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:

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

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)

η_{Drift} = Drift loss of circulating water (%)

ρ_{H_2O} = Density of Water (lb/MMgal) = Density of Water (lbs/gal × 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:

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

Where:

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

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

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

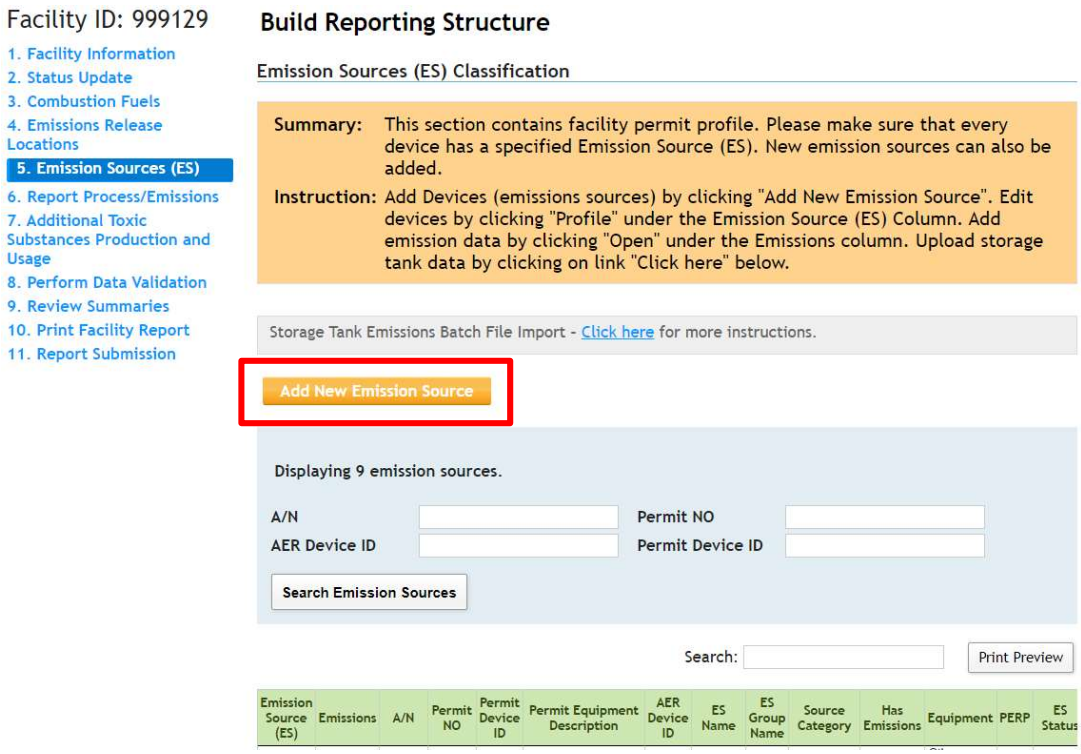
EXAMPLE ON HOW TO REPORT EMISSIONS FROM A COOLING TOWER:

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.

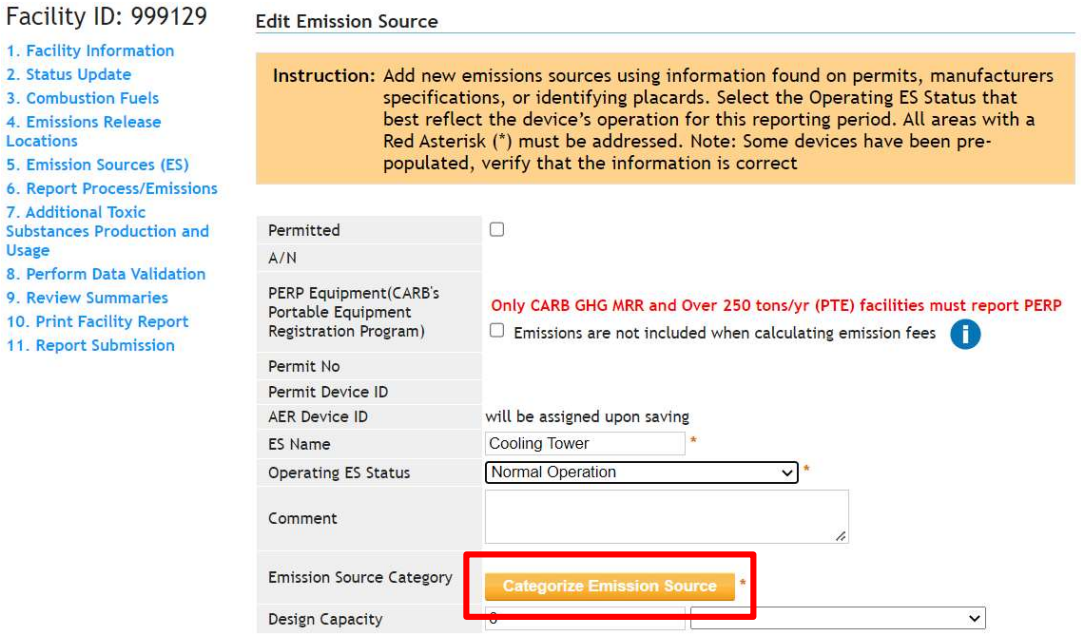
Facilities are required to report their VOC, PM, and TAC emissions from the cooling tower using the AER Reporting Tool.

