{ax} = 1255.774$ in.-lb. per in.

$p := H \cdot 0.0361 \cdot SGL + P_{app}$ $\quad p = 12.866$ psi

ν = Poisson Ratio

$\nu := 0.3$

$M_{hp} := \nu \cdot M_{ax}$ $\quad M_{hp} = 376.732$ in.-lb. per in.

Axial load due to pressure

$N_{ax} := \frac{(P_{app} \cdot R_m)}{2}$ $\quad N_{ax} = 0$ lb. per in.

Hoop load due to pressure

$N_{hp} := p \cdot R_m$ $\quad N_{hp} = 1091.04$ lb. per in.

Axial stress

$\sigma_{ax} := \frac{N_{ax}}{t_k} + \frac{(6 \cdot M_{ax})}{t_k^2}$ $\quad \sigma_{ax} = 4008.555$ psi $\leq$ 4,500 psi OK

Hoop stress

$\sigma_{hp} := \frac{N_{hp}}{t_k} + \frac{(6 \cdot M_{hp})}{t_k^2}$ $\quad \sigma_{hp} = 1998.365$ psi $\leq$ 4,500 psi OK

CHAPTER D: LIFT LUG CALCULATIONS

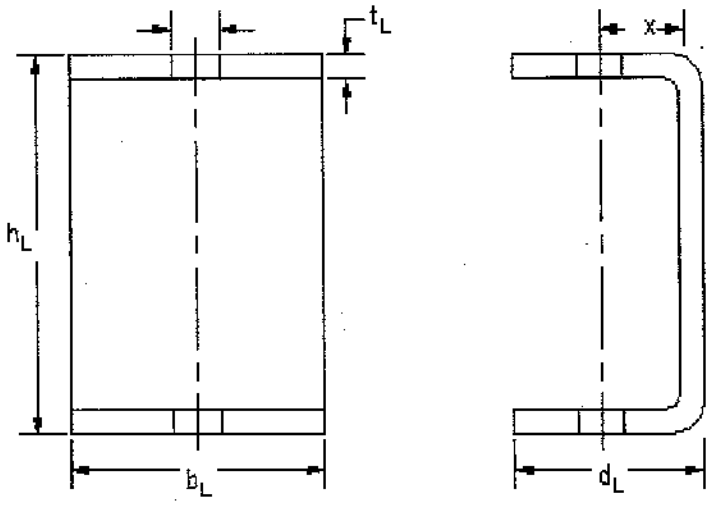


FIG. 1

NOTE: CALCULATIONS ASSUME BOTH FLANGES ARE LOADED.

I) Design Properties

A) Lug Geometry

Total empty tank weight, (lbf) ;	$W_{vef} := 6500$
Number of lift lugs ;	$N_L := 4$
Thickness of lift lugs, (in) ;	$t_L := 0.35$
Depth of lifting lugs, (in) ;	$d_L := 3$
Width of lift lugs, (in) ;	$b_L := 6$
Height of lift lugs, (in) ;	$h_L := 8$
Distance from back to hole center line, (in) ;	$x := 1.5$
Distance to neutral axis, (in) ;	$c := \frac{t_L}{2}$ $\quad c = 0.175$
Design factor ;	$DF := 4$
Overwind thickness, (in) ;	$t_{Lo} := 0.25$
Shell thickness at top of tank, (in) ;	$t_{st} := 0.248$

B) Allowable Stresses

Allowable flexural steel stress, (psi) ;	$\sigma_{all} := 20000$
Allowable FRP wall shear, (psi) ;	$S_v := 2000$

D-2

II) Calculations for Steel Lug

A) Bolting Calculations

A_L = cross sectional area of lug, (in^2)

$A_L := t_L \cdot b_L$

$A_L = 2.1$

I_L = lug moment of inertia, (in)

$$I_L := 2 \cdot \left(\frac{b_L \cdot t_L^3}{12} \right)$$

$I_L = 0.043$

P_L = load per lift lug plus 50% shock factor (lb/lug)

$$P_L := \frac{1.5 \cdot W_{vef}}{N_L}$$

$P_L = 2438$

M_L = moment in lift lug, (lbf-in)

$M_L := P_L \cdot x$

$M_L = 3656$

σ_{act} = resulting stress, (psi)

$$\sigma_{act} := \frac{M_L \cdot c}{I_L}$$

$\sigma_{act} = 14923$

$$CHECK := \begin{cases} \text{"OK"} & \text{if } \sigma_{act} \le \sigma_{all} \\ \text{"Excessive"} & \text{otherwise} \end{cases}$$

CHECK = "OK" **CHECK**

B) Check Overwind

h_o = overwind height or width, (in)

$h_o := h_L - 2.25 \cdot t_L$

$h_o = 7.213$

W_o = unit radial load on overwind, (lbf/in)

$$W_o := \frac{3 \cdot P_L \cdot x}{h_o^2}$$

$W_o = 210.9$

P_r = radial load due to moment, (lbf)

$$P_r := W_o \cdot \left(\frac{h_o}{2}\right)$$

$P_r = 760$

τ_w = shear across vessel wall, (psi)

$$\tau_w := \frac{P_r}{t_{st} \cdot (b_L + h_o)}$$

$\tau_w = 232$

$$CHECK := \begin{cases} \text{"OK"} & \text{if } \tau_w \le S_v \\ \text{"Too High"} & \text{otherwise} \end{cases}$$

CHECK = "OK" **CHECK**

τ_o = shear on lug overwind, (psi)

$$\tau_o := \frac{P_L}{2 \cdot t_{Lo} \cdot h_o}$$

$\tau_o = 676$

$$CHECK := \begin{cases} \text{"OK"} & \text{if } \tau_o \le S_v \\ \text{"Too High"} & \text{otherwise} \end{cases}$$

CHECK = "OK" **CHECK**

III) Stresses in Shell Wall

P_{app} = Applied pressure over and above hydrostatic pressure

$P_{app} := 0$ psi

W_{MAX} = Unit radial load on overwrap

e = load eccentricity on lug

$e := x$

$e = 1.5$

h = height of lug

$h := h_L$

$h = 8$

$W_{MAX} := 3 \cdot P_L \frac{e}{h^2}$ $\quad W_{MAX} = 171.387$ lb. per in.

P = Radial load due to moment

$P := W_{MAX} \cdot \frac{h}{2}$ $\quad P = 685.547$ lb.

T_{tot} = Hoop overwind load

R_m = Mean radius of overwind $\quad R_m := 84.6$ in.

t_w = Shell wall thickness (in.)

$t_w := 0.248$ in.

t_r = Reinforcement thickness at lug (in.)

$t_r := 0.271$ in.

w = Lug width

$w := b_L$

$w = 6$

$T_{tot} := \frac{P \cdot R_m}{w}$ $\quad T_{tot} = 9666.211$

$t_1 := t_{Lo}$ $\quad t_1 = 0.25$ in.

σ_T = Hoop overwind tensile stress

h_1 = Height of wound overwrap

$h_1 := h_L - 2 \cdot t_L$

$h_1 = 7.3$

$\sigma_T := \frac{T_{tot}}{h_1 \cdot t_1}$ $\quad \sigma_T = 5296.554$ psi $<$ $\frac{40000}{5} = 8000$ psi allowable ok

τ_w = Shear across vessel wall

t_k = Thickness of reinforced region at the lifting lug
= shell thickness plus reinforcement (in.)

$t_k := t_w + t_r$ $\quad t_k = 0.519$ in.

$\tau_w := \frac{P}{(t_k \cdot w)}$ $\quad \tau_w = 220.15$ psi $<$ $\frac{3000}{2} = 1500$ psi allowable ok

β = coefficient of bending in the vessel wall

$\beta := \frac{1.28}{(R_m \cdot t_k)^{\frac{1}{2}}}$ $\quad \beta = 0.193$ in.$^{-1}$

P* = Unit radial loading

$P^* := \frac{P}{w}$ $\quad P^* = 114.258$ lb. per in.

Axial and hoop bending loads

$M_{ax} := \frac{P^*}{4 \cdot \beta}$ $\quad M_{ax} = 147.872$ in.-lb. per in.

$p := P_{app}$

$p = 0$

ν = Poisson Ratio

$\nu := 0.3$

D-4

$M_{hp} := \nu \cdot M_{ax}$ $\quad M_{hp} = 44.361$ in.-lb. per in.

Axial load due to pressure

$N_{ax} := \frac{(P_{app} \cdot R_m)}{2}$ $\quad N_{ax} = 0$ lb. per in.

Hoop load due to pressure

$N_{hp} := p \cdot R_m$ $\quad N_{hp} = 0$ lb. per in.

Axial stress

$\sigma_{ax} := \frac{N_{ax}}{t_k} + \frac{(6 \cdot M_{ax})}{t_k^2}$ $\quad \sigma_{ax} = 3293.831$ psi $\leq$ 4,000 psi OK

Hoop stress

$\sigma_{hp} := \frac{N_{hp}}{t_k} + \frac{(6 \cdot M_{hp})}{t_k^2}$ $\quad \sigma_{hp} = 988.149$ psi $\leq$ 4,000 psi OK

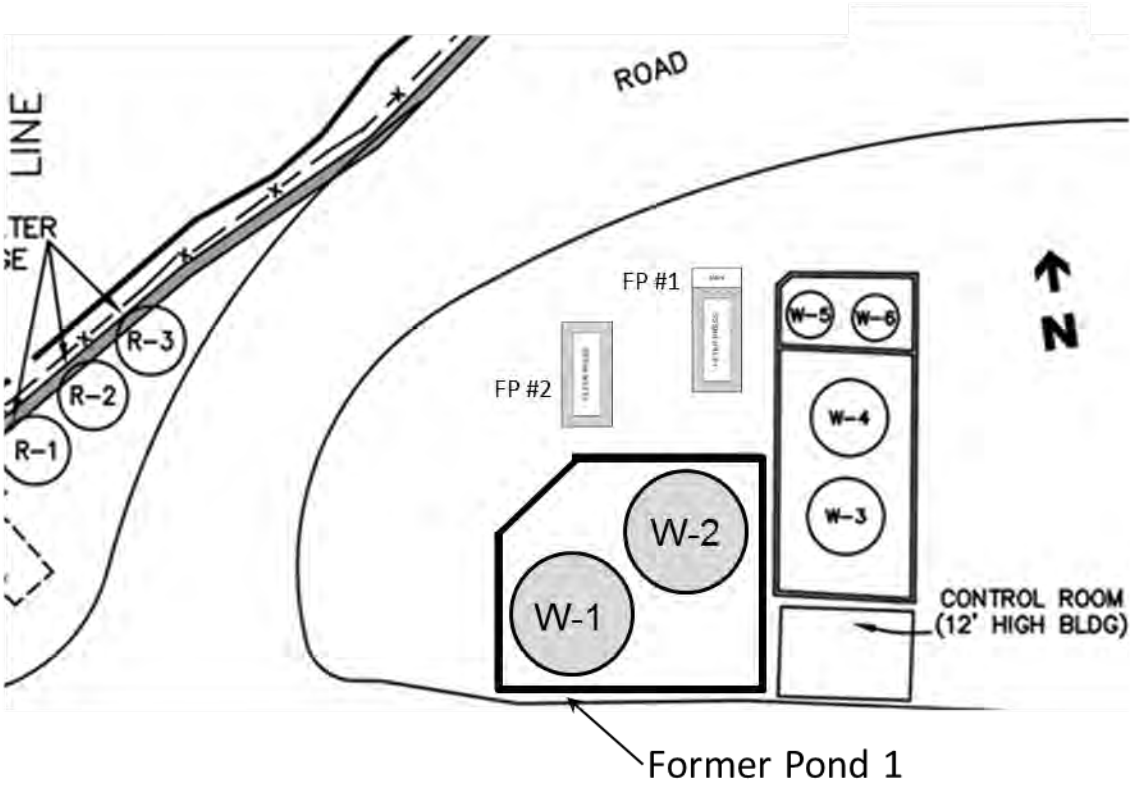
ATTACHMENT 5 – TANK CONSTRUCTION SEQUENCE

ATTACHMENT 5 – TANK CONSTRUCTION PLAN

1. TANK AND CONTAINMENT AREA CONSTRUCTION PLAN

This section describes the required sequence of activities to install new tanks that will allow Tanks W-1 and W-2 to be removed from service, cleaned, and removed, thus allowing for the closure of Pond 1. In addition, this section describes the sequence of events that will similarly allow for removal of the current W-3 and W-4 tanks, which are subject to the February 23, 1988, Hazardous Waste Unit Permit Variance (1988 Variance) issued to Southern California Chemical Company by the California Department of Health Services, Toxic Substances Control Division. Additional details of the construction plans have been provided in other referenced attachments. The existing layout is shown in Sequence #1.

Sequence #1 – Existing Layout

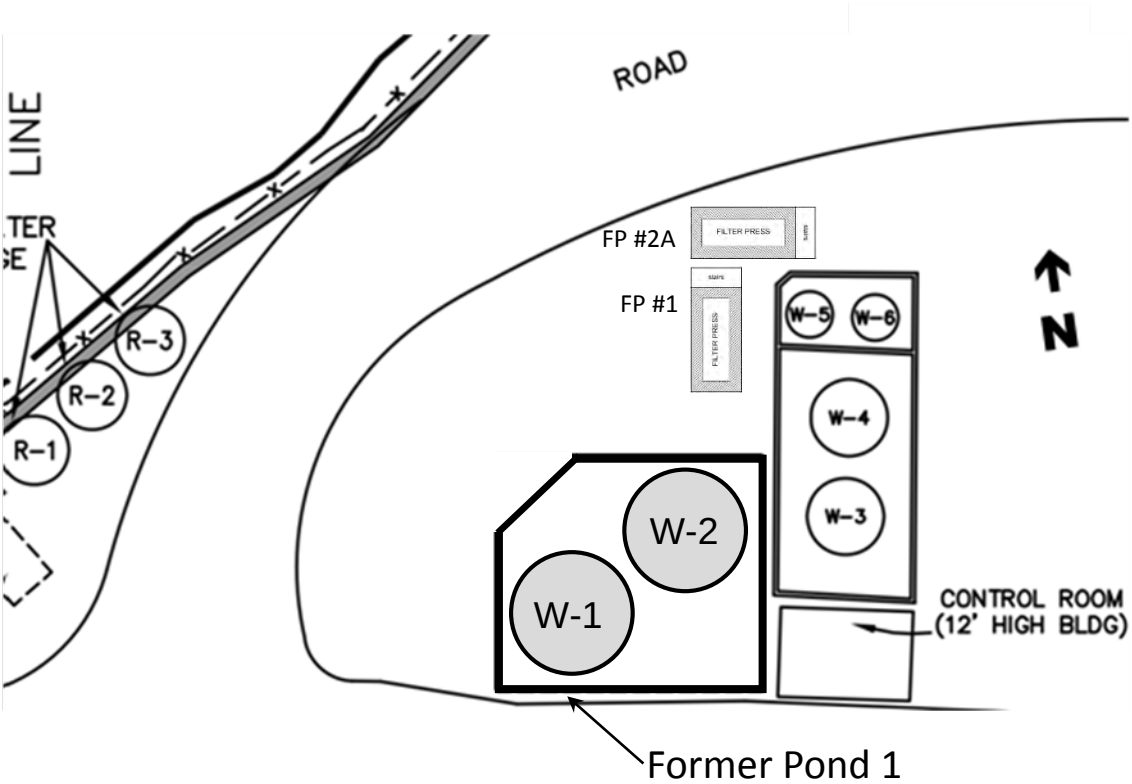


1. Review soil data for area north of former Pond 1 (where filter presses are) or collect new data if necessary. Soil samples will be collected following the methodology in the Soil Sampling Plan in Attachment 11 to the Class 2 Permit Modification package. Sample depths in the area of the Filter Press are not expected to be collected more than 10 feet below ground surface (bgs). Soil samples will be obtained at the specified depth using either a slide hammer or direct push equipment to drive and retrieve sample cores.
2. Install the new plate and frame filter press, Filter Press #2A (see Attachment 1, Section 3), north of the W-5/W-6 containment area (non-regulated wastewater tanks). This would involve fabricating wood and/or cardboard forms and pouring concrete using a concrete pumping truck for construction

of the foundation and then using and a 17 or 23-ton boom truck for placing the filter press components on the foundation.

3. Clean and close Filter Press #2 using procedures as described in the final Pond 1 Closure Plan[1]. Dismantle Filter Press #2 using 17 or 23-ton boom truck. Filter plates and hydraulic oil will be removed and managed separately as closure wastes. The filter press metal components will be placed on a truck for management as scrap metal or as closure generated waste (See Sequence #2).

Sequence #2 – Filter Press #2 Replaced with New Filter Press #2A

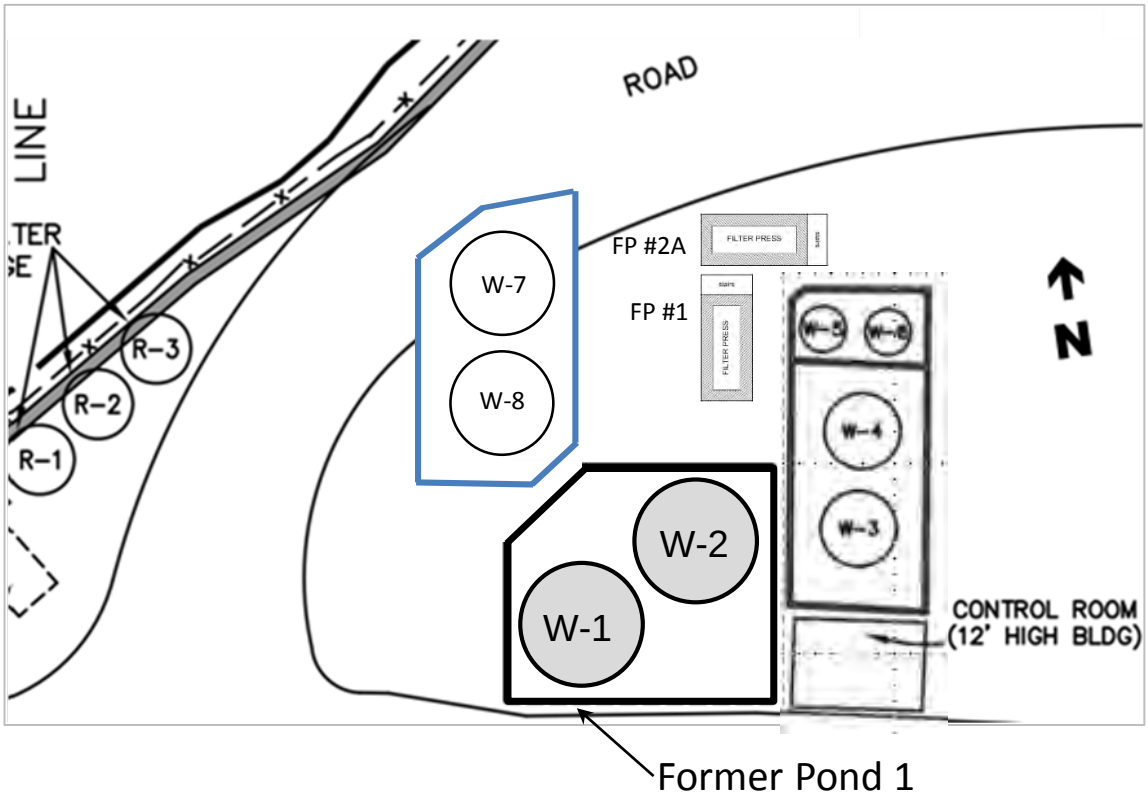


4. Review soil data for area northwest of former Pond 1 or collect new data if necessary in the area where the new Tank W-7 and W-8 containment area will be provided. Soil samples will be collected following the methodology in the Soil Sampling Plan in Attachment 11 to the Class 2 Permit Modification package. Sample depths in this area are not expected to be collected more than 10 feet bgs. Soil samples will be obtained at the specified depth using either a slide hammer or direct push equipment to drive and retrieve sample cores.

5. Construct the new Tank W-7 and W-8 Tank containment area (see Attachment 1, Section 1). This will be north of Pond 1 as shown in Sequence #3 and install the two new 30,500-gallon tanks, W-7 and W-8.

[1]On December 4, 2015, the Department of Toxic Substances Control (DTSC) conditionally approved the Pond 1 Closure Plan document dated September 2015, with updated appendices dated November 30, 2015.

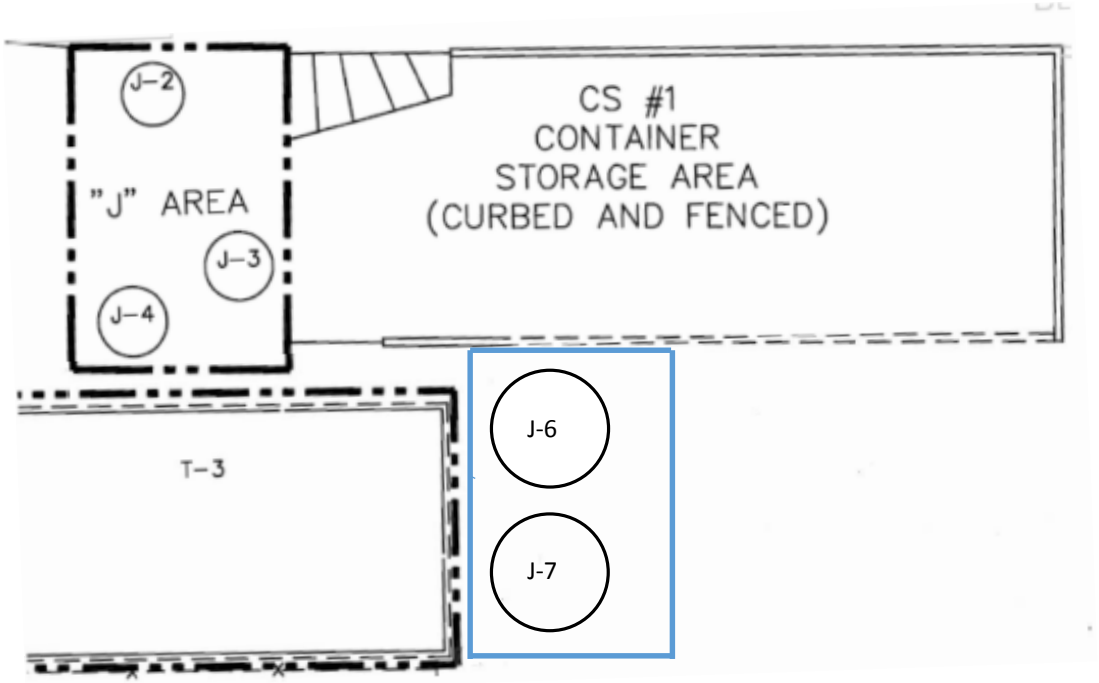
Sequence #3 – New Containment Area Built and Tanks W-7 and W-8 Installed



6. Review soil data for area southeast of Container Storage Area #1 or collect new data if necessary in the area where the new Tank J-6 and J-7 containment area will be placed. Soil samples will be collected following the methodology in the Soil Sampling Plan in Attachment 11 to the Class 2 Permit Modification package. Sample depths in this area are not expected to be collected more than 10 feet bgs. Soil samples will be obtained at the specified depth using either a slide hammer or direct push equipment to drive and retrieve sample cores.

7. Phibro-Tech, Inc. (PTI) will construct a new J-Area adjacent to the south and east of Containment Storage Area #1 and near the existing J-Area. Tanks J-6 and J-7 will be installed with the same capacity (12,500 gallons) as Variance tanks W-3 and W-4. See details and additional construction plans in Attachment 1, Section 2.

Sequence #4 – New Containment J-Area Built and Tanks J-6 and J-7 Installed



8. Once Tanks J-6 and J-7 are placed into service, Tanks W-3 and W-4 will be cleaned and dismantled using procedures as described in the final Pond 1 Closure Plan. The tanks will be cut up using saws and a small boom truck will remove the pieces and place them into a roll-off bin for management as closure wastes. The concrete containment area floor and walls will be demolished along with the Pond 1 containment area. Closure of Pond 1 will progress and implementation of the Pond 1 Area Subsurface Remediation Work Plan (Appendix F) of the final Pond 1 Closure Plan will be implemented.

Tank Replacement Schedule

No.	Description	Time for Activity (Weeks)	Completion From Start (Weeks)[1]
1.	Procure New Filter Press and (order W-7, W-8, J-6 and J-7)	14	14
2.	Install New Filter Press FP #2A	4	18
3.	Demo Old Filter Press FP #2 and Construct New W-7/W-8 Containment Area	10	28
4.	Construct New J-Area	3	30
5.	Install and Commission New Tanks W-7/W-8	5	33
6.	Install and Commission New Tanks J-6 and J-7	5	35
7.	Commence Pond 1 Closure by Cleaning and Demolishing Tanks W-1/W-2	4	39
8.	Continue with Pond 1 Closure Activities per Pond 1 Closure Plan	26	65

Notes:

1. Some tasks may overlap.

ATTACHMENT 6 – TANK CERTIFICATION – TANKS J-6 AND J-7

TANK J-6

Tank Assessment Document
CCR Section 66264.192

THIS DOCUMENT WAS PREPARED FOR:

Phibro-Tech
8851 Dice Road
Santa Fe Springs, CA 90670

TANK SYSTEM/IDENTIFICATION:

Tank J-6

DATE OF DESIGN/ASSESSMENT:

October 14, 2013

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to be the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information including the possibility of fine and imprisonment for knowing violations.

Dr. Joseph Matthew Plecnik
California PE No.: C26354
3562 Cerritos Ave.
Los Alamitos, CA 90720

REGISTERED PROFESSIONAL ENGINEER
JOSEPH M. PLECNIK
No. C26354
CIVIL
STATE OF CALIFORNIA

Date stamped/signed: 10/14/2013

TANK ASSESSMENT:

TANK NAME/MARKING	**Tank J-6**
TANK AGE	**New tank to be fabricated**
ESTIMATED LIFE OF SERVICE	**20 Years**
MANUFACTURER	**To be determined**
DATE OF FABRICATION	**To be determined**
SERIAL NUMBER OR OTHER	**To be determined**
DIAMETER	**12 ft**
HEIGHT	**Shell: 14 ft – 2 in** **FRP skirt: 48 in**
OPERATING CAPACITY	**12,500 gal**
SHAPE	**Cylindrical, Dish bottom**
ORIENTATION	**Vertical**
LOCATION	**"W" Containment Area**
MATERIAL OF CONSTRUCTION	**Fiberglass construction throughout**
EMPTY WEIGHT	**To be determined**
THICKNESS AND METHOD USED TO DETERMINE	**To be determined**
LINING MATERIAL AND THICKNESS	**To be determined**
CORROSION PROTECTION EQUIPMENT	**N/A**
STRUCTURAL SUPPORT	**Douhle FRP skirt**
DESIGN TEMPERATURE	**150°F**
DESIGN PRESSURE	**Atmospheric**

MATERIAL STORAGE:

MATERIAL AND CHARACTERISTICS	**Hazardous Waste; See Table B-1 in Chapter B for possible chemical constituents in the waste streams**
SPECIFIC GRAVITY	**1.45**
OPERATING CAPACITY	**12,500 gal**

CHEMICAL COMPATIBILITY FINDINGS:

Refer to Table B-1 in Chapter B regarding corrosion resistance data for bisphenol-A epoxy vinyl ester resins (to be used to fabricate the corrosion barrier) exposed to chemicals in this tank.

Derakane 411 is compatible with the contents of this tank up to 150°F.

The materials noted in the material storage section described above are compatible with the material of construction or lining material noted in the tank construction section above.

Initials:

DESIGN OF CONTAINMENT AREA:

The design of the containment area will satisfy the requirements of Title 22 CCR Section 66264.192.

SEISMIC ANCHORING:

Seismic/Hydrostatic Anchorage Description:

Anchors: _Based on CBC 2010_

Seismic/Hydrostatic Anchorage Drawings: See _Chapter A_

Seismic/Hydrostatic Analysis: See _Chapter A_

SEISMIC/ANCHORING FINDINGS: The tank as designed and the containment area in which it will be located are adequately anchored and are seismically sound.

Initials: JMP

TESTING, INSPECTION & CERTIFICATION SERVICES

CLIENT: Phibro Tech
Santa Fe Springs, CA

TI&CS Report Number: 13-10-23

Report Title: Design of Tanks J-6 and J-7 for Phibro Tech Facility at Santa Fe Springs, CA for Waste Management System

Author(s): Joseph M. Plecnik Jr., BSCE
Christine Bosque, Ph.D., Chemistry
Joseph M. Plecnik, Ph.D., P.E.
TI&CS
3562 Cerritos Ave.
Los Alamitos, CA 90720
(562) 900-3118

Date of Issue: October 11, 2013

NOTES:

TESTING, INSPECTION AND CERTIFICATION SERVICES
TI&CS
3562 CERRITOS AVE.
LOS ALAMITOS, CA 90720 (562) 493-7911

J6 J7

CHAPTER A: SUMMARY OF FRP TANK DESIGN: DIAMETER 12 FT. HEIGHT 14'-2" (CYLINDER)
DOME BOTTOM WITH SKIRT (2'-8")

I. WALL THICKNESS DESIGN

1. For tank dome, use 3/8" in. wall thickness. See Fig. A-2

2. For tank wall, use the following thicknesses starting from the tank bottom. See Page A-2

a) From 0 ft. to 8 ft., use 0.431 in. wall thick., LAMINAR COMB. AA17

b) From 8 ft. to TOP ft., use 0.288 in. wall thick., LAMINAR COMB. AA6

c) From _____ ft. to _____ ft., use _____ in. wall thick., LAMINAR COMB. _____

d) From _____ ft. to _____ ft., use _____ in. wall thick., LAMINAR COMB. _____

e) From _____ ft. to _____ ft., use _____ in. wall thick., LAMINAR COMB. _____

f) See Fig. A-3 for Inside skirt design

g. See See Fig. A-4 for Skirt Reinforcement at Base.

II. LAMINAR CONSTRUCTION AND MATERIAL PROPERTIES ARE PROVIDED IN CHAPTER B.

See Fig. A-6 For skirt to dome Bond.

III. LUG DESIGN

1. Use 12 lugs uniformly spaced over tank circumference.

2. Use ONE bolt per lug with 1 in. diameter and See Fig. A-5 type.

3. Fig. A-5 provides lug design details.

4. If extensive corrosion on the outside of the tank is probable, use stainless or other types of corrosion resistant lugs.

IV. SPECIFICATIONS

1. Seismic and Wind Loads per CBC 2010 & ASCE 7-10

2. Specific gravity of liquid contents; G = 1.45.

3. ASTM D3299 used for filament winding and tank dome construction.

4. AISC-14th edition is used for steel design.

5. A36 steel used for lugs (unless stated otherwise).

CHAPTER A: DESIGN OF 144 in. ϕ x 218 in. HIGH TANK USING THE API 650 METHOD, CBC 2010, ASCE 7-10 AND ASTM D3299

J6, J7

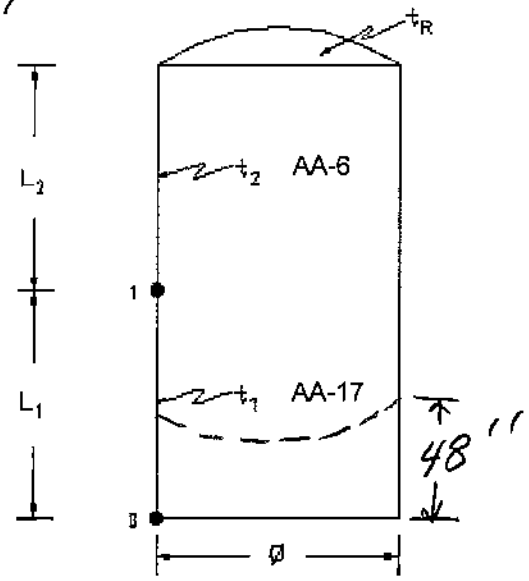


Fig. A-1: Tank Geometry

Min. Dome Thickness ; $t_R := 0.375$ (in.)
Type of Cover; Flat or Dish Type
Radius of Cover (∞ for Flat Cover);

Length 2 ; $L_2 := 122$ (in.)

Minimum Thickness for L2 ; $t_2 := 0.288$ (in.)

$E_{h2} := 3.13132 \cdot 10^6$ $E_{a2} := 1.60548 \cdot 10^6$

Length 1 ; $L_1 := 96$ (in.)

Minimum Thickness for L1 ; $t_1 := 0.431$ (in.)

$E_{h1} := 3.08498 \cdot 10^6$ $E_{a1} := 2.26082 \cdot 10^6$

I) Seismic Design Parameters (per CBC 2010 and ASCE 7-10)

For plant site, ASCE 7-10 gives the following seismic parameters:

Seismic Risk Category: III

Seismic Design Category: D

Site Class: D

Importance Factor: I $I := 1.25$

Response Modification Coefficient; $RR := 3$

Specific Gravity of Liquid ; $SGL := 1.45$

MATERIAL PROPERTIES AND LAMINATE CONSTRUCTIONS FOR SHELL

Total Height ; $HH := 218$ (in.)

Tank Diameter ; $D := 144$ (in.)

Tank Radius ; $R := \frac{D}{2}$ $R = 72$ (in.)

P_{app} = applied pressure (+) or vacuum (-) $P_{app} := 0$ (psi)

Specific Gravity of Shell Material; $SGS := 1.7$

Poisson Ratio (for shell); $\nu := 0.27$

Number of Anchor Lugs; $nn := 12$

Thickness of Corrosion Barrier $t_L := 0.02$ (in.) (not used in structural)

Shell Weight Added Factor $SWAF := 1.1$

A-3a

FB1 = Minimum Free Board $FB1 := 0$ (in.)

BWR = maximum width of flat bottom resisting overturning $BWR := 21$ (in.)

Seismic Response Spectral Acceleration Values:

$S_S := 1.83$

$S_1 := 0.65$

$F_a := 1.0$

$F_v := 1.5$

$S_{MS} := F_a \cdot S_S$

$S_{MS} = 1.83$

$S_{M1} := F_v \cdot S_1$

$S_{M1} = 0.975$

$S_{DS} := \frac{2}{3} \cdot S_{MS}$

$S_{DS} = 1.22$

$S_{D1} := \frac{2}{3} \cdot S_{M1}$

$S_{D1} = 0.65$

$T_s := \frac{S_{D1}}{S_{DS}}$

$T_s = 0.532787$ sec.

Since $T_s < T_c$:

$S_{ai} := S_{DS}$

$S_{ai} = 1.22$

W_i = impulsive weight component

$W_i = W_1$

ZC = resultant impulsive spectral acceleration

$ZC := S_{ai} \cdot I \div RR$

$ZC = 0.508$

$ZC_{1S} := ZC$

$ZC_{1R} := ZC$

$ZC_{11} := ZC$

A-36

A) Convective Component or Sloshing Seismic Coefficient

T_C = natural period for sloshing

$g := 32.2$ ft./sec. sec. = gravitational acceleration

$$T_C := 2\cdot\pi\cdot\sqrt{\frac{D \div 12}{3.68\cdot g\cdot \tanh\left(\frac{3.68\cdot HH}{D}\right)}}$$

$T_C = 2$

Since $T_C < 4$ sec.

$$S_{ac} := \frac{1.5\cdot S_{D1}}{T_c}$$

$S_{ac} = 0.488$

C_2 = sloshing spectral acceleration

$$C_2 := \frac{S_{ac}\cdot I}{1.5}$$

$C_2 = 0.406$

B) Height of Sloshing Wave Analysis (ASCE 7-05)

SWH = sloshing wave height

$SWH := 0.5\cdot D\cdot I\cdot S_{ac}$

$SWH = 43.886$ (in.)

FB = Free Board

$FB := SWH + 0.005\cdot D$

$FB = 44.606$ (in.)

$$FB2 := \begin{cases} FB & \text{if } FB < FB1 \\ FB1 & \text{otherwise} \end{cases}$$

$FB2 = 0$

H = design liquid height at base of tank

$H := HH - FB2$

$H = 218$ (in.)

A-4

VII) Calculation of Overturning Moments

A) AT TANK BOTTOM (POINT 0, FIG. A-1)

$M_0 = M_{0S} + M_{0R} + M_{01} + M_{02}$

Where,

M_{0S} = (1/1.4) ZC W_S X_S = overturning moment due to shell weight

M_{0R} = (1/1.4) ZC W_R H = overturning moment due to roof weight

M_{01} = (1/1.4) ZC W_1 X_1 = overturning moment due to liquid inertial force

M_{02} = (1/1.4) C_2 W_2 X_2 = overturning moment due to liquid sloshing

W_S = Total weight of shell

$W_S := \pi \cdot D \cdot (SGS) \cdot (0.0361) \cdot \left[L_1 \cdot (t_1 + t_L) + L_2 \cdot (t_2 + t_L) \right] \cdot SWAF$

$W_S = 2469.786$ lbs

X_S = Half tank height ; $X_S := \frac{H}{2}$

$X_S = 109$ in.

W_R = Weight of tank roof

$W_R := \pi \cdot R^2 \cdot t_R \cdot (SGS) \cdot 0.0361 \cdot SWAF$

$W_R = 412.283$ lbs

W_L = Weight of tank contents

$W_L := \pi \cdot R^2 \cdot H \cdot 0.0361 \cdot SGL$

$W_L = 185843.152$ lbs

$F_{A1} := \frac{0.866 \cdot D}{H}$ $\qquad F_{A1} = 0.572$

$F_{A2} := \frac{3.67 \cdot H}{D}$ $\qquad F_{A2} = 5.556$

$F_{A3} := \cosh(F_{A2}) - 1$ $\qquad F_{A3} = 128.391$

$AW_{1a} := \frac{\tanh(F_{A1}) \cdot W_L}{F_{A1}}$ $\qquad AW_{1a} = 167915.237$ lb.

$AW_{1b} := \left(1 - \frac{0.218 \cdot D}{H}\right) \cdot W_L$ $\qquad AW_{1b} = 159081.738$ lb.

$W_1 := \begin{cases} AW_{1a} & \text{if } \frac{D}{H} \geq 1.33 \\ AW_{1b} & \text{otherwise} \end{cases}$ $\qquad W_1 = 159081.738$ lb.

$W_2 := 0.230 \cdot \left(\frac{D}{H}\right) \cdot \tanh(F_{A2}) \cdot W_L$ $\qquad W_2 = 28233.676$ lb.

A-5

X_1 = moment arm for liquid seismic inertial force

X_2 = moment arm for sloshing seismic force

$X_{1a} := 0.375 \cdot H$ $\qquad X_{1a} = 81.75$ in.

$X_{1b} := \left(0.5 - 0.094 \cdot \frac{D}{H}\right) \cdot H$ $\qquad X_{1b} = 95.464$ in.

$$X_1 := \begin{cases} X_{1a} & \text{if } \frac{D}{H} \geq 1.33 \\ X_{1b} & \text{otherwise} \end{cases}$$ $\qquad X_1 = 95.464$ in.

$X_2 := \left(1 - \frac{F_{A3}}{F_{A2} \cdot \sinh(F_{A2})}\right) \cdot H$ $\qquad X_2 = 179.065$ in.

M_0 = overturning moment at Point "0"

$M_{0s} := \left(\frac{1}{1.4}\right) \cdot ZC \cdot W_s \cdot X_s$ $\qquad M_{0s} = 97747.669$

$M_{0R} := \left(\frac{1}{1.4}\right) \cdot ZC \cdot W_R \cdot H$ $\qquad M_{0R} = 32634.126$

$M_{01} := \left(\frac{1}{1.4}\right) \cdot ZC \cdot W_1 \cdot X_1$ $\qquad M_{01} = 5514174.542$

$M_{02} := \left(\frac{1}{1.4}\right) \cdot C_2 \cdot W_2 \cdot X_2$ $\qquad M_{02} = 1467400.247$

$M_0 := M_{0s} + M_{0R} + M_{01} + M_{02}$

$M_0 = 7111956.584$ (in - lbs.)

F_H = horizontal base shear

$F_H := M_{0s} \div X_s + M_{0R} \div H + M_{01} \div X_1 + M_{02} \div X_2$

$F_H = 67003.077$ (lbs.)

A-6

B) OVERTURNING MOMENT AT POINT 1 (SEE FIG. A-1)

$M_1 = M_{1S} + M_{1R} + M_{11} + M_{12}$

Where,

$M_{1S} = (1/1.4)\ ZC\ BW_S\ BX_S$

$M_{1R} = (1/1.4)\ ZC\ W_R\ (L_2 + L_3 + L_4)$

$M_{11} = (1/1.4)\ ZC\ BW_1\ BX_1$

$M_{12} = (1/1.4)\ C_2\ BW_2\ BX_2$

BWs = total weight of shell above point 1. (See Fig. A-1)

$BW_s := \pi \cdot D \cdot (SGS) \cdot (0.0361) \cdot \left[L_2 \cdot (t_2 + t_L)\right] \cdot SWAF$

$BW_s = 1147.55$ lbs.

$BX_s := \frac{L_2}{2}$

$BX_s = 61$ in.

W_R = weight of tank roof

$W_R = 412.283$ lbs.

For $\frac{D}{L_2} = 1.18$

BW_L = weight of tank contents above point 1.

$BW_L := \pi \cdot R^2 \cdot (0.0361) \cdot (SGL) \cdot (L_2)$

$BW_L = 104003.966$ lbs.

$F_{B1} := \frac{0.866 \cdot D}{(L_2)}$ $\qquad F_{B1} = 1.022$

$F_{B2} := \frac{3.67 \cdot (L_2)}{D}$ $\qquad F_{B2} = 3.109$

$F_{B3} := \cosh(F_{B2}) - 1$ $\qquad F_{B3} = 10.225$

$BW_{1a} := \frac{\tanh(F_{B1}) \cdot BW_L}{F_{B1}}$ $\qquad BW_{1a} = 78422.536$ lb.

$BW_{1b} := \left[1 - \frac{0.218 \cdot D}{(L_2)}\right] \cdot BW_L$ $\qquad BW_{1b} = 77242.552$ lb.

$BW_1 := \begin{cases} BW_{1a} & \text{if } \frac{D}{(L_2)} \geq 1.33 \\ BW_{1b} & \text{otherwise} \end{cases}$ $\qquad BW_1 = 77242.552$ lb.

$BW_2 := 0.230 \cdot \left[\frac{D}{(L_2)}\right] \cdot \tanh(F_{B2}) \cdot BW_L$ $\qquad BW_2 = 28122.256$ lb.

A-7

$BX_{1a} := 0.375 \cdot (L_2)$ $\qquad BX_{1a} = 45.75$ in.

$BX_{1b} := \left[0.5 - 0.094 \cdot \frac{D}{(L_2)}\right] \cdot (L_2)$ $\qquad BX_{1b} = 47.464$ in.

$BX_1 := \begin{cases} BX_{1a} & \text{if } \frac{D}{(L_2)} \geq 1.33 \\ BX_{1b} & \text{otherwise} \end{cases}$ $\qquad BX_1 = 47.464$ in.

$BX_2 := \left(1 - \frac{F_{B3}}{F_{B2} \cdot \sinh(F_{B2})}\right) \cdot (L_2)$ $\qquad BX_2 = 86.116$ in.

M_1 = overturning moment at Point "1"

$M_{1s} := \left(\frac{1}{1.4}\right) \cdot ZC \cdot BW_s \cdot BX_s$ $\qquad M_{1s} = 25416.872$

$M_{1R} := \left(\frac{1}{1.4}\right) \cdot ZC \cdot W_R \cdot (L_2)$ $\qquad M_{1R} = 18263.135$

$M_{11} := \left(\frac{1}{1.4}\right) \cdot ZC \cdot BW_1 \cdot BX_1$ $\qquad M_{11} = 1331194.463$

$M_{12} := \left(\frac{1}{1.4}\right) \cdot C_2 \cdot BW_2 \cdot BX_2$ $\qquad M_{12} = 702915.554$

$M_1 := M_{1s} + M_{1R} + M_{11} + M_{12}$

$M_1 = 2077790.024$ (in - lbs.)

VIII) Calculation of Flexural Stresses

A-8

A) Flexural Stresses At Tank Bottom (Point 0)

1) S_1 = section modulus for t_1

R_{m1} = mean tank radius

$R_{m1} := R + .50 \cdot (t_1)$

$R_{m1} = 72.216$

$S_1 := \pi \cdot (R_{m1})^2 \cdot (t_1)$

$S_1 = 7061.354$ in.^{3}

$\sigma_0 := \left(\frac{M_0}{S_1}\right)$

$\sigma_0 = 1007.166$ psi

ε_0 = axial strain at tank bottom due to flexure

E_{a1} = axial modulus of elasticity

$\varepsilon_0 := \frac{\sigma_0}{E_{a1}}$

$\varepsilon_0 = 0.000445$ in./in.

where Ea_1 = axial modulus for t_1 thick lamina

ε_{allow} = allowable axial strain

= 0.00133 in./in. (ASTM D3299 with 33% increase for seismic)

= 0.002 in./in. (ASME RTP-1)

Hence,

$\varepsilon_0 = 0.000445$ in./in. $\leq$ ε_{allow}

Ref. 1: *Structural Analysis of Shells* by Baker, Kovalevsky and Rish.

