PROPOSED AMENDED RULES 1147 AND 1100 WORKING GROUP MEETING #7

NOVEMBER 12, 2020
SOUTH COAST AQMD
DIAMOND BAR, CA

Zoom Meeting:	https://scaqmd.zoom.us/j/96775184779
Meeting ID:	967 7518 4779
Passcode:	606512
Conference Call:	1 (669) 900-6833

AGENDA

- Summary of Previous Working Group
- Status of BARCT Assessment and Proposed Implementation Approach
- Cost-Effectiveness Analysis
  - Afterburner, Thermal Oxidizer, RTO, and Oxidizer
  - Evaporator, Fryer, Heated Process Tank, and Parts Washer
  - Burn-off Furnace, Burnout Oven, Incinerator, Crematory with or without Integrated Afterburner
  - Tenter Frame, Fabric or Carpet Dryer
- Next Steps

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PREVIOUS WORKING GROUP RECAP

Working Group #6

- Presented BARCT analysis for:
  - Diesel fire tar pots,
  - Singeing machines,
  - Absorption chillers,
  - Microturbines (natural gas and diesel), and
  - Autoclaves
- Presented cost-effectiveness analysis for the category "Oven, Dryer, Heater, Furnace, Kiln, and Heated Process Tank"

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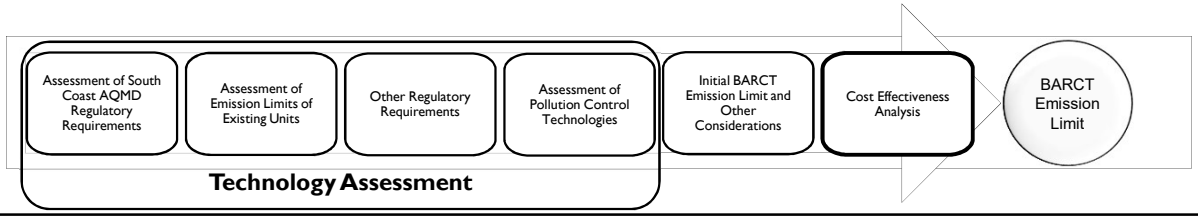
Cost-Effectiveness Analysis

STATUS OF BARCT ASSESSMENT



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STATUS SUMMARY OF BARCT ASSESSMENT

Cost-Effectiveness Analysis

Equipment Category	Equipment Size	Operating Temperature	Current Rule Limit^	Initial BARCT Limit^	Cost-Effectiveness	Proposed BARCT Limit
Oven, Dehydrator, Dryer, Heater, Kiln, Calciner, Cooker, Roaster, Furnace, or Heated Storage Tank	<40 MMBtu/hr	<1,200°F	30 ppm	20 ppm	**$12,700/Ton**	**20 ppm**
		≥1,200°F	60 ppm	30 ppm	**$5,600/Ton**	**30 ppm**
	≥40 MMBtu/hr	<1,200°F	30 ppm	5 ppm	**Pending**	
		≥1,200°F	60 ppm	5 ppm	**Pending**	
Afterburner, Degassing Unit, Remediation Unit, Thermal Oxidizer, Catalytic Oxidizer or Vapor Incinerator	All	All	60 ppm	20 ppm	**Pending**	
Evaporator, Fryer, Heated Process Tank, and Parts Washer	All	All	60 ppm	30 ppm	**Pending**	
Burn-off Furnace, Burnout Oven, Incinerator, Crematory with or without Integrated Afterburner	All	All	60 ppm	30 ppm	**Pending**	
Tenter Frame, Fabric or Carpet Dryer	All	All	30 ppm	20 ppm	**Pending**	
Other Unit and Process Temperature	All	<1,200°F	30 ppm	No Change	**Pending**	
		≥1,200°F	60 ppm			

^ *NOx concentrations are corrected to 3% O_2 dry*

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STATUS SUMMARY OF BARCT ASSESSMENT (CONT'D)

Cost-Effectiveness Analysis

Equipment Category	Equipment Size	Operating Temperature	Current Rule Limit^	Initial BARCT Limit^	Cost-Effectiveness	Proposed BARCT Limit^
Absorption Chillers	All	All	30 ppm	20 ppm	**Pending**	
Micro-Turbines (Natural Gas)	All	All	N/A	9 ppm*	**Pending**	
Micro-Turbines (Diesel)	All	All	40 ppm	40 to 77 ppm*	**Pending**	
Auto-Claves	All	All	30 ppm	30 ppm	**Pending**	
All Liquid Fuel-Fired Units	All	<1,200°F	40 ppm	40 ppm	**Pending**	
	All	≥1,200°F	60 ppm	60 ppm	**Pending**	

^ *NOx concentrations are corrected to 3% O_2 dry*

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Revised

PROPOSED IMPLEMENTATION APPROACH

Cost-Effectiveness Analysis

- Staff is proposing different implementation schedules for RECLAIM and non-RECLAIM facilities
- Different schedules are to recognize that non-RECLAIM facilities were required to meet Rule 1147 emission limits
- Non-RECLAIM facilities are currently required to meet the current Rule 1147 NOx emission limits when:
  - Unit turns 15 years of age (unit emissions are ≥ 1 pound per day);
  - July 1 of the year the unit becomes 35 years or older (for units < 1 pound per day);
  - A permit is required for:
    - A new, relocated, or replacement unit;
    - Combustion system modification or combustion system replacement; or
- Since not all units (≥ 1 pound per day) that are regulated under Rule 1147 have met the current Rule 1147 NOx emission limits, some existing Rule 1147 units will need to meet the proposed NOx emission limits when the unit reaches 15 years

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PROPOSED IMPLEMENTATION APPROACH FOR COST-EFFECTIVENESS EVALUATION

Cost-Effectiveness Analysis

RECLAIM Facilities

- Must meet proposed NOx BARCT emission limit by January 1, 2024
  - Evaluated the cost-effectiveness to meet the initial NOx limit by January 1, 2024
  - Accounted for stranded assets if unit was < 15 years old

