Guidelines for Calculating VOC Emissions from Lithographic Printing Operations – December 2014

The following methodology should be used to calculate VOC emissions from lithographic printing operations. This methodology has been developed by the SCAQMD in cooperation with the Printing Industries Association.

Lithographic Inks

$$\textbf{Emissions} = Q * EF * (1 - RF) * (1 - CE_{overall}) \qquad \text{Eq. (1)}$$

where:

Emissions	=	Emissions of volatile organic compounds (lbs)
Q	=	Throughput (quantity of ink applied in lbs or gallons)
EF	=	Emission Factor (lb/lb ink or lb/gal)
RF	=	Retention factor (ink type specific in decimal)
$CE_{overall}$	=	Overall Efficiency of Control System (decimal)

(1) User may refer to the product Material Safety Data Sheet (MSDS) to determine the emission factor (EF) based on volatile organic compounds (VOC) content of the ink. This may include, but not limited to, one or more of the following:

a) Volatile organic compounds (VOC)
b) Lithographic oil content (LOC) such as:
   - Petroleum-based oils
   - Vegetable-based oils
   - Oxidizing oils
   - Middle distillates
   - Linseed oil
   - White mineral oil
   - Other oils

If MSDS provides both VOC and LOC percentages or fractions, use the higher number for calculation purposes. **NOTE:** Unit of EF must be consistent with that of ink applied (Q), i.e., EF in weight fraction of lb/lb for Q in pounds.

(2) Depending on type of inks, the following retention factors are applicable for equation (1):

HEATSET INKS: **RF = 0.20**

NON-HEATSET INKS: **RF = 0.95**

NOTES:

(1) RF is applicable to Conventional Products that contain VOC and/or LOC;

(2) RF is not applicable to the following:

a. UV/EB products,

b. Printing inks in Flexography, Gravure, Screen, Letterpress, and Inkjet;

c. Printing inks used in conjunction with IR Light Sources (they are not considered Heatset inks).

(3) Overall efficiency ($CE_{overall}$) of a control system is defined as:

$$\mathbf{CE_{overall} = CE_{cap} * CE_{des}} \qquad \text{Eq. (2)}$$

where:

CE_{cap} = Capture Efficiency of Control System (fraction)

CE_{des} = Destruction Efficiency of Control Equipment (fraction)

In general, control system performance is tested to determine capture and control efficiencies. In the absence of project-specific source tested capture efficiency results, a default **capture efficiency** of 99.5% (**CE_{cap}** = 0.995) is allowed for **heatset materials only**. Any deviation from this default capture efficiency must be substantiated with supporting documentation.

Assumptions for Other Lithographic Printing Ink Operations

Fountain solutions and blanket/roller washes do not possess the same characteristics as lithographic inks; therefore, retention factors are not applicable to emissions from the use of these materials. However, in the absence of a specific source test, a carry-over factor is allowed as follows:

- 70% of emissions from **fountain solution** are allowed as default carry-over to the **heat set dryer**, provided that the dryer is vented to the afterburner. The VOC emissions from the use of fountain solutions (**$E_{fountain}$**) are calculated using the following equation:

$$\mathbf{E_{fountain} = Q * EF * [1 - (0.70*CE_{overall})]} \qquad \text{Eq. (3)}$$

- 40% of emissions from **blanket/roller washes** are allowed as default carry-over to the **heat set dryers only** for **automatic wash operations** provided that the dryers are vented to afterburners. The VOC emissions from the use of blanket/roller washes (**E_{wash}**) are calculated using the following equation:

$$\mathbf{E_{wash} = Q * EF * [1 - (0.40*CE_{overall})]} \qquad \text{Eq. (4)}$$

where:

$E_{fountain}$	= Emissions of VOC (lbs) from the use of fountain solutions
E_{wash}	= Emissions of VOC (lbs) from the use of blanket/roller washes
Q	= Throughput (quantity of material applied in lbs or gallons)
EF	= Emission factor (lb/lb or lb/gal)
$C_{overall}$	= Overall Efficiency of Control System (decimal)

STEPS TO REPORT EMISSIONS

Example: One web fed heat set printer used 4000 pounds of black ink (VOC = 0.375 lb/lb per MSDS); 20 gallons fountain solution (VOC = 0.8 lb/gal per MSDS); and 10 gallons universal blanket/roller wash with an automatic cleaning system (VOC = 6.7 lb/gal per MSDS) throughput the reporting period. The operation is vented to a control system operating at 99.5 % overall.

Emissions for the black ink are calculated below using Eq. (1):

E_{ink} = 4000 lb * 0.375 lb/lb * (1-0.2)] * (1 – 0.995) =6.0 lbs

Emissions for the fountain solution are calculated using Eq. (3):

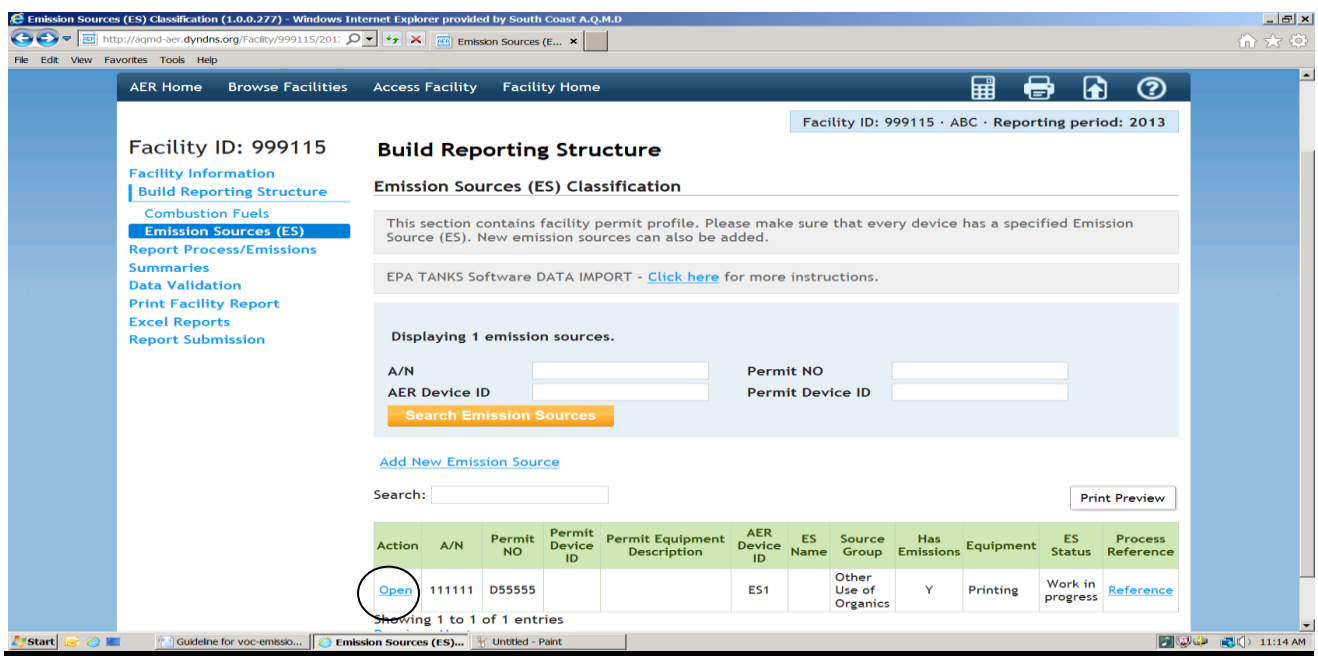
$E_{fountain}$ = 20 gal * 0.8 lb/gal * [1 – (0.70 * 0.995)] = 4.86 lbs

Emissions for the blanket wash are calculated using Eq. (4):