2) Check for buckling at tank bottom

From Fig. 10-13 of Ref. 1

$M_{cr/0}$ = critical buckling moment at tank bottom

$M_{cr/0} = \pi R^2 t_1 \sigma_{cr/0}$

where,

$\sigma_{cr/0}$ = critical buckling axial stress at tank bottom.

$\sigma_{cr/0} = \gamma_1 \cdot C_b \cdot \left(\frac{E_{e1} \cdot t_1}{R}\right)$

A-9

$RAT1 := \frac{R}{t_1}$ $\quad RAT1 = 167.053$,From Fig.10-13 of Ref. 1: $\gamma_1 := 0.61$

$C_b := \left[\frac{1}{\sqrt{3\cdot(1-\nu^2)}}\right]$ $\quad C_b = 0.6$

E_{e1} = effective modulus for buckling for t_1 lamina.

$E_{e1} := \sqrt{E_{a1}\cdot E_{h1}}$ $\quad E_{e1} = 2.640944 \times 10^6$ psi

$\sigma_{cr0} := \gamma_1\cdot C_b\cdot\left(\frac{E_{e1}\cdot t_1}{R}\right)$

$\sigma_{cr0} = 5782.423$ psi

$M_{cr0} := \pi\cdot R^2\cdot t_1\cdot\sigma_{cr0}$

$M_{cr0} = 40588406.027$ in. - lbs

SF_0 = Safety factor against buckling due to M_0

$SF_0 := \left(\frac{M_{cr0}}{M_0}\right)$ $\quad SF_0 = 5.707$

A minimum safety factor against buckling of 4.0 is recommended.

B) Flexural Stresses At Point 1

A-10

1) S_2 = section modulus for t_2

R_{m2} = mean tank radius

$R_{m2} := R + .50 \cdot (t_2)$

$R_{m2} = 72.144$

$S_2 := \pi \cdot (R_{m2})^2 \cdot (t_2)$

$S_2 = 4709.153$ in.^{3}

$$\sigma_1 := \left(\frac{M_1}{S_2}\right)$$

$\sigma_1 = 441.224$ psi

ε_1 = strain at Point 1 in axial direction due to flexure

$$\varepsilon_1 := \frac{\sigma_1}{E_{a2}}$$

$\varepsilon_1 = 0.000275$ in./in.

where Ea_2 = axial modulus for t_2 thick lamina

ε_{allow} = allowable axial strain

= 0.00133 in./in. (ASTM D3299 with 33% increase for seismic)

= 0.002 in./in. (ASME RTP-1)

$\varepsilon_1 = 0.000275$ in./in. $\leq$ εallow

2) Check for buckling at Point 1

From Fig. 10-13 of Ref. 1

M_{cr1} = critical buckling moment at Point 1

$M_{cr1} = \pi R^2 t_2 \sigma_{cr/1}$

where,

$\sigma_{cr/1}$ = critical buckling axial stress at Point 1

$$\sigma_{cr/1} = \gamma \cdot C_b \cdot \left(\frac{E_{e2} \cdot t_2}{R}\right)$$

A-11

$RAT2 := \frac{R}{t_2}$ $\quad RAT2 = 250$,From Fig.10-13 of Ref. 1: $\gamma_2 := 0.54$

$$C_b := \left[\frac{1}{\sqrt{3\cdot\left(1-\nu^2\right)}}\right] \quad C_b = 0.6$$

E_{e2} = effective modulus for buckling for t_2 lamina.

$E_{e2} := \sqrt{\left(E_{a2}\cdot E_{h2}\right)}$ $\quad E_{e2} = 2.242158\times 10^6$ psi

$$\sigma_{cr1} := \gamma_2\cdot C_b\cdot\left(\frac{E_{e2}\cdot t_2}{R}\right)$$

$\sigma_{cr1} = 2903.996$ psi

$M_{cr1} := \pi\cdot R^2\cdot t_2\cdot\sigma_{cr1}$

$M_{cr1} = 13620823.408$ in. - lbs

SF_1 = Safety factor against buckling due to M_1

$$SF_1 := \left(\frac{M_{cr1}}{M_1}\right) \quad SF_1 = 6.555$$

A minimum safety factor against buckling of 4.0 is recommended.

IX) Calculation of Hoop and Resultant Stresses And Strains

A-12

A) Hoop and Resultant Stresses and Strains at Tank Bottom (Point 0)

σ_{h0} = hoop stress = $\left(\frac{P_0 \cdot R_{m1}}{t_1}\right)$

P_{app} = applied pressure (+) or vacuum (-), (psi)

P_0 = pressure at tank bottom + P_{app}

$P_0 := SGL \cdot 0.0361 \cdot H + (P_{app})$

$P_0 = 11.411$ psi

$\sigma_{h0} := \left(\frac{P_0 \cdot R_{m1}}{t_1}\right)$

$\sigma_{h0} = 1911.987$ psi

ε_{h0} = hoop strain at tank bottom

$\varepsilon_{h0} := \frac{\sigma_{h0}}{E_{h1}}$ $\varepsilon_{h0} = 0.00062$ in./in.

where E_{h1} = hoop modulus for t_1 thick lamina

$\varepsilon_{h0} = 0.00062$ in./in. $\leq$ 0.00100 in./in. (ASTM D3299 and RTP-1) OK

ε_{0T} = total axial strain due to bending and internal pressure (vacuum)

ε_{aappo} = axial strain due to P_{app}

$\varepsilon_{aappo} := \left(\frac{P_{app} \cdot R_{m1}}{2 \cdot t_1 \cdot E_{a1}}\right)$

$\varepsilon_{aappo} = 0$

$\varepsilon_{0T} := \varepsilon_0 + \varepsilon_{aappo}$

$\varepsilon_{0T} = 0.0004455$

ε_{res0} = resultant strain for t_1 thick laminate

$\varepsilon_{res0} := \sqrt{(\varepsilon_{h0})^2 + (\varepsilon_{0T})^2}$

$\varepsilon_{res0} = 0.000763$ in./in. $\leq$ ε_{allow}

ε_{allow} = allowable resultant strain

= 0.00133 in./in. (ASTM D3299 with 33% increase for seismic)

= 0.002 in./in. (ASME RTP-1)

A-13

B) Hoop and Resultant Stresses and Strains at Point 1

σ_{h1} = hoop stress = $\left(\frac{P_1 \cdot R_{m2}}{t_2}\right)$

P_{app} = applied pressure (+) or vacuum (-), (psi)

P_1 = pressure at Point 1 + P_{app}

$P_1 := SGL \cdot 0.0361 \cdot (L_2 - FB) + (P_{app})$

$P_1 = 4.051$ psi

$\sigma_{h1} := \left(\frac{P_1 \cdot R_{m2}}{t_2}\right)$

$\sigma_{h1} = 1014.828$ psi

ε_{h1} = hoop strain at Point 1

$\varepsilon_{h1} := \frac{\sigma_{h1}}{E_{h2}}$ $\varepsilon_{h1} = 0.000324$ in./in.

where E_{h2} = hoop modulus for t_2 thick lamina

$\varepsilon_{h1} = 0.000324$ in./in. $\leq$ 0.00100 in./in. (ASTM D3299 AND RTP-1) OK

ε_{1T} = total axial strain due to bending and internal pressure (vacuum)

ε_{aapp1} = axial strain due to P_{app}

$\varepsilon_{aapp1} := \left(\frac{P_{app} \cdot R_{m2}}{2 \cdot t_2 \cdot E_{a2}}\right)$

$\varepsilon_{aapp1} = 0$

$\varepsilon_{1T} := \varepsilon_1 + \varepsilon_{aapp1}$

$\varepsilon_{1T} = 0.0002748$

ε_{res1} = resultant strain for t_2 thick laminate

$\varepsilon_{res1} := \sqrt{(\varepsilon_{h1})^2 + (\varepsilon_{1T})^2}$

$\varepsilon_{res1} = 0.000425$ in./in. $\leq$ ε_{allow}

ε_{allow} = allowable resultant strain

= 0.00133 in./in. (ASTM D3299 with 33% increase for seismic)

= 0.002 in./in. (ASME RTP-1)

ANCHOR LUG DESIGN FOR SEISMIC LOADS

From page _____

$\sigma_0 = 1007.166$ psi

$$LS := \frac{\pi \cdot D}{nn}$$

$LS = 37.699$ in. / lug (lug spacing around tank perimeter)

P_L = tension force per lug

$$ZZ := \begin{cases} BWR & \text{if } BWR < 0.035 \cdot D \\ D \cdot 0.035 & \text{otherwise} \end{cases}$$

$ZZ = 5.04$ in.

Use $ZZ := BWR$

$ZZ = 21$

$$P_L := (t_1) \cdot (LS) \cdot (\sigma_0) + \pi \cdot R^2 \cdot \left(\frac{P_{app}}{nn}\right) - ZZ \cdot LS \cdot H \cdot SGL \cdot 0.0361 - \frac{W_s}{nn} - \frac{W_R}{nn}$$

$P_L = 7090.54$ lbs TENSION (ASD)

P_S = avg. shear force per lug

$$P_S := \frac{F_H}{nn}$$

$P_S = 5583.59$ lbs SHEAR (ASD)

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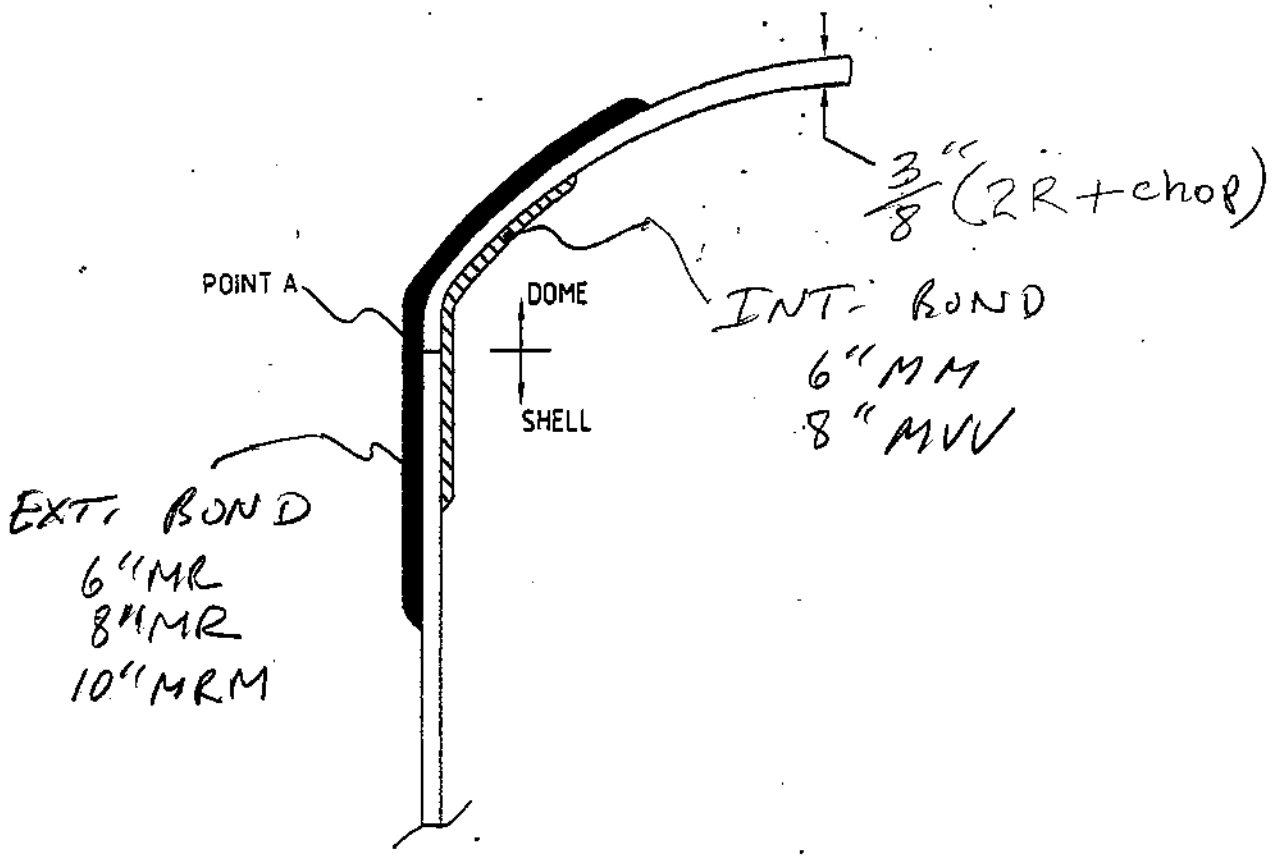
2011

A-15

FIG. A-2: DOME TOP DESIGN AND BOND



NOTE: CENTER BONDS ON POINT A

M = 1-1/2 OZ. MAT
R = 24 OZ. WOVEN ROVING
V = VEILS, AS REQUIRED BY SPECS.
E = exotherm = 1½ oz Mat

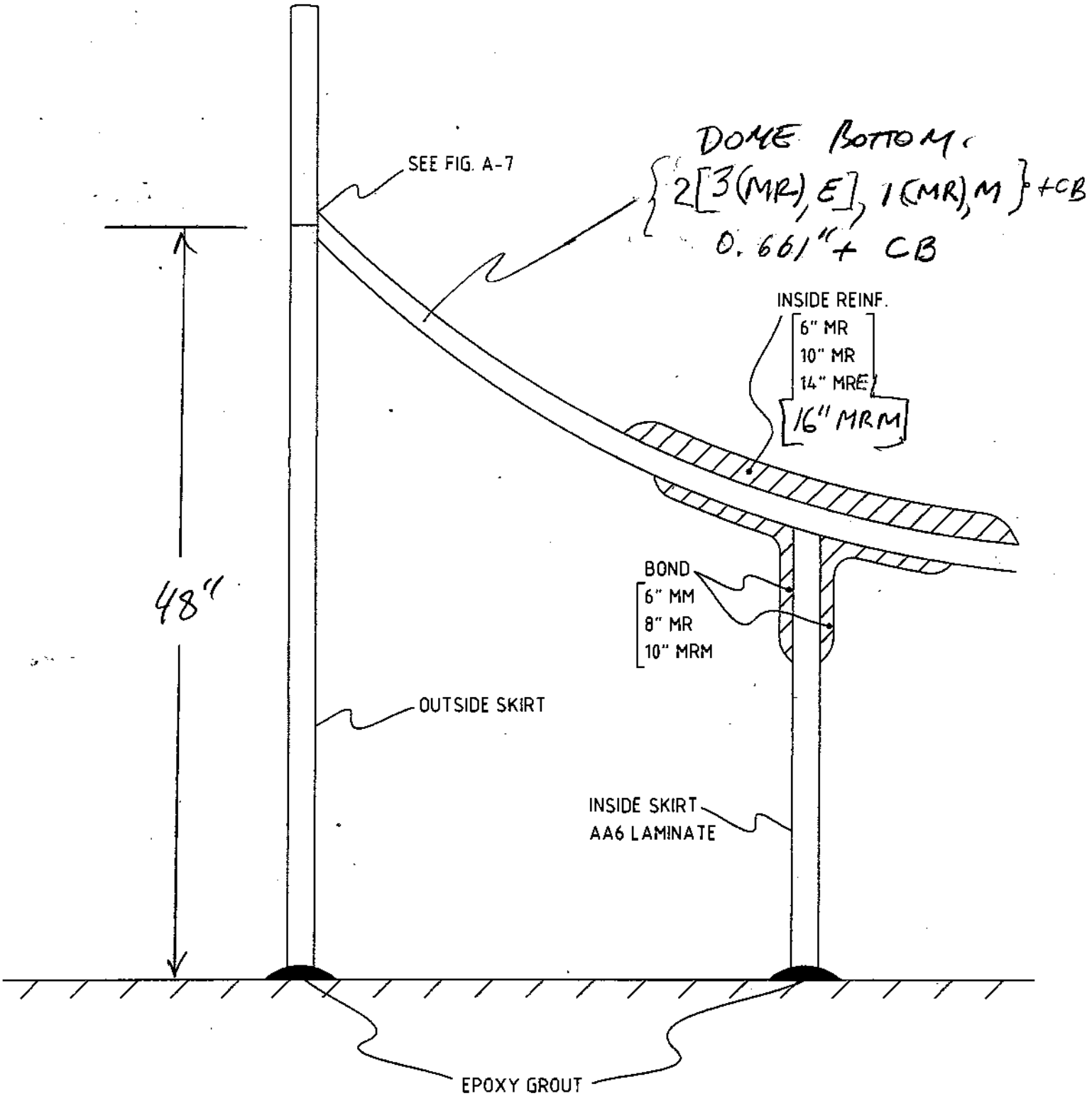


FIG. A-3: INSIDE SKIRT DESIGN

J6, J7 TANK

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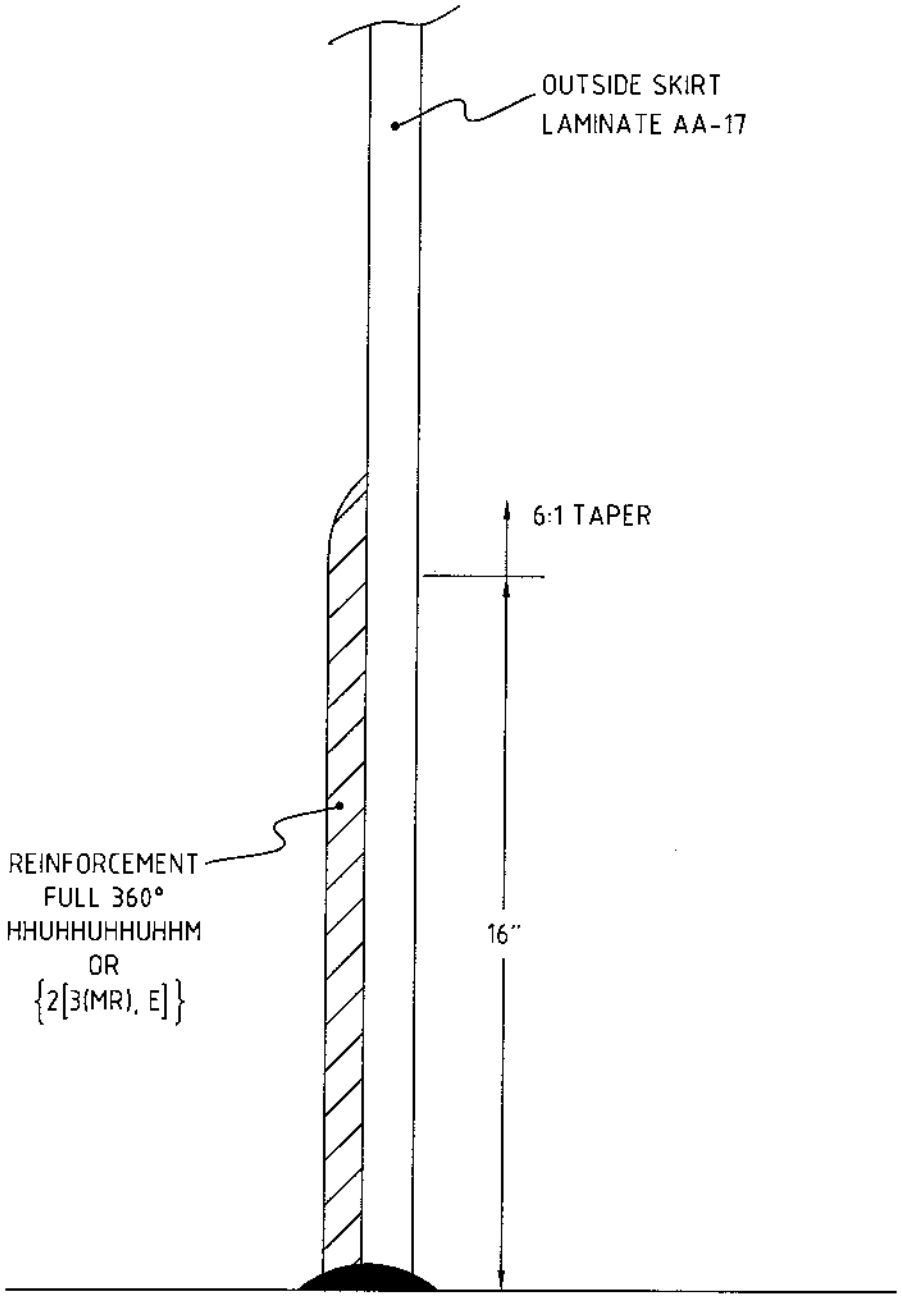
FIG. A-4: REINFORCEMENT FOR BASE OF SKIRT
(FULL 360°)
J6, J7



H = HOOP WINDING = 0.050 IN.
U = UNI = 0.020 IN.
M = 1-1/2 OZ. MAT E = EXOTHERM = 1-1/2 OZ. MAT
R = 24 OZ. WOVEN ROVING

TYPE B LUG DESIGN 4,000 - 12,000 LBS.

A-18

CAPACITY OF LUG AS SHOWN IN FIG. BELOW IS 4,000 - 12,000 LBS.

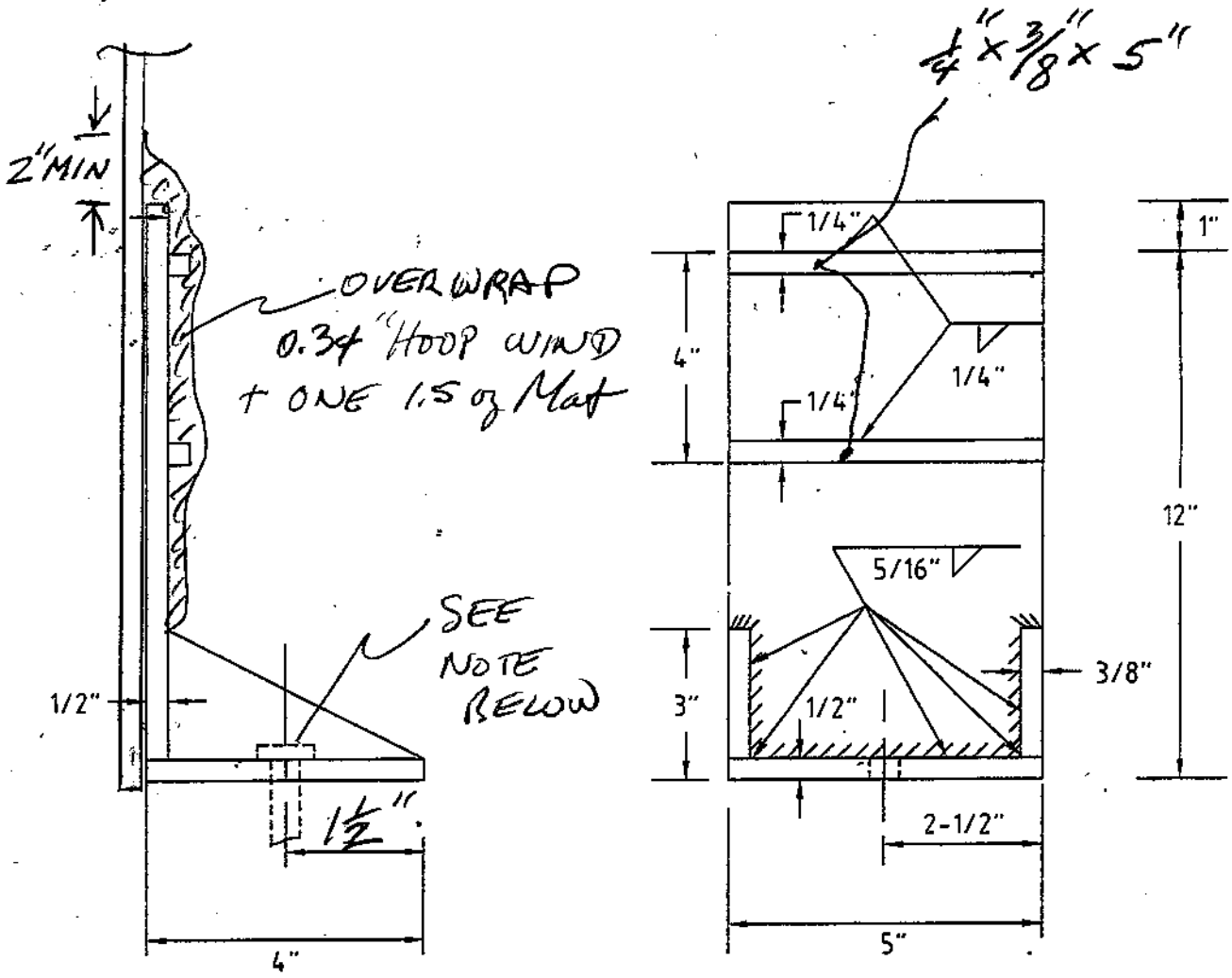


FIG. A-5: LUG TYPE B

This lug is designed to develop plastic moment at top of stiffener with the remaining moment taken into tank wall.

Note: FOR ANCHOR BOLT FORCES ON PAGE A-14, 1" Ø ANCHOR BOLTS WILL PROBABLY BE REQD. DRILL HOLES IN LUG 1¼" Ø. FINAL ANCHOR BOLT DESIGN BY FOOTING ENGR.

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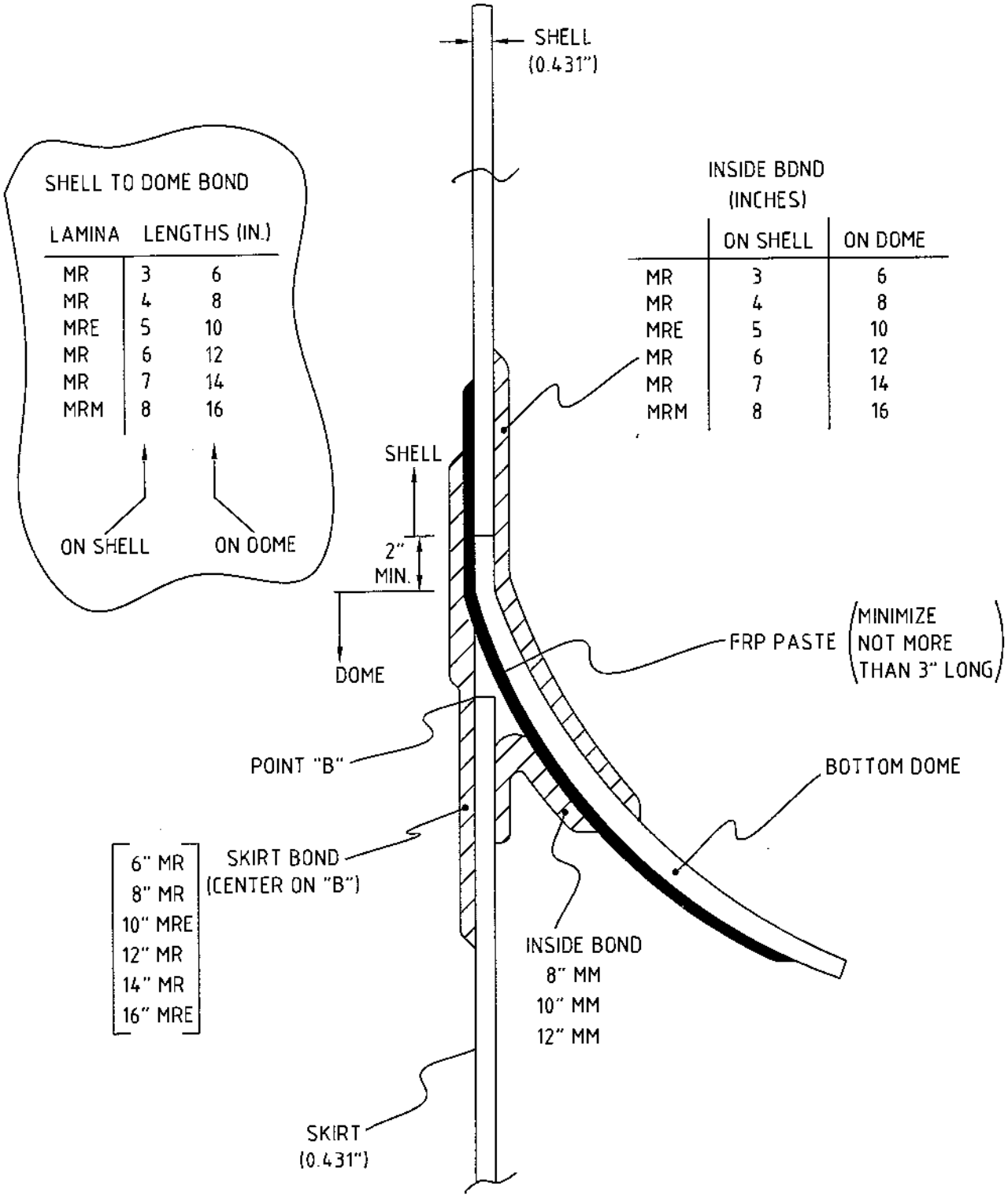
FIG. A-6: SHELL TO BOTTOM DOME BONDS (J6, J7)

NOTE: FINAL DESIGN FOR THIS BOND WILL DEPEND ON FABRICATOR CHOSEN.



M = 1-1/2 OZ. MAT E = EXOTHERM = 1-1/2 OZ. MAT

C = 7 OZ. CLOTH

R = 24 OZ. WOVEN ROVING

ULTRA FIBER
C.S.U.L.B. S.C.L.
Laminate Model

DATE: 07-30-1993 TIME: 09:40:54
PAGE: 1

File Name :AA17 LAMINATE AA17

Material Properties for Laminate Model in L-T Coordinates (psi)

El(Times E6)	Et(Times E6)	G(Times E6)	Poisson Ratio
5.7000	0.8000	0.2800	0.2800
1.0000	1.0000	0.4000	0.2500

Data for each Lamina (Theta(θ) measured clockwise from +Y axis)

Lamina#	Material #	Theta(θ) (deg)	Thickness (in.)	Graphical Layup
1	2	LINER	0.0800	
2	1	70	0.0210	<><><>
3	1	0	0.0200	
4	1	0	0.0200	
5	1	-70	0.0210	<><><>
6	1	70	0.0210	<><><>
7	1	0	0.0200	
8	1	-70	0.0210	<><><>
9	1	90	0.0210	======
10	1	90	0.0210	======
11	1	90	0.0210	======
12	1	-70	0.0210	<><><>
13	1	0	0.0200	
14	1	70	0.0210	<><><>
15	1	-70	0.0210	<><><>
16	1	0	0.0200	
17	1	0	0.0200	
18	1	70	0.0210	<><><>

	CORROSSION LINER HAS	1 LAYERS WITH	0.080	in. THICKNESS
<><><>	HELIX WINDING CONSISTS OF	8 LAYERS WITH	0.168	in. THICKNESS
	CHOPPED LAMINA CONSISTS OF	0 LAYERS WITH	0.000	in. THICKNESS
======	CERT WINDING CONSISTS OF	3 LAYERS WITH	0.063	in. THICKNESS
	UNI WINDING CONSISTS OF	6 LAYERS WITH	0.120	in. THICKNESS

The Total Thickness of the Composite Construction = 0.431 inches

LAMINATE PROPERTIES

Helical winding at 70° shall have a minimum glass content by weight of 62% and maximum glass content by weight of 68%. The uni-directionals or unis (0°) shall be placed along the longitudinal axis of the shell with minimum glass content by weight of 60% and maximum glass content by weight of 68%. The liner or corrosion barrier shall meet the requirements set forth in ASTM D3299 and ASTM D4097. The minimum glass content for the two mats which form the liner shall be as specified in ASTM D3299.

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ULTRA FIBER

C.S.U.L.B. S.C.L.

LAMINATE MATRIX DATA

Units are in in. lbs.

DATE: 07-30-1993 TIME: 09:40:59

PAGE: 2

File Name :AA17 LAMINATE AA17

Force-Moment Total Matrix (Times E6)

1.329628	0.187587	0.000000	0.034796	0.002906	0.000000
0.187587	0.974412	0.000000	0.002906	0.020587	0.000000
0.000000	0.000000	0.217035	0.000000	0.000000	0.001785
0.034796	0.002906	0.000000	0.015274	0.002767	0.001277
0.002906	0.020587	0.000000	0.002767	0.015139	0.000163
0.000000	0.000000	0.001785	0.001277	0.000163	0.003324

Inverse Force-Moment Total Matrix (Times E-6)

0.826100	-0.161900	-0.006100	-1.989000	0.417000	0.746800
-0.161900	1.088400	0.000800	0.446900	-1.529600	-0.096900
-0.006100	0.000800	4.628700	0.231700	-0.014400	-2.574700
-1.989000	0.446900	0.231700	74.730800	-13.578100	-28.162200
0.417000	-1.529600	-0.014400	-13.578100	70.514900	1.755000
0.746800	-0.096900	-2.574700	-28.162200	1.755000	312.986200

A Elasticity Matix (Times E6)

3.08498	0.43524	0.00000
0.43524	2.26082	0.00000
0.00000	0.00000	0.50356

AInv Elasticity Matrix (Times E-6)

0.33320	-0.06415	0.00000
-0.06415	0.45467	0.00000
0.00000	0.00000	1.98585

B Elasticity Matix (Times E6)

0.08073	0.00674	0.00000
0.00674	0.04777	0.00000
0.00000	0.00000	0.00414

BInv Elasticity Matrix (Times E-6)

12.53434	-1.76940	0.00000
-1.76940	21.18518	0.00000
0.00000	0.00000	241.40040

D Elasticity Matix (Times E6)

0.03544	0.00642	0.00296
0.00642	0.03513	0.00038
0.00296	0.00038	0.00771

DInv Elasticity Matrix (Times E-6)

30.13910	-5.38546	-11.31214
-5.38546	29.44611	0.62033
-11.31214	0.62033	133.99045

4A

B-3

C.S.U.L.B. ULTRA FIBER S.C.L.
Laminate Model

DATE: 07-29-1993

TIME: 12:18:59
PAGE: 1

File Name :LMAA6

LAMINATE AA-6

Material Properties for Laminate Model in L-T Coordinates (psi)

El(Times E6)	Et(Times E6)	G(Times E6)	Poisson Ratio
5.7000	0.8000	0.2800	0.2800
1.0000	1.0000	0.4000	0.2500

Data for each Lamina (Theta(θ) measured clockwise from +Y axis)

Lamina#	Material #	Theta(θ) (deg)	Thickness (in.)	Graphical Layup
1	2	LINER	0.0800	
2	1	70	0.0210	<><><>
3	1	0	0.0200	|||||||
4	1	-70	0.0210	<><><>
5	1	70	0.0210	<><><>
6	1	-70	0.0210	<><><>
7	1	-70	0.0210	<><><>
8	1	70	0.0210	<><><>
9	1	-70	0.0210	<><><>
10	1	0	0.0200	|||||||
11	1	70	0.0210	<><><>

	CORROSSION LINER HAS	1 LAYERS WITH	0.080	in. THICKNESS
<><><>	HELIX WINDING CONSISTS OF	8 LAYERS WITH	0.168	in. THICKNESS
	CHOPPED LAMINA CONSISTS OF	0 LAYERS WITH	0.000	in. THICKNESS
=======	CERT WINDING CONSISTS OF	0 LAYERS WITH	0.000	in. THICKNESS
|||||||	UNI WINDING CONSISTS OF	2 LAYERS WITH	0.040	in. THICKNESS

The Total Thickness of the Composite Construction = 0.288 inches

B-4

ULTRA FIBER

C.S.U.L.B. S.C.L.

LAMINATE MATRIX DATA

Units are in in. lbs.

DATE: 07-29-1993 TIME: 12:19:03

PAGE: 2

File Name :LMAA6 LAMINATE AA-6

Force-Moment Total Matrix (Times E6)

0.901821	0.155199	0.000000	0.023785	0.003136	0.000000
0.155199	0.462377	0.000000	0.003136	0.006207	0.000000
0.000000	0.000000	0.176995	0.000000	0.000000	0.002472
0.023785	0.003136	0.000000	0.004947	0.000903	0.000407
0.003136	0.006207	0.000000	0.000903	0.003275	0.000052
0.000000	0.000000	0.002472	0.000407	0.000052	0.001082

Inverse Force-Moment Total Matrix (Times E-6)

1.354100	-0.426800	-0.035400	-6.688200	1.315400	2.535300
-0.426800	2.356100	0.004500	1.394300	-4.436100	-0.321300
-0.035400	0.004500	5.843300	1.329100	-0.120500	-13.847900
-6.688200	1.394300	1.329100	252.989200	-64.453500	-95.168700
1.315400	-4.436100	-0.120500	-64.453500	330.130900	8.625300
2.535300	-0.321300	-13.847900	-95.168700	8.625300	991.582700

A Elasticity Matix (Times E6)

Ex 3.13132	0.53889	0.00000
0.53889	1.60548 Ey	0.00000
0.00000	0.00000	0.61457

AInv Elasticity Matrix (Times E-6)

0.33893	-0.11376	0.00000
-0.11376	0.66105	0.00000
0.00000	0.00000	1.62716

B Elasticity Matix (Times E6)

0.08259	0.01089	0.00000
0.01089	0.02155	0.00000
0.00000	0.00000	0.00858

BInv Elasticity Matrix (Times E-6)

12.97270	-6.55410	0.00000
-6.55410	49.70976	0.00000
0.00000	0.00000	116.51355

D Elasticity Matix (Times E6)

0.01718	0.00313	0.00141
0.00313	0.01137	0.00018
0.00141	0.00018	0.00376

DInv Elasticity Matrix (Times E-6)

63.21572	-17.05811	-22.97543
-17.05811	92.61262	1.95726
-22.97543	1.95726	274.81830

POSSIBLE CHEMICAL ENVIRONMENT IN THE TANK & THE CHEMICAL RESISTANCE OF RESINS TO THESE CHEMICALS (FOR CORROSION BARRIER)

This chapter provides corrosion resistance data for resins that could be used to fabricate the corrosion barrier of Tanks J-5, J-6, and J-7. Two bisphenol-A epoxy vinyl ester resins were considered: Derakane 411 by Ashland and Vipel F010 by AOC. The general composition of the waste streams was provided by Phibro-Tech. Note that in most cases, specific chemicals were not listed in the waste stream descriptions. Consequently, the chemical content of the waste streams was inferred. Also, the concentrations of the chemicals were not precisely specified.

Table B-1 displays the possible chemical environment in the tanks, the designated waste stream, and the resin manufacturer's recommended maximum exposure temperature for various concentrations of each chemical. *Derakane 411 is compatible with the contents of these tanks up to 150°F.* Vipel F010 has lower resistance than Derakane 411 to solutions of sodium carbonate and sodium hydroxide. Phibro-Tech intends to use 12% sodium carbonate in these "J" Tanks.

Recommendation:

Derakane 411 is recommended for the fabrication of the corrosion barrier of Tanks J-5, J-6, and J-7. In addition based on the recommendations of Ashland (see Notes at bottom of table), it is proposed that a double surfacing veil is used along with post-curing the laminates. The maximum operating temperature of these tanks should not exceed 150°F. The concentration of nitric acid in these tanks should not exceed 10%.

TABLE B-1
Corrosion resistance data for the bisphenol-A vinyl ester resins, Derakane 411 and Vipel F010, exposed to chemicals in Tanks J-5, J-6, and J-7

Possible Chemical Environment in Tanks J-5, J-6, and J-7	Waste Stream Designation	Concentration (%) [Δ]	Resin Manufacturer's Recommended Max. Exposure Temperature (°F)	
			Ashland Derakane 411	*AOC Vipel F010*
Ammonium Chloride	K [?]	All	210	200
Ammonium Hydroxide	IB [?], K [?]	1 – 5	180 [5]	180 [5]
Copper Chloride	C	All	210	200
Copper Chloride / Ammonium Chloride / Ammonium Hydroxide	K	26 / 5 / 2	See Ammonium Hydroxide	–
Copper Nitrate	E, G	All	210	200
Copper Sulfate	A, B	All	210	200
Ferric Nitrate	F [?]	All	–	200
Hydrochloric Acid	C, IA, L	1 – 20	180 [1,2,3]	180 [2,4]
Nickel Nitrate	E, G	All	210	210
Nitric Acid	E, F, G, IA, L	1 – 10	150	150
Sodium Carbonate	D, IB	10 35	180 [5] 180 [5]	180 [5] 160 [5]
Sodium Hydroxide	D, IB, L	1 5 25	180 [5,6] 180 [5,6] 180 [5,6]	180 [5,6,7] 120 [5,6,7] 150 [5,6,7]
Sodium Chloride	C, K	All	210	210
Sodium Hypochlorite	X	pH>11; Active chlorine <18%	180 [2,6,8]	180 [5,6,8]
Sulfuric Acid	C, IA, L	1 – 25	210	210

NOTES:
See next page

NOTES:

[Δ]: Concentration according to resin manufacturer's corrosion guide.

[?]: It is not known if these chemicals are constituents in the waste streams.

–: No data available

X: Possible chemical used in the future

[1] Double surfacing veil and a 200 mil corrosion barrier should be used.

[2] Double C-veil should be used in the corrosion barrier.

[3] Above 120°F, acid resistant glass should be used in the corrosion barrier and may be used in the structural wall.

[4] Acid resistant glass is recommended in the chopped glass layer behind the veil layer.

[5] Double synthetic veil is recommended.

[6] Post-cure is recommended.

[7] Carbon veil is recommended for improved service life.

[8] Benzoyl peroxide / amine cure system with post-cure is recommended.

References

AOC, LLC, *Corrosion Resistant Resin Guide for Using Corrosion Resistance Vipel Resins*, Collierville, TN: AOC, LLC., February 2012.

Ashland, *DERAKANE Epoxy Vinyl Ester Resins Chemical Resistance Guide: Resin Selection Guide for Corrosion Resistant FRP Applications*, 2011.

CHAPTER C1

C-1

DESIGN OF HOLD-DOWN LUGS FOR 144 in. ϕ X 218 in. HIGH TANK (HOOP WOUND)

P_{app} = Applied pressure over and above hydrostatic pressure

$P_{app} := 0$ psi

S_0= Section modulus of tank

$R_0 := 72$ in.

$t_0 := 0.431$ in.

$S_0 := \pi \cdot R_0^2 \cdot t_0$ $S_0 = 7019.273$ in.^{3} (S_0 = section modulus for t_0 thickness)

F_L = Tension force per lug

SGL = Specific gravity of the liquid $SGL := 1.45$

$D_0 := 2 \cdot R_0$ $D_0 = 144$ in.

H = Height of tank $H := 218$ in.

$Lugs := 12$

SSL = Lug spacing

$SSL := \pi \cdot D_0 \div Lugs$ $SSL = 37.699$ in.

$F_L := 7090$ lb.

W_{MAX} = Unit radial load on overwrap

e = load eccentricity on lug $e := 2.25$ in.

h = height of lug $h := 13$ in.

$W_{MAX} := 3 \cdot F_L \frac{e}{h^2}$ $W_{MAX} = 283.18$ lb. per in.

P = Radial load due to moment

$P := W_{MAX} \cdot \frac{h}{2}$ $\quad P = 1840.673$ lb.

T_{tot} = Hoop overwind load

R_m = Mean radius of overwind $\quad R_m := 72.7$ in.

w = Lug width $\quad w := 5$ in.

$T_{tot} := \frac{P \cdot R_m}{w}$ $\quad T_{tot} = 26763.387$

Try overwrap thickness, t_1 $\quad t_1 := 0.34$ in.

σ_T = Hoop overwind tensile stress

h_1 = Height of wound overwrap, in $\quad h_1 := 10$ in.

$\sigma_T := \frac{T_{tot}}{h_1 \cdot t_1}$ $\quad \sigma_T = 7871.584$ psi $<$ $\frac{40000}{5} = 8000$ psi allowable ok

τ_b = shear across lug bond

$\tau_b := \frac{F_L}{2 \cdot h_1 \cdot t_1}$

$\tau_b = 1042.647 \quad \leq$ 3,000 psi

τ_w = Shear across vessel wall

t_b = Tank bottom thickness $\quad t_b := 0$ in.

t_r = Knuckle reinforcement thickness $\quad t_r := 0.54$ in.

t_k = Total thickness above knuckle radius

$t_k := 0.97$ in.

$\tau_w := \frac{P}{(t_k \cdot w)}$ $\quad \tau_w = 379.52$ psi $<$ $\frac{3000}{2} = 1500$ psi allowable ok

β = Coefficient of bending in the vessel wall

$\beta := \frac{1.28}{(R_m \cdot t_k)^{\frac{1}{2}}}$ $\quad \beta = 0.152$ in.$^{-1}$

P* = Unit radial loading

$P^* := \frac{P}{w}$ $\quad P^* = 368.135$ lb. per in.

Axial and hoop bending loads

$M_{ax} := \frac{P^*}{4 \cdot \beta}$ $\quad M_{ax} = 603.795$ in.-lb. per in.

$p := H \cdot 0.0361 \cdot SGL + P_{app}$ $\quad p = 11.411$ psi

ν = Poisson Ratio

$\nu := 0.3$

$M_{hp} := \nu \cdot M_{ax}$ $\quad M_{hp} = 181.139$ in.-lb. per in.

Axial load due to pressure

$N_{ax} := \frac{(P_{app} \cdot R_m)}{2}$ $\quad N_{ax} = 0$ lb. per in.

Hoop load due to pressure

$N_{hp} := p \cdot R_m$ $\quad N_{hp} = 829.595$ lb. per in.