Non-RECLAIM Facilities

- Equipment ≥ 1 pound per day, must meet the proposed NOx limit when the equipment turns 15 years of age or burner replacement, whichever is earlier (consistent with existing Rule 1147 provisions)
  - No cost-effectiveness analysis conducted
  - No additional costs to meet the proposed lower limit via burner replacement
- Equipment < 1 pound per day, must meet the proposed NOx limit July 1 of the year the unit becomes 35 years or older or when the unit is replaced, whichever is earlier
  - No cost-effectiveness analysis conducted
  - No additional costs to meet the proposed lower limit via burner replacement*

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* *Allow compliance demonstration to be postponed with recurring biennial source tests to demonstrate <1 LB/Day NOx, consistent with existing Rule 1147*

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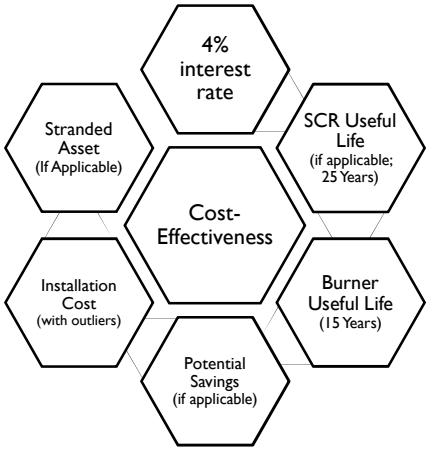
APPROACH FOR ANALYZING THE COST-EFFECTIVENESS

Cost-Effectiveness Analysis

- For each Rule 1147 equipment category, staff used a bottom-up approach to calculate cost-effectiveness for <u>each RECLAIM unit</u>
  - Cost-effectiveness is expressed in dollar per ton of NOx reduced ($/Ton)
- Cost-effectiveness for non-RECLAIM sources is not calculated
  - Staff is proposing non-RECLAIM units to follow existing Rule 1147 compliance schedule to meet new BARCT limits
  - No additional cost for burner replacement
- Outliers with cost-effectiveness figures of >$100,000/ton are identified and further analyzed
  - Staff will assess alternative implementation approaches for outliers, if needed



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ASSESSMENT OF PROCESS TEMPERATURES

Cost-Effectiveness Analysis

- Table 1 of Rule 1147 limits NOx emissions for each equipment category based on process temperatures
- <u>For the categories presented in this working group</u>, Rule 1147 establishes the same NOx limit across all process temperatures
- Staff proposes to collapse temperature separation and conduct BARCT assessment for each category as a whole, independent of process temperature
  - Staff found that burner and process type are found to be similar for equipment across all temperatures

Table 1 – NO_x Emission Limit for Unit Heat Ratings ≥ 325,000 BTU/hour

Equipment Category(ies)	NOx Emission Limit PPM @ 3% O_2, dry or Pound/mmBtu heat input		
	Process Temperature		
Gaseous Fuel-Fired Equipment	≤ 800° F	> 800 ° F and < 1200° F	≥ 1200 ° F
Asphalt Manufacturing Operation	40 ppm	40 ppm	
Afterburner, Degassing Unit, Remediation Unit, Thermal Oxidizer, Catalytic Oxidizer or Vapor Incinerator [1]	60 ppm or 0.073 lb/mmBtu	60 ppm or 0.073 lb/mmBtu	60 ppm or 0.073 lb/mmBtu
Burn-off Furnace, Burnout Oven, Incinerator or Crematory with or without Integrated Afterburner	60 ppm or 0.073 lb/mmBtu	60 ppm or 0.073 lb/mmBtu	60 ppm or 0.073 lb/mmBtu
Evaporator, Fryer, Heated Process Tank, or Parts Washer	60 ppm or 0.073 lb/mmBtu	60 ppm or 0.073 lb/mmBtu	
Metal Heat Treating, Metal Melting Furnace, Metal Pot, or Tar Pot	60 ppm or 0.073 lb/mmBtu	60 ppm or 0.073 lb/mmBtu	60 ppm or 0.073 lb/mmBtu
Oven, Dehydrator, Dryer, Heater, Kiln, Calciner, Cooker, Roaster, Furnace, or Heated Storage Tank	30 ppm or 0.036 lb/mmBtu	30 ppm or 0.036 lb/mmBtu	60 ppm or 0.073 lb/mmBtu
Make-Up Air Heater or other Air Heater located outside of building with temperature controlled zone inside building	30 ppm or 0.036 lb/mmBtu	30 ppm or 0.036 lb/mmBtu	
Tenter Frame or Fabric or Carpet Dryer	30 ppm or 0.036 lb/mmBtu		
Other Unit or Process Temperature	30 ppm or 0.036 lb/mmBtu	30 ppm or 0.036 lb/mmBtu	60 ppm or 0.073 lb/mmBtu
Liquid Fuel-Fired Equipment	≤ 800° F	> 800 ° F and < 1200° F	≥ 1200 ° F
All liquid fuel-fired Units	40 ppm or 0.053 lb/mmBtu	40 ppm or 0.053 lb/mmBtu	60 ppm or 0.080 lb/mmBtu

1. Emission limit applies to burners in units fueled by 100% natural gas that are used to incinerate air toxics, VOCs, or other vapors; or to heat a unit. The emission limit applies solely when burning 100% fuel and not when the burner is incinerating air toxics, VOCs, or other vapors. The unit shall be tested or certified to meet the emission limit while fueled with natural gas.

