Air Quality
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# Quality Assurance Project Plan for the North Carolina Division of Air Quality $SO_2$ Data Requirements Rule Monitoring Program

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# Quality Assurance Project Plan Acronym Glossary

ADQ - Audit of Data Quality
AQS - Air Quality System (EPA's Air database)
ARM – Approved regional method
CFR – Code of Federal Regulations
CV – Coefficient of Variation
DAQ - North Carolina Division of Air Quality
DEQ – North Carolina Department of Environmental Quality
DQA - Data quality assessment (AQS AMP600 Report)
DQI - Data quality indicators
DQO - Data quality objectives
DSMS – Duke Skyland Monitoring Station
e-log – electronic logbook
ECB – Electronics and Calibration Branch
EHS – Environmental Health and Safety
EIDM – Duke Energy Environmental Instrumentation and Data Management
EPA – United States Environmental Protection Agency
FEM – Federal equivalent method
FRM – Federal reference method
GNV – TRC Environmental Corporation's Gainesville, FL office location
HUNT – Duke Energy EIDM Huntersville, NC laboratory
km - kilometers
LDL – Lower detection limit
m – meters
$m^3$/hour – Cubic meters per hour
MQO – Measurement quality objective
NAAQS - National Ambient Air Quality Standards
NIST - National Institute of Science and Technology
NPAP - National performance audit program
PFA – Perfluoroalkoxy
ppb – parts per billion
ppm – parts per million
PQAO – Primary quality assurance organization
QA/QC - Quality assurance/quality control
QAPP - Quality assurance project plan
QC – Quality control
RCO – Raleigh central office
RSD – Relative standard deviation
SD – Standard deviation
SLAMS - State and local air monitoring station
$SO_2$- Sulfur dioxide
SOP - Standard operating procedure
SPM - Special purpose monitor
SRP – EPA standard ozone reference photometer
TSA - Technical systems audit
VIP – Value in Performance
WNCRAQA – Western North Carolina Regional Air Quality Agency

# 1.0 Approval Sheet

**Title:** Quality Assurance Project Plan for the North Carolina Division of Air Quality $SO_2$ Data Requirements Rule Monitoring Program

The attached *Quality Assurance Project Plan for the North Carolina Division of Air Quality $SO_2$ Data Requirements Rule Monitoring Program* is hereby recommended for approval and commits the State of *North Carolina*, Department of Environmental Quality (Division of Air Quality) to follow the elements described within.

1) Signature: _____ Date 12/20/16
DEQ, Air Quality Division Director for S.H.

2) Signature: _____ Date 12/20/16
DAQ Acting Quality Assurance Manager

3) Signature: _____ Date 12/14/2016
Duke Energy Project Manager

4) Signature: _____ Date _____
EPA Region 4 Quality Assurance Officer

# 2.0 Table of Contents

## 3.0 Distribution

**Table 3.1 $SO_2$ DRR Monitoring Program Quality Assurance Project Plan Distribution List – DAQ Personnel**

| Name | Address | Telephone | e-mail |
|---|---|---|---|
| Sheila Holman | DAQ<br>1641 Mail Service Center<br>Raleigh, NC 27699-1641 | (919) 707-8430 | sheila.holman@ncdenr.gov |
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| Brad Newland | Wilmington Regional Office<br>127 Cardinal Drive Extension<br>Wilmington, NC 28405 | (910) 796-7215 | brad.newland@ncdenr.gov |
| Robert Fisher | Washington Regional Office<br>943 Washington Square Mall<br>Washington, NC 27889 | (252) 948-3834 | robert.fisher@ncdenr.gov |
| Brendan Davey | Asheville Regional Office<br>2090 U.S. Highway 70<br>Swannanoa, NC 28778 | (828) 296-4500 | brendan.davey@ncdenr.gov |
| Joette Steger | DAQ<br>1641 Mail Service Center<br>Raleigh, NC 27699-1641 | (919) 707-8449 | joette.steger@ncdenr.gov |
| Derrick House | DAQ<br>1730 Mail Service Center<br>Raleigh, NC 27699-1730 | (919) 715-1761 | derrick.house@ncdenr.gov |
| James Bowyer | DAQ<br>1622 Mail Service Center<br>Raleigh, NC 27699-1622 | (919) 715-7484 | jim.bowyer@ncdenr.gov |
| David Brigman | Western North Carolina Regional Air Quality Agency<br>P.O. Box 2749<br>Asheville, NC 28802 | (828) 250-6777 | wncair@buncombecounty.org |

**Table 3.2 $SO_2$ DRR Monitoring Program Quality Assurance Project Plan Distribution List – Duke Personnel**

| Name | Position | Affiliation |
|---|---|---|
| Kris Knudsen | Project Manager | EHS - Env. Programs |
| Zach Hall | Director | EHS - Env. Science |
| Susan Robinson[1] | Supervising Scientist/ EIDM | EHS - Env. Inst. & Data Mgt. |
| Dawn Lowe | Data Coordinator | EHS - Env. Inst. & Data Mgt. |
| Vince Houston | Field Technician | EHS - Env. Inst. & Data Mgt. |
| Andrew Morris | Field Technician | EHS - Env. Inst. & Data Mgt. |
| Derek Grady | Field Technician | EHS - Env. Inst. & Data Mgt. |

[1] As of January, 2017.

# 4.0 Project/Task Organization

The DAQ Ambient Monitoring Section is organized into three main branches, two of them relevant to the scope of this project: The Projects and Procedures Branch, and the Electronics and Calibration Branch. The chief of the Ambient Monitoring Section has responsibility for managing these branches according to stated policy. The chief delegates the responsibility and authority to develop, organize, and maintain and implement quality programs to the supervisors of each branch, in accordance with the quality management plan. The supervisors and the line managers under them have direct responsibility for assuring data quality.

The North Carolina Division of Air Quality (DAQ) and Duke Energy will work together to complete the monitoring requirements for the $SO_2$ DRR site located in Semora, NC.

The North Carolina Division of Air Quality (DAQ) and Western North Carolina Regional Air Quality Agency (WNCRAQA), along with Duke Energy, will work together to complete the monitoring requirements for the $SO_2$ monitoring site located in Skyland, NC.

DAQ will be responsible for the final validation and data submittal steps for data collected from all $SO_2$ sites, as DAQ is the primary quality assurance organization (PQAO) for both Duke Energy and WNCRAQA.

The organizational structure for the implementation of the monitoring program is shown in Figure 4.1. The figure also shows the relationship between the DAQ and Duke Energy technical and review staff.

## 4.1 DAQ Ambient Monitoring Section

The Ambient Monitoring Section contains the Projects and Procedures and Electronics and Calibration Branches and is responsible for coordinating all aspects (quality assurance, data collection, and data processing) of the $SO_2$ DRR monitoring program.

The Director of the Division of Air Quality has the ultimate authority for the $SO_2$ DRR sites at Bayview, Southport, Canton, and Semora. The Director of the Western North Carolina Regional Air Quality Agency has the ultimate authority for the $SO_2$ monitoring site at Skyland. If the DAQ Central Office Chemist has determined that an error has taken place, affecting the quality of any $SO_2$ data, they will communicate to the appropriate field technician that monitoring must stop until the error can be rectified. If further dispute exists, the issue will be escalated up the NC DAQ or WNCRAQA chain of command until a decision has been reached.

**Section Chief**: The chief of the Ambient Monitoring Section has direct access to the Director of the Division of Air Quality on all matters relating to DAQ's $SO_2$ DRR ambient monitoring operation. The chief's duties include, but are not limited to the following:

- Maintaining oversight of QA activities;
- Approving division standard operation procedures (SOPs) and quality assurance project plans (QAPPs);
- Developing, administering and maintaining the quality management plan;
- Assuring that QAPPs are established and effectively implemented for each project as applicable;
- Preparing budgets, contracts, and proposals; and
- Reviewing budgets, contracts, grants and proposals.

In the event that the Section Chief is unavailable to perform these duties, the Projects and Procedures Branch Supervisor is responsible.

**Database Manager:** The database manager has direct access to the chief of ambient monitoring on all matters relating to DAQ's $SO_2$ DRR ambient monitoring database management. The database manager's duties include, but are not limited, to the following:

- Ensuring correct data is being transferred from the Duke Energy FTP site;
- Uploading environmental data from DAQ and Duke Energy operated sites to the Air Quality System (AQS) and AirNow Tech databases;
- Ensuring correct data is being transferred to the DAQ IBEAM database and DAQ Real-Time Air Quality Data webpage;
- Maintaining the central office data polling station, ensuring it polls hourly, five-minute, and minute data for each hour of every day; and
- Maintaining and updating the central office data polling software and AQS database when sites and monitors are established or shut down.

### 4.1.1 Projects and Procedures Branch

**Project and Procedures Branch Supervisor**: The Projects and Procedure Branch supervisor reports to the chief of the Ambient Monitoring Section. This supervisor's duties include the following:

- Maintaining oversight of all QA activities;
- Verifying implementation of all Ambient Monitoring Section QAPPs and procedures;
- Maintaining overall responsibility for the monitoring network design and review;
- Responding to public records requests and statistical consulting requests;
- Ensuring training availability and utilization; and
- Approving and implementing procedures.

**Central Office Chemists:** The central office chemists report to the Project and Procedure Branch supervisor and are responsible for coordinating the activities of the $SO_2$ DRR monitoring program. The central office chemists' duties include the following:

- Organizing the collection, verification, and reporting of data
- Assessing the effectiveness of the network system
- Writing new SOPs and QAPPs and ensuring timely and appropriate SOP and QAPP updates
- Collecting, verifying, and reporting data
- Generating and evaluating air quality models
- Documenting position statements developed from modeling activities
- Verifying all required QA activities are performed and that measurement quality objectives are met by performing annual system audits;
- Identifying quality problems and initiating action which results in solutions;
- Assessing the efficacy of corrective actions to operational errors; and
- Providing training and certification to appropriate personnel.

**Statistician**: The statistician provides statistical programming support to the branch supervisor and other staff of the central and regional offices, including:

- Assisting the branch supervisor with responding to consulting and data requests;
- Uploading all applicable DAQ and Duke Energy environmental data to the Air Quality System (AQS);
- Participating in training and certification programs to keep current on technology;
- Interpreting data and developing and maintaining statistical reports that include tabulations of data, statistical analysis and summaries of the data, graphs, maps, recommendations and conclusions;

- Planning and conducting statistical and scientific studies based on interpretation of data;
- Preparing and delivering data and statistical advice to the regional offices and DAQ; and
- Responding to public records requests and statistical consulting requests.

### 4.1.2 Regional Offices and WNCRAQA Local Program

**Regional Supervisor**: The regional supervisor, or the Director for the WNCRAQA local program, has direct access to the chief on all matters relating to the $SO_2$ DRR ambient monitoring operation. The regional supervisor's, and/or local program director's, duties include:

- Assuring that division policies are maintained at the regional office or local program level;
- Verifying implementation of quality programs;
- Recommending changes when needed in the QA Program;
- Providing and approving regional input for the design and documentation of the monitoring network; and
- Supervising and delineating duties for the regional monitoring chemist.

**Regional Monitoring Chemists**: Regional chemists report directly to the regional supervisor. Regional chemists have the overall responsibility of ensuring the implementation of the QA program at the regional level. They direct the activities of the regional monitoring staff. Their responsibilities include:

- Coordinating and reviewing the collection of environmental data;
- Implementing the DAQ QA program within the region;
- Acting as conduits for information to regional monitoring staff;
- Training staff in the requirements of the QAPP and SOPs;
- Providing a backup to the regional monitoring staff;
- Participating in systems audits;
- Recommending changes, when needed, in the QA program;
- Providing regional input on the design and documentation of the monitoring network
- Ensuring that monitoring personnel follow the QAPP and associated SOPs; and
- Documenting and assessing corrective actions.