Axial stress

$\sigma_{ax} := \frac{N_{ax}}{t_k} + \frac{(6 \cdot M_{ax})}{t_k^2}$ $\quad \sigma_{ax} = 3850.326$ psi $\leq$ 4,000 psi OK

Hoop stress

$\sigma_{hp} := \frac{N_{hp}}{t_k} + \frac{(6 \cdot M_{hp})}{t_k^2}$ $\quad \sigma_{hp} = 2010.35$ psi $\leq$ 4,000 psi OK

TANK J-7

Tank Assessment Document
CCR Section 66264.192

THIS DOCUMENT WAS PREPARED FOR:

Phibro-Tech
8851 Dice Road
Santa Fe Springs, CA 90670

TANK SYSTEM/IDENTIFICATION:

Tank J-7

DATE OF DESIGN/ASSESSMENT:

October 14, 2013

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified persounel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to be the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information including the possibility of fine and imprisonment for knowing violations.

Dr. Joseph Matthew Plecnik
California PE No.: C26354
3562 Cerritos Ave.
Los Alamitos, CA 90720

REGISTERED PROFESSIONAL ENGINEER
JOSEPH M. PLECNIK
No. C26354
3/14
CIVIL
STATE OF CALIFORNIA

Date stamped/signed: 10/14/2013

TANK ASSESSMENT:

TANK NAME/MARKING	**Tank J-7**
TANK AGE	**New tank to be fabricated**
ESTIMATED LIFE OF SERVICE	**20 Years**
MANUFACTURER	**To be determined**
DATE OF FABRICATION	**To be determined**
SERIAL NUMBER OR OTHER	**To be determined**
DIAMETER	**12 ft**
HEIGHT	**Shell: 14 ft – 2 in** **FRP skirt: 48 in**
OPERATING CAPACITY	**12,500 gal**
SHAPE	**Cylindrical, Dish bottom**
ORIENTATION	**Vertical**
LOCATION	**"W" Containment Area**
MATERIAL OF CONSTRUCTION	**Fiberglass construction throughout**
EMPTY WEIGHT	**To be determined**
THICKNESS AND METHOD USED TO DETERMINE	**To be determined**
LINING MATERIAL AND THICKNESS	**To be determined**
CORROSION PROTECTION EQUIPMENT	**N/A**
STRUCTURAL SUPPORT	**Double FRP skirt**
DESIGN TEMPERATURE	**150°F**
DESIGN PRESSURE	**Atmospheric**

MATERIAL STORAGE:

MATERIAL AND CHARACTERISTICS	**Hazardous Waste; See Table B-1 in Chapter B for possible chemical constituents in the waste streams**
SPECIFIC GRAVITY	**1.45**
OPERATING CAPACITY	**12,500 gal**

CHEMICAL COMPATIBILITY FINDINGS:

Refer to Table B-1 in Chapter B regarding corrosion resistance data for bisphenol-A epoxy vinyl ester resins (to be used to fabricate the corrosion barrier) exposed to chemicals in this tank.

Derakane 411 is compatible with the contents of this tank up to 150°F.

The materials noted in the material storage section described above are compatible with the material of construction or lining material noted in the tank construction section above.

Initials: JMP

DESIGN OF CONTAINMENT AREA:

The design of the containment area will satisfy the requirements of Title 22 CCR Section 66264.192.

SEISMIC ANCHORING:

Seismic/Hydrostatic Anchorage Description:

Anchors: _Based on CBC 2010_

Seismic/Hydrostatic Anchorage Drawings: See _Chapter A_

Seismic/Hydrostatic Analysis: See _Chapter A_

SEISMIC/ANCHORING FINDINGS: The tank as designed and the containment area in which it will be located are adequately anchored and are seismically sound.

Initials:

TESTING, INSPECTION & CERTIFICATION SERVICES

CLIENT: Phibro Tech
Santa Fe Springs, CA

TI&CS Report Number: 13-10-23

Report Title: Design of Tanks J-6 and J-7 for Phibro Tech Facility at Santa Fe Springs, CA for Waste Management System

Author(s): Joseph M. Plecnik Jr., BSCE
Christine Bosque, Ph.D., Chemistry
Joseph M. Plecnik, Ph.D., P.E.
TI&CS
3562 Cerritos Ave.
Los Alamitos, CA 90720
(562) 900-3118

Date of Issue: October 11, 2013

NOTES:

TESTING, INSPECTION AND CERTIFICATION SERVICES
TI&CS
3562 CERRITOS AVE.
LOS ALAMITOS, CA 90720 (562) 493-7911

J6 J7

CHAPTER A: SUMMARY OF FRP TANK DESIGN: DIAMETER 12 FT. HEIGHT 14'-2" (CYLINDER)
DOME BOTTOM WITH SKIRT (2'-8")

I. WALL THICKNESS DESIGN

1. For tank dome, use 3/8" in. wall thickness. See Fig. A-2

2. For tank wall, use the following thicknesses starting from the tank bottom. See Page A-2

a) From 0 ft. to 8 ft., use 0.431 in. wall thick., LAMINAR COMB. AA17

b) From 8 ft. to TOP ft., use 0.288 in. wall thick., LAMINAR COMB. AA6

c) From _____ ft. to _____ ft., use _____ in. wall thick., LAMINAR COMB. _____

d) From _____ ft. to _____ ft., use _____ in. wall thick., LAMINAR COMB. _____

e) From _____ ft. to _____ ft., use _____ in. wall thick., LAMINAR COMB. _____

f) See Fig. A-3 for Inside skirt design

g. See See Fig. A-4 for Skirt Reinforcement at Base.

II. LAMINAR CONSTRUCTION AND MATERIAL PROPERTIES ARE PROVIDED IN CHAPTER B.

See Fig. A-6 For skirt to dome Bond.

III. LUG DESIGN

1. Use 12 lugs uniformly spaced over tank circumference.

2. Use ONE bolt per lug with 1 in. diameter and See Fig. A-5 type.

3. Fig. A-5 provides lug design details.

4. If extensive corrosion on the outside of the tank is probable, use stainless or other types of corrosion resistant lugs.

IV. SPECIFICATIONS

1. Seismic and Wind Loads per CBC 2010 & ASCE 7-10

2. Specific gravity of liquid contents; G = 1.45.

3. ASTM D3299 used for filament winding and tank dome construction.

4. AISC-14th edition is used for steel design.

5. A36 steel used for lugs (unless stated otherwise).

CHAPTER A: DESIGN OF 144 in. ϕ x 218 in. HIGH TANK USING THE API 650 METHOD, CBC 2010, ASCE 7-10 AND ASTM D3299

J6, J7

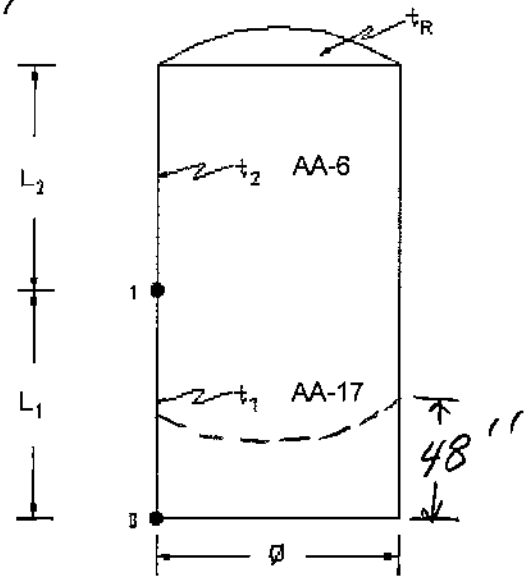


Fig. A-1: Tank Geometry

Min. Dome Thickness ; $t_R := 0.375$ (in.)
Type of Cover; Flat or Dish Type
Radius of Cover (∞ for Flat Cover);

Length 2 ; $L_2 := 122$ (in.)

Minimum Thickness for L2 ; $t_2 := 0.288$ (in.)

$E_{h2} := 3.13132 \cdot 10^6$ $E_{a2} := 1.60548 \cdot 10^6$

Length 1 ; $L_1 := 96$ (in.)

Minimum Thickness for L1 ; $t_1 := 0.431$ (in.)

$E_{h1} := 3.08498 \cdot 10^6$ $E_{a1} := 2.26082 \cdot 10^6$

I) Seismic Design Parameters (per CBC 2010 and ASCE 7-10)

For plant site, ASCE 7-10 gives the following seismic parameters:

Seismic Risk Category: III

Seismic Design Category: D

Site Class: D

Importance Factor: I $I := 1.25$

Response Modification Coefficient; $RR := 3$

Specific Gravity of Liquid ; $SGL := 1.45$

MATERIAL PROPERTIES AND LAMINATE CONSTRUCTIONS FOR SHELL

Total Height ; $HH := 218$ (in.)

Tank Diameter ; $D := 144$ (in.)

Tank Radius ; $R := \frac{D}{2}$ $R = 72$ (in.)

P_{app} = applied pressure (+) or vacuum (-) $P_{app} := 0$ (psi)

Specific Gravity of Shell Material; $SGS := 1.7$

Poisson Ratio (for shell); $\nu := 0.27$

Number of Anchor Lugs; $nn := 12$

Thickness of Corrosion Barrier $t_L := 0.02$ (in.) (not used in structural)

Shell Weight Added Factor $SWAF := 1.1$

A-3a

FB1 = Minimum Free Board $FB1 := 0$ (in.)

BWR = maximum width of flat bottom resisting overturning $BWR := 21$ (in.)

Seismic Response Spectral Acceleration Values:

$S_S := 1.83$

$S_1 := 0.65$

$F_a := 1.0$

$F_v := 1.5$

$S_{MS} := F_a \cdot S_S$

$S_{MS} = 1.83$

$S_{M1} := F_v \cdot S_1$

$S_{M1} = 0.975$

$S_{DS} := \frac{2}{3} \cdot S_{MS}$

$S_{DS} = 1.22$

$S_{D1} := \frac{2}{3} \cdot S_{M1}$

$S_{D1} = 0.65$

$T_s := \frac{S_{D1}}{S_{DS}}$

$T_s = 0.532787$ sec.

Since $T_s < T_c$:

$S_{ai} := S_{DS}$

$S_{ai} = 1.22$

W_i = impulsive weight component

$W_i = W_1$

ZC = resultant impulsive spectral acceleration

$ZC := S_{ai} \cdot I \div RR$

$ZC = 0.508$

$ZC_{1S} := ZC$

$ZC_{1R} := ZC$

$ZC_{11} := ZC$

A-36

A) Convective Component or Sloshing Seismic Coefficient

T_C = natural period for sloshing

$g := 32.2$ ft./sec. sec. = gravitational acceleration

$$T_C := 2\cdot\pi\cdot\sqrt{\frac{D \div 12}{3.68\cdot g\cdot \tanh\left(\frac{3.68\cdot HH}{D}\right)}}$$

$T_C = 2$

Since $T_C < 4$ sec.

$$S_{ac} := \frac{1.5\cdot S_{D1}}{T_c}$$

$S_{ac} = 0.488$

C_2 = sloshing spectral acceleration

$$C_2 := \frac{S_{ac}\cdot I}{1.5}$$

$C_2 = 0.406$

B) Height of Sloshing Wave Analysis (ASCE 7-05)

SWH = sloshing wave height

$SWH := 0.5\cdot D\cdot I\cdot S_{ac}$

$SWH = 43.886$ (in.)

FB = Free Board

$FB := SWH + 0.005\cdot D$

$FB = 44.606$ (in.)

$$FB2 := \begin{cases} FB & \text{if } FB < FB1 \\ FB1 & \text{otherwise} \end{cases}$$

$FB2 = 0$

H = design liquid height at base of tank

$H := HH - FB2$

$H = 218$ (in.)

A-4

VII) Calculation of Overturning Moments

A) AT TANK BOTTOM (POINT 0, FIG. A-1)

$M_0 = M_{0S} + M_{0R} + M_{01} + M_{02}$

Where,

M_{0S} = (1/1.4) ZC W_S X_S = overturning moment due to shell weight

M_{0R} = (1/1.4) ZC W_R H = overturning moment due to roof weight

M_{01} = (1/1.4) ZC W_1 X_1 = overturning moment due to liquid inertial force

M_{02} = (1/1.4) C_2 W_2 X_2 = overturning moment due to liquid sloshing

W_S = Total weight of shell

$W_S := \pi \cdot D \cdot (SGS) \cdot (0.0361) \cdot \left[L_1 \cdot (t_1 + t_L) + L_2 \cdot (t_2 + t_L) \right] \cdot SWAF$

$W_S = 2469.786$ lbs

X_S = Half tank height ; $X_S := \frac{H}{2}$

$X_S = 109$ in.

W_R = Weight of tank roof

$W_R := \pi \cdot R^2 \cdot t_R \cdot (SGS) \cdot 0.0361 \cdot SWAF$

$W_R = 412.283$ lbs

W_L = Weight of tank contents

$W_L := \pi \cdot R^2 \cdot H \cdot 0.0361 \cdot SGL$

$W_L = 185843.152$ lbs

$F_{A1} := \frac{0.866 \cdot D}{H}$ $\qquad F_{A1} = 0.572$

$F_{A2} := \frac{3.67 \cdot H}{D}$ $\qquad F_{A2} = 5.556$

$F_{A3} := \cosh(F_{A2}) - 1$ $\qquad F_{A3} = 128.391$

$AW_{1a} := \frac{\tanh(F_{A1}) \cdot W_L}{F_{A1}}$ $\qquad AW_{1a} = 167915.237$ lb.

$AW_{1b} := \left(1 - \frac{0.218 \cdot D}{H}\right) \cdot W_L$ $\qquad AW_{1b} = 159081.738$ lb.

$W_1 := \begin{cases} AW_{1a} & \text{if } \frac{D}{H} \geq 1.33 \\ AW_{1b} & \text{otherwise} \end{cases}$ $\qquad W_1 = 159081.738$ lb.

$W_2 := 0.230 \cdot \left(\frac{D}{H}\right) \cdot \tanh(F_{A2}) \cdot W_L$ $\qquad W_2 = 28233.676$ lb.

A-5

X_1 = moment arm for liquid seismic inertial force

X_2 = moment arm for sloshing seismic force

$X_{1a} := 0.375 \cdot H$ $\qquad X_{1a} = 81.75$ in.

$X_{1b} := \left(0.5 - 0.094 \cdot \frac{D}{H}\right) \cdot H$ $\qquad X_{1b} = 95.464$ in.

$$X_1 := \begin{cases} X_{1a} & \text{if } \frac{D}{H} \geq 1.33 \\ X_{1b} & \text{otherwise} \end{cases}$$ $\qquad X_1 = 95.464$ in.

$X_2 := \left(1 - \frac{F_{A3}}{F_{A2} \cdot \sinh(F_{A2})}\right) \cdot H$ $\qquad X_2 = 179.065$ in.

M_0 = overturning moment at Point "0"

$M_{0s} := \left(\frac{1}{1.4}\right) \cdot ZC \cdot W_s \cdot X_s$ $\qquad M_{0s} = 97747.669$

$M_{0R} := \left(\frac{1}{1.4}\right) \cdot ZC \cdot W_R \cdot H$ $\qquad M_{0R} = 32634.126$

$M_{01} := \left(\frac{1}{1.4}\right) \cdot ZC \cdot W_1 \cdot X_1$ $\qquad M_{01} = 5514174.542$

$M_{02} := \left(\frac{1}{1.4}\right) \cdot C_2 \cdot W_2 \cdot X_2$ $\qquad M_{02} = 1467400.247$

$M_0 := M_{0s} + M_{0R} + M_{01} + M_{02}$

$M_0 = 7111956.584$ (in - lbs.)

F_H = horizontal base shear

$F_H := M_{0s} \div X_s + M_{0R} \div H + M_{01} \div X_1 + M_{02} \div X_2$

$F_H = 67003.077$ (lbs.)

A-6

B) OVERTURNING MOMENT AT POINT 1 (SEE FIG. A-1)

$M_1 = M_{1S} + M_{1R} + M_{11} + M_{12}$

Where,

$M_{1S} = (1/1.4)\ ZC\ BW_S\ BX_S$

$M_{1R} = (1/1.4)\ ZC\ W_R\ (L_2 + L_3 + L_4)$

$M_{11} = (1/1.4)\ ZC\ BW_1\ BX_1$

$M_{12} = (1/1.4)\ C_2\ BW_2\ BX_2$

BWs = total weight of shell above point 1. (See Fig. A-1)

$BW_s := \pi \cdot D \cdot (SGS) \cdot (0.0361) \cdot \left[L_2 \cdot (t_2 + t_L)\right] \cdot SWAF$

$BW_s = 1147.55$ lbs.

$BX_s := \frac{L_2}{2}$

$BX_s = 61$ in.

W_R = weight of tank roof

$W_R = 412.283$ lbs.

For $\frac{D}{L_2} = 1.18$

BW_L = weight of tank contents above point 1.

$BW_L := \pi \cdot R^2 \cdot (0.0361) \cdot (SGL) \cdot (L_2)$

$BW_L = 104003.966$ lbs.

$F_{B1} := \frac{0.866 \cdot D}{(L_2)}$ $\qquad F_{B1} = 1.022$

$F_{B2} := \frac{3.67 \cdot (L_2)}{D}$ $\qquad F_{B2} = 3.109$

$F_{B3} := \cosh(F_{B2}) - 1$ $\qquad F_{B3} = 10.225$

$BW_{1a} := \frac{\tanh(F_{B1}) \cdot BW_L}{F_{B1}}$ $\qquad BW_{1a} = 78422.536$ lb.

$BW_{1b} := \left[1 - \frac{0.218 \cdot D}{(L_2)}\right] \cdot BW_L$ $\qquad BW_{1b} = 77242.552$ lb.

$BW_1 := \begin{cases} BW_{1a} & \text{if } \frac{D}{(L_2)} \geq 1.33 \\ BW_{1b} & \text{otherwise} \end{cases}$ $\qquad BW_1 = 77242.552$ lb.

$BW_2 := 0.230 \cdot \left[\frac{D}{(L_2)}\right] \cdot \tanh(F_{B2}) \cdot BW_L$ $\qquad BW_2 = 28122.256$ lb.

A-7

$BX_{1a} := 0.375 \cdot (L_2)$ $\qquad BX_{1a} = 45.75$ in.

$BX_{1b} := \left[0.5 - 0.094 \cdot \frac{D}{(L_2)}\right] \cdot (L_2)$ $\qquad BX_{1b} = 47.464$ in.

$BX_1 := \begin{cases} BX_{1a} & \text{if } \frac{D}{(L_2)} \geq 1.33 \\ BX_{1b} & \text{otherwise} \end{cases}$ $\qquad BX_1 = 47.464$ in.

$BX_2 := \left(1 - \frac{F_{B3}}{F_{B2} \cdot \sinh(F_{B2})}\right) \cdot (L_2)$ $\qquad BX_2 = 86.116$ in.

M_1 = overturning moment at Point "1"

$M_{1s} := \left(\frac{1}{1.4}\right) \cdot ZC \cdot BW_s \cdot BX_s$ $\qquad M_{1s} = 25416.872$

$M_{1R} := \left(\frac{1}{1.4}\right) \cdot ZC \cdot W_R \cdot (L_2)$ $\qquad M_{1R} = 18263.135$

$M_{11} := \left(\frac{1}{1.4}\right) \cdot ZC \cdot BW_1 \cdot BX_1$ $\qquad M_{11} = 1331194.463$

$M_{12} := \left(\frac{1}{1.4}\right) \cdot C_2 \cdot BW_2 \cdot BX_2$ $\qquad M_{12} = 702915.554$

$M_1 := M_{1s} + M_{1R} + M_{11} + M_{12}$

$M_1 = 2077790.024$ (in - lbs.)

VIII) Calculation of Flexural Stresses

A-8

A) Flexural Stresses At Tank Bottom (Point 0)

1) S_1 = section modulus for t_1

R_{m1} = mean tank radius

$R_{m1} := R + .50 \cdot (t_1)$

$R_{m1} = 72.216$

$S_1 := \pi \cdot (R_{m1})^2 \cdot (t_1)$

$S_1 = 7061.354$ in.^{3}

$\sigma_0 := \left(\frac{M_0}{S_1}\right)$

$\sigma_0 = 1007.166$ psi

ε_0 = axial strain at tank bottom due to flexure

E_{a1} = axial modulus of elasticity

$\varepsilon_0 := \frac{\sigma_0}{E_{a1}}$

$\varepsilon_0 = 0.000445$ in./in.

where Ea_1 = axial modulus for t_1 thick lamina

ε_{allow} = allowable axial strain

= 0.00133 in./in. (ASTM D3299 with 33% increase for seismic)

= 0.002 in./in. (ASME RTP-1)

Hence,

$\varepsilon_0 = 0.000445$ in./in. $\leq$ ε_{allow}

Ref. 1: *Structural Analysis of Shells* by Baker, Kovalevsky and Rish.

2) Check for buckling at tank bottom

From Fig. 10-13 of Ref. 1

$M_{cr/0}$ = critical buckling moment at tank bottom

$M_{cr/0} = \pi R^2 t_1 \sigma_{cr/0}$

where,

$\sigma_{cr/0}$ = critical buckling axial stress at tank bottom.

$\sigma_{cr/0} = \gamma_1 \cdot C_b \cdot \left(\frac{E_{e1} \cdot t_1}{R}\right)$

A-9

$RAT1 := \frac{R}{t_1}$ $\quad RAT1 = 167.053$,From Fig.10-13 of Ref. 1: $\gamma_1 := 0.61$

$C_b := \left[\frac{1}{\sqrt{3\cdot(1-\nu^2)}}\right]$ $\quad C_b = 0.6$

E_{e1} = effective modulus for buckling for t_1 lamina.

$E_{e1} := \sqrt{E_{a1}\cdot E_{h1}}$ $\quad E_{e1} = 2.640944 \times 10^6$ psi

$\sigma_{cr0} := \gamma_1\cdot C_b\cdot\left(\frac{E_{e1}\cdot t_1}{R}\right)$

$\sigma_{cr0} = 5782.423$ psi

$M_{cr0} := \pi\cdot R^2\cdot t_1\cdot\sigma_{cr0}$

$M_{cr0} = 40588406.027$ in. - lbs

SF_0 = Safety factor against buckling due to M_0

$SF_0 := \left(\frac{M_{cr0}}{M_0}\right)$ $\quad SF_0 = 5.707$

A minimum safety factor against buckling of 4.0 is recommended.

B) Flexural Stresses At Point 1

A-10

1) S_2 = section modulus for t_2

R_{m2} = mean tank radius

$R_{m2} := R + .50 \cdot (t_2)$

$R_{m2} = 72.144$

$S_2 := \pi \cdot (R_{m2})^2 \cdot (t_2)$

$S_2 = 4709.153$ in.^{3}

$$\sigma_1 := \left(\frac{M_1}{S_2}\right)$$

$\sigma_1 = 441.224$ psi

ε_1 = strain at Point 1 in axial direction due to flexure

$$\varepsilon_1 := \frac{\sigma_1}{E_{a2}}$$

$\varepsilon_1 = 0.000275$ in./in.

where Ea_2 = axial modulus for t_2 thick lamina

ε_{allow} = allowable axial strain

= 0.00133 in./in. (ASTM D3299 with 33% increase for seismic)

= 0.002 in./in. (ASME RTP-1)

$\varepsilon_1 = 0.000275$ in./in. $\leq$ εallow

2) Check for buckling at Point 1

From Fig. 10-13 of Ref. 1

M_{cr1} = critical buckling moment at Point 1

$M_{cr1} = \pi R^2 t_2 \sigma_{cr/1}$

where,

$\sigma_{cr/1}$ = critical buckling axial stress at Point 1

$$\sigma_{cr/1} = \gamma \cdot C_b \cdot \left(\frac{E_{e2} \cdot t_2}{R}\right)$$

A-11

$RAT2 := \frac{R}{t_2}$ $\quad RAT2 = 250$,From Fig.10-13 of Ref. 1: $\gamma_2 := 0.54$

$$C_b := \left[\frac{1}{\sqrt{3\cdot\left(1-\nu^2\right)}}\right] \quad C_b = 0.6$$

E_{e2} = effective modulus for buckling for t_2 lamina.

$E_{e2} := \sqrt{\left(E_{a2}\cdot E_{h2}\right)}$ $\quad E_{e2} = 2.242158\times 10^6$ psi

$$\sigma_{cr1} := \gamma_2\cdot C_b\cdot\left(\frac{E_{e2}\cdot t_2}{R}\right)$$

$\sigma_{cr1} = 2903.996$ psi

$M_{cr1} := \pi\cdot R^2\cdot t_2\cdot\sigma_{cr1}$

$M_{cr1} = 13620823.408$ in. - lbs

SF_1 = Safety factor against buckling due to M_1

$$SF_1 := \left(\frac{M_{cr1}}{M_1}\right) \quad SF_1 = 6.555$$

A minimum safety factor against buckling of 4.0 is recommended.

IX) Calculation of Hoop and Resultant Stresses And Strains

A-12

A) Hoop and Resultant Stresses and Strains at Tank Bottom (Point 0)

σ_{h0} = hoop stress = $\left(\frac{P_0 \cdot R_{m1}}{t_1}\right)$

P_{app} = applied pressure (+) or vacuum (-), (psi)

P_0 = pressure at tank bottom + P_{app}

$P_0 := SGL \cdot 0.0361 \cdot H + (P_{app})$

$P_0 = 11.411$ psi

$\sigma_{h0} := \left(\frac{P_0 \cdot R_{m1}}{t_1}\right)$

$\sigma_{h0} = 1911.987$ psi

ε_{h0} = hoop strain at tank bottom

$\varepsilon_{h0} := \frac{\sigma_{h0}}{E_{h1}}$ $\varepsilon_{h0} = 0.00062$ in./in.

where E_{h1} = hoop modulus for t_1 thick lamina

$\varepsilon_{h0} = 0.00062$ in./in. $\leq$ 0.00100 in./in. (ASTM D3299 and RTP-1) OK

ε_{0T} = total axial strain due to bending and internal pressure (vacuum)

ε_{aappo} = axial strain due to P_{app}

$\varepsilon_{aappo} := \left(\frac{P_{app} \cdot R_{m1}}{2 \cdot t_1 \cdot E_{a1}}\right)$

$\varepsilon_{aappo} = 0$

$\varepsilon_{0T} := \varepsilon_0 + \varepsilon_{aappo}$

$\varepsilon_{0T} = 0.0004455$

ε_{res0} = resultant strain for t_1 thick laminate

$\varepsilon_{res0} := \sqrt{(\varepsilon_{h0})^2 + (\varepsilon_{0T})^2}$

$\varepsilon_{res0} = 0.000763$ in./in. $\leq$ ε_{allow}

ε_{allow} = allowable resultant strain

= 0.00133 in./in. (ASTM D3299 with 33% increase for seismic)

= 0.002 in./in. (ASME RTP-1)

A-13

B) Hoop and Resultant Stresses and Strains at Point 1

σ_{h1} = hoop stress = $\left(\frac{P_1 \cdot R_{m2}}{t_2}\right)$

P_{app} = applied pressure (+) or vacuum (-), (psi)

P_1 = pressure at Point 1 + P_{app}

$P_1 := SGL \cdot 0.0361 \cdot (L_2 - FB) + (P_{app})$

$P_1 = 4.051$ psi

$\sigma_{h1} := \left(\frac{P_1 \cdot R_{m2}}{t_2}\right)$

$\sigma_{h1} = 1014.828$ psi

ε_{h1} = hoop strain at Point 1

$\varepsilon_{h1} := \frac{\sigma_{h1}}{E_{h2}}$ $\varepsilon_{h1} = 0.000324$ in./in.

where E_{h2} = hoop modulus for t_2 thick lamina

$\varepsilon_{h1} = 0.000324$ in./in. $\leq$ 0.00100 in./in. (ASTM D3299 AND RTP-1) OK

ε_{1T} = total axial strain due to bending and internal pressure (vacuum)

ε_{aapp1} = axial strain due to P_{app}

$\varepsilon_{aapp1} := \left(\frac{P_{app} \cdot R_{m2}}{2 \cdot t_2 \cdot E_{a2}}\right)$

$\varepsilon_{aapp1} = 0$

$\varepsilon_{1T} := \varepsilon_1 + \varepsilon_{aapp1}$

$\varepsilon_{1T} = 0.0002748$

ε_{res1} = resultant strain for t_2 thick laminate

$\varepsilon_{res1} := \sqrt{(\varepsilon_{h1})^2 + (\varepsilon_{1T})^2}$

$\varepsilon_{res1} = 0.000425$ in./in. $\leq$ ε_{allow}

ε_{allow} = allowable resultant strain

= 0.00133 in./in. (ASTM D3299 with 33% increase for seismic)

= 0.002 in./in. (ASME RTP-1)

ANCHOR LUG DESIGN FOR SEISMIC LOADS

From page _____

$\sigma_0 = 1007.166$ psi

$$LS := \frac{\pi \cdot D}{nn}$$

$LS = 37.699$ in. / lug (lug spacing around tank perimeter)

P_L = tension force per lug

$$ZZ := \begin{cases} BWR & \text{if } BWR < 0.035 \cdot D \\ D \cdot 0.035 & \text{otherwise} \end{cases}$$

$ZZ = 5.04$ in.

Use $ZZ := BWR$

$ZZ = 21$

$$P_L := (t_1) \cdot (LS) \cdot (\sigma_0) + \pi \cdot R^2 \cdot \left(\frac{P_{app}}{nn}\right) - ZZ \cdot LS \cdot H \cdot SGL \cdot 0.0361 - \frac{W_s}{nn} - \frac{W_R}{nn}$$

$P_L = 7090.54$ lbs TENSION (ASD)

P_S = avg. shear force per lug

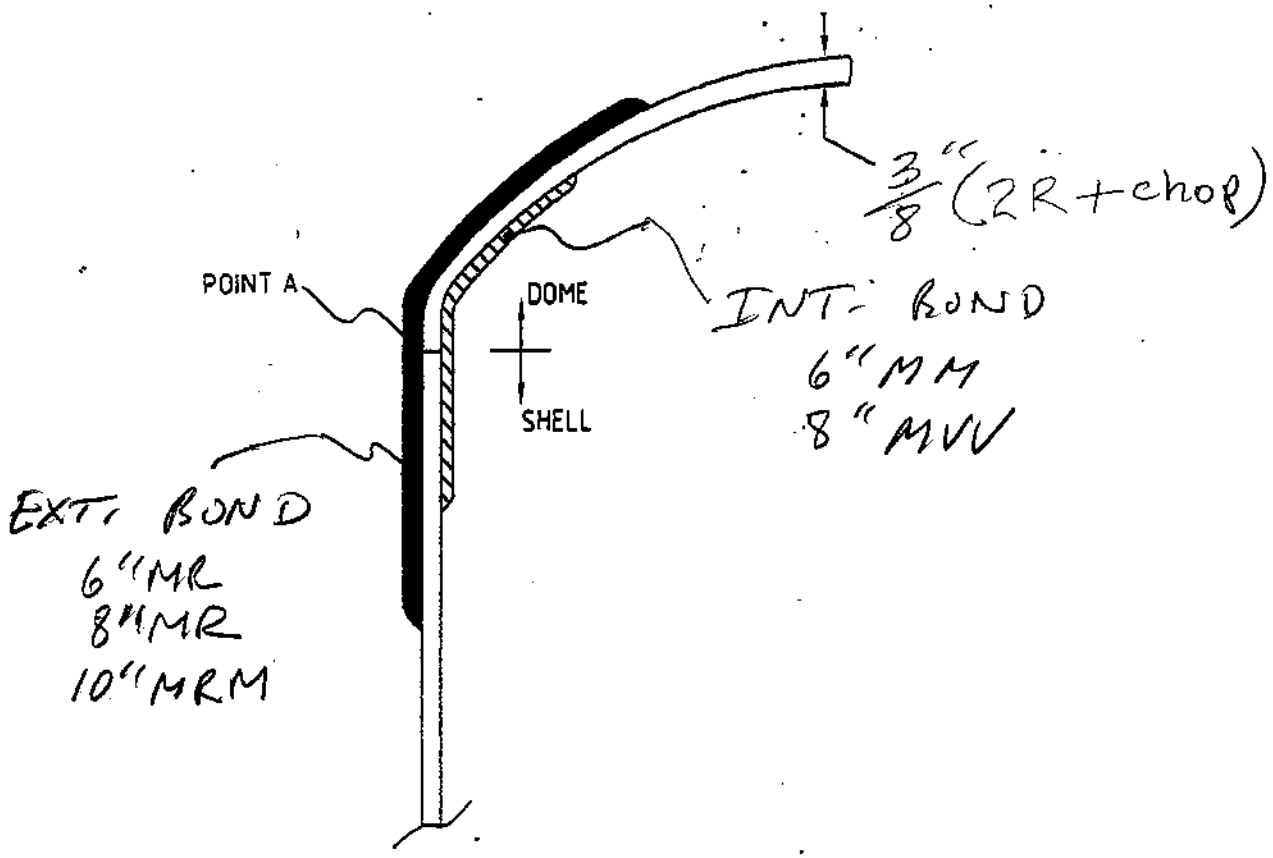
$$P_S := \frac{F_H}{nn}$$

$P_S = 5583.59$ lbs SHEAR (ASD)

Tech
2011

A-15

FIG. A-2: DOME TOP DESIGN AND BOND



NOTE: CENTER BONDS ON POINT A

M = 1-1/2 OZ. MAT
R = 24 OZ. WOVEN ROVING
V = VEILS, AS REQUIRED BY SPECS.
E = exotherm = 1½ oz Mat

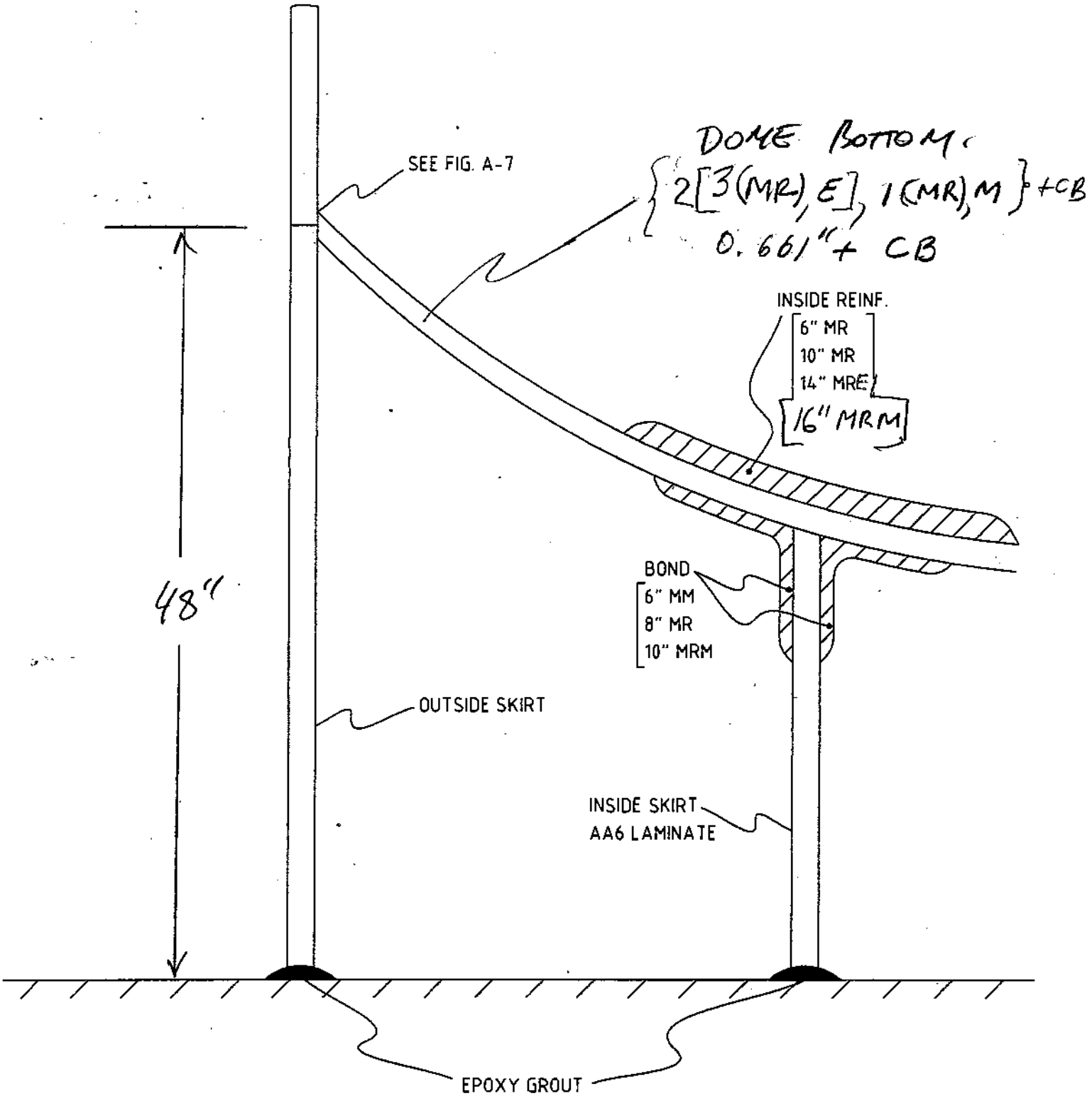
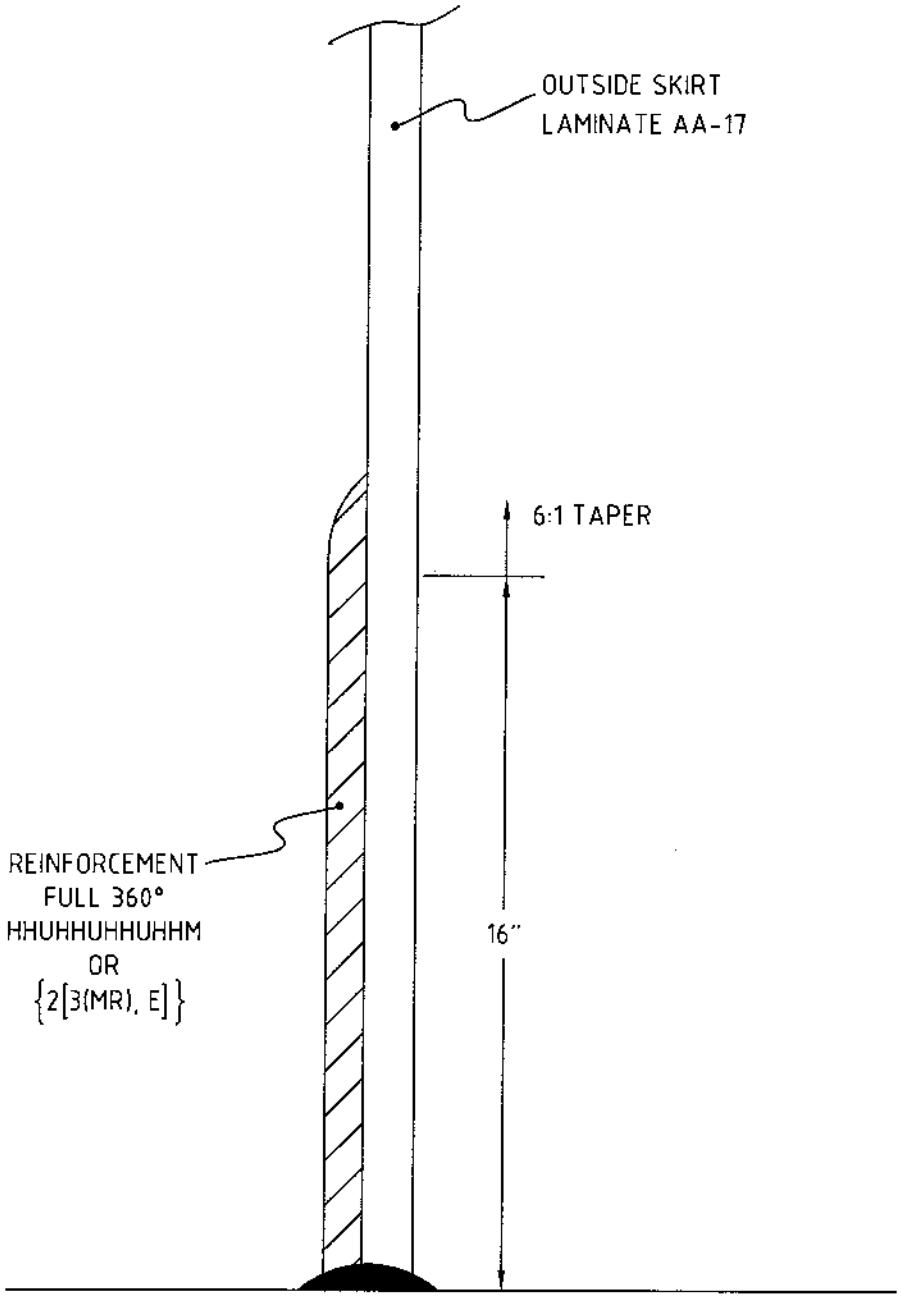


FIG. A-3: INSIDE SKIRT DESIGN

J6, J7 TANK

Phibro Tech 2013-20

FIG. A-4: REINFORCEMENT FOR BASE OF SKIRT
(FULL 360°)
J6, J7



H = HOOP WINDING = 0.050 IN.
U = UNI = 0.020 IN.
M = 1-1/2 OZ. MAT E = EXOTHERM = 1-1/2 OZ. MAT
R = 24 OZ. WOVEN ROVING

TYPE B LUG DESIGN 4,000 - 12,000 LBS.

A-18

CAPACITY OF LUG AS SHOWN IN FIG. BELOW IS 4,000 - 12,000 LBS.

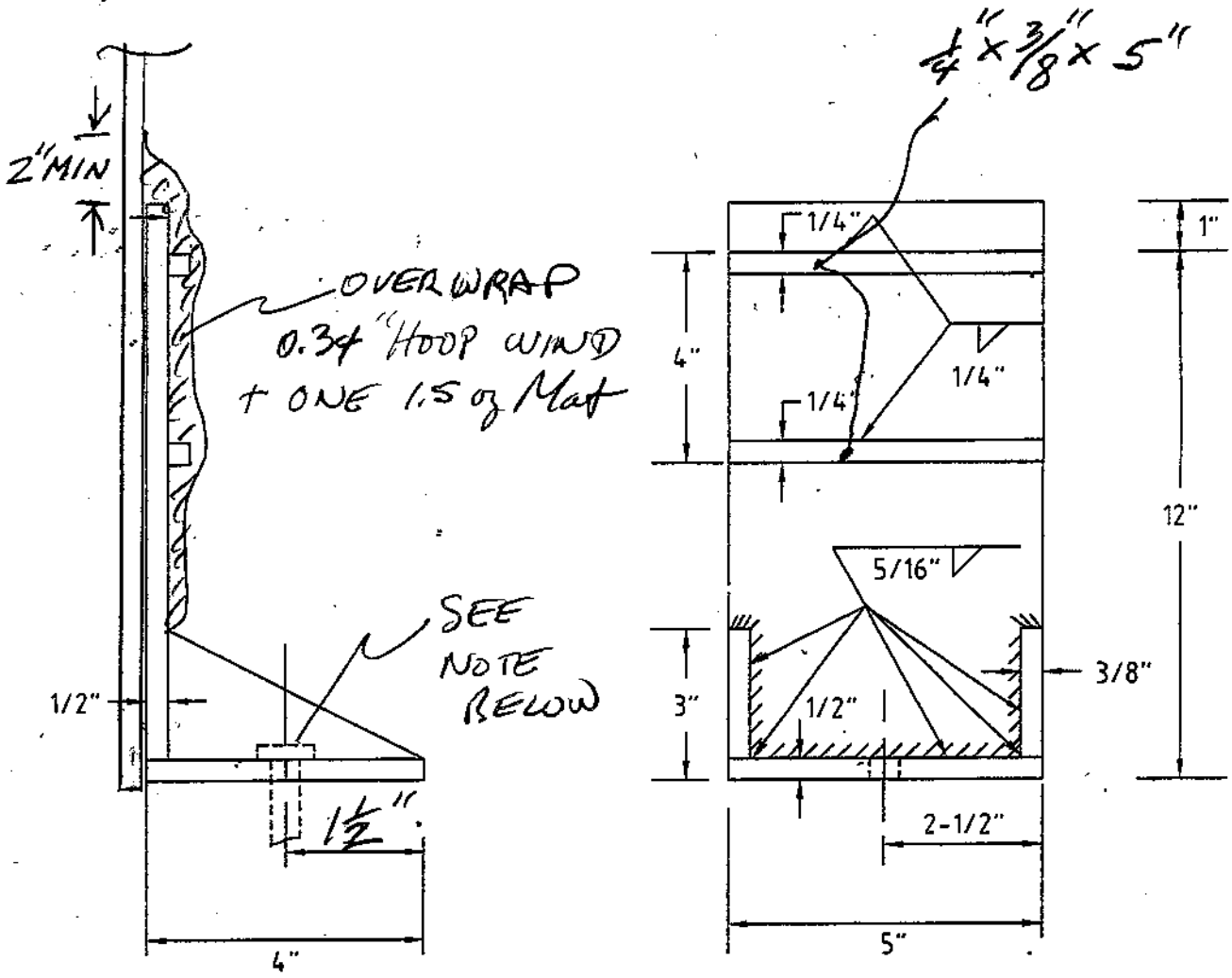


FIG. A-5: LUG TYPE B

This lug is designed to develop plastic moment at top of stiffener with the remaining moment taken into tank wall.

