



# Guidelines for Calculating Emissions from Cooling Towers

December 2022

## ***Introduction:***

Beginning 2006, facilities are required to report the particulate matter (PM), volatile organic compounds (VOCs), and toxics air contaminant (TAC) emissions from their cooling towers. The PM emissions are the result of the total dissolved solids in the circulating water which are carried out with the water that is entrained in the air being discharged from the tower. VOC emissions typically result from the leakage from process heat exchangers that service hydrocarbon (HC) process streams as well as from chemical treatment with VOC containing material added to the circulating water. VOC emissions are expected from cooling towers used in refineries and chemical plants, where the circulating water is used to cool down the process stream. VOC emissions are not expected from cooling towers used in Heating, Ventilating, and Air Conditioning (HVAC) and other industries such as power plant facilities, high rise buildings, hotels, hospitals, etc). TACs emissions are typically from the toxic constituents of PM and/or VOC in the circulating water.

## ***Emission Calculations Procedures:***

1. Facilities may use the default emission factors listed below to estimate the PM and VOC emissions using the equation below:

$$E = Q \times EF \quad (\text{Eq. 1})$$

Where:

E = Annual Emissions in pounds per year (lb/yr)

Q = Cooling tower circulating water (MMgal/yr or equipment rating (ton)/yr)

EF = Emission factor (lb/MMgal or lb/equipment rating (ton)) consistent with the unit of throughput (Q)

Table 1: Default Emission Factors for Cooling Towers

Type of Industry	Annual Throughput Unit	VOC EF	PM EF
Refineries	Million gallon / Year	0.7	19
Chemical mfg Plant	Million gallon / Year	0.7	19
Others	Million gallon / Year	—	19
HVAC	Ton / Year	—	1.643

References:

VOC: AP-42, Section 5.1, Table 5.1-2

PM: AP-42, Section 13.4, Table 13.4-1

HVAC: Operating 8,760 hours/year; at 3 GPM circulating water rate; with 2500 ppm solid in water; and drift loss of 0.005%. Cooling capacity (1 ton = 12,000 Btu/hr)

- 2. Alternative PM Emission Factor Calculation Method:** Alternatively, facilities may use this equation to calculate PM emissions using site specific parameters:

$$EF = \frac{TDS}{10^6} \times \frac{\eta_{Drift}}{100} \times \rho_{H_2O} \quad (\text{Eq. 2})$$

Where:

$EF$  = emission factor (lb/MMgal)

$TDS$  = Concentration of total dissolved solids in circulating water (PPM by weight)

$\eta_{Drift}$  = Drift loss of circulating water (%)

$\rho_{H_2O}$  = Density of Water (lb/MMgal) = Density of Water (lbs/gal  $\times 10^6$ )

- 3. Toxic Air Contaminants:** Facility may also use this equation using Eq 1 to calculate TACs emissions (if applicable). TAC emission factor calculation is shown below:

$$EF_{TAC} = EF_{VOC \text{ or } PM} \times W \quad (\text{Eq. 3})$$

Where:

$EF_{TAC}$  = Toxics air contaminants emission factor (lb/MMgal)

$EF_{VOC \text{ or } PM}$  = VOC or PM emission factor used to report cooling towers emissions (lb/MMgal)

$W$  = Weight fraction of TAC in VOC or PM (decimal)

**EXAMPLE ON HOW TO REPORT EMISSIONS FROM A COOLING TOWER:**

A chemical plant operates a mechanical draft cooling tower circulating 3,650 million gallons for the year of water to cool down process stream. The source test indicated 0.2% Nickel present in the PM emissions from the cooling tower.

Facilities are required to report their VOC, PM, and TAC emissions from the cooling tower using the AER Reporting Tool.

## Add a New Cooling Tower Emission Source

Since the cooling tower is not a permitted source, it must be added to the list by clicking **Add New Emission Source**.

Facility ID: 999129

1. Facility Information
2. Status Update
3. Combustion Fuels
4. Emissions Release Locations
5. Emission Sources (ES)
6. Report Process/Emissions
7. Additional Toxic Substances Production and Usage
8. Perform Data Validation
9. Review Summaries
10. Print Facility Report
11. Report Submission

### Build Reporting Structure

#### Emission Sources (ES) Classification

**Summary:** This section contains facility permit profile. Please make sure that every device has a specified Emission Source (ES). New emission sources can also be added.

**Instruction:** Add Devices (emissions sources) by clicking "Add New Emission Source". Edit devices by clicking "Profile" under the Emission Source (ES) Column. Add emission data by clicking "Open" under the Emissions column. Upload storage tank data by clicking on link "Click here" below.