Add a New Cooling Tower Emission Source

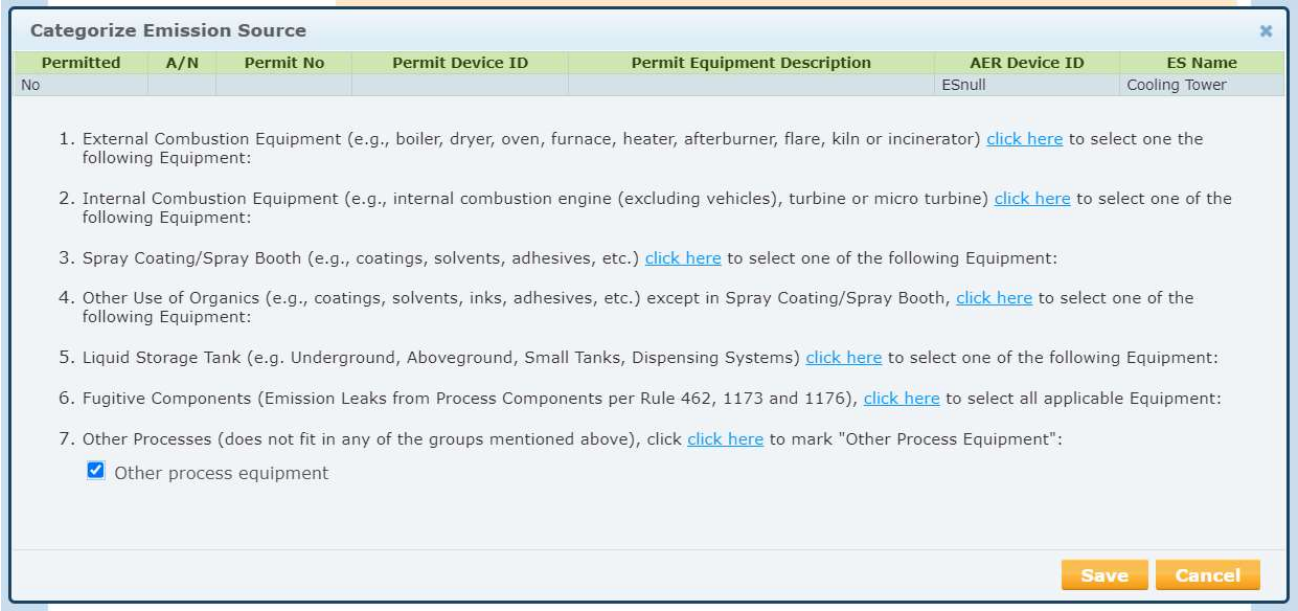
Since the cooling tower is not a permitted source, it must be added to the list by clicking **Add New Emission Source**.



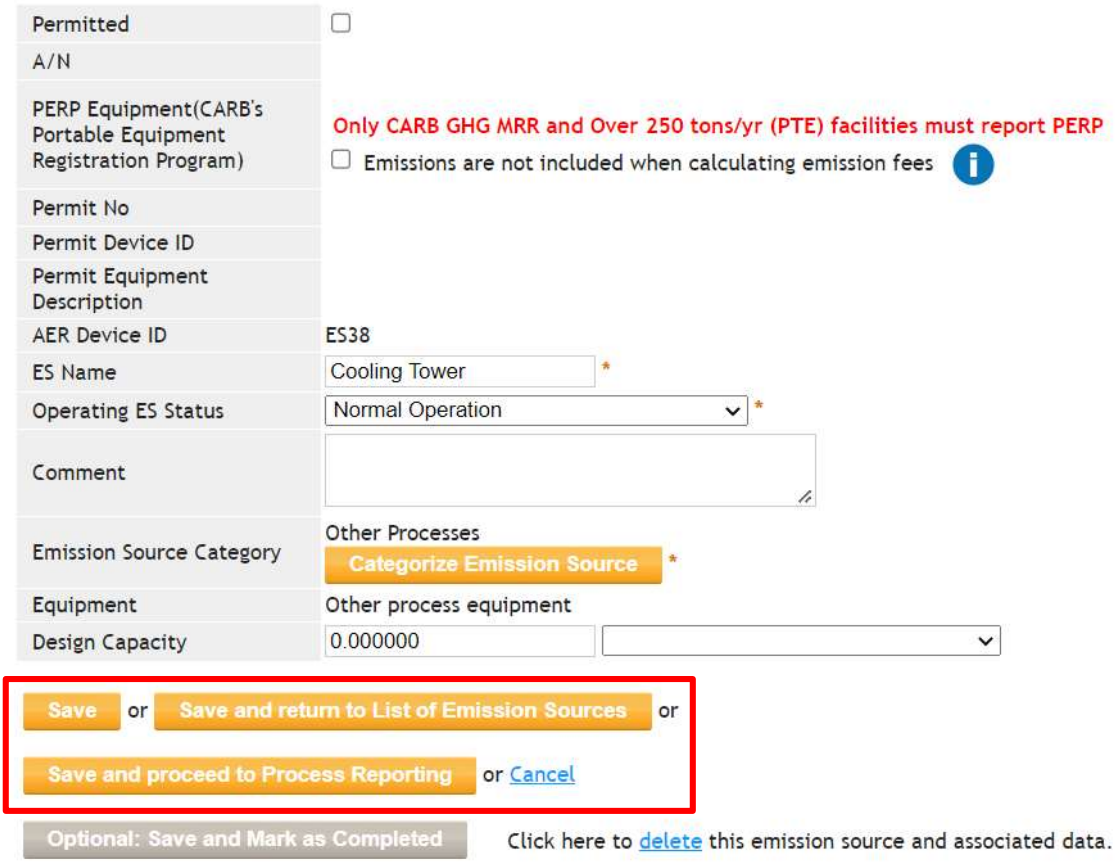
Fill out relevant information to the added Emission Source by identifying ES Name (example: Cooling Tower) and selecting the Operating ES Status (i.e. Normal Operation) from the drop-down menu. Then, click **Categorize Emission Source**.