Note: FOR ANCHOR BOLT FORCES ON PAGE A-14, 1" Ø ANCHOR BOLTS WILL PROBABLY BE REQD. DRILL HOLES IN LUG 1¼" Ø. FINAL ANCHOR BOLT DESIGN BY FOOTING ENGR.

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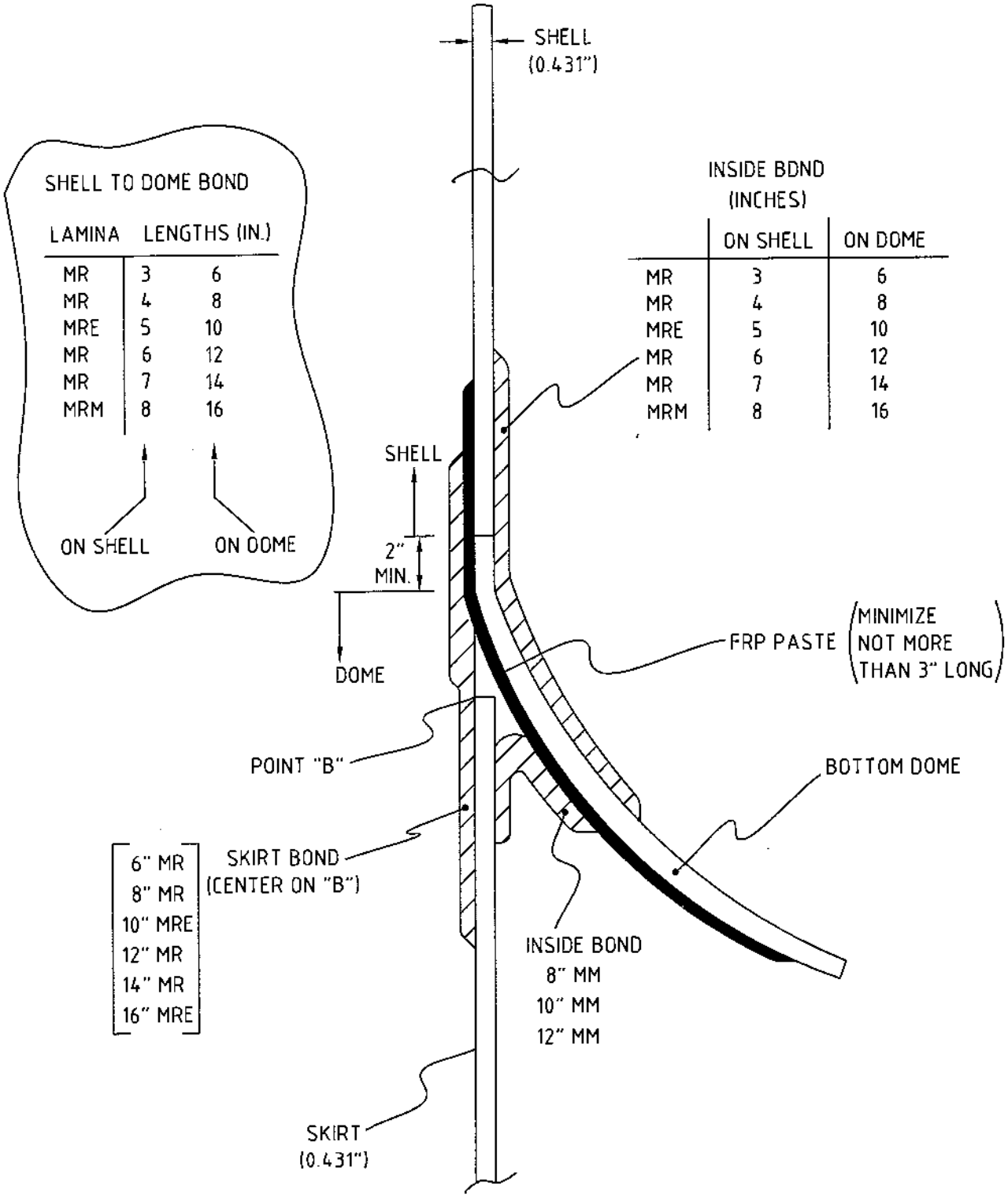
FIG. A-6: SHELL TO BOTTOM DOME BONDS (J6, J7)

NOTE: FINAL DESIGN FOR THIS BOND WILL DEPEND ON FABRICATOR CHOSEN.



M = 1-1/2 OZ. MAT E = EXOTHERM = 1-1/2 OZ. MAT

C = 7 OZ. CLOTH

R = 24 OZ. WOVEN ROVING

ULTRA FIBER
C.S.U.L.B. S.C.L.
Laminate Model

DATE: 07-30-1993 TIME: 09:40:54
PAGE: 1

File Name :AA17 LAMINATE AA17

Material Properties for Laminate Model in L-T Coordinates (psi)

El(Times E6)	Et(Times E6)	G(Times E6)	Poisson Ratio
5.7000	0.8000	0.2800	0.2800
1.0000	1.0000	0.4000	0.2500

Data for each Lamina (Theta(θ) measured clockwise from +Y axis)

Lamina#	Material #	Theta(θ) (deg)	Thickness (in.)	Graphical Layup
1	2	LINER	0.0800	
2	1	70	0.0210	<><><>
3	1	0	0.0200	
4	1	0	0.0200	
5	1	-70	0.0210	<><><>
6	1	70	0.0210	<><><>
7	1	0	0.0200	
8	1	-70	0.0210	<><><>
9	1	90	0.0210	======
10	1	90	0.0210	======
11	1	90	0.0210	======
12	1	-70	0.0210	<><><>
13	1	0	0.0200	
14	1	70	0.0210	<><><>
15	1	-70	0.0210	<><><>
16	1	0	0.0200	
17	1	0	0.0200	
18	1	70	0.0210	<><><>

	CORROSSION LINER HAS	1 LAYERS WITH	0.080	in. THICKNESS
<><><>	HELIX WINDING CONSISTS OF	8 LAYERS WITH	0.168	in. THICKNESS
	CHOPPED LAMINA CONSISTS OF	0 LAYERS WITH	0.000	in. THICKNESS
======	CERT WINDING CONSISTS OF	3 LAYERS WITH	0.063	in. THICKNESS
	UNI WINDING CONSISTS OF	6 LAYERS WITH	0.120	in. THICKNESS

The Total Thickness of the Composite Construction = 0.431 inches

LAMINATE PROPERTIES

Helical winding at 70° shall have a minimum glass content by weight of 62% and maximum glass content by weight of 68%. The uni-directionals or unis (0°) shall be placed along the longitudinal axis of the shell with minimum glass content by weight of 60% and maximum glass content by weight of 68%. The liner or corrosion barrier shall meet the requirements set forth in ASTM D3299 and ASTM D4097. The minimum glass content for the two mats which form the liner shall be as specified in ASTM D3299.

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ULTRA FIBER

C.S.U.L.B. S.C.L.

LAMINATE MATRIX DATA

Units are in in. lbs.

DATE: 07-30-1993 TIME: 09:40:59

PAGE: 2

File Name :AA17 LAMINATE AA17

Force-Moment Total Matrix (Times E6)

1.329628	0.187587	0.000000	0.034796	0.002906	0.000000
0.187587	0.974412	0.000000	0.002906	0.020587	0.000000
0.000000	0.000000	0.217035	0.000000	0.000000	0.001785
0.034796	0.002906	0.000000	0.015274	0.002767	0.001277
0.002906	0.020587	0.000000	0.002767	0.015139	0.000163
0.000000	0.000000	0.001785	0.001277	0.000163	0.003324

Inverse Force-Moment Total Matrix (Times E-6)

0.826100	-0.161900	-0.006100	-1.989000	0.417000	0.746800
-0.161900	1.088400	0.000800	0.446900	-1.529600	-0.096900
-0.006100	0.000800	4.628700	0.231700	-0.014400	-2.574700
-1.989000	0.446900	0.231700	74.730800	-13.578100	-28.162200
0.417000	-1.529600	-0.014400	-13.578100	70.514900	1.755000
0.746800	-0.096900	-2.574700	-28.162200	1.755000	312.986200

A Elasticity Matix (Times E6)

3.08498	0.43524	0.00000
0.43524	2.26082	0.00000
0.00000	0.00000	0.50356

AInv Elasticity Matrix (Times E-6)

0.33320	-0.06415	0.00000
-0.06415	0.45467	0.00000
0.00000	0.00000	1.98585

B Elasticity Matix (Times E6)

0.08073	0.00674	0.00000
0.00674	0.04777	0.00000
0.00000	0.00000	0.00414

BInv Elasticity Matrix (Times E-6)

12.53434	-1.76940	0.00000
-1.76940	21.18518	0.00000
0.00000	0.00000	241.40040

D Elasticity Matix (Times E6)

0.03544	0.00642	0.00296
0.00642	0.03513	0.00038
0.00296	0.00038	0.00771

DInv Elasticity Matrix (Times E-6)

30.13910	-5.38546	-11.31214
-5.38546	29.44611	0.62033
-11.31214	0.62033	133.99045

4A

B-3

C.S.U.L.B. ULTRA FIBER S.C.L.
Laminate Model

DATE: 07-29-1993

TIME: 12:18:59
PAGE: 1

File Name :LMAA6

LAMINATE AA-6

Material Properties for Laminate Model in L-T Coordinates (psi)

El(Times E6)	Et(Times E6)	G(Times E6)	Poisson Ratio
5.7000	0.8000	0.2800	0.2800
1.0000	1.0000	0.4000	0.2500

Data for each Lamina (Theta(θ) measured clockwise from +Y axis)

Lamina#	Material #	Theta(θ) (deg)	Thickness (in.)	Graphical Layup
1	2	LINER	0.0800	
2	1	70	0.0210	<><><>
3	1	0	0.0200	|||||||
4	1	-70	0.0210	<><><>
5	1	70	0.0210	<><><>
6	1	-70	0.0210	<><><>
7	1	-70	0.0210	<><><>
8	1	70	0.0210	<><><>
9	1	-70	0.0210	<><><>
10	1	0	0.0200	|||||||
11	1	70	0.0210	<><><>

	CORROSSION LINER HAS	1 LAYERS WITH	0.080	in. THICKNESS
<><><>	HELIX WINDING CONSISTS OF	8 LAYERS WITH	0.168	in. THICKNESS
	CHOPPED LAMINA CONSISTS OF	0 LAYERS WITH	0.000	in. THICKNESS
=======	CERT WINDING CONSISTS OF	0 LAYERS WITH	0.000	in. THICKNESS
|||||||	UNI WINDING CONSISTS OF	2 LAYERS WITH	0.040	in. THICKNESS

The Total Thickness of the Composite Construction = 0.288 inches

B-4

ULTRA FIBER

C.S.U.L.B. S.C.L.

LAMINATE MATRIX DATA

Units are in in. lbs.

DATE: 07-29-1993 TIME: 12:19:03

PAGE: 2

File Name :LMAA6 LAMINATE AA-6

Force-Moment Total Matrix (Times E6)

0.901821	0.155199	0.000000	0.023785	0.003136	0.000000
0.155199	0.462377	0.000000	0.003136	0.006207	0.000000
0.000000	0.000000	0.176995	0.000000	0.000000	0.002472
0.023785	0.003136	0.000000	0.004947	0.000903	0.000407
0.003136	0.006207	0.000000	0.000903	0.003275	0.000052
0.000000	0.000000	0.002472	0.000407	0.000052	0.001082

Inverse Force-Moment Total Matrix (Times E-6)

1.354100	-0.426800	-0.035400	-6.688200	1.315400	2.535300
-0.426800	2.356100	0.004500	1.394300	-4.436100	-0.321300
-0.035400	0.004500	5.843300	1.329100	-0.120500	-13.847900
-6.688200	1.394300	1.329100	252.989200	-64.453500	-95.168700
1.315400	-4.436100	-0.120500	-64.453500	330.130900	8.625300
2.535300	-0.321300	-13.847900	-95.168700	8.625300	991.582700

A Elasticity Matix (Times E6)

Ex 3.13132	0.53889	0.00000
0.53889	1.60548 Ey	0.00000
0.00000	0.00000	0.61457

AInv Elasticity Matrix (Times E-6)

0.33893	-0.11376	0.00000
-0.11376	0.66105	0.00000
0.00000	0.00000	1.62716

B Elasticity Matix (Times E6)

0.08259	0.01089	0.00000
0.01089	0.02155	0.00000
0.00000	0.00000	0.00858

BInv Elasticity Matrix (Times E-6)

12.97270	-6.55410	0.00000
-6.55410	49.70976	0.00000
0.00000	0.00000	116.51355

D Elasticity Matix (Times E6)

0.01718	0.00313	0.00141
0.00313	0.01137	0.00018
0.00141	0.00018	0.00376

DInv Elasticity Matrix (Times E-6)

63.21572	-17.05811	-22.97543
-17.05811	92.61262	1.95726
-22.97543	1.95726	274.81830

POSSIBLE CHEMICAL ENVIRONMENT IN THE TANK & THE CHEMICAL RESISTANCE OF RESINS TO THESE CHEMICALS (FOR CORROSION BARRIER)

This chapter provides corrosion resistance data for resins that could be used to fabricate the corrosion barrier of Tanks J-5, J-6, and J-7. Two bisphenol-A epoxy vinyl ester resins were considered: Derakane 411 by Ashland and Vipel F010 by AOC. The general composition of the waste streams was provided by Phibro-Tech. Note that in most cases, specific chemicals were not listed in the waste stream descriptions. Consequently, the chemical content of the waste streams was inferred. Also, the concentrations of the chemicals were not precisely specified.

Table B-1 displays the possible chemical environment in the tanks, the designated waste stream, and the resin manufacturer's recommended maximum exposure temperature for various concentrations of each chemical. *Derakane 411 is compatible with the contents of these tanks up to 150°F.* Vipel F010 has lower resistance than Derakane 411 to solutions of sodium carbonate and sodium hydroxide. Phibro-Tech intends to use 12% sodium carbonate in these "J" Tanks.

Recommendation:

Derakane 411 is recommended for the fabrication of the corrosion barrier of Tanks J-5, J-6, and J-7. In addition based on the recommendations of Ashland (see Notes at bottom of table), it is proposed that a double surfacing veil is used along with post-curing the laminates. The maximum operating temperature of these tanks should not exceed 150°F. The concentration of nitric acid in these tanks should not exceed 10%.

TABLE B-1
Corrosion resistance data for the bisphenol-A vinyl ester resins, Derakane 411 and Vipel F010, exposed to chemicals in Tanks J-5, J-6, and J-7

Possible Chemical Environment in Tanks J-5, J-6, and J-7	Waste Stream Designation	Concentration (%) [Δ]	Resin Manufacturer's Recommended Max. Exposure Temperature (°F)	
			Ashland Derakane 411	*AOC Vipel F010*
Ammonium Chloride	K [?]	All	210	200
Ammonium Hydroxide	IB [?], K [?]	1 – 5	180 [5]	180 [5]
Copper Chloride	C	All	210	200
Copper Chloride / Ammonium Chloride / Ammonium Hydroxide	K	26 / 5 / 2	See Ammonium Hydroxide	–
Copper Nitrate	E, G	All	210	200
Copper Sulfate	A, B	All	210	200
Ferric Nitrate	F [?]	All	–	200
Hydrochloric Acid	C, IA, L	1 – 20	180 [1,2,3]	180 [2,4]
Nickel Nitrate	E, G	All	210	210
Nitric Acid	E, F, G, IA, L	1 – 10	150	150
Sodium Carbonate	D, IB	10 35	180 [5] 180 [5]	180 [5] 160 [5]
Sodium Hydroxide	D, IB, L	1 5 25	180 [5,6] 180 [5,6] 180 [5,6]	180 [5,6,7] 120 [5,6,7] 150 [5,6,7]
Sodium Chloride	C, K	All	210	210
Sodium Hypochlorite	X	pH>11; Active chlorine <18%	180 [2,6,8]	180 [5,6,8]
Sulfuric Acid	C, IA, L	1 – 25	210	210

NOTES:
See next page

NOTES:

[Δ]: Concentration according to resin manufacturer's corrosion guide.

[?]: It is not known if these chemicals are constituents in the waste streams.

–: No data available

X: Possible chemical used in the future

[1] Double surfacing veil and a 200 mil corrosion barrier should be used.

[2] Double C-veil should be used in the corrosion barrier.

[3] Above 120°F, acid resistant glass should be used in the corrosion barrier and may be used in the structural wall.

[4] Acid resistant glass is recommended in the chopped glass layer behind the veil layer.

[5] Double synthetic veil is recommended.

[6] Post-cure is recommended.

[7] Carbon veil is recommended for improved service life.

[8] Benzoyl peroxide / amine cure system with post-cure is recommended.

References

AOC, LLC, *Corrosion Resistant Resin Guide for Using Corrosion Resistance Vipel Resins*, Collierville, TN: AOC, LLC., February 2012.

Ashland, *DERAKANE Epoxy Vinyl Ester Resins Chemical Resistance Guide: Resin Selection Guide for Corrosion Resistant FRP Applications*, 2011.

CHAPTER C1

C-1

DESIGN OF HOLD-DOWN LUGS FOR 144 in. ϕ X 218 in. HIGH TANK (HOOP WOUND)

P_{app} = Applied pressure over and above hydrostatic pressure

$P_{app} := 0$ psi

S_0= Section modulus of tank

$R_0 := 72$ in.

$t_0 := 0.431$ in.

$S_0 := \pi \cdot R_0^2 \cdot t_0$ $S_0 = 7019.273$ in.^{3} (S_0 = section modulus for t_0 thickness)

F_L = Tension force per lug

SGL = Specific gravity of the liquid $SGL := 1.45$

$D_0 := 2 \cdot R_0$ $D_0 = 144$ in.

H = Height of tank $H := 218$ in.

$Lugs := 12$

SSL = Lug spacing

$SSL := \pi \cdot D_0 \div Lugs$ $SSL = 37.699$ in.

$F_L := 7090$ lb.

W_{MAX} = Unit radial load on overwrap

e = load eccentricity on lug $e := 2.25$ in.

h = height of lug $h := 13$ in.

$W_{MAX} := 3 \cdot F_L \frac{e}{h^2}$ $W_{MAX} = 283.18$ lb. per in.

P = Radial load due to moment

$P := W_{MAX} \cdot \frac{h}{2}$ $\quad P = 1840.673$ lb.

T_{tot} = Hoop overwind load

R_m = Mean radius of overwind $\quad R_m := 72.7$ in.

w = Lug width $\quad w := 5$ in.

$T_{tot} := \frac{P \cdot R_m}{w}$ $\quad T_{tot} = 26763.387$

Try overwrap thickness, t_1 $\quad t_1 := 0.34$ in.

σ_T = Hoop overwind tensile stress

h_1 = Height of wound overwrap, in $\quad h_1 := 10$ in.

$\sigma_T := \frac{T_{tot}}{h_1 \cdot t_1}$ $\quad \sigma_T = 7871.584$ psi $<$ $\frac{40000}{5} = 8000$ psi allowable ok

τ_b = shear across lug bond

$\tau_b := \frac{F_L}{2 \cdot h_1 \cdot t_1}$

$\tau_b = 1042.647 \quad \leq$ 3,000 psi

τ_w = Shear across vessel wall

t_b = Tank bottom thickness $\quad t_b := 0$ in.

t_r = Knuckle reinforcement thickness $\quad t_r := 0.54$ in.

t_k = Total thickness above knuckle radius

$t_k := 0.97$ in.

$\tau_w := \frac{P}{(t_k \cdot w)}$ $\quad \tau_w = 379.52$ psi $<$ $\frac{3000}{2} = 1500$ psi allowable ok

β = Coefficient of bending in the vessel wall

$\beta := \frac{1.28}{(R_m \cdot t_k)^{\frac{1}{2}}}$ $\quad \beta = 0.152$ in.$^{-1}$

P* = Unit radial loading

$P^* := \frac{P}{w}$ $\quad P^* = 368.135$ lb. per in.

Axial and hoop bending loads

$M_{ax} := \frac{P^*}{4 \cdot \beta}$ $\quad M_{ax} = 603.795$ in.-lb. per in.

$p := H \cdot 0.0361 \cdot SGL + P_{app}$ $\quad p = 11.411$ psi

ν = Poisson Ratio

$\nu := 0.3$

$M_{hp} := \nu \cdot M_{ax}$ $\quad M_{hp} = 181.139$ in.-lb. per in.

Axial load due to pressure

$N_{ax} := \frac{(P_{app} \cdot R_m)}{2}$ $\quad N_{ax} = 0$ lb. per in.

Hoop load due to pressure

$N_{hp} := p \cdot R_m$ $\quad N_{hp} = 829.595$ lb. per in.

Axial stress

$\sigma_{ax} := \frac{N_{ax}}{t_k} + \frac{(6 \cdot M_{ax})}{t_k^2}$ $\quad \sigma_{ax} = 3850.326$ psi $\leq$ 4,000 psi OK

Hoop stress

$\sigma_{hp} := \frac{N_{hp}}{t_k} + \frac{(6 \cdot M_{hp})}{t_k^2}$ $\quad \sigma_{hp} = 2010.35$ psi $\leq$ 4,000 psi OK

ATTACHMENT 7 – CERTIFICATION REPORT CS-1 EX (TI&CS REPORT NO. 15-10-24)

TESTING, INSPECTION & CERTIFICATION SERVICES
www.frpengineer.com

CLIENT: Phibro Tech
Santa Fe Springs, CA

TI&CS Report Number: 15-10-24

Report Title: Calculation of Allowable Volume for Storage of 55 Gallon Drums and/or Totes in Containment Area ERS-1 Which has Been Relabeled as CS-1 Due to Proposed Expansion

Author(s): Joseph M. Plecnik Jr., BSCE
Christine Bosque, Ph.D.
Joseph M. Plecnik, Ph.D., P.E.
TI&CS
3562 Cerritos Ave.
Los Alamitos, CA 90720
(562) 900-3118

Date of Issue: October 21, 2015

NOTES:

CHAPTER A: INTRODUCTION AND SUMMARY

This report provides allowable containment volume in terms of the number of drums for expansion of ERS-1 containment area at the Phibro Tech facility in Santa Fe Springs, CA. This containment area is relabeled as CS-1. Fig. A-1 provides plan view of total containment area which consists of the existing or old containment area and the incorporation of new area adjacent to the existing containment area. This area will contain drums located on wooden pallets and/or 300 gallon totes. However, the calculations provided in Chapter B provide the total number of allowable drums of 55 gallon capacity. The total allowable storage volume is also included on page B-3 in cubic inches.

The area in Fig. A-1 was surveyed by TI&CS including planar dimensions as well as elevations. The results of this evaluation are summarized in Chapter B in terms of areas and/or containment volumes for both the old or existing area, as well as the proposed addition labeled as the new area. The calculations are summarized in Chapter B. The allowable storage volume is based on 10% of the net volume that may be stored in the combined new and old existing areas.

SUMMARY OF RESULTS

On page B-3, the total allowable volume for storage purposes is 46.17×10^6 in.^{3} which equals 199,780 gallons. This volume translates into 3,634 drums each with a capacity of 55 gallons.

A-2

III) Total Capacity for Combined Existing and New Areas for CS-1

$N_{EXT} = 2240$ drums

$N_{NEW} = 1394$ drums

Total Number of Drums Allowed in CS-1

$N_{EXT} + N_{NEW} = 3634$ drums

Allowable Storage Capacity in Cubic Inches

$V_{EXT} := N_{EXT} \cdot 231 \cdot 55$

$V_{EXT} = 28.46 \times 10^6$ in.^{3}

$V_{ENEW} := N_{NEW} \cdot 231 \cdot 55$

$V_{ENEW} = 17.71 \times 10^6$ in.^{3}

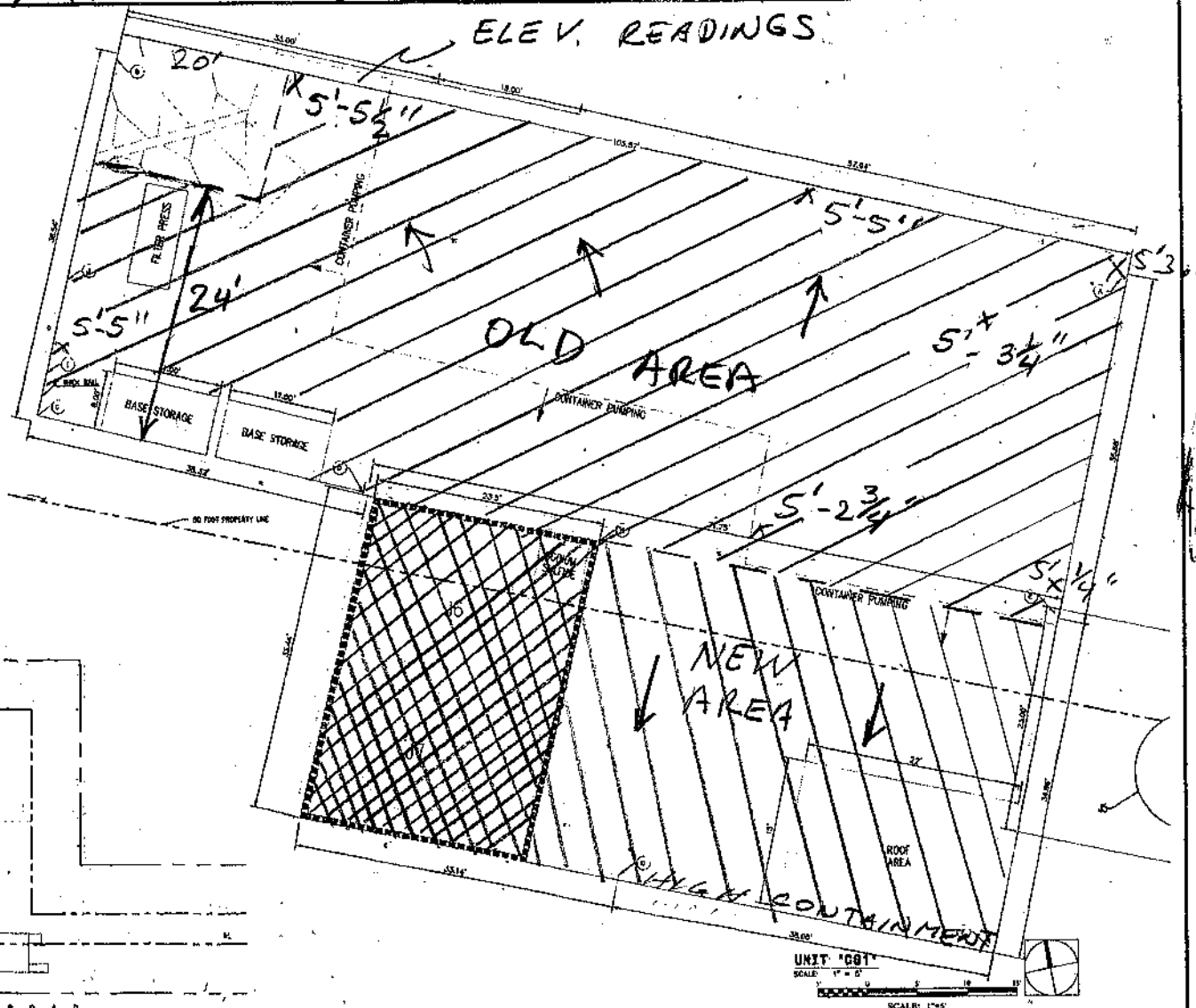
Total Allowabel Volume in Cubic Inches

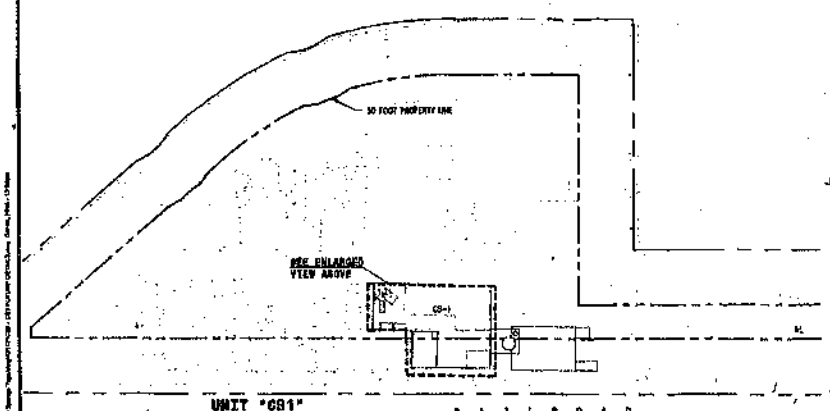
$V_{EXT} + V_{ENEW} = 46.17 \times 10^6$ in.^{3} $= \frac{46.17 \cdot 10^6}{1728} = 26718.75$ ft.^{3}

FIG. A-1: PLAN VIEW OF CS-1 CONTAINMENT

LOCATION	CONTAINMENT HEIGHT
A	11"
B	10"
C	11"
D	10"
E	10"
F	10"
G	10"
H	10"
I	11"
J	29"

Ref.	Item	value	Comments
	Non-Used Containment Volume		
A.	Volume of Largest Tank (Gal)	6,500.00	
B.	10% of Total Tank Volume (gal)	880.00	
C.	Required Containment Volume (Gal)	880.00	
D.	Required Containment Volume (ft^3)	117.65	
	Available Containment Volume		
E.	Containment Area (ft^2)	3,100.00	Inner Line
F.	Berm Height (ft.)	10.00	Average height
G.	Gross Volume Total (ft^3)	4,675.00	Area (E) x Height (F)/12
H.	Volume Relief (ft^3)	3,000.35	Related at 25 yr. Mike rain & Elevation
I.	Footprint of other Tank Shells (ft^2)	-	Subtract out footprint of tanks
K.	Volume of other Tank Shells (ft^3)	-	Volume of other shells (area of each tank x (gross height - pad height))
L.	Volume of Pads (ft^3)		
M.	Available Containment Volume (ft^3)	3,557.75	Basic Vol. (G) - Relief Vol. (H) - Shells (I) - Pad (L)
N.	Invert Volume Assessment	Yes	If Line 1 Min. > Line 1 (C)





KEY MAP
SCALE: 1" = 50'
SCALE: 1"=50'

NO.	DATE	REVISION DESCRIPTION	APP'D	DATE

PLUMP ENGINEERING INC.
CONSULTING ENGINEERS IN CIVIL/STRUCTURAL ENGINEERING & SURVEYING
10/2/2015
DATE

CS1-FUTURE DETAILS

PHIBRO-TECH INC. **PHIBRO-TECH**
8851 DICE ROAD, SANTA FE SPRINGS, CALIFORNIA 90670
(562) 946-8030

JOB NO. 131131.CS
DATE 10/2/2015
SHEET C20
20 OF 35 SHEETS

A-3

CHAPTER B: SUMMARY OF CONTAINMENT VOLUMES

I) Existing Containment Area:

Area of Existing Containment Area = A_{EX}

(Calculated from measurements and Auto Cad data.)

$A_{EX} := 564260$ in.^{2} (NO RAMP)

Gross volume of Existing Containment Area = V_{EXG}

Volume of sloped area = 829,440 in.^{3}

Volume of Area with 10" High Wall = 5,642,000 in.^{3}

V_{EXG} = Gross Volume

$V_{EXG} := 829440 + 5642600$

$V_{EXG} = 6472040$ in.^{3}

Volume of Rain in Existing Area from 25 year 24 hour event = V_{EXR}

Rain Amount = 4.5 in.

$AA_{EX} := 590018$ in.^{2} (WITH RAMP)

$V_{EXR} := AA_{EX} \cdot 4.5$

$V_{EXR} = 2655081$ in.^{3}

Take away volume of pallets: (15% of gross) = V_{EX15}

$V_{EX15} := 0.85 \cdot (V_{EXG})$

$V_{EX15} = 5501234$ in.^{3}

Take away volume of rain = V_{EXNET}

$V_{EXNET} := V_{EX15} - V_{EXR}$

$V_{EXNET} = 2846153$ in.^{3}

Area has to contain 10% of stored volume.

$(0.1) \cdot (V_{STORCAP}) \leq V_{EXNET}$

$$V_{STORCAP} \leq \frac{V_{EXNET}}{0.1} = 28.5 \times 10^6 \text{ in.}^3$$

$$V_{STORCAP} \leq \frac{V_{EXNET} \div 0.1}{231} = 123210.087 \text{ gal.}$$

For 55 gallon drums,

Number of Allowable Drums in Existing Area = $N_{EXT} := 2240$ drums

B-2

II) New Containment Area:

Area of New Area = A_N

$A_N := 389641$ in.^{2}

Covered Area = 47,355 in.^{2} (No Rain)

Gross Volume of New Containment Area = V_{NG}

(Assuming a 10 in. high wall.)

$V_{NG} := 3896410$ in.^{3}

Volume of Rain in New Area from 25 year 24 hour (4.5 in.) event = V_{NR}

(Exclude covered area.)

$V_{NR} := (389641 - 47355) \cdot 4.5$

$V_{NR} = 1540287$ in.^{3}

Take away volume of pallets: (15% of gross) = V_{N15}

$V_{N15} := 0.85 \cdot (V_{NG})$

$V_{N15} = 3311948.5$ in.^{3}

Take away volume of rain = V_{NNET}

$V_{NNET} := V_{N15} - V_{NR}$

$V_{NNET} = 1771661.5$ in.^{3}

Area has to contain 10% of stored volume.

$(0.1) \cdot (NEWV_{STORCAP}) \leq V_{NNET}$

$NEWV_{STORCAP} \leq \frac{V_{NNET}}{0.1} = 17.7 \times 10^6$ in.^{3}

$NEWV_{STORCAP} \leq \frac{V_{NNET} \div 0.1}{231} = 76695.303$ gal.

For 55 gallon drums,

Number of Allowable Drums in New Area = $N_{NEW} := 1394$ drums

ATTACHMENT 8 – CERTIFICATION REPORT CS-2 EX (TI&CS REPORT NO. 15-10-9)

TESTING, INSPECTION & CERTIFICATION SERVICES
www.frpengineer.com

CLIENT: Phibro Tech
Santa Fe Springs, CA

TI&CS Report Number: 15-10-9

Report Title: Design of Containment Area and Allowable Containment Volume for Containment Area CS-2 Located at the Phibro Tech Facility in Santa Fe Springs, CA

Author(s): Joseph M. Plecnik Jr., BSCE
Christine Bosque, Ph.D.
Joseph M. Plecnik, Ph.D., P.E.
TI&CS
3562 Cerritos Ave.
Los Alamitos, CA 90720
(562) 900-3118

REGISTERED PROFESSIONAL ENGINEER
JOSEPH M. PLECNIK
No. C26354
3/2016
CIVIL
STATE OF CALIFORNIA

Date of Issue: October 5, 2015

NOTES:

CHAPTER A: INTRODUCTION AND SUMMARY

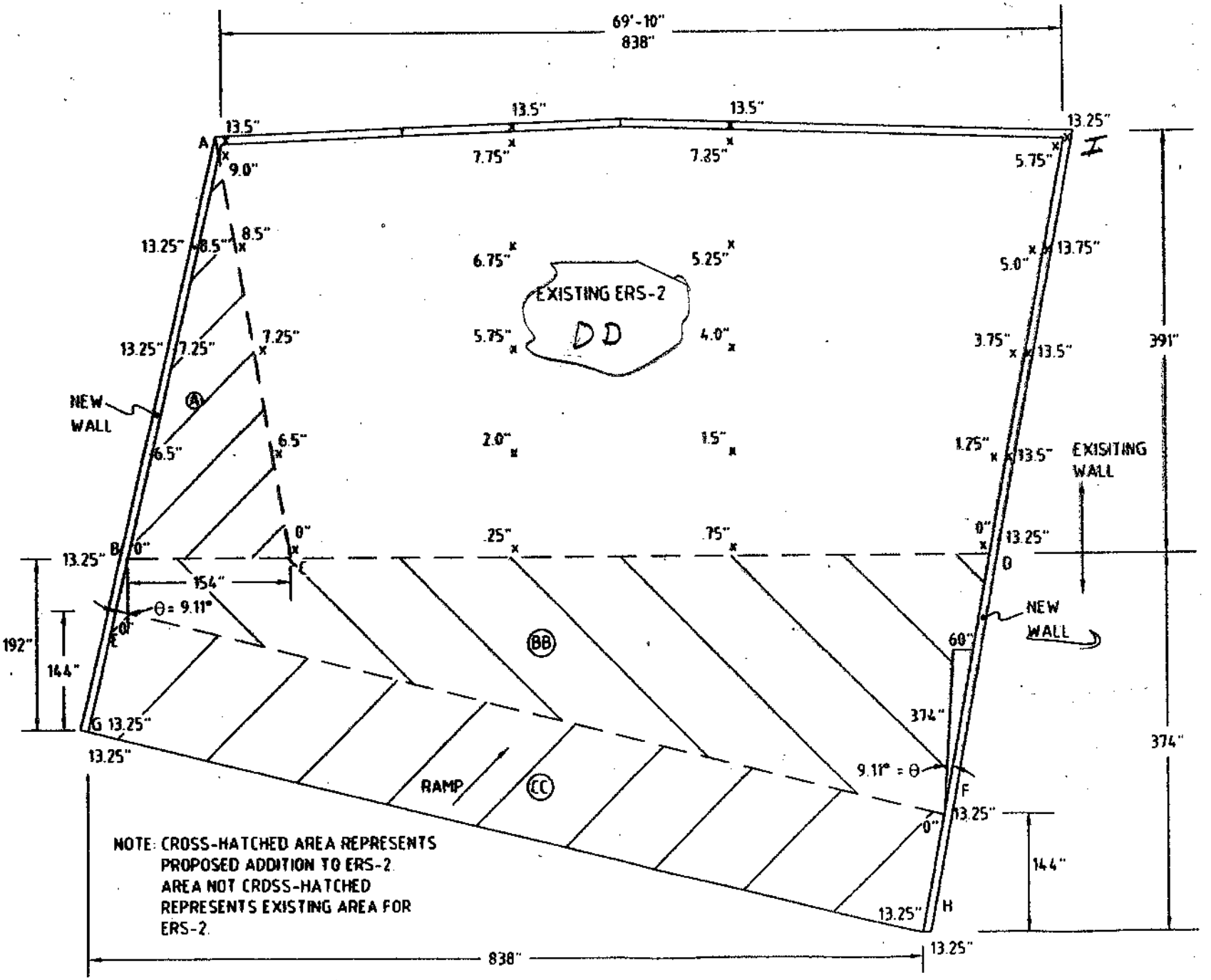
This report provides allowable containment volume for containment area CS-2 located on the North side of the Phibro Tech plant. The plan view is provided in Fig. **A**-1 for the containment area, as well as the ramps leading into the containment area. The containment calculations are provided in Chapter B, assuming 300 gallon totes are being stored on top of the shown containment area. The allowance for rain is 4.5 inches over the entire containment area. The gross containment volume is reduced by 15% due to the displacement of the tote supporting structure.

FINAL ALLOWABLE STORAGE

The total number of 300 gallon totes allowed in this containment area is 278 as shown on page B-3.

Phibro Tech 2015-10

FIG. A-1: PROPOSED EXPANSION OF ERS-2 (ENTIRE AREA LABEL = CS-2)



NOTE: CROSS-HATCHED AREA REPRESENTS PROPOSED ADDITION TO ERS-2. AREA NOT CROSS-HATCHED REPRESENTS EXISTING AREA FOR ERS-2.

A-2

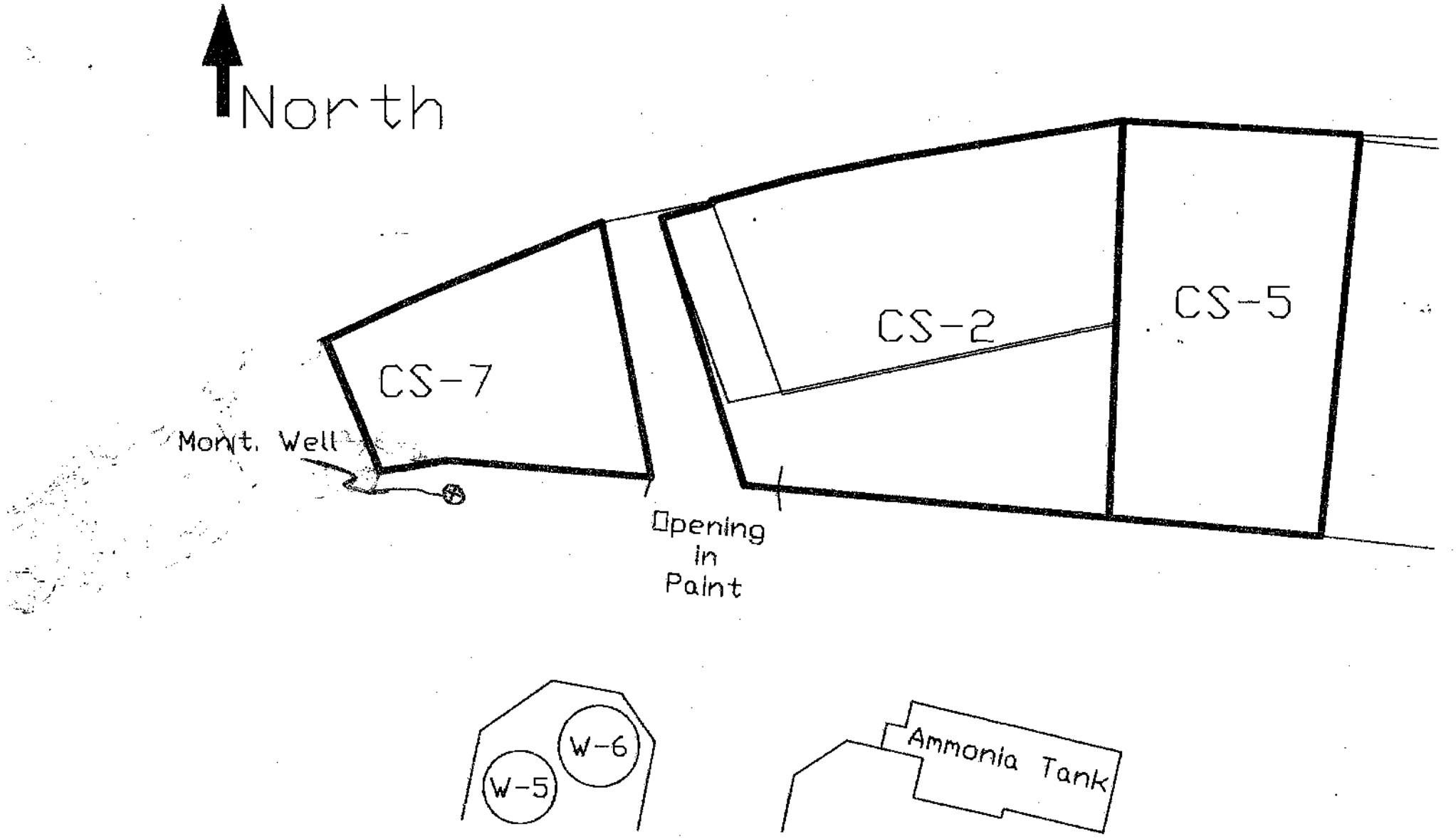


FIG. A-2.