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Cost-Effectiveness Analysis

COST-EFFECTIVENESS ANALYSIS

Afterburner, Degassing Unit, Remediation Unit, Thermal Oxidizer, Catalytic Oxidizer or Vapor Incinerator at RECLAIM Facilities

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SUMMARY OF INITIAL BARCT LIMIT

AFTERBURNER, DEGASSING UNIT, REMEDIATION UNIT, THERMAL OXIDIZER, CATALYTIC OXIDIZER OR VAPOR INCINERATOR

Cost-Effectiveness Analysis

Existing Units Meeting Initial BARCT Limit[+^]	South Coast AQMD Limit[^]	Other Regulatory[#]	Technology Assessment[^]	Initial BARCT NOx Limit[*^]
7 of 13 RECLAIM Units Source Tested <20 ppm	60 ppm (30 ppm BACT)	30 to 175 ppm	30 ppm (via LNB[1])	20 ppm (via LNB[1])
27 of 67 Non-RECLAIM Units Source Tested <20 ppm				

60 RECLAIM units representing 0.08 tons/day of NOx emissions[2]

Cost-Effectiveness Analysis is needed

[+] *Emissions data collected from source test results*
[^] *NOx concentrations are corrected to 3% O_2 dry*
[#] *Oxygen corrections for NOx concentrations vary depending on regulatory agency*
[1] *Low NOx Burner (LNB) technology assessment is based off of vendor guarantees. Source test results analyzed demonstrate burners can achieve lower concentrations*
[2] *Emissions calculated based on permitted levels*

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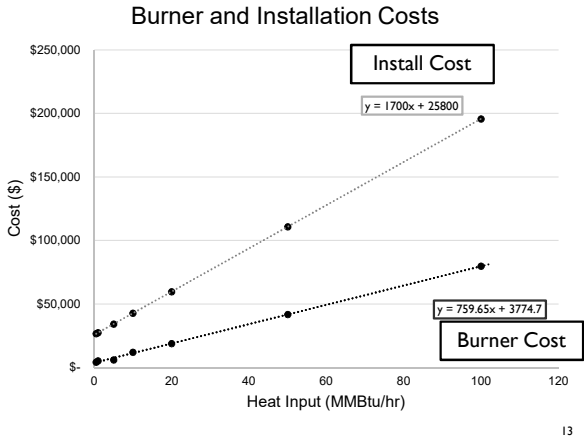
BASIS FOR BURNER COSTS

AFTERBURNER, DEGASSING UNIT, REMEDIATION UNIT, THERMAL OXIDIZER, CATALYTIC OXIDIZER OR VAPOR INCINERATOR

Cost-Effectiveness Analysis

- Cost-effectiveness analysis to achieve 20 ppm is based on burner replacement
- Burner costs were obtained from two burner manufacturers
  - Of the two manufacturers, staff used the burner manufacturer with the higher cost estimates
  - Costs for larger equipment were extrapolated from cost provided by manufacturers
- Used installation cost from Rule 1146 equipment



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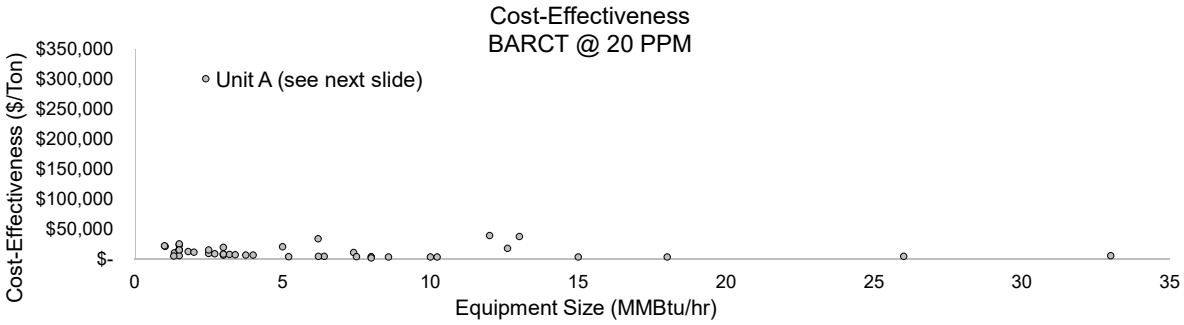
COST-EFFECTIVENESS ANALYSIS

AFTERBURNER, DEGASSING UNIT, REMEDIATION UNIT, THERMAL OXIDIZER, CATALYTIC OXIDIZER OR VAPOR INCINERATOR

Cost-Effectiveness Analysis

Units with Permit Limit >20 ppm and Estimated Usage ≥1 Pound Per Day



Average Cost-Effectiveness	RECLAIM	$18,800 /Ton
# of Identified Equipment		44 Units

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ADDITIONAL OUTLIER ANALYSIS (UNIT A)

AFTERBURNER, DEGASSING UNIT, REMEDIATION UNIT, THERMAL OXIDIZER, CATALYTIC OXIDIZER OR VAPOR INCINERATOR

Cost-Effectiveness Analysis

- Unit A has a cost-effectiveness of $300,700/Ton:

Heat Input	2.4 MMBtu/Hr
Permit Limit	30 PPM^
Source Test Results	24 PPM^
Permit Date	01/03/2019

- Equipment permit limit reflects current BACT
- Staff recommends to allow RECLAIM units with a permit limit at or below 30 ppm to meet rule limit at 15 years of age or burner replacement, whichever is earlier