Storage Tank Emissions Batch File Import - [Click here](#) for more instructions.

**Add New Emission Source**

Displaying 9 emission sources.

A/N	<input type="text"/>	Permit NO	<input type="text"/>
AER Device ID	<input type="text"/>	Permit Device ID	<input type="text"/>
<input type="button" value="Search Emission Sources"/>			

Search:

Emission Source (ES)	Emissions	A/N	Permit NO	Permit Device ID	Permit Equipment Description	AER Device ID	ES Name	ES Group Name	Source Category	Has Emissions	Equipment	PERP	ES Status
----------------------	-----------	-----	-----------	------------------	------------------------------	---------------	---------	---------------	-----------------	---------------	-----------	------	-----------


Fill out relevant information to the added Emission Source by identifying ES Name (example: Cooling Tower) and selecting the Operating ES Status (i.e. Normal Operation) from the drop-down menu. Then, click **Categorize Emission Source**.

Facility ID: 999129

1. Facility Information
2. Status Update
3. Combustion Fuels
4. Emissions Release Locations
5. Emission Sources (ES)
6. Report Process/Emissions
7. Additional Toxic Substances Production and Usage
8. Perform Data Validation
9. Review Summaries
10. Print Facility Report
11. Report Submission

### Edit Emission Source

**Instruction:** Add new emissions sources using information found on permits, manufacturers specifications, or identifying placards. Select the Operating ES Status that best reflect the device's operation for this reporting period. All areas with a Red Asterisk (\*) must be addressed. Note: Some devices have been pre-populated, verify that the information is correct

Permitted	<input type="checkbox"/>
A/N	
PERP Equipment(CARB's Portable Equipment Registration Program)	<input type="checkbox"/> Only CARB GHG MRR and Over 250 tons/yr (PTE) facilities must report PERP Emissions are not included when calculating emission fees 
Permit No	
Permit Device ID	
AER Device ID	will be assigned upon saving
ES Name	Cooling Tower *
Operating ES Status	Normal Operation *
Comment	<input type="text"/>
Emission Source Category	<b>Categorize Emission Source</b> *
Design Capacity	0 <input type="text"/>

After clicking **Categorize Emission Source**, the following pop-up will appear. Select **Other Processes** to reveal the check box for Other process equipment. Check the box for **Other process equipment**. Click **Save** to save and close the pop-up.

Categorize Emission Source

Permitted	A/N	Permit No	Permit Device ID	Permit Equipment Description	AER Device ID	ES Name
No					ESnull	Cooling Tower

1. External Combustion Equipment (e.g., boiler, dryer, oven, furnace, heater, afterburner, flare, kiln or incinerator) [click here](#) to select one the following Equipment:

2. Internal Combustion Equipment (e.g., internal combustion engine (excluding vehicles), turbine or micro turbine) [click here](#) to select one of the following Equipment:

3. Spray Coating/Spray Booth (e.g., coatings, solvents, adhesives, etc.) [click here](#) to select one of the following Equipment:

4. Other Use of Organics (e.g., coatings, solvents, inks, adhesives, etc.) except in Spray Coating/Spray Booth, [click here](#) to select one of the following Equipment:

5. Liquid Storage Tank (e.g. Underground, Aboveground, Small Tanks, Dispensing Systems) [click here](#) to select one of the following Equipment:

6. Fugitive Components (Emission Leaks from Process Components per Rule 462, 1173 and 1176), [click here](#) to select all applicable Equipment:

7. Other Processes (does not fit in any of the groups mentioned above), click [click here](#) to mark "Other Process Equipment":

☒ Other process equipment

Save

Cancel

Click any of the orange buttons to save the device. An AER Device ID will be assigned. Click **Save and return to List of Emission Sources** to proceed to the Emission Source page or click **Save and proceed to Process Reporting** to continue to emissions reporting for this device.

Permitted

A/N

PERP Equipment(CARB's Portable Equipment Registration Program)

Permit No

Permit Device ID

Permit Equipment Description

AER Device ID

ES Name

Operating ES Status

Comment

Emission Source Category

Equipment

Design Capacity

☐

ES38

Cooling Tower \*

Normal Operation \*

Other Processes

Other process equipment

0.000000

Only CARB GHG MRR and Over 250 tons/yr (PTE) facilities must report PERP

☐ Emissions are not included when calculating emission fees

Categorize Emission Source \*

Save or Save and return to List of Emission Sources or

Save and proceed to Process Reporting or Cancel

Optional: Save and Mark as Completed

Click here to [delete](#) this emission source and associated data.

