San Joaquin Valley
Unified Air Pollution Control District

Permit Services

Emissions Monitoring for Rule 4309

Approved By: _____ Arnaud Marjollet Director of Permit Services	Approval Date: February 2, 2009 Revision Date: February 15, 2017

Purpose: To identify pre-approved monitoring schemes that can be used as alternatives to continuous emissions monitoring systems (CEM's), and to establish procedures and criteria for case-by-case approval of other alternate monitoring proposals for compliance with Rule 4309, Dryers, Dehydrators, and Ovens. As an alternative to CEM's, an applicant may choose from the pre-approved monitoring schemes or may make a different alternate monitoring proposal for approval by the APCO.

An application for Authority to Construct must be submitted to the District in order to add or change monitoring permit conditions.

I. Applicability

This policy applies to dryers and ovens that are subject to the monitoring requirements of District Rule 4309.

II. Background

Rule 4309 requires that the owner of any unit subject to the emissions limits of the rule shall either install and maintain continuous emission monitoring equipment for NO_X and oxygen, as identified in Rule 1080 (Stack Monitoring), or install and maintain APCO-approved alternate monitoring consisting of one or more of the following:

- periodic NO_X exhaust emission concentrations,
- periodic exhaust oxygen concentration,
- flow rate of reducing agent added to exhaust,
- catalyst inlet and exhaust temperature,
- catalyst inlet and exhaust oxygen concentration,
- periodic flue gas recirculation rate,
- other operational characteristics

III. Guiding principles

The guiding principle of this policy in reference to the monitoring requirements of Rule 4309 is to establish monitoring procedures that provide a reasonable assurance of compliance with applicable emissions limits, while encouraging preventative maintenance and repair of emission systems. The primary goal is to ensure that a control technology, once installed or otherwise employed, is properly operated and maintained so that the control efficiency does not deteriorate to the point where the unit fails to remain in compliance with an applicable emission limit.

An approvable monitoring procedure must (1) document continued operation within ranges of specified emissions-related performance indicators (such as emissions, control device parameters, and process parameters) that provide a reasonable assurance of compliance with applicable emission limits; (2) record and indicate any deviations from these ranges; and (3) require prompt response to any deviations either by correcting the deviations or by demonstrating compliance with applicable emissions limitations by further emissions testing.

If the equipment is found to be operating outside acceptable ranges for emission limits or emissions-related performance indicators, owners will be required to take prompt corrective actions to the equipment as well as notify the District that potential compliance problems may exist. Specific requirements for taking corrective action and notification are addressed in the individual monitoring procedures included in Section VI of this policy.

Devising an approvable monitoring procedure requires a clear understanding of the pollutant formation mechanisms, the manner by which the control technology reduces emissions, and the parameters that contribute to the degradation of performance of the control technology. See Appendix A for discussion of NO_X formation mechanisms and control techniques.

Testing and engineering data may be needed to identify and establish acceptable ranges or levels of surrogate parameters that can serve as indicators of acceptable performance.

Some facilities that have dryers and ovens subject to the monitoring requirements of Rule 4309 are Title V sources. Although the monitoring requirements in this policy often meet Title V monitoring and recordkeeping requirements, the Title V permit may require additional monitoring not covered by this policy.

IV. Definitions

The following definitions are applicable to this policy:

A. **Normal Range or Level:** A range or a level for a surrogate parameter, based on source testing and engineering data, designed to provide a reasonable assurance of compliance with applicable emissions limits.

B. **Surrogate Parameter:** A parameter (such as a control device parameter, a process parameter, or exhaust gas emission concentration when measured with a portable analyzer) that can be used an indicator of the emission control system performance.

V. Compliance Issues

The surrogate parameters are seen as indicators that provide a reasonable assurance that the equipment or emission control system has been properly maintained and is operating in compliance with the applicable emission limits. However, excursions from normal ranges or levels for these surrogate parameters alone may not serve as credible evidence of the violation of an applicable emission limit. Such excursions place a burden on the owner to either correct the situation or conduct additional testing to verify compliance under the new operating conditions.