Overview of Northern Containment Areas
(Not to Scale)

CHAPTER B: CONTAINMENT CALCULATION FOR CS-2

I) CALCULATION OF ORIGINAL CONTAINMENT VOLUME, See Area DD in Fig. A-1

Total Containment Area = 318608 in.^{2} (See TI&CS Report 14-3-21)

Mean Elevation = 4.75 in., See Fig. B-1
(from statistical analysis of elevations)

Depth of Containment = Lowest Wall Height - Mean Elevation

$$= 13.25 - 4.75 = 8.5 \text{ in.}$$

Total Volume of Containment = Total Area x (Depth)

$$= 318608 \cdot 8.5 = 2708168 \text{ in.}^3$$

Useable Volume Before Rain = 85% of Total Volume (15% reduction for pallets)

$$= 0.85 \cdot 2708168 = 2301943 \text{ in.}^3$$

Net Volume Including Rain = $2301943 - 4.5 \cdot (318608) = 868207$ in.^{3}

$$= \frac{868207}{231} = 3758 \text{ gallons}$$

B-2

II) NET VOLUME CALCS WITH RAINWATER FOR

NEW AREAS A, BB AND CC IN FIG. A-1

Proposed New Area Total Volumes

Area A

$V_A := 308597 \text{ in.}^3$

Area BB

$V_{BB} := 1543385 \text{ in.}^3$

Area CC

$V_{CC} := 827305 \text{ in.}^3$

New Area Total Volume = $308597 + 1543385 + 827305 = 2679287 \text{ in.}^3$

Useable Volume Before Rain = $0.85 \cdot 2679287 = 2277394$

Net Volume Including Rain = $2277394 - 4.5 \cdot (30107 + 116482 + 124870) = 1055802 \text{ in.}^3$

$$= \frac{1055802}{231} = 4571 \text{ gallons}$$

B-3

III) MAX. ALLOWABLE STORED VOLUME

(10% Governs)

Total Net Volume of Containment = $3758 + 4571 = 8329$ gallons

$$V_{STORAGE} := \frac{8329}{0.10}$$

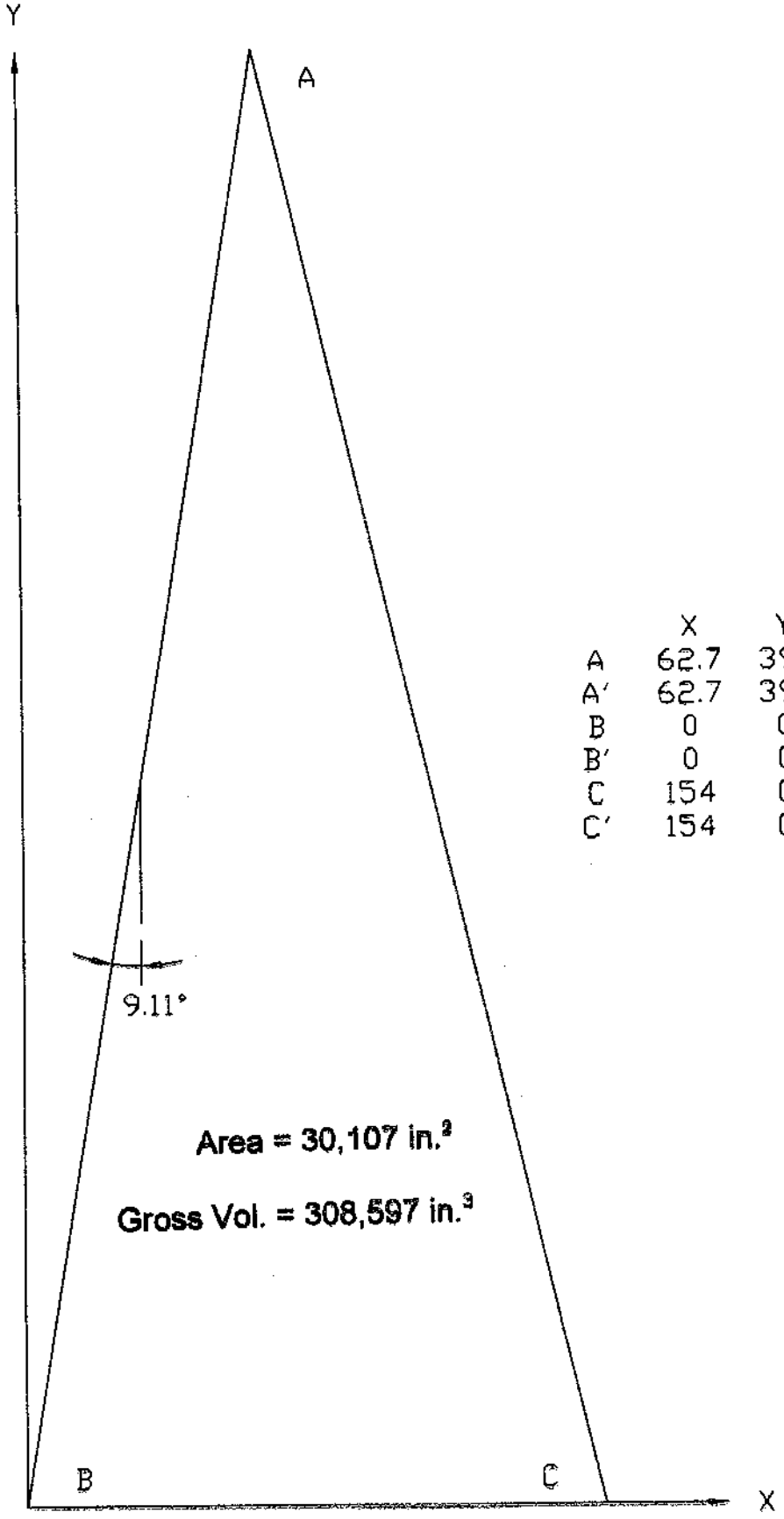
$V_{STORAGE} = 83290$ gallons

At 300 gal. per Tote

No. of Allow. Totes = $\frac{83290}{300} = 277.6$ Totes

Max. number of 300 gallon totes that can be stored in area CS-2 is <u>278</u>.

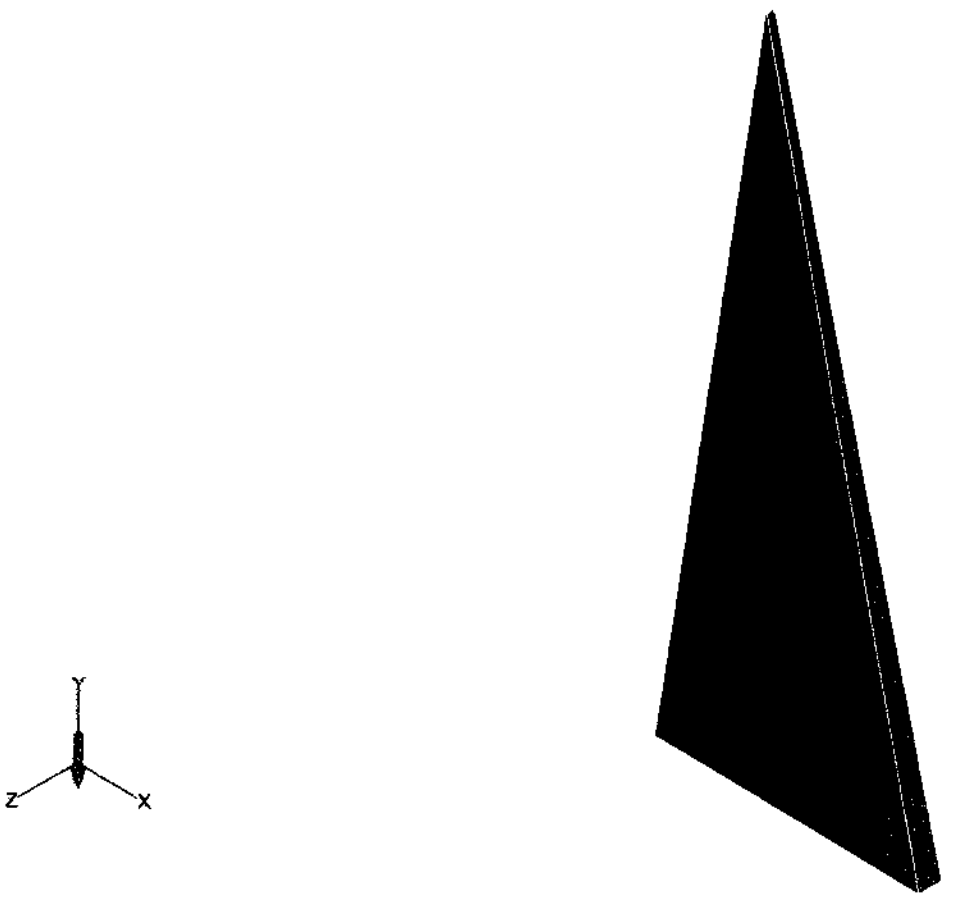
B-4/B-5



	X	Y	Z
A	62.7	391	9.0
A′	62.7	391	13.25
B	0	0	0
B′	0	0	13.25
C	154	0	0
C′	154	0	13.25

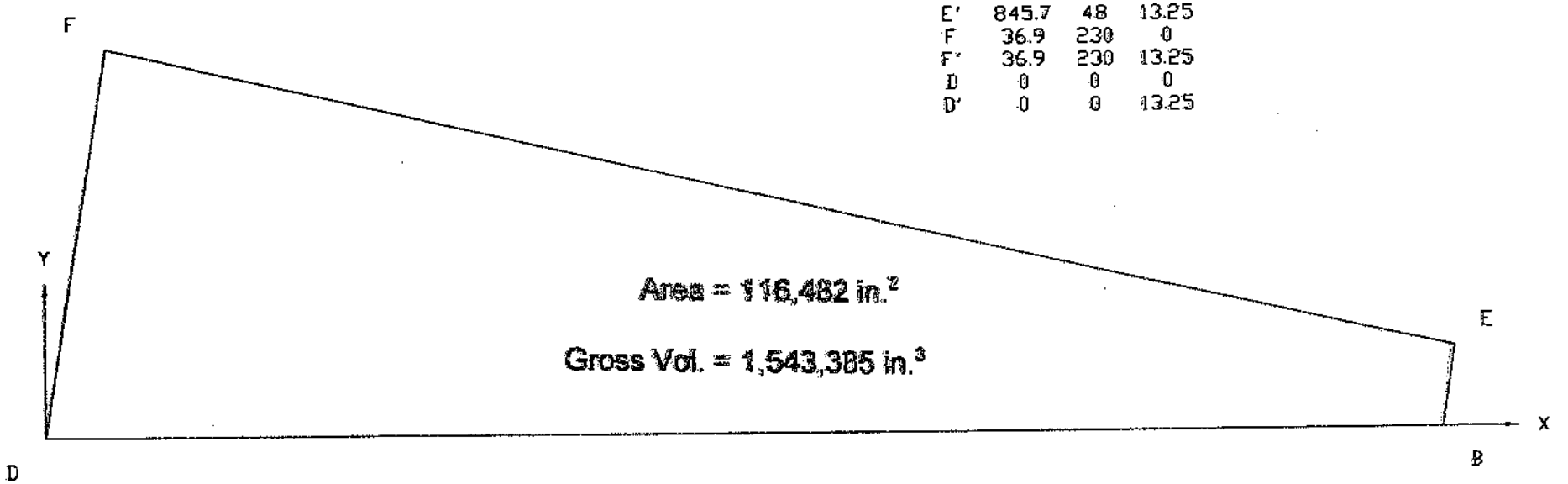
AREA "A"

PHIBROTECH: AREA "A"



B-4

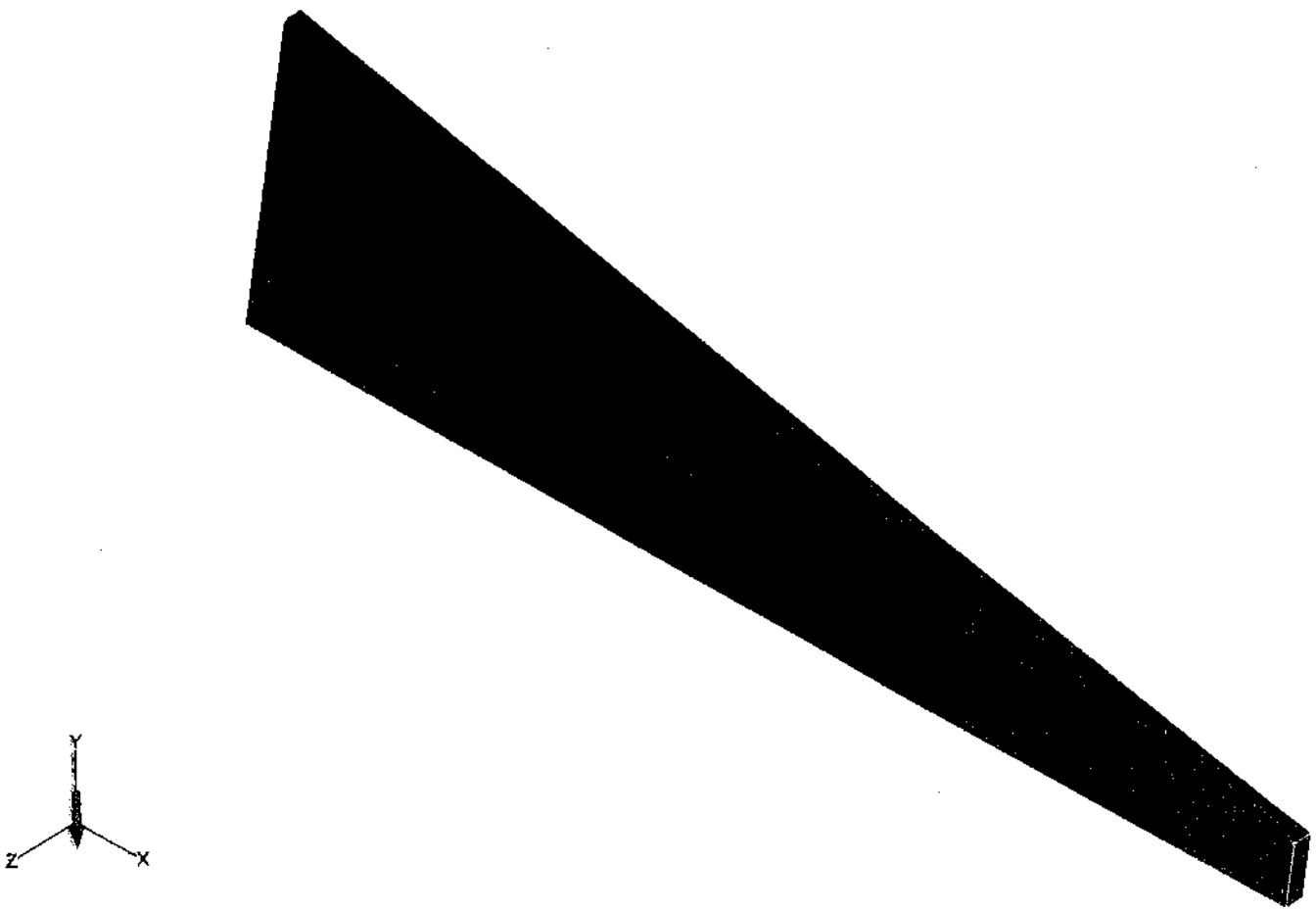
	X	Y	Z
B	838	0	0
B'	838	0	13.25
E	845.7	48	0
E'	845.7	48	13.25
F	36.9	230	0
F'	36.9	230	13.25
D	0	0	0
D'	0	0	13.25



AREA "BB"

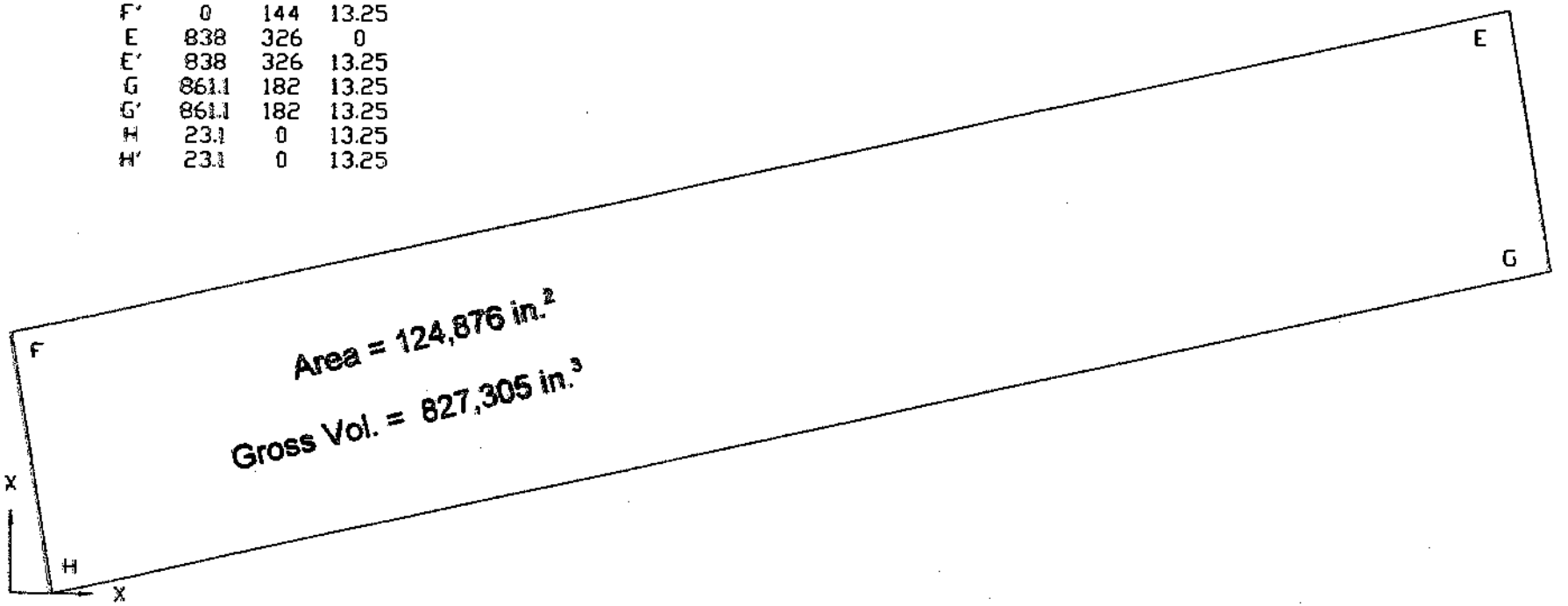
B-7

PHIBROTECH : AREA "BB"



B-8

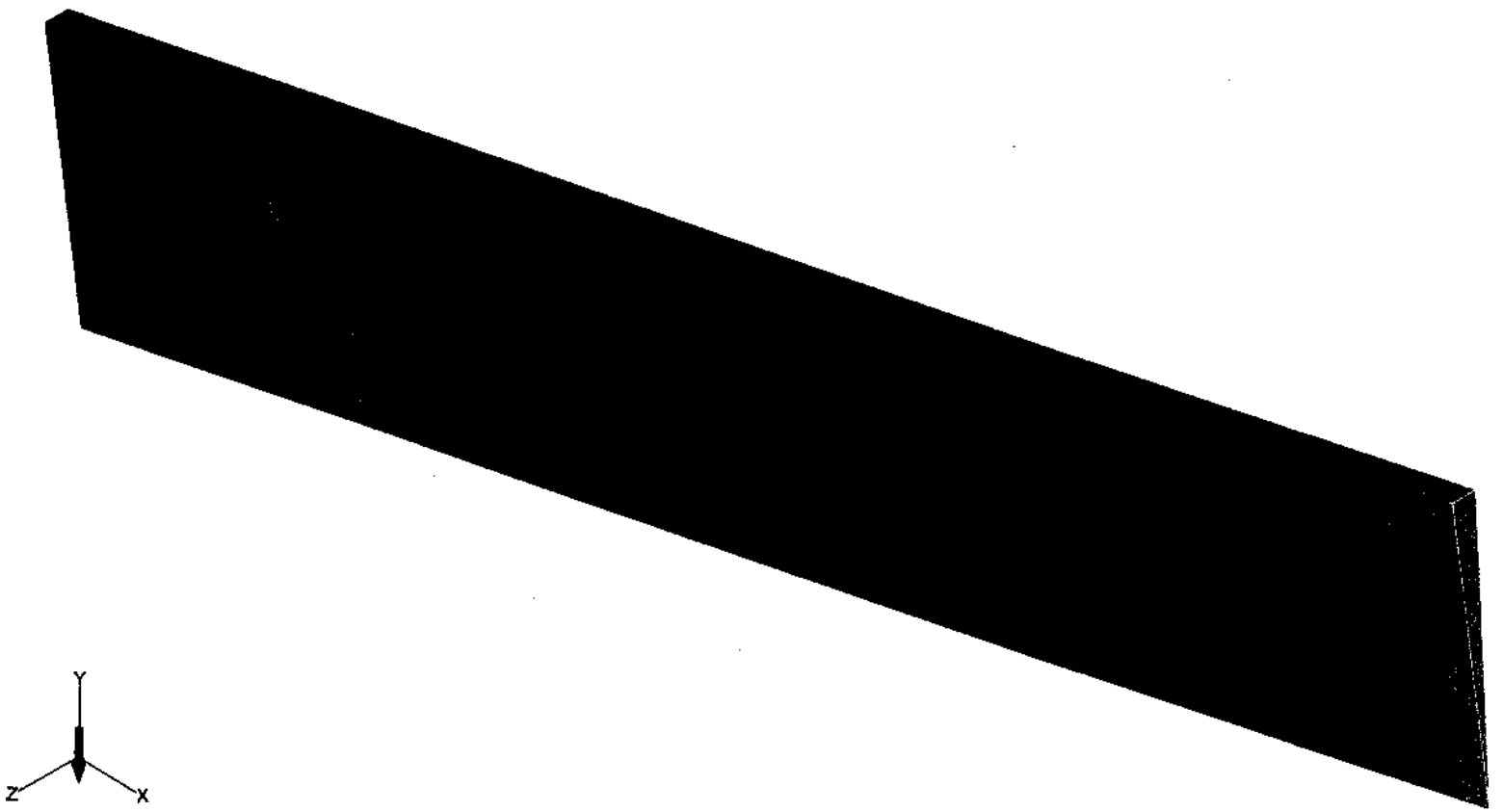
	X	Y	Z
F	0	144	0
F'	0	144	13.25
E	838	326	0
E'	838	326	13.25
G	861.1	182	13.25
G'	861.1	182	13.25
H	23.1	0	13.25
H'	23.1	0	13.25



AREA "CC"

B-9

PHIBROTECH : AREA "CC"



B-10

Phibro-Tech
ERS-2 Containment Area

FIG. B-1: CALCULATION FOR ELEVATIONS IN FIG. A-1. MEAN VALUE USED FOR STORAGE VOLUME CALCULATIONS

Elevation
Statistical Analysis

Elevation
9.00
7.75
7.25
5.75
8.50
6.75
5.25
5.00
7.25
5.75
4.00
3.75
6.50
2.00
1.50
1.25
6.75
0.25
0.75
0.00

Elevation	
Mean	4.75
Standard Error	0.6443
Median	5.50
Mode	7.25
Standard Deviation	2.8814
Sample Variance	8.3026
Kurtosis	-1.2108
Skewness	-0.3678
Range	9.00
Minimum	0.00
Maximum	9.00
Sum	95.00
Count	20
Confidence Level (95.0%)	1.3486

NOTE: See TICS Report 14-3-21 FOR RAW DATA

ATTACHMENT 9 – CLOSURE PROCEDURES FOR NEWLY ADDED EQUIPMENT

PHIBRO-TECH, INC.

CAD 008 488 025

Santa Fe Springs, California TSD Facility

Closure Plan for Class 2 Permit Mod Equipment

December 2015

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1.0 INTRODUCTION

This Closure Plan (Part B Closure Plan) has been prepared on behalf of Phibro-Tech Inc. (PTI) to address the requirements of 22 CCR 66264.110 et seq., and 40 CFR Part 264, Subpart G pertaining to closure of certain equipment at the PTI facility (the Facility) located at 8851 Dice Road, in Santa Fe Springs, California. The Closure Plan describes procedures that the Facility will use when hazardous waste activities cease to occur at this location for equipment added pursuant to a Class 2 Permit Modification request. This Closure Plan provides sufficient detail should third party closure be required.

This Closure Plan is intended to work in conjunction with the Pond 1 Closure Plan and Contingent Post Closure Plan and Closure Cost Estimate which was conditionally approved by DTSC on December 4, 2015 (referred to as Conditionally Approved Pond 1 Closure Plan) and the full facility closure plan included in Volume 2 of the Part B Operating Plan, dated September 2015. Since the equipment covered by the December 2015 Class 2 Permit Modification is also included in the full facility closure plan in the Part B Operating Plan submittal, it is assumed that receipt of a permit revision will supersede the closure procedures provided herein.

This Closure Plan defines the procedures to close the Facility in a manner that: 1) minimizes the need for further maintenance and controls, and 2) minimizes or eliminates to the extent necessary to protect human health and the environment, post-closure release of hazardous constituents, leachate, contaminated rainfall and runoff or hazardous waste decomposition products to the ground, surface waters, or to the atmosphere.

The Closure Plan addresses the present and former hazardous waste storage and treatment units, including hazardous waste generator storage areas that are under the regulatory authority of the California Department of Toxic Substances Control (DTSC).

This Closure Plan outlines the scope of closure, expected date of closure, and tentative schedule. It details the inventory of wastes on site and describes final treatment. It also presents the decontamination and disposal procedures, which will be utilized at closure and provides a closure cost estimate in accordance with the regulations.

This Plan and subsequent revisions will be kept on-site until closure is completed and certified in accordance with 22 CCR 66264.115 (see Section 13).

2.0 FACILITY INFORMATION

This section provides a brief summary on the nature of the Facility described by the Part B Application and a history of previous hazardous waste management practices inventories.

2.1 OWNER/OPERATOR INFORMATION

The pertinent information identifying the Facility is identified below.

Facility Name(s):	Phibro-Tech, Inc. (effective 1/1/94)
EPA ID Number:	CAD008488025
Facility Physical Address:	8851 Dice Road, Santa Fe Springs, California 90670
Contact Person:	Mr. David Thaete EHS Manager Phibro-Tech Inc. 8851 Dice Road Santa Fe Springs, California 90670 (562) 273-0170
Facility Operator:	Phibro-Tech, Inc.
Property Owner:	First Dice Road Company, A California Limited Partnership Glenpointe Centre East, 3rd Fl 300 Frank W. Burr Blvd., Ste 21 Teaneck, New Jersey 07666-6712 (800) 220-4371
Other Applicable Environmental Permits:	Industrial Waste Discharge Permit with Los Angeles County Sanitation District Various Permits to Operate with South Coast Air Quality Management District City of Santa Fe Springs – Fire and Industrial Waste Permit and Hazardous Materials Storage Permit

2.2 GENERAL FACILITY DESCRIPTION

The PTI facility is a hazardous waste treatment, storage and transfer facility accepting off-site generated inorganic hazardous waste (e.g. copper bearing etchants used for printed circuit board manufacturing) for the purpose of reclaiming metals. In addition, Phibro-Tech, Inc. proposes to install a new system to treat, store, and transfer oily wastewater.

Records indicate that the earliest use of this land was as a railroad switching station owned by Pacific Electric Railway Company. From the late 1940s to the early 1950s, a foundry casting facility operated on the land. Pacific Western Chemical Company occupied the site from 1957 to 1959; in December of 1959, Pacific Western Chemical Company changed their name to

Southern California Chemical. Ferric Chloride production commenced on site in 1958. During the 1960's, operations were added for copper recovery, copper oxide manufacturing, etchant processing, and other inorganic processes. In 1984, CP Chemicals, Inc. acquired the assets and operations and began operating the facility through a new legal entity named Southern California Chemical Company, Inc. In the early 1990's, the parent company considered taking the division public and operated the site as Entech Recovery, Inc. for approximately one year. In 1994, the company changed their operating name to Phibro-Tech, Inc. (PTI) which is a subsidiary of Phibro Animal Health Corporation (PAHC). As described in Section B4.1, Phibro-Tech, Inc. leases the property under the Santa Fe Springs facility from the First Dice Road Company, A California Limited Partnership.

The Facility is a fully permitted hazardous waste treatment and storage facility. Southern California Chemical Company received notification of an Interim Status Document effective on December 16, 1981. Both the DTSC and the United States Environmental Protection Agency (USEPA) granted Southern California Chemical operating permits on June 19, 1991 and July 29, 1991, respectively. Prior to this, the Facility operated under Interim Status. The state permit came up for automatic renewal in July 1996 with revised applications filed. The DTSC has since been granted full jurisdiction for permitting RCRA facilities in California; therefore the separate USEPA permit is no longer needed. A complete revised permit application was submitted in February 2006. In accordance with the Part B procedure for renewal, the Facility is allowed to continue to operate under the terms of its 1991 permit pending the renewal of the Part B permit.

The Facility receives off-site wastes from several industries, including but not limited to, the electronic, chemical, and aerospace industries. Types of wastes managed by the Facility include waste materials generated from non-cyanide metal plating operations, etching solutions, and wastewaters including oily wastewaters. Waste management units at the Facility include metal recovery area with associated storage and treatment tanks, other storage tanks, oily water processing area, four drum storage areas, rail car loading and unloading and tank truck unloading areas.

The facility is located on a 4.8-acre parcel in an industrialized section of Santa Fe Springs in Los Angeles County. The facility is entirely paved or covered with coated or uncoated concrete except for the railroad tracks.

2.3 FACILITY LOCATION DESCRIPTION

Information on the location and description of the Facility and surrounding area is provided below. Refer to the Part B Permit Application for more detailed information.

2.3.1 General

A Facility location map is included in this Plan as Figure CP-1 and a site layout in Figure CP-2. The Facility is located in an industrial area along Dice Road that extends between Slauson Avenue to the north and Los Nietos Avenue to the south. The area immediately surrounding the Facility includes industrial activity. The nearest residential development is located approximately 1,000 feet north of the Facility.

2.3.2 Geology and Surface Water Hydrology

The Facility is located in the Santa Fe Springs Plain within the coastal plain of Los Angeles County. This is a slightly rolling plain that dips northeast towards the City of Whittier. The

Facility itself is located on fairly flat land that slopes from northeast to southwest. Elevations on the site range from 148 to 154 mean sea level (MSL).

The underlying geology consists of the Older Pleistocene undivided alluvial fan and valley deposits (USGS Geology of the Whittier 7.5' Quadrangle, 1999) consisting of stream and flood plain deposits. These predominantly sand, silt, and clay deposits are moderately- to well-consolidated soils.

Three miles to the northeast, the Whittier Fault Zone, the primary regional structure, trends southeast along the southern flanks of the Puente Hills. It extends from the Whittier Narrows into Orange County to the southeast. The Facility is located on the northern leg of the regional west-northwest to east-southeast trending Santa Fe Springs Anticline.

The Facility is located about one mile east of the San Gabriel River and about three miles northwest of Coyote Creek. The regional drainage in the area is to the San Gabriel River that flows to the southwest in the region. Local drainage is discharged into the Sorenson Avenue drain which is approximately 0.25 miles northeast of the facility. This drain feeds into La Canada Leffingwell Creek and forms La Canada Verde Creek. La Canada Verde Creek flows into Coyote Creek, which flows into the San Gabriel River.

2.3.3 Subsurface Hydrology

The regional stratigraphy consists of interbedded fine-grained materials and sands. During the RCRA Facility Investigation in 1991, Camp Dresser & McKee Inc. identified the uppermost hydrostatic units under the Facility. The uppermost lithological unit is the Bellflower aquiclude. According to the Data Gap Investigation conducted in 2007 by Iris Environmental, fill material is present in the upper three to five feet. Below this, the Bellflower aquiclude consists of silty sand with fine to medium sand and a trace of clay and extends to a depth of about 15 feet below the ground surface. The Gage Aquifer, beneath the Bellflower aquiclude, extends from approximately 15 to 31 feet below ground surface (bgs), depending on location. The Gage Aquifer is characterized as a laterally extensive sand unit with a high permeability to both air and fluids and has been unsaturated since investigations began in 1985. The underlying unnamed aquitard is a hard, dense, fine-grained unit that consists of silts, clays, and fine sand with occasional silty sand and thin, sandy silt lenses. These sediments have a low hydraulic conductivity (1.64×10^{-7} to 1.03×10^{-5} centimeters per second [cm/s]), low permeability to air (0.309 to 125 millidarcies), high porosity (30 to 49 percent [%]), and moderate moisture content (14.7 %-weight to 31.7 %-weight, or alternatively, 0.260 to 0.437 cubic centimeter per cubic centimeter [cm^3/cm^3]; Iris Environmental 2007b). The unnamed aquitard is approximately 20 feet thick on the eastern portion of the Site, and between Pond 1 and groundwater monitoring wells MW-14S and -14D, it bifurcates and both lenses thin to the west.

The Hollydale Aquifer occurs below the unnamed aquitard at depths typically starting at 50 to 55 feet bgs. The Hollydale Aquifer consists primarily of fine to coarse sand with high hydraulic conductivity (3.62×10^{-4} cm/s to 1.90×10^{-3} cm/s) and high porosity (34.3 % to 40.1 %). At boring location JEB-01, south of Pond 1, the Hollydale Aquifer extends from 53 feet bgs (or 99 feet above mean sea level [amsl]) to 147 feet bgs (or 5 feet amsl; Iris Environmental 2013). The upper Hollydale Aquifer is classified as extending from the bottom of the unnamed aquitard at approximately 50 or 55 feet bgs to approximately 74 or 79 feet bgs, and the lower Hollydale Aquifer extends from approximately 74 or 79 feet bgs to around 147 feet bgs. The Hollydale

Aquifer unit ranges from fully to partially saturated and is considered lithologically similar across the Facility (Iris Environmental 2007). The Hollydale Aquifer is confined by the overlying unnamed aquitard or unconfined, depending on groundwater elevation fluctuations. At boring location JEB-01, an approximately 16-foot thick silt and clay aquitard separates the Hollydale Aquifer from an underlying sand unit assumed to be the uppermost part of the Jefferson Aquifer. At this time, there is not enough evidence to interpret whether or not there is water exchange between the Hollydale and Jefferson Aquifers in the region, although a robust aquitard is present between the two at JEB-01.

The Bellflower aquiclude and the Gage aquifer are part of the Lakewood Formation, and the Hollydale and Jefferson Aquifers (and separating aquitards) are part of the San Pedro Formation (California Department of Water Resources, Bulletin No. 104, June 1961).

2.3.4 Weather

The climate in the area is semi-arid. The mean temperature is approximately 62°F with extremes in nearby areas of 18°F and 116°F. The average rainfall is 13 to 14 inches per year. The rain occurs mostly between December and April, although precipitation exceeds evaporation during much of the year. The maximum 25-year, 24-hour rainfall is 4.5 inches. The wind direction is predominantly from the southwest.

2.4 WASTE MANAGEMENT UNITS

These closure procedures cover the equipment contained in the December 2015 Class 2 Permit Modification. Thee equipment items include:

- 30,500 gallon fiberglass reinforced plastic (FRP) Tank W-7;
- 30,500 gallon fiberglass reinforced plastic (FRP) Tank W-8;
- 925 square foot concrete containment area with 6-foot walls for Tanks W-7 and W-8;
- 210 square foot concrete container pumping station with 12.5 inch curbs and fiberglass grating;
- Filter Press FP-2A
- 12,500 gallon fiberglass reinforced plastic (FRP) Tank J-6;
- 12,500 gallon fiberglass reinforced plastic (FRP) Tank J-7;
- 720 square foot concrete containment area with 3.5-foot walls for Tanks J-6 and J-7;
- 1,733 square feet added to Container Storage Area 1 (CS-1 or ERS-1) with a 22 feet by 15 feet and 12 foot high roof structure; and
- 1,885 square feet added to Container Storage Area 2 (CS-2 or ERS-2).

3.0 WASTE DESCRIPTION AND MAXIMUM INVENTORY

3.1 WASTE DESCRIPTION

The wastes that the Facility received and managed onsite for storage and/or treatment are shown in the attached Table CP-1.

None of the waste streams identified in Table CP-1 were known to contain cyanide. Furthermore, wastes were not accepted that were identified to contain cyanide on the profile or during waste analysis prior to profile approval.

All liquid wastes handled at the facility were stored onsite in either tanks or containers. The Facility did not store or treat any RCRA-listed hazardous wastes (such as F006 sludge or K062) in tanks. Accordingly, the RCRA-derived from and mixture rule will not require that residues from cleaning the tanks be managed as RCRA-listed hazardous waste.

3.2 CONSTITUENTS OF CONCERN

Specific constituents of concern (COCs) are listed below based on the waste materials managed at the Facility and are consistent with the full facility closure plan. The list below applies to the equipment discussed in Section 2.4. Inorganic wastes received at the Facility are not EPA characteristic wastes for organic constituents and they do not carry any California Waste Codes that indicate the wastes would contain organic compounds.

The constituents of concern for soil and groundwater samples are:

- Arsenic;
- Cadmium;
- Chromium (Total);
- Copper;
- Iron;
- Lead;
- Nickel
- Corrosivity (pH)

The constituents of concern above are selected based on their likelihood of occurrence within the waste types. Although there may be low levels of other trace metals present in the wastes received on site (e.g. silver), they are present in much lower concentrations and in total quantities than the identified COCs. Therefore, the COCs identified above will be appropriate markers to identify the effectiveness of decontamination methods used in this Closure Plan. Corrosivity is selected only for soil and rinsewaters because they are usually both near normal pH and thus measuring pH can provide information regarding thoroughness of cleaning/decontamination of acidic or alkaline materials. Since concrete is normally highly alkaline, pH is not a viable parameter to measure level of decontamination, especially for alkaline waste materials. Wipe samples are also not an appropriate medium for pH measurements because they are influenced by the amount of water used on the wipe pad, the water retained prior to analysis, and the amount of extraction water.

3.3 WASTE MANAGEMENT UNITS AND MAXIMUM WASTE INVENTORY

The waste management units to be closed are the modified equipment items identified in Section 2.4.

As the two sets of replacement tanks (W-7 and W-8 and J-6 and J-7) are identically sized as the tanks they replace; and the container storage areas 1 and 2 are only increased in surface area and not in allowable storage capacity, there is no increase in waste inventory over that in the currently approved closure plan and closure cost estimate. Thus there is no closure cost allocated for inventory elimination. However procedures are discussed in Section 5.

Hazardous wastes may be generated from implementing the closure steps identified in Section 5. The closure wastes may include contaminated rinse waters, waste residues, contaminated personal protective equipment (PPE), miscellaneous equipment wastes (such as pumps, filters, and pipes or hoses), sampling wastes, soil or concrete debris, and other wastes. These will be managed as hazardous wastes unless they are shown to be non-hazardous based on analysis as discussed in Section 6 and in the Sampling and Analysis Plan (Appendix A). The costs associated with managing these wastes are addressed in the Closure Cost Estimate.

3.4 DISPOSITION OF WASTES

Prior to sending any closure wastes off site for treatment and/or disposal, PTI will assess that each of the TSDFs are permitted to receive the specific waste. In addition, an effort will be made to determine if the TSDFs are in good standing with the authorizing agency. This can be assessed by determining if the TSDF is approved for use by EPA pursuant to the CERCLA Off Site Rule under 40 CFR 300.440. If the TSDF has such approval, it will be deemed acceptable. If the TSDF does not have CERCLA Off Site Rule approval, additional due diligence will be performed to determine if the proposed TSDF is an acceptable facility.

Standard TSDF waste acceptance procedures will be followed including establishing waste profiles. Potential TSDFs that could be used for liquid and solid hazardous wastes generated by closure activities or wastes present on site at time of closure are identified in Table 3-2. The waste profile documentation should be filled out using the standard form for the designated TSDF. The profile form should be filled out to accurately describe the wastes in terms of the hazardous waste characteristics, physical properties, process generating the waste, estimated volumes, Land Disposal Restriction (LDR) status under RCRA and California regulations, and other relevant characteristics. For RCRA hazardous wastes subject to LDRs, statements regarding possible presence of underlying hazardous constituents will be required to define the proper processing methods to meet the universal treatment standards. The TSDF may require analytical results or even a sample of the waste prior to approval of a waste profile.

Table 3-1 Potential TSDFs for Disposition of Closure Wastes

Possible TSDF	Location	Approx. Distance (miles)	Waste Types They Can Accept
Evoqua	5375 S. Boyle Ave. Vernon, CA 90058	10	RCRA or non-RCRA Wastewater streams in bulk; any others in containers. (Waste Types B, G, H, I, and M)
Old Bridge Chemicals Inc.	P.O. Box 194 Old Bridge, NJ 08857	2,840	Waste Types A, C, J, and K
Shoreland Metals	3601 Enterprise Ave, Valparaiso, IN 46383	2,100	Waste Type F
Heritage Environmental Services	7901 W Morris St Indianapolis, IN 46231	2,060	Waste Types A, C, J, and K
World Resources Co.	8113 W. Sherman St. Phoenix, AZ 85043	360	Waste Type D
Vickery Environmental, Inc.	3956 State Route 412 Vickery, OH 43464	2,340	Almost any RCRA or non-RCRA liquid waste streams
Waste Management	35251 Old Skyline Rd. Kettleman City, CA 93239	190	Almost any RCRA or non-RCRA solid waste for land disposal that meets LDR standards or they can treat to LDRs such as soils and miscellaneous closure-generated wastes
US Ecology	Highway 95 - 12 miles South of. Beatty, NV Beatty, NV 89003	300	Almost any RCRA or non-RCRA solid or liquid waste streams that meet LDR standards.

Any closure wastes sent off site for disposal will be placed in proper containers or bulk packagings (including trucks or rail cars) that meet the United Nations performance-oriented packaging standards or bulk containers that meet the U.S. Department of Transportation (DOT) requirements under 49 CFR 172 et seq. All containers used will be properly labeled at time of waste generation and manifested in accordance with generator standards under 22 CCR 66262. A hazardous waste manifest form approved by the state where the receiving facility is located will also accompany all shipments of hazardous waste. Shipments will also be placarded and marked in accordance with U.S. DOT rules. If the receiving state has no special manifest form, a California Manifest form will be used. Land Disposal Restriction (LDR) Forms will be filled out for any hazardous wastes subject to LDR standards. This form will be filled out to identify all the applicable waste codes and treatment standards. These LDR forms will be either maintained with the profile or they will accompany each hazardous waste manifest, depending on the standard procedures of the receiving TSDF. Copies of any LDR forms used will be included with the closure report.

3.5 ESTIMATED DATE OF CLOSURE

There are no current circumstances that would indicate the need to close the Facility. However, for the purposes of this Closure Plan, the Facility will be assumed to operate for another 25 years and have an estimated closure date of December 2040. The Facility may remain in service past this date as economic and regulatory factors allow. If the closure date is to be extended, such will be indicated in an amendment to the Closure Plan as indicated in Section 14.0 or as the Closure Plan is updated in future permit renewals.

4.0 CLOSURE PROCEDURES

This section describes the specific procedures to be used to close the Facility.

4.1 CLOSURE GOALS

This Closure Plan defines the procedures to close the Facility in a manner that: 1) minimizes the need for further maintenance and controls, and 2) minimizes or eliminates to the extent necessary to protect human health and the environment, post-closure release of hazardous constituents, leachate, contaminated rainfall and runoff or hazardous waste decomposition products to the ground, surface waters, or to the atmosphere.

The intent of this Closure Plan is to remove hazardous wastes and hazardous waste contaminated materials associated with the storage and treatment units. This will involve removal and proper disposal of some units, while others will be clean closed and left in place or reused. Any units that cannot be appropriately decontaminated in accordance with the closure goals defined below, will be removed and managed as a hazardous waste, unless they can be properly characterized as a non-hazardous waste. The specific closure performance standards are shown below for the types of equipment, structures, and media if they are to be left in place or reused:

1. **Metal Equipment –** Metallic equipment (e.g. filter press frames) may be designated as closure waste and sent for off-site disposal or scrap metal recycling if there is no reuse alternative. In this case, the closure performance standard will be the waste disposal criteria.
2. **FRP Tanks –** There are no performance standards for such tanks. Such tanks will be cut-up, removed and managed appropriately as closure generated waste described in Section 3.4 after being characterized as described in Section 6.0. Testing of the FRP tanks will be through bulk samples of the tank shell (coupons or small pieces that can be transported to an independent third party laboratory for analysis).
3. **Lined Containment Areas –** Attainment of the closure performance standard for lined containment areas in good condition (no cracks, gaps, or deterioration of the liner through to the concrete) will be based on wipe samples showing inorganic or organic constituents of concern as described for metal tanks above. Lined containment areas that cannot be cleaned to meet the closure performance standard will be removed and managed as closure generated waste as described in Section 3.4 after being characterized as described in Section 6.0.
4. **Soils / Groundwater –** The soil and groundwater screening cleanup levels are shown in **Table 4-1** below and are the same as those identified in the September 2015 Pond 1 Closure Plan (updated in December 2015).

Table 4-1 Target Cleanup Levels

Constituent of Concern	Soil Screening Level[1] (mg/kg)	Groundwater Screening Level[2] (µg/L)
Arsenic	1.6 / 500[4]	10

Constituent of Concern	Soil Screening Level[1] (mg/kg)	Groundwater Screening Level[2] (µg/L)
Cadmium	5.1 / 100[4]	5
Chromium (Total)	1,500,000 / 2,500[4] (as Cr^{+3})	50
Hexavalent Chromium (Cr^{+6})	5.6 / 500[4]	10
Copper	41,000 / 2,500[4]	1,300
Iron	720,000 (RSL)	11,000 (Tapwater RSL)[3]
Lead, Inorganic	320 (95% UCL) / 1,000[4]	15
Nickel	20,000 / 2,000[4]	300 (Tapwater RSL)[3]
Zinc	5,000[4]	6,000 (Tapwater RSL)[3]

Notes:

1. In accordance with DTSC Office of Human and Ecological Risk (HERO) Note 3 updated July 2014, Regional Screening Levels (RSLs) from US Environmental Protection Agency Region 9, are appropriate human health risk screening levels. HERO has documented specific changes to RSLs which are reflected above. In all cases, the commercial/industrial exposure scenario was selected using the January 2015 tables.
2. Unless noted, groundwater screening levels are based on the lower of the California or US Environmental Protection Agency primary drinking water maximum contaminant level (MCL) for each constituent, which is consistent with Corrective Action Consent Order with DTSC (Docket HWCAP4-11/12-003).
3. Tapwater RSL is a health risk value from US Environmental Protection Agency Region 9, Regional Screening Levels, January 2015.
4. Per CCR 66261.24; based on TTLC test values (wet weight).

In addition to the above, background levels may be used for soil (e.g., arsenic) and groundwater if site specific statistically-derived background levels have been quantified and agreed to by DTSC.

