Guidelines for Calculating Emissions from Crematory Operations

April 2023

Crematory operations generate emissions of organic gases, oxides of nitrogen (NO_X), oxides of sulfur (SO_X), carbon monoxide (CO), particulate matter (PM), and Toxic Air Contaminants (TACs) from combustion of assist fuel as well as the cremation of human or animal remains.

1. GENERAL INSTRUCTIONS

Emissions can be estimated in several ways. The simplest way is to estimate emissions from emission factors. The most accurate is to estimate emissions from continual monitoring systems or source tests.

Even if emissions are estimated using a source test, depending on permit conditions, the source test may not include all pollutants. In such cases, default emission factors can be used to supplement the pollutants that were not included in the source test.

Emissions Estimated Using Default Emission Factors

Emissions from fuel combustion, and emissions from remains are reported as two separate processes (e.g., Process P1, and Process P2). Natural gas combustion emissions are reported under the crematorium external combustion device, which is typically permitted by South Coast AQMD. Emissions from the combustion of human or animal remains are reported under the other process category. Each of these methods are detailed below.

Process 1 - Natural Gas Combustion

Facilities can estimate their criteria pollutant and TAC emissions from the combustion of assist fuel using the following equations:

$$\boldsymbol{E = Q \times EF}$$

where,

E = Annual Emissions of VOC, NOx, SOx, CO, PM, and TACs
Q = Annual fuel usage (units as shown in Table 1 and 2)
EF = Emission factors from Tables 1 and 2

Default Natural Gas Criteria Pollutant Emission Factors

Table 1: External Combustion Equipment (for all sizes)					
Fuel Type (Fuel unit)	**Organic Gases (lb/unit)**	**Nitrogen Oxides (lb/unit)**	**Sulfur Oxides (lb/unit)**	**Carbon Monoxide (lb/unit)**	**Particulate Matter (lb/unit)**
Natural Gas (mmscf) / Boilers Only	5.50	100.00	0.60	84.00	7.60
Natural Gas (mmscf) / Other Equipment	7.00	130.00	0.60	35.00	7.50
LPG, Propane, Butane (1000 gal.)	0.26	12.80	4.60	3.20	0.28
Diesel/Distillate Oil (1000 gal.)	1.32	20.00	0.21	5.00	2.00

[1] http://www.aqmd.gov/docs/default-source/planning/annual-emission-reporting/default-combustion-emission-factors.pdf

Default Natural Gas Toxic Air Contaminant Emission Factors[1]

Table 2: Default EF for Natural Gas Combustion - External Combustion Equipment <10MMBtu/Hr			
TAC Code	**Pollutant**	**CAS No**	**lb/mmscf**
2	Benzene	71432	0.0080
12	Formaldehyde	50000	0.0170
19	Total PAHs (excluding Naphthalene)	1151	0.0001
19	Naphthalene	91203	0.0003
29	Acetaldehyde	75070	0.0043
30	Acrolein	107028	0.0027
32	Ammonia*	7664417	18.000
40	Ethyl benzene	100414	0.0095
44	Hexane	110543	0.0063
68	Toluene	108883	0.0366
70	Xylene	1330207	0.0272

***** This value corresponds to equipment with selective non-catalytic reduction (SNCR), for equipment with selective catalytic reduction (SCR) substitute listed value using 9.1 lb/mmscf, and for equipment without SNCR or SCR substitute using 3.2 lb/mmscf.

[1] AB2588 Guideline for TACs - http://www.aqmd.gov/docs/default-source/planning/risk-assessment/quadrennial_atir_procedure.pdf

Process 2 - Emissions from the Cremation of Remains (Human or Animal)

Facilities can estimate their criteria pollutant and TAC emissions from the cremation of human or animal remains using the following equations:

$$\boldsymbol{E = Q \times EF}$$

where,

E = Annual Emissions of VOC and Toxic Air Contaminants (TACs)
Q = Annual throughput of human or animal remains in tons
EF = Emission factors for VOC or from Table 3

Default Criteria Pollutant Emissions Factors

Table 3: Cremation of Remains
Organic Gases (lb/unit)
5.50

Default Toxic Air Contaminant Emission Factors

Table 4: Default TAC EF for Cremation of Human and Animal Remains				
TAC Code	**Compound**	**CAS No**	**Human Cremation (lb/ton)**	**Animal Cremation (lb/ton)**
	Arsenic and Compounds (Inorganic)	7440382	4.00E-04	4.00E-04
	Beryllium and Compounds	7440417	1.84E-05	1.84E-05
	Cadmium and Compounds	7440439	1.46E-03	1.46E-03
	Chromium, hexavalent	18540299	1.91E-04	1.91E-04
	Polychlorinated Dibenzofurans (PCDF)	1080	1.43E-07	1.43E-07
	2,3,7,8-Tetrachlorodibenzo-p-Dioxin	1086	7.74E-08	7.74E-08
	Formaldehyde	50000	2.89E-09	2.89E-09
	Hydrochloric Acid (Hydrogen Chloride)	7647010	1.97E+00	1.97E+00
	Lead and Compounds (Inorganic)	7439921	9.39E-03	9.39E-03
	Nickel and Compounds	7440020	5.09E-04	5.09E-04
	Mercury and Compounds (Inorganic)	7439976	5.32E-03	0.00E+00
	Polycyclic Aromatic Hydrocarbon (PAH)	1151	9.63E-04	9.63E-04

Emissions Estimated Using Continuous Emissions Monitoring Systems or Source Test Data

Emission factors based on source tests may be used for emissions reporting so long as they are submitted for review by South Coast AQMD's Source Test Engineering staff. The review may find that the emission factor from the source test is underreported, or the source test is not acceptable, which will result in an amendment to the submitted emission report(s). For these situations, Rule 301 (e)(10)(E) waves any surcharges for underreported emissions estimated using a source test that was submitted for review prior to or at the time of the official AER submittal due date. The difference or underpayment is required to be paid, but no surcharges will be applied. Facility personnel should verify with South Coast AQMD Compliance staff that their source test was submitted for review prior to using the resulting emission factors for AER.

If all emissions are estimated by continuous emission monitoring system (CEMS) data or source testing of a single stack that emits both fuel and remains combustion emissions, then all emissions can be reported from a single process.

If fuel combustion emissions and cremation of remains emissions are not combined (e.g., two separate stacks) then emissions from each operation should be reported in separate devices (if permitted separately) or processes (if permitted as one device, e.g., Device ES1 and ES2, or Process P1 and Process P2).