Therefore, as condition of approval for an alternate monitoring procedure in lieu of CEM's, the equipment operator must agree to take prompt corrective actions of excursions and document those actions. Excursions must be rectified within 1 hour of operation after detection unless source testing using an approved method to show compliance under the observed operating conditions is conducted within 60 days. Alternatively, if excursions are corrected after more than 1 hour of operation after detection and the permittee stipulates a violation has occurred, source testing will not be required. For excursions of surrogate parameters (excluding excursions of emission concentrations measured with a portable analyzer), a portable analyzer may be used to establish compliance with applicable emission limits at the new surrogate parameter values. For excursions of emission concentrations, compliance testing must follow EPA approved test methods. Where monitoring with a portable emissions analyzer is allowed, testing using EPA approved methods can be substituted for testing with a portable emissions analyzer. Retesting shall be performed under the same operational conditions that existed when the excursion was first detected.

District Rule 1100, Equipment Breakdown, defines a breakdown and specifies the procedures to follow if a breakdown occurs. Should any excursion from normal ranges/levels for either emissions or surrogate parameters be detected, and the cause of such excursion can be traced to a viable breakdown condition as defined in Rule 1100, then the owner/operator may seek relief from enforcement action by fully complying with Rule 1100, including notification and immediate undertaking of appropriate corrective measures to come into compliance.

For units that operate intermittently throughout the year, the units need not be started solely to perform monitoring required by this policy. Monitoring shall be performed within 5 days of restarting the units unless monitoring has been performed within the time period specified on the permit. Records must be maintained of the dates of non-operation to validate extended monitoring frequencies allowed by this section.

Normal range or level for surrogate parameters shall be re-established at each scheduled source test. Should different ranges or levels be established, for non-Title V sources the Permit to Operate shall be revised administratively to reflect the new ranges or levels. For Title V sources, an application is required to change ranges or levels.

Appendix B contains a flow chart detailing courses of action when an excursion is detected.

VI. Pre-Approved Alternate Monitoring Schemes

The following alternate monitoring schemes have been approved as meeting the applicable provisions of Rule 4309.

A. Periodic Monitoring of NO_X, CO and O_2 Concentrations

COMPATIBLE NO_X and CO CONTROL TECHNIQUES: All units subject to the monitoring requirements of Rule 4309 will be allowed to monitor NO_X, CO and O_2 concentrations.

FREQUENCY: Monitoring of NO_X, CO and O_2 shall be conducted at least once per month (in which a source test is not performed).

For units in the asphaltic concrete industry subject to the requirements of Rule 4309, monitoring is only required during months in which asphalt is produced on at least five days, or for at least 32 hours.

MEASUREMENT: The exhaust gas shall be monitored for NO_X, CO and O_2 concentrations with a portable emission monitor that meets District specifications prescribed in Compliance's Portable Emission Analyzer Policy for Industry, COM 1150B.

RESULTS: NO_X and CO concentration corrected to 19% O_2 or if measured O_2 concentration is greater than 19%, the corrected NOx or CO concentration is equal to the measured NOx or CO concentration.

NORMAL RANGE OR LEVEL: NO_X and CO concentration, corrected to 19% O_2 (or no correction if measured above 19%), at or below the emissions limit specified in the permit.

REPORTING: If the equipment is operated outside the normal range or level for NO_X and the deviation is not corrected within 1 hour of operation after detection, the District shall be notified within the following 1 hour. Deviations corrected within 1 hour of operation after detection must only be recorded.

RECORDKEEPING: The date and time of measurement, and NO_X concentrations (corrected to 19% O_2 or no correction if measured above 19%) shall be recorded. If any deviations from the normal range or level are observed, the types of corrective actions taken and the time and dates of such corrective action shall also be recorded. Records shall be kept onsite for a period of five years, and made available for inspection upon request.