## Report Emissions Data from a Cooling Tower

To add emissions data, open the process from the **Emission Sources (ES)** page. Then, click **Open** under the Emissions column for the device. A window will pop-up showing the new process (P1). Click **Open** to continue to the Edit Emissions Source page.

Facility ID: 999129

### Build Reporting Structure

1. Facility Information
2. Status Update
3. Combustion Fuels
4. Emissions Release Locations
5. Emission Sources (ES)
6. Report Process/Emissions
7. Additional Toxic Substances Production and Usage
8. Facility Emissions
9. Facility Emissions
10. Facility Emissions
11. Facility Emissions

### Emission Sources (ES) Classification

**Summary:** This section contains facility permit profile. Please make sure that every device has a specified Emission Source (ES). New emission sources can also be added.

**Instruction:** Add Devices (emissions sources) by clicking "Add New Emission Source". Edit devices by clicking "Profile" under the Emission Source (ES) Column. Add emission data by clicking "Open" under the Emissions column. Upload storage tank data by clicking on link "Click here" below.

Process References

A/N	Permit No	Permit Device ID	Permit Device Description	AER Device ID	ES Name	ES Group Name	Source Category	Emissions?	Equipment	PERP	ES Status
<a href="#">Open</a>					ES38	Cooling Tower		Other Processes	Y	Other process equipment	N

Process ID	Source Group	Process/Material/Fuel Name	Status	Operation Type
<a href="#">Open</a>	P1	Other Process Emissions	Work in progress	routine

Add Process/Material/Fuel
*i*

OK

Search:

Print Preview

Emission Source (ES)	Emissions	A/N	Permit NO	Permit Device ID	Permit Equipment Description	AER Device ID	ES Name	ES Group Name	Source Category	Has Emissions	Equipment	PERP	ES Status
<a href="#">Profile</a>	<a href="#">Open</a>						ES38	Cooling Tower	Other Processes	Y	Other process equipment	N	Work in progress

The following steps must be completed to report emissions:

1. Process
2. Throughput
3. Criteria Emissions
4. Toxic (TAC/ODC) Emissions
5. Process Release Locations – this feature is only available for Core CTR facilities.



**Step 1: Process** – Click **Open** under **Step 1: Process** to open the Process section.

Facility ID: 999129

1. Facility Information
2. Status Update
3. Combustion Fuels
4. Emissions Release Locations
5. Emission Sources (ES)
- 6. Report Process/Emissions**
  - Combustion
    - External Combustion
    - Internal Combustion
  - Use of organics
    - Spray Coating/Spray Booth
    - Other Use of Organics
  - Storage Tanks
  - Fugitive Components
  - Other Processes**
    - Process Upset
7. Additional Toxic Substances Production and Usage
8. Perform Data Validation
9. Review Summaries
10. Print Facility Report
11. Report Submission

**Step 1: Process**

Optional: Mark as Completed

AER Device ID	Permit Device ID	A/N	Process ID	Rule #	Activity
<a href="#">Open</a>	ES38		P1		

Click here to [delete](#) this process.

**Step 2: Throughput**

Annual Throughput
<a href="#">Open</a>

**Step 3: Criteria Emissions (lbs)**

Use [Default Emission Factors](#) if available.

Pollutant	EF	Unit	Controlled EF	EF Data Source	Overall CE	Emissions
<a href="#">Add New</a>						

**Step 4: Toxic (TAC/ODC) Emissions (lbs)**

TAC/ODC Group	CAS #	EF	Unit	Controlled EF	EF Data Source	Overall CE	Emissions
<a href="#">Add New</a>							

**Step 5: Process Release Locations**

Emission Release Locations need to be added before they can be linked to processes. If you do not see your emission release location for this process, please add it in the [Emissions Release Locations](#) page.

Release Location ID	Release Name	Release Type	Stack Configuration	Latitude	Longitude	Stack Height Above Ground (ft)	Stack Exit Gas Temperature (°F)	Stack Diameter (ft)	Stack Exit Gas Velocity (ft/min)	Stack Exit Gas Flow Rate (Actual CFM)	Action
---------------------	--------------	--------------	---------------------	----------	-----------	--------------------------------	---------------------------------	---------------------	----------------------------------	---------------------------------------	--------

[Link Emissions Release Locations to this Process](#)

In the pop-up window, identify the Name and Activity Code. Select the appropriate Sector, Industry, Operation, Process, and applicable rule by selecting the appropriate selection from the drop-down menu. This below image shows an example of sector, industry, operation, process, and rule for a Cooling Tower. Click **Save** to return to the emissions reporting page.