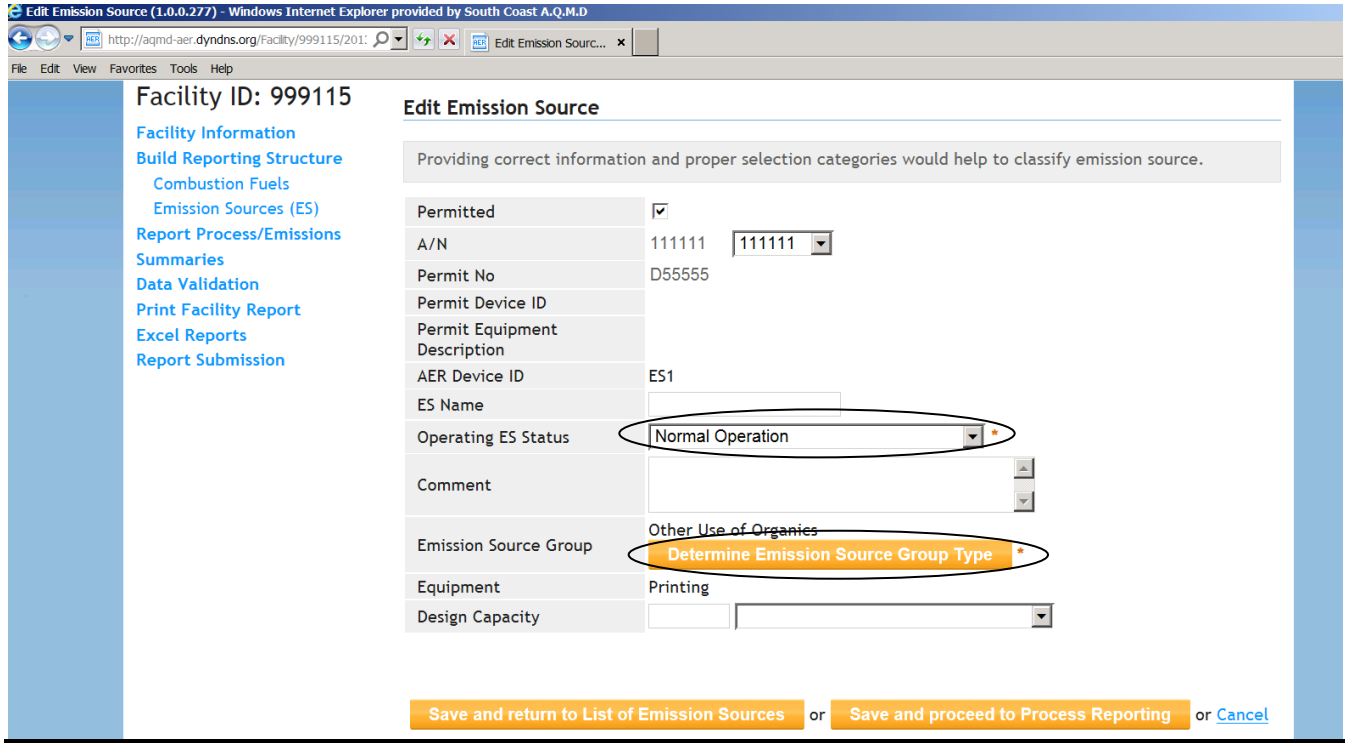
E_{wash} = 10 gal * 6.7 lb/gal * ([1 – (0.4 * 0.995)] = 40.33 lbs

AER Tool Data Entry For The Above Example

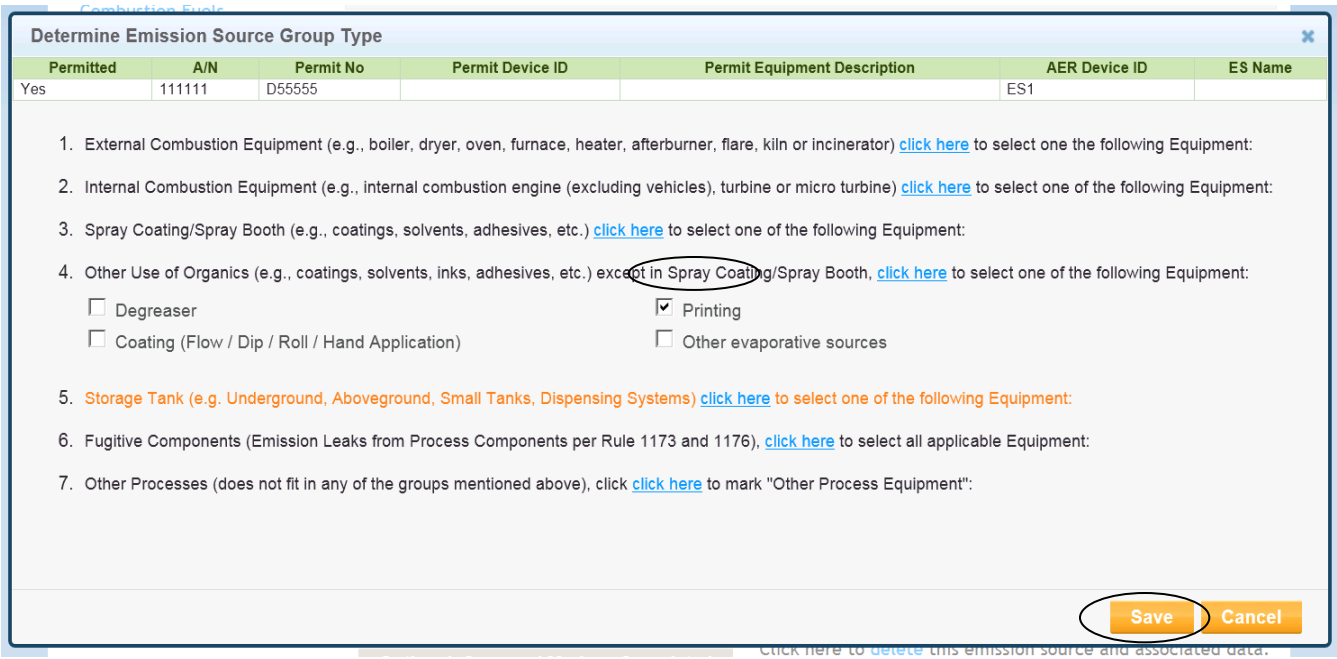
- Click **Emissions Sources (ES)** to see the equipment list (left side of split screen). Click **Open** to access AER device ID ES1.



- Click down arrow for **Operating ES Status** and select **normal operation** from the drop down menu. Next, click on the button for **Determine Emission Source Group Type.**

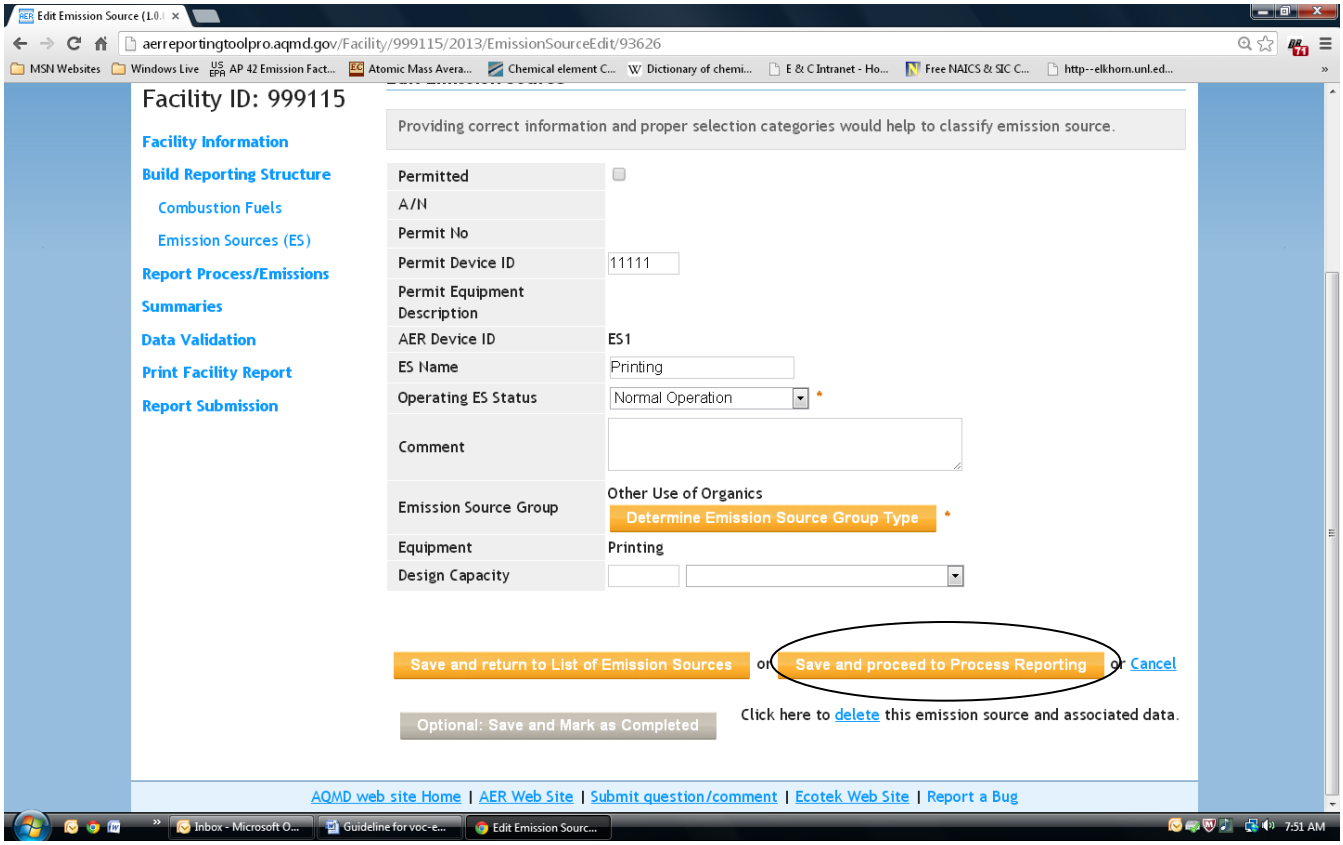


- The following screen will appear and click on **click here** number 4 **Other Use of Organics.** Select **Click Here**
- Checkmark **Printing** box by clicking on it
- Click **Save**