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.

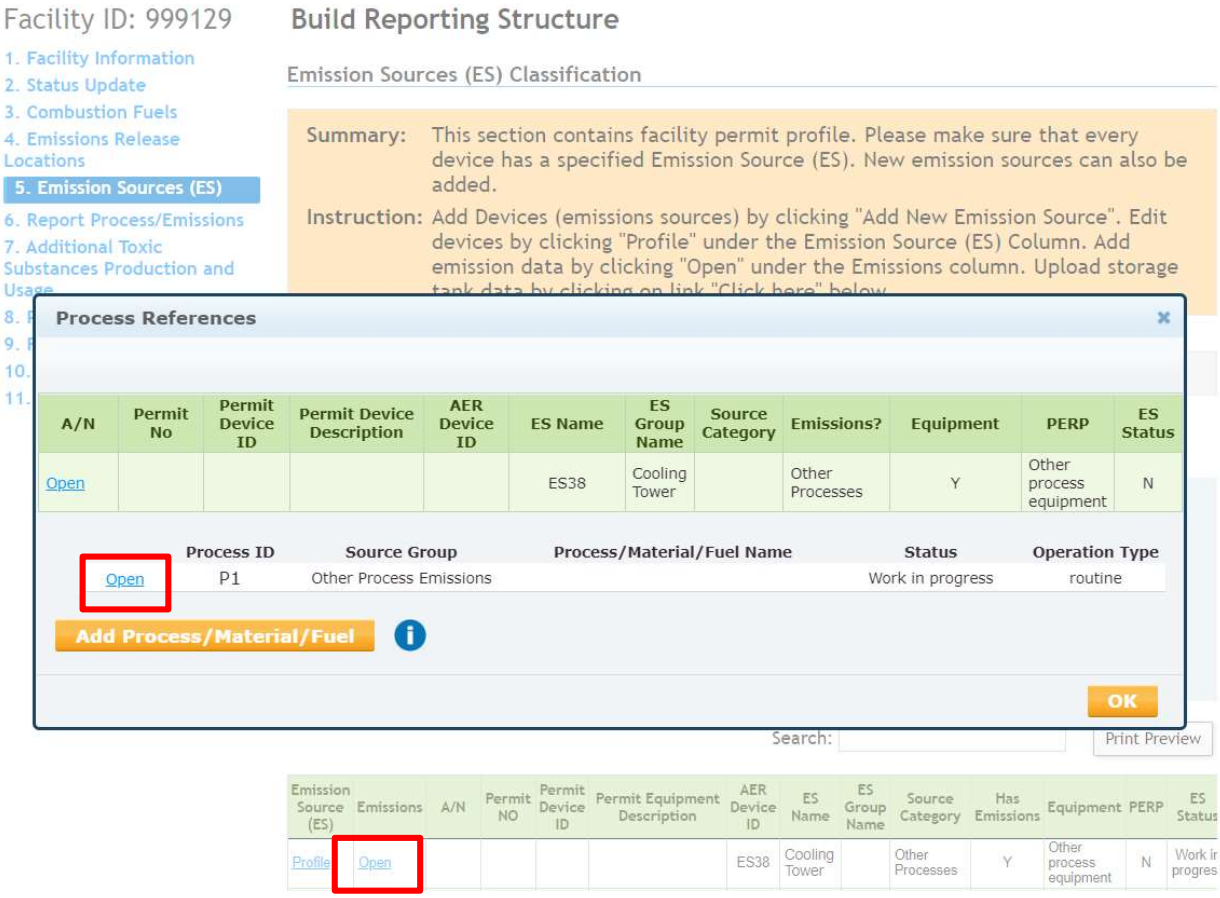


Click any of the orange buttons to save the device. An AER Device ID will be assigned. Click **Save and return to List of Emission Sources** to proceed to the Emission Source page or click **Save and proceed to Process Reporting** to continue to emissions reporting for this device.