Emissions Estimated Using Source Test and Default Emission Factors

If a mixture of source test and default emission factors are used, then emissions from fuel combustion and emissions from cremation of remains should be reported in separate processes. An example of this is when a stack is only source tested for NOx emissions. In this case, the default NOx emission factor from Table 1 may be substituted using the NOx emission factor from the source test. All other default emission factors should be used for the other criteria and TAC emissions.

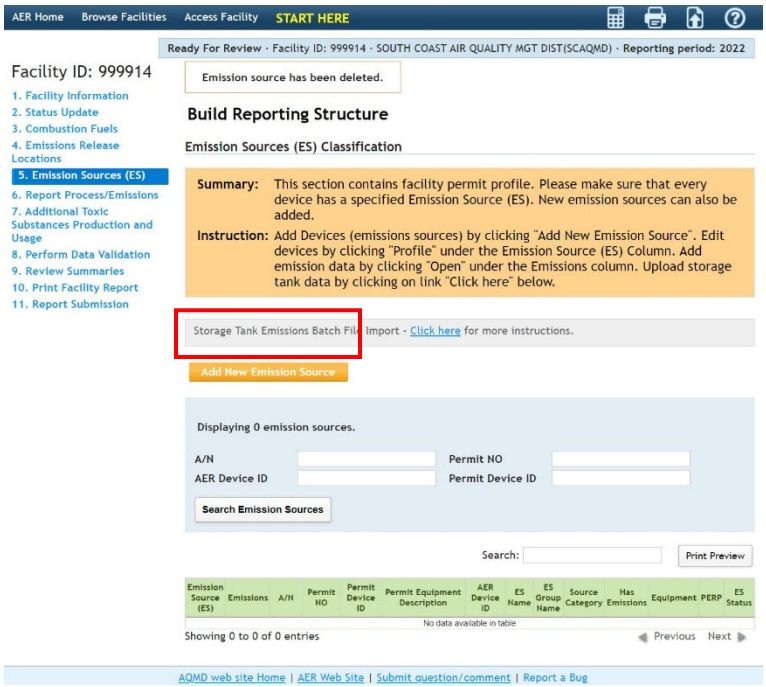
2. EXAMPLES SHOWING HOW TO REPORT

Criteria pollutant and TAC emissions must be reported separately for each process; combustion of assist fuel, human remains, and animal remains. This can be done through the following steps:

1. Determine the annual fuel usage and human and animals remains, (Throughput, Q).
2. Collect any approved CEMS or source test reports, if applicable.
3. Enter the information into the AER Reporting Tool.

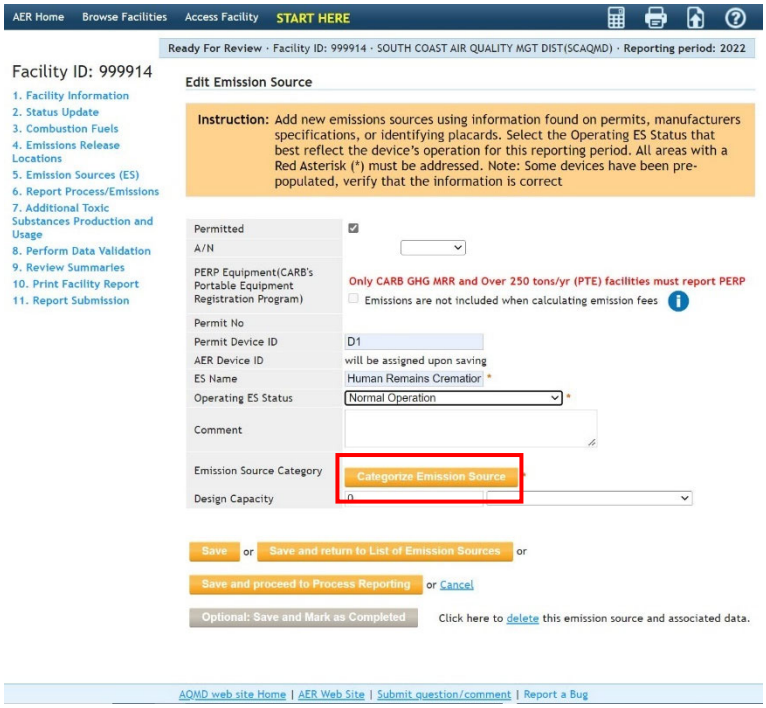
EXAMPLE 1:

Click **Emission Sources (ES) in the blue Navigation Menu**. The reporting tool displays existing emission sources in the green table as shown at bottom of the image below. If a crematory emission source is not listed, it must be added to the list by clicking on the Add New Emission Source link.

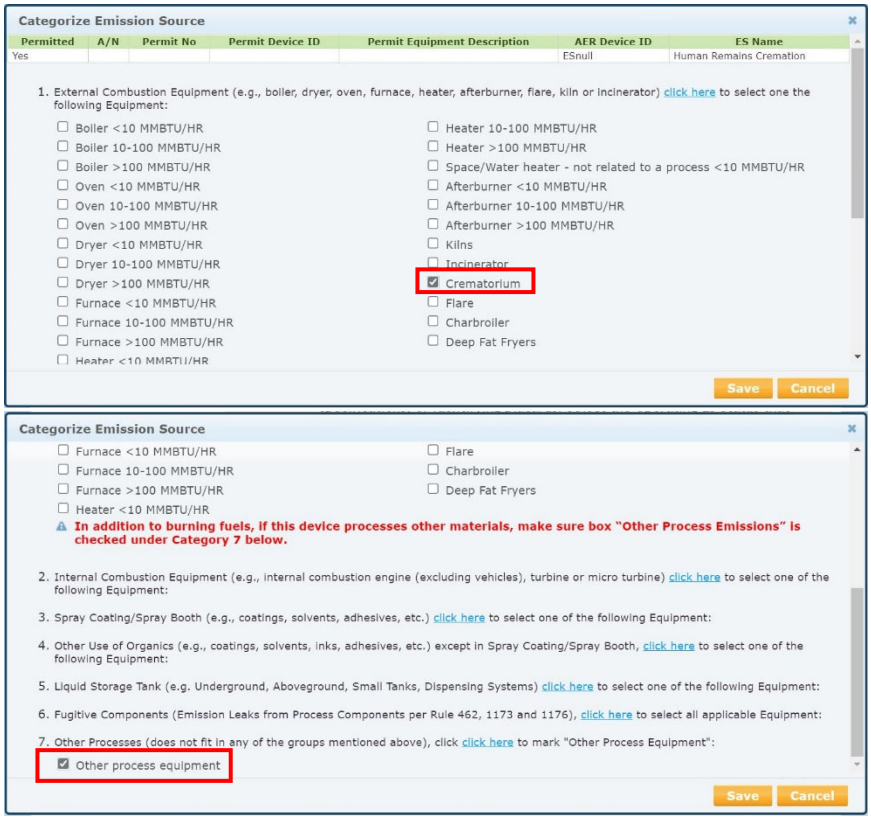


Adding Emission Sources

If you need to add an emission source for a crematory follow these directions. If you do not, then skip to Entering Emissions below. Fill out relevant information to the Emission Source by identifying ES Name (example – Human Remains Cremation) and selecting the appropriate Operating ES Status (typically normal operation), the Categorize Emission Source button will appear. By clicking this button, the tool will take the user to the next screen for categorizing this emissions source.