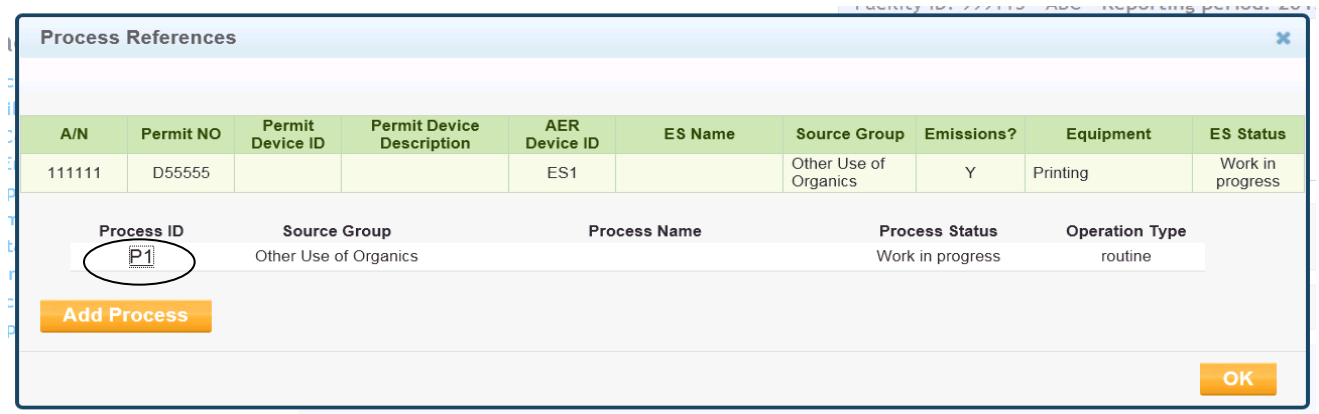
Display returns to previous image.

- Click **Save and Proceed to Process Reporting**.

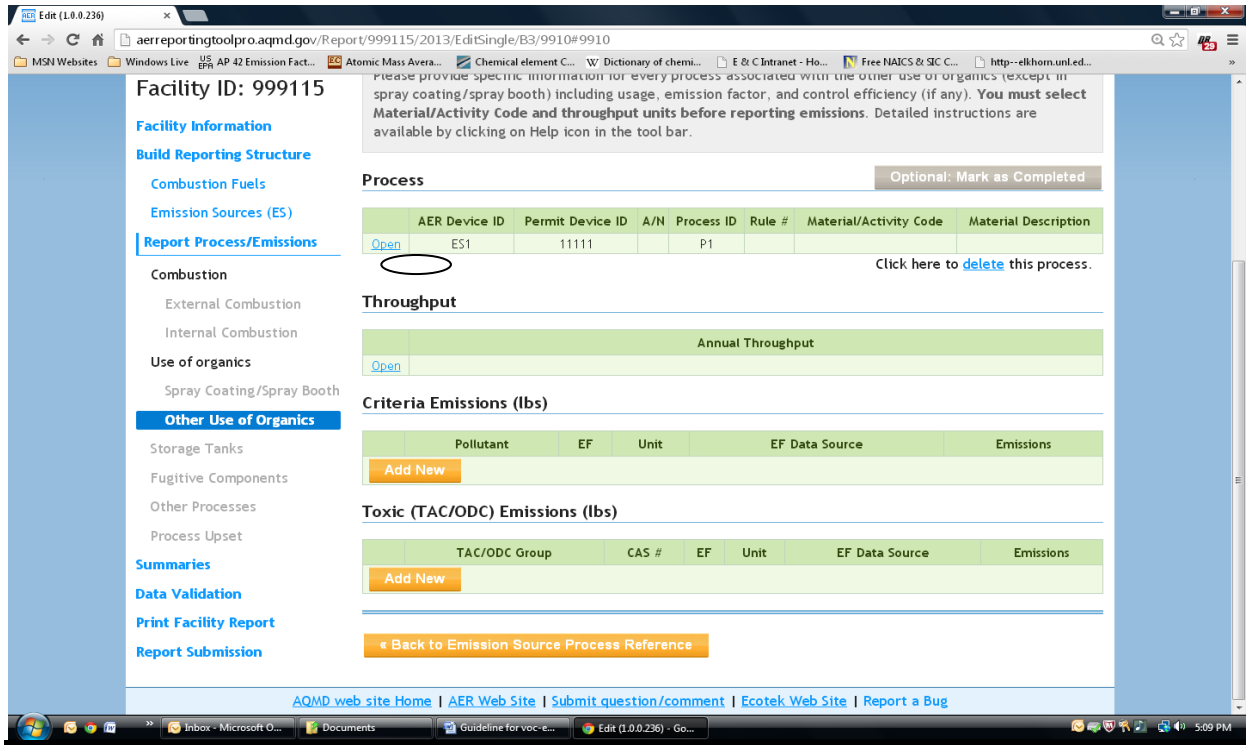


- Click on P1 for the first process.

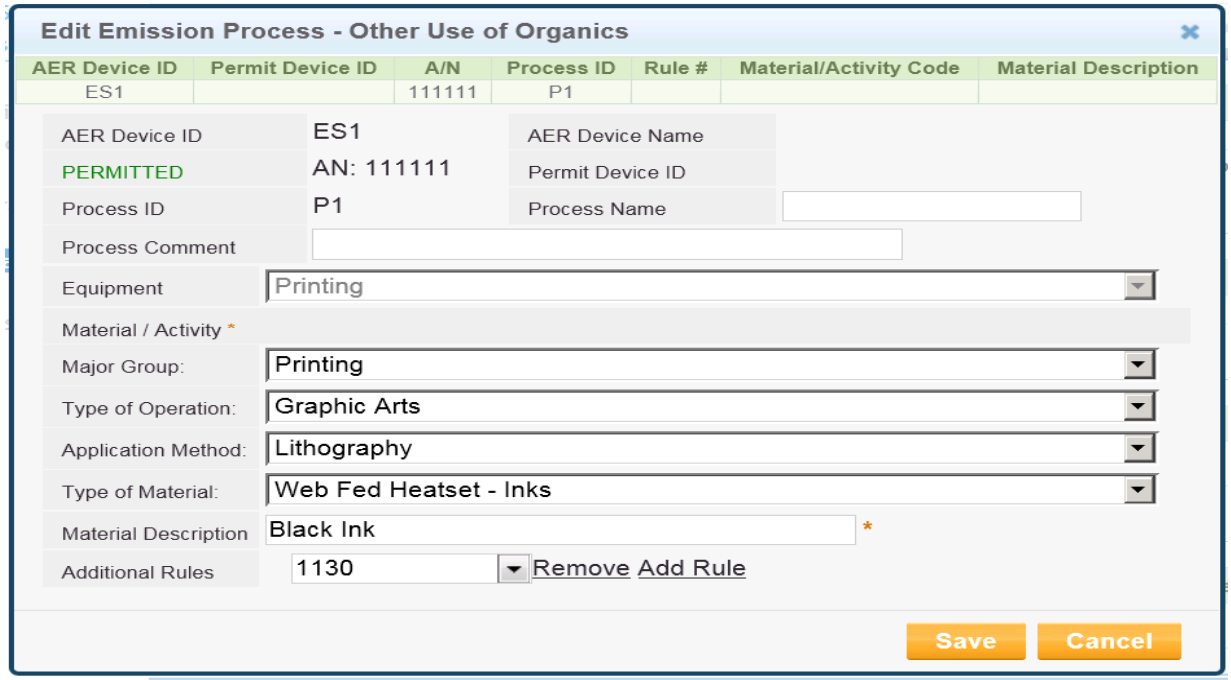
  Process, in printing operation represent materials used in the printing operation. For each material type (Inks, Varnish, Coatings, Fountain Solution, Metering Roller wash, Roller wash, Blanket wash, etc.), there will be a new process number P1, P2, P3, ...Pn and will be generated by clicking on material type from "Other Use Of Organic" drop-down menu below "Add Process" command, after clicking on "**Back to Emission Source Process Reference"** command for the same permit or emission source from top or bottom left of the data-entry screen for P1. The drop-down menu is generated by clicking on "Add Process" command.