^ *NOx concentrations corrected to 3% O_2 dry*

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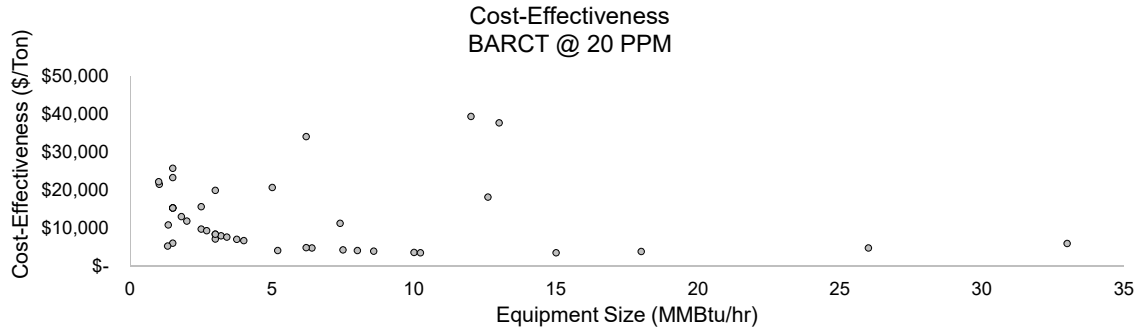
COST-EFFECTIVENESS ANALYSIS

AFTERBURNER, DEGASSING UNIT, REMEDIATION UNIT, THERMAL OXIDIZER, CATALYTIC OXIDIZER OR VAPOR INCINERATOR

Cost-Effectiveness Analysis

Units with Permit Limit >20 ppm and Estimated Usage >1 LB/Day
Removing Outlier (Unit A)



Average Cost-Effectiveness	RECLAIM	$12,300 /Ton
# of Identified Equipment		43 Units

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STAFF RECOMMENDATIONS

AFTERBURNER, DEGASSING UNIT, REMEDIATION UNIT, THERMAL OXIDIZER, CATALYTIC OXIDIZER OR VAPOR INCINERATOR

Unit	NOx Emission Limit	Compliance Date
RECLAIM Facilities		
Afterburner, Degassing Unit, Remediation Unit, Thermal Oxidizer, Catalytic Oxidizer or Vapor Incinerator	20 ppm	January 1, 2024
Non-RECLAIM Facilities		
Afterburner, Degassing Unit, Remediation Unit, Thermal Oxidizer, Catalytic Oxidizer or Vapor Incinerator	20 ppm	When burner is 15 years old or burner is replaced, whichever is sooner

- RECLAIM units with NOx permit limit less than 30 ppm, must meet 20 ppm limit when burner reaches 15 years or at burner replacement, whichever is sooner

Total NOx emission reductions (RECLAIM and non-RECLAIM): 0.05 TPD by 2024 and 1.2 TPD at final implementation

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COST-EFFECTIVENESS ANALYSIS

Evaporator, Fryer, Heated Process Tank, and Parts Washer at RECLAIM Facilities

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SUMMARY OF INITIAL BARCT LIMIT
EVAPORATOR, FRYER, HEATED PROCESS TANK, AND PARTS WASHER

Initial BARCT Emission Limit

Existing Units Meeting Initial BARCT Limit+^	South Coast AQMD Limit^	Other Regulatory#	Technology Assessment^	Initial BARCT NOx Limit^
No RECLAIM Units with Source Tests				
8 of 8 Non-RECLAIM Units Source Tested <60 ppm	60 ppm	125 to 175 ppm	30 ppm (via LNB[1])	30 ppm (via LNB[1])

2 RECLAIM units representing 0.002 tons/day of NOx emissions[2]

Cost-Effectiveness Analysis is needed

+ Emissions data collected from source test results
^ NOx concentrations are corrected to 3% O_2 dry
 # Oxygen corrections for NOx concentrations vary depending on regulatory agency
[1] Low NOx Burner (LNB) technology assessment is based off of vendor guarantees. Source test results analyzed demonstrate burners can achieve lower concentrations
[2]Emissions calculated based on permitted levels

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ADDITIONAL CONSIDERATIONS
AVAILABILITY OF BURNER TECHNOLOGY

Cost-Effectiveness Analysis

- One burner manufacturer has burners available that are capable of achieving 30 ppm for retrofit applications for this category
  - Burner size is generally limited to units <3 MMBtu/hr
  - Staff is not aware of any units within this category that are achieving 30 ppm
- Burner manufacturers for larger applications could not commit to meet NOx limit below 30 ppm for burner applications for this category of equipment
- Maximum heat input identified in analysis of this category is rated 14 MMBtu/hr
- Staff recommends to maintain the current Rule 1147 limit of 60 ppm

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ADDITIONAL CONSIDERATIONS EXISTING EXEMPTIONS IN RULE 1147

Cost-Effectiveness Analysis

- Rule 1147 existing exemptions for equipment in this category:
  - **Rule 1147(g)(6) –** Provides additional time for fryers installed and operated between December 5, 2008 and January 1, 2014 to meet rule limit
  - **Rule 1147(g)(8) –** Provides additional time for evaporators, heated process tanks, or parts washers installed and operating prior to January 1, 2014 to meet rule limit
- Staff recommends to retain existing exemption for non-RECLAIM equipment
- Cost-effectiveness analysis conducted for RECLAIM equipment to demonstrate compliance by January 1, 2024

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ADDITIONAL CONSIDERATIONS BIFURCATING FRYER CATEGORIES

Cost-Effectiveness Analysis

- Staff proposes to include new definitions for **"Non-Integrated Fryer"** and **"Integrated Fryer"** to be consistent with BACT guidelines
  1. **Integrated Fryer** – Heating element is also used as an integrated emission control equipment
  2. **Non-integrated Fryer** – Heating element solely used to heat oil bath

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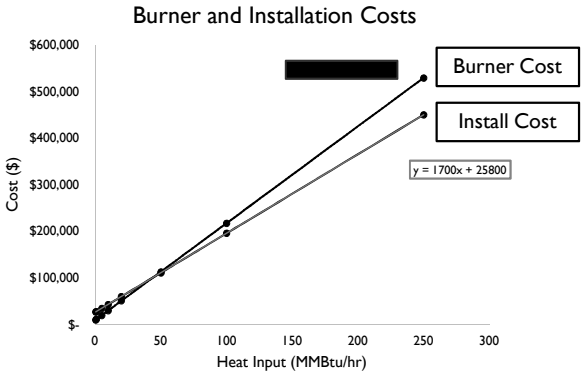
BASIS FOR BURNER COSTS
EVAPORATOR, FRYER, HEATED PROCESS TANK, AND PARTS WASHER