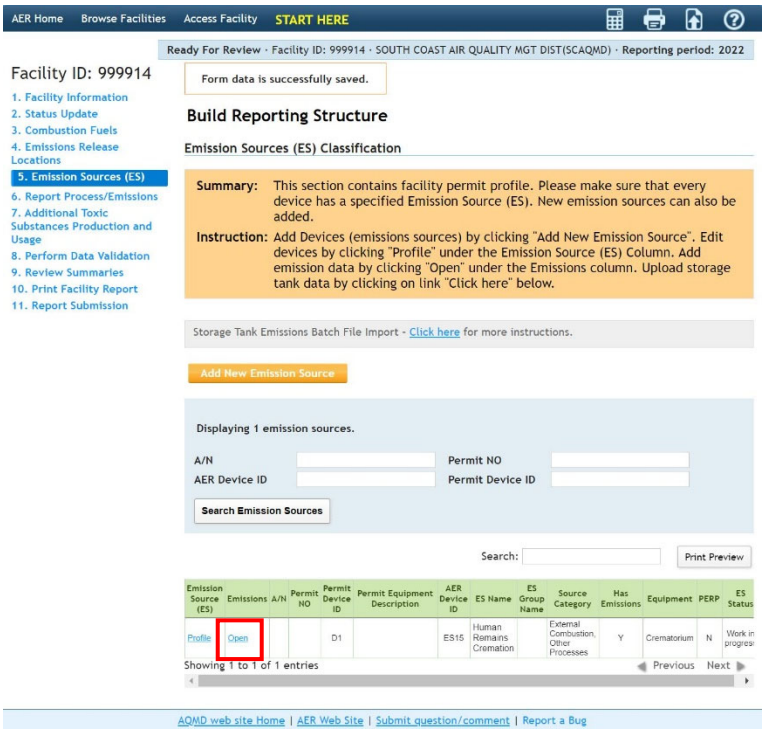
Crematory Operations are comprised of two processes; No. 1 External Combustion Equipment and No. 7 Other Processes (for the combustion of human or animal remains). Click No. 1 and a list of external combustion equipment will appear. Select *Crematorium*. Now, click No. 7 and select *Other process equipment*. See the next two screens for examples for selecting these two processes.



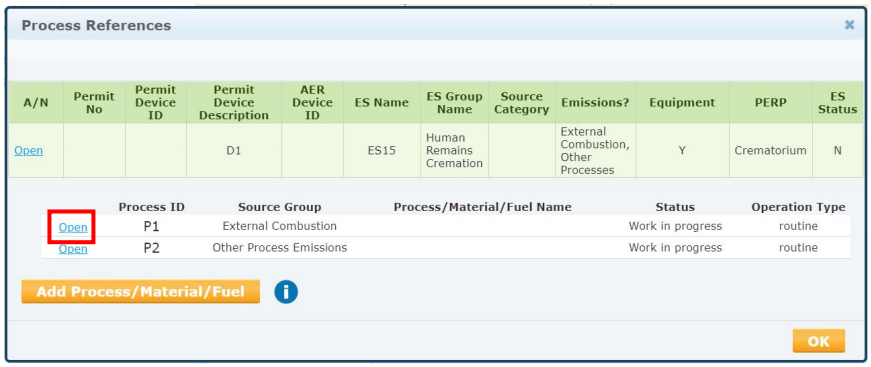
After saving, the user will be returned to the Device page. Click on the Save and proceed to List of Emission Sources button which will navigate you to the Emission Source Page.

Reporting Process Emissions

Click on the "Open" link in the Emissions column next to the Emission Source for the crematory operations, as shown below.

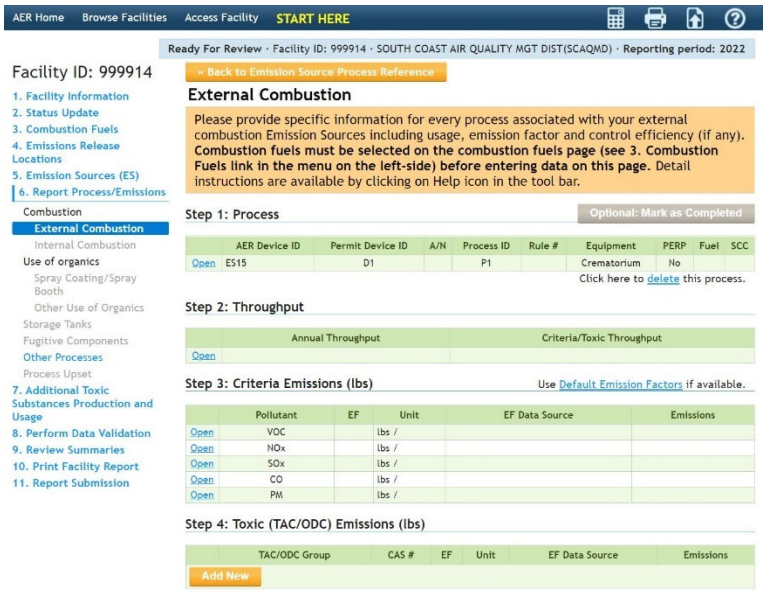


The reporting tool adds a new pop-up window that shows processes P1 and P2. Click the hyperlink "Open" to enter process information: process, throughput, criteria emissions, and TACs.

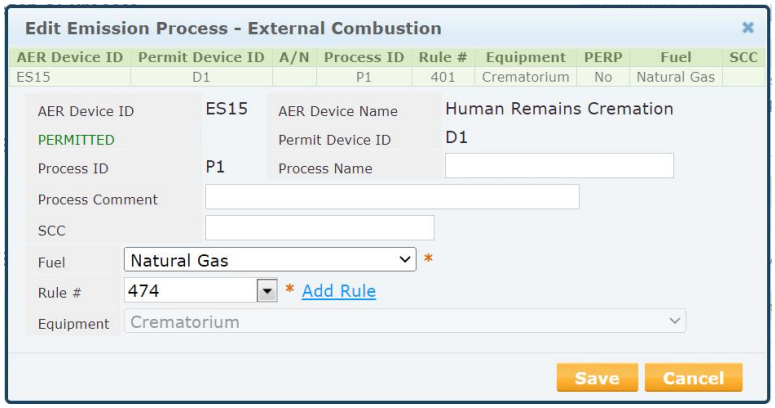


The hyperlinks "Open" will take the user to the Process page for that process.

