Spill Prevention Control and Countermeasure (SPCC) Plan

Construct New Secondary Containment

EXAMPLE

This worksheet determines the possible dimensions for a rectangular or square dike or berm to meet the secondary containment requirement for aboveground bulk storage containers.

Steps:

A. Determining required dike or berm dimensions for largest single tank

1. Calculate the volume of the tank
2. Specify the containment wall height and one containment lateral dimension D1 to calculate lateral dimension D2
3. Calculate the volume of rain, V_{Rain} to be collected in the secondary containment with area A_{SC} for the specified rain event
4. Calculate the required secondary containment volume, V_{SCReq} to account for the additional volume of rain, V_{Rain}

B. Accounting for the displacements from other vertical cylindrical tanks to be located in dike or berm with the largest tank

C. Accounting for the displacements from other horizontal cylindrical tanks to be located In dike or berm with the largest tank

1. For SC_{Height} (ft), calculate the displacement from additional horizontal cylindrical tanks, Tank 2, 3, 4, etc., to be located with the largest tank in the dike or berm
2. Calculate the total displacement volume from the additional horizontal cylindrical tanks in the dike or berm

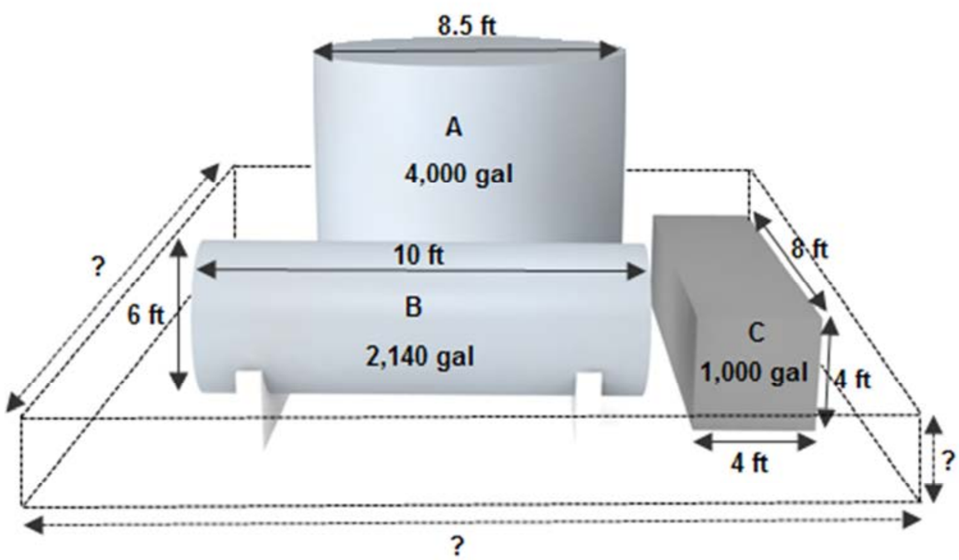
D. Accounting for the displacements from other rectangular tanks to be located in dike or berm with the largest tank

1. For SC_{Height} (ft), calculate the displacement from additional rectangular tanks, Tank 2, 3, 4, etc., to be located with the largest tank in the dike or berm
2. Calculate the total displacement volume from the additional rectangular tanks in the dike or berm

Disclaimer: Please note that these are simplified calculations for qualified facilities that assume: 1) the secondary containment is designed with a flat floor; 2) the wall height is equal for all four walls; and 3) the corners of the secondary containment system are 90 degrees. Additionally, the calculations do not include displacement for support structures or foundations. For Professional Engineer (PE) certified Plans, the PE may need to account for site-specific conditions associated with the secondary containment structure which may require modifications to these sample calculations to ensure good engineering practice.

Information needed to use this worksheet:

- Tank shell capacity, diameter, length, and height
  See diagram for dimensions
- Secondary containment wall height
  Cannot exceed 6 feet per local fire code
- Rainfall amount
  Rainfall can collect in the secondary containment; the selected rain event for the location is 6 inches.
- Other considerations
  With a proposed containment wall height of 5 ft. and one lateral containment dimension of 10 ft., the height of Tank B below the top of the wall is 4 ft.



A. Determining required dike or berm dimensions for largest single tank

1. Calculate the volume of the tank

Largest Tank Shell Capacity (gal) = 4,000
a

Largest Tank Volume (ft^3) = 4,000 ÷ 7.48
a (gal) gal/ft^3

= 535 ft^3
b

Note that state and local fire and safety codes may prescribe limits on the height of containment walls, minimum separation distances between tanks, and setback distances. For instance, Occupational Safety and Health Administration (OSHA) flammable and combustible liquids standards in 29 CFR 1910.106 prescribe separation distances between adjacent tanks. Such requirements may present constraints on the location, dimensions, and configuration of the secondary containment structure. The footprint of the tank or tanks and arrangement of the tanks when there is to be more than a single tank within secondary containment may also present constraints on the containment dimensions.