**Regional Monitoring Staff:** The regional monitoring staff's duties include:

- Ensuring that monitoring programs implement the QA elements of SOPs and QAPPs;
- Reviewing environmental data prior to submittal;
- Assisting in the acquisition of resources, calibration and maintenance of equipment, and maintenance of inventories;
- Participating in training and certification activities;
- Verifying that all required quality control (QC) activities are performed and that measurement quality objectives are met as prescribed in the QAPP and SOPs;
- Performing corrective actions to address any activities that do not meet acceptance criteria as prescribed in the QAPP and SOPs;
- Documenting deviations from established procedures and methods;
- Reporting nonconforming conditions and corrective actions to the regional chemist and the regional supervisor;
- Assessing data quality and flagging suspect data;
- Completing the Annual Network Assessment to document annually that monitoring sites continue to meet 40 Code of Federal Regulations (CFR) Part 58 Appendix E requirements;
- Recommending changes, when needed, in the quality assurance program; and
- Preparing reports for the Ambient Monitoring Section.

The air quality staff at the WNCRAQA perform the roles of both the Regional Monitoring Chemists and the Regional Monitoring Staff.

### 4.1.3 Electronics and Calibration Branch

**Electronics and Calibration Branch Supervisor:** The Electronics and Calibration Branch (ECB) supervisor has direct access to the chief and has the responsibility and authority to:

- Identify quality problems and initiate action which results in solutions and
- Provide training and certification to field personnel.

**Electronics and Calibration Branch Staff:** The ECB staff are responsible for:

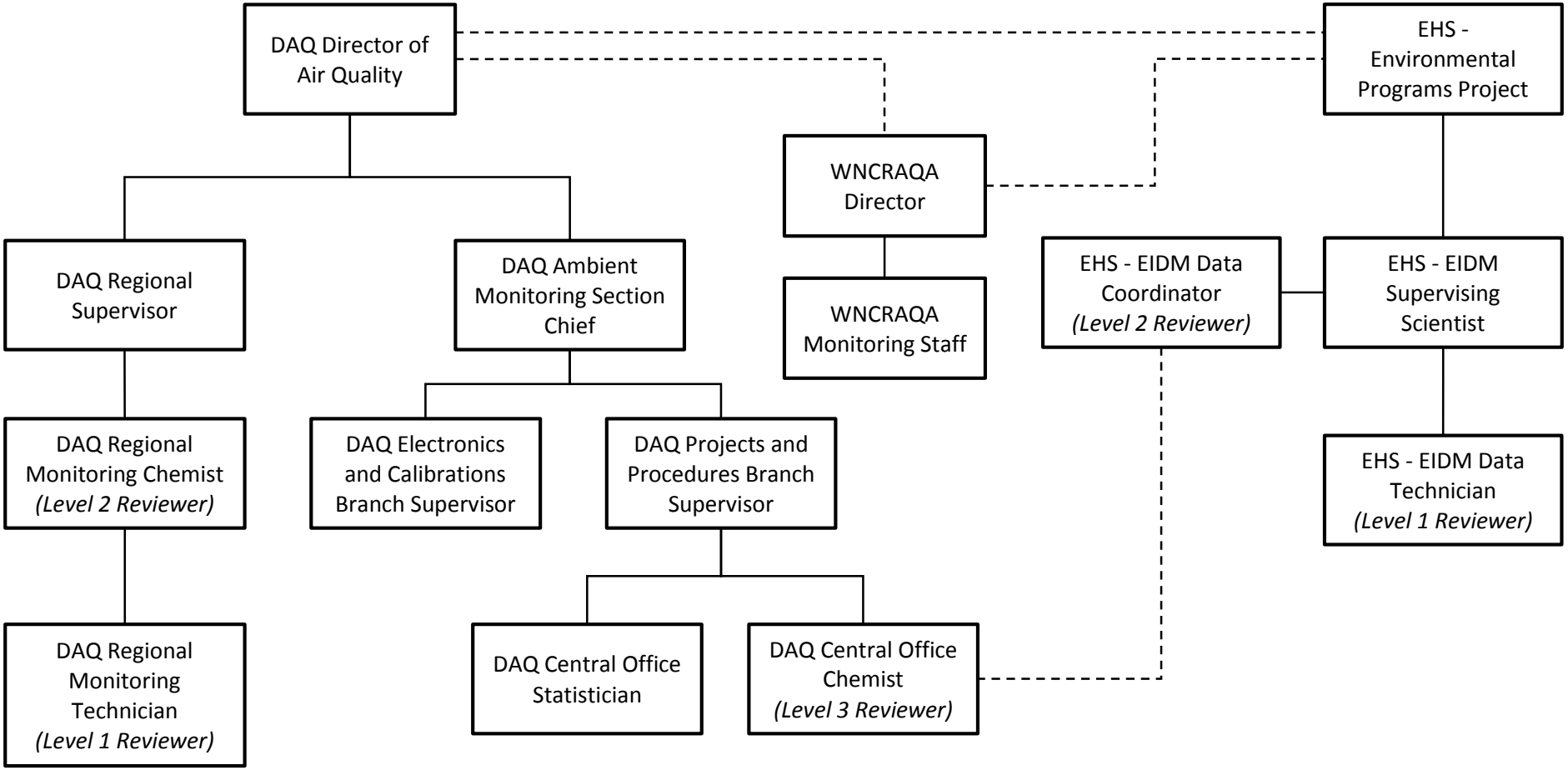
- Providing performance audit services for the continuous gaseous and meteorological monitoring networks;
- Installing all field equipment and monitoring sites;
- Maintaining an inventory of spare parts, spare equipment, and cylinders to prevent unnecessary downtime;
- Calibrating and certifying all transfer standards and periodically checking calibration of primary standards to ensure quality calibrations;
- Assisting in prescribing corrective actions;
- Recommending changes, when needed, in the QA program; and
- Performing and documenting all maintenance of field equipment as described by the standard operating procedures (SOP).

## 4.2 Duke Energy Personnel

**EHS – Environmental Programs:** responsible for assisting in the selection of sites, securing use of the site locations, site security, installation of utilities and overall leadership of the project. EHS – Environmental Programs at Duke will review all data reports prepared by EIDM and submit reports to DAQ.

**EHS – Environmental Instrumentation and Data Management (EIDM):** responsible for system operation, and data collection, data validation and reporting. EIDM will assume operation of the system following a turnover from the vendor (TRC Environmental Corporation) contracted to install and initially maintain the site. Turnover will be accomplished following a successful operation by TRC that includes a review (independent audit) by DAQ to assure all monitoring requirements are being met and a final system calibration observed by EIDM personnel. Following the turnover, EIDM will assume operation and maintenance of the equipment and instrumentation provided by TRC and will provide personnel necessary to ensure that the data are of sufficient quantity and quality to meet the objectives of the program. EDIM will ensure that quality control (QC) and standard operating procedures (SOPs) are followed in accordance with EPA and DAQ requirements such that the quality assurance (QA) objectives of this plan are met.

**Figure 4.1: Project Organizational Chart**



# 5.0 Problem Definition and Background

On June 22, 2010, the EPA revised the primary sulfur dioxide ($SO_2$) National Ambient Air Quality Standard (NAAQS) (75 FR 35520). The EPA promulgated a new 1-hour daily maximum primary $SO_2$ standard at a level of 75 parts per billion (ppb), based on the 3-year average of the annual 99th percentile of 1-hour daily maximum concentrations.

On May 13, 2014, the EPA proposed the Data Requirements Rule (DRR) for the 1-Hour $SO_2$ NAAQS (79 FR 27445). The final DRR was promulgated on Aug. 21, 2015 (80 FR 51051) and requires states to gather and submit to the EPA additional information characterizing $SO_2$ air quality in areas with larger sources of $SO_2$ emissions. In the DRR, air agencies have the choice to use either monitoring or modeling to characterize $SO_2$ air quality in the vicinity of priority $SO_2$ sources and submit the modeling and/or monitoring to the EPA on a schedule specified by the rule. If choosing to monitor the facility, monitoring activities must start by January 1, 2017.

It was determined that four facilities would be subject to the monitoring portion of the $SO_2$ DRR regulation. After these facilities were identified, analysis was conducted as instructed in the $SO_2$ NAAQS Designations Source-Orientated Monitoring Technical Assistance Document. The analysis was conducted to identify suitable 1-hour $SO_2$ source oriented monitoring site locations for the 2017-2019 monitoring period to satisfy the DRR for these four industrial facilities within the state of North Carolina. These facilities, along with their respective monitoring stations and operating body, are listed below in Table 5.1.

A fifth location, the Duke Energy – Asheville Steam Electric Plant, will submit a modeling protocol to show attainment under the $SO_2$ DRR. The facility has also decided to operate a DRR-like monitor in Skyland, NC, to show continued compliance with the NAAQS. While this monitor will not be used to meet the requirement of the DRR, the monitor will be operated in accordance with all regulations and this QAPP.

The DRR is a short-term project. $SO_2$ DRR monitors may be shut down after three complete years of monitoring if the certified data yields a design value that is less than 50% of the NAAQS.

The purpose of this QAPP is to prescribe requirements, procedures, and guidelines for the Ambient Air Quality Monitoring program, specifically for data collection and review for the fulfillment of the $SO_2$ DRR. It is intended to serve as a reference document for implementing and expanding the QA program and provides detailed operational procedures for measurement processes used by DAQ. The QAPP should be particularly beneficial to operators, chemists, project officers, and program managers responsible for implementing, designing, and coordinating air pollution monitoring projects. The QAPP is a compilation of QA requirements, procedures, and guidelines that are applicable to air pollution and meteorological measurements systems. They are designed to achieve a high percentage of valid data samples (>75 %) while maintaining integrity and accuracy. This QAPP clearly and thoroughly establishes QA protocols and QC criteria required to successfully implement and maintain the state of NC's DRR $SO_2$ monitoring program. Though the monitoring stations are operated by both Duke Energy and DAQ personnel, the monitoring program is administered by DAQ. It is the responsibility of DAQ to ensure that the quality assurance programs for the field and data processing phases of the monitoring program are implemented and adhered to.

**Table 5.1 North Carolina $SO_2$ DRR Monitoring Locations**

| Facility | Location | DRR Site Name | Operator |
|---|---|---|---|
| PCS Phosphate Company – Aurora | Bayview, NC | Bayview Ferry | NC DAQ |
| CPI USA North Carolina – Southport | Southport, NC | Southport DRR | NC DAQ |
| Blue Ridge Paper Products – Canton Mill | Canton, NC | Canton DRR | NC DAQ |
| Duke Energy – Roxboro Steam Electric Plant | Semora, NC | Semora DRR | Duke EIDM |
| Duke Energy – Asheville Steam Electric Plant | Skyland, NC | Skyland[1] | Duke EIDM |

[1] Site will not be operated as a DRR monitor, but as DRR-like, in accordance with this QAPP.

# 6.0 Project/Task Description

This QAPP was developed to ensure that the $SO_2$ monitoring network to fulfill the DRR collects $SO_2$ data that meet or exceed EPA quality assurance requirements. These data are entered into the EPA AQS database.