Cost-Effectiveness Analysis

- Cost-effectiveness analysis to achieve 60 ppm is based on burner replacement
- Burner costs were similar to the ovens category
  - Cost comparison based on information from one burner manufacturer
  - Used same cost equation to derive burner cost for different burner sizes
- Used installation cost from Rule 1146 equipment



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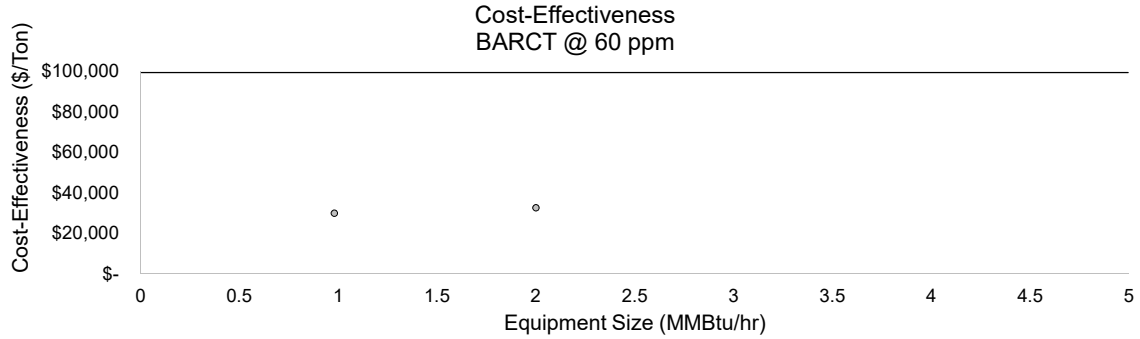
COST-EFFECTIVENESS ANALYSIS
EVAPORATOR, FRYER, HEATED PROCESS TANK, AND PARTS WASHER

Cost-Effectiveness Analysis

Units with Permit Limit >60 ppm and Estimated Usage ≥1 Pound Per Day



Average Cost-Effectiveness	**RECLAIM**	$31,300/Ton
# of Identified Equipment		2 Units

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STAFF RECOMMENDATIONS
EVAPORATOR, FRYER, HEATED PROCESS TANK, AND PARTS WASHER

Unit	NOx Emission Limit	Compliance Date
RECLAIM Facilities		
Evaporator, Fryer, Heated Process Tank, and Parts Washer	60 ppm	January 1, 2024
Non-RECLAIM Facilities		
Evaporator, Heated Process Tank, Fryer, and Parts Washer	60 ppm	When burner is 15 years old or burner is replaced, whichever is sooner; unless applicable to exemption in Rule 1147(g)(5) or (g)(8)

- Identified RECLAIM equipment are cost-effective to demonstrate compliance to 60 ppm NOx limit by January 1, 2024
  - Feasibility supported by the July 2017 Technology Assessment

Total NOx emission reductions (RECLAIM and non-RECLAIM):
0.001 TPD by 2024 and 0.044 TPD at final implementation

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INITIAL BARCT EMISSION LIMIT

Burn-off Furnace, Burnout Oven, Incinerator, Crematory with or without Integrated Afterburner at RECLAIM Facilities

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SUMMARY OF INITIAL BARCT LIMIT

BURN-OFF FURNACE, BURNOUT OVEN, INCINERATOR, CREMATORY WITH OR WITHOUT INTEGRATED AFTERBURNER

Cost-Effectiveness Analysis

Existing Units Meeting Initial BARCT Limit+^	South Coast AQMD Limit^	Other Regulatory#	Technology Assessment^	Initial BARCT NOx Limit^
No RECLAIM Units with Source Tests	60 ppm	125 to 175 ppm	30 ppm (via LNB[1])	30 ppm (via LNB[1])
9 of 69 Non-RECLAIM Units Source Tested <30 ppm				

11 RECLAIM units representing 0.008 tons/day of NOx emissions

Cost-Effectiveness Analysis is needed

+ *Emissions data collected from source test results*
^ *NOx concentrations are corrected to 3% O_2 dry*
# *Oxygen corrections for NOx concentrations vary depending on regulatory agency*
[1] *Low NOx Burner (LNB) technology assessment is based off of vendor guarantees. Source test results analyzed demonstrate burners can achieve lower concentrations*
[2] *Emissions calculated based on permitted levels*

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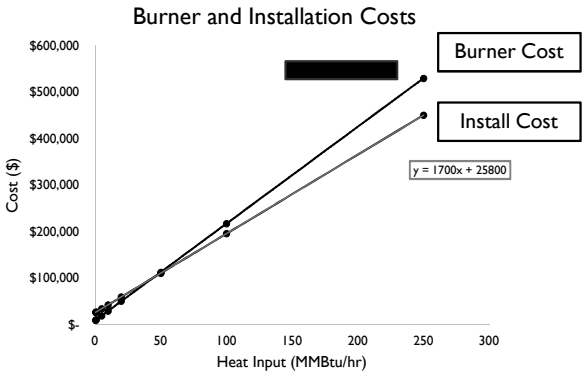
BASIS FOR BURNER COSTS

BURN-OFF FURNACE, BURNOUT OVEN, INCINERATOR, CREMATORY WITH OR WITHOUT INTEGRATED AFTERBURNER

Cost-Effectiveness Analysis

- Cost-effectiveness analysis to achieve 30 ppm is based on burner replacement
- Burner costs were found to be similar to that of the ovens category
  - Used same cost equation to derive burner cost
- Used installation cost from Rule 1146 equipment
- Units in this category are equipped with primary and secondary burners
  - Burner and installation costs assume use of two burners to make up total equipment heat input