Report Emissions Data from a Cooling Tower

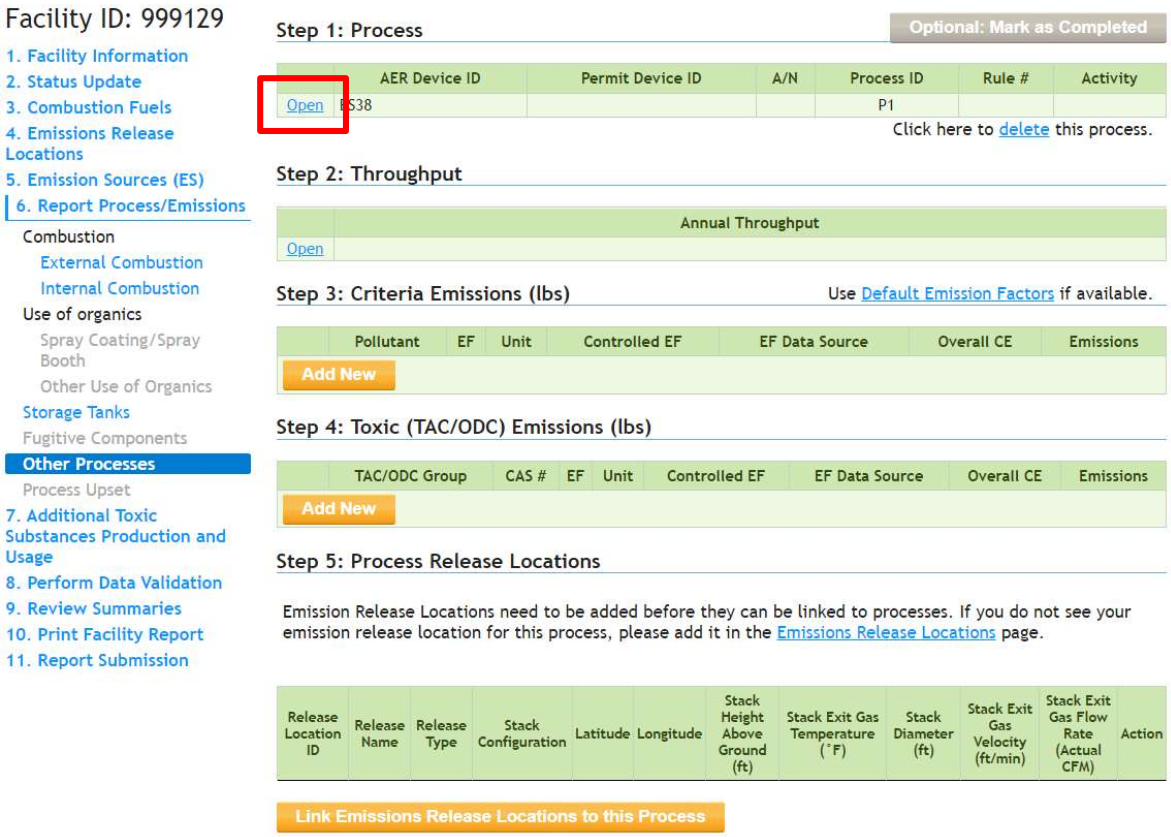
To add emissions data, open the process from the **Emission Sources (ES)** page. Then, click **Open** under the Emissions column for the device. A window will pop-up showing the new process (P1). Click **Open** to continue to the Edit Emissions Source page.