The $SO_2$ DRR monitoring stations are established in order to characterize maximum hourly $SO_2$ concentrations in the immediate vicinity of the facilities listed in Table 5.1. Each monitor operated is assigned a scale of representativeness based on the definitions of 40 CFR Part 58, Appendix D. The spatial scale of representativeness describes the physical dimensions of a parcel of air, in which pollutant concentrations are reasonably homogenous throughout. Based upon the monitoring objective and the site locations, the data collected at all of the $SO_2$ DRR sites will be representative of the expected maximum-hourly source-oriented $SO_2$ concentrations on a neighborhood scale. This scale defines air volumes with an area of a city that has relatively uniform land use with dimensions in the 500 to 4,000 m (0.5 to 4 km) range.

The work required to collect, document, and report these data include, but is not limited to:

- Establishing a monitoring network that has accurate and reliable monitors and data recording equipment
- Developing encompassing documentation for:
    - Data and report format, content, and schedules
    - Quality objectives and criteria
    - SOPs providing activities and schedules for
        - Equipment operation and preventative maintenance, and
        - Instrument calibrations, zero, span, precision, and accuracy evaluations
- Establishing assessment criteria and schedules.

## 6.1 Field Activities

Field operations personnel will perform those activities that support continued successful operation of the statewide $SO_2$ DRR monitoring network. Personnel will perform field activities that include, but are not limited, to conducting periodic preventative maintenance and servicing equipment located at the DRR monitoring sites.

## 6.2 Project Assessment Techniques

An assessment is an evaluation process used to measure the performance or effectiveness of a system and its elements. As used here, “assessment” is an all-inclusive term used to denote any of the following: audit, performance evaluation, peer review, inspection, or surveillance. Section 19 discusses the details of assessments. Information on the parties implementing assessments and their frequency is provided in Table 6-1.

Efforts will be made to ensure that National Performance Audit Program (NPAP) audits, which have to be performed at each site once every 6 years, are conducted at all DRR sites within the first three years of the $SO_2$ DRR monitoring period.

**Table 6.1 Assessment Schedule**

| Assessment Type | Assessment Agency | Frequency |
|---|---|---|
| Technical System Audit (EPA) | EPA Region 4 | Every 3 years |
| Network Assessment | EPA Region 4, DAQ | Every 5 years |
| Network Review | EPA Region 4, DAQ | Annually |
| Technical System Audit (DAQ) | DAQ | Annually |
| Data Qualifiers/Flags Review | DAQ | Quarterly |
| Standard Operating Procedures Reviews | DAQ | Annually |
| Data Quality Assessment | DAQ | As needed |
| National Performance Audit Program | EPA designated contractor | 20 % of sites per year/each site once every 6 years |

## 6.3 Project Records

DAQ will establish and maintain procedures for the timely preparation, review, approval, issuance, use, control, revision, and maintenance of documents and records. The categories and types of records and documents that are applicable to document control for ambient air quality information are presented in Table 6-2. Information on key documents in each category is explained in more detail in Section 9.

**Table 6.2 Critical Documents and Records**

| Categories | Record/Document Type |
|---|---|
| Site Information | Network Descriptions<br>Site Files<br>Site Maps<br>Site Pictures |
| Environmental Data Operations | Quality Assurance Project Plans<br>Standard Operating Procedures<br>Field Notebooks and Logbooks<br>Inspection/Maintenance Records |
| Raw Data | Any Original Data (routine and quality control) Including Data Entry Forms |
| Data Reporting | Annual SLAMS Report<br>Data/Summary Reports |
| Data Management | Data Algorithms<br>Data Management Plans/Flowcharts<br>Data Management Systems |
| Quality Assurance | Network Reviews<br>Data Quality Assessments<br>Quality Assurance Reports<br>Technical System Audits<br>Response/Corrective Action Documentation<br>Site Audits |

# 7.0 Data and Measurement Quality Objectives and Criteria

## 7.1 Data Quality Objectives

Data quality objectives are qualitative and quantitative statements that:

- Clarify the intended use of the data
- Define the type of data needed, and
- Specify the tolerable limits on the probability of making a decision error due to uncertainty in the data.

In general, the goal of the $SO_2$ DRR monitoring program is to determine the highest concentration expected to occur in the area surrounding a designated $SO_2$ source.

The data necessary for the fulfillment of the DRR are:

- Continuous hourly averaged $SO_2$ concentration data;
- Maximum 5-minute average $SO_2$ concentration data for each valid hour;
- Continuous shelter temperature measurements for ensuring conformity to environmental requirements of the $SO_2$ monitors;
- Precision measurements;
- Bias measurements; and,
- Locational measurements (geographical, topographical, etc.).

These data will be used to:

- Evaluate compliance with the NAAQS,
- Monitor the current dynamic concentrations of $SO_2$,
- Monitor progress made towards meeting ambient air quality standards,
- Activate control procedures that prevent or alleviate air pollution episodes,
- Verify the performance of air quality models,
- Provide data upon which long term control strategies can be reliably developed, and
- Provide a database for researching and evaluating effects.

Per 40 CFR 58, Appendix A Section 2.3.1.5, the goal for acceptable measurement uncertainty for precision is defined as an upper 90 percent confidence limit for the coefficient of variation (CV) of 10 percent and for bias as an upper 95 percent confidence limit for the absolute bias of 10 percent. A summary of the precision and bias acceptable limits can be seen below in Table 7.1.

**Table 7.1 Acceptable Precision as Measured by Coefficient of Variation (CV) and Bias for the $SO_2$ DRR Monitoring Program**

| Pollutant | Acceptable Precision | Acceptable Bias |
|---|---|---|
| $SO_2$ | upper 90 % confidence limit for the CV of ≤10 % | upper 95 percent confidence limit for the absolute bias of ≤10 % |

## 7.2 Measurement Quality Objectives

Measurement quality objectives (MQOs) are designed to evaluate and control various phases (sampling, preparation, analysis) of the measurement process to ensure that total measurement uncertainty is

within the range prescribed by the DQOs. The MQOs for the $SO_2$ DRR monitoring program will be defined in terms of the following Data Quality Indicators (DQIs):

- **Precision**: a measure of agreement between two replicate measurements of the same property, under prescribed similar conditions. This agreement is calculated as either the range or as the standard deviation." (US EPA QA/G-5, Appendix D) This is the random component of error.
- **Bias**: the systematic or persistent distortion of a measurement process that causes errors in one direction. (US EPA QA/G-5, Appendix D) Bias is determined by estimating the positive and negative deviation from the true value as a percentage of the true value.
- **Representativeness**: a measure of the degree to which data accurately and precisely represent a characteristic of a population parameter at a sampling point or for a process condition or environmental condition. Representativeness is a qualitative term that should be evaluated to determine whether in situ or other measurements are made and physical samples collected in such a manner that the resulting data appropriately reflect the media and phenomenon measured or studied. (US EPA QA/G-5, Appendix D)
- **Completeness**: a metric quantifying the amount of valid data obtained from a measurement system compared to the amount that were expected to be obtained under correct, normal conditions. Completeness can be expressed as a ratio or a percentage. Data completeness requirements are included in the reference methods (40 CFR Part 50).
- **Comparability**: the qualitative term that expresses the confidence that two data sets can contribute to a common analysis and interpolation. Comparability must be carefully evaluated to establish whether two data sets can be considered equivalent in regard to the measurement of a specific variable or groups of variables. (US EPA QA/G-5, Appendix D)

Acceptance criteria has been developed for each of these attributes using various parts of 40 CFR and EPA supplied guidance documents. The MQOs for the $SO_2$ DRR monitoring program are listed in Table 7.2. More detailed descriptions of these MQOs and how they will be used to control and assess measurement uncertainty are described in the SOPs associated with this QAPP that are specific to the $SO_2$ monitor.

| Table 7.2 Sulfur Dioxide Measurement Quality Objectives Parameter – Sulfur Dioxide (SO2) (Ultraviolet Fluorescence). | | | |
|---|---|---|---|
| **1) Requirement ($SO_2$)** | **2) Frequency** | **3) Acceptance Criteria** | **Information /Action** |
| **CRITICAL CRITERIA- $SO_2$** | | | |
| ***One Point QC Check Single analyzer*** | ***14 days*** | ≤ ±10% (percent difference) | 1 and 2) 40 CFR Part 58 App A Sec 3.1.1<br>3) Recommendation based on DQO in 40 CFR Part 58 App A Sec 2.3.1.5<br>QC Check Concentration range 0.005 and 0.080 ppm<br>Relative to mean or median monitor concentrations |
| Zero/span check | 14 days | Zero drift ≤ ± 1.5 ppb (24-hour)<br>≤ ± 2.5 ppb (>24hr-14 day)<br>Span drift ≤ ± 10 % | 1 and 2) QA Handbook Volume 2 Section 12.3<br>3) Recommendation and related to DQO |
| Shelter Temperature Range | **Daily**<br>(hourly values) | 20 to 30° C. (Hourly average) | 1, 2 and 3) QA Handbook Volume 2 Section 7.2.2 |
| **OPERATIONAL CRITERIA- $SO_2$** | | | |
| Shelter Temperature Control | Daily (hourly values) | ≤ ± 2° C SD over 24 hours | 1, 2 and 3) QA Handbook Volume 2 Section 7.2.2 |
| Shelter Temperature Device Check | 180 days | ± 2° C of standard | 1, 2 and 3) QA Handbook Volume 2 Section 7.2.2 |
| ***Annual Performance Evaluation Single Analyzer*** | ***Every site 1/365 days with an equal proportion of sites in each of the 4 quarters*** | Percent difference of audit levels 3-10 ≤ ±15%<br>Audit levels 1&2 ± 1.5 ppb difference or ±15% | 1 and 2) 40 CFR Part 58 App A sec 3.1.2<br>3) Recommendation - 3 audit concentrations not including zero. AMTIC guidance 2/17/2011<br>http://www.epa.gov/ttn/amtic/cpreldoc.html |
| ***Federal Audits (NPAP)*** | 100 percent of sites every 6 years;<br>20% of sites audited each year | Audit levels 1&2 ± 1.5 ppb difference;<br>all other levels percent difference ± 15% | 1) 40 CFR Part 58 App A sec 3.1.3<br>2) 40 CFR Part 58 App A sec 3.1.3.1<br>3) NPAP QAPP/SOP |
| ***Verification/Calibration*** | Upon receipt/adjustment/repair/ installation/moving;<br>When one-point QC check is > 7 % difference;<br>1/365 days if continuous zero/span performed daily | Span 1&2 within ± 5% of expected<br>1-point QC check within ± 3.5 ppb of expected<br>Zero within ± 1 ppb of expected | 1) 40 CFR Part 50 App A-1 Section 4<br>2 and 3) Recommendation<br><br>Multi-point calibration (0 and 3 upscale points) |
| ***Gaseous Standards*** | ***All gas cylinders*** | ***NIST Traceable (e.g., EPA Protocol Gas)*** | 1) 40 CFR Part 50 App A-1 Section 4.1.6.1<br>2) NA Green book<br>3) 40 CFR Part 50 App A-1 Section 4.1.6.1<br>Producers must participate in Ambient Air Protocol Gas Verification Program 40 CFR Part 58 App A sec 2.6.1 |
| ***Zero Air/ Zero Air Check*** | Chemicals changed 1/365 days | Concentrations below LDL<br>< 0.1 ppm aromatic hydrocarbons | 1) 40 CFR Part 50 App A-1 Section 4.1.6.2<br>2) Recommendation<br>3) Recommendation and 40 CFR Part 50 App A-1 Section 4.1.6.2 |