PERMIT CONDITIONS: The permit must outline the facility's approach to monitoring and the manner by which a normal range/level for surrogate parameters is established. The permit must also include requirements for adequate recordkeeping and reporting, prompt notification and correction of excursions from the normal range of operations. The following general conditions must be incorporated in permits for which alternate monitoring is allowed:

1. {3741} The permittee shall monitor and record the stack concentration of NOx, CO, and O2 at least once every month (in which a source test is not performed) using a portable emission monitor that meets District specifications. Monitoring shall not be required if the unit is not in operation, i.e. the unit need not be started solely to perform monitoring. Monitoring shall be performed within 5 days of restarting the unit unless monitoring has been performed within the last month. [District Rule 4309]

For units in the asphaltic concrete industry subject to the requirements of Rule 4309, the above condition is replaced with the following condition:

1a. The asphalt batch plant permittee shall monitor and record the stack concentration of NOx, CO, and O2 at least once every month in which asphalt is produced on at least five days or for at least 32 hours, whichever comes first (and in which a source test is not performed), using a portable emission monitor that meets District specifications. Monitoring shall not be required if the unit is not in operation, i.e. the unit need not be started solely to perform monitoring. Monitoring shall be performed within 5 production days of restarting the unit unless monitoring has been performed within the last month. [District Rule 4309]

2. {3742} If either the NOx or CO concentrations corrected to 19% O2 (or no correction if measured above 19% O2), as measured by the portable analyzer, exceed the allowable emissions concentration, the permittee shall return the emissions to within the acceptable range as soon as possible, but no longer than 1 hour of operation after detection. If the portable analyzer readings continue to exceed the allowable emissions concentration after 1 hour of operation after detection, the permittee shall notify the District within the following 1 hour and conduct a certified source test within 60 days of the first exceedance. In lieu of conducting a source test, the permittee may stipulate a violation has occurred, subject to enforcement action. The permittee must then correct the violation, show compliance has been re-established, and resume monitoring procedures. If the deviations are the result of a qualifying breakdown condition pursuant to Rule 1100, the permittee may fully comply with Rule 1100 in lieu of the performing the notification and testing required by this condition. [District Rule 4309]

3. {3743} All alternate monitoring parameter emission readings shall be taken with the unit operating either at conditions representative of normal operations or conditions specified in the Permit to Operate. The analyzer shall be calibrated, maintained, and operated in accordance with the manufacturer's specifications and recommendations or a protocol approved by the APCO. Emission readings taken shall be averaged over a 15 consecutive-minute period by either taking a cumulative 15 consecutive-minute sample reading or by taking at least five (5) readings, evenly spaced out over the 15 consecutive-minute period. [District Rule 4309]

4. {3744} The permittee shall maintain records of: (1) the date and time of NOx, CO, and O2 measurements, (2) the O2 concentration in percent and the measured NOx and CO concentrations corrected to 19% O2 (or no correction if measured above 19% O2), (3) make and model of exhaust gas analyzer, (4) exhaust gas analyzer calibration records, and (5) a description of any corrective action taken to maintain the emissions within the acceptable range [District Rule 4309]

B. Monitoring of the FGR valves settings

COMPATIBLE NO_X CONTROL TECHNIQUES: Units equipped with FGR where the FGR rate is set by one or more mechanical valve adjustments will be allowed to monitor the FGR valves settings. Units where the FGR valve position is continuously or intermittently varied in conjunction with the opening and closing of the fuel-throttling valve through linkage between the FGR valve and the fuel-throttling valve, or units where the FGR fan speed is continuously or intermittently varied are precluded from using this technique

FREQUENCY: Monitoring of the FGR valves settings shall be conducted at least once per week.

MEASUREMENT: The applicant shall outline in writing, and it will be verified at the initial startup inspection how the FGR valves are mechanically set. The applicant shall also outline how the FGR valves mechanical setting can be visibly inspected. This outline will also be verified at the initial startup inspection.

RESULTS: Mechanical setting for the FGR valves

NORMAL RANGE OR LEVEL: FGR valves mechanical setting equal to or greater (more FGR) than the value established by initial source testing of the unit. Normal range or level shall be re-established at each scheduled source test.

REPORTING: If the equipment is operated outside the normal range or level for the FGR valves mechanical setting and the deviation is not corrected within 1 hour of operation after detection, the District shall be notified within the following 1 hour. Deviations corrected within 1 hour of operation after detection must only be recorded.

RECORDKEEPING: The date and time of observation and the FGR valves mechanical settings shall be recorded. If any deviations from the normal range or level are observed, the types of corrective actions taken and the time and dates of such corrective action shall also be recorded. Records shall be kept onsite for a period of five years, and made available for inspection upon request.