- Under **Process** click **Open**



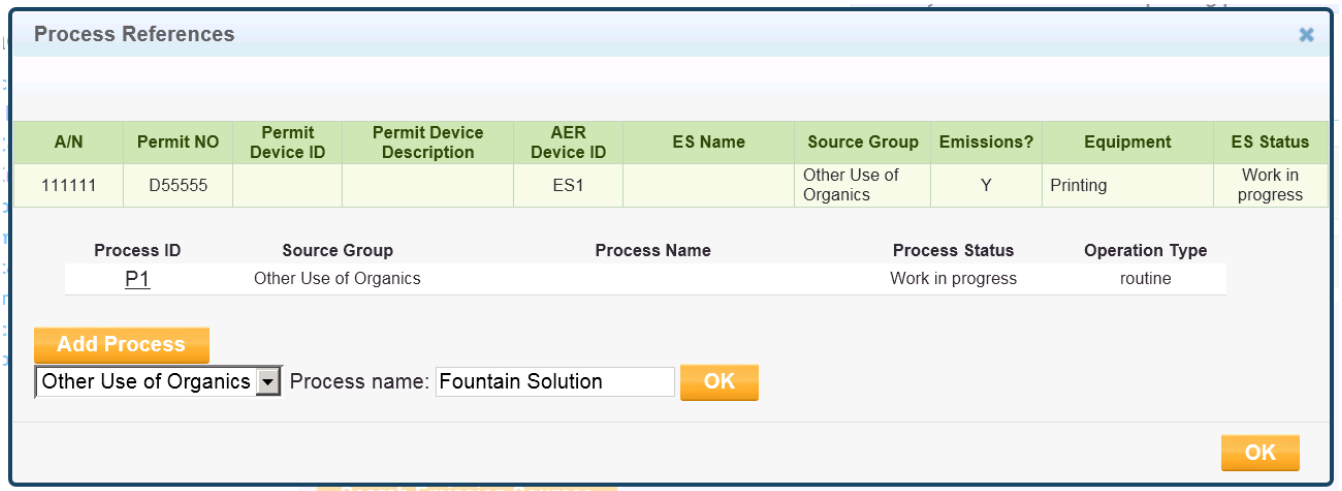
- The following screen will appear. Fill out and select appropriate data: **Process Name, Major Group, Type of Operation, Application Method, Material Description,** and **Additional Rule** by clicking the drop-down arrow for each field.
- Click **Save.**



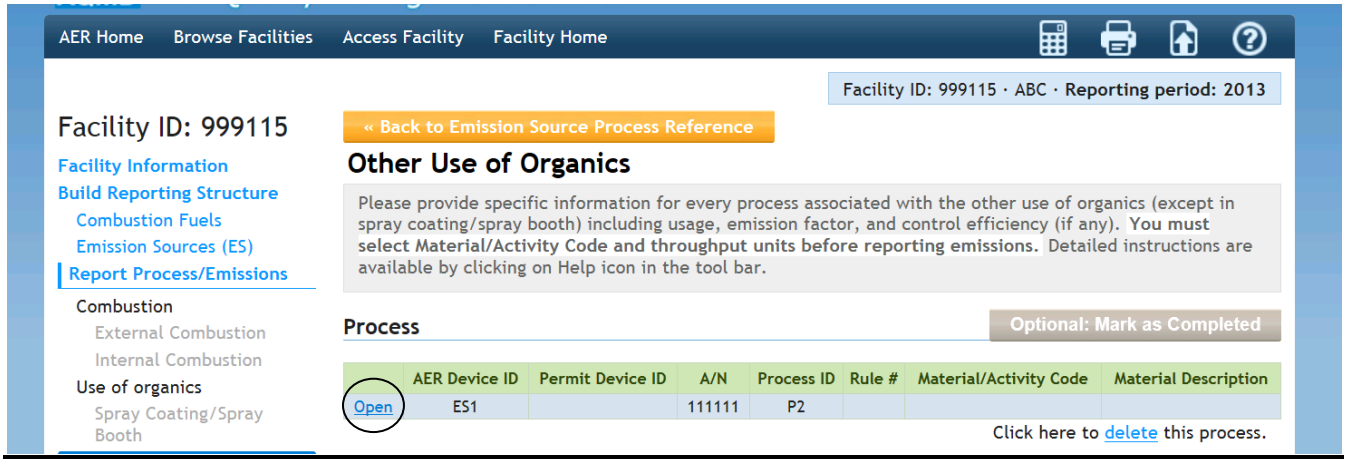
At this point, add the other two processes that emit VOCs (Fountain Solution and Blanket/Roller Wash), to complete the individual process associated with this example for Emission Source ES1.

- Click "**Back to Emission Source Process Reference".**

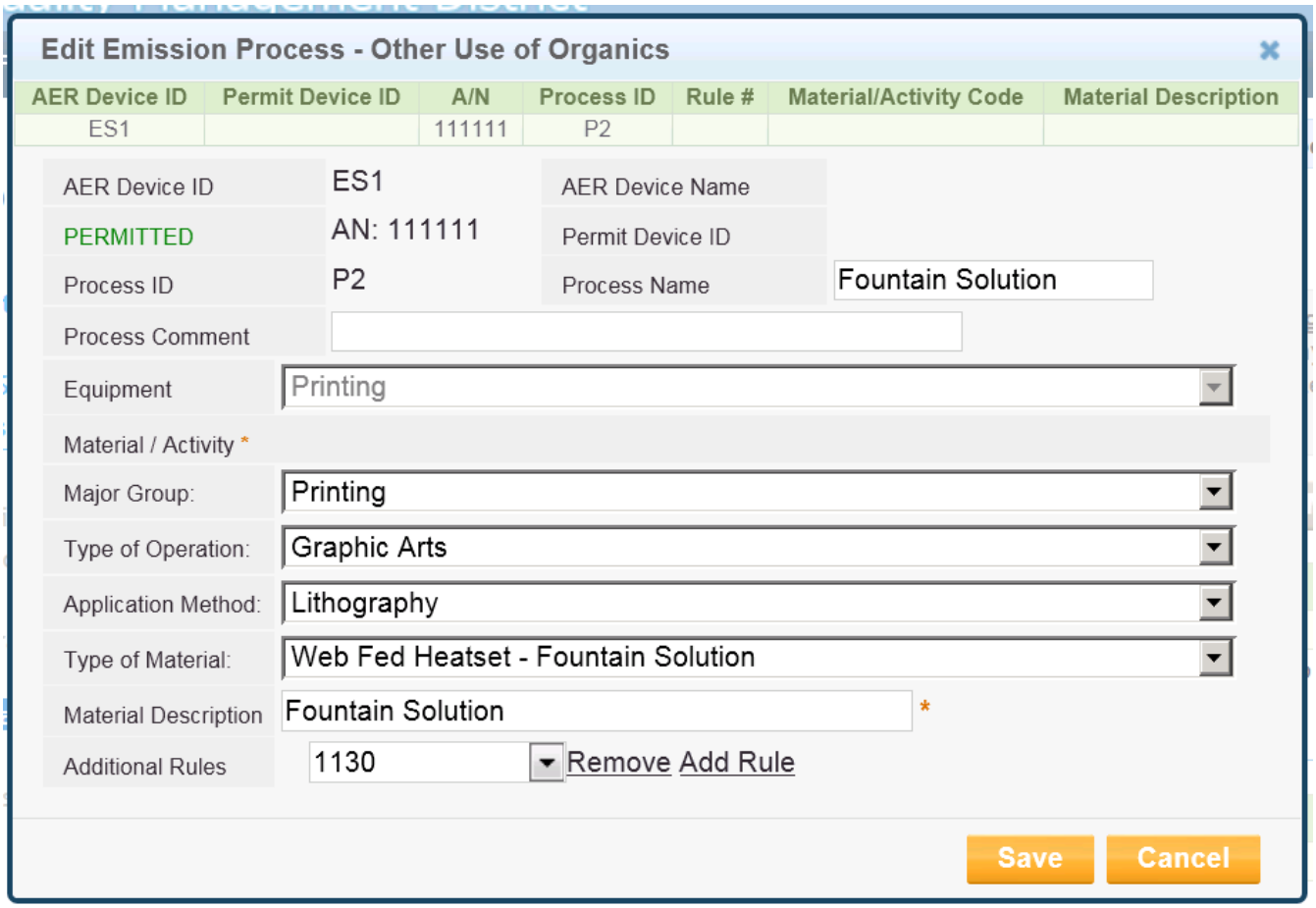
- Click **Add Process**; select '**Other use of Organics"** from the down arrow pick list. Call the process name **Fountain Solution** and click on **OK**.