| Table 7.2 Sulfur Dioxide Measurement Quality Objectives Parameter – Sulfur Dioxide (SO2) (Ultraviolet Fluorescence) | | | |
|---|---|---|---|
| **1) Requirement ($SO_2$)** | **2) Frequency** | **3) Acceptance Criteria** | **Information /Action** |
| ***Gas Dilution Systems*** | 1/365 days or after failure of 1-point QC check or performance evaluation | ***Accuracy ± 2 %*** | 1) 40 CFR Part 50 App A-1sec 4.1.2<br>2) Recommendation<br>3) 40 CFR Part 50 App A-1 sec 4.1.2 |
| **Detection (FEM/FRMs)** | | | |
| ***Noise*** | NA | ***0.001 ppm (standard range)***<br>***0.0005 ppm (lower range)*** | 1) 40 CFR Part 53.23 (b) (definition & procedure)<br>2) NA<br>3) 40 CFR Part 53.20 Table B-1 |
| ***Lower detectable level*** | Verified by manufacturer at purchase | ***0.002 ppm (standard range)***<br>***0.001 ppm (lower range)*** | 1) 40 CFR Part 53.23 (c) (definition & procedure)<br>2) Recommendation<br>3) 40 CFR Part 53.20 Table B-1 |
| **SYSTEMATIC CRITERIA- $SO_2$** | | | |
| ***Sampler/Monitor*** | NA | ***Meets requirements listed in FRM/FEM designation*** | 1) 40 CFR Part 58 App C Section 2.1<br>2) NA<br>3) 40 CFR Part 53 & FRM/FEM method list |
| ***Standard Reporting Units*** | ***All data*** | ***ppb (final units in AQS)*** | 1, 2 and 3) 40 CFR Part 50 App T Sec 2 (c) |
| ***Rounding convention for data reported to AQS*** | ***All data*** | ***1 place after decimal with digits to right truncated*** | 1, 2 and 3) 40 CFR Part 50 App T Sec 2 (c) |
| ***Completeness*** | ***1-hour standard*** | ***Hour – 75% of hour***<br>***Day- 75% hourly concentrations***<br>***Quarter- 75% complete days***<br>***Years-4 complete quarters***<br>***5-min maximum value reported only for valid hours*** | 1, 2 and 3) 40 CFR Part 50 App T Section 3 (b), (c)<br>More details in CFR on acceptable completeness. |
| ***Sample Residence Time Verification*** | At installation | ***< 20 seconds*** | 1) 40 CFR Part 58 App E, section 9 (c)<br>2) Recommendation<br>3) 40 CFR Part 58 App E, section 9 (c) |
| ***Sample Probe, Inlet, Sampling train*** | ***All sites*** | ***Borosilicate glass (e.g., Pyrex®) or Teflon®***<br>(FEP and PFA have been accepted as equivalent material to Teflon.) | 1, 2 and 3) 40 CFR Part 58 App E sec 9 (a)<br>Replace 1 / 2 years; more frequently if pollutant load or contamination dictate |
| ***Siting*** | 1/365 days | ***Meets siting criteria or waiver documented*** | 1) 40 CFR Part 58 App E, sections 2-5<br>2) Recommendation<br>3) 40 CFR Part 58 App E, sections 2-5 |
| ***Precision (using 1-point QC checks)*** | ***Calculated annually and as appropriate for design value estimates*** | ***90% CL CV ≤ 10%*** | 1) 40 CFR Part 58 App A sec 2.3.1.5 & 3.1.1<br>2) 40 CFR Part 58 App A sec 4 (b)<br>3) 40 CFR Part 58 App A sec 4.1.2 |
| ***Bias (using 1-point QC checks)*** | ***Calculated annually and as appropriate for design value estimates*** | ***95% CL ≤ ± 10%*** | 1) 40 CFR Part 58 App A sec 2.3.1.5 & 3.1.1<br>2) 40 CFR Part 58 App A sec 4 (b)<br>3) 40 CFR Part 58 App A sec 4.1.3 |

### 7.2.1 General Data Quality Objectives

- All data should be traceable to a National Institute of Science and Technology (NIST) primary standard.
- All data shall be of a known and documented quality. Two major measurements used to define quality are precision and bias. Please reference Section 7.2 for a definition of precision and bias.
- All data shall be comparable. This means all data shall be produced in a similar and scientific manner. The use of the standard methodologies for sampling, calibration, auditing, etc. referenced in the QAPP should achieve this goal.
- All data shall be representative of the parameters being measured with respect to time, location, and the conditions from which the data are obtained. The use of approved standard methodologies should ensure that the data generated are representative.
- The QAPP must be dynamic to continue to achieve its stated goals as techniques, systems, concepts, and project goals change.

### 7.2.2 Specific Data Quality Objectives

- Determine whether or not the daily maximum hourly average NAAQS for $SO_2$ of 75 parts per billion (ppb) (99th percentile of 1-hour daily maximum concentration, averaged over 3 years) is exceeded.
- Determine whether or not the 3-hour average NAAQS for $SO_2$ of 0.5 ppm (maximum 3-hour average for the year) is exceeded.

# 8.0 Training Requirements

Adequate education and training are integral to any monitoring program that strives for reliable and comparable data. Training is aimed at increasing the effectiveness of employees and their organization.

Air monitoring personnel training consists of required reading prior to implementing the requirements of this QAPP. Documents required to be read shall include this QAPP, and the operational procedures specific to the equipment personnel will be working with or servicing.

Required reading shall be documented on a form indicating that the person has read and understood the QAPP or SOP or in the NC Learning Management System for DAQ employees. For DAQ employees reading of the QAPPs and SOPs are also documented in the employee Value in Performance, VIP, performance management system.

Training for each Duke Energy EIDM employee is recorded and maintained in the EIDM files. Prior to the start of the on-site work, all field personnel will be given instruction specific to the project, covering the following areas:

- Organization and lines of communication and authority,
- Overview of the QAPP, including monitor maintenance, calibration, and quality control activities,
- QA/QC requirements,
- Documentation requirements, and
- Health and safety requirements.

Monitoring staff provides new monitoring personnel and local station operators the necessary on the job training for their individual monitoring tasks.

All DAQ regional chemists and technicians, along with technicians from Duke Energy, are invited to the NC DAQ Ambient Monitoring Workshop held each Spring. This workshop provides an opportunity to discuss and train on the $SO_2$ DRR project and the QC and QA processes for the project.

# 9.0 Documentation and Records

The following table describes DAQ's and Duke Energy's document and records procedures for the $SO_2$ DRR monitoring program. The documents and records pertaining to all data required to be collected and all other data deemed important by its policies and records management procedures, including documents and records required to support the concentration data reported to EPA, are listed in Table 9.1.

**Table 9.1 Documentation and Records Information**

| Categories | Record/Document Type | File Locations |
|---|---|---|
| Management and Organization | State Implementation Plan<br>Reporting Agency Information<br>Organizational Structure<br>Personnel Qualifications and Training<br>Training Certification<br>Quality Management Plan<br>EPA Directives<br>Grant Allocations<br>Support Contracts | Raleigh, NC – DAQ Central Office<br><br>Huntersville, NC – HUNT/GNV |
| Site Information | Network Descriptions<br>Site Files<br>Site Maps<br>Site Pictures | Raleigh, NC – Central Office and Regional Offices<br><br>Huntersville, NC – HUNT, GNV, DSMS |
| Environmental Data Operations | Quality Assurance Project Plans<br>Standard Operating Procedures<br>Field Notebooks<br>Inspection/Maintenance Records | Raleigh, NC – Central Office and Regional Offices<br><br>Huntersville, NC – HUNT, GNV, DSMS |
| Raw Data | Any Original Data (routine and quality control) including Data Entry Forms | Raleigh, NC – Central Office<br><br>Huntersville, NC – DSMS, EIDM Central Server |
| Data Reporting | Air Quality Index Reports<br>Annual SLAMS Report<br>Data/Summary Reports<br>Journals/Articles/Papers/Presentations | Raleigh, NC – Central Office<br><br>Huntersville, NC – HUNT/GNV |
| Data Management | Data Algorithms<br>Data Management Plans/Flowcharts<br>Data Management Systems<br>Pollutant Data<br>Meteorological Data | Raleigh, NC – Central Office<br><br>Huntersville, NC – HUNT/GNV |

**Table 9.1 Documentation and Records Information**

| Categories | Record/Document Type | File Locations |
|---|---|---|
| Quality Assurance | Network Reviews<br>Control Charts<br>Data Quality Assessments<br>Quality Assurance Reports<br>Technical System Audits<br>Response/Corrective Action Reports<br>Site Audits | Raleigh, NC – Central Office and Regional Offices<br><br>Huntersville, NC – HUNT, GNV, DSMS |

HUNT – EIDM Huntersville, NC laboratory
GNV – TRC's Gainesville, FL office location
DSMS – Duke Energy's Skyland Monitoring Station

## 9.1 Routine Data Activities

### 9.1.1 Quarterly Data Submittal to AQS

DAQ shall load data, on a quarterly basis, to the AQS data system. These data shall be submitted no later than 90 days following the close of each calendar quarter. This process allows for the identification of any problems with data submittals or data completeness. The quarterly data submittal shall contain the following data:

- the AQS site code, monitoring method code, and POC;
- the results of all valid precision, bias, and accuracy tests performed during the quarter, and
- all ambient air quality data obtained on $SO_2$, wind speed, wind direction.

This will include data acquired at any sites operated by Duke Energy. The DAQ will also notify the EPA if a $SO_2$ DRR monitor does not meet the completeness level summarized in Table 7.2.

### 9.1.2 Annual Summary Reports Submitted to EPA

DAQ shall submit to the EPA an annual summary report, the AQS AMP600 report, of all $SO_2$ DRR monitoring stations that meet requisite criteria in accordance with 40 CFR Section 58.15. DAQ will also submit a signed certification letter on DAQ agency letterhead and will be signed by the Ambient Monitoring Section Chief. The report will be submitted by May 1 of each year for the data collected from January 1 through December 31 of the previous year.

DAQ's Ambient Monitoring Section chief, or designee, must certify the report to be accurate to the best of his/her knowledge. This certification will be based on the various assessments and reports performed by the organization, in particular, the annual QA report discussed in Section 20 that documents the quality of the ambient air quality data and the effectiveness of the quality system.

## 9.2 Documentation Control

Tables 9.1 and 9.2 list the documents and records that must retained. The details of these various documents and records will be discussed in the appropriate sections of this document. All raw data required for calculations, the submissions to the AQS database, and quality assurance/quality control (QA/QC) data shall be collected electronically or on data forms that are included in the field and analytical methods.

All hardcopy information shall be filled out in indelible ink. Corrections shall be made by inserting one line through the incorrect entry, initialing and dating this correction, and placing the correct entry

alongside the incorrect entry, if this can be accomplished legibly, or by providing the information on a new line if the above is not possible.

### 9.2.1 Logbooks

Each field technician will be responsible for obtaining appropriate logbooks. Each DAQ-operated $SO_2$ monitor has an electronic logbook (e-log) that has been created for that specific monitor type. The Duke Energy-operated $SO_2$ sites have paper-bound logbooks, as well as electronic notepad files. Duke Energy technicians will also be completing the DAQ electronic logbook in accordance with the DAQ procedures.

After each use, all e-logs are uniquely numbered by being given a specific file name before saving to a storage device such as a laptop computer. Each paper logbook (and its associated electronic notepad file) will be bound and each page uniquely numbered. The e-logs and paper logbooks will be used to record information about site operations, as well as document routine operations.

Completion of data entry forms, associated with all routine environmental data operations, are required even when the field logbooks contain all appropriate and associated information required for the routine operation being performed.

### 9.2.2 Electronic Data Collection

The $SO_2$ analyzers, along with the data acquisition systems, provide an automated means for collecting information that would otherwise be recorded on data entry forms. Information on these systems is detailed in Section 18. To reduce the potential for data entry errors, automated systems will be used where appropriate and will record the same information that would be recorded on data entry forms. Duke Energy $SO_2$ data will also be polled and transmitted to DAQ on an hourly basis.