PERMIT CONDITIONS: The permit must outline the facility's approach to monitoring and the manner by which a normal range/level for surrogate parameters is established. The permit must also include requirements for adequate recordkeeping and reporting, prompt notification and correction of excursions from the normal range of operations. The following general conditions must be incorporated in permits for which alternate monitoring is allowed:

1. The flue gas recirculation valve(s) setting shall be monitored at least on a weekly basis. Monitoring shall not be required if the unit is not in operation, i.e. the unit need not be started solely to perform monitoring. Monitoring shall be performed within 5 days of restarting the unit unless monitoring has been performed within the last week. Records must be maintained of the dates of non-operation to validate extended monitoring frequencies. [District Rule 4309]

2a. The acceptable settings for the flue gas recirculation valve(s) shall be established by source testing this unit or other representative units per Rule 4309 and as approved by the District. The normal range/level shall be that for which compliance with applicable NOx and CO emissions rates have been demonstrated through source testing at a similar firing rate. [District Rule 4309]

The above condition will be changed to the following upon conversion of the Authority to Construct to a Permit to Operate:

2b. The flue gas recirculation valve(s) setting shall not be less than [*describe valve(s) setting at which compliance was demonstrated at the initial source test*] at firing rates less than XX%. The flue gas recirculation valve(s) setting shall not be less than [*describe valve(s) settings at which compliance was demonstrated at the initial source test*] at firing rates greater than XX% and less than XX%. The flue gas recirculation valve(s) setting shall not be less than [*describe valve(s) settings at which compliance was demonstrated at the initial source test*] at firing rates greater than XX%. [District Rule 4309]

3. Normal range or level for the flue gas recirculation valve(s) settings shall be re-established during each source test required by this permit. [District Rule 4309]

4. If the flue gas recirculation valve(s) setting is less than the normal range/level, the permittee shall return the flue gas recirculation valve(s) setting to the normal range/level as soon as possible, but no longer than 1 hour of operation after detection. If the flue gas recirculation valve(s) setting is not returned to the normal range/level within 1 hour of operation after detection, the permittee shall notify the District within the following 1 hour, and conduct a source test within 60 days of the first exceedance, to demonstrate compliance with the applicable emission limits at the new flue gas recirculation valve(s) setting. A District-approved portable analyzer may be used in lieu of a source test to demonstrate compliance. In lieu of conducting a source test, the permittee may stipulate a violation has occurred, subject to enforcement action. The permittee must then correct the violation, show compliance has been re-established, and resume monitoring procedures. If the

deviations are the result of a qualifying breakdown condition pursuant to Rule 1100, the permittee may fully comply with Rule 1100 in lieu of the performing the notification and testing required by this condition. [District Rule 4309]

5. The permittee shall maintain records of the date and time of flue gas recirculation valve(s) settings, the observed setting, and the firing rate at the time of the flue gas recirculation valve(s) setting measurements. The records must also include a description of any corrective action taken to maintain the flue gas recirculation valve(s) setting within the acceptable range. [District Rule 4309]

VII. Pre-Approved Monitoring Procedures for Units without NO_X Reduction Technology

With respect to monitoring, the current version of Rules 4309 does not differentiate between units equipped with NO_x reduction technology versus those without NO_x reduction technology. All units subject to the monitoring requirements of this rule must utilize the same degree of monitoring.

VIII. Case-By-Case Approvals of Other Alternate Monitoring Procedures

The permittee may seek a case-by-case approval of monitoring procedures other than those pre-approved above. The applicant must provide a technical justification and demonstrate that the parameters to be monitored have a strong correlation with NO_X emissions, and will provide a reasonable assurance of compliance. Monitoring proposals are to be submitted to the Director of Permit Services for approval. (Once Director approval is granted for a monitoring procedure, the evaluation and the associated documents must be distributed to the other regional offices and posted to the District's intranet site and website. Subsequent approval of identical proposals may be made by the Regional Permit Services Manager.) Monitoring proposal should contain information on the following:

A. **Control technology** - This should include specific details about the how the control technology operates and how NO_X reduction occurs.