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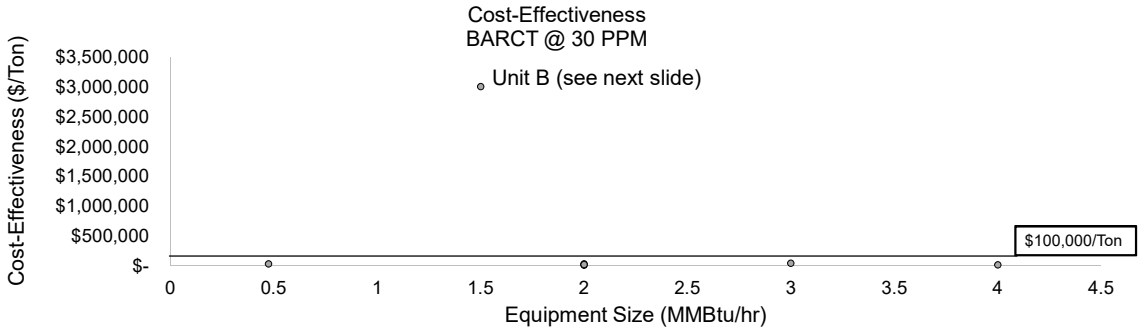
COST-EFFECTIVENESS ANALYSIS

BURN-OFF FURNACE, BURNOUT OVEN, INCINERATOR, CREMATORY WITH OR WITHOUT INTEGRATED AFTERBURNER

Cost-Effectiveness Analysis

Units with Permit Limit >30 ppm and Estimated Usage ≥1 Pound Per Day



Average Cost-Effectiveness	**RECLAIM**	$452,400/Ton
# of Identified Equipment		7 Units

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ADDITIONAL OUTLIER ANALYSIS (UNIT B)

BURN-OFF FURNACE, BURNOUT OVEN, INCINERATOR, CREMATORY WITH OR WITHOUT INTEGRATED AFTERBURNER

Cost-Effectiveness Analysis

- Unit B has a cost-effectiveness of $3,012,100/ton
  - Equipment Information:

Heat Input	1.5 MMBtu/Hr
Permit Limit	50 PPM^
Source Test Results	34 PPM^
Year Installed	2018

  - Unit complies with existing Rule 1147 requirements
- Staff recommends to allow RECLAIM units with a permit limit below 40 ppm to meet rule limit at 15 years of age or at burner replacement, whichever is earlier
  - Requires operator to modify permit to lower the limit to 40 ppm – no burner replacement would be needed

^ *NOx concentrations are corrected to 3% O_2 dry*

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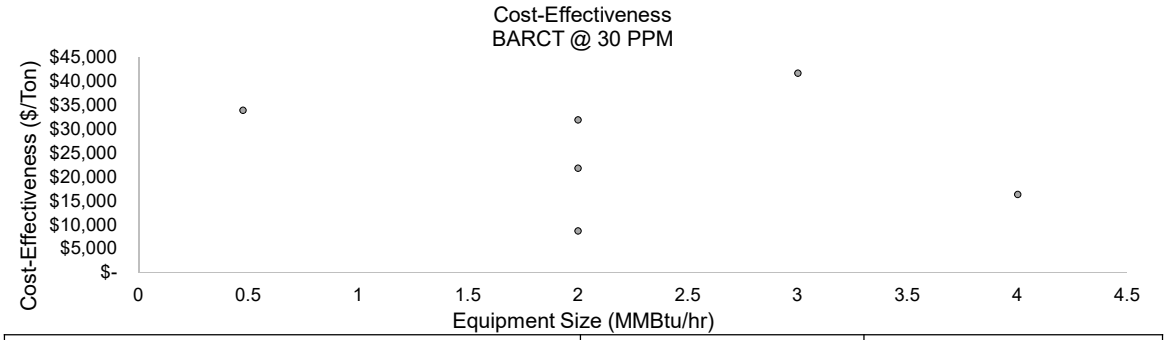
COST-EFFECTIVENESS ANALYSIS

BURN-OFF FURNACE, BURNOUT OVEN, INCINERATOR, CREMATORY WITH OR WITHOUT INTEGRATED AFTERBURNER

Cost-Effectiveness Analysis

Units with Permit Limit >30 ppm and Estimated Usage ≥1 Pound Per Day
Removing Outlier (Unit B)



Average Cost-Effectiveness	**RECLAIM**	$25,800/Ton
# of Identified Equipment		6 Units

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STAFF RECOMMENDATIONS

BURN-OFF FURNACE, BURNOUT OVEN, INCINERATOR, CREMATORY WITH OR WITHOUT INTEGRATED AFTERBURNER

Unit	NOx Emission Limit	Compliance Date
RECLAIM Facilities		
Burn-off Furnace, Burnout Oven, Incinerator, Crematory with or without Integrated Afterburner	30 ppm	January 1, 2024
Non-RECLAIM Facilities		
Burn-off Furnace, Burnout Oven, Incinerator, Crematory with or without Integrated Afterburner	30 ppm	When burner is 15 years old or burner is replaced, whichever is sooner

- Units with permitted limit less than 40 ppm, meet limit when burner reaches 15 years or at burner replacement, whichever is sooner

Total NOx emission reductions (RECLAIM and non-RECLAIM):
0.004 TPD by 2024 and 0.23 TPD at final implementation