To provide a backup, electronic copies of the data collected electronically (daily poll) from the DAQ-operated sites will be stored for an appropriate time frame by the DAQ Project and Procedures Branch staff on the group drive. Electronic backup copies of automated data collection information will also be stored on the site computers, in the regional offices and in the central office.

For any Duke Energy-operated sites, in order to provide a backup, electronic copies of the automated data collected will be stored on the local PC as well a server located at the EIDM laboratory in Huntersville, NC. Electronic copies will then be maintained on the central server located at the EIDM laboratory in Huntersville, North Carolina for the remainder of the study. DAQ will also retain electronic copies of data collected by Duke Energy.

## 9.3 Data Archiving and Retrieval

All the information listed in Tables 9.1 will be retained by DAQ for four complete calendar years from the date of collection in accordance with 2 CFR Section 200.333. All of the information listed in Table 9.1 will be retained by Duke Energy EIDM for four complete calendar years from the date of collection as well. DAQ will also maintain copies of all logbook and certification data produced by Duke Energy over the course of the $SO_2$ DRR monitoring project.

However, if any litigation, claim, negotiation, audit, or other action involving the records has been started before the expiration of the four-year period, the records will be retained until completion of the action and resolution of all issues that arise from it, or until the end of the regular four-year period, whichever is later.

# 10.0 Network Description

## 10.1 Probe Siting Criteria

General probe and monitoring path siting criteria for analyzers at the $SO_2$ DRR sites shall adhere to the requirements listed in 40 CFR58, Appendix E, and the instructions outlined below.

### 10.1.1 $SO_2$

The $SO_2$ intake probe must be 2 to 15 m above the ground. The probe must be at least one meter away, both vertically and horizontally, from any supporting structure. The probe must be at least 2 m away from any small local obstruction. The probe must be at least 10 m from any trees. The distance shall be measured from the drip-line or outside edge of the crown, not the trunk. For monitors to be operated at the same site for several years, it is best to allow some additional space for vegetation growth. In situations where trees or shrubs could be considered an obstruction (this is particularly true of large coniferous trees), the distance between the trees or shrubs and the monitor shall be at least twice the height the tree protrudes above the probe intake. The distance between the probe and any large obstruction (such as buildings) higher than the probe must be more than twice the height that the obstruction extends above the probe. There should be no minor sources of $SO_2$ (coal or oil fired stoves or furnaces) within 100 m of the probe intake that could have a significant impact.

The monitor must have an unrestricted airflow in at least a 270° arc around the monitor. The arc must include the predominant wind directions and any major sources in the area. See 40 CFR Part 58, Appendix E, for an explanation of these and other siting criteria.

### 10.1.2 Meteorological Sensors

Instruments shall be mounted on booms at the top of, or projecting horizontally from, the tower. The booms shall be securely fastened to the tower and shall be strong enough so that they will not sway or vibrate in strong winds. Wind instruments shall be mounted on a boom so that the sensors are twice the maximum diameter or diagonal of the tower away from the tower. The boom shall project into the prevailing winds. Wind sensors shall be mounted on booms or cross arms so that a sensor's wake does not impact adjacent sensors. Usually, this means mounting the sensors a minimum of 0.6 meters apart. If the wind sensors are to be mounted on top of a tower, they shall be mounted at a height and distance from the tower so that the diagonal distance between the sensor and the tower is equal to twice the maximum diameter or diagonal of the tower.

#### *10.1.2.1 Towers*

The sensor should be securely mounted on a mast (tower or pole) that will not twist, rotate, or sway. The towers shall be of an open grid-type construction and designed so that they either tilt or can be cranked into place so that the sensors can be installed, serviced and audited from the ground so that the operator will not need to climb the tower. A tower must be rigid enough to maintain all mounted instruments in proper alignment and orientation in high winds.

When instruments are located on a cross arm projecting out from the tower, the cross arms shall be securely fastened to the tower and shall be strong enough so that the sensors do not sway or vibrate in high winds. The sensors shall be securely fastened to the cross arm at a distance of two tower diameters or widths, measured from the edge of the tower to the sensor, to avoid any influence of tower-induced turbulence on the sensors. The cross arm shall be installed so that it is horizontally level and the sensors shall be installed so that they are vertical. The cross arm shall be mounted and aligned so that the wind

direction sensor is correctly aligned. (The correct alignment varies on a sensor-by-sensor basis. Consult the appropriate section of manufacturer's operator's manual for the correct alignment.)

#### *10.1.2.2 Wind Velocity Sensors*

Wind sensors are used to measure wind speed and wind direction at a height near the sampling probe. For source-oriented monitors, it is appropriate to place the sensor at or slightly above the level of the probe to best measure wind data at probe height without interfering with air flow at the probe.

## 10.2 Sampling Frequency

Minimum sampling frequencies are established by EPA and followed accordingly. The monitors used in the $SO_2$ DRR project sample continuously.

The minimum number of samples required for appropriate summary statistics should be taken. At least 75 percent of the total possible observations must be present before summary statistics are calculated. The exact requirements appear below in Table 10.1. The sampling schedule and frequency for $SO_2$ and meteorological data are provided in Table 10.2.

**Table 10.1 Requirements for Calculating Summary Statistics**

| Pollutant | Completeness Requirement (%) | Time Frame |
|---|---|---|
| Sulfur dioxide | 75 % | Per hour, quarter, and day |
| Wind speed | 75 % | Per hour and quarter |
| Wind direction | 75 % | Per hour and quarter |

**Table 10.2 Pollutant Sampling Schedule and Frequency**

| Pollutant | Time Frame | Frequency | Monitor Type |
|---|---|---|---|
| Sulfur dioxide | Midnight to midnight | 24/7 | Continuous |
| Wind Speed | Midnight to midnight | 24/7 | Continuous |
| Wind Direction | Midnight to midnight | 24/7 | Continuous |

# 11.0 Sampling Methods Requirements

The purpose of this section is to:

- Identify the sampling methods
- Identify the procedures for collecting the required samples
- Describe the equipment used, necessary support facilities, sample preservation requirements, implementation requirements, and processes for preparing and decontaminating sampling equipment

## 11.1 Sample Methodology

The $SO_2$ DRR monitoring network utilizes the Thermo 43i and Thermo 43i-TLE $SO_2$ analyzers. These analyzers use UV fluorescence. The physical principle used in $SO_2$ measurement relies on exciting an electron shell of a $SO_2$ molecule, which occurs in the presence of a specific wavelength (214 nanometers [nm]) of ultraviolet (UV) radiation, and the subsequent relaxation, which produces a photon of light. A photo multiplier tube allows the light emissions to be measured as the $SO_2$ molecule returns to the ground state. The intensity of this light is proportional to the quantity of $SO_2$ present in the sample. A reference detector continuously monitors the intensity of the UV lamp, used to excite the $SO_2$, and allows use of a ratiometric measurement technique that compensates for lamp degradation. A hydrocarbon scrubbing system, containing no consumable material, removes interfering hydrocarbons prior to the ambient sample entering the measurement chamber.

The analyzers used in the $SO_2$ DRR monitoring network are listed below in Table 11.1.

**Table 11.1 DAQ $SO_2$ DRR Ambient Air Monitoring Network Analyzers**

| Pollutant | Analyzer | EPA Reference/Equivalence |
|---|---|---|
| Sulfur Dioxide | Thermo Environmental Instruments, Inc. Model 43i | EQSA-0486-060 |
| Sulfur Dioxide | Thermo Environmental Instruments, Inc. Model 43i-TLE | EQSA-0486-060 |

## 11.2 Monitoring Technology/Methodology

Specific SOP titles used in the network are listed in Table 11.2.

Electronic data collection is possible through the $SO_2$ DRR monitoring network's data acquisition systems and wireless modems. This equipment is located in the shelters where the data loggers record the data history and the modems provide a path to download the data for analysis.

For sites that are operated by DAQ personnel, hourly data is automatically retrieved hourly, and minute data is retrieved twice a day, by computers in the state's central office. Monitoring personnel can contact the stations manually to retrieve data or determine the status of the systems, if needed.

For sites that are operated by Duke Energy personnel, data are recorded digitally from the instruments. The data acquisition system will store data in a local database and transmit measurements to the Air Vision central computer, located at Duke Energy, via a 4G cellular modem. Data acquired by Duke Energy is sent to a secure FTP server where it is retrieved by DAQ on an hourly basis.

## 11.3 Support Facilities

### 11.3.1 Monitoring Station Design

The monitoring station design must encompass the operational needs of the equipment, provide an environment that supports sample integrity, and allow the operator to safely and easily service and maintain the equipment. Winter weather conditions must be considered during site selection in order to meet the station safety and serviceability requirements.

### 11.3.2 Shelter Criteria

Air pollution analyzers, with the exception of meteorological sensors, must be housed in a shelter capable of fulfilling the following requirements.

- The shelter temperature must be maintained between 20° and 30°C for $SO_2$ monitors.
- The power supply should not vary more than ±10% from 117 alternating current voltage.
- The shelter must protect the instrumentation from precipitation and excessive dust and dirt, provide third wire grounding as in modern electrical codes, meet federal Occupational Safety and Health Administration regulations, and be cleaned regularly to prevent a buildup of dust.
- The shelter must protect the instrumentation from any environmental stress such as vibration, corrosive chemicals, intense light, or radiation.

Single sample lines are used to provide sample air from the outside. The analyzers draw samples from the probe inlet. $SO_2$ analyzers require that the probe material must be either borosilicate glass, or an acceptable inert plastic, such as polytetrafluoroethylene (PTFE or TFE), perfluoroalkoxy (PFA), or other Teflon®-type materials.

Any probe design used must ensure that the probe material is non-reactive with $SO_2$. The probe, intake vent, and interconnecting tubing design must provide a minimum number of bends to avoid particles impacting onto surfaces. Impacted particles may provide surfaces to which $SO_2$ may adsorb, or, if the impacted particle is metallic, catalyze to a non-criteria species. Additionally, the probe used must prevent rainwater from entering the analyzers. Any liquid water will absorb pollutants, impacting the $SO_2$ concentration by removing it from the sample, and consequently, yielding inaccurate environmental data.

The residence time in the probe must be 20 seconds or less. If the physical configuration of the probe restricts the flow such that both of these constraints cannot be simultaneously met, then modify the physical configuration to rectify this deficiency. This may be accomplished by reducing the length of interconnecting tubing, increasing the tubing and/or decreasing the number of tube bends between the probe and the analyzer, or other alterations that allow the system to meet the residence time requirements.

All probe sample lines used should be replaced or cleaned at least once every 2 years or as needed when the line is dirty or contaminated. Please reference the applicable site visit SOP for descriptions of what may require a line replacement earlier than the two-year requirement.

All Duke Energy SOPs listed within Table 11.2 have been reviewed and accepted by DAQ.