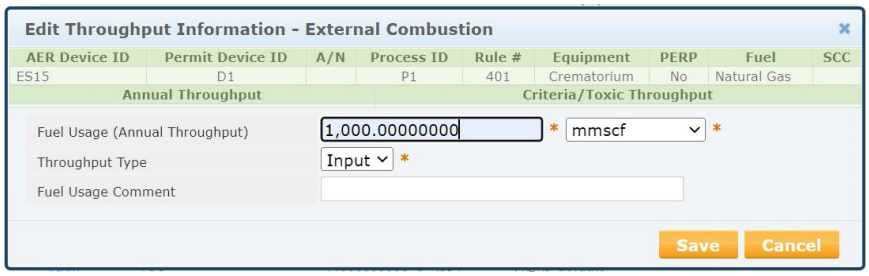
After clicking the "Open" link, the Process page will open. The following is for the *External Combustion Equipment* process. The process information for *Other Processes* will require additional information which will be discussed later.



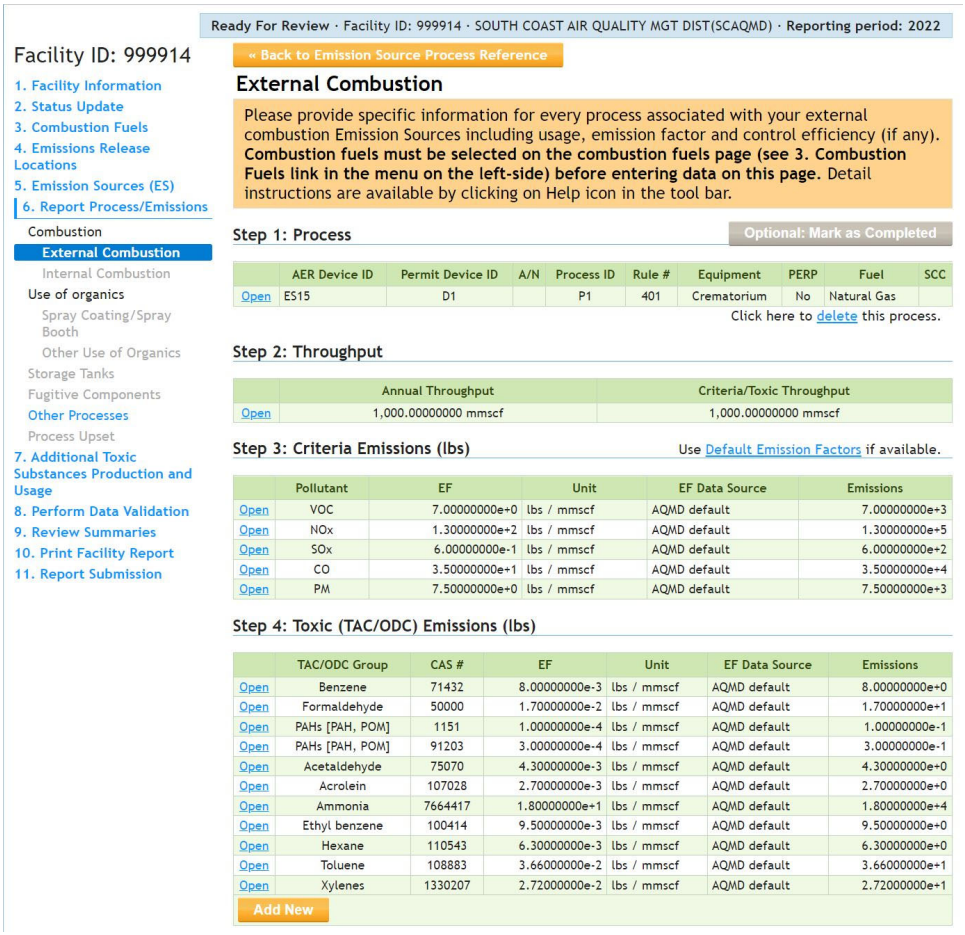
Click on the "Open" link in the green table under Step 1, as shown in the screen above. Information can be selected and entered in every field, however only *Fuel* and *Rule #* are required entries as noted by the red asterisk next to those fields. Click Save button, as shown in the screen below.



After saving, the pop-up window for Step 1 closes. Click open on the Step 2 Throughput section. Enter the Fuel Usage (Annual Throughput) and Throughput Type (Input because it is based on the amount of fuel input to the incinerator) and Fuel Usage Comment in the pop-up window, as shown below. Click Save button.



Default emission factors are entered into Step 3 and Step 4.



Ready For Review · Facility ID: 999914 · SOUTH COAST AIR QUALITY MGT DIST(SCAQMD) · Reporting period: 2022

Facility ID: 999914

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

« Back to Emission Source Process Reference

External Combustion

Please provide specific information for every process associated with your external combustion Emission Sources including usage, emission factor and control efficiency (if any). **Combustion fuels must be selected on the combustion fuels page (see 3. Combustion Fuels link in the menu on the left-side) before entering data on this page.** Detail instructions are available by clicking on Help icon in the tool bar.

Step 1: Process

Optional: Mark as Completed

	AER Device ID	Permit Device ID	A/N	Process ID	Rule #	Equipment	PERP	Fuel	SCC
Open	ES15	D1		P1	401	Crematorium	No	Natural Gas	

Click here to delete this process.

Step 2: Throughput

	Annual Throughput	Criteria/Toxic Throughput
Open	1,000.00000000 mmscf	1,000.00000000 mmscf

Step 3: Criteria Emissions (lbs)

Use Default Emission Factors if available.