- Click on **Open**

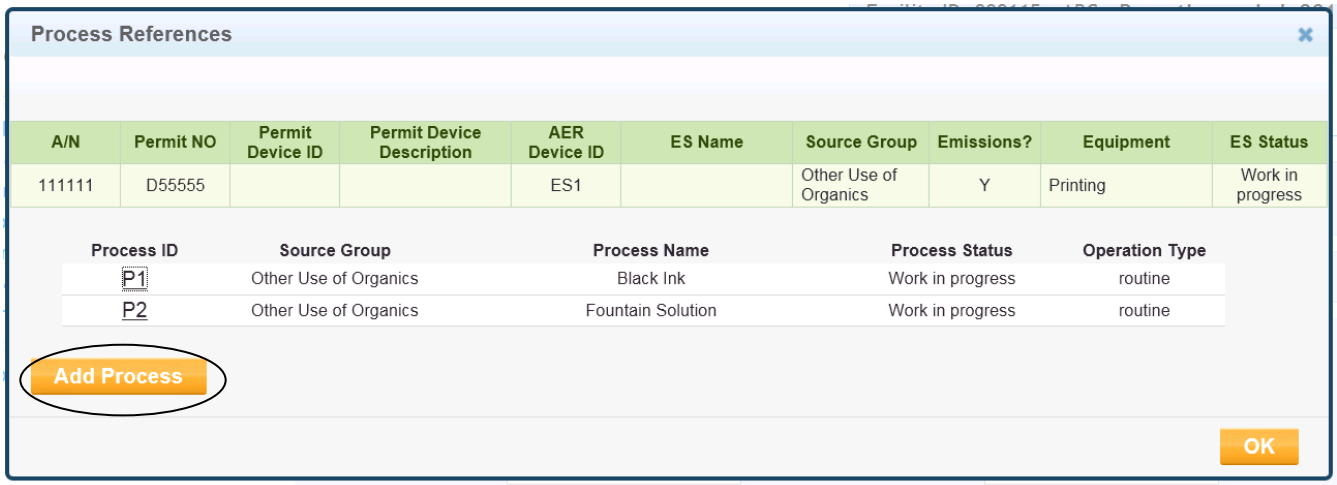


- The following screen pops up. Fill out and select appropriate data: **Process Name, Major Group, Type of Operation, Application Method, Material Description, Additional Rule** by clicking the drop-down arrow for each field.
- Click **Save. This becomes process P2.**

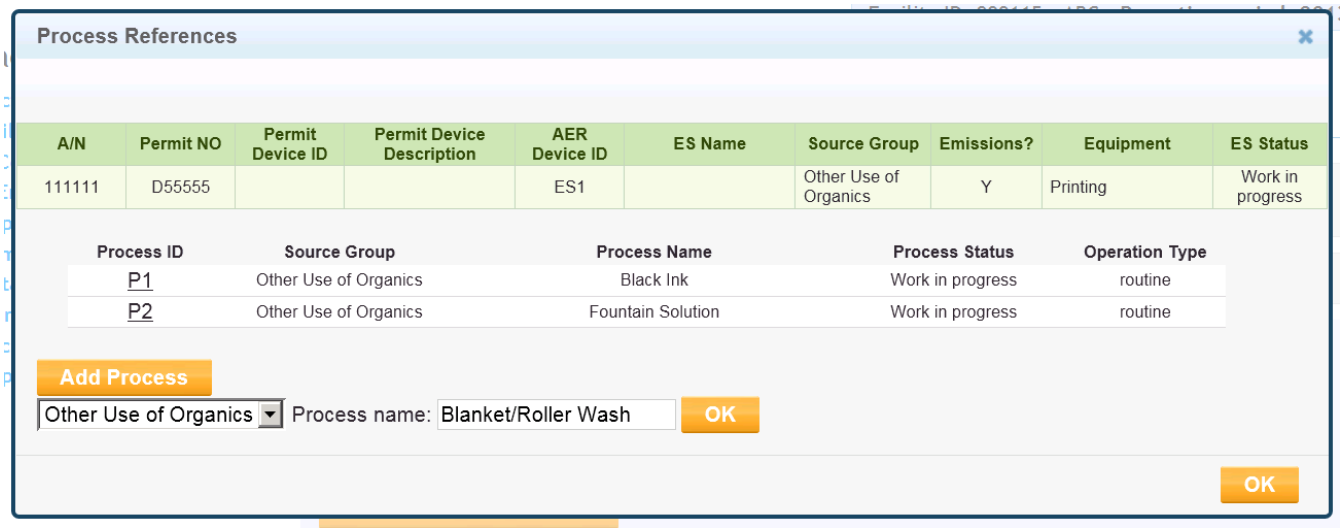


- Click on the **Back to Emission Source Process Reference** button at the bottom of the subsequent screen.

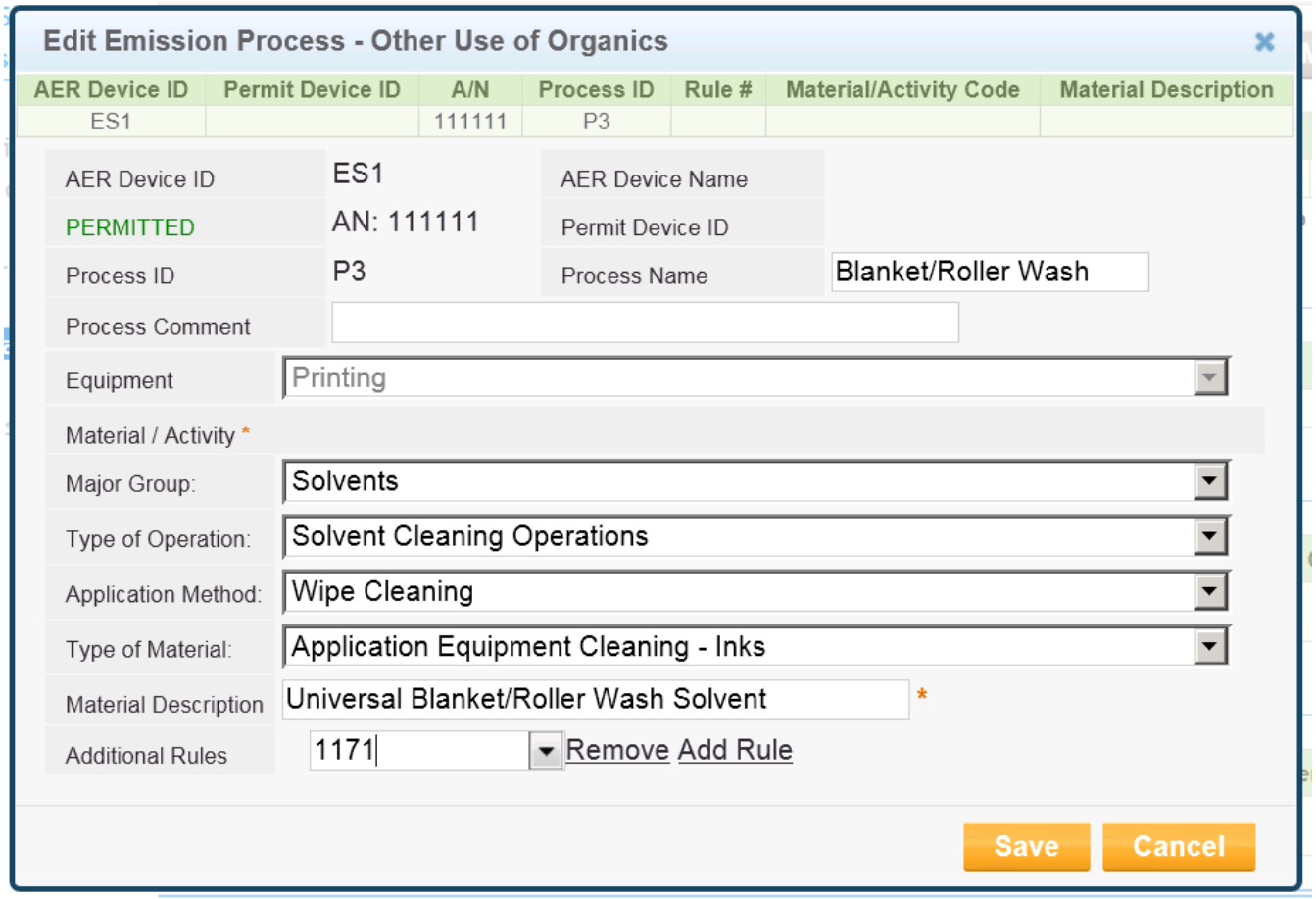
- The following screen pops up. Select **Add Process.**



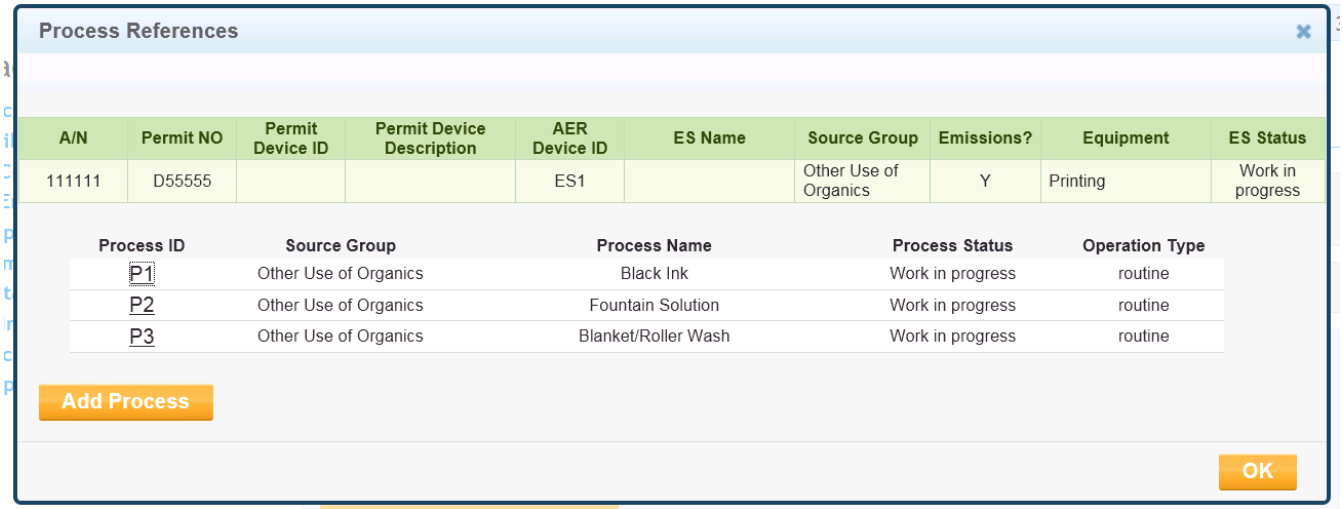
- The following screen pops up. Select **Other use of Organics** from the down arrow pick list. Call the process name **Fountain Solution** and click on **OK**.