B. **Monitored Parameters** - This should describe the correlation between the proposed monitoring parameters and NO_X emissions.

C. **Measurement** - This should include the specifics of the proposed measuring equipment and the location(s) of the equipment.

D. **Frequency** - This should include a justification showing that the frequency of monitoring proposed is sufficient to show ongoing compliance.

E. **Results** -The permit must contain an enforceable condition specifying the acceptable range of values for all parameters to be monitored. For units equipped with NO_X reduction technology, the range(s) may be established by source testing of the unit or through source test data for other units determined by the APCO to be applicable to the unit. For units not equipped with NO_X reduction technology, the range(s) may be obtained from the equipment manufacturer or control system supplier, or by source testing of the unit.

APPENDIX A

External Combustion NO_X Formation Mechanisms and Control Techniques

I. NO_X Formation Mechanisms

A. Thermal NO_X:

In fossil fuel combustion, O_2 and N_2 combine to form nitric oxide (NO) and nitrogen dioxide (NO_2) in the high temperature zones in the burner flame. The main factors affecting the quantity of NO_x formed by thermal fixation are (1) the flame temperature, (2) the residence time of the combustion gases in the peak temperature zone, and (3) the amount of oxygen present in the peak temperature zone. This is the primary NO_X formation mechanism for natural gas fired combustion equipment.

B. Fuel NO_X:

In fossil fuel combustion, fuel bound nitrogen can react with O_2 to form NO_X emissions. The rate of NO_X formation due to fuel nitrogen converted is dependent upon the amount of nitrogen contained in the fuel, oxygen concentration present in the flame and the mixing rate of the fuel and air. Most natural gas contains no fuel bound nitrogen.

C. Prompt NO_X:

In fossil fuel combustion, NO_X can also form due to the reaction of molecular nitrogen with free radicals such as HCN, NH, and N present in the burner flame. These reactions are not related to the peak flame temperature. Therefore, combustion modifications do not have a strong influence on the NO_X formed by this mechanism.

II. NO_X Control Techniques

A. Low Excess Air Operation

Operating with low excess air reduces the O_2 concentration in the peak temperature zone. This inhibits the reactions responsible for both thermal and fuel bound NO_X. Low excess air operation is generally used in conjunction with other NO_X control techniques. Low excess air operation is usually accomplished through the use of an O_2 analyzer/controller.

B. Conventional Burner with Off-Stoichiometric Combustion (Staged Combustion)

Combustion of the fuel is carried out in two stages. The first stage is a fuel rich zone in the region of the primary flame. The second stage is an air rich zone that completes the combustion of the fuel. Staging the combustion results in lower NO_X emissions by 1) limiting available O_2 for NO_X formation in the fuel rich primary stage, 2) lowering flame temperature in the fuel rich primary stage, and 3) flame temperature is lower in the air rich secondary stage. Common off-stoichiometric combustion systems in conventional burners are listed below:

1. Overfire Air Ports (OFA)

Separate air injection nozzles are located above the burner(s). The burner(s) are operated fuel rich and the overfire air ports maintain the rest of the combustion.

2. Biased Firing

In dryers and ovens with multiple burners, some burners are operated fuel rich while other burners are operated air rich in a staggered configuration.

3. Burners Out of Service

In dryers and ovens with multiple burners, some burners are operated fuel rich while other burners are not fired but provide combustion air only.

C. Flue Gas Recirculation (FGR)

A portion of the exhaust gas stream is recycled back into the main combustion zone by extracting it from the exhaust and mixing it with the combustion air or the combustion air/fuel mixture. This reduces thermal NO_X formation by reducing the peak temperature and by diluting the oxygen content in the combustion zone. The two types of FGR systems are forced draft and induced draft. Forced draft systems use a separate exhaust gas blower to recirculate the flue gas. Induced draft systems use the primary combustion blower to recirculate the flue gas. In both systems the primary combustion air and the recycled exhaust gas are typically mixed in the windbox. As the FGR rate increases, the amount of NO_X produced decreases.

D. Low NO_X Burner

Low NO_X burners control mixing of fuel and air in a pattern that keeps flame temperature low and dissipates the heat quickly. Low NO_X burners incorporate many design principles to achieve low NO_X operation. Some low NO_X burners use multiple design principles. The design principles are listed below.