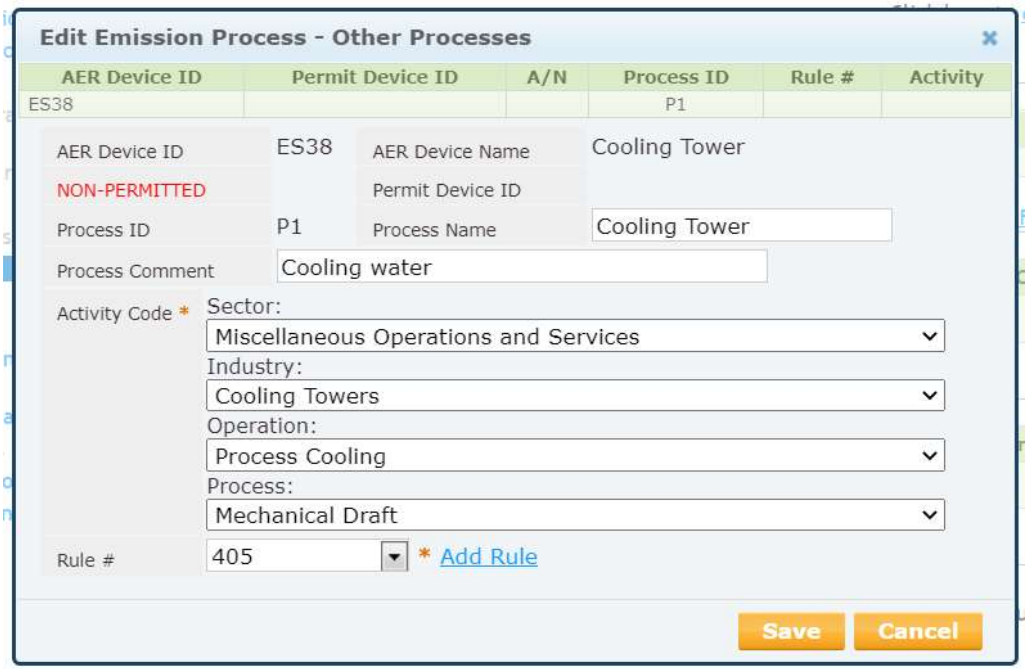
The following steps must be completed to report emissions:

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.

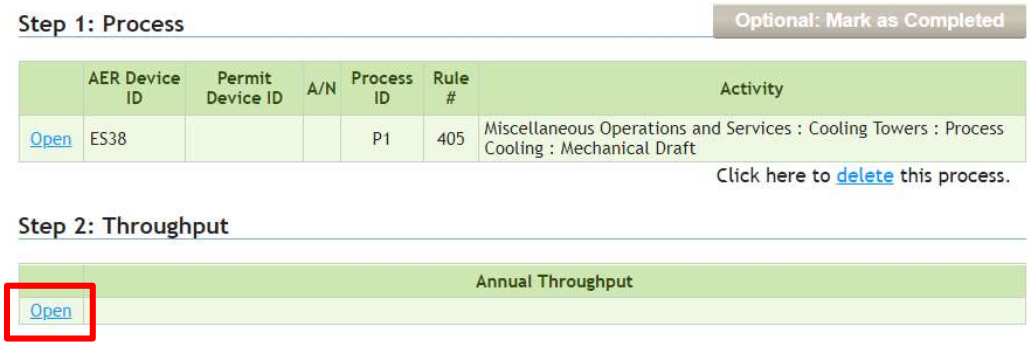
Step 1: Process – Click **Open** under **Step 1: Process** to open the Process section.



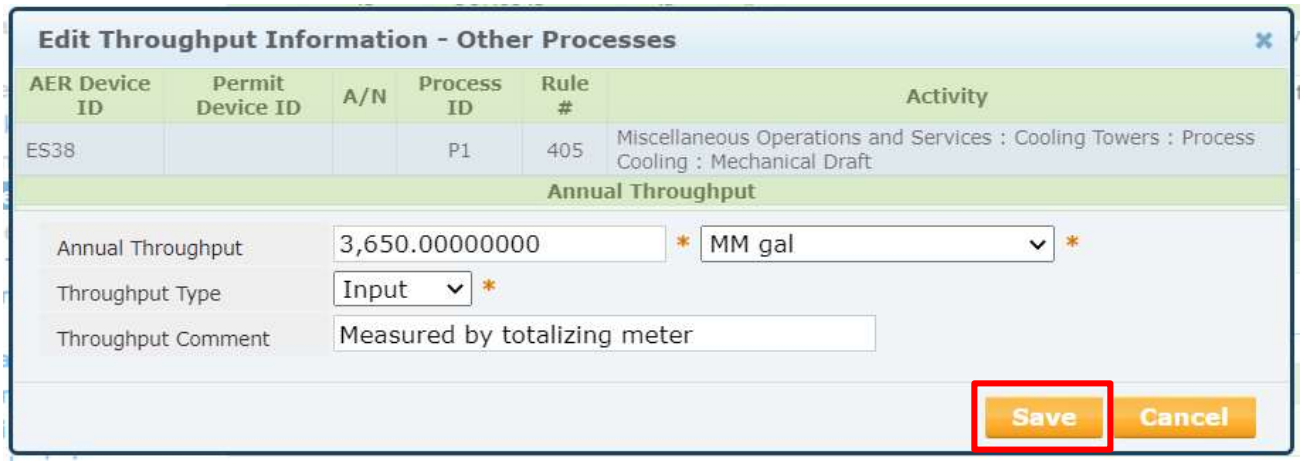
In the pop-up window, identify the Name and Activity Code. Select the appropriate Sector, Industry, Operation, Process, and applicable rule by selecting the appropriate selection from the drop-down menu. This below image shows an example of sector, industry, operation, process, and rule for a Cooling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