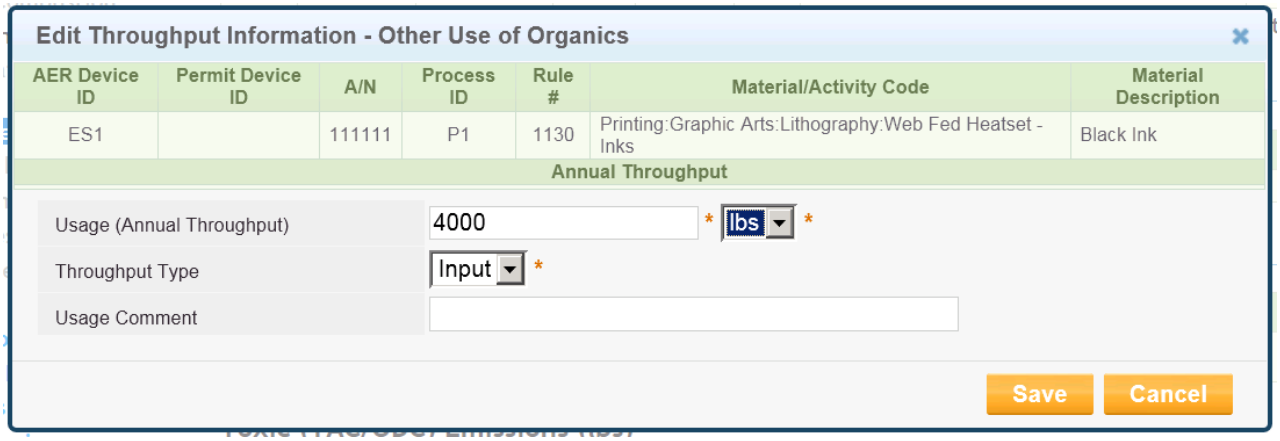
- Click down arrows and select appropriate group, operation, application method, type of material, material description, and Rule 1171. Click **Save**. **This becomes process P3.**



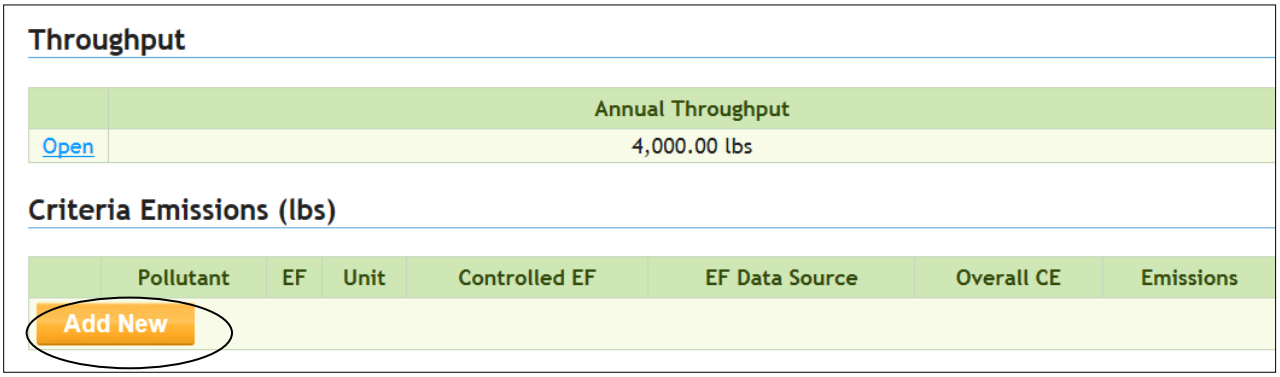
- Click on the **Back to Emission Source Process Reference** button at the bottom of the subsequent screen.



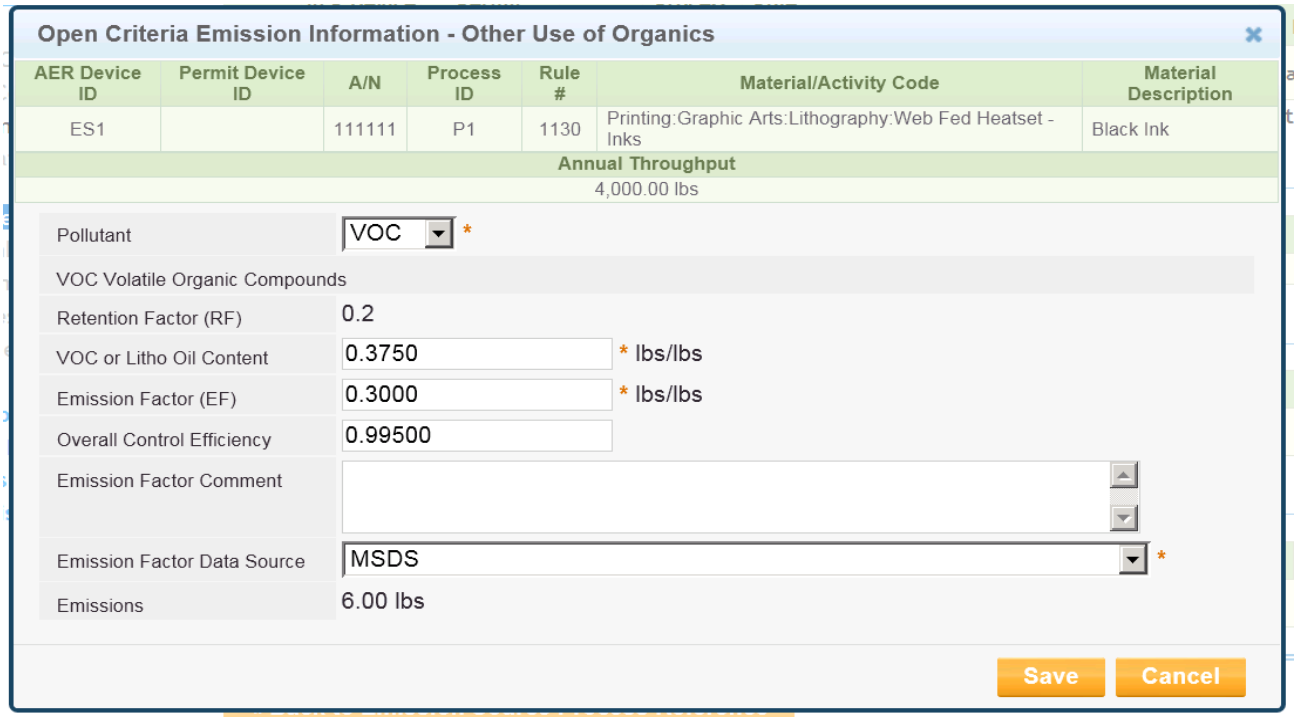
- Click on **P1** to begin data entry of throughput (4,000 lb ink as input). Click **Save.**



- After entering the throughput, click on **Add New** (Criteria Emissions).



- Enter the **VOC content** of 0.375 lb/lb, and the **overall control efficiency** of 0.995. The retention factor and the emission factor will be populated for you. Heat set ink oils are 20% retentive (80% evaporative in the heat set dryer). Click **Save.**