Table 4-1 provides target levels for the identified COCs. At the time of closure, the most current values for the constituents above from the same resources (DTSC HERO, EPA MCLs, and EPA RSLs) will be used. An MCL is the legal threshold limit on the amount of a substance that is allowed in public water systems. Soil and Tap Water RSLs are health risk-based values. Because site investigation and groundwater monitoring may detect other contaminants, closure criteria will follow the same procedures as above and use: RSLs for

soil constituents or MCLs for groundwater. If there is not an MCL for a groundwater constituent, the Tapwater RSL will be used.

5. **Rinse Waters (from small miscellaneous pieces of equipment) –** Cleanliness of a small piece of equipment will be determined by comparing the chemical concentrations of used rinse water to the fresh (unused) rinse water from the city water system. The allowable increase of chemical contaminants in the used rinsewater used for cleaning will be the Industrial Risk-Based Screening Level identified for groundwater (see No. 5 above). If the rinse water contains an increase less than the risk-based value specified, the equipment is deemed to be clean. Note that rinse waters will be disposed of appropriately as closure waste and will not remain on site upon completion of closure. Grab samples of the rinsewater will be collected and compared to one background sample of the city water collected at the start of the closure process from a water faucet in the Facility.
6. **Pipe, Pipe Components, and Small Miscellaneous Pieces of Equipment** - These equipment items if not proven clean by the rinse water test above may be designated as closure-generated waste. Such equipment, if hazardous waste, will be subject to the hazardous debris alternative treatment standards (e.g., treatment to "clean debris surface") under the Land Disposal Restriction Requirements in 22 CCR 66268.45.

4.2 CLOSURE NOTIFICATION

The Facility will notify the Regional Office of the California DTSC at least 180-days prior to the date closure is expected to begin. This notification will include the proposed risk-based soil cleanup standards as described in Section 4.1.

5.0 CLOSURE ACTIVITIES

All closure work described below in this section will be performed with the knowledge and concurrence of the certifying engineer (or their agent), who will observe and document closure activities for the Closure Report as described in Section 13. The manager of the fieldwork will also maintain a field logbook that will also be used to document that closure activities have been performed properly. Photographs, diagrams, and other records will be developed as necessary to describe the closure activities performed. All confirmation samples of equipment or media will be performed in accordance with the Sampling and Analysis Plan in Appendix A. This will include the appropriate use of quality control samples, trip blanks, and equipment blanks. The sample locations are summarized in Appendix E.

All closure activities are expected to be completed within the 180 days from the date of DTSC approval of the Closure Plan. The detailed Closure Schedule is provided in Section 9.0. If unexpected circumstances arise during implementation of the Closure Plan, the Facility will request an extension and provide appropriate justification.

5.1 PREPARATORY WORK

Step 1. All contractors shall prepare a Final Site-Specific Health and Safety Plan (HASP) for the closure activities in accordance with 8 CCR 5192. Refer to the Model HASP contained in Appendix A of the conditionally approved Pond 1 Closure Plan (dated September 2015, with updated appendices dated November 30, 2015) as a guide, however, any Closure Contractors performing work on site shall develop their own HASP which may be more protective of worker health than the Model Health & Safety Plan without review. If the final HASP is less protective of worker health (e.g., reduced use of personal protective equipment), the HASP will be certified by a Certified Industrial Hygienist (CIH) and offered to DTSC for review prior to closure implementation.

Contract employees shall be under the direct control of PTI or their on-site agent (e.g. consultant) who will have the authority to enforce the HASP and to shut down the work to evaluate new safety hazards or to address non-conformances with established safety procedures.

Step 2. As needed notify the City of Santa Fe Springs, the Los Angeles County Sanitation District, and DTSC, of the date that field closure activities will commence.

5.2 REMOVAL OF CONTAINERIZED WASTE INVENTORY

Step 3. Inventory all waste on site in containers within CS-1 and CS-2. Assign each container a unique number and maintain a database of container numbers and the waste description and generator from the label. During this inspection of the drums, they will also be inspected for signs of leakage or deterioration of the containers. Any such containers that are found will be placed in overpack drums.

Obtain waste profiles and copies of the receipt analysis testing for the containers, if available. Containers of on-site generated hazardous waste will be checked to verify they conform to their profile. If any on-site generated wastes cannot be properly characterized, the procedures of Section 6.0 shall be followed.

Any containers that are unlabeled or that have illegible labels will be handled as described below in Step 4.

Step 4. Each drum that is unlabeled or illegibly labeled will be subjected to a field hazard categorization (HAZCAT) procedure. First collect a sample, and visually check the color and measure the pH and visually look for the presence of an oil layer. Compare the information to the waste characteristics in Table CP-1. If it is necessary to perform additional tests to identify the waste, standard HAZCAT protocols will be employed and samples will be collected as necessary. The samples will be analyzed for laboratory analysis for pH (EPA SW-846 Method 9040) and CAM-17 metals by flame Atomic Absorption for the constituents of concern (EPA SW-846 Method 6010).

Step 5. Upon review of the waste profiles, container labels, receipt analysis testing, and HAZCAT data, the containers of waste will be sent to one of the authorized facilities described in Section 3.4 for appropriate disposal or recycling. The containerized wastes will be properly labeled (or relabeled) as necessary, and sent to a TSDF following the procedures described in Section 3.4 (including proper use of manifests, DOT packaging, placarding and other transportation procedures). Large volume waste streams may be bulked for more efficient transportation by pumping the waste from the containers into tanker trucks or into on-site tanks of the same waste type. Such containers shall remain in secondary containment during such transfers.

Step 6. Note that if PTI is performing the closure of the facility, they may elect to process as much of the containerized waste on site as possible using treatment processes authorized by DTSC.

5.3 REMOVAL OF WASTE INVENTORY IN TANKS

Step 7. Inventory all waste on site in tanks by identifying the tank number and the height of liquid in each tank. Note that although rail cars are considered containers, they will be sampled as described in this section since the approach of determining depths of any layers is more appropriate.

Estimate the volume of liquids in stationary tanks by obtaining tank data from the discussion of waste management units in Section 3.3 of this Closure Plan. Collect one vertically integrated sample of the liquids in each tank. (Refer to the Sampling and Analysis Plan in Appendix A and the referenced model HASP).

Step 8. Using the approach described in Section 4.2 of the Sampling and Analysis Plan (see Appendix A), determine if the tank contents are homogenous or there are discrete layers present. Collect one sample from each layer within each tank and each rail car. Visually check the color and measure the pH of each sample and visually look for the presence of an oil layer. Compare the information to the waste characteristics in Table CP-1. If it is necessary to perform additional tests to identify the waste, standard HAZCAT protocols will be employed and samples will be collected as necessary. The samples will be analyzed for laboratory analysis for pH (EPA SW-846 Method 9040) and CAM-17 metals by flame Atomic Absorption for the constituents of concern (EPA SW-846 Method 6010).

Step 9. The tank contents will be transferred to tanker trucks or to rail cars for shipment to an appropriate TSDF. Trucks will be staged in the truck unloading area. The bulked wastes will be sent to a TSDF following the procedures described in Section 3.4 (pre-approval of the TSDF, and proper use of manifests and LDR notifications, DOT/UN approved packaging, placarding and other transportation procedures). If the identified TSDF cannot accept shipment of the waste in the rail car(s), the rail car will be pumped into tanker trucks for transfer to the TSDF. If any residual waste amounts can be pumped from the tank after bulking, the residues will be pumped into 55-gallon poly drums or IBCs and labeled with the appropriate waste stream characteristics. These drums or IBCs will be located within permanent or temporary secondary containment areas. A worker shall remain at the drums while waste is being pumped into them. If this worker does not have the ability to shut off the flow, the worker shall be in direct communication with the person who can stop the flow. After the drums are filled, they shall be closed and labeled as required by Section 345.

Step 10. Note that if PTI is performing the closure of the facility, they may elect to process as much of the waste as possible that is in tanks and rail cars by using the treatment processes on site authorized by DTSC. (See note in Step 6).

5.4 TANK CLEANING PROCEDURES

The general procedure below describes the tank cleaning process. It will be repeated for all hazardous waste tanks identified in Closure Plan Section 2.4.

Step 11. After waste has been substantially removed from the tanks, each hazardous waste management tank will be inspected from the top access ports for the presence of residual sludge or adhered material on the tank walls. For tanks that are to be sent for disposal, openings may also be cut on the sidewall using mechanical shears and/or saws to allow access for cleaning. The inspection shall be performed without physically entering the tank.

If sludge residues are observed in the bottom of a tank, the sludge will be removed from the bottom of each tank, if possible, and placed into containers (drums or IBCs) using pumps or vacuum trucks. Add water if needed to mobilize the sludge. These wastes will be properly characterized as described in Section 6.0 to determine if they are a hazardous waste or not. These containers will then be sent for appropriate disposal/recycling to one of the facilities identified in Section 3.4. Based on the analysis of the tank contents, the residual sludge from various tanks may be commingled.

Step 12. Rinse all hazardous waste management tanks with water and a pressure nozzle to remove waste residues. Clean both the interior and the exterior surfaces. Tanks will be rinsed until the water is transparent with a faint color for inorganic waste tanks. Since the primary waste streams handled at the Facility had deep colors as shown in Table CP-1, this will indicate that the waste residues have been substantially reduced. For example, three of the highest volume waste streams, waste types C, J, and H have deep green, blue, and brown colors, respectively. When the water is only faintly colored, it will indicate that the tank is ready for the

next step, either dismantling for disposal or sampling to confirm the cleanliness. Follow the procedures below for further cleaning or disposition of the tanks. Tanks that are visibly discolored by waste materials on the exterior, will also be similarly cleaned on the exterior by washing to a visual standard of cleanliness.

If a tank is heavily contaminated, it may first be rinsed with previously used wash water pumped through a normal hose and nozzle system (i.e., not a high-pressure system). The wash water may be slightly acidic to remove basic wastes and slightly basic to remove acidic waste materials. No adverse reactions would be expected because the wastes handled at the PTI Facility are weak acids or weak bases and are not known to be incompatible with one another. A mild detergent such as Alconox may also be used to facilitate tank cleaning. Subsequent wash(es) will be made with potable water and high-pressure. Tanks will not be entered to perform any acidic or basic washing. Work will be performed from the top port or side manway of each tank if present. Some tanks may be removed from their foundation and placed on their side within secondary containment to facilitate cleaning. If tanks are entered during the cleaning process, the provisions of 8 CCR 5157 or 8 CCR 5158, as applicable, shall be followed to determine whether or not the tank will be a permit-required confined space entry.

During high-pressure washing of tank interiors and exteriors, efforts will be made to minimize or eliminate any carryover outside containment areas. Refer to the additional procedures for pressure washing in Section 5.11.2. In addition, workers shall not be in the direction of high-pressure water washing or abrasive blasting. Wash water or solid wastes from abrasive blasting will be collected and managed as closure-generated waste as described in Section 3.4 after being characterized as described in Section 6.0.

The rinse waters will be pumped into a designated consolidation tank. The consolidation tank will be either one or more of the on-site tanks deemed to be in good condition or one or more temporary tanks brought on site. If a temporary tank is brought on site, the tank will be placed on field erected temporary secondary containment system that is lined with materials such as rubber or 60-mil thick high-density polyethylene. Such a secondary containment system would be designed to hold minor spills and releases that may happen during material handling operations, changing of pumps, and hoses, and similar operations. Because it is temporary, it will not be fabricated to handle the full capacity of the temporary storage tank.

Step 13. Any remaining instrumentation on the tanks (such as level controls, level switches, temperature gauges, and pH probes) will be removed and sent to other facilities for reuse, or placed in either the scrap metal bin or debris bin for disposal as closure waste. If any instrument contains mercury (common in some level and temperature devices), the instrument will be placed in a separate container and managed appropriately as hazardous waste or universal waste. Before being sent to another PTI facility, such instruments will be rinsed to remove any significant visible contamination.

Step 14. Remove any mixer systems remaining on tanks. Separate the mixer blade and shaft assembly from the motor. Dispose of the mixer and shaft as closure generated wastes or as scrap metal, as appropriate. The motor may be sent to another company site or disposed as scrap metal. The motors will not be sampled since they were not in contact with waste materials and are not expected to be contaminated.

5.5 TANK SAMPLING PROCEDURES

This section defines the sampling procedures that will be used to either determine that a tank has met the closure performance standard specified in Section 4.1 and can be left on site or reused elsewhere (for other than food or pharmaceutical uses) or to determine if it is a hazardous waste or non-hazardous waste for disposal purposes. The number, rationale, and type of closure samples are summarized in Appendix B. The general procedure below will be repeated for all hazardous waste tanks identified in Closure Plan Section 2.4.

Step 15. The FRP waste tanks identified in Section 2.4 will be emptied of any residual liquids from the cleaning steps described above in Section 5.4. The tanks may be cut in place as they are removed. If tanks are cut to facilitate disposal, they will be cut by mechanical saws or shears. Samples of the tank will be collected by sawing an appropriately sized piece (specified by the analytical laboratory) from the bottom (one sample location) and at two locations from the wall of each tank (one-third up from the bottom and another one-third down from the top). The three samples will be composited by the laboratory. All samples will be taken as described in the Sampling and Analysis Plan (Appendix A). These samples will be submitted for laboratory analysis for the COCs and the acute aquatic 96-hour fish bioassay test for hazardous waste characterization.

Based on these results, and other analytical tests that may be needed, each tank will be categorized as a RCRA hazardous waste, non-RCRA hazardous waste, or non-hazardous waste. The tanks will be crushed or cut to consolidate them for shipment in accordance with DOT regulations to an appropriate receiving facility.

5.6 DECONTAMINATION OF MISCELLANEOUS PLANT EQUIPMENT ITEMS

Step 16. Unless discussed in another Closure Step such as instrumentation and mixer systems in Section 5.4, all other miscellaneous DTSC-regulated plant equipment such as pumps, filter housings, hazardous waste transfer piping, and hazardous waste transfer hoses associated with the equipment in Section 2.4 will be identified and inspected. The certifying engineer (or their agent) will assess each piece of equipment to determine whether or not it should be cleaned. This decision will be based on judging whether the value of the part will justify the cost of cleaning it for reuse. Rather than cleaning, it is expected that most small miscellaneous equipment items will be discarded into a debris bin for off-site disposal or as scrap metal if the items meet the scrap metal definition. Any wastes generated will be collected and managed as closure-generated waste as described in Section 3.4 after being characterized as described in Section 6.0.

If a piece of miscellaneous equipment is to be cleaned prior to being reused elsewhere or left on site, or to assure it can meet the definition of scrap metal, or to

otherwise facilitate it's disposal, the equipment will be cleaned by wiping, pressure washing, steam cleaning, or use of detergents or other cleaners, and/or wipes. During high-pressure washing, efforts will be made to minimize or eliminate any carryover outside containment areas. Refer to the additional procedures for pressure washing in Section 5.11.2. In addition, workers shall not be in the direction of high-pressure water washing. If the equipment item is metal, it can be placed in the scrap metal bin, provided it is not dripping oil or other hazardous wastes and otherwise meets the scrap metal definition in 22 CCR 66260.10. Non-metal equipment will be placed in the debris bin along with metal pieces that cannot be sent off as scrap metal. The waste in this bin will be managed as described in Section 3.4 after being characterized as described in Section 6.0.

Equipment may only be left in place or elsewhere on site if it has been cleaned and it is proven to meet the closure performance standard in Section 4.1. Cleaning methods may include wiping, pressure washing, steam cleaning, or use of detergents or other cleaners, and/or wipes. During high-pressure washing, efforts will be made to minimize or eliminate any carryover outside containment areas. Refer to the additional procedures for pressure washing in Section 5.11.2. In addition, workers shall not be in the direction of high-pressure water washing. If sampling shows contamination (i.e., the closure performance standard has not been attained), the equipment will be either cleaned further, or removed and placed in the debris bin and managed appropriately as a hazardous or a non-hazardous waste pending waste characterization.

Piping that contained hazardous wastes will be flushed with water until sampled and shown to meet the closure performance standard, or it will be removed and placed in a debris bin for disposal as a hazardous or non-hazardous waste, as appropriate in accordance with Section 6.0.

5.7 CLEANING AND CONFIRMATION SAMPLING FOR TANK CONTAINMENT AREAS

Step 17. The secondary containment systems for the W-7 and W-8 tanks and the J-6 and J-7 tanks will be decontaminated by high-pressure water wash after the tanks have been cleaned. During high-pressure washing, efforts will be made to minimize or eliminate any carryover outside containment areas. Refer to the additional procedures for pressure washing in Section 5.11.2. In addition, workers shall not be in the direction of high-pressure water washing. The wash water will be collected and managed as a closure waste as described in Section 3.4 after being characterized as described in Section 6.0.

Step 18. The certifying engineer (or their agent) will visually inspect the concrete containment areas for coating integrity, structural damage (cracks, gaps in joints, etc.), and any potential route of leakage. Significant areas will be photographed or diagrammed for the closure record.

Based on the inspection of the tank containment areas, the certifying engineer (or their agent) will select locations for confirmation samples from each secondary containment area. These will be both concrete chip samples and soil

samples from the specified number of locations in each containment area as summarized in Appendix B.

The number of soil samples collected will be in accordance with DTSC guidance. This specifies at a minimum that there will be one sample from along each of the four walls at the approximate midpoint plus one sample under each regulated management unit (i.e., under each tank). Soil samples shall be collected using the procedures described in Section 5.10. The concrete samples will be obtained from the same location of the soil samples (since a core must be made through the concrete to allow collection of the soil sample).

The concrete containment area will be deemed suitable to be left in place if the sample analytical results from concrete and soil meet their respective closure performance standards established as described in Section 4.1. If it is necessary to remove concrete containment areas, the procedures in Section 5.14 shall be followed.

5.8 CLEANING/CONFIRMATION SAMPLING FOR CONTAINER MANAGEMENT AREAS

Container Storage #1 (CS-1) and Container Storage #2 (CS-2) will be closed as described below.

Step 19. After all containers are removed from CS-1 and CS-2, the containment areas will be cleaned with a high-pressure water wash. A low phosphate detergent may be used to assist cleaning if needed. During high-pressure washing, efforts will be made to minimize or eliminate any carryover outside containment areas. Workers shall not be in the direction of high-pressure water washing or abrasive blasting. The wash water will be collected and managed as a closure waste as described in Section 3.4 after being characterized as described in Section 6.0.

Step 20. The certifying engineer (or their agent) will inspect the coated concrete containment areas for coating integrity, structural damage (cracks, gaps in joints, etc.), and any potential route of leakage. Significant areas will be photographed for the closure record.

Step 21. Based on the inspection of the containment areas, the certifying engineer (or their agent) will select locations for confirmation wipe samples. The sample locations will be biased towards those with the most visible erosion, pitting, or evidence of spilling. One wipe sample will be collected for each 500 square feet of incremental floor area. This will require 4 samples from CS-1 (1,733 square feet added) and 4 samples from CS-2 (1,885 square feet added). See Appendix B.

The certifying engineer (or their agent) will determine if the wipe samples show residual contamination. The container storage areas will be deemed suitable to be left in place if the sample analytical results meet the closure performance standards described in Section 4.1.

In addition, four soil samples from CS-1 and CS-2 will be collected and analyzed as described in Section 5.10.

5.9 FILTER PRESS CLOSURE

Step 22. Filter press plates from FP-#2A will be removed from the filter press and managed as hazardous waste debris. The frames, surrounding areas on the structure, and structural support members under the filter presses will be washed with a high-pressure water spray as described in Section 5.11.2 to remove accumulated sludge. Visqueen plastic will be draped around the equipment and used as necessary to confine the spray washing. A visual closure performance standard will be used. The cleaned metal components will be either be sent off site as scrap metal or sent to a landfill as non-hazardous waste. Piping will either be managed as a closure generated waste or cleaned to the closure performance standard and managed as non-hazardous waste. Soil samples from two locations under the filter press will be collected as described in Section 5.10.

5.10 CONFIRMATION SOIL AND CONCRETE SAMPLING

This section describes the methods for collecting confirmation soil and concrete samples to demonstrate that the closure performance standard in Section 4.1 has been met. Soil and concrete samples will be collected at the locations identified on Figure CP-2 and summarized in the Sample Summary Table in Appendix B. These sample locations cover all waste management locations identified in Closure Plan Section 3.3. In addition, background soil samples will be collected from at least four locations that were not impacted by hazardous waste or residues.

Step 23. When soil samples are collected from under concrete containment areas it will be necessary to core through the concrete. The top portion of this core will also serve as the concrete sample for analysis and comparison to the closure performance standard. When additional concrete samples are needed, such as from background locations, they can also be obtained by using a drill with masonry bit, Roto-Hammer, or core drill to collect samples for laboratory analysis. The minimum volume of sample to be collected will be determined by the analytical laboratory. Refer to the Sampling and Analysis Plan in Appendix A. A minimum of four background concrete samples will be collected from concrete areas not exposed to hazardous wastes.

Step 24. At least 48 hours prior to drilling, the site boundaries will be marked with white paint, and Underground Service Alert (USA) will be notified as required by law. In addition, a drilling permit will be obtained from the local Water District, if required. A professional utility locating service will also be hired to attempt to identify the location of underground utilities in the near vicinity of proposed boring locations. The drilling contractor will not be allowed to advance a boring within three feet from a known underground utility.

Notify DTSC of the anticipated soil sampling efforts in accordance with the schedule and procedures prescribed by them.

Step 25. Core drill holes through asphalt or concrete as needed to collect samples in the approximate locations shown in Figure CP-2 and/or described in the Sample Summary in Appendix B. Actual sample locations can only be determined after identification of subsurface utilities by the procedures in Step 24.

Step 26. The borings will be advanced using truck-mounted direct push equipment in the presence of a field geologist. The borings will be advanced to about six feet

below ground surface (bgs). Soil samples will be collected at six inches to one foot bgs and also at about three feet and six feet bgs. Soil samples will be obtained using a direct push sampler (for example, Geoprobe) with plastic (acetate) liners or stainless steel liners. Brass sample tubes will not be used to avoid possible cross-contamination.

The direct push method for soil sampling is preferred because it minimizes excess soil cuttings and does not generate dust during sampling. The soil borings and samples will be collected from the approximate locations shown in Figure CP-2 and/or described in the Sample Summary in Appendix B. The borings will be continuously cored and boring logs generated. The geologist will screen extracted soil cores for physical evidence of contamination (e.g., odors, chemical sheen, or discoloration). The soil samples will be cut from the acetate sample tubes, sealed with Teflon tape, capped, labeled, and placed in a pre-chilled ice chest.

After the samples are collected, each boring will be backfilled with grout. The collected samples will be transferred under formal chain-of-custody documentation to a state-certified laboratory to be analyzed individually as specified in the Sampling and Analysis Plan (Appendix A) and in Section 11.

Step 27. Background samples will be similarly collected from the approximate six locations identified in Figure CP-2.

Step 28. Attainment of the closure performance standard will be determined by comparison of analytical data to the background levels or the risk-based closure performance standard developed in accordance with Section 4.1. If necessary to achieve the closure performance standard, soil will be removed. Removal procedures shall follow the procedures in Section 5.14. In lieu of removal, the Facility may elect to remediate the soil. However, the methods of remediation used shall be submitted to DTSC for review and approval prior to implementation.

Step 29. Based on a review of the initial soil data, an evaluation will be made whether additional soil samples from other depths and/or locations are warranted and if grab groundwater samples are required or if samples should be collected from on site monitoring wells, if they are properly located and are functional. If grab groundwater samples are obtained, a minimum of three samples will be collected with one being upgradient of the Facility. The procedures identified in Closure Step 24 shall be followed prior to collection of groundwater samples.

5.11 PROCEDURES FOR SANDBLASTING AND PRESSURE WASHING

Sandblasting or pressure washing methods used at the site to clean horizontal or vertical surfaces shall be performed as described below.

5.11.1 Sandblasting

Abrasive blasting methods will be used on exterior surfaces of tanks and on containment areas only when high-pressure washing is determined to not be effective. When abrasive blasting is used, preference shall be given to wet methods. Furthermore, all applicable provisions of South Coast Air Quality Management District (SCAQMD) Regulations shall be followed to minimize

the effects of carryover. Dry unconfined abrasive blasting shall not be used unless the abrasives have been approved for use by SCAQMD.

All residues from abrasive blasting shall be managed as a closure waste as described in Section 3.4 after they are characterized as described in Section 6.0.

5.11.2 Pressure Washing

During pressure washing operations, workers shall follow at a minimum the procedures identified in the Health and Safety Plan. In addition, the workers shall take measures to prevent carryover of the spray into non-target areas especially off site or onto soil areas of the facility. The specific measures to be used will depend on the surfaces to be cleaned and other factors such as:

- Whether the surface to be cleaned is horizontal or vertical,
- The elevation of the surface to be cleaned,
- Whether the surface is inside or outside of a structure,
- The presence and height of containment walls,
- Whether it is an internal surface or external surface (for example, it may be possible to clean the inside of a tank without special precautions to prevent overspray),
- The pressure of the pressure washing system and physical or chemical additives that may be used to enhance the cleaning effectiveness,
- Other engineering controls that may be used to control the pressure washing process.

Measures to be used may include a shield on top of secondary containment walls; enclosures similar to welding hoods or sandblasting shrouds; or wand and nozzle combinations that control the direction of spray so as to reduce the possibility of overspray. Furthermore, tanks shall be cleaned within secondary containment systems so that the wash water may be collected and managed as a closure waste as described in Section 3.4 after they are characterized as described in Section 6.0. Residues from pressure washing secondary containment surfaces shall be removed by pump or by wet vacuum and similarly managed as closure waste.

5.12 CLEANING CLOSURE EQUIPMENT

Step 30. Upon nearing completion of closure, or upon completion of specific closure steps, closure equipment used will be decontaminated. One or a combination of more than one of the following techniques will be used: high-pressure water wash; steam cleaning; acidic or basic rinses; or cleaning in a solution of a commercial cleaner, followed by triple rinsing with clean potable water. Pressure washing shall follow the procedures in Section 5.11. These cleaning wastes will be collected and managed as described below in Section 5.13.

5.13 DISPOSITION OF CLOSURE WASTES

Step 31. All closure-generated wastes will be properly containerized or bulked. The waste streams will be properly characterized in accordance with Section 6 to determine their proper waste classification. All closure waste will be managed as described in Section 3.4.

Records will be maintained of all shipments from the site including materials to be reused, scrap metal, and non-hazardous wastes.

5.14 REMOVAL OF CLOSURE WASTES

For the purposes of this Closure Plan, it is assumed that there will be the following waste shipments from closure activities:

- Truck shipment (bulk) and truck shipment of drums for remaining inventory of off-site waste at facility
- Rinse water from closure decontamination
- Roll-off bins of closure-generated waste (and one of on-site generated waste)

Closure wastes generated on site shall be loaded onto trucks in a manner to minimize the potential for spills and other releases. Trucks will be staged on neighboring industrial streets in a way to not impede traffic flows. A minimum number of trucks will be allowed to enter the Facility so as not to interfere with site safety and equipment. Containerized waste in plastic or fiber containers will be placed securely on wood or plastic pallets and handled by a fork truck. Containerized waste in metal drums will be handled by a fork truck with drum grabbers or placed securely on wood or metal pallets. Loading shall occur in contained areas. If there were any spills or releases suspected during the loading process and such containment areas had been previously cleaned prior to their use, they may require further cleaning and additional confirmation samples may be needed. Prior to leaving the site, the trucks will be inspected for proper shipping paperwork, integrity of the load (including the use of tarps) and cleanliness.

If closure confirmation samples for soil indicate that the closure performance standard has not been met and soil excavation is required the procedures below shall be followed. Additional marking of utilities will be required in each area of excavation. A grading permit will be obtained from the city, if required. Any other permits will be obtained as required, for example from the South Coast Air Quality Management District.

If an excavation is to be greater than five feet in depth, a competent person shall be on site. A competent person can be an industrial hygienist, safety engineer, professional engineer, or other supervisor, who, by way of training or experience, is capable of classifying soils in accordance with 29 CFR 1910.120 Subpart P, Appendix A and who is also capable of identifying existing and predictable hazards in the excavation/trenching work area and who has the authority to take prompt corrective measures to eliminate them.

The contractor will use only experienced, demonstrably proficient, equipment operators for use of a backhoe or excavator to remove soil. Soil that is excavated will preferably be loaded directly into trucks for direct transit to a pre-determined and properly licensed disposal facility. If soil is to be staged before shipment for waste characterization or other purposes, the requirements of HSC 25123.3 for remediation waste staging shall be followed. If it is necessary to stockpile soil it will be placed onto high-density polyethylene sheet with a minimum thickness of 60 mils. Provisions such as tarps shall be employed to minimize wind blowing of the soil. In addition, soil being loaded onto trucks shall be moistened sufficiently to reduce windblown emissions. Wetting will not be necessary for soil types such as compacted clays that will not be dispersed by the wind. The dumping height of the soil shall also be minimized to further reduce potential emissions. Once loaded, the soil shall be covered by a tarp before the truck travels on public roads.

The extent of soil excavation, if any, cannot be determined at this time. Coordination will be required with the destination facility to assure that the anticipated soil volumes can be managed and to determine the daily limits that may be imposed on the waste soil shipments. Refer to Section 3.4 of this Closure Plan for guidance on appropriate waste disposal facilities.

If any concrete or asphalt secondary containment areas or other surfaces are to be removed, they will need to be broken into pieces that can be handled by an excavator bucket and loaded into a truck. When breaking concrete surfaces, the generation of dust shall be minimized through use of a water mist, selection of size reduction technique, or other measures. It will not be necessary to tarp truckloads of concrete or asphalt rubble.

6.0 CHARACTERIZATION OF CLOSURE WASTES

Closure wastes will be classified as hazardous or nonhazardous prior to disposal. The general methodology will be to first determine if the waste is a federal Resource Conservation and Recovery Act (RCRA) hazardous waste and then if it is a California-only (non-RCRA) hazardous waste. This procedure is consistent with Section 66262.11 of Title 22 of the California Code of Regulations (22 CCR 66262.11). If the waste is not hazardous under both federal and state laws and regulations, the closure wastes may be disposed of as non-hazardous waste.

Waste classification procedures are fully described in the Sampling and Analysis Plan (Appendix A to the Closure Plan). For wastes that are sampled for waste characterization purposes, the sample control provisions of Section 11 shall be followed. This includes the use of appropriate analytical techniques, use of a California-certified laboratory and chain-of-custody procedures. Wastes that are determined to be hazardous from this evaluation will be placed in appropriate containers, labeled as hazardous wastes, and manifested and transported to an off-site permitted TSDF for recycling or disposal as hazardous waste.

Water used for decontamination of tank or containment surfaces may be processed in the on-site wastewater treatment system prior to the wastewater treatment system being decontaminated. Such wastewaters must be treated to meet the permitted discharge conditions with the LACSD. Once the regulated wastewater treatment components have completed closure activities as described in Section 5, rinse waters shall be accumulated and managed as a closure waste.

In addition to properly characterizing closure wastes to determine if they are hazardous or not, the applicability of California and/or federal EPA Land Disposal Restriction Requirements (LDR) must be determined. The LDR status must be properly asserted on the waste profile or with the shipment manifest depending on the preference of the destination facility. See additional information in the Sampling and Analysis Plan, Appendix A of the Closure Plan.

7.0 PREVENTION OF CONTAMINATION DURING CLOSURE

It is not anticipated that performance of closure activities will impact a saturated zone of soil. Closure activities will be performed in a safe, well-organized manner and no additional precautions or special procedures are expected to be necessary. Any rainfall that occurs prior to completion of closure will be pumped to a clean tank and managed in the wastewater system on site and discharged to Los Angeles County Sanitation District under permit. Accumulated storm water may also be managed appropriately as a closure waste as described in Section 3.4 after being appropriately characterized as described in Section 6.0.

8.0 PARTIAL CLOSURE ACTIVITIES

The closure as outlined in this Closure Plan is intended to constitute the final closure of the identified units, which comprise only a portion of the facility. However it is likely that closure of these units would occur concurrently with full facility closure. If during the course of operations it may be necessary to close a portion of hazardous waste management unit in the facility, t will be deemed partial closure. An example of this type of closure would be replacement of a tank that has developed a leak or when a tank integrity assessment indicates that the minimum shell thickness is inadequate for storage or treatment.

Tanks and ancillary equipment may be closed in their original location, or moved to an alternative location on the site, as long as the closure is conducted within a secondary containment system. Tanks and ancillary equipment shall be moved to an alternative location only if such transport can be achieved without spilling any waste from the vessel or ancillary equipment; and the movement will not jeopardize the integrity of the waste management equipment. The Facility shall maintain records of partial closure activities and include them with the final documentation of Closure as described in Section 13. The procedures for partial closure should follow the same procedures described in this Closure Plan to the extent practical. (For example, closure of an FRP tank so that it can be used in non-hazardous service would follow the cleaning requirements for tanks in this Closure Plan.

9.0 SCHEDULE FOR CLOSURE

The closure schedule is provided in Figure CP-3 and shows the activities and estimated time to complete each in weeks (assuming 4 weeks per month). This schedule shows completion of all closure activities within 180 days of DTSC approval of the Closure Plan. If an extension is required, such a request shall be made to DTSC in accordance with 22 CCR 66264.113(b).

10.0 CLOSURE COST ESTIMATE

In a letter dated November 17, 2015 to Mr. David Thaete of Phibro-Tech, Inc., the Department requested a closure cost estimate be provided for the units being added as part of the December 2015 Class 2 Permit Modification. A closure cost estimate and the Cost Pro computer model output is provided in Attachment 10 to the Class 2 Permit Modification package and was estimated to be $359,207. This closure cost will be added to the currently approved closure cost estimate until a new closure cost basis is approved via the Part B renewal or other process.

10.1 REGULATORY REQUIREMENTS

- PTI has prepared a closure cost estimate in accordance with 22 CCR 66264.142(a).
- PTI will adjust the closure cost estimate annually for inflation, and/or other factors, in accordance with 22 CCR 66264.142(b). PTI will make this adjustment within sixty days prior to the anniversary date of its closure financial assurance mechanism.
- PTI will revise the closure cost estimate as necessary in accordance with 22 CCR 66264.142(c), within thirty days of any modification of the closure plan that results in a change in the cost required to close the facility.
- PTI will maintain at the facility a copy of the most current cost estimate in accordance with 22 CCR 66264.142(d).

10.2 COST FACTORS

The unit costs associated with closure of the facility are based on the following assumptions and procedures.

- The unit costs for all closure activities are based on the cost of hiring a third party to close the facility. A third party is someone other than the parent or subsidiary of the owner or operator. However, it is intended that trained site personnel will be used to conduct closure activities to the greatest extent possible in order to maintain continuity of facility operation.

10.2.1 Assumptions

- Cost for decontaminating sampling equipment between samples is considered to be negligible.
- Detailed estimates for sampling and analytical costs are included in the CCE. An allowance for Quality Control/Quality Assurance (QA/QC) samples is included at the rate of one QA/QC sample per eight samples. This is to account for duplicates, field blanks, and equipment blanks. No cost for collecting the QA/QC samples was assumed since these will normally be blanks or split from another sample already collected.
-

11.0 SAMPLE CONTROL

The closure procedures will require samples of one or more of the following materials: wastewater, liquid wastes, solid wastes, wipe samples, concrete samples, and soil samples. All sample collection, handling, and analysis procedures will be done in accordance with EPA Publication SW-846. All samples will be labeled and sealed to prevent contamination or tampering.

To establish the documentation necessary to trace sample possession from the time of collection, a Chain-of-Custody Record will be filled out and will accompany every set of samples. Only laboratories that are state certified for the specific analyses desired may be used.

The laboratory will follow established quality control protocols throughout the analyses. This will include blanks, spikes, internal standards, and duplicate samples. This information will be available for each sample set.

Further details are presented in the Sampling and Analysis Plan in Appendix A.

12.0 FACILITY SECURITY ARRANGEMENTS DURING CLOSURE

During closure, the Facility access gates will be locked when no one is on site. All perimeter fencing will be maintained intact and the current alarm system will be maintained. Signs stating, "Danger Hazardous Waste - Unauthorized Personnel Keep Out" will be maintained at conspicuous points around the Facility perimeter. Visitors will gain access to the site thorough a controlled location during closure work. A security guard will be stationed at the entrance to control access during the work period. These security measures are designed to prevent exposure of unauthorized individuals during execution of the closure activities. If necessary, security guards will be hired to control access to the site.

13.0 CLOSURE REPORT AND CERTIFICATION

Closure activities will be completed as described in this plan. Any deviations from the plan will be documented in the closure report. The closure report will also document the sampling and analytical results of all confirmation samples. Records of the disposition of all hazardous wastes and hazardous materials will be included in the closure report.

The closure report will be prepared within the DTSC required 60 days of completion of closure and will contain a certification from the owner or operator of the Facility and an independent certifying engineer. The certification will include the certification statements required under 22 CCR 66264.115. In accordance with DTSC regulations, the certifying engineer will be a registered professional engineer in California.

The Closure Report will contain, at a minimum, the following:

1. Certification by an independent registered professional engineer;
2. Supervisory personnel description;
3. Summary of Closure Activities;
4. Field Engineer Observation Reports;
5. Sampling Data and Analyses (i.e., sampling locations, soil boring logs, chain of custody, analytical results, etc.);
6. Discussion of Analytical Results;
7. Manifests showing disposition of waste inventory;
8. Modifications and Amendments to Closure Plan (if applicable);
9. Photographs.

Until Facility Closure is obtained, the following documents will be maintained and readily available to DTSC upon Facility visits until the approval of closure certification:

- Approved closure plan
- Copies of the independent qualified professional engineer's field observation reports
- Laboratory results of samples analyzed
- Quality assurance/quality control demonstrations
- Manifests showing disposition of waste inventory
- Miscellaneous documentation (e.g., photographs)
- Closure certification report

14.0 PLAN AMENDMENTS

This Closure Plan may be amended any time prior to the notification of partial or final closure of the Facility as provided by 22 CCR 66264.112(c). Amendments will be made:

- Whenever changes in the Part B Permit or design of the Facility affect the Closure Plan, or
- There is a change in the expected year of closure, or
- Unexpected events occur while performing partial or final closure activities that require a modification of the approved Closure Plan.

The Facility will modify the Closure Plan upon authorized request by DTSC. Such an amendment will be submitted within 60 days of the request, or within 30 days if this occurs during partial or final closure activities. Amendments to the Closure Plan will be in accordance with 22 CCR 66264.112.

In particular, the Closure Plan will be amended and submitted to DTSC for review and approval if extensive soil contamination is discovered during implementation of the closure work plan. Such an amendment will address the required removal or remediation procedures necessary to achieve the Closure Performance Standard in Section 4.1.

15.0 MISCELLANEOUS REQUIREMENTS

This section lists remaining regulatory requirements and how they apply to the Facility.

15.1 POST-CLOSURE PLAN/CONTINGENT POST-CLOSURE PLAN

The objective of this Closure Plan is to close the Facility in a manner that precludes the need for post-closure care. Some allowances have been made to facilitate this. These include the following:

- Preparation of a Health Risk Assessment to determine site-specific, risk-based cleanup goals.

Should extensive soil contamination be detected that cannot be adequately removed, or the groundwater quality has been impacted, an amended Closure Plan will be submitted to DTSC for review and approval. This amendment shall include a Post-Closure Plan and Post Closure Control Cost Estimate (see Section 15.3).

15.2 SURVEY PLAT

This requirement will apply if the site is closed and hazardous waste remains on site in the soil (i.e., the Closure Performance Standard for clean closure is not attained). In such a case, the Facility shall discuss with DTSC options for additional removal or remediation of subsurface contaminants, or whether such materials will remain on site. If waste contaminants are to remain on site with DTSC concurrence, the Facility shall submit a survey plat to the local zoning authority, or the authority with jurisdiction over land use, and to DTSC. This shall be submitted no later than the submission of the Closure Certification Report (see Section 13). Sufficient subsurface investigation data from closure samples as well as other historical samples must exist so that the survey plat can indicate the location and dimensions of hazardous waste disposal units with respect to permanently surveyed vertical and horizontal benchmarks. This plat shall be prepared and certified by a professional land surveyor licensed in California. The documents filed with the local authority with jurisdiction over land use, must state the owner's or operator's obligation to restrict disturbance of the hazardous waste area in accordance with DTSC regulations.

15.3 POST-CLOSURE COST ESTIMATE

Using the soil cleanup levels described in **Section 4.1**, if not all contaminated soils and groundwater can be practically removed at time of closure, Contingent Post-Closure Requirements will be employed. These will be as described in Section 15 of the May 2013 Pond 1 Closure Plan.

TABLES

Table CP-1
FACILITY WASTE STREAM IDENTIFICATION TABLE

Facility Waste Type Code[1]	Waste Stream	Physical Description	Typical EPA Waste Codes[2,3]	Typical California Waste Codes[4]	Hazardous Properties	Waste Handling Processes
A	**Copper Sulfate Crystal**	Solid deep blue crystals	D002; D004, D006, D007, D008	133, 141, 171, 172, 181	Corrosive and Toxic	Treatment, Transfer, Consolidate, Storage
B	**Copper Sulfate Solution**	Blue liquid	D002; D004, D006, D007, D008	132, 133, 135, 141, 791, 792	Corrosive and Toxic	Treatment, Transfer, Consolidate, Storage
C	**Cupric Chloride Etchant**	Dark Green Liquid	D002; D004, D006, D007, D008	132, 135, 141, 791, 792	Corrosive and Toxic	Treatment, Transfer, Consolidate, Storage
D	**Sludge, Copper or Nickel**	Green/black semi-solid sludge	D002; F006, D004, D006, D007, D008	132, 135, 162, 171, 172, 181, 421, 491	Corrosive and Toxic	Treatment[5], Transfer, Consolidate, Storage
E	**Nitric Acid Copper Rack Strip**	Green to Blue Liquid	D002; D001, D004, D006, D007, D008	132, 135, 141, 726, 791, 792	Corrosive and Toxic	Treatment, Transfer, Consolidate, Storage
F	**Solder Tin Stripper**	Liquid, various colors, may contain solids	D002; D004, D006, D007, D008	132, 135, 141, 792	Corrosive and Toxic	Treatment, Transfer, Consolidate, Storage
G	**Copper / Nickel Plating / Stripping Solutions**	Dark Green to Blue Liquid	D002; D004, D006, D007, D008	132, 135, 141, 726, 791, 792	Corrosive and Toxic	Treatment, Transfer, Consolidate, Storage
H	**Ferric Chloride Solution**	Brown to Green Liquid	D002; K062, D004, D006, D007, D008	132, 135, 141, 791, 792	Corrosive and Toxic	Treatment[5], Transfer, Consolidate, Storage
IA	**Miscellaneous Inorganic Acid**	Liquid, various colors, may contain solids	D002; D004, D006, D007, D008	123, 131, 132, 133, 135, 141, 721, 722, 723, 724, 726, 727, 791, 792	Corrosive or Corrosive and Toxic	Treatment, Transfer, Consolidate, Storage
IB	**Miscellaneous Inorganic Base**	Liquid, various colors, may contain solids	D002; D004, D006, D007, D008	121, 122, 123, 131, 132, 133, 135, 141, 541, 721, 722, 723, 724, 726, 727	Corrosive or Corrosive and Toxic	Treatment, Transfer, Consolidate, Storage
J	**Spent Alkaline Copper Etchant**	Dark Blue Liquid	D002; D004, D006, D007, D008	121, 123, 141, 132, 135	Corrosive and Toxic	Treatment, Transfer, Consolidate, Storage
K	**Alk-Cu-Strip Copper Etchant**	Dark Blue Liquid	D002; D004, D006, D007, D008	121, 123, 141, 132, 135	Corrosive and Toxic	Treatment, Transfer, Consolidate, Storage
L	**Non-Hazardous, Miscellaneous Wastes**	Liquid, various colors	N/A	N/A	N/A	Treatment, Transfer, Consolidate, Storage
M	**Oily Water**	Clear or brown/gray liquid, may contain solids	D004, D006, D007, D008	132, 133, 134, 135, 221, 222, 223, 241, 331, 342, 343, 352, 491, 551	Toxic	Treatment, Transfer, Consolidate, Storage

1. The Facility waste type letter code system is subject to change, however, the Facility will be limited to onsite management of wastes containing only permit-approved EPA and California waste codes.
2. EPA Code D002 is typically the primary waste code for metal wastes; additional waste codes listed may be attached to waste streams by the generator for LDR or other purposes. See Tables C-1 and C-2 for a complete listing of all acceptable waste codes.
3. D002 - Corrosivity; D004 - Arsenic; D006 - Cadmium; D007 - Chromium; D008 - Lead; F006 - Wastewater treatment sludges from electroplating operations (see 22 CCR 66261.31(a) for electroplating operations that are exceptions to this waste code), and K062 - Spent Pickle Liquor
4. California Waste codes defined in 22 CCR 66261 Appendix XII
5. RCRA Listed waste codes will be accepted for storage, consolidation in containers, and transfer but will not be treated in on site tanks.