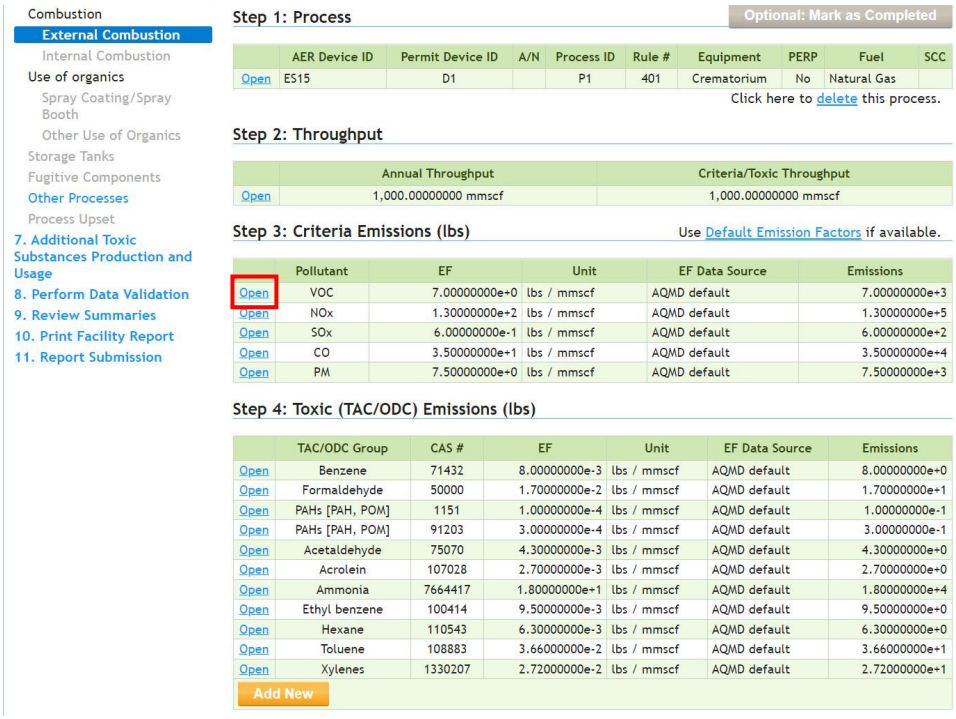
	Pollutant	EF	Unit	EF Data Source	Emissions
Open	VOC	7.00000000e+0	lbs / mmscf	AQMD default	7.00000000e+3
Open	NOx	1.30000000e+2	lbs / mmscf	AQMD default	1.30000000e+5
Open	SOx	6.00000000e-1	lbs / mmscf	AQMD default	6.00000000e+2
Open	CO	3.50000000e+1	lbs / mmscf	AQMD default	3.50000000e+4
Open	PM	7.50000000e+0	lbs / mmscf	AQMD default	7.50000000e+3

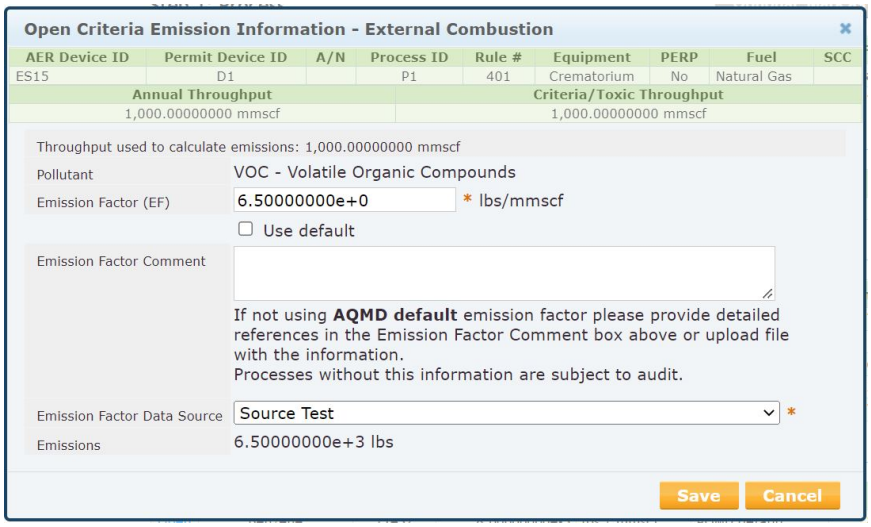
Step 4: Toxic (TAC/ODC) Emissions (lbs)

	TAC/ODC Group	CAS #	EF	Unit	EF Data Source	Emissions
Open	Benzene	71432	8.00000000e-3	lbs / mmscf	AQMD default	8.00000000e+0
Open	Formaldehyde	50000	1.70000000e-2	lbs / mmscf	AQMD default	1.70000000e+1
Open	PAHs [PAH, POM]	1151	1.00000000e-4	lbs / mmscf	AQMD default	1.00000000e-1
Open	PAHs [PAH, POM]	91203	3.00000000e-4	lbs / mmscf	AQMD default	3.00000000e-1
Open	Acetaldehyde	75070	4.30000000e-3	lbs / mmscf	AQMD default	4.30000000e+0
Open	Acrolein	107028	2.70000000e-3	lbs / mmscf	AQMD default	2.70000000e+0
Open	Ammonia	7664417	1.80000000e+1	lbs / mmscf	AQMD default	1.80000000e+4
Open	Ethyl benzene	100414	9.50000000e-3	lbs / mmscf	AQMD default	9.50000000e+0
Open	Hexane	110543	6.30000000e-3	lbs / mmscf	AQMD default	6.30000000e+0
Open	Toluene	108883	3.66000000e-2	lbs / mmscf	AQMD default	3.66000000e+1
Open	Xylenes	1330207	2.72000000e-2	lbs / mmscf	AQMD default	2.72000000e+1