Open Criteria Emission Information - Other Use of Organics

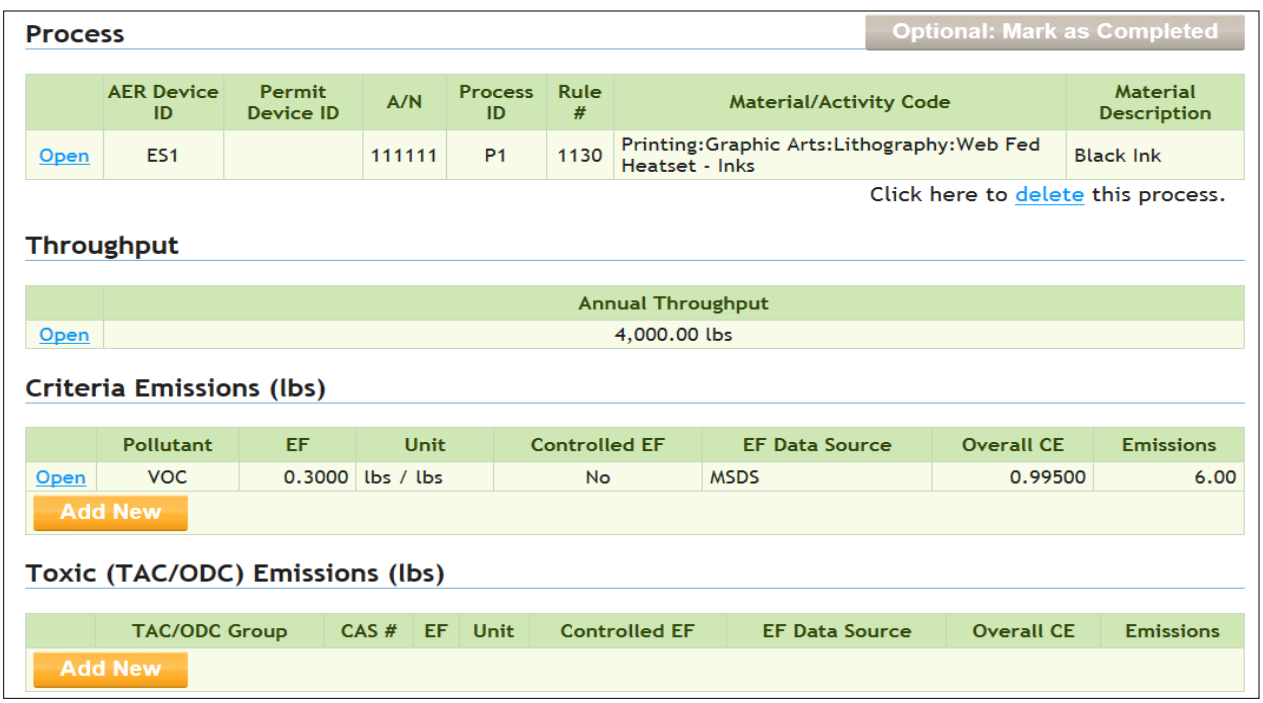
AER Device ID	Permit Device ID	A/N	Process ID	Rule #	Material/Activity Code	Material Description
ES1		111111	P1	1130	Printing:Graphic Arts:Lithography:Web Fed Heatset - Inks	Black Ink

Annual Throughput: 4,000.00 lbs

Pollutant	VOC *
VOC Volatile Organic Compounds	
Retention Factor (RF)	0.2
VOC or Litho Oil Content	0.3750 * lbs/lbs
Emission Factor (EF)	0.3000 * lbs/lbs
Overall Control Efficiency	0.99500
Emission Factor Comment	
Emission Factor Data Source	MSDS *
Emissions	6.00 lbs

Save Cancel

Data entry for the ink in complete as per the next screenshot. The ink MSDS shows no standard toxic content.



Process Optional: Mark as Completed

	AER Device ID	Permit Device ID	A/N	Process ID	Rule #	Material/Activity Code	Material Description
Open	ES1		111111	P1	1130	Printing:Graphic Arts:Lithography:Web Fed Heatset - Inks	Black Ink

Click here to delete this process.

Throughput

	Annual Throughput
Open	4,000.00 lbs

Criteria Emissions (lbs)

	Pollutant	EF	Unit	Controlled EF	EF Data Source	Overall CE	Emissions
Open	VOC	0.3000	lbs / lbs	No	MSDS	0.99500	6.00

Add New

Toxic (TAC/ODC) Emissions (lbs)

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

Add New

- Click **Back to Emission Source Process Reference**, and Select process **P2**.

« Back to Emission Source Process Reference

Process References

A/N	Permit NO	Permit Device ID	Permit Device Description	AER Device ID	ES Name	Source Group	Emissions?	Equipment	ES Status
111111	D55555			ES1		Other Use of Organics	Y	Printing	Work in progress

Process ID	Source Group	Process Name	Process Status	Operation Type
P1	Other Use of Organics	Black Ink	Work in progress	routine
P2	Other Use of Organics	Fountain Solution	Work in progress	routine
P3	Other Use of Organics	Blanket/Roller Wash	Work in progress	routine

Add Process

OK

- Select **Throughput** and enter data (20 gallons fountain solution input). Click **Save**.

Edit Throughput Information - Other Use of Organics

AER Device ID	Permit Device ID	A/N	Process ID	Rule #	Material/Activity Code	Material Description
ES1		111111	P2	1130	Printing:Graphic Arts:Lithography:Web Fed Heatset - Fountain Solution	Fountain Solution

Annual Throughput

Usage (Annual Throughput)	20 * gal *
Throughput Type	Input *
Usage Comment	

Save Cancel

- After saving throughput data, click on **Add New** (Criteria Emissions).

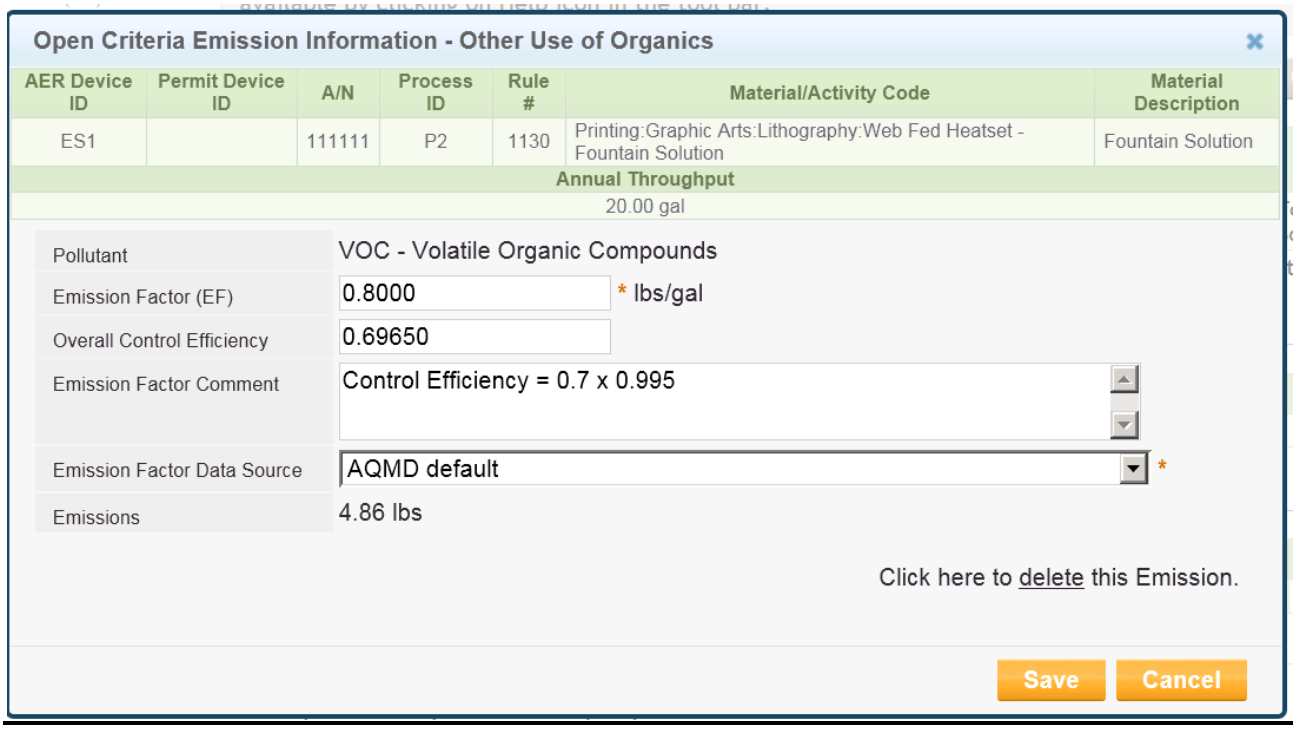
Throughput

	Annual Throughput
Open	20.00 gal

Criteria Emissions (lbs)