Edit Emission Process - Other Processes

AER Device ID	Permit Device ID	A/N	Process ID	Rule #	Activity
ES38			P1		

AER Device ID  
NON-PERMITTED

ES38  
Permit Device ID

AER Device Name  
Cooling Tower

Process ID  
P1

Process Name  
Cooling Tower

Process Comment  
Cooling water

Activity Code \*

Sector:  
Miscellaneous Operations and Services

Industry:  
Cooling Towers

Operation:  
Process Cooling

Process:  
Mechanical Draft

Rule #

405

\* Add Rule

Save

Cancel

**Step 2: Throughput** – Click **Open** under **Step 2: Throughput** to open the Throughput section.

**Step 1: Process** Optional: Mark as Completed

	AER Device ID	Permit Device ID	A/N	Process ID	Rule #	Activity
<a href="#">Open</a>	ES38			P1	405	Miscellaneous Operations and Services : Cooling Towers : Process Cooling : Mechanical Draft

Click here to [delete](#) this process.

**Step 2: Throughput**

Annual Throughput	
<a href="#">Open</a>	

The following window will pop-out. Enter the Annual Throughput, the appropriate unit, and Throughput Type (Input, Existing, or Output). Enter a comment for throughput and click **Save**.

**Edit Throughput Information - Other Processes** ✕

AER Device ID	Permit Device ID	A/N	Process ID	Rule #	Activity
ES38			P1	405	Miscellaneous Operations and Services : Cooling Towers : Process Cooling : Mechanical Draft

**Annual Throughput**

Annual Throughput

3,650.00000000 \*

MM gal ▼ \*

Throughput Type

Input ▼ \*

Throughput Comment

Measured by totalizing meter

Save

Cancel

**Step 3: Criteria Emissions (lbs)** – Click **Add New** under **Step 3: Criteria Emissions (lbs)** to open the emissions pop-up box.

**Step 3: Criteria Emissions (lbs)** Use [Default Emission Factors](#) if available.

Pollutant	EF	Unit	Controlled EF	EF Data Source	Overall CE	Emissions
<div style="border: 1px solid #ccc; padding: 2px 10px; background-color: #f4a460; display: inline-block;">Add New</div>						

Enter the VOC Emission Factor (EF) from Table 1, ensuring the units are consistent with the reported throughput. In the Emission Factor Comment field, explain how the EF was determined. Select an option in the drop-down menu for Emission Factor Data Source.

The webtool will then calculate the emissions. Click **Save**.

**Open Criteria Emission Information - Other Processes**

AER Device ID	Permit Device ID	A/N	Process ID	Rule #	Activity
ES38			P1	405	Miscellaneous Operations and Services : Cooling Towers : Process Cooling : Mechanical Draft

**Annual Throughput**  
3,650.00000000 MM gal

Pollutant: **VOC** \*

Emission Factor (EF): **0.7000** \* lbs/MM gal

☐ Controlled EF value  
(mark checkbox if EF listed represents EF determined after control)

Overall Control Efficiency:

Emission Factor Comment: Based on SCAQMD guidelines, Default VOC EF, and AP-42, Chapter 5.1.

If not using **AQMD default** emission factor please provide detailed references in the Emission Factor Comment box above or upload file with the information.  
Processes without this information are subject to audit.

Emission Factor Data Source: **SCAQMD Guidelines** \*

Emissions: 2.55500000e+3 lbs

**Save** **Cancel**

To add the next pollutant, PM, click **Add New** under **Criteria Emissions** section again.

### Step 3: Criteria Emissions (lbs)

Use [Default Emission Factors](#) if available.

	Pollutant	EF	Unit	Controlled EF	EF Data Source	Overall CE	Emissions
<a href="#">Open</a>	VOC	7.00000000e-1	lbs / MM gal	No	SCAQMD Guidelines		2.55500000e+3
<b>Add New</b>							

Select PM from drop-down menu, enter the applicable emission factor (from Table 1), emission factor comment, and its source. Click **Save**.

**Open Criteria Emission Information - Other Processes**

AER Device ID	Permit Device ID	A/N	Process ID	Rule #	Activity
ES38			P1	405	Miscellaneous Operations and Services : Cooling Towers : Process Cooling : Mechanical Draft

**Annual Throughput**  
3,650.00000000 MM gal

Pollutant: **PM** \*

Emission Factor (EF): **19.000** \* lbs/MM gal

☐ Controlled EF value  
(mark checkbox if EF listed represents EF determined after control)

Overall Control Efficiency:

Emission Factor Comment: Based on SCAQMD Guidelines, default PM EF

If not using **AQMD default** emission factor please provide detailed references in the Emission Factor Comment box above or upload file with the information.  
Processes without this information are subject to audit.