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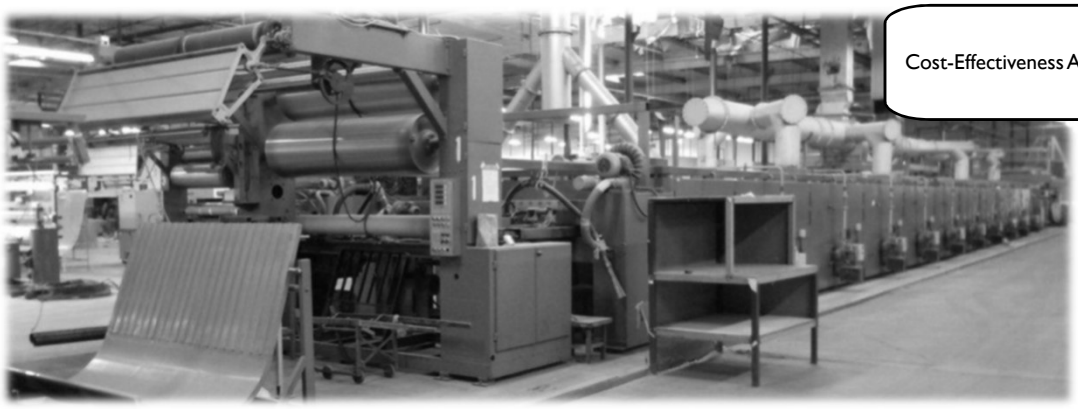

Cost-Effectiveness Analysis

INITIAL BARCT EMISSION LIMIT

Tenter Frame, Fabric or Carpet Dryer at RECLAIM Facilities

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SUMMARY OF INITIAL BARCT LIMIT

TENTER FRAME, FABRIC OR CARPET DRYER

Initial BARCT Emission Limit

Existing Units Meeting Initial BARCT Limit+^	South Coast AQMD Limit^	Other Regulatory#	Technology Assessment^	Initial BARCT NOx Limit^
0 of 9 RECLAIM Units Tested <20 ppm	30 ppm	30 to 175 ppm	20 ppm (via LNB[1])	20 ppm (via LNB[1])
1 of 20 Non-RECLAIM Units Tested <20 ppm				

Assessment of burner technology from previous categories with same burner types show feasibility for this category to meet NOx emission of 20 ppm

26 RECLAIM units representing 0.13 tons/day of NOx emissions

Cost-Effectiveness Analysis is needed

+ Emissions data collected from source test results
^ NOx concentrations are corrected to 3% O_2 dry
 # Oxygen corrections for NOx concentrations vary depending on regulatory agency
[1] Low NOx Burner (LNB) technology assessment is based off of vendor guarantees. Source test results analyzed demonstrate burners can achieve lower concentrations
[2]Emissions calculated based on permitted levels

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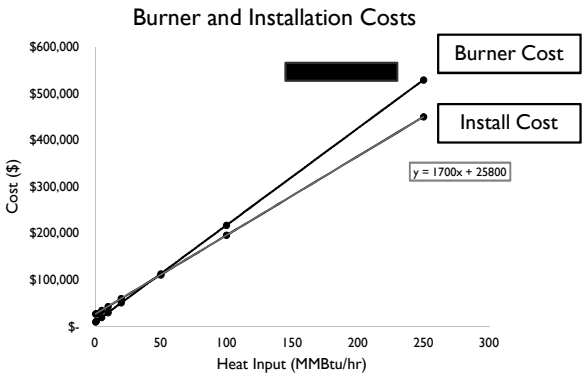
BASIS FOR BURNER COSTS
TENTER FRAME, FABRIC OR CARPET DRYER

Cost-Effectiveness Analysis

- Cost-effectiveness analysis to achieve 20 ppm is based on burner replacement
- Burner costs were similar to the ovens category
  - Cost comparison based on information from one burner manufacturer
  - Used same cost equation to derive burner cost for different burner sizes
- Used installation cost from Rule 1146 equipment
- Units in this category use multiple smaller burners instead of one large burner
  - Burner and installation costs assume use of multiple burners each with heat input of 1.5MMBtu/hr



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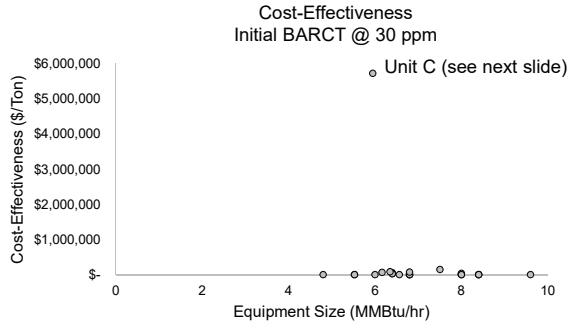
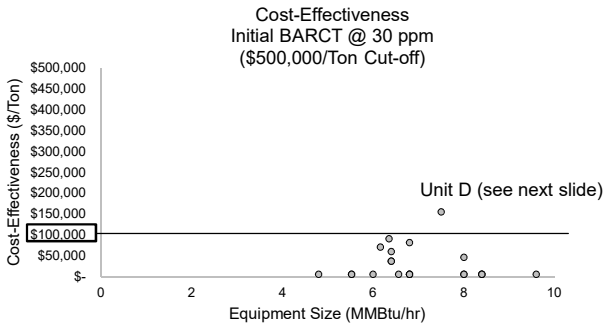
COST-EFFECTIVENESS ANALYSIS
TENTER FRAME, FABRIC OR CARPET DRYER

Cost-Effectiveness Analysis

Units with Permit Limit >30 ppm and Estimated Usage ≥1 Pound Per Day





Average Cost-Effectiveness	**RECLAIM**	$277,200/Ton
# of Identified Equipment		23 Units

* Additional analysis on next slide

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ADDITIONAL OUTLIER ANALYSIS (UNITS C & D)
TENTER FRAME, FABRIC OR CARPET DRYER

Cost-Effectiveness Analysis

- Two units with cost-effectiveness greater than $100,000/Ton:

Unit	Unit Size (MMBtu/hr)	Permit Date	Permit Limit	Source Test Result^	Cost-Effectiveness
C	6.0	08/12/2004	40	20.3	$ 5,724,400
D	7.5	11/17/2000	40	34.7	$ 155,100