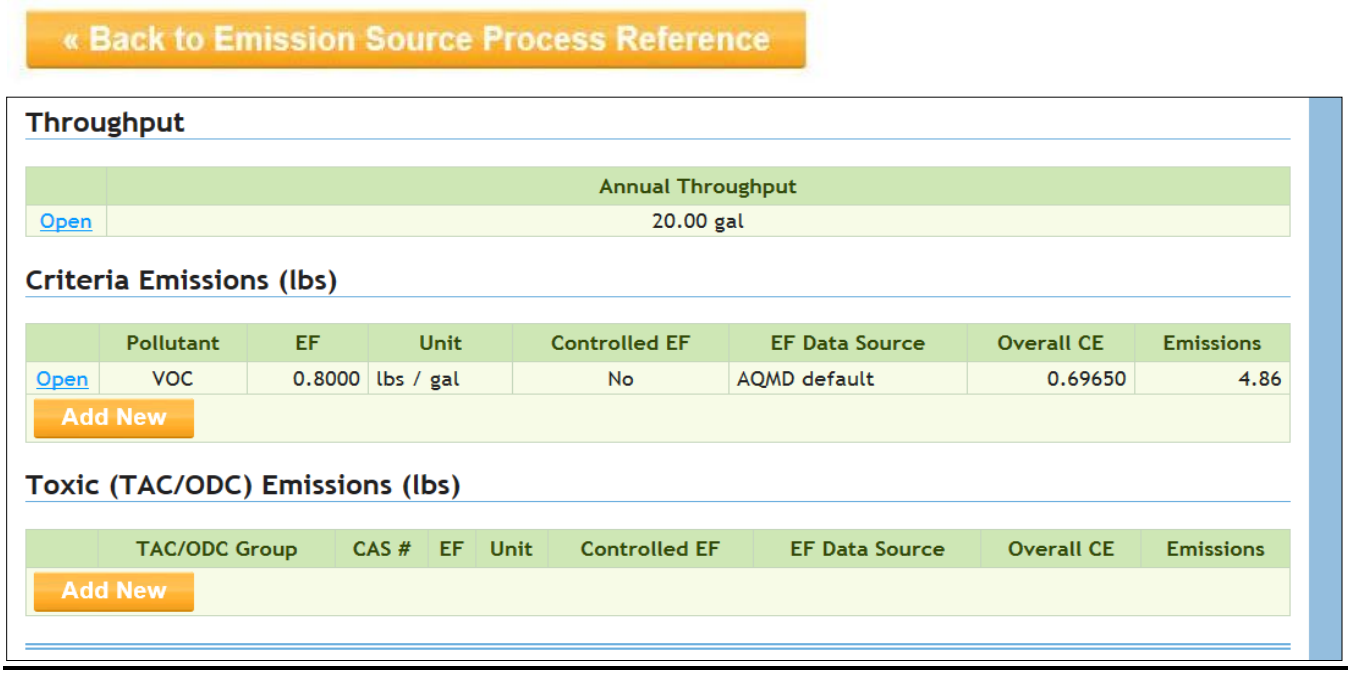
	Pollutant	EF	Unit	Controlled EF	EF Data Source	Overall CE	Emissions
Add New							

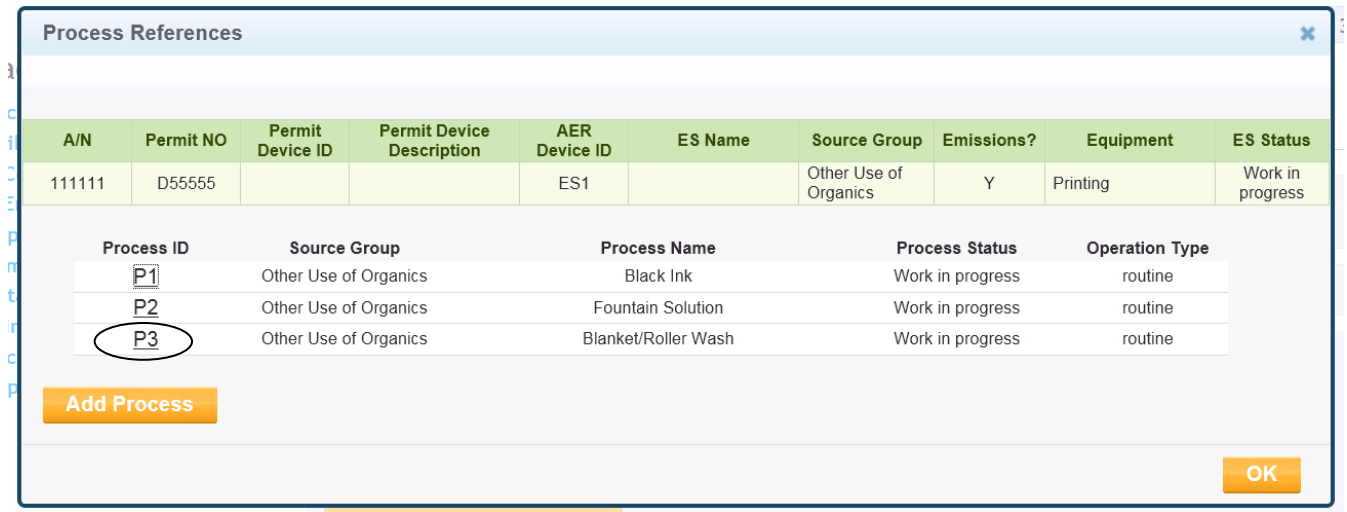
- Enter the **VOC content** of 0.8 lb/gal, and the **overall control efficiency** *as the product of the capture efficiency and the destruction efficiency (*0.7 x 0.995 = 0.6965). Calculation is performed automatically. Click **Save.**



Data entry for the ink in complete as per the next screenshot. The ink MSDS shows no standard toxic content.

- Click **Back to Emission Source Process Reference**, and Select process **P3**.





Process References

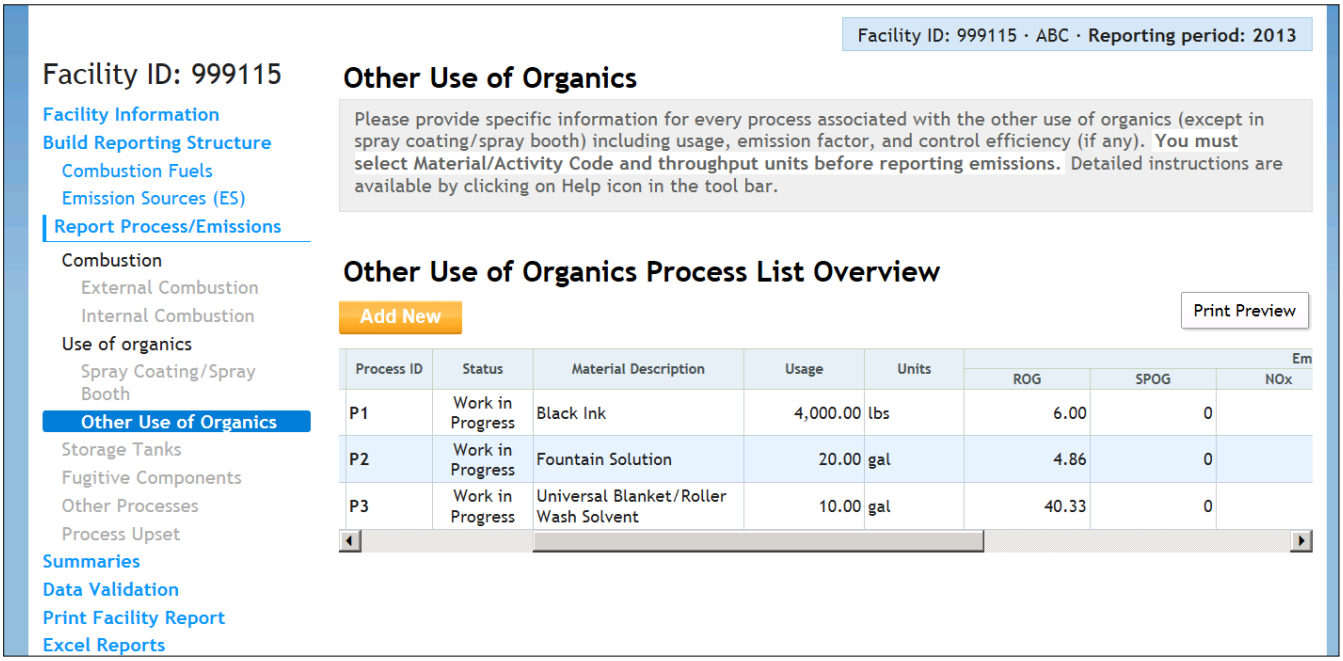
A/N	Permit NO	Permit Device ID	Permit Device Description	AER Device ID	ES Name	Source Group	Emissions?	Equipment	ES Status
111111	D55555			ES1		Other Use of Organics	Y	Printing	Work in progress

Process ID	Source Group	Process Name	Process Status	Operation Type
P1	Other Use of Organics	Black Ink	Work in progress	routine
P2	Other Use of Organics	Fountain Solution	Work in progress	routine
P3	Other Use of Organics	Blanket/Roller Wash	Work in progress	routine

Add Process

OK

- Repeat steps for Process ID P3 as for P1 and P2. *The throughput is 10 gallons and the emission factor for this example is 6.7 lb/gal. The overall efficiency will be 0.4 x 0995 = 0.398* when entering criteria emission information. The final screenshot below shows all three processes input into the program, as viewed in **Report Process/Emissions.**



Facility ID: 999115 · ABC · Reporting period: 2013

Facility ID: 999115

Facility Information
Build Reporting Structure
Combustion Fuels
Emission Sources (ES)
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
Summaries
Data Validation
Print Facility Report
Excel Reports

Other Use of Organics

Please provide specific information for every process associated with the other use of organics (except in spray coating/spray booth) including usage, emission factor, and control efficiency (if any). **You must select Material/Activity Code and throughput units before reporting emissions.** Detailed instructions are available by clicking on Help icon in the tool bar.

Other Use of Organics Process List Overview

Add New

Print Preview

Process ID	Status	Material Description	Usage	Units	Em ROG	SPOG	NOx
P1	Work in Progress	Black Ink	4,000.00	lbs	6.00	0	
P2	Work in Progress	Fountain Solution	20.00	gal	4.86	0	
P3	Work in Progress	Universal Blanket/Roller Wash Solvent	10.00	gal	40.33	0	