1. Staged Air Burners

Staged air burners operate with a fuel rich primary zone and air rich secondary zone (off-stoichiometric combustion). The fuel rich primary zone reduces the O_2 available for NO_X formation and can lower combustion temperatures in both zones.

2. Staged Fuel Burners

The fuel is added in stages. The first stage is an oxygen rich, fuel lean stage in which the peak zone temperature is reduced. The second stage is a fuel rich, oxygen lean stage that carries out the combustion. Lower flame temperature reduces the formation of thermal NO_X.

3. Pre-Mix Burners

Fuel and air are pre-mixed prior to introduction into the burner. Good mixing allows complete combustion to take place with less excess air. Operating with low excess air reduces the O_2 concentration in the peak temperature zone. This inhibits the sets of reactions responsible for both thermal and fuel bound NO_X formation.

4. Internal Recirculation

Burner geometry induces combustion gases to recirculate in the combustion zone. This reduces NO_X formation by reducing the flame temperature and diluting the oxygen content in the peak temperature zone similar to FGR.

5. Radiant Burners

Radiant burners have an incandescent surface that transfers heat as radiant energy from the burner to the heat exchanger walls. The burner consists of a porous ceramic fiber matrix. Pre-mixed gas and air are forced through the openings in the ceramic fiber matrix. Once ignition occurs, combustion stabilizes on the outer surface of the ceramic burner. The burner operates at a lower temperature than conventional burners. The low burner temperature reduces the formation of thermal NO_X.

E. Flue Gas Treatment

NO_X can be reduced to molecular nitrogen by adding flue gas treatment systems located after the dryer/oven firebox. The two basic system types are listed below:

1. Selective Noncatalytic Reduction

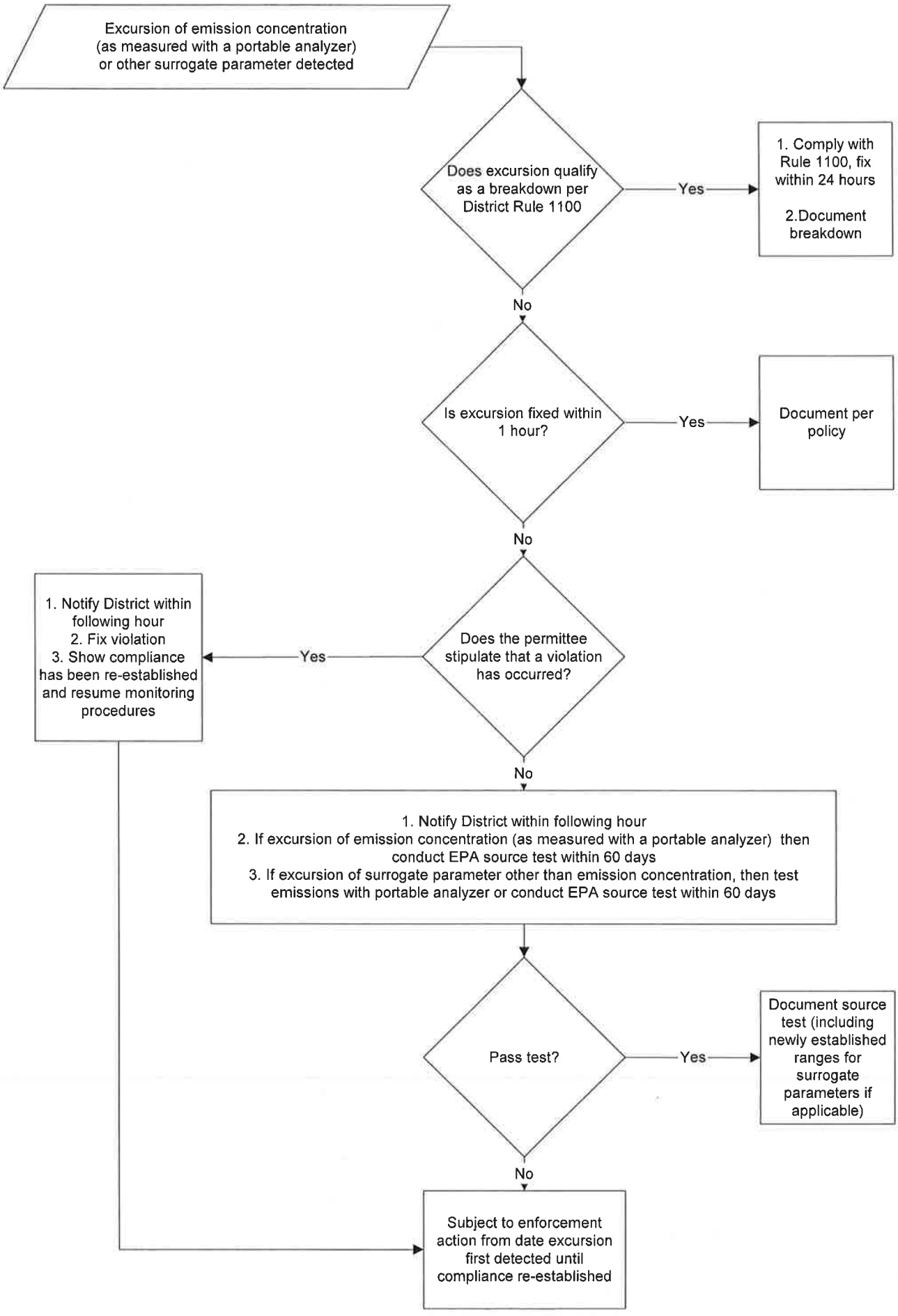
Ammonia (NH_3) or urea (NH_2CONH_2) is injected into the post combustion zone of the dryer/oven. The ammonia/urea reacts with the NO_X formed during combustion to form molecular nitrogen and water. This reaction is largely dependent upon temperature. The reaction only occurs at temperatures between 1600° F and 2000° F. At temperatures above 2000° F the nitrogen in the ammonia/urea is oxidized to produce NO_X. At temperatures below 1600° F the ammonia/urea passes through unreacted. Due to the temperature dependence of the reaction the location of the ammonia/urea injectors is critical. The optimum injection point changes with dryer/oven load. Due to this fact most SNCR systems have two sets of injection points. The ratio of the ammonia/urea concentration to the NO_X concentration is an important parameter. Injection of ammonia/urea at a higher stoichiometric ratio increases NO_X conversion efficiency but also increases ammonia/urea slip.