- Unit D was found to have an estimated usage of near 1 pound/day
- Staff recommends to allow RECLAIM units with a permit limit below 30 ppm to meet rule limit at 15 years of age or burner replacement, whichever is earlier

^ *NOx concentrations are corrected to 3% O_2 dry*

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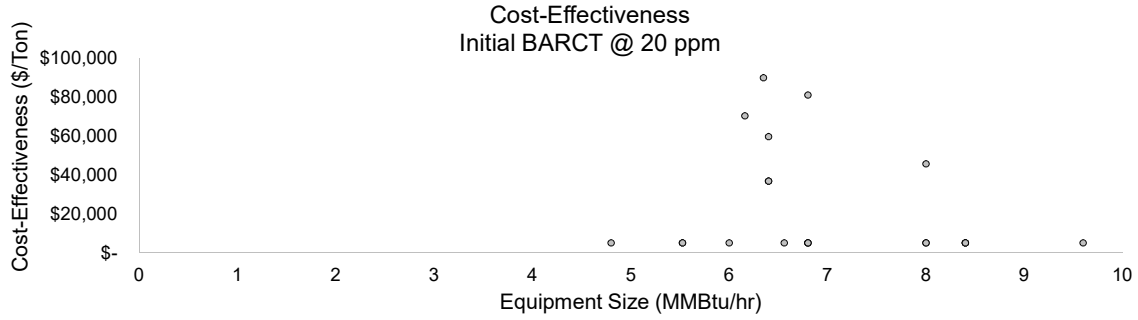
COST-EFFECTIVENESS ANALYSIS
TENTER FRAME, FABRIC OR CARPET DRYER

Cost-Effectiveness Analysis

Units with Permit Limit >20 ppm and Estimated Usage ≥1 Pound Per Day
Removing Outliers (Unit C & D)



Average Cost-Effectiveness	**RECLAIM**	$23,600/Ton
# of Identified Equipment		21 Units

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STAFF RECOMMENDATIONS
TENTER FRAME, FABRIC OR CARPET DRYER

Unit	NOx Emission Limit	Compliance Date
RECLAIM Facilities		
Tenter Frame, Fabric or Carpet Dryer	20 ppm	January 1, 2024
Non-RECLAIM Facilities		
Tenter Frame, Fabric or Carpet Dryer	20 ppm	When burner is 15 years old or burner is replaced, whichever is sooner

- Units with permitted limit less than 30 ppm, meet limit when burner reaches 15 years or at burner replacement, whichever is sooner

Total NOx emission reductions (RECLAIM and non-RECLAIM):
0.09 TPD by 2024 and 0.12 TPD at final implementation

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UPDATED STATUS SUMMARY OF BARCT ASSESSMENT

Cost-Effectiveness Analysis

Equipment Category	Equipment Size	Operating Temperature	Current Rule Limit^	Initial BARCT Limit^	Cost-Effectiveness*	Proposed BARCT Limit
Oven, Dehydrator, Dryer, Heater, Kiln, Calciner, Cooker, Roaster, Furnace, or Heated Storage Tank	<40 MMBtu/hr	<1,200°F	30 ppm	20 ppm	**$12,700/Ton**	**20 ppm**
		≥1,200°F	60 ppm	30 ppm	**$5,600/Ton**	**30 ppm**
	≥40 MMBtu/hr	<1,200°F	30 ppm	5 ppm	**Pending**	
		≥1,200°F	60 ppm	5 ppm	**Pending**	
Afterburner, Degassing Unit, Remediation Unit, Thermal Oxidizer, Catalytic Oxidizer or Vapor Incinerator	All	All	60 ppm	20 ppm	**$12,300/Ton**	**20 ppm**
Evaporator, Fryer, Heated Process Tank, and Parts Washer	All	All	60 ppm	30 ppm	**$31,300/Ton**	**60 ppm**
Burn-off Furnace, Burnout Oven, Incinerator, Crematory with or without Integrated Afterburner	All	All	60 ppm	30 ppm	**$25,800/Ton**	**30 ppm**
Tenter Frame, Fabric or Carpet Dryer	All	All	30 ppm	20 ppm	**$23,600/Ton**	**20 ppm**
Other Unit and Process Temperature	All	<1,200°F	30 ppm	No Change	**Pending**	
	All	≥1,200°F	60 ppm			

^ *NOx concentrations are corrected to 3% O_2 dry*
* *Cost-effectiveness for RECLAIM facilities to meet NOx limit by January 1, 2024*

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UPDATED STATUS SUMMARY OF BARCT ASSESSMENT (CONT'D)

Cost-Effectiveness Analysis

Equipment Category	Equipment Size	Operating Temperature	Current Rule Limit^	Initial BARCT Limit^	Cost-Effectiveness	Proposed BARCT Limit^
Absorption Chillers	All	All	30 ppm	20 ppm	**Pending**	
Micro-Turbines (Natural Gas)	All	All	N/A	9 ppm*	**Pending**	
Micro-Turbines (Diesel)	All	All	40 ppm	40 to 77 ppm*	**Pending**	
Auto-Claves	All	All	30 ppm	30 ppm	**Pending**	
All Liquid Fuel-Fired Units	All	<1,200°F	40 ppm	40 ppm	**Pending**	
	All	≥1,200°F	60 ppm	60 ppm	**Pending**	

^ *NOx concentrations are corrected to 3% O_2 dry*

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NEXT STEPS

- Conduct cost-effectiveness analysis for remaining categories
- Continue to hold stakeholder meetings
- Next Working Group Meeting – TBD

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CONTACTS

General RECLAIM Questions	Proposed Amended Rules 1147 and 1100	Proposed Amended Rule 1147, 1100 and Proposed Rule 1147.1	Proposed Amended Rule 1147, 1100 and Proposed Rule 1147.2
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