**Table 11.2 List of SOPs Associated with this Quality Assurance Project Plan**

| **DAQ Standard Operating Procedures** | |
|---|---|
| Section 2.3.4 | Thermo Environmental Model 146C Calibrator Certification, Revision 12.2, Sept. 17, 2014 |
| Section 2.3.6 | Protocol Gas Verification for Compressed Gas Cylinders Containing Either $SO_2$, NO or CO, Revision 0, Nov. 30, 2009 |
| Section 2.8.1 | Sulfur Dioxide Standard Operating Procedures for the Electronics and Calibration Branch, Revision 10, Nov. 1 2016 |
| Section 2.47.2 | Sulfur Dioxide Standard Operating Procedures for Operator Responsibilities, Revision 12, Nov. 1, 2016 |
| Section 2.8.3 | Regional Office Polling and Data Review: E-DAS set-up; Retrieval, Review, Correction, and Storage of Data; Report Submission; QA Standard Operating Procedures, Revision 0, Oct. 26, 2006 |
| Section 2.12.1 | Meteorological Monitoring QA Plan, Revision 1.5, Jul. 1, 2015 |
| Section 2.39 | SOP for Preparing SOPs for the DAQ, Revision 0, Nov. 1, 2010 |
| Section 2.41.4 | Data Review & Validation for Continuous Gaseous & Non-Speciated Particulate Monitors, Raleigh Central Office Responsibilities, Revision 1.6, Oct. 15, 2014 |
| Section 2.43 | SOP for Completing the Annual Network Review for the DAQ, Revision 1, Aug. 7, 2015 |
| **Duke Energy Standard Operating Procedures** | |
| 7404 | Data Validation Procedure for Ambient Air Quality, Ambient Water Quality, and Meteorological Data |
| 7830 | Environmental Systems Corp. (ESC) 8832 Data Logger Calibration Procedure for $SO_2$ Sites |
| 7831 | AirVision Setup; Retrieval, Review, Correction, and Storage of Data; Report Submission |
| 7832 | Manual Calibration Check Procedure |
| 7833 | Ambient Air Quality Site Check |
| 7834.1 | Thermo Environmental Model 43i-TLE Analyzer Calibration Procedure |
| 7835 | R.M. Young 05305v Wind Speed/Direction Transmitter Bench Calibration Procedure |
| 7836 | R.M. Young 05305v Wind Speed/Direction Transmitter Field Calibration Procedure |

## 11.4 Sampling/Measurement System Corrective Action

Corrective action measures in the ambient air quality monitoring network will be taken to ensure the DQOs are attained. There is the potential for many types of sampling and measurement system

corrective actions. Each approved SOP details some expected problems and corrective actions needed for a well-run monitoring network. If an error has been identified, a corrective action will be in place within 30 days.

## 11.5 Analyzer Audits

For each $SO_2$ analyzer audit procedures are performed by DAQ ECB technicians, following the procedures defined by the approved SOP.

## 12.0 Sampling Handling and Custody

The $SO_2$ DRR monitoring program does not require any samples to be taken that would warrant a sample custody procedure. All ambient air samples are analyzed directly through the instrumentation set at each monitoring location.

# 13.0 Analytical Methods

The $SO_2$ DRR ambient monitoring network does not use any laboratory analytical methodologies to complete the analysis of any $SO_2$ samples. Specifics on the $SO_2$ analyzer's analytics can be found in 40 CFR Part 50, Appendix A-1. A summary of the $SO_2$ analyzer's analytics can be found in Section 11.1 of this QAPP.

# 14.0 Quality Control Requirements and Procedures

To assure the quality of data from air monitoring measurements, two distinct and important interrelated functions must be performed. One function is the control of the measurement process through broad QA activities, such as establishing policies and procedures, developing DQOs, assigning roles and responsibilities, conducting oversight and reviews, and implementing corrective actions. The other function is the control of the measurement process through the implementation of specific quality control procedures, such as audits, calibrations, calibration checks, etc.

Quality control is the overall system of technical activities that measure the attributes and performance of a process, item, or service against defined standards to verify they meet the stated requirements established by the end user. For the $SO_2$ DRR monitoring network, QC activities are used to ensure measurement uncertainty is maintained within acceptance criteria for the attainment of the DQOs. Lists of pertinent QC checks are provided in the SOPs and instrument manuals.

Quality control activities will include, but not be limited to, the following:

- Daily automated calibration checks (zero, span, and 1-pt QC check),
- Daily review of instrument measurements,
- Annual multipoint calibrations (or as needed),
- Monthly operational checks by site operator,
- Routine maintenance as specified per the SOP, and
- Performance audits by DAQ, as determined by their schedule.

Data analyzed from monitors in the DAQ $SO_2$ DRR network do not undergo routine post-processing to correct for zero and span drift.

## 14.1 Calibrations

Calibration is the process used to compare an instrument with a standard, or measurement of higher accuracy, to detect and quantify inaccuracies and to report or eliminate those inaccuracies by adjustment. This multiphase process begins with certifying a calibration or transfer standard against an authoritative standard. The $SO_2$ analyzer's measurements are then compared to this calibration/transfer standard. If significant deviations exist between the analyzer's measurements and the calibration/transfer standard's measurements, an adjustment of the analyzer takes place to rectify the analyzer's measurements.

All calibrations for analyzers within the $SO_2$ DRR network are calibrated using a gas dilution system. The zero and span values of the calibration have tight acceptance ranges, between which the analyzer's measured values must fall.

These calibrations are then verified by the zero and span checks that occur nightly.

Specific calibration requirements for the $SO_2$ analyzer are found in the SOPs and in the instruments' operations manuals, and a brief summary can be seen below in Table 14.1.

Table 14.1 Acceptance Criteria for Calibrations and Daily Auto-Checks

| Operation | Concentration [A] / Acceptance Criteria | SPAN | | | |
|---|---|---|---|---|---|
| | | Zero | Span 1 | Span 2 | Span 3 |
| Daily Auto-Calibration Check | Concentration (ppb) | 0 | 400 | N/A[B] | 50[C], 20[D] |
| | Acceptance (±) | 1 ppb | 5% | N/A | 7% |
| Calibration and Calibration Verification | Concentration (ppb) | 0 | 400 | 100 | 45 |
| | Acceptance (±) | 1 ppb | 5% | 5% | 7% |

[A] Concentrations are nominal values
[B] Span 2 for Daily Auto Calibration is not used
[C] Span 3 value must be between 5 and 80 ppb per EPA
[D] Span 3 value of 20ppb is only for Bayview site.

## 14.2 Precision Checks

Precision is the measure of mutual agreement among individual measurements of the same property, usually under prescribed similar conditions. In order to meet the DQOs for precision, it will be ensured that the entire measurement process is within statistical control. Various tools will be employed in evaluating and monitoring precision measurements. The instrument's precision is challenged with a 1-pt QC check that will provide evidence of deviations from the required precision measurement.

The 1-pt QC check for all analyzers within the $SO_2$ DRR monitoring network is at 50ppb, EXCEPT for the analyzer at the Bayview site. The 50ppb was chosen with the objectives of the $SO_2$ DRR monitoring project in mind. The Bayview site, while considered an $SO_2$ DRR monitoring site, has been a site within the NC DAQ SLAMS network, and will remain an $SO_2$ monitoring site after the conclusion of the $SO_2$ DRR project. The 1-pt QC check level for the Bayview site will be 20ppb. This value was chosen because it is closer to the expected $SO_2$ concentration level for the surrounding area.

The 1-pt QC check and precision requirements for the $SO_2$ analyzer are found in the SOPs and in the specific instruments' operations manuals.

## 14.3 Documentation

All events, including routine site visits, calibrations, analyzer maintenance, and calibration equipment maintenance, will be documented in field data records and logbooks. Field activities associated with equipment used by the technical staff will be kept in record logbooks as well. The records will normally be controlled by the regional chemists and Duke technicians and located in the field sites when in use or at regional or Duke offices when being reviewed or used for data validation.

# 15.0 Instrument/Equipment Testing, Inspection, and Maintenance Requirements

All instruments and equipment are tested and maintained to verify that they are operating in sound condition and are capable of operating at acceptable performance levels. All instrument inspection and maintenance activities must be documented and filed.

All $SO_2$ monitors used in the $SO_2$ DRR monitoring network shall be certified to adhere to EPA equivalent or reference methods. Therefore, the monitors and procedures used are assumed to be of sufficient quality for the data collection operation. The model designations are identified in Table 11.2.

Prior to field installation of the $SO_2$ monitors, the analyzers shall successfully undergo zero/span and multi-point calibrations. Following site installation, the field operators will initiate, observe, and document the successful completion of a zero/span cycle. If the analyzers meet the acceptance criteria, they will be assumed to be operating properly. These tests will be properly documented and filed as indicated in Section 14.

All $SO_2$ monitors undergo inspection at the end of each calendar year as part of the Annual Network Review. The monitor and site are reviewed to ensure continuing compliance with 40 CFR Part 50, Appendix E.

All $SO_2$ monitors also undergo routine maintenance as part of the monthly site visit. If necessary, DAQ technicians may contact the DAQ ECB for specific non-routine maintenance. Duke Energy technicians may contact either personnel within the Duke Energy organization or personnel at the DAQ ECB for assistance. The procedure for the routine site visit and maintenance can be found in the applicable SOP.

# 16.0 Instrument Calibration and Frequency

Dedicated traceable standard gases are maintained for the certification of the $SO_2$ monitoring systems. These standards provide a direct link to established national standards (i.e. NIST) and are the foundation for the collection of the highest quality ambient air pollution data possible in accordance with current procedures and existing federal regulations and guidelines.

Specific calibration procedures for field equipment can be found in the applicable SOPs or operation manuals.

## 16.1 Calibration Gases

All $SO_2$ calibration gases should be NIST traceable and include the following information:

- Cylinder serial number
- $SO_2$ concentration
- Recertification status
- Gas type
- PSI (double checked upon receipt)
- Impurity
- Expiration date

Zero air generators used at the $SO_2$ DRR monitoring sites are serviced annually, or more frequently if needed.

The calibration gas standards will have their own certifications and will be re-verified or recertified after four years for 1-50 ppm $SO_2$ in nitrogen standards.

## 16.2 Calibrators

The Thermo Environmental 146i calibrators are used as field calibration devices and audit devices for $SO_2$ monitoring. The mass flow controllers within field calibrators are certified every 12 months and audit calibrators every nine months by Alicat flow measurement units. The appropriate SOPs can be references for further detail on calibration procedures.

## 16.3 Documentation

Calibrator certification documentation for all DAQ operated sites will be retained at the DAQ ECB facility in Raleigh, NC. All calibrator certification documentation for all Duke Energy operated sites will be stored at the EIDM location in Huntersville, NC. DAQ will also retain copies of all Duke Energy calibrator certification documentation. Please reference Table 9.1 for the storage location of all documentation.

## 17.0 Non-Direct Measurements

During the course of the $SO_2$ DRR monitoring project, data not obtained by direct measurement from the $SO_2$ DRR air quality monitoring program may be used or evaluated. This includes data from outside sources and historical monitoring data. At this time, DAQ has not formally determined the types of additional data that may be needed in support of the $SO_2$ DRR monitoring program.

Possible databases and types of data and information that might be used include:

- $SO_2$ DRR site selection modeling information
- Chemical and physical properties data
- Monitor manufacturers' operational literature
- Geographic location data
- Historical monitoring information
- External monitoring databases
- National Weather Service data and
- Traffic count data from the North Carolina Department of Transportation

Any use of outside data will be quality controlled to the extent possible following QA procedures outlined in this document and in applicable EPA guidance documents.

# 18.0 Data Management

## 18.1 Data Recording

For the DAQ $SO_2$ DRR monitoring network, all ambient $SO_2$ data are collected using Thermo 43i-TLE $SO_2$ analyzers. Information on these instruments can be found in Section 11 and detailed information can be found in the instrument's operating manual. The procedures for operating these instruments can be found in Table 11.2.

All of the $SO_2$ data within the NC DAQ network is recorded electronically. Each site is equipped with a data acquisition system and a wireless modem used to transmit data to data storage databases. Each data acquisition system and site computer has the capability to record the monitor's output, perform any required data transformation, and format the resulting data in preparation for downloading to a database or spreadsheet.