2. Selective Catalytic Reduction

Ammonia is injected through a series of nozzles arranged in a grid to facilitate uniform mixing prior to a catalyst bed. The ammonia reduces the NO_X on the catalyst surface. The operating range for SCR catalysts is typically 550° F to 750° F. Any particular SCR catalyst has a narrow temperature window for optimum operation. Variations in exhaust gas temperature of 50° F can have an impact on NO_X reduction efficiency. There are a variety of problems that can affect catalyst bed performance. Phosphorus, lead and arsenic can irreversibly poison the catalyst material. The catalyst can also be masked by chemicals or particulate adsorbing to the surface. The ratio of the ammonia concentration to the NO_X concentration is critical. Injection of ammonia at a higher stoichiometric ratio increases NO_X conversion efficiency but also increases ammonia slip. The ammonia injection grid must also uniformly mix and atomize the ammonia.

APPENDIX B

Excursion Flow Chart


Excursion of emission concentration (as measured with a portable analyzer) or other surrogate parameter detected
Does excursion qualify as a breakdown per District Rule 1100
Yes
1. Comply with Rule 1100, fix within 24 hours
2.Document breakdown
No
Is excursion fixed within 1 hour?
Yes
Document per policy
No
Does the permittee stipulate that a violation has occurred?
Yes
1. Notify District within following hour
2. Fix violation
3. Show compliance has been re-established and resume monitoring procedures
No
1. Notify District within following hour
2. If excursion of emission concentration (as measured with a portable analyzer) then conduct EPA source test within 60 days
3. If excursion of surrogate parameter other than emission concentration, then test emissions with portable analyzer or conduct EPA source test within 60 days
Pass test?
Yes
Document source test (including newly established ranges for surrogate parameters if applicable)
No
Subject to enforcement action from date excursion first detected until compliance re-established

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