FIGURES

Figure CP-2 - Facility Layout

LEGEND:

- AREA "C" (SEE SHEETS 4)
- AREA "J" (SEE SHEETS 5)
- AREA "F" (SEE SHEETS 6.0 & 6.1)
- AREA "S" (SEE SHEETS 8)
- AREA "W" (SEE SHEETS 9)
- AREA "CS2" (SEE SHEET 11)
- AREA "CS1" (SEE SHEET 10)

TANKS

OVERALL SITE MAP

SCALE: 1" = 20'

30' 0 30' 60' 90'

SCALE: 1" = 30'

NO.	DATE	REVISION DESCRIPTION	APP'D	DATE

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CONSULTING ENGINEERS IN CIVIL / STRUCTURAL ENGINEERING & SURVEYING
314 E. KATELLA AVENUE
ANAHEIM, CALIFORNIA 92805
(714) 385-1835, FAX (714) 385-1834

REGISTERED PROFESSIONAL ENGINEER
TRYFON TRYFONOPOULOS
C 65859 EXP. 12/31/15
CIVIL
STATE OF CALIFORNIA

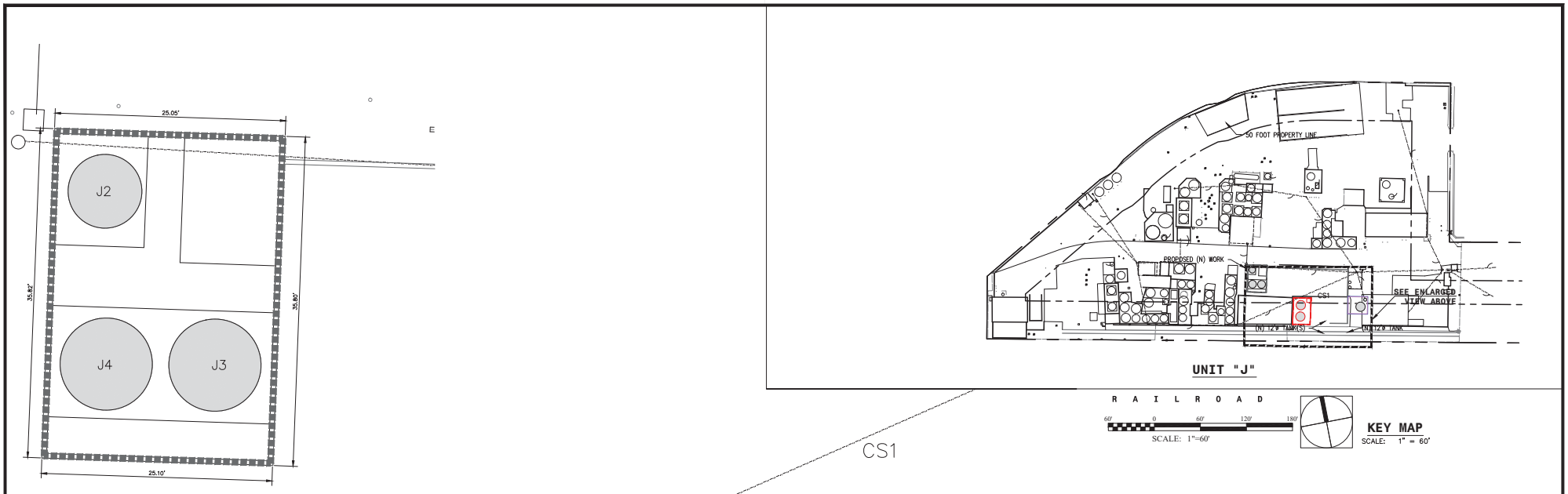
12 / 3 / 2015
TRYFON TRYFONOPOULOS DATE

SITE PLAN-CURRENT OPERATIONS

PHIBRO-TECH
8851 DICE ROAD, SANTA FE SPRINGS, CALIFORNIA 90670
(562) 698-8036

JOB NO. 131131.CS
DATE: 12 / 3 / 2015
SHEET C2
2 OF 40 SHEETS

P:\Civil & Surveying\Projects\131131 Santa Fe Springs Tripolina\131131C02 - SITE PLAN CURRENT OPERATIONS.dwg Dec 03, 2015 - 1:36pm



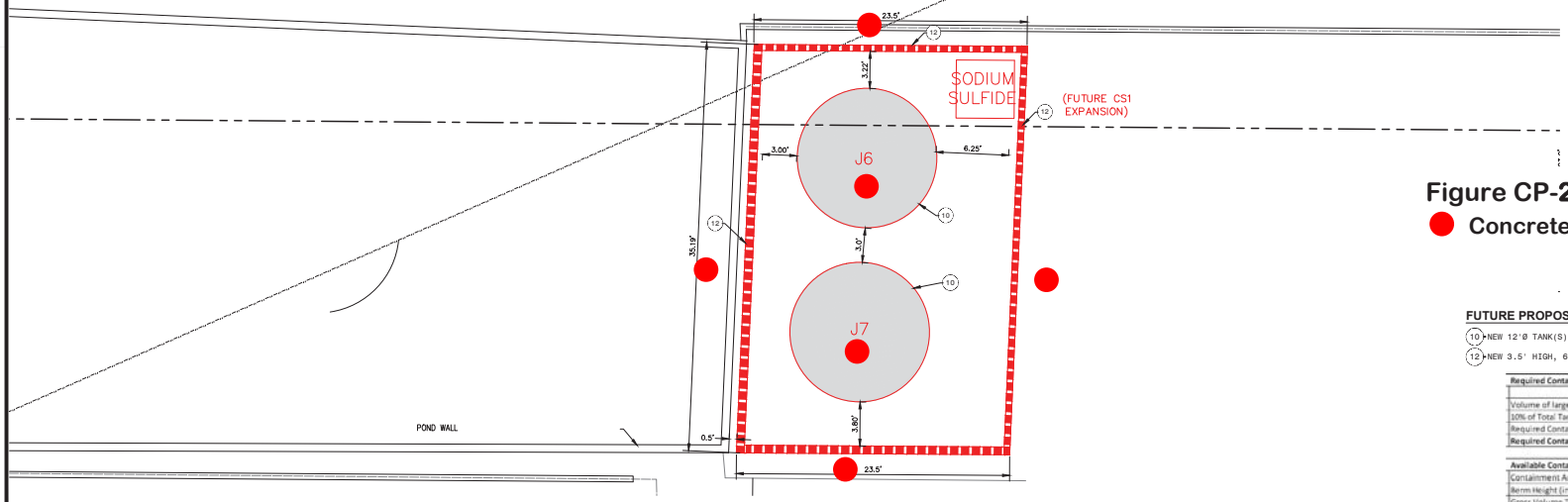


Figure CP-2 Closure Sampling Locations

● Concrete/soil sampling location (approx.)

FUTURE PROPOSED CONSTRUCTION NOTES:

(10) NEW 12'Ø TANK(S).(COLOR ——)

(12) NEW 3.5' HIGH, 6" THICK POURED CONCRETE WALL.(COLOR ——)

Required Containment Volume		
Item	value	Comments
Volume of largest Tank (Gal)	12,500.00	Containment of 17
10% of Total Tank Volume(Gal)	1,250.00	
Required Containment Volume (Gal)	1,250.00	
Required Containment Volume (ft^3)	**1,671.12**	

Available Containment Volume		
Containment Area (ft^2)	700.00	Irregular
Berm Height (in.)	42.00	overall height
Gross Volume Total (ft^3)	2,660.00	Area (E.) x Height (F)/12
Volume Rainfall (ft^3)	285.00	Rainfall at 25 yr-24hr max:4.5 inches
Footprint of other Tank Shells (ft^2)	-	Subtract out footprint of tanks
Volume of other Tank Shells (ft^3)	145.00	Volume of other shells(area of each tank x [dike height - pad height]
Volume of Pads (ft^3)	-	
Available Containment Volume (ft^3)	2,230.00	Gross Vol. (G) - Rain Vol (H) -Tank Shells (K) -Pad (L)
Meets Volume Requirments?	yes	If Line (M) > Line (D)

NO.	DATE	REVISION DESCRIPTION	APP'D	DATE

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314 E. KATELLA AVENUE
ANAHEIM, CALIFORNIA 92805
(714) 385-1835, FAX (714) 385-1834

REGISTERED PROFESSIONAL ENGINEER TRYFON P. TRYFONOPOULOS NO. 65859 EXP. 12/31/15 CIVIL STATE OF CALIFORNIA

TRYFON TRYFONOPOULOS — 12 / 3 / 2015 DATE

UNIT J-FUTURE TANK AND CONTAINMENT DETAILS

PHIBRO-TECH INC.
PHIBRO-TECH
8851 DICE ROAD, SANTA FE SPRINGS, CALIFORNIA 90670
(562) 698-8036

JOB NO. 131131.CS
DATE: 12 / 3 / 2015
SHEET **C16**
16 OF 40 SHEETS

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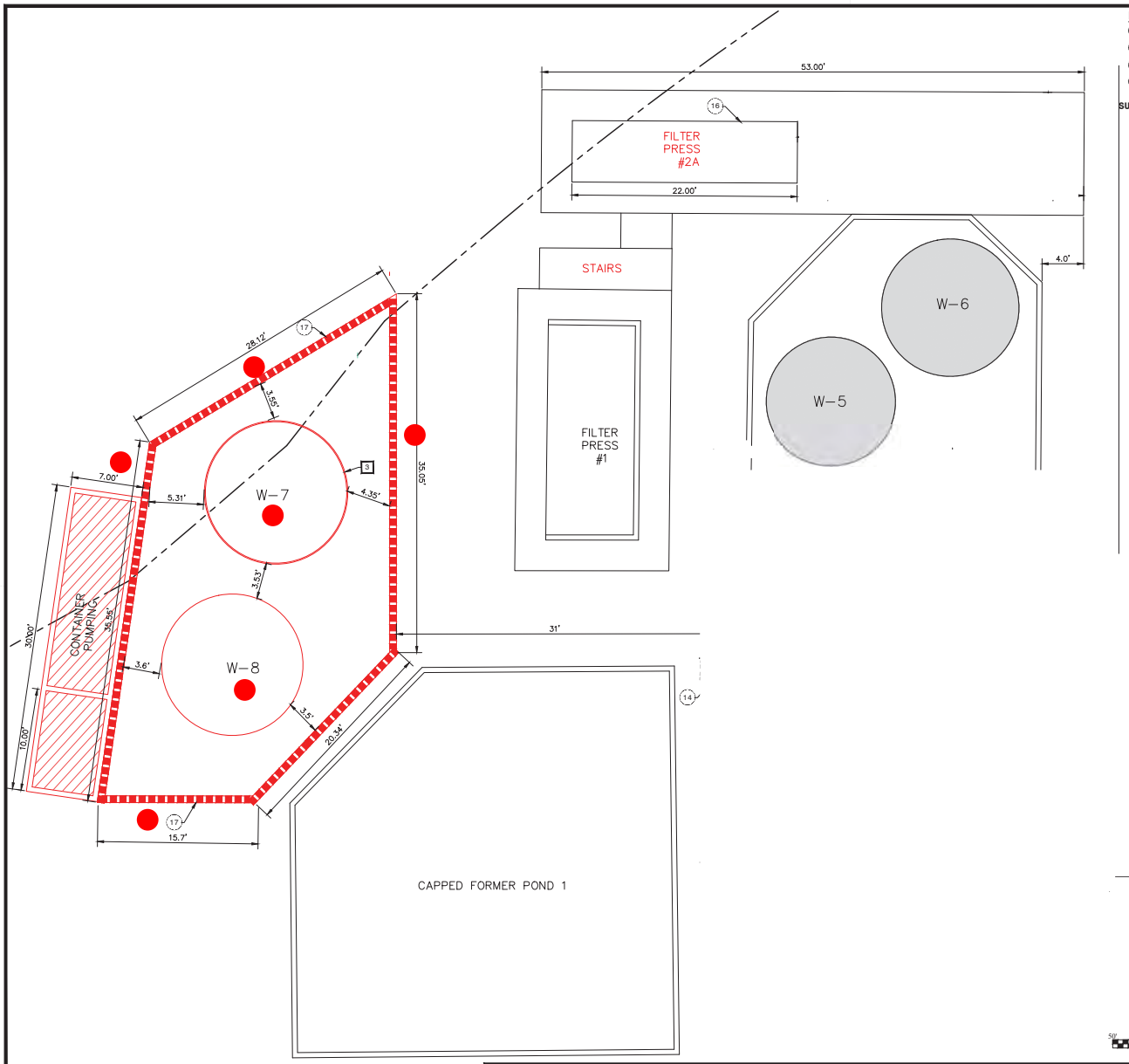


FUTURE PROPOSED CONSTRUCTION NOTES:

3 - NEW 14' DIA. TANK. (COLOR ——)

14 - NEW 6' (HEIGHT OF THE CONTAINMENT WALL), 6" THICK WALL. (COLOR ——)

16 - NEW FILTER PRESS.(COLOR ——)

17 - NEW 72" HIGH, 6" THICK WALL. (COLOR ——)

FUTURE PROPOSED DEMOLITION NOTES:

3 - REMOVE AND DISPOSE OF EXISTING CMU WALL.(COLOR ——)

SUBAREA W4: Containment Sub Area W4 (Proposed)

Tank Identification	Volume (gal)	Volume (cf)	Diameter (ft)	Footprint (ft^2)	Location	Shell Hgt (in.) w/in containment	Shell vol (ft^3)
W-7	30,500.00	4,077.54	14	153.86	New Pad	66	846.23
W-8	30,500.00	4,077.54	14	153.86	New Pad	66	846.23
Totals	61,000.00	8,155.08		307.72		This is the area of the tank that would occupy containment vol. and must be excluded.	1692.46

Pads Internal to Containment Area

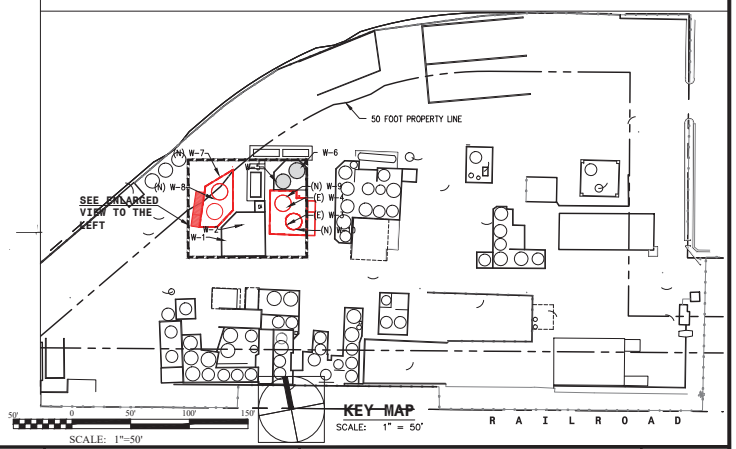
Description	Dimesions (width)(ft.)	Length (ft.)	Depth (in.)	Vol. (ft^3)
New Pad	0	0	0	0.00
Total				0.00

Ref.	Required Containment Volume Item	value	Comments
A.	Volume of largest Tank (Gal)	30,500.00	Tank W-7
B.	10% of Total Tank Volume(Gal)	4,000.00	
C.	Required Containment Volume (Gal)	30,500.00	Greater of (A) or (B)
D.	**Required Containment Volume (ft^3)**	**4,077.54**	

	Available Containment Volume		
E.	Containment Area (ft^2)	925.00	Irregular
F.	Berm Height (in.)	72.00	overall height
G.	Gross Volume Total (ft^3)	5,550.00	Area (E.) x Height (F)/12
H.	Volume Rainfall (ft^3)	346.88	Rainfall at 25 yr-24hr max: 4.5 inches
J.	Footprint of other Tank Shells (ft^2)	846.23	Subtract out footprint of tank W-8
K.	Volume of other Tank Shells (ft^3)	846.23	Volume of other shells(area of each tank x (dike height - pad height)
L.	Volume of Pads (ft^3)	-	
M.	**Available Containment Volume (ft^3)**	4,356.90	Gross Vol. (G) - Rain Vol (H) -Tank Shells (K) -Pad (L)
N.	**Meets Volume Requirments?**	yes	If Line (M) > Line (D)

Figure CP-2 Closure Sampling Locations

● Concrete/soil sampling location (approx.)



AREA "W"
SCALE: 1" = 5'

5' 0 5' 10' 15'
SCALE: 1"=5'

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CONSULTING ENGINEERS IN CIVIL / STRUCTURAL ENGINEERING & SURVEYING
314 E. KATELLA AVENUE
ANAHEIM, CALIFORNIA 92805
(714) 385-1835, FAX (714) 385-1834

REGISTERED PROFESSIONAL ENGINEER — TRYFON P. TRYFONOPOULOS — C.E. NO. 65859 — EXP. 12/31/15 — CIVIL — STATE OF CALIFORNIA

TRYFON TRYFONOPOULOS — 12 / 3 / 2015 DATE

UNIT W-FUTURE TANK AND CONTAINMENT DETAILS

Phibro Tech Inc.
PHIBRO-TECH
8851 DICE ROAD, SANTA FE SPRINGS, CALIFORNIA 90670
(562) 698-8036

JOB NO. 131131.CS
DATE: 12 / 3 / 2015
SHEET **C19**
19 OF 40 SHEETS

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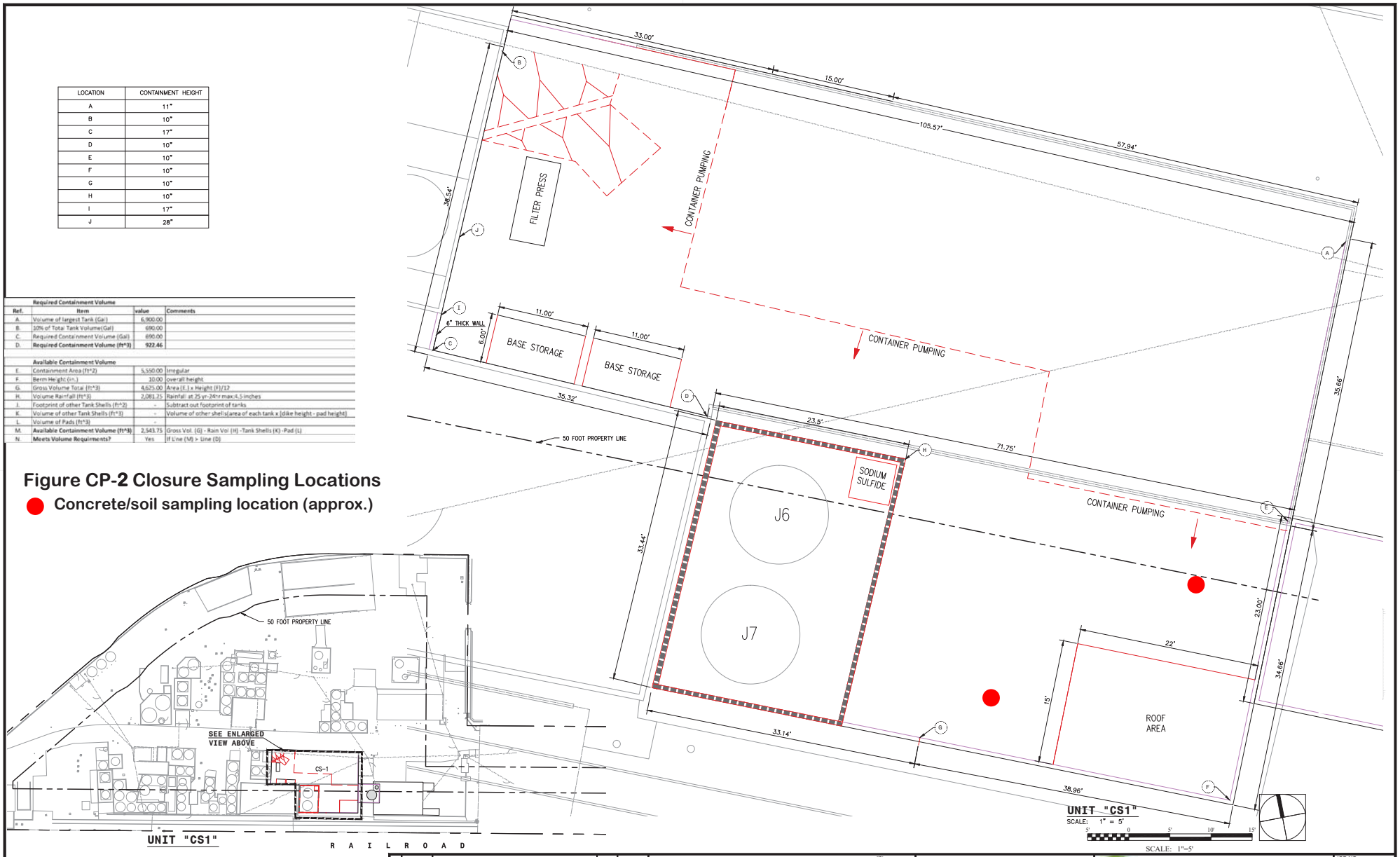
LOCATION	CONTAINMENT HEIGHT
A	11"
B	10"
C	17"
D	10"
E	10"
F	10"
G	10"
H	10"
I	17"
J	28"

Ref.	Item	value	Comments
	Required Containment Volume		
A.	Volume of largest Tank (Gal)	6,900.00	
B.	10% of Total Tank Volume(Gal)	690.00	
C.	Required Containment Volume (Gal)	690.00	
D.	**Required Containment Volume (ft^3)**	**922.46**	
	Available Containment Volume		
E.	Containment Area (ft^2)	5,550.00	Irregular
F.	Berm Height (in.)	10.00	overall height
G.	Gross Volume Total (ft^3)	4,625.00	Area (E.) x Height (F)/12
H.	Volume Rainfall (ft^3)	2,081.25	Rainfall at 25 yr-24hr max.4.5 inches
I.	Footprint of other Tank Shells (ft^2)	-	Subtract out footprint of tanks
K.	Volume of other Tank Shells (ft^3)	-	Volume of other shells(area of each tank x [dike height - pad height]
L.	Volume of Pads (ft^3)	-	
M.	**Available Containment Volume (ft^3)**	2,543.75	Gross Vol. (G) - Rain Vol (H) -Tank Shells (K) -Pad (L)
N.	**Meets Volume Requirments?**	Yes	If Line (M) > Line (D)

Figure CP-2 Closure Sampling Locations

● Concrete/soil sampling location (approx.)



KEY MAP

SCALE: 1" = 50'

50' 0 50' 100' 150'

SCALE: 1"=50'

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314 E. KATELLA AVENUE
ANAHEIM, CALIFORNIA 92805
(714) 385-1835, FAX (714) 385-1834

REGISTERED PROFESSIONAL ENGINEER TRYFON P. TRYFONOPOULOS NO. 65859 EXP. 12/31/15 CIVIL STATE OF CALIFORNIA

12 / 3 / 2015
TRYFON TRYFONOPOULOS DATE

CS1-FUTURE DETAILS

PHIBRO-TECH INC.
PHIBRO-TECH
8851 DICE ROAD, SANTA FE SPRINGS, CALIFORNIA 90670
(562) 698-8036

JOB NO. 131131.CS
DATE: 12 / 3 / 2015
SHEET **C20**
20 OF 40 SHEETS

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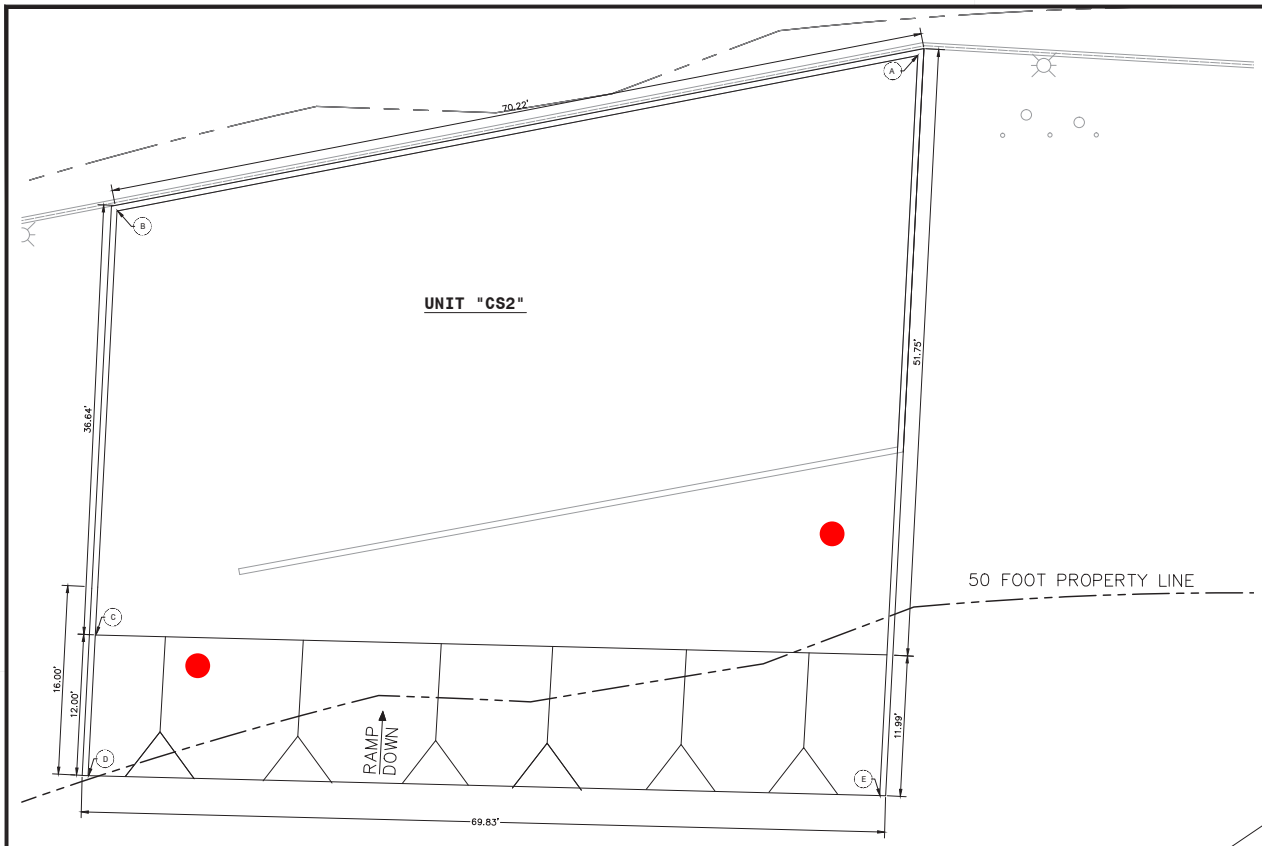

UNIT "CS2"

Required Containment Volume			
Ref.	Item	value	Comments
A.	Gross Volume (Gallons)	33321	
B.	Volume Rainfall (Gallons)	11494	
C.	Displacement Volume of Containers (Gallons)	3498	
D.	**Available Containment Volume (Gallons)**	**8329**	A-B-C
E.	Maximum Storage Capacity	83290	D. multiplied by 10

✱ NOTE: FOR DETAILS OF CALCULATIONS SEE REPORT "DESIGN OF PROPOSED EXPANSION FOR ERS 2 STORAGE AREA AT PHIBRO TECH FACILITY IN SANTA FE SPRINGS, CA."

LOCATION	CONTAINMENT HEIGHT	WALL THICKNESS
A	7"	6"
B	5"	6"
C	13.25"	6"
D	0"	6"
E	0"	6"

UNIT "CS2"
SCALE: 1" = 5'

5' 0 5' 10' 15'
SCALE: 1"=5'

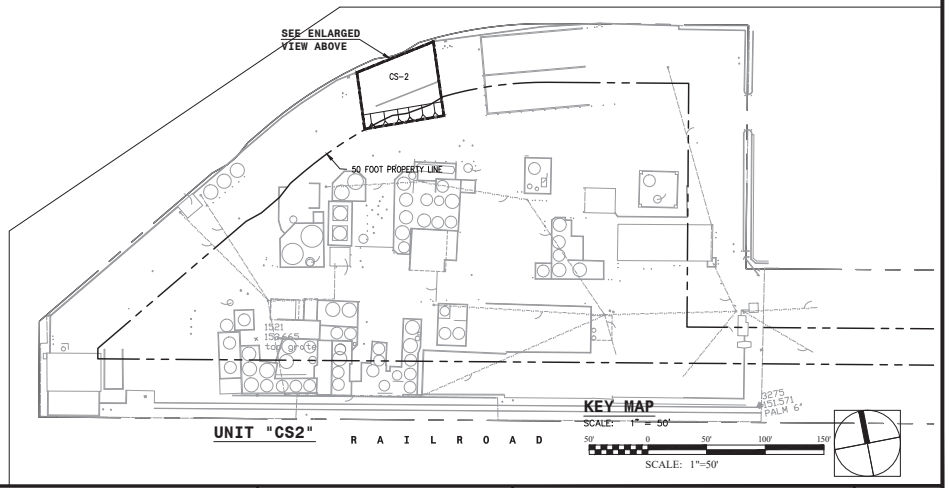

Figure CP-2 Closure Sampling Locations

● Concrete/soil sampling location (approx.)

NO.	DATE	REVISION DESCRIPTION	APP'D	DATE

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CONSULTING ENGINEERS IN CIVIL / STRUCTURAL ENGINEERING & SURVEYING
314 E. KATELLA AVENUE
ANAHEIM, CALIFORNIA 92805
(714) 385-1835, FAX (714) 385-1834

REGISTERED PROFESSIONAL ENGINEER TRYFON P. TRYFONOPOULOS NO. 65859 EXP. 12/31/15 CIVIL STATE OF CALIFORNIA

12 / 3 / 2015
TRYFON TRYFONOPOULOS DATE

CS2-FUTURE DETAILS

Phibro Tech Inc.
PHIBRO-TECH
8851 DICE ROAD, SANTA FE SPRINGS, CALIFORNIA 90670
(562) 698-8036

JOB NO. 131131.CS
DATE: 12 / 3 / 2015
SHEET **C34**
34 OF 40 SHEETS

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APPENDICES

APPENDIX A

SAMPLING AND ANALYSIS PLAN FOR FACILITY CLOSURE

CAD 008 488 025

Santa Fe Springs, California
TSD Facility

Appendix A to
Closure Procedures

Sampling and Analysis Plan for Facility Closure

Rev. September 2015

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Table 1A Sampling Methods And Containers For Closure Confirmation Samples
Table 1B Sampling Methods And Containers For Closure Waste Characterization Samples

Appendices

Attachment A Hazardous Waste Characterization Methodology

1.0 INTRODUCTION

This Sampling and Analysis Plan (SAP) has been prepared for closure sampling activities at the Phibro-Tech Inc. (PTI) facility in Santa Fe Springs, California (the Facility). This SAP will be reviewed and amended as needed at the time of closure.

1.1 SAMPLING AND ANALYSIS PLAN OVERVIEW

This SAP includes:

- Detailed description of the methods to be used to identify all tanks and drums at the Facility which contain liquid, sludge or solid material and to identify the volume of such materials within each tank and drum; and
- Detailed description of the sampling and analytical methods to be used to verify if the closure performance standards have been met from wipe samples, and samples of soils, concrete, rinsewaters, and groundwater.
- Detailed description of the sampling and analytical methods to be used to characterize the liquid, sludge, or solid material for disposal purposes.

1.2 RELATIONSHIP TO OTHER PLANS

This SAP describes specific field sampling procedures and laboratory analytical tests to be used during implementation of the Closure Plan. All work performed to implement this SAP shall also be performed in accordance with the site specific Health and Safety Procedures identified in the Closure Plan.

Although the project will follow general quality assurance procedures, a specific Quality Assurance Project Plan (QAPP) has not been prepared. A QAPP may be required at the time of closure if such actions are performed in accordance with rules under the federal Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).

2.0 SAMPLING OBJECTIVES

This SAP has been prepared to accomplish the following objectives:

- Identify whether wastes present on site at time of closure and closure-generated wastes at the Facility should be managed as RCRA hazardous waste, non-RCRA State of California hazardous waste, or non-hazardous waste;
- Help screen potential treatment, recycling, and disposal options;
- Obtain information needed for waste profiles;
- Assist in the safe-handling of waste materials at the Facility;
- Sample and analyze each waste layer (water, if present, sludge and solids);
- Collect samples from the containers to characterize the waste in each for disposal purposes;
- Determine if the Closure Performance Standard has been achieved.

3.0 SAMPLING PROTOCOLS

This section discusses the protocols for collecting samples from tank and equipment at the Facility, as well as closure confirmation samples for equipment, structures, and media such as soil and groundwater. The specific analytical methods to be used are discussed in Section 3.9 based on the constituents of concern at the Facility.

3.1 OVERVIEW

Samples will be collected from the top of the tanks and any rail cars present onsite. Before sampling activities occur, a mechanical and structural integrity examination will be made of the tank access platforms to determine if they can properly support the weight of sampling personnel and equipment. A manlift, ladder, or scaffolding will be used as necessary to provide additional sampling workspace and for transport of sampling personnel and equipment.

Multiple samples will be collected from each location as described in the specific sampling to be discussed. All samples will be collected from the existing openings in the top of the tanks.

All sampling activities shall be consistent with the approved HASP for the site. Sampling locations or procedures may be modified in the field to improve safety. Modifications to reduce safety requirements will require an amendment to the HASP.

3.2 LAYER MEASUREMENTS

The initial step in sampling any tank and/or rail cars will be to assess whether the contents have separated into different phases and to measure the thickness of each layer. This field verification will provide information so that targeted sample locations from each layer can be established.

The first measurement will be from the top of the tank to the top of the liquid layer. Measurements will be taken as needed to relate the elevation of the top of the sampling port to the top of the tank.

The depth of the liquid/sludge interface will be measured with a tape measure, a weighted platform to rest on top of semi-solid sludge, and/or a product-water interface sounder. If the liquid/sludge interface cannot be determined by these methods, a 500-milliliter stainless steel bomb sampler, or dredge sampler will be used to collect samples to estimate the location of the sludge layer.

The suspension cord for the bomb or weighted bottle sampler will be made of 304 stainless steel wire coated with Teflon, and will be depth calibrated. The sampler will be lowered in 6-inch increments around the assumed interface until the oil-water interface depth is identified. The sampler will be decontaminated between measurements by washing in a non-phosphate detergent solution and rinsing with tap water. The sampler will be lowered in 6-inch increments around the assumed interface until the water-sludge interface depth is identified.

3.3 COLLECTION OF SAMPLES FROM TANKS

Samples will be obtained from each tank and rail car as described in the Closure Plan. Since the tanks are not very large, it is believed that one sample location with collections at different depths (if different layers are present) will be sufficient to identify the wastes. The number of sample locations may vary based on the size of the tank and the size of the layer. It may be

necessary to collect multiple sample volumes at each location to fill all required sample containers.

Samples will be collected from the top of the tank using a manlift, ladder, or scaffold. The designated sampling locations may also be adjusted in the field based on access and health and safety considerations.

Sampling of the tank contents at each location will be from top to bottom within the tank so as to minimize the contamination of other layers. Sample collection equipment will be rigorously decontaminated as described below in the specific sampling procedures.

Table 1 summarizes all analytical test methods that may be used on collected samples.

3.3.1 Liquid Layers

Samples of the liquid will be collected using a peristaltic pump, a Coliwasa, a weighted-bottle sampler, or similar devices. These allow samples to be collected at targeted depths.

If a peristaltic pump is used, clean food-grade polyethylene tubing will be used for sample collection in each tank. The end of the tubing will be weighted with a clean stainless steel weight, suspended 6 inches below the end of the tubing.

To collect the sample, the tube will be lowered to the desired depth. Then the sampling pump will be turned on and run to purge 1.5 times the volume of the tubing at that depth. At this point, sample containers will be filled. The liquid pulled from the pump during this purge stage will be deposited back into the same tank it came from after sample(s) have been collected. The water sample will start at the highest depth and work down the tank. After all required sample containers are filled for that depth, the end of the tubing will be lowered to the next sampling depth. The sample tubing and the tubing at the pump head will be replaced at each sample location.

If necessary, liquid samples will be collected with a bomb or weighted bottle sampler. The sampler will be lowered to the proper depth, filled, then raised. The sampler will be poured into appropriate sample containers. The sampler will be lowered to the same depth and this process will be repeated until all sample containers have been filled. The sampler will be thoroughly decontaminated in accordance with standard procedures before the sampler is lowered to another depth for sample collection.

Because of the limited height of the tanks, a Coliwasa or similar type sampler may be used to collect composite sample of the liquid layer.

3.3.2 Sludge Layers

Sludge samples, if needed, will be obtained after removal of the liquid layer. Sludge samples will be collected by an appropriate means depending on the nature of the sludge. Typical methods that may be used are: dredge samplers, vacuum tank exhausting into drums followed by sampling of the containerized material, or use of a peristaltic pump (as described for liquid samples).

3.4 CONTAINER SAMPLES

Containers will be opened for sampling. (Note that as described in the Closure Plan, only those that have inadequate labeling will be sampled). Prior to opening, containers will be inspected for bulging, or other signs of possible overpressure or other potential safety problems. Containers that do not have labels to identify the likely contents will be subject to hazard categorization procedures as described in the Closure Plan and the HASP.

Each container of liquid will be opened using a non-sparking chisel and hammer if needed to remove the bung. Fiber containers will be opened as appropriate, and open top drums will be opened using an air-wrench or non-sparking tools. Samples of the containers will be obtained by a Coliwasa for liquids, a Thief for dry powders, a Trier for moist or large grained solids, and an auger for solids or semi-solids that cannot otherwise be properly sampled.

3.5 EQUIPMENT DECONTAMINATION WIPE SAMPLES

To verify that equipment has been properly decontaminated, confirmation wipe samples will be taken. Wipe samples are an approved sampling method for relatively smooth, non-porous surfaces.

Wipe samples must be prepared differently depending on the intended analyte(s). Wipe samples to be analyzed for metals will be collected by a filter moistened with deionized water. If wipe samples are collected for other target analytes, the proper wipe solvent will be used (for example, the wipe will be moistened with methanol for many organic target analytes).

Typically a wipe sample size is 100 cm^2. This can be a 10-cm by 10-cm square, but it can also be 11.28-cm diameter circle, or other shape and dimensions. Templates will be prepared in advance to allow tracing on the area to be sampled. Templates may either be single use and disposed, or be capable of being rinsed between uses to avoid cross-contamination between discreet sample locations.

The surface(s) to be wipe sampled will be sampled by following the procedure described below:

- Mark off area to be sampled with sampling template. Record the sample location/description in the field logbook. If an area other than 100 cm^2 is used, notify the lab and record the information in the field logbook.
- Do not collect samples from the same location for different analyses. For example, if analyses are to be done for both metals and organics, collect samples from two different 100 cm^2 surface areas.
- Choose filter paper moistened with appropriate solvent for the samples to be taken. Generally these will be deionized water (for metals analytes) and methanol (for organic analytes).
- Using stainless steel forceps, or by hand with a clean latex glove, swab the surface area that contained in the template. Replace the filter into the appropriate container and mark with an appropriate sample identification and other required information.
- Clean any equipment to be reused (forceps or template) before collecting next sample.
- Discard disposable materials, such as disposable templates (the preferred approach) or gloves used to collect a wipe sample.

- Collect an appropriate number of trip and field blanks. Trip blanks will be moistened filter paper shipped to the site, but the container will never be opened until it is returned to the analytical laboratory with the other samples. These are used to verify that samples were not contaminated at the lab, at the field location, or between the lab and field location. Field blanks are collected from the sampling equipment (e.g. forceps) to confirm that equipment was cleaned properly.

3.6 MEDIA SAMPLES

To detect if a release of hazardous waste or hazardous materials has occurred, it may be necessary to collect samples from concrete, soil, or other media. These samples will be collected as indicated by the Closure Plan. Also if evidence is found during closure activities to indicate the possibility of a release, the certifying engineer, or designee, may require that such samples be collected. When required, concrete and soil samples shall be collected as described below. If groundwater samples are required, a separate sampling and analysis plan shall be prepared or this plan modified since groundwater sampling may involve specific requirements of the local water agency.

3.6.1 Concrete Sampling And Analysis

A visual inspection of the area will precede collection of any concrete samples. This inspection will identify any cracks, deterioration in the structural base or coating of an area, or other visible signs of possible leakage.

The visual inspection will be performed by an independent engineer certifying the closure (or their agent). The inspector(s) will look for visible cracks in the concrete floor and for signs of possible spills or leaks in and around all equipment items. A photographic record of the inspection may also be kept to show any significant structural or piping problems encountered.

Based on the visual inspection, locations to be sampled will be identified as directed in the Closure Plan. Concrete chip samples will be taken by use of a drill with a masonry bit, Roto-Hammer, or core drill. The sample to be analyzed will be from the top one-inch of the concrete. If a Roto-Hammer or drill is used to collect samples, the holes drilled shall within a 10 cm by 10 cm area to comprise one sample of sufficient quantity needed by the laboratory for analysis. Background concrete samples will also be taken as directed by the Closure Plan. Concrete chip samples will be of sufficient quantity for the selected laboratory to perform their required analyses. If concrete coring is done to collect soil or groundwater samples, chips can be collected from the core, or the core submitted to the laboratory in its entirety with the top surface identified for the laboratory to collect the required sample amount. (When cores are used, samples should be biased towards the top surface of the core since this would be area most likely impacted by any releases). The Roto-Hammer method yields an homogenized sample that is ready for analysis.

The concrete samples will be analyzed for metals, total petroleum hydrocarbons, and if necessary semi-volatile hydrocarbons. Additional analyses may be required for chemical compounds identified as part of a health risk-based closure performance standard as described in the Closure Plan.

The background levels for concrete pH and metals content will be either the highest value of the background samples collected, or the 95% upper confidence limit (UCL) of the mean. Background samples will be collected from concrete locations that had not been exposed to hazardous waste or hazardous materials. The background for organic compounds (e.g., solvents) in concrete is generally considered to be "Non-Detect" unless there are site specific circumstances to justify another level. If the recorded values are above the statistically expected range for background concrete samples, the concrete will be assumed to be contaminated by a release.

Alternatively, the HRA methodology may derive site-specific closure performance goals for concrete. If this approach is used, the closure performance standard will be the health-based value for each constituent rather than above the statistically derived background levels.

3.6.2 Soil Sampling And Analysis

To establish if a release occurred to the site's soil, it will be necessary to determine background concentrations for each COC. This will be done by collecting soil samples in an appropriate manner from select locations or through use of previously obtained data. Note that at the time this SAP is being submitted, additional subsurface investigations and corrective action work is anticipated to be performed. If these investigations have properly established site background levels by the time this SAP is implemented, these previously derived values will be used rather than deriving background concentrations as part of the closure process. If background levels are established at time of closure, samples will be collected from unimpacted areas and analyzed. Only soils of similar characteristics (e.g., same general soil type) will be used in establishing the appropriate background level for a target sample. VOCs will be analyzed as a constituent of concern.

The background levels for soil pH and metals content will be either the highest concentration value of the background samples collected, or the 95% upper confidence limit (UCL) of the mean. Background samples will be collected from concrete locations that had not been exposed to hazardous waste or hazardous materials.

To collect soil samples, borings will be drilled with a hand or power auger, or direct push equipment. Access cores may be required if the surface is overlain by asphalt or concrete. Core-drilling techniques may require the use of cooling water; however, the use of liquids will be minimized and kept from entering the boring. The boring equipment will be selected based on the desired depth of sampling and the type of lithology encountered. Soil samples will be obtained at the specified depth using either a slide-hammer or direct push equipment to drive and retrieve sample cores

The depth of sampling is specified in the Closure Plan. Typically, DTSC requires samples be collected at various depths below ground surface (bgs). If samples are taken beneath a containment structure, sampling will start beneath the concrete containment pad. The initial sample will be collected at zero to six inches beneath the bottom of the containment structure (or ground surface for surficial samples). Additional samples will be collected at depth intervals of 2.5 feet to 3.5 feet bgs and 5.5 feet to 6.5 bgs to assess potential vertical migration of hazardous wastes and hazardous materials. If laboratory analytical results indicate significant impacts to

the soil in the approximate 6 foot sample, this SAP shall be modified or a new plan prepared to fully characterize the impacts.

Prior to collecting samples, the sampling device will be steam cleaned or cleaned with a non-phosphate detergent then rinsed with distilled water. Rinse water and residues from the sampling procedures will be collected and temporarily stored as a closure waste. Core samplers lined with stainless steel or plastic liners will be retrieved where soil samples will be retained for laboratory analysis. Once collected, the sample liners will be removed from the sampler, and the ends will be covered with Teflon tape and sealed with plastic caps. The samples will then be labeled and placed on ice in a cooler. A chain-of-custody document will be completed that will accompany the samples during transportation to the laboratory.

The lithology will be described according to the Unified Soil Classification System (USCS) by a geologist or engineer under the supervision of a Registered Geologist or Professional Civil Engineer. After completion of each boring, the bore hole will be sealed with bentonite-cement grout to prevent any possible contamination or migration through the boring pathway.

The soil samples will be analyzed for metals, total petroleum hydrocarbons, and if necessary, semi-volatile organic compounds. Additional analyses may be required for chemical compounds identified as part of a health risk-based closure performance standard as described in the Closure Plan.