Emission Factor Data Source: **SCAQMD Guidelines** \*

Emissions: 6.93500000e+4 lbs

**Save** **Cancel**



**Step 4: Criteria Emissions (lbs)** – Click **Add New** under **Step 4: Toxic (TAC/ODC) Emissions (lbs)** to open the emissions pop-up box.

#### Step 4: Toxic (TAC/ODC) Emissions (lbs)

TAC/ODC Group	CAS #	EF	Unit	Controlled EF	EF Data Source	Overall CE	Emissions
Add New							

Select the pollutant Group and CAS #, Nickel in this example, from drop-down menus and enter applicable Emission Factor, Control Efficiency, Comment, and Data Source.

In this example, the Nickel EF is calculated using Equation 3 as follows:

$$EF_{TAC} = EF_{PM} \times W$$

$$EF_{Ni} = 0.19 \text{ lb/MMgal} \times 0.2\% = 0.00038 \text{ lb/MMgal}$$

**Open Toxic (TAC/ODC) Emission Information - Other Processes**

AER Device ID	Permit Device ID	A/N	Process ID	Rule #	Activity
ES38			P1	405	Miscellaneous Operations and Services : Cooling Towers : Process Cooling : Mechanical Draft
<b>Annual Throughput</b>					
3,650.00000000 MM gal					

TAC/ODC Toxic Pollutants / Ozone Depleting Compounds

Pollutant: 17 - Nickel \*

CAS # (Pollutant): 7440020 - Nickel

Emission Factor (EF): 0.00038 \* lbs/MM gal

☐ Controlled EF value  
(mark checkbox if EF listed represents EF determined after control)

Overall Control Efficiency:

Emission Factor Comment: Source test dated 11/10/2021: 0.2% Nickel; SCAQMD Guidelines Equation 3

If not using **AQMD default** emission factor please provide detailed references in the Emission Factor Comment box above or upload file with the information.  
Processes without this information are subject to audit.

Emission Factor Data Source: Source Test \*

Emissions: 1.38700000e+0 lbs

**Save** **Cancel**

Click **Save**. If there is additional TAC/ODC from the same process, repeat the steps shown above.

### Step 1: Process

Optional: Mark as Completed

	AER Device ID	Permit Device ID	A/N	Process ID	Rule #	Activity
<a href="#">Open</a>	ES38			P1	405	Miscellaneous Operations and Services : Cooling Towers : Process Cooling : Mechanical Draft

Click here to [delete](#) this process.

### Step 2: Throughput

	Annual Throughput
<a href="#">Open</a>	3,650.00000000 MM gal

### Step 3: Criteria Emissions (lbs)

Use [Default Emission Factors](#) if available.

	Pollutant	EF	Unit	Controlled EF	EF Data Source	Overall CE	Emissions
<a href="#">Open</a>	VOC	7.00000000e-1	lbs / MM gal	No	SCAQMD Guidelines		2.55500000e+3
<a href="#">Open</a>	PM	1.90000000e+1	lbs / MM gal	No	SCAQMD Guidelines		6.93500000e+4
<a href="#">Add New</a>							

### Step 4: Toxic (TAC/ODC) Emissions (lbs)

	TAC/ODC Group	CAS #	EF	Unit	Controlled EF	EF Data Source	Overall CE	Emissions
<a href="#">Open</a>	Nickel	7440020	3.80000000e-4	lbs / MM gal	No	Source Test		1.38700000e+0
<a href="#">Add New</a>								

Core CTR facilities will see an additional step: **Step 5: Process Release locations**. For guidance on completing this section, refer to the Core CTR Guideline available on the AER Website.

### Step 5: Process Release Locations

Emission Release Locations need to be added before they can be linked to processes. If you do not see your emission release location for this process, please add it in the [Emissions Release Locations](#) page.

Release Location ID	Release Name	Release Type	Stack Configuration	Latitude	Longitude	Stack Height Above Ground (ft)	Stack Exit Gas Temperature (°F)	Stack Diameter (ft)	Stack Exit Gas Velocity (ft/min)	Stack Exit Gas Flow Rate (Actual CFM)	Action
---------------------	--------------	--------------	---------------------	----------	-----------	--------------------------------	---------------------------------	---------------------	----------------------------------	---------------------------------------	--------

[Link Emissions Release Locations to this Process](#)