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



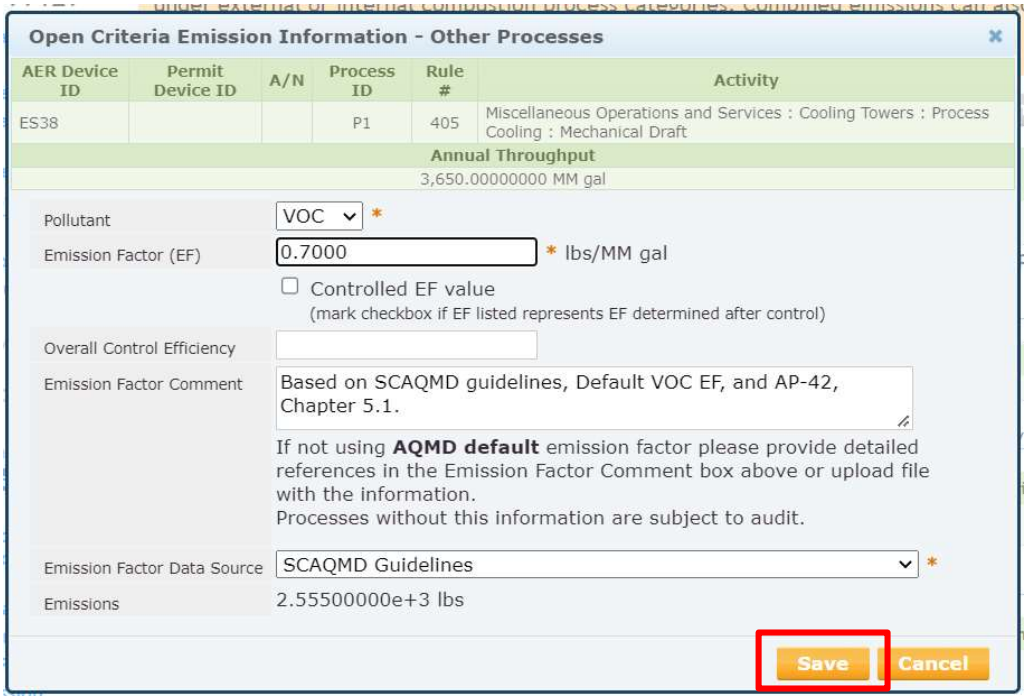
The following window will pop-out. Enter the Annual Throughput, the appropriate unit, and Throughput Type (Input, Existing, or Output). Enter a comment for throughput and click **Save**.



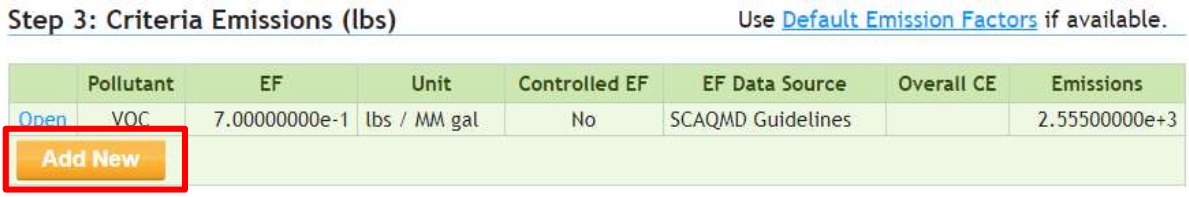
Step 3: Criteria Emissions (lbs) – Click **Add New** under **Step 3: Criteria Emissions (lbs)** to open the emissions pop-up box.

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.

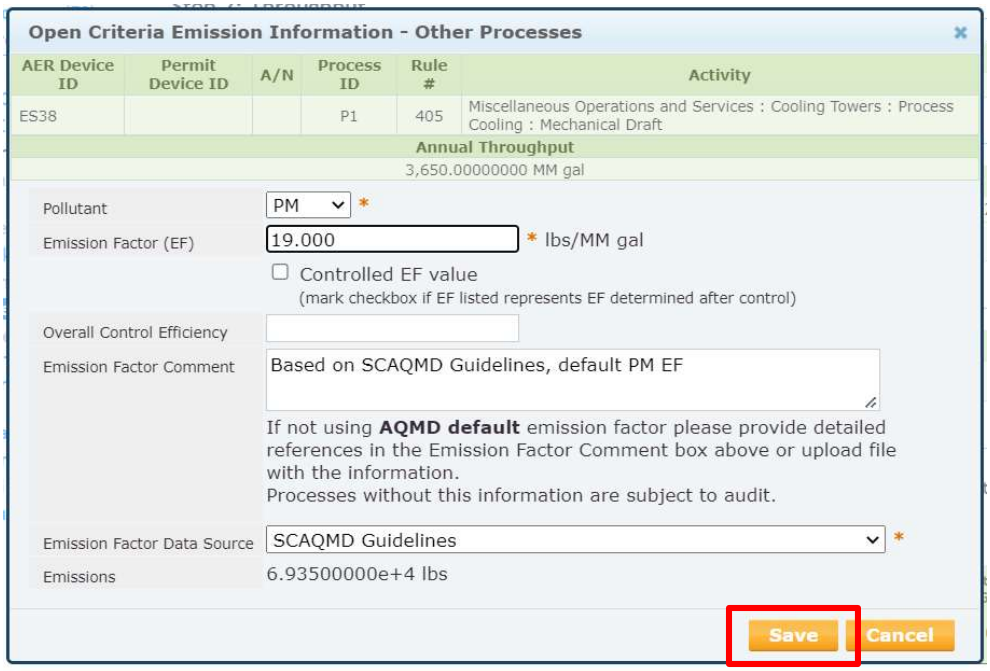
The webtool will then calculate the emissions. Click **Save**.