2. Specify the containment wall height and one containment lateral dimension D1 to calculate lateral dimension D2

Height of Containment Wall, SC_{Height} *(ft)* = 5 ft
c

Height of Containment Wall, SC_{Height} *(in)* = 5 x 12
c (ft) in/ft

= 60 in
d

D1 (ft) = 10 ft
e

b *is the volume of the largest tank calculated in Step 1.*

D2 (ft) = 535 ÷ 5 ÷ 10 = 10.7 ft
b (ft^3) c (ft) e (ft) **f**

3. Calculate the volume of rain, V_{Rain} to be collected in the secondary containment with area A_{SC} for the specified rain event

Selected Rainfall Event:

24— Hr 25— Yr

Rainfall (in) = 6 in (**g**)

f is lateral dimension D2 calculated in Step 2.

A_{SC} (ft^2) = 10 [e (ft)] x 10.7 [f (ft)] = 107 [**h**] ft^2

V_{Rain} (ft^3) = 6 [g (in)] ÷ 12 [in/ft] x 107 [h (ft^2)]

= 53.5 ft^3 (**i**)

4. Calculate the required secondary containment volume, V_{SCReq} to account for the additional volume of rain, V_{Rain}

__b__ is the volume of the largest tank calculated in Step 1.

V_{SCReq} (ft^3) = 535 [b (ft^3)] + 53.5 [i (ft^3)] = 588.5 [**j**] ft^3

Vary the secondary containment height and lateral dimensions, or footprint, in Step 2 to meet any space or dimension constraints or requirements and the required containment volume, V_{SCReq} by using V_{SCReq} in place of the volume of the largest shell capacity tank, **b** in Step 2.

2. (Repeated with a required containment capacity of 588.5 ft³) Specify the containment wall height and one containment lateral dimension D1 to calculate lateral dimension D2

Height of Containment Wall, SC_{Height} (ft) = 5 ft (c)

Height of Containment Wall, SC_{Height} (in) = 5 [c (ft)] x 12 [in/ft]

= 60 in (**d**)

D1 (ft) = 10 ft (e)

__b__ is the volume of the largest tank calculated in Step 1. 588.5 ft^3 was used for this calculation.

D2 (ft) = 588.5 [b (ft^3)] ÷ 5 [c (ft)] ÷ 10 [e (ft)] = 11.8 [**f**] ft

For the same containment wall height and lateral dimension D1, D2 has to increase to 11.8 ft for the secondary containment capacity to be adequate.

IF APPLICABLE: When other tanks or containers are also to be located within the secondary containment along with the largest tank, calculate the displacement volumes from these other tanks or containers using Parts B, C and D as applicable. Add the total displacement volume from the other tanks or containers to the volume of rain, V_{Rain} and the largest tank volume, **b**, in Step 1, to obtain a net secondary containment volume, V_{NetSC}:

V_{NetSC} (ft^3) = [588.5] j (ft^3) + [331] Total Displacement Volume (ft^3) = [919.5] **k** ft^3

__j__ is the required secondary containment volume calculated in Step 4.

Note: In this example, the total displacement of 331 ft^3 result from the displacement of 203 ft^3 from the horizontal cylindrical tank calculated in Part C and 128 ft^3 from the rectangular tank calculated in Part D.

Vary the secondary containment height and lateral dimensions, or footprint, in Step 2 to meet any space or dimension constraints or requirements and the net required containment volume, V_{NetSC} by using V_{NetSC} in place of the volume of the largest shell capacity tank, **b**.

2. (*Repeated with a required containment capacity of 919.5 ft^3) Specify the containment wall height and one containment lateral dimension D1 to calculate lateral dimension D2*

Height of Containment Wall, SC_{Height} (ft) = [6] c ft

Height of Containment Wall, SC_{Height} (in) = [6] c (ft) x 12 in/ft

= [72] **d** in

D1 (ft) = [10] e ft

D2 (ft) = [919.5] b (ft^3) ÷ [6] c (ft) ÷ [10] e (ft) = [15.3] **f** ft

__b__ is the volume of the largest tank calculated in Step 1. 919.5 ft^3 was used for this calculation.

Increasing the containment wall height from 5 ft. to the limit of 6 ft. with the same D1 lateral dimension of 10 ft. increases D2 to 15.3 ft. for the secondary containment capacity to be adequate and account for the other tank displacements. Changing the containment wall height will require reviewing and recalculating displacement volumes if necessary as the tank heights below the top of the wall may change. Also, as the containment area or footprint increase, recalculations of the corresponding increase in the volume of rain, V_{Rain}, that can collect in the containment using Step 3 and reassessment of containment capacity will be necessary.