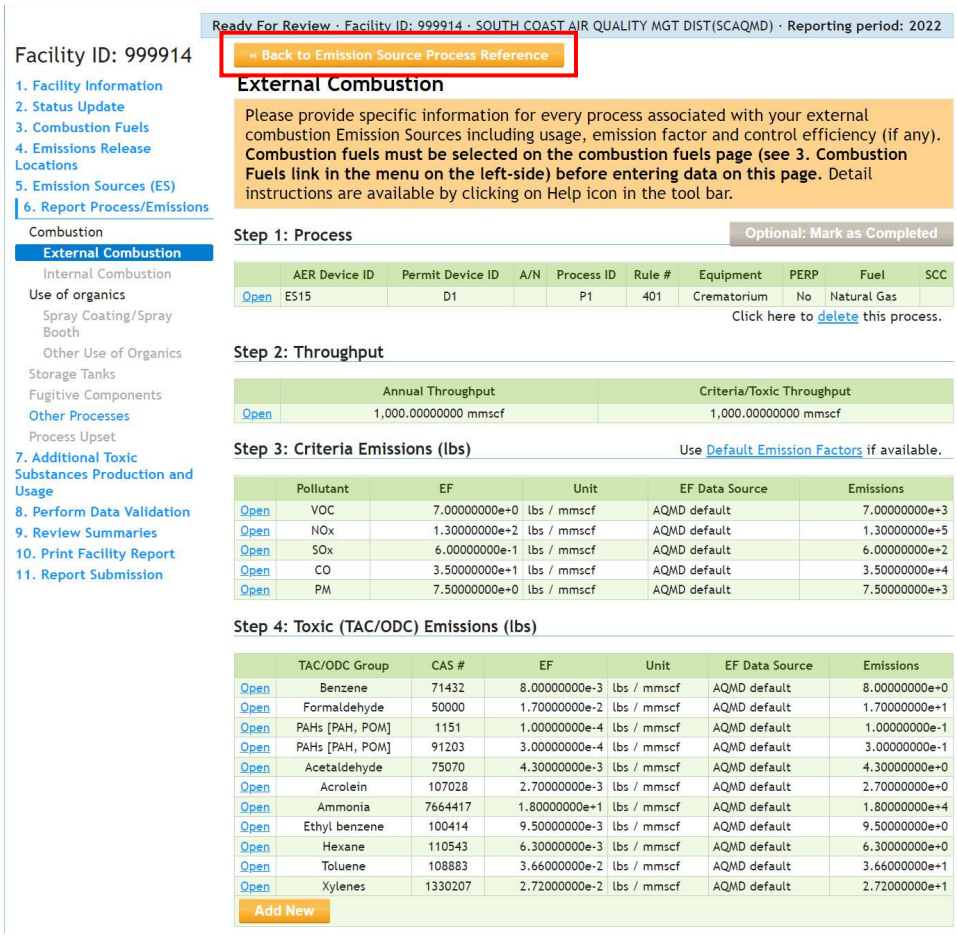
Add New

If you would like to change the emission factors by substituting using results from a source test, click on the "Open" link next to the pollutant that has the emission factor you would like to replace. In the pop-up window, click the Use Default checkbox to uncheck the box. Enter the new emission factor. Enter the reference for the emission factor. If it is a source test, enter the South Coast AQMD Source Test ID. As noted previously, only source tests that have been either approved or submitted for review can be used for emission reporting in AER. If your source test does not have a South Coast AQMD Source Test ID, contact the South Coast AQMD inspector for your facility. Select the appropriate Emission Factor Data Source from the dropdown menu. Click the save button.

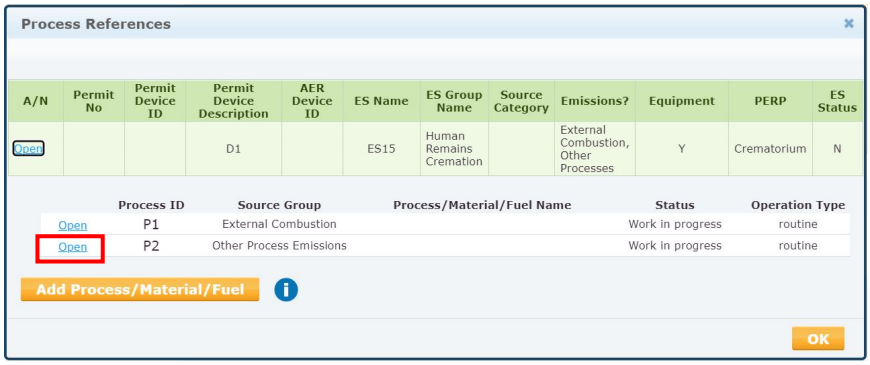




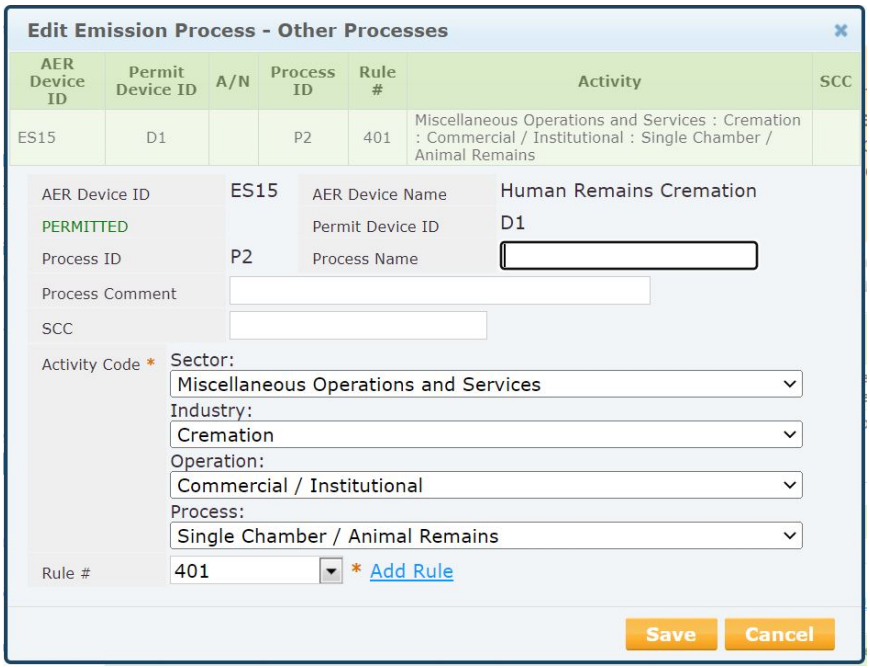
If you are satisfied with all the information entered in the Process page, click on the <<Back to Emission Source Process Reference button on the bottom of the page, as shown in the screen below.



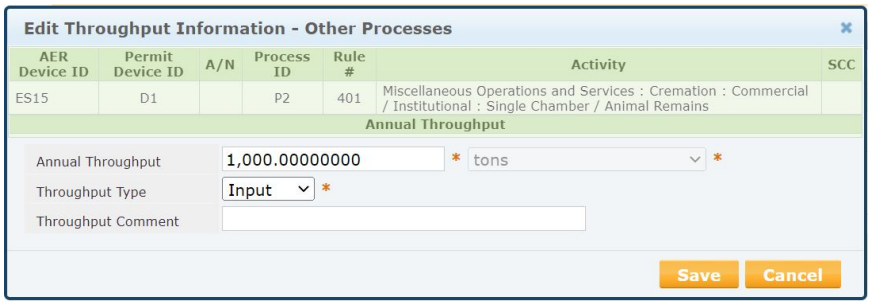
Click the "Open" link next to Process 2 *Other Process Emissions* in the Process References pop-up box.