## 18.2 Data Transmittal and Transformation

Data transmittal is accomplished using wireless communication to access the site's modems. Downloading collected data does not delete data from the data acquisition system. Data are removed from the site computer by overwriting data on a first-in, first-out basis. This configuration requires the data to be extracted from the site computer on a regular basis to prevent any data loss. If communications problems arise, data are retrieved from the data acquisition system when communication to the site has been restored. A site visit is mandatory if the communications problems are not expected to be corrected in a timely fashion.

The data acquisition system reads instantaneous $SO_2$ values from the monitor and averages each 60-second interval to create a 1-minute average. The data acquisition system stores each minute average, and this acts as the base unit for all measurements taken by monitors within the DAQ $SO_2$ DRR monitoring network.

These stored 1-minute averages are then averaged to form averaged hourly values, which are the blocks of ambient $SO_2$ measured concentrations that are submitted to the EPA. Additionally, the 1-minute averages are used to form 5-minute averages, of which the maximum 5-minute average of each hour is submitted to the EPA. All of these values are transmitted to the DAQ Central Office computer or the Duke Energy data storage computer for retention.

All raw direct measurement data sets are also stored electronically.

## 18.3 Data Validation

Data validation is an important routine process that involves several steps to ensure that field and data processing operations have been carried out correctly. The validation process will identify data with errors, biases, and physically unrealistic values before they are used for the identification of exceedances, for further analysis, or for modeling. Once these problems have been identified, the data can be corrected or invalidated. If necessary, corrective actions can be taken by field personnel.

Each of the network's analytical instruments employed to measure meteorological conditions and the ambient concentrations of $SO_2$ undergo periodic audits, daily one-point quality control checks, and calibrations. These procedures are outlined in the appropriate SOPs. Performance audits and one-point

quality control checks ascertain the accuracy, precision and repeatability of each instrument in performing its required function.

The instrument-generated data are stored at each monitoring site. When the data are accessed through the wireless modems, they are downloaded to a database located at the DAQ Central Office. The first data verification step is performed electronically by searching the data download for status flags and comparing reported values to acceptable range criteria. After data are flagged as questionable, Level 2 and 3 reviewers evaluate the flagged data to identify underlying causes and decide whether the data are valid. If the data are invalid, they are not used in calculations. If the data are valid, but flagged due to some extenuating circumstance, then the data will be used in calculations, accompanied by a comment documenting the situation.

The DAQ central office air quality chemists monitor and review the data sets, reviewed by supervisors from both the DAQ regional offices and Duke Energy, for invalid flags. If the data are deemed invalid, they are disqualified from the data set, and consequently, not used. Criteria for the quantity of valid data points required within a data set is defined in 40 CFR Part 50. These criteria are adhered to when performing the data reduction operations. Further information can be found in Section 22.

## 18.4 Data Storage and Retrieval

Retaining copies of all data sets electronically recorded provides a data audit trail. The raw data from all $SO_2$ DRR monitors are archived on backup systems in addition to being retained on computers. This allows reduction and validation operations to be performed while still retaining the integrity of the raw data set.

The NC DAQ has an electronic archiving system that makes it possible to store and retrieve all collected air quality monitoring data. The data are stored for a minimum of four years.

Duke Energy has an electronic data archiving system, making it possible to store and retrieve all collected air quality monitoring data. All electronic and paper logbooks and data sheets will be retained at the Duke Energy facility. These data will be stored for a minimum of four years. DAQ will also store all hourly and minute $SO_2$ data collected by the Duke Energy monitor on the state servers in the DAQ central office.

## 18.5 Data Submission

After the three levels of validation are completed for a month of data, the data are compiled into a document for upload to the Air Quality System (AQS). In addition to hourly data and the maximum 5-minute value for each valid hour, daily automated precision checks are also uploaded to AQS. At the end of each quarter, a report is run on AQS and the central office verifies that all hourly and maximum 5-minute data, daily precision data, and ECB performance audit data entered is valid.

Every year before the data certification deadline, the DAQ Central Office Section Chief reviews the data from the EPA AQS summary reports, along with internal performance evaluation and audit reports to confirm that the data meets the required criteria. Any concerns with the data are addressed.

Upon completion of the certification review, the Ambient Monitoring Chief certifies the data by submitting the AQS AMP600 report to the US EPA. This report is submitted before the annual May 1 deadline.

## 18.6 Data Reduction and Analysis

Data reduction activities takes place throughout the entire data management process. These activities aggregate raw data into the hourly averages that are required to compare against the NAAQS criteria pollutant limits. These values obtained from reducing these data sets establish whether or not the NAAQS have been exceeded. The quantity of valid data points required within a data set is defined in 40 CFR Part 50, and are summarized in Table 7.2.

The submitted results are compared to the NAAQS for $SO_2$. All validated data are reviewed looking for trends, outliers, etc. to establish the reasonableness of the data sets. This is done by retrieving several reports from the AQS, and analyzing the results.

# 19.0 Assessments and Response Actions

An assessment is the process used to measure the performance or effectiveness of the quality system, the $SO_2$ DRR ambient air quality monitoring network and its sites, and various phases of the data operation. To ensure the adequate performance of the quality system, DAQ will perform:

- Network reviews and assessments
- Technical systems audits
- Data quality audits and assessments

## 19.1 Network Reviews/Assessments

Network requirements of the $SO_2$ ambient air quality monitoring network is set forth in 40 CFR Part 51 Subpart BB, 40 CFR Part 58, Appendix E, and the $SO_2$ NAAQS Designations Source-Oriented Monitoring Technical Assistance Document. Conformance is determined through annual network reviews of the $SO_2$ monitoring system as required by 40 CFR Section 58.10(a). The network review is used to determine if the network is collecting adequate, representative, and useful data in pursuit of its $SO_2$ monitoring objectives.

Prior to implementing a network review, significant data and information pertaining to the network will be compiled and evaluated. Such information may include:

- Network files (including updated site information and site photographs);
- AQS reports;
- Emissions information, such as a monitor's emission density maps and maps delineating an area's major emission sources

Upon receiving the information, it will be checked to ensure it is current. Discrepancies will be noted and resolved during the review. Files and/or photographs that need to be updated will also be identified during the review. Several categories, such as the how analysis of the monitoring network, monitor locations, siting requirements will be emphasized during network review.

### 19.1.1 $SO_2$ DRR Monitoring Stations

Adequacy of the network will be determined using the following information:

- Data Requirements Rule for the 2010 1-Hour Sulfur Dioxide ($SO_2$) Primary National Ambient Air Quality Standard (NAAQS)
- The most current measured ambient $SO_2$ concentrations;
- Maps of emission densities;
- Dispersion modeling, and
- Best professional judgement

All of the $SO_2$ DRR monitors will be designated as Industrial monitors, serving a regulatory purpose. The exception to this is the Bayview $SO_2$ monitor, which has long been run as a SLAMS monitor by DAQ. The Bayview monitor will continue to operate as a SLAMS monitor, but is included in this QAPP and will operate with the intent of fulfilling the $SO_2$ DRR.

### 19.1.2 Monitor Locations

For the $SO_2$ DRR sites, the geographical location of each monitor is specified by the $SO_2$ NAAQS Designations Source-Oriented Monitoring Technical Assistance Document. Suitable monitoring locations can only be determined based on the stated objectives.

During the network review, the stated objective for each monitoring site will be reconfirmed and the locations spatial scale will be re-verified.

### 19.1.3 Probe Siting Requirements

Applicable siting criteria for the $SO_2$ DRR monitors are specified in 40 CFR Part 58, Appendix E. The on-site visit will consist of physical measurements and observations to determine compliance with the 40 CFR Part 58, Appendix E requirements, such as height above ground level, distance from trees, appropriate ground cover, etc. This check at each site is performed every year and measurements are documented on Annual Network Review forms, which are included in the DAQ Annual Network Plan.

The annual network review and probe site check will also:

- Review the most recent hard copy of the site description (including any photographs) for any updates needed for the RCO;
- Report on any new industries in the area and review their emission impacts based on the site of the facility and predominant wind directions; and
- Determine conformance with 40 CFR Part 58 Appendix E.

The checklist is found on pages 44-46 of this QAPP and in the applicable SOPs, and is used to determine conformance with 40 CFR Part 58, Appendix E. In addition to the items on the checklist, the reviewer will also perform the following tasks:

- Ensure that the inlet is clean and the funnel is whole and functions properly;
- Perform annual site safety check, including checking equipment for missing parts, frayed cords, damage, etc.;
- Record findings on the site safety audit form and the annual network review checklist, as appropriate, to be turned into the RCO;
- Take photographs/video in the eight directions (east, southeast, south, southwest, west, northwest, north, and northeast) when significant changes are observed in vegetation, trees, or roadways;
- Document any significant changes in site conditions on the network review checklist.

In addition to the items included in the checklists, other subjects for discussion are part of the network review and overall adequacy of the monitoring program will include:

- Installation of new monitors,
- Relocation of existing monitors,
- Siting criteria problems and suggested solutions,
- Maintenance and replacement of existing monitors and related equipment,
- Air quality studies and special monitoring programs, and
- Other issues such as proposed regulations and funding.

The network review report will be distributed to the appropriate senior staff and EPA.

# Site Review Form Calendar Year 2017

## Site Information

| | | |
|---|---|---|
| **Region**_____ | **Site Name** _____ | **AQS Site # 37-**_____-_____ |
| **Street Address-**_____ | **City** _____ | |
| **Urban Area** Choose an item. | **Core-based Statistical Area** Choose an item. | |

| **Enter Exact** | | **Method of Measuring** | |
|---|---|---|---|
| **Longitude** _____ | **Latitude** _____ | | |
| In Decimal Degrees | In Decimal Degrees | Select one | **Explanation:** _____ |
| Elevation Above/below Mean Sea Level (in meters) | | _____ | |

Name of nearest road to inlet probe _____ ADT _____ Year Choose one _____

Comments: _____

Distance of site to nearest major road (m) _____ Direction from site to nearest major road ___

Name of nearest major road _____ ADT _____ Year Choose one _____

Comments: _____

| | | |
|---|---|---|
| Site located near electrical substation/high voltage power lines? | | Yes ☐ No ☐ |
| Distance of site to nearest railroad track | (m) _____ Direction to RR ___ | ☐NA |
| **OPTIONAL** Distance of site to nearest power pole w/transformer | (m) _____ Direction ___ | |
| Distance between site and drip line of water tower (m) _____ Direction from site to water tower _____ | | ☐NA |

Explain any sources of potential bias; include cultivated fields, loose bulk storage, stacks, vents, railroad tracks, construction activities, fast food restaurants, and swimming pools.

_____

**ANSWER ALL APPLICABLE QUESTIONS**:

| Parameters | Monitoring Objective | Scale | Monitor Type |
|---|---|---|---|
| ☐ $SO_2$ (DRR)<br>☐ $SO_2$ (NAAQS)<br>☐ $SO_2$ (trace-level) | ☐General/Background<br>☐Highest Concentration<br>☐Population Exposure<br>☐Source Oriented<br>☐Transport<br>☐Upwind Background<br>☐Welfare Related Impacts | ☐Micro<br>☐Middle<br>☐Neighborhood<br>☐Urban<br>☐Regional | ☐INDUSTRIAL<br>☐SLAMS<br>☐SPM |

Probe inlet height (from ground) 2-15 m? Yes ☐ No ☐ Give actual measured height from ground (meters) _____

Distance of outer edge of probe inlet from horizontal (wall) and/or vertical (roof) supporting structure > 1 m? Yes ☐ No ☐

Actual measured distance from outer edge of probe to supporting structure (meters) _____

Distance of outer edge of probe inlet from other gas monitoring probe inlets > 0.25 m? Yes ☐ No ☐ NA ☐

Is probe > 20 m from the nearest tree drip line? Yes ☐ *No ☐ (answer *'d questions)

*Is probe > 10 m from the nearest tree drip line? Yes ☐ *No ☐ *Number of trees within 10 meters _____

*Distance from probe to closest tree (m) _____ Direction from probe to tree ___ *Height of tree above probe (m) _____

Are there any obstacles to air flow? *Yes ☐ (answer *'d questions) No ☐

*Identify obstacle _____ Distance from probe inlet (m) _____ Direction from probe inlet to obstacle ___

*Is distance from inlet probe to obstacle at least twice the height that the obstacle protrudes above the probe? Yes ☐ No ☐

Distance of probe to nearest traffic lane (m) _____ Direction from probe to nearest traffic lane ___

# Site Review Form Calendar Year 2017

**Instructions:**

Urban Area: If the monitor is located within the bounds of an urban area (an incorporated area with a population of 10,000 or more people), select the appropriate urban area from the list. Otherwise select "Not in an Urban Area".