B. <u>Accounting for the displacements from other vertical cylindrical tanks to be located in dike or berm with the largest tank</u>

The single vertical cylindrical tank is the largest shell capacity tank; there are no other vertical cylindrical tanks within the same secondary containment.

C. Accounting for the displacements from other horizontal cylindrical tanks to be located in dike or berm with the largest tank

1. For SC_{Height} (ft), calculate the displacement from additional horizontal cylindrical tanks, Tank 2, 3, 4, etc., to be located with the largest tank in the dike or berm

The easiest way to determine the displacement volume in a horizontal cylindrical tank is to use the tank manufacturer's liquid height to gallons conversion chart for the tank in Method 1 calculation. If this information is not available, use Method 2 calculation to obtain the displacement volumes.

METHOD 1

Height of Tank B Below Containment Wall (in) = [ ] in

$V_{Tank\ B}$ Displacement (gal) From Tank Conversion Chart = [ ] gal
q

$V_{Tank\ B}$ Displacement (ft^3) = [ ] q (gal) x 0.1337 ft^3/gal = [ ] **r** ft^3

Repeat to calculate the displacement of each additional horizontal cylindrical tank located with the largest tank in the dike or berm.

Total Displacement Volume (ft^3) = [ ] r (ft^3) + [ ] r1 (ft^3) + [ ] r2 (ft^3) + …

= [ ] **s** ft^3

METHOD 2

Height of Tank B Below Containment Wall (in) = 48 **t** in

Tank B Diameter (in) = 6 Diameter (ft) x 12 in/ft = 72 **u** in

Height to Diameter Ratio for Tank B = 48 t (in) ÷ 72 u (in) = 0.67 **v**

Tank B Volume Fraction for Height to Diameter Ratio (Table) = 0.71 **w**

<u>If the tank shell capacity in gallons is known:</u>

Tank Volume $V_{Tank\ B}$ (ft^3) = 2,140 Shell Capacity (gal) x 0.1337 ft^3/gal = 286 **x** ft^3

METHOD 2 (CONT)

Or, if the tank shell capacity in gallons is not known:

Tank B radius (ft) = [ ] ÷ 2 = [ ] ft
Diameter (ft)

$V_{Tank\ B}$ *(ft³)* = 3.14 x [( )²] x [ ] = [ ] ft³
Radius (ft) — Tank Length (ft) — **y**

Displacement, $V_{Tank\ B}$ *(ft³)* = [286] x [0.71] = [203] ft³
x or y (ft³) — w — **z**

Repeat to calculate the displacement volume of each additional horizontal cylindrical tank to be located with the largest tank in the dike or berm.

2. Calculate the total displacement volume from the additional horizontal cylindrical tanks in the dike or berm

Total Displacement Volume (ft³) = [203] + [0] + [0] + ...
z (ft³) — z1 (ft³) — z2 (ft³)

***z** is the displacement volume calculated in Step 1, Method 2 of C.*

= [203] ft³
aa

D. Accounting for the displacements from other rectangular tanks to be located in dike or berm with the largest tank

1. Calculate the total displacement volume from the additional horizontal cylindrical tanks in the dike or berm

Height of Tank C Below Containment Wall (ft) = 4 ft
ab

Length of Tank C (ft) = 8
ac

Width of Tank 2 (ft) = 4
ad

Displacement Area, $DA_{Tank\ C}$ (ft^2) = 8 x 4 = 32 ft^2
ac (ft) ad (ft) **ae**

Displacement Volume, $DV_{Tank\ C}$ (ft^3) = 32 x 4
ae (ft^2) ab (ft)

= 128 ft^3
af

Repeat Step 1 to calculate the displacement area and volume of each additional rectangular tank to be located with the largest tank in the dike or berm.

2. Calculate the total displacement volume from the additional horizontal cylindrical tanks in the dike or berm

Total Displacement Volume (ft^3) = 203 + 0 + 0 + …
af (ft^3) af1 (ft^3) af2 (ft^3)

***af** is the displacement volume calculated in Step 1 of D.*

= 203 ft^3
ag

Calculated acceptable dike dimensions

The preceding calculations produced the following dimensions shown in the diagram for one possible dike configuration that would meet the required secondary capacity to conform to the SPCC regulation and the local fire code's 6 ft dike height limit.