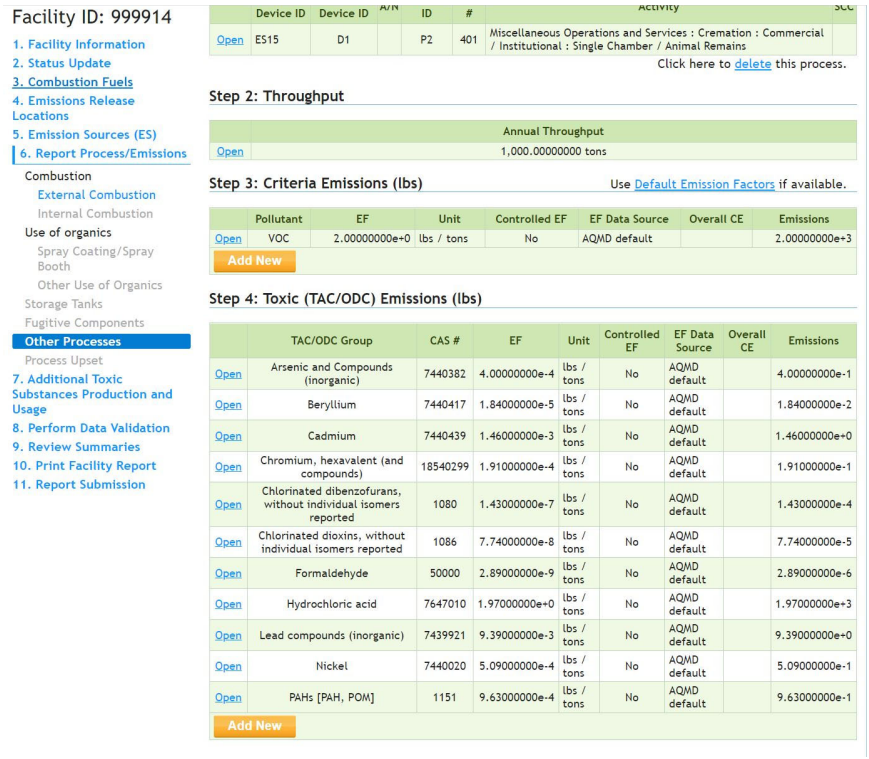
Click on the "Open" link in the green table under Step 1. Identify the Process Name and fill out the Activity Code by selecting the appropriate information from the drop-down menu from each box. The example below shows entries for the correct sector, industry, operation, process, and rule for crematory operations. Click Save button.



After saving, the pop-up window for Step 1 closes. Click open on the Step 2 Throughput section. Enter the Throughput Type (for this example, the second process would be throughput of remains in tons), as shown below. Click Save button.



Default emission factors are entered into Step 3 and Step 4.



Facility ID: 999914

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

	Device ID	Device ID	A/N	ID	#	Activity	SCC
Open	ES15	D1		P2	401	Miscellaneous Operations and Services : Cremation : Commercial / Institutional : Single Chamber / Animal Remains	

Click here to delete this process.

Step 2: Throughput

	Annual Throughput
Open	1,000.00000000 tons

Step 3: Criteria Emissions (lbs) Use Default Emission Factors if available.

	Pollutant	EF	Unit	Controlled EF	EF Data Source	Overall CE	Emissions
Open	VOC	2.00000000e+0	lbs / tons	No	AQMD default		2.00000000e+3

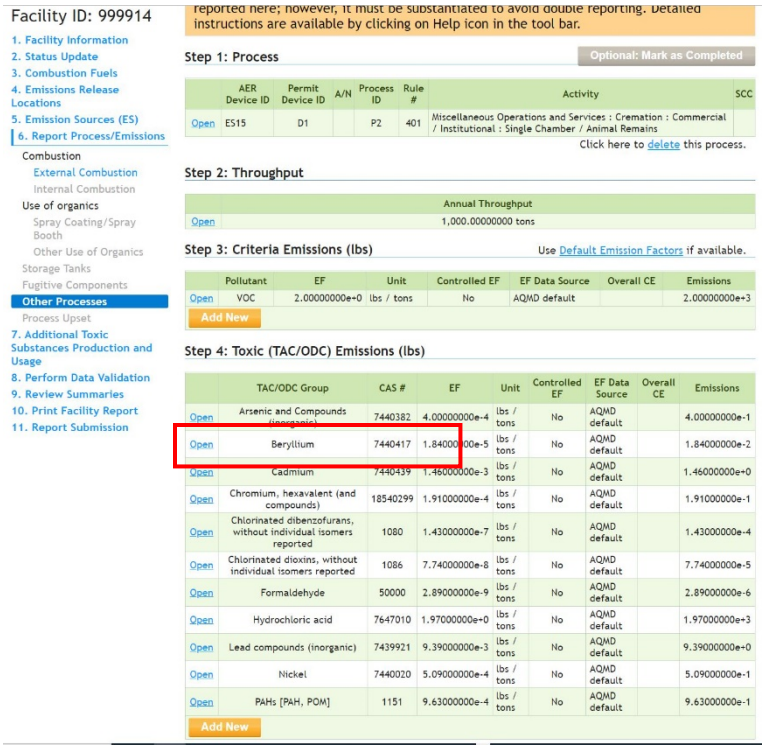
Add New

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

	TAC/ODC Group	CAS #	EF	Unit	Controlled EF	EF Data Source	Overall CE	Emissions
Open	Arsenic and Compounds (inorganic)	7440382	4.00000000e-4	lbs / tons	No	AQMD default		4.00000000e-1
Open	Beryllium	7440417	1.84000000e-5	lbs / tons	No	AQMD default		1.84000000e-2
Open	Cadmium	7440439	1.46000000e-3	lbs / tons	No	AQMD default		1.46000000e+0
Open	Chromium, hexavalent (and compounds)	18540299	1.91000000e-4	lbs / tons	No	AQMD default		1.91000000e-1
Open	Chlorinated dibenzofurans, without individual isomers reported	1080	1.43000000e-7	lbs / tons	No	AQMD default		1.43000000e-4
Open	Chlorinated dioxins, without individual isomers reported	1086	7.74000000e-8	lbs / tons	No	AQMD default		7.74000000e-5
Open	Formaldehyde	50000	2.89000000e-9	lbs / tons	No	AQMD default		2.89000000e-6
Open	Hydrochloric acid	7647010	1.97000000e+0	lbs / tons	No	AQMD default		1.97000000e+3
Open	Lead compounds (inorganic)	7439921	9.39000000e-3	lbs / tons	No	AQMD default		9.39000000e+0
Open	Nickel	7440020	5.09000000e-4	lbs / tons	No	AQMD default		5.09000000e-1
Open	PAHs [PAH, POM]	1151	9.63000000e-4	lbs / tons	No	AQMD default		9.63000000e-1