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



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



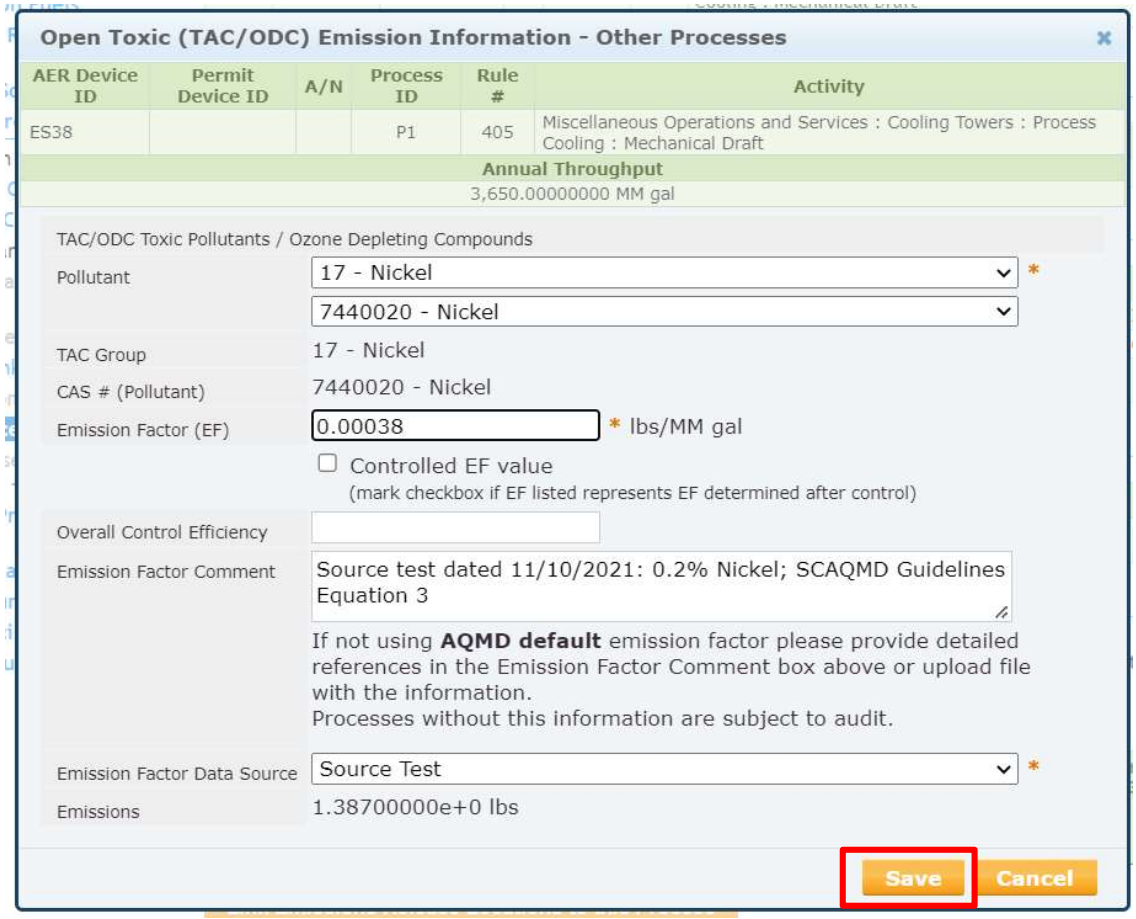
Step 4: Criteria Emissions (lbs) – Click **Add New** under **Step 4: Toxic (TAC/ODC) Emissions (lbs)** to open the emissions pop-up box.

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.