The background levels for soil pH and metals content will be either the highest value of the background samples collected, or the 95% upper confidence limit (UCL) of the mean. Background samples will be collected from locations that were not exposed to hazardous wastes or hazardous materials. The background for organic compounds (e.g., solvents) in soils is generally considered to be “Non-Detect” unless there are site specific circumstances to justify another level. If the recorded values are above the statistically expected range for background soil samples, the soil will be assumed to be contaminated by a release, unless the contaminant can be shown to be a result of an off-site release.

Alternatively, the HRA methodology may derive site-specific closure performance goals for soils. If this approach is used, the closure performance standard will be the health-based value for each constituent rather than the above statistically-derived background levels.

3.7 CLOSURE WASTES

3.7.1 Description

Wastes generated during implementation of the Closure Plan may include any or all of the following:

- Rinse waters from cleaning
- Excess chemicals onsite
- Residues left in equipment
- Contaminated equipment such as disposable tools or wipe pads used during closure
- Rinse waters and disposable equipment from sampling
- Personal protective equipment such as gloves and garments

- Concrete (above background or health-based closure performance goals)
- Soil (above background or health-based closure performance goals)

Closure wastes must be sampled as described below (Section 4.7.2) and analyzed to properly determine if the waste is hazardous or nonhazardous so that it may be disposed of properly in accordance with California Health and Safety Code and regulations in Title 22.

3.7.2 Sampling Methods For Closure Wastes

Concrete and soil samples, when required, will be collected as described above in Section 4.6.

All decontamination rinse waters associated with the closure activities will be collected in drums, portable tank, or the onsite wastewater tanks. Prior to disposal, a sample of the wastewater will be taken from the vessel using a Coliwasa or bailer, and analyzed for pH, CAM-17 metals, or other analyses that may be required by the disposal facility or needed based on the closure work. For example, a detection of a solvent odor would necessitate that samples be analyzed for organic compounds.

When samples are needed for waste characterization purposes of bulk wastes, a representative sample, as appropriate, to the waste will be collected. Care shall be used to not alter the character of the waste. Some examples of bulk waste samples and sampling methods are:

- Polyethylene or FRP tanks – a bulk sample will be collected from location(s) identified in the Closure Plan. Samples will be coupons or pieces cut out of the tank walls or bottom.
- Pipes – a representative section of the pipe will be cut and submitted to the laboratory.

The sampler shall use good judgement in collecting samples and shall provide documentation of the sample location as described in Section 5.6.2 of this SAP.

3.8 GROUNDWATER SAMPLES

The Facility has an active groundwater monitoring program that has been in place since at least the early 1990's. If during closure, it is determined that additional groundwater samples are warranted to add to the knowledge base of the site or to determine potential migration from a unit, groundwater samples will be collected. A determination will first be made if samples should be collected from on-site monitoring wells, if they are properly located and are functional. Alternatively, grab groundwater samples may be required. Using a combination of fixed wells and/or grab groundwater samples, a minimum of three samples will be collected with one being upgradient of the unit being sampled. The notification procedures identified in Closure Step 29 shall be followed prior to collection of groundwater samples.

3.9 SAMPLE ANALYTICAL METHODS

The analytical methods below shall be used for samples collected as described in Sections 3.2 through 3.8 when chemical analyses are required for the constituents of concern.

Constituent of Concern[1]	Analytical Method and Description	Prep Method
Corrosivity (pH)	EPA 150.1 (pH)	N/A
Corrosivity (pH)	SW 9040B (pH for solids)	N/A
Volatile Organic Compounds	SW 8260 (volatile organic compounds, see Note 2);	5030 (5035 for Encore samples)
Arsenic	SW 6010/7471	3010
Cadmium	SW 6010/7471	3010
Chromium (Total)	SW 6010/7471	3010
Copper	SW 6010/7471	3010
Lead	SW 6010/7471	3010
Nickel	SW 6010/7471	3010
Iron	SW 6010/7471	3010
Hexavalent Chromium	SW 7196	SW 7196

Note:

1. See Closure Plan Section 3.2 for a discussion of the Constituents of Concern
2. Included here for waste characterizations and profiling purposes with a TSDF.

The above list of constituents of concern, represent the primary waste characteristics of the hazardous wastes received and processed at the Facility. This considers both concentration of the constituent in the wastes (e.g. copper is typically present in very high concentrations) and constituents that may be present in lower concentrations but have higher toxicity values (e.g., lead or hexavalent chromium). The COCs shown above will provide good markers to demonstrate that no releases occurred, or if one is confirmed, to determine the extent of cleanup required.

4.0 SAMPLE COMPOSITES

As indicated in the closure plans, various samples may be composited in the laboratory prior to analysis. The standard procedures of the laboratory will be used. The treatment approaches that may be used at the facility for waste removal will most likely homogenize each of the individual tank layers; therefore, composite samples are inherently more representative. Only similar layers from each tank will be composited; such as, liquid samples with liquid samples, and sludge samples with sludge samples. Therefore, there will be one sample per layer per tank that will be analyzed for waste characterization.

5.0 MISCELLANEOUS FIELD PROCEDURES

5.1 EQUIPMENT DECONTAMINATION

In addition to the specific decontamination procedures previously discussed, the following general procedures shall be followed for collecting decontamination fluids and other materials. Excess waste samples and decontamination solutions will be returned to the tank being sampled after all sampling is completed from that tank. Used personal protective equipment (PPE) and other contaminated materials will be stored in 55-gallon drums lined with plastic bags, labeled, and left on site for disposal at a later date pending analytical results. Non-hazardous waste trash will be placed in plastic trash bags for disposal at an appropriately licensed landfill.

Sampling equipment will be decontaminated upon arrival at the site, during waste phase interface measurement, sampling activities, and before removal from the site. Containers used to hold decontamination water will be placed within a plastic lined and bermed area to contain possible spills. Containers will be covered and sealed immediately after use.

5.2 SAMPLE CONTAINERS

Table 1 includes a list of sample containers to be used for the proposed chemical and physical analyses and for treatability testing. Laboratory analyses that have compatible container requirements have been consolidated for convenience in the field and in the laboratory.

All samples for organic constituents will be collected in such a manner so as to minimize the volatilization of a sample due to agitation and/or transfer from sampling equipment to sample container.

5.3 SAMPLE PRESERVATION

Table 1 also includes a list of sample preservatives to be used for the sample bottles. Appropriate chemical preservatives will be added to the sample bottles by the analytical laboratory prior to arrival at the Facility. If samples require cold preservation, this will be done by placing the sample bottles in a well-insulated cooler and adding double-bagged ice or blue-ice packs to cool the samples. Samples will be placed in coolers immediately after sampling.

5.4 SAMPLE PACKAGING AND SHIPMENT

When samples are collected, sample containers appropriate for the analytical test will be used and each sample container will be labeled as described below. Breakable or otherwise fragile sample containers will be wrapped in plastic bubble-wrap to prevent damage during transport to the laboratory.

The completed chain-of-custody form will be placed in a plastic bag and taped to the underside of the lid of the cooler containing the samples designated on the form. Coolers will be sealed with tape to verify that samples are not tampered with during shipment.

Samples will be delivered to the laboratory as soon as possible. Samples will be transported to the laboratory by the sampling personnel, courier, or an overnight shipping service. The elapsed time between sample collection and delivery to the laboratory shall not exceed 48 hours. If the allowable time limit for a particular analytical method specifies less than 48 hours (for example

for hexavalent chromium), arrangement s shall be made to get the sample to the lab within that time limit.

5.5 QUALITY CONTROL SAMPLES

Field quality control samples will be collected during the sampling program and include field duplicate samples, trip blanks, and equipment blanks. The description and purpose of these samples is discussed below.

Field Duplicate Sample. Field duplicate samples are samples that are collected at the same time, from the same location, and in the same manner as a field sample. Field duplicate samples are used to evaluate the precision of the sampling method.

Equipment Blank. Equipment blanks are obtained by filling decontaminated sampling equipment with reagent-grade deionized water prepared by the analytical laboratory, then pouring the water into sample containers and handling them with identical shipping and analysis procedures as sludge and water samples. Equipment blanks are used to assess potential contamination from the sampling method.

Trip Blank. Trip blanks are filled at the laboratory with reagent-grade deionized water, transported to the sampling site, handled like a sample, and returned to the laboratory for analysis. Trip blanks are used to assess potential sample contamination during shipment or storage.

A trip blank will be prepared for each round of sampling. The trip blanks will be prepared at the laboratory and will consist of deionized water. One trip blank will be used and analyzed for volatile organic compounds.

One equipment blank sample will be prepared for each round of sampling. The equipment blanks will consist of deionized water and will be handled in a manner similar to the samples, that is, the water will be exposed to the sampling equipment or other sampling devices.

One duplicate sample per sampling round will be collected from a random oil and water layer and will be submitted to the laboratory with a separate sample identifier. The sample will be collected from the same location and at the same time as the primary sample.

5.6 CHAIN-OF-CUSTODY PROCEDURES

The Chain-of-Custody procedures will be used to record the sample possession from time of collection to receipt at the laboratory. The chain-of-custody procedure includes sample seals, sample labels, a field logbook, a Chain of Custody Record, and a sample analysis request sheet.

5.6.1 Sample Labels and Seals

When each sample is collected, that sample will be noted in the log and labeled. Each sample will be labeled with the following information:

- facility name;
- sample number;
- sample location;
- sample type;

- date of sample;
- time of sample; and
- name of sampler.

Under no circumstances are sealed sample containers to be opened by anyone other than the laboratory personnel who perform the requested analyses. If it is necessary for samples or sample chests to leave the immediate control of the sampler prior to delivery to the laboratory, for example during shipment by an overnight shipper, a custody seal is placed on each sample container and/or sample chest to ensure that the samples have not been tampered with during transportation. The custody seal is initialed by the sampler, and includes the date and time that the seal was placed is recorded. Seals will be applied to each container immediately after collection to prevent tampering with the samples.

5.6.2 Field Sampling Logbook

The detailed description of field sampling activities will be recorded in a hardbound logbook. Entries in the logbook will include the following information:

- facility name;
- purpose of sampling;
- location at sampling site;
- type of waste sampled;
- description of sampling methodology;
- date and time of collection;
- weather at time of collection;
- soil classification, when applicable;
- field measurements;
- photos (if taken); and
- unusual sampling activities or deviation from the SAP.

Archived samples and extracts for analyses will be stored in compliance with the conditions specified in EPA SW-846 and the California Department of Toxic Substances Control (DTSC) analytical protocol documents. Archived samples may be used for additional analyses, if necessary.

5.6.3 Chain of Custody Record

A Chain of Custody Record will be completed to establish the documentation necessary to trace sample possession from the time of collection until laboratory analysis. The Chain of Custody Record will include:

- sample number;
- signature of collector;
- date and time of sampling;
- place and address of collection;

- waste type;
- persons involved in the chain of possession; and
- inclusive dates of possession
- Sample Analysis Request Sheet

The sample analysis request sheet is intended to accompany the sample on delivery to the laboratory. This will be included on the chain-of-custody form. The additional data to be placed on the chain-of-custody record includes the following at a minimum:

- analyses to be performed;
- name of person receiving the sample;
- laboratory sample number or identifier;
- date and time of sample receipt; and
- sample allocation.

The sampler will indicate the analyses to be performed and the receiving laboratory will fill in the remainder of the above information after receipt at the laboratory.

Unless specifically authorized, all analytical tests for samples collected as a result of this SAP, shall be performed by a laboratory certified by the state of California for the specific tests performed.

TABLE

Table 1A
SAMPLING METHODS AND CONTAINERS FOR CLOSURE CONFIRMATION SAMPLES

Test Description	Method No[1]	Prep Method [1]	Matrix	Container Type [2]	Preservative	Extraction Holding Time	Analysis Holding Time
SOLID/SOIL AND WIPE SAMPLES							
CAM 17 metals (for wipe samples)	SW 6010/7471	3010	Wipe samples	40 ml or greater; P, G (Sufficient to hold wipes)	Cool, 4°C	7 days	6 mo., 28 days for Hg
CAM 17 metals	SW 6010/7471	3010	Solids and soil	P, G, 125-mL	Cool, 4°C	7 days	6 mo., 28 days for Hg
Hexavalent chromium)	SW 7196	SW 7196	Soil	P or G 500 mL	Cool, 4°C	N/A	24 Hours
pH for solids	SW 9040B	N/A	Solids and soil	P, G 125 mL	Cool, 4°C	N/A	14 days
Semi-volatile organic compounds (see Note 3);	SW 8270	3520	Solids and soil	B, G 125 mL	N/A	14 days	40 days
Semi-volatile organic compounds for wipe samples	SW 8270	3520	Wipe samples	40 ml or greater; P, G (Sufficient to hold wipes)	N/A	14 days	40 days
Total Petroleum Hydrocarbons	SW 8015M	3520	Solids and soil	B, G-TLC, 125 mL	Cool, 4°C	14 days	40 days
Volatile organic compounds (see Note 3);	SW 8260	5030	Solids and soil	B, G-TLC, 125 mL	Cool, 4°C	N/A	14 days
	SW 8260	5035	Solids and soil for Encore Sampler	EnCore Sampler	Cool, 4°C	N/A	2 days
LIQUID SAMPLES							
CAM 17 metals	SW 6010/7471	N/A	Water	P, 1 L	Adjust to pH <2 with Nitric Acid, Cool, 4°C	N/A	6 mos., 28 days for Hg
Hexavalent chromium)	SW 7196	SW 7196	Ground water	P or G 125 mL	Cool, 4°C	N/A	24 Hours
pH	EPA 150.1	N/A	Water	P, 100 mL	Cool, 4°C	N/A	Analyze immediately
Semi-volatile organic compounds (see Note 3);	SW 8270	3520	Water	G, 1L	N/A	7 days	40 days
Total Petroleum Hydrocarbons	SW 8015M	3520	Water	G, 1 L	HCl	14 days	40 days
Volatile organic compounds (see Note 3);	SW 8260	5030	Water	G, 40 mL vial-TLS (2 needed)	HCl to pH<2, Cool, 4°C	N/A	14 days

Legend and Notes:

1. Method Sources: SW= SW 846, Test Methods for Evaluating Solid Waste: Physical/Chemical Methods by US EPA, Office of Solid Waste and Emergency Response: EPA
2. Sample Container Codes: B – Brass or steel tube; G - glass; P - polyethylene; TLC – Teflon-lined cap; TLS – Teflon-lined septum
3. May not be required. Included here if required prior to disposal by a specific TSDF or for risk-based closure sampling.

Table 1B
SAMPLING METHODS AND CONTAINERS FOR CLOSURE WASTE CHARACTERIZATION SAMPLES

Test Description	Method No[1]	Prep Method [1]	Matrix	Container Type [2]	Preservative	Extraction Holding Time	Analysis Holding Time
SOLID/SOIL SAMPLES							
CAM 17 metals	SW 6010/7471	3010	Solids and soil	P, G, 125-mL	Cool, 4°C	7 days	6 mo., 28 days for Hg
DTSC Fish Bioassay (96-hour bioassay per 22 CCR 66261.24(a)(6))	DTSC protocol	N/A	Solids and soil	G, 250-mL	None required	N/A	None specified
Hexavalent chromium	SW 7196	SW 7196	Soil	P or G 500 mL	Cool, 4°C	N/A	24 Hours
pH for solids	SW 9040B	N/A	Solids and soil	P, G 125 mL	Cool, 4°C	N/A	14 days
Semi-volatile organic compounds (see Note 3);	SW 8270	3520	Solids and soil	B, G 125 mL	N/A	14 days	40 days
Volatile organic compounds (see Note 3);	SW 8260	5030	Solids and soil	B, G-TLC, 125 mL	Cool, 4°C	N/A	14 days
LIQUID SAMPLES							
CAM 17 metals	SW 6010/7471	N/A	Water	P, 1 L	Adjust to pH <2 with Nitric Acid, Cool, 4°C	N/A	6 mos., 28 days for Hg
DTSC Fish Bioassay (96-hour bioassay per 22 CCR 66261.24(a)(6))	DTSC protocol	N/A	Water	P, G 2.5-gallons	None required	N/A	None specified
Hexavalent chromium	SW 7196	SW 7196	Ground water	P or G 125 mL	Cool, 4°C	N/A	24 Hours
pH	EPA 150.1	N/A	Water	P, 100 mL	Cool, 4°C	N/A	Analyze immediately
Semi-volatile organic compounds (see Note 3);	SW 8270	3520	Water	G, 1L	N/A	7 days	40 days
Volatile organic compounds (see Note 3);	SW 8260	5030	Water	G, 40 mL vial-TLS (2 needed)	HCl to pH<2, Cool, 4°C	N/A	14 days

Legend and Notes:

1. Method Sources: SW= SW 846, Test Methods for Evaluating Solid Waste: Physical/Chemical Methods by US EPA, Office of Solid Waste and Emergency Response: EPA
2. Sample Container Codes: B – Brass or steel tube; G-glass; P-polyethylene; TLC – Teflon-lined cap; TLS – Teflon-lined septum
3. May not be required. Included here if required prior to disposal by a specific TSDF or for risk-based closure sampling.

ATTACHMENT A

HAZARDOUS WASTE CHARACTERIZATION METHODOLOGY

HAZARDOUS WASTE CHARACTERIZATION METHODOLOGY

Site wastes must be classified as hazardous or nonhazardous prior to disposal. The methodology described below shall be used in conjunction with the procedures identified in Extraction Test Protocols in Section 2 to properly and cost-effectively classify wastes. These waste characterization procedures comply with Section 66261.11 of Title 22 of the California Code of Regulations (22 CCR 66262.11). The general methodology is to first determine if the waste is a federal Resource Conservation and Recovery Act (RCRA) hazardous waste. If the waste is not RCRA hazardous waste, then it will be determined if it is a California-only (non-RCRA) hazardous waste. Although this determination must be made sequentially, analytical tests may be run concurrently for expediency. If the waste is not hazardous under either federal or state laws and regulations, the site wastes will be deemed nonhazardous. However, in some cases, it may be necessary for generators to transfer nonhazardous wastes to a Class II or Class III disposal facility.

STEP 1. IS IT A LISTED RCRA HAZARDOUS WASTE?

EPA has four lists of hazardous wastes. If the waste is on one of these lists, the waste is a "listed" RCRA hazardous waste. These lists include a variety of halogenated and non-halogenated solvents as well as specific wastes from specified industrial operations. In addition, there may be off-specification commercial chemical products at the site that could be a listed hazardous waste when sent for disposal. EPA has listed these commercial chemical products in "P Lists" and "U Lists." These lists only apply to the commercial grade of certain chemicals that are to be discarded, are off-specification, or are cleanup residues from spills of these chemicals. Examples of chemicals included in this list are methanol and methyl ethyl ketone (MEK). For example, if a container of a commercial grade of methyl ethyl ketone is to be disposed of, it is a AU159" waste. If it is a spent MEK solvent solution the waste is an AF003" listed waste. If the waste is not a commercial grade of a chemical, or only contains one or more of the listed chemicals (e.g., MEK), it is not a "P" or "U" listed waste. At the Facility, this would apply only to waste in drums or smaller containers, and not wastes materials removed from tanks.

A "listed" hazardous waste has no threshold concentration, therefore, dilution does not create a non-hazardous waste. "Dilution" creates a greater volume of listed waste. Also, material "derived from" a listed hazardous waste (e.g., rinsewater from cleaning a listed waste) retains the identity of the listed waste, unless a specific regulatory exemption applies.

STEP 2. IS IT A CHARACTERISTIC RCRA HAZARDOUS WASTE?

This will be assessed by determining if the waste meets the RCRA characteristics of ignitability, corrosivity, reactivity, or toxicity. These are discussed below.

2.A. Is the waste ignitable?

This will be determined by addressing the following questions.

YES NO

1. If liquid, is flash point equal to or less than 140EF (except for aqueous alcohol solutions less than 24% by volume)?	( )	( )
2. If non-liquid, is it capable of causing fire through absorption of moisture or spontaneous chemical change, and which burns so vigorously that it creates a hazard?	( )	( )
3. Is it an ignitable compressed gas?	( )	( )
4. Is it an oxidizer?	( )	( )

If the answers to <u>any</u> of the above questions is "YES", the waste is a characteristic RCRA hazardous waste by ignitability and is given an EPA waste code of "D001." Proceed to **Step 2.B.**

2.B. Is the waste <u>corrosive</u>?

This will be determined by addressing the following questions:

	YES	NO
1. Is it an aqueous liquid with a pH less than or equal to 2 <u>or</u> greater than or equal to 12.5?	( )	( )
2. Is it a liquid capable of corroding steel at a rate greater than 0.25 inches per year at a test temperature of 130ºF?	( )	( )

Because waste materials have been stored in tanks for several years, only test 1 above will be performed for aqueous solutions by testing their pH. The oil will not be tested for corrosion by test 2 above. If the answer to question 1 is "YES", the waste is a characteristic RCRA hazardous waste by corrosivity and is given an EPA waste code of "D002." Proceed to **Step 2.C.**

2.C. Is the waste reactive?

This will be determined by addressing the following questions:

	YES	NO
1. Is it a solid waste that is a <u>sulfide</u> bearing waste that can release toxic gases in excess of 500 mg/kg when exposed to pH conditions between 2 and 12.5 using the test method described in SW 846, Section 7.3.4.2.?	( )	( )

	YES	NO
2 Is it a solid waste that is a cyanide bearing waste that can release toxic gases in excess of 250 mg/kg when exposed to pH conditions between 2 and 12.5 using the test method described in SW 846, Section 7.3.3.2.?	( )	( )
3. Is waste normally unstable or does it react violently with water, form potentially explosive mixtures with water, or is it capable of detonation or explosive reaction?	( )	( )

The questions in 2.A. to 2.C. will be addressed by running a standard RCI on the waste materials. If the answers to any of the above questions in 2.C. is "YES", the waste is a characteristic RCRA hazardous waste by reactivity and is given an EPA waste code of "D003." Proceed to **Step 2.D.**

2.D. Is the waste toxic?

The TCLP[1] analytical test is used to determine if a waste meets EPA's definition of toxicity. A waste is toxic if the extract from the waste contains certain concentrations of specific toxic heavy metals (such as lead, mercury, and arsenic) or certain organic compounds (such as benzene). The lab can be asked to analyze for only compounds which are likely to be present in the waste. A specific EPA waste code applies depending on which component(s) exceeded the TCLP limits (such as D018 if benzene is present in greater than 0.5 mg/l in the extract).

The analytical protocols described in Section 2 below should be followed to minimize the overall analytical costs associated with determining if a waste is a RCRA or California-only hazardous waste.

If the waste does not meet any of the characteristics defined by **Steps 2.A to 2.D.** and is not a RCRA-listed hazardous waste, the waste is not a RCRA hazardous waste. Proceed to **Step 3** to determine if the waste is a non-RCRA (California-only) hazardous waste.

STEP 3. IS IT A CALIFORNIA HAZARDOUS WASTE?

DTSC has defined additional tests such as corrosivity and toxicity to be performed on waste streams that are not RCRA hazardous wastes.

3.A. Is the waste a California corrosive waste?

This will be determined by addressing the following questions:

	YES	NO
1. Is it a non-aqueous waste (liquid but not water based) which when mixed with an equal weight of water produces a solution with a pH less than or equal to 2 or greater than or equal to 12.5?	( )	( )

1. The toxicity characteristic leachate procedure (TCLP) is a test designed to simulate the leaching of metals and organics from wastes that might occur in a landfill. The component concentrations shown are those in the aqueous extract.

2. Is it a solid which when mixed with an equal weight of water produces a liquid that corrodes steel at a rate greater than 0.25 inch per year at 130EF. ( ) ( )

If "YES" can be answered to either of the above questions, the waste is a non-RCRA hazardous waste by the characteristic of corrosivity. Note that the EPA waste code D002 does not apply; however, one of four California waste codes (121, 122, 791, or 792) will apply. Proceed to **Step 3.B.** to determine if the waste meets California's stricter toxicity requirements.

3.B. Is the waste a California toxic waste?

Follow the analytical protocols described in Section 4.3 to minimize laboratory analytical costs. Depending on specific analytical results, it may not be necessary to perform all of the tests below:

	YES	NO
1. Does the TTLC[2] of the waste exceed the values listed for persistent and bioaccumulative toxic substances?	( )	( )
2. Does the STLC[3] of the waste exceed the values listed for persistent and bioaccumulative toxic substances?	( )	( )
3. Does the waste have a fish toxicity (using fathead minnows[4]) LC_{50} (concentration at which 50 % of the fish die) less than 500 mg/l?	( )	( )
4. Does the waste have an acute oral LD_{50} (oral concentration at which 50 % of the target species die) or calculated equivalent oral LD_{50} for mixtures that is less than 5,000 mg/kg?	( )	( )

Because wastes at the time of closure may be completely known, test 4 above will not be practical. Test 3, the acute fish toxicity test, will only be performed on wastes that have heretofore been determined to be nonhazardous. The bioassay test will be required to verify the nonhazardous designation. If "YES" was answered to any of the above questions the waste is a non-RCRA hazardous waste by the characteristic of toxicity. Note that the EPA waste codes do not apply. If "NO" was answered to all questions in **Steps 1, 2, and 3,** then the waste is nonhazardous.

LAND DISPOSAL RESTRICTION (LDR) REQUIREMENTS

It is not sufficient to analyze a waste to only determine it is hazardous. In accordance with 22 CCR 66262.10, a generator must first assess whether the waste is a RCRA hazardous waste , and then if not determine if is a California hazardous waste. Once a waste is hazardous, additional testing may be necessary to fully describe a waste for LDR purposes. Sufficient information

2 The Total Threshold Limit Concentration (TTLC) test measures the total concentration of a substance in the waste and includes 19 metals and organics such as PCBs, pesticides, and some chlorinated compounds.

3 The soluble threshold limit concentration (STLC) test is used to simulate the leaching that may occur in a landfill and like the TCLP measures component concentrations in the aqueous extract.

4 Rainbow trout and golden shiners may also be used.

must be developed to describe all RCRA hazardous waste codes that apply to the waste so the appropriate LDR treatment technologies can be used.

LDR information should be entered on the standard form for the designated TSDF. The profile form should be filled out to accurately describe the wastes in terms of the hazardous waste characteristics, physical properties, process generating the waste, estimated volumes, Land Disposal Restriction (LDR) status under RCRA and California regulations, and other relevant characteristics. For RCRA hazardous wastes subject to LDRs, statements regarding possible presence of underlying hazardous constituents (UHCs) will be required to define the proper processing methods to meet the universal treatment standards. It is not necessary for the generator to analyze a waste stream for UHCs. However, the TSDF may require analytical results or even a sample of the waste prior to approval of a waste profile, whether or not the waste is subject to LDRs.

PROCEDURES FOR EXTRACTION TESTS

The analytical lab used to characterize the site wastes should be instructed to follow the general procedures below. The methodology is designed to avoid performing the extraction tests (TCLP for RCRA hazardous wastes and the California Waste Extraction Test to STLC levels for non-RCRA hazardous wastes) when there is no chance that the waste will fail these tests.

The following approach is valid because the TCLP test dilutes the waste by a factor of 20 and the Waste Extraction Test for STLC dilutes the samples by a factor of 10.

1. Digest the waste sample and analyze for total metals and total organics.
2. If the waste sample is less than the TTLC but greater than 20 times the TCLP level for any individual component, it will be necessary to perform a TCLP extraction test for these components. Analyze only for those components whose concentrations are greater than 20 times the TCLP level. If the concentration in the sample exceeds the corresponding TCLP level, that waste is a RCRA hazardous waste. If it is below all TCLP levels, continue with #3.
3. If the waste sample exceeds the TTLC for any component, it is a California-only hazardous waste. However solid materials may be managed at a Class I, II, or III landfill in accordance with Health & Safety Code Section 25141.5(b)(3) if the waste does not exceed any STLC concentrations as described in #4.
4. If the waste sample is less than the TTLC but greater than 10 times the STLC for any individual component, it will be necessary to perform an STLC extraction test for these components. Perform these analyses only for those components whose concentrations are greater than ten times the STLCs. If the concentration in the sample exceeds the corresponding STLC, that waste represented by the sample is a California hazardous waste.

APPENDIX B

CLOSURE SAMPLE SUMMARY

APPENDIX B
SUMMARY OF SAMPLES TO BE ANALYZED (BY TYPE)

Sample Location	Type of Samples	No. of HAZCAT Samples Analyzed	No. of Wipe Samples Analyzed	No. of Concrete Samples Analyzed	No. of Soil Samples Analyzed (1)	No. Of Rinse or Water Samples	Total No. of Waste Samples Analyzed
Tank Contents	Waste	--	--	--	--	--	4
FRP Tanks	Bulk	--	--	--	--	--	4
Small pieces of equipment (such as pumps or pipe) that will be left onsite.	Water rinsate from final rinse	--	--	--	--	None anticipated (to be disposed	None anticipated (to be disposed of)
Filter Presses (1)	Wipe	--	3	--	--	--	6
Container Storage # 1ex (incremental samples only in expanded area)	Wipe	--	4	--	--	--	--
	Soil	--	--	2	6	--	--
Container Storage # 2ex (incremental samples only in expanded area)	Wipe	--	4	--	--		
	Soil	--	--	2	6		
New W Area (Tanks W-7 and W-8)	Concrete	--	--	6	--	--	--
	Soil	--	--	--	18	--	--
New Area J (Tanks J-6 and J-7)	Concrete	--	--	6	--		
	Soil	--	--	--	18		
Filter Press FP-#2A	Concrete	--	--	2	--	--	--
	Soil	--	--	--	6	--	--
Background Soil – from uncontaminated areas	Soil	--	--	--	12	--	--
Background Concrete – from uncontaminated areas	Concrete	--	--	4	--	--	--
Closure Generated Liquids	Liquid or Semi-solid Wastes	--	--	--	--	2	--
Closure Generated Solids	Solid	--	--	--	--	--	1
		Total Number of Samples Collected					
		0	11	22	66	2	15
		Allowance for QA/QC Samples Including Blanks (at 1 QA/QC per 8 samples)					
		0	2	3	9	1	2
		TOTAL NUMBER OF SAMPLES TO BE ANALYZED					
		0	**13**	**25**	**75**	**3**	**17**

Notes:

APPENDIX B

SUMMARY OF SAMPLES TO BE ANALYZED (BY TYPE)

Sample Location	Type of Samples	No. of HAZCAT Samples Analyzed	No. of Wipe Samples Analyzed	No. of Concrete Samples Analyzed	No. of Soil Samples Analyzed (1)	No. Of Rinse or Water Samples	Total No. of Waste Samples Analyzed

1. Number shown for soil samples is the number of samples to be sent to lab based on 3 soil samples per location at depths of near surface, 3 ft and 6 ft.

BREAKDOWN OF SAMPLE ANALYTICAL COSTS

Soil Sampling Costs

Sampling Costs

	$/per ft.	
Direct Push	$30.00	Basis - recent work
Geologist	$3.54	$85/hr with 24 ft of Direct Push per hour
Total	$33.54	

Total feet	132	@6 ft per soil sample location
Est. Cost	$4,427.50	
Cost per Soil Sample	$59.03	(includes QA/QC Allowance)

Analytical Costs - Inorganics

Source: Analytical Suite (Amercian Scientific Laboratories, Los Angeles)

7 metals (SW 6010/7471)	$58.00	(includes iron)
pH (EPA 150.1/SW 9040B)	$8.00	
Hex. Chrome (SW7196)	$41.00	($32 plus $9 prep)
Total	$107.00	

Analytical Costs - Organics (Not analyzed for)

Source: Analytical Suite (Amercian Scientific Laboratories, Los Angeles)

VOCs (SW 8260)	$180.00
Semi-VOCs (SW 8270)	$225.00
TPH (SW 8015M)	$70.00
Total	$0.00

Concrete Sampling Costs

Assumptions

- Use $30 collection cost for each sample (core drilling)

Source: Analytical Suite (Amercian Scientific Laboratories, Los Angeles)

7 metals (SW 6010/7471)	$58.00	(includes iron)
Concrete grinding/prep.	$10.00	
Collection Cost	$30.00	
Total	$98.00	

Wipe Sampling Costs

Assumptions

- Use $20 per sample for collection
-No organic analyses

Source: Analytical Suite (Amercian Scientific Laboratories, Los Angeles)

7 metals (SW 6010/7471)	$58.00	(includes iron)
VOCs (SW 8260)	$0.00	
Semi-VOCs (SW 8270)	$0.00	
Collection Cost	$20.00	
Total	$78.00	

Rinse/Water Sampling Costs

Assumptions

- Use $20 per sample for collection
-No organic analyses

Source: Analytical Suite (Amercian Scientific Laboratories, Los Angeles)

7 metals (SW 6010/7471)	$58.00	(includes iron)
pH (EPA 150.1/SW 9040B)	$8.00	
Hex. Chrome (SW7196)	$41.00	($32 plus $9 prep)
TPH (SW 8015M)	$0.00	
Collection Cost	$20.00	
Total	$127.00	

Waste Sampling Costs

Assumptions

- Use same costs for HAZCAT as for Waste Analysis
- included organic analyses - may be required by the TSDF

Source: Analytical Suite (Amercian Scientific Laboratories, Los Angeles)

7 metals (SW 6010/7471)	$58.00	(includes iron)
VOCs (SW 8260)	$180.00	(may eliminate from HAZCAT samples but include here)
pH (EPA 150.1)	$8.00	
Sample Composition	$5.00	For waste tanks (FRP coupon samples)
Hex. Chrome (SW7196)	$41.00	($32 plus $9 prep)
Collection Cost	$20.00	
Total	$312.00	

Grab Groundwater Costs

Assumptions

- 40 ft average depth of direct push
- No organic analyses

7 metals (SW 6010/7471)	$58.00	(includes iron)
VOCs (SW 8260)	$0.00	
Semi-VOCs (SW 8270)	$0.00	
pH (EPA 150.1)	$8.00	
Hex. Chrome (SW7196)	$41.00	($32 plus $9 prep)
Sample Collection	$1,324.80	
Total	$1,431.80	

Type of Sample	No. of Samples	Cost. Ea.	Total
Haz Cat Samples	0	$150.00	$0
Wipe Samples	13	$78.00	$1,014
Concrete Samples	25	$98.00	$2,450
Soil Samples (Inorganic Only)	18	$166.03	$2,989
Soil Samples (with Organics)	57	$166.03	$9,464
Rinsate Samples	3	$127.00	$381
Waste Characterization	17	$312.00	$5,304
Grab Groundwater	11	$1,431.80	$15,750
			$37,351

ATTACHMENT 10 – CLOSURE COST ESTIMATES FOR NEWLY ADDED EQUIPMENT

Attachment 10
Closure Cost Estimate Summary - for Class 2 Permit Mod Equipment
(Adjusted from 2015 Part B Operating Plan Cost Pro 6.0 Estimate)
Phibro-Tech Inc., Santa Fe Springs, CA

Cost Pro Description	Closure Cost Estimate ($)	Discussion	Summary of Closure Work
Container Storage Area #1 expanded (CS-1ex)	$47,860	Total cost of CS-1ex area from CostPro 6 prorated for the new area only	Removal of drums; pressure washing containment area; and decon of forklift. (Sampling included elsewhere. Waste Inventory Elimination not included -no incrmental volume stored). Includes contingency.
Container Storage Area #2 expanded (CS-2ex)	$48,131	Total cost of CS-2ex area from CostPro 6 prorated for the new area only	Same as Unit #1 except no decon - since forklift would be decontaminated only once.
Container Pumping Stations	$4,190	W7/W8 CPS is 10% (210 sq. ft. of 2148 sq. ft total)	Same as CS-1ex; No soil removal: No waste inventory costs included here
J-Area (J-6 and J-7)	$60,701	Only two tanks are being iunstalled out of 3 proposed. Used 2/3 of CostPro 6.0 estimate	Assumed 1 foot of soil removal
W-7/W-8	$102,427	No adjustments needed	Assumed 1 foot of soil removal
Miscellaneous Equioment Decon, Removal and Disposal	$26,532	1 filter press is one-sixth of miscellaneous equipment. So pro-rate by 1/6.	Dyer, blender, centrifuge, 3 filter presses
Facility Sampling	$37,351	Based on samples identified in Appendix B	Used sheet for costs calculated separately
COST PRO CLOSURE COST ESTIMATE	**$327,190**		
2Q 2009 Implicit Price Deflator	99.895		From US Dept. of Commerce, Bureau of Economic Analysis, Table 1.1.9. Implicit Price Deflators for Gross Domestic Product,
2Q 2015 Implicit Price Deflator	109.670		From US Dept. of Commerce, Bureau of Economic Analysis, Table 1.1.9. Implicit Price Deflators for Gross Domestic Product,
Inflation Factor	1.098		Ratio of 2015 to 2009
ESCALATED COST PRO CLOSURE ESTIMATE	**$359,207**		2009 CostPro Closure Estimate x Inflation Factor

ATTACHMENT 11 – SOIL SAMPLING PROCEDURES

Sampling and Analysis Plan for New Units

1.0 INTRODUCTION

This Sampling and Analysis Plan (SAP) has been prepared at the request of the Department of Toxic Substances Control (DTSC)[1] for the Phibro-Tech, Inc. (PTI) facility located at 8851 Dice Road, Santa Fe Springs, California (the Facility), and contains soil sampling and analysis requirements for areas to be sampled prior to the construction of new units proposed under modification to the Facility's existing Hazardous Waste Facility Permit. This SAP has been prepared to be consistent with the approved Tank Relocation Plan dated November 22, 2006 (updated to reflect current analytical methods). New units and equipment will not be placed in locations where existing contamination exceeds the corrective action cleanup goals (discussed below) unless PTI first demonstrates that implementation of the facility-wide corrective action would not be compromised by the construction of the new units and equipment. All sampling activities shall be consistent with the approved Health and Safety Plan (HASP) for the site or the HASP in Appendix A of the conditionally approved Pond 1 Closure Plan (dated September 2015, with updated appendices dated November 30, 2015). Sampling locations or procedures may be modified in the field to improve safety. Modifications to reduce safety requirements will require an amendment to the HASP.

2.0 CORRECTIVE ACTION CLEANUP GOALS

Target cleanup levels for the Facility were approved by the DTSC on December 4, 2015, in the agency's conditional approval of the Pond 1 Closure Plan (dated September 2015, with updated appendices dated November 30, 2015). The DTSC-approved target cleanup levels are the corrective action cleanup goals for the Facility. Where multiple values are provided for a particular constituent in the approved target cleanup levels, the lowest value will apply.

3.0 SOIL SAMPLING LOCATIONS

Areas proposed for construction of new units will be sampled prior to the construction to determine whether Constituents of Concern are present in the soil above the approved target cleanup levels. Constituents of Concern are listed in the attached Table 1. Sample locations and density will be dependent upon the size of the construction area. It is anticipated that at least four locations will be selected for vertical soil borings: one boring near the center of the proposed unit location and three or four locations beyond the footprint of the proposed unit. If visual signs of contamination are encountered after any existing asphalt cover is removed, additional samples will be collected in those areas. Specific soil sample locations will be provided to the DTSC for review and approval prior to sample collection.

Sample analytical results will be evaluated in the context of the 2005 Site Conceptual Model (SCM). Any site data obtained from the sampling that is inconsistent with the SCM may require

[1] November 17, 2015 letter from the DTSC to Phibro-Tech regarding DTSC Review of Request for Determination of Class 2 Permit Modification.

further analysis. Such analysis may include further sampling at "step out" locations to characterize the lateral extent or at other locations to identify a suspected source location. In the event that additional data is required because initial samples collected are inconsistent with the SCM, a work plan will be submitted to the DTSC prior to field sampling.

4.0 SOIL SAMPLING

Drilling to targeted subsurface sampling depths will generally be conducted using a hydraulically-driven direct push drill rig; however, a hand or power auger may also be used. Boring equipment selection will be based on the desired depth of sampling, the lithology encountered, and any access restrictions. Soil samples will be obtained at the specified depth using either a slide hammer or direct push equipment to drive and retrieve sample cores.

4.1 Soil Sample Collection

For direct push samples, a 1.25-inch Macro Core sampler (or equal) will be used to collect sufficient soil volume for laboratory analysis. Required soil volumes are specified in the attached Table 1. Direct push samples will be contained within acetate liners, brass sleeves, or steel sleeves. The sleeves, or a 4 to 6 inch length of acetate liner, will be retrieved from the sampler for laboratory analysis. Consistent with United States Environmental Protection Agency (EPA) Method 5035 for soil samples collected for volatile organic compound(VOC) analysis, a minimum of 15 grams of soil will be collected from the primary core immediately following core retrieval in EnCore™-type soil sample containers (or equivalent) and submitted for VOC analysis by EPA Method 8260B. Soil for other proposed analyses will be retained in the sample sleeve. After removal of the EnCore plugs, the sleeve or liner will be capped with Teflon tape and plastic end caps. The samples will then be labeled with the soil boring number and the depth and placed in an ice chilled cooler. A chain of custody document will be completed that will accompany the samples during transportation to the laboratory. Soil cores not submitted for analysis will be used in field screening for VOCs and lithologic logging.

4.2 Sampling Depths

Samples from each soil boring will be collected at the approximate sampling depths of 1 foot below ground surface (bgs), 2 feet bgs, 3 feet bgs, and 5 feet bgs to assess potential vertical migration of hazardous wastes and hazardous materials. Soil samples may be collected at 10 feet bgs and at five-foot intervals thereafter to a maximum depth of 40 feet bgs or until groundwater is encountered (whichever comes first) and archived for later analysis if constituents of concern are present above corrective action cleanup goals to aid in vertical extent determination. In addition to the sample interval indicated above, additional samples will be collected at depths where a distinct change in soil occurs, where visual evidence of contamination is present, and where field monitoring equipment indicates contamination.

4.3 Boring Logs

During drilling operations, soil boring logs will be prepared by a field geologist. The following information will be recorded on the soil boring log forms: boring number and location, sample identification numbers, sample location identification, date and time, sample depth, lithologic description in accordance with the Unified Soil Classification System (USCS), and description of any visible evidence of soil contamination. The boring logs will be included with a post-investigation report to the department. A California Professional Geologist/Engineer in charge of

the field investigation will conduct or directly oversee the activities and sign all boring logs and related documents. Upon completion of each borehole, the borehole will be backfilled with hydrated bentonite and/or a Portland cement grout and restored to grade with materials similar to the surrounding surface.

4.4 Equipment Decontamination

Sampling equipment will be steam cleaned or cleaned with a non-phosphate detergent, then rinsed with distilled water prior to sample collection. Rinse water and residues from the sampling procedures will be treated as investigation-derived waste and managed as described in Section 7.

5.0 SAMPLE ANALYTICAL METHODS

Soil samples specified for analysis (those collected at depths of at least 0 to 5 feet bgs) will be analyzed for Constituents of Concern using the analytical methods specified in the attached Table 1. Archive samples will be held by the laboratory for possible analysis pending the results of the shallower soil samples.

6.0 QUALITY ASSURANCE/QUALITY CONTROL

Quality assurance/quality control (QA/QC) requirements will be followed during sample collection as specified in the DTSC-approved Closure Plan. Duplicate soil samples representing about 10% of the total number of samples will be collected and tested for the same suite of analytes as the unique soil sample collected in the sampling program. The duplicate samples will also be identified by soil boring numbers and the depths at which the samples were collected. To avoid bias by the laboratory, artificial boring numbers will be used. A log will be maintained to allow correlation of the duplicate to the original sample number.

In addition, one equipment blank sample will be collected for each day that the drill rig is operating. The equipment blank samples will be collected to assess the thoroughness of equipment cleaning procedures in the field and as a means of evaluating the potential for cross-contamination between sample locations. The equipment blanks will consist of a distilled water rinse of the sampling equipment after the equipment is cleaned. The distilled water will be collected and analyzed for the same constituents as the soil samples.

7.0 DISPOSAL OF INVESTIGATION DERIVED WASTES

Investigation-derived wastes (soil cuttings generated during drilling and sampling and water generated by sampling equipment decontamination) will be placed in 55-gallon drums to be located on-site. The waste material will be held until the analysis is received by the laboratory for the samples collected. Based on the sample results, the waste will be disposed of properly according to applicable regulations.

Table 1: Soil Constituents of Concern and Analyses

Constituent of Concern	Analytical Method[1]	Prep Method[1]	Container Type[2]	Minimum Sample Size	Preservative	Extraction Holding Time	Analysis Holding Time
Metals[3]	6010D	3010	PTFE, P, G	200 g	None	N/A	6 months
Hexavalent Chromium (Cr^{+6})	7196A		PTFE, P, G	100 g	Cool, ≤ 6 °C	30 days	7 days
Mercury	7471B		PTFE, P, G	200 g	Cool, ≤ 6 °C	N/A	28 days
Semi-Volatile Organic Compounds	8270D		G[4]	30 g	Cool, ≤ 6 °C	14 days	40 days
Volatile Organic Compounds	8260B	5035A	EnCore Sampler, or equivalent	10 g	Freeze	N/A	7 days

[1]*Test Methods for Evaluating Solid Waste, Physical/Chemical Methods* (SW-846)
[2]PTFE = Polytetrafluoroethylene Plastic; P = Plastic; G = Glass
[3]"Metals" include antimony, arsenic, beryllium, cadmium, chromium (total), copper, iron, lead, nickel, selenium, silver, thallium, and zinc.
[4]250-mL wide-mouth glass container with PTFE-lined lid