Add New

If you would like to change the emission factors, for example replace them with source tested values, click on the "Open" link next to the pollutant that has the emission factor you would like to replace. In the pop-up window, click the Use Default checkbox to uncheck the box. Enter the new emission factor. Enter the reference for the emission factor. If it is a source test, enter the South Coast AQMD Source Test ID. As noted previously, only source tests that have been either approved or submitted for review can be used for emission reporting in AER. If your source test does not have a South Coast AQMD Source Test ID contact the South Coast AQMD inspector for your facility. Select the appropriate Emission Factor Data Source from the drop-down menu. Click the save button. The following screenshots show an example of how to substitute a default emission factor for beryllium with one from a source test.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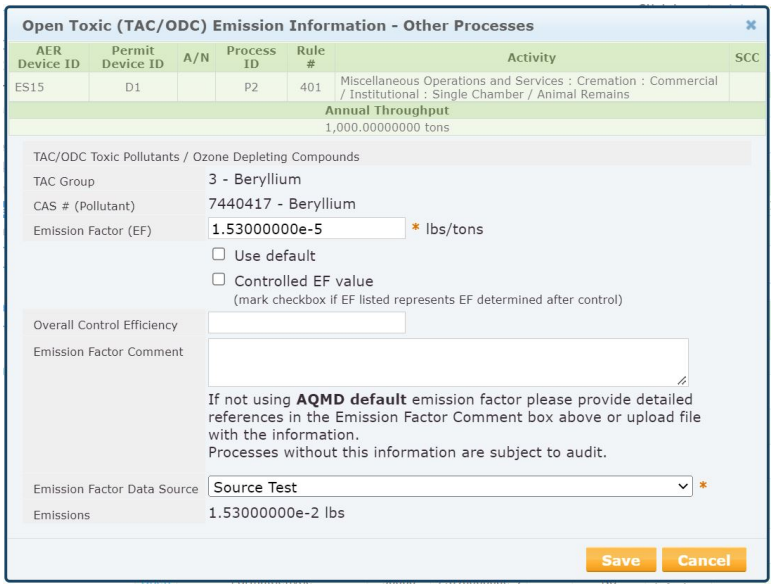
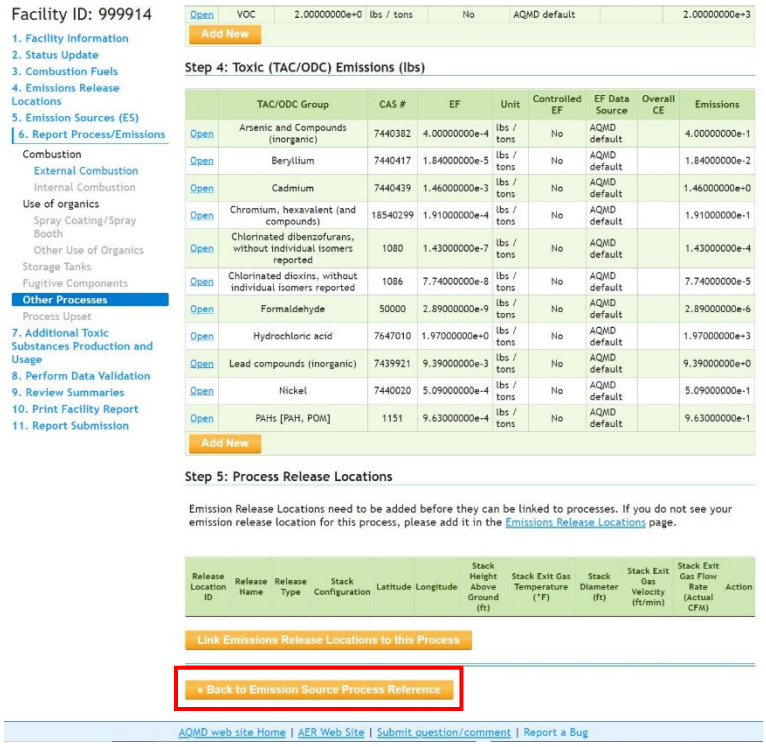
reported here; however, it must be substantiated to avoid double reporting. Detailed instructions are available by clicking on Help icon in the tool bar.
Step 1: Process
Optional: Mark as Completed
Open ES15 D1 P2 401 Miscellaneous Operations and Services : Cremation : Commercial / Institutional : Single Chamber / Animal Remains
Click here to delete this process.
Step 2: Throughput
Annual Throughput
Open 1,000.00000000 tons
Step 3: Criteria Emissions (lbs)
Use Default Emission Factors if available.
Open VOC 2.00000000e+0 lbs / tons No AQMD default 2.00000000e+3
Add New
Step 4: Toxic (TAC/ODC) Emissions (lbs)
Open Arsenic and Compounds (inorganic) 7440382 4.00000000e-4 lbs / tons No AQMD default 4.00000000e-1
Open Beryllium 7440417 1.84000000e-5 lbs / tons No AQMD default 1.84000000e-2
Open Cadmium 7440439 1.46000000e-3 lbs / tons No AQMD default 1.46000000e+0
Open Chromium, hexavalent (and compounds) 18540299 1.91000000e-4 lbs / tons No AQMD default 1.91000000e-1
Open Chlorinated dibenzofurans, without individual isomers reported 1080 1.43000000e-7 lbs / tons No AQMD default 1.43000000e-4
Open Chlorinated dioxins, without individual isomers reported 1086 7.74000000e-8 lbs / tons No AQMD default 7.74000000e-5
Open Formaldehyde 50000 2.89000000e-9 lbs / tons No AQMD default 2.89000000e-6
Open Hydrochloric acid 7647010 1.97000000e+0 lbs / tons No AQMD default 1.97000000e+3
Open Lead compounds (inorganic) 7439921 9.39000000e-3 lbs / tons No AQMD default 9.39000000e+0
Open Nickel 7440020 5.09000000e-4 lbs / tons No AQMD default 5.09000000e-1
Open PAHs [PAH, POM] 1151 9.63000000e-4 lbs / tons No AQMD default 9.63000000e-1
Add New


Open Toxic (TAC/ODC) Emission Information - Other Processes
AER Device ID Permit Device ID A/N Process ID Rule # Activity SCC
ES15 D1 P2 401 Miscellaneous Operations and Services : Cremation : Commercial / Institutional : Single Chamber / Animal Remains
Annual Throughput
1,000.00000000 tons
TAC/ODC Toxic Pollutants / Ozone Depleting Compounds
TAC Group 3 - Beryllium
CAS # (Pollutant) 7440417 - Beryllium
Emission Factor (EF) 1.53000000e-5 * lbs/tons
Use default
Controlled EF value
(mark checkbox if EF listed represents EF determined after control)
Overall Control Efficiency
Emission Factor Comment
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 1.53000000e-2 lbs
Save
Cancel



Clicking the << Back to Emission Source Process Reference_button on the bottom of the Process page, returns to the user to the Process References pop-up box, if changes need to be made to Process 1. Clicking on the Emission Sources (ES) link on the Navigation Menu on the left side of the page, returns the user to the Emission Sources page, where the next Emission Source, if any, can be accessed.