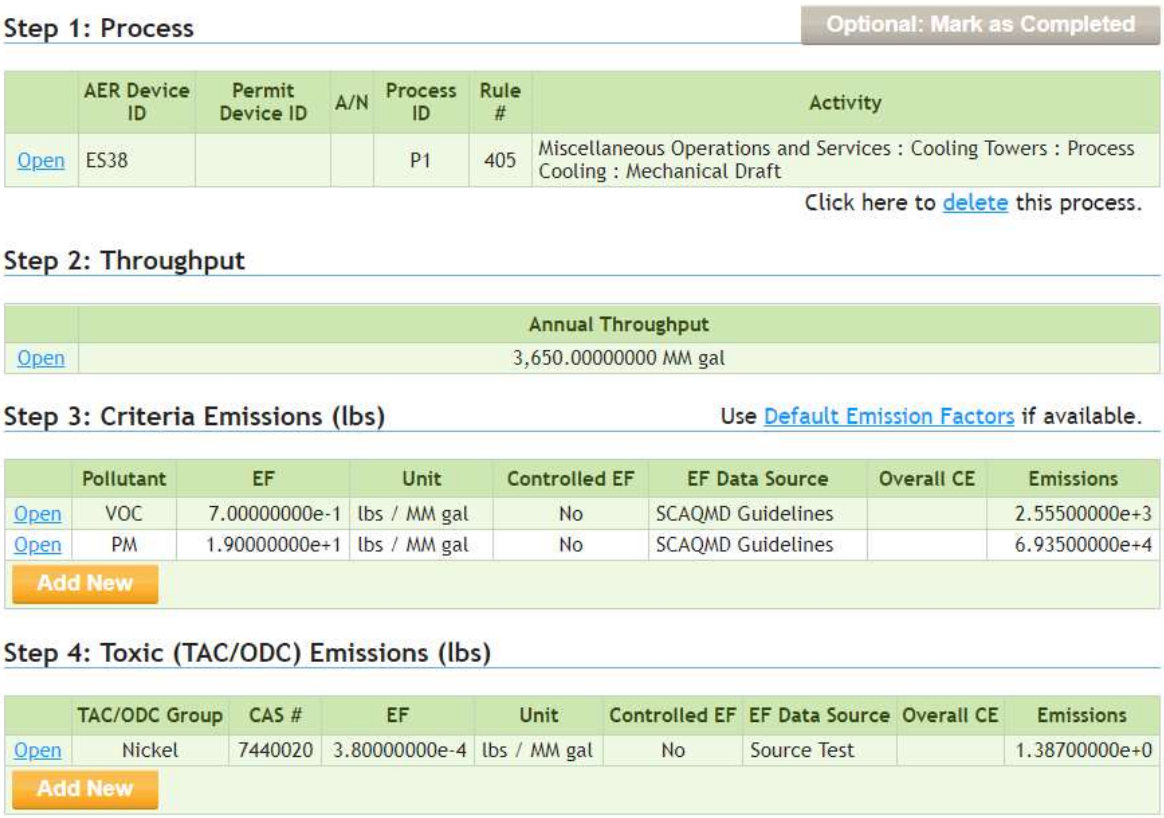
In this example, the Nickel EF is calculated using Equation 3 as follows:

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

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



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
Open	ES38			P1	405	Miscellaneous Operations and Services : Cooling Towers : Process Cooling : Mechanical Draft

Click here to delete this process.

Step 2: Throughput

	Annual Throughput
Open	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
Open	VOC	7.00000000e-1	lbs / MM gal	No	SCAQMD Guidelines		2.55500000e+3
Open	PM	1.90000000e+1	lbs / MM gal	No	SCAQMD Guidelines		6.93500000e+4

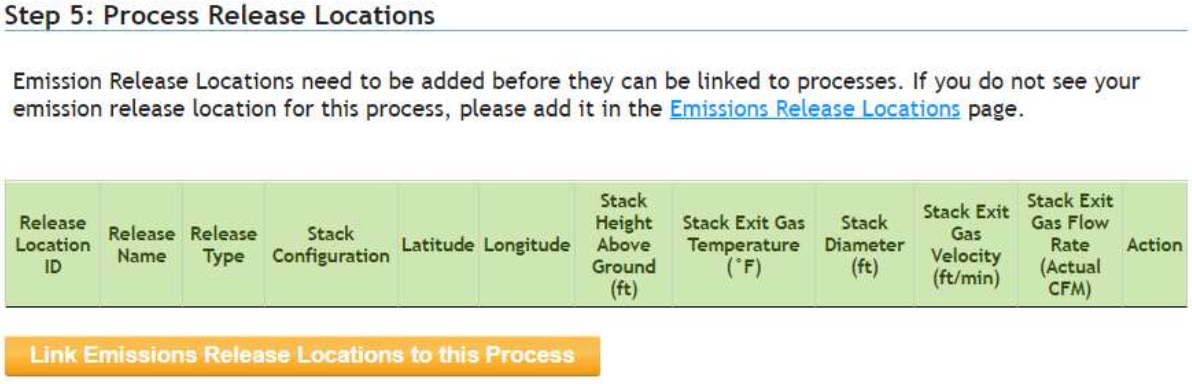
Add New

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

	TAC/ODC Group	CAS #	EF	Unit	Controlled EF	EF Data Source	Overall CE	Emissions
Open	Nickel	7440020	3.80000000e-4	lbs / MM gal	No	Source Test		1.38700000e+0

Add New

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