Core-Based Statistical Area (CBSA): If the monitor is located within a county that is part of a metropolitan statistical area (MSA) or a micropolitan statistical area (MiSA), then it is located within a core-based statistical area. If the monitoring station is located in a county included in a MSA or MiSA, select the appropriate CBSA from the list. Otherwise select "None".

Road Information: For the nearest road to the inlet probe, list whatever roadway that carries vehicles that is closest to the probe, whether or not it is a named or public road and even if the road has very little traffic. Use the comments space if necessary to describe the road or the source of the annual average daily traffic (AADT) counts. If the monitor is located near an unnamed, little used, private road, use the nearest major road space to list the closest named public road to the site. Include the distance and direction of the nearest major road from the site as well as the AADT if it is available. If the closest road is a small public road but there is a large major roadway such as an interstate highway, divided highway, major thoroughfare, etc., near the monitoring station use the nearest major road space to list the information about this major roadway. Include the distance and direction of the major road from the site as well as the AADT. The AADT for state roads can be obtained from the North Carolina Division of Transportation at http://www.ncdot.gov/travel/statemapping/trafficvolumemaps/default.html. For AADT values for local roadways contact the appropriate local governments.

Monitoring Objective: Why is this monitor here? What purpose does it serve? Monitoring objectives include: (a) Highest Concentration, which determine the highest concentrations of ozone expected to occur in the area covered by the network; (b) Population Exposure, which measure typical concentrations of ozone in areas of high population density; (c) Source Oriented, which determine the impact of significant sources or source categories of ozone precursors on air quality; (d) General/Background, which determine general background ozone concentrations; (e) Transport, which determine the extent of regional ozone transport among populated areas and in support of secondary standards; and (f) Welfare Related Impacts, which measure ozone impacts on visibility, vegetation damage, or other welfare-based impacts. Sites established with the objective of studying ozone and its precursors may also be Maximum Ozone Concentration or Upwind Background sites. A monitor may have multiple objectives.

Scale: The scale of representativeness is determined by how close the monitor is located to a potential source or by the local terrain or urban development. For $SO_2$ monitors the scale of representativeness is determined by how close the monitor is to the nearest source of $SO_2$:

| **Scale** | **Distance from Source** |
|---|---|
| Micro | < 100 meters |
| Middle | 100 meters to <0.5 kilometers |
| Neighborhood | 0.5 to 4 kilometers |
| Urban | Greater than 4 kilometers to 50 kilometers |
| Regional | Greater than 50 kilometers |

Monitor Type: There are two basic site types. A monitor is either a state and local air monitoring station, SLAMS, or a special purpose monitor, SPM. An SPM is defined as any monitor included in an agency's monitoring network that the agency has designated as a special purpose monitor in its annual monitoring network plan and in AQS, and which the agency does not count when showing compliance with the minimum requirements of 40 CFR 58 Appendix D for the number and siting of monitors of various types. All DRR monitors are SLAMS.

Probe Location: The probe must be located between 2 and 15 meters above ground level for all $SO_2$ monitoring sites. The probe for $SO_2$ must be at least 1 meter vertically or horizontally away from any supporting structure, walls, parapets, penthouses, *etc.*, and away from dusty or dirty areas. If the probe is located near the side of a building or wall, then it should be located on the southwest side of the building.

Trees: The probe or inlet must be at least 10 meters or further from the drip line of trees. A distance of at least 20 meters between the probe and any tree or trees is preferred.

Obstacles: An obstacle is anything that restricts air flow. A tree can be an obstacle because it has branches and leaves that restrict the flow of air but a pole is not considered to be an obstacle. To avoid interference from obstacles, the probe or inlet must have unrestricted airflow and be located away from obstacles. The distance from the obstacle to the probe or inlet must be at least twice the height that the obstacle protrudes above the probe. For source-oriented monitors there should be no obstructions between the monitor probe and source.

# Site Review Form Calendar Year 2017

SULFUR DIOXIDE MONITOR RECOMMENDATIONS:

1) Maintain current monitor status? Yes ☐ *No ☐ (answer *'d questions)

*2) Change monitoring objective? Yes ☐ (enter new objective _____) No ☐-

*3) Change scale of representativeness? Yes ☐ (enter new scale _) No ☐

*4) Relocate monitor? Yes ☐ No ☐

Comments: _____

Date of Last Site Pictures _____ New Pictures Submitted? Yes ☐ No ☐

Reviewer _____Date_____

Ambient Monitoring Coordinator _____Date _____

Revised 2016-12-2014

**Instructions:**

If the annual network review has indicated that the monitoring objectives and scale of representativeness for the site have not changed and the siting criteria still meets those monitoring objectives and that scale of representativeness and there are no other reasons to modify the site in any way, check "Yes" to the question "Maintain current site status?" and skip the rest of the recommendations section.

If the annual network review has indicated that the monitoring objectives, scale of representativeness, or siting criteria have changed for some reason or there is another reason to modify the site in some way, check "No" to the question "Maintain current site status?" and complete the rest of the recommendations section. If the monitoring objective or scale of representativeness needs to be changed, check the "Yes" box and write in the new monitoring objective or scale of representativeness on the line. Otherwise check the "No" box. If the site needs to be relocated, check the "Yes" box. If the site needs to be shut down, write "Shut down" in the comments line. Also use the comments line to explain any change requested.

Check the site picture archive to find out when the last set of site pictures were taken and write the date down on the line. If the pictures are more than five years old or if something at the site has changed in the past year, take new site pictures. Changes that require new site pictures include additions, removals, or movement of monitors at the site, growth or removal of trees and other shrubs at the site, and construction of roads or buildings at or in the vicinity of the site.

Pictures of the site should at a minimum include at least one picture showing the site itself and pictures standing at the probe or inlet or as close as possible to the probe or inlet looking in the four compass directions (north, east, south, and west). If meteorological data are collected at the site, pictures standing at the meteorological tower looking southwest and northeast should also be included. Sometimes pictures looking at the site from the four compass directions are also helpful.

Be sure to correctly identify the pictures as to which compass direction they show. This documentation may be achieved by using good notes when taking the pictures, holding a compass in front of the camera, or placing a sign with the appropriate direction indicated somewhere in the picture. Label the pictures with the name of the site using the two digit logger ID (HC, JW, *etc.*), the direction (N, NE, E, SE, S, SW, W, NW), and the date taken (YYYYMMDD) and transfer the pictures to the group drive in the appropriate Incoming/Regional Office directory.

### 19.1.4 Technical Systems Audits

A technical system audit (TSA) is a thorough and systematic qualitative audit, where facilities, equipment, personnel, training procedures, protocols, and record keeping are examined for conformance with the QAPP. A TSA will be performed on-site by a DAQ Central Office Chemist during the early stage of the project, and anytime senior staff feels it is appropriate, to assist in identifying deficiencies and providing timely corrective actions. Annual TSA's will take place after each calendar year's collection of data to maintain high quality data collection and reporting. EPA Region 4 will also conduct TSA's on a three-year basis.

A TSA team, made up of individuals from either DAQ or EPA Region 4, or an individual TSA auditor, may segregate TSA activities into two categories. The categories may be audited independently or they may be combined. The TSA categories are:

- Field activities: Handling, sampling
- Data management activities: Collecting, flagging, editing, and uploading data; providing data security

Key personnel to be interviewed during the audit are those individuals with responsibilities for planning, field operations, QA/QC, data management and reporting. Following the completion of the audit, the audit team will prepare a brief written report summarizing the findings. The following areas may be included but all reports will include items c, d and e:

a. Planning,
b. Field operations,
c. QA/QC,
d. Data management, and
e. Reporting.

Problems with specific areas will be documented and corrective actions will be implemented.

#### *19.1.4.1 Post-Audit Activities*

The major post-audit activity is the preparation of the systems audit report. The report will include:

- Audit title, identification number, date of report and any other identifying information;
- Audit team leaders, audit team participants and audited participants;
- Background information about the project, purpose of the audit, dates of the audit, measurement phase or parameters that were audited and a brief description of the audit process;
- Summary and conclusions of the audit and corrective action required; and
- Attachments or appendices that include all audit evaluations and audit finding forms.

To prepare the report, the audit team will meet and compare observations with collected documents and results of interviews with key personnel. Expected QAPP implementation is compared with observed accomplishments and deficiencies. The audit findings are reviewed in detail and, within 30 calendar days of the completion of the audit, a comprehensive audit report will be generated and distributed to senior staff for comment.

If the $SO_2$ DRR site operator, Regional Chemist, or Duke Energy personnel have written comments or questions concerning the audit report, the audit team will review and incorporate them as appropriate. Subsequently, a modified report will be prepared and resubmitted in final form within 30 days of receipt

of the written comments. The report will include an agreed-upon schedule for corrective action implementation.

#### *19.1.4.2 Follow-up and Corrective Action Requirements*

As part of corrective action and follow-up, an audit finding response form will be generated by either Duke Energy or DAQ, depending on the monitoring site that was audited, for each finding in the TSA report. For an audit performed by EPA Region 4, the DAQ audit team will generate the audit response form. The audit finding response form is signed by the respective personnel in charge of monitoring and sent to the TSA team, which reviews and accepts or rejects the corrective action. The audit response form will be completed within 30 days of acceptance of the audit report.

#### *19.1.4.3 Audit of Data Quality*

An audit of data quality (ADQ) reveals how data are handled, what judgments were made and whether uncorrected mistakes were made. An ADQ can often identify the means to correct systematic data reduction errors. An ADQ shall be included as part of the annual systems audit. Sufficient time and effort will be devoted to this activity so that the auditors have a clear understanding and complete documentation of data flow. Pertinent ADQ questions appear on the TSA check sheets, which shall be used in executing an ADQ. The TSA check sheets shall be used to ensure that the data collection and handling integrity is maintained. The ADQ will serve as an effective framework for organizing the extensive amount of information gathered during the audit of field monitoring and support functions within the agency.

### 19.1.5 Performance Evaluation

Performance evaluation activities are addressed by DAQ $SO_2$ DRR monitoring sites participating in the EPA's National Performance Audit Program (NPAP). Only qualified and authorized personnel execute performance audits. Twenty percent of all sites will be audited by the NPAP program per year, and each site will be audited every 6 years. Efforts will be made to ensure that all DRR sites are audited before the end of the project period.

Every $SO_2$ DRR site will be audited internally by DAQ ECB personnel on an annual basis. The procedure and acceptance criteria for these internal performance audits can be found in the applicable SOPs.

### 19.1.6 Data Quality Assessments

A data quality assessment (DQA) is the statistical analysis of environmental data to determine whether the data meet the assumptions that the DQOs and data collection design were developed under and whether the total error in the data is tolerable. Calculations for DQA activities shall follow the requirements and equations identified in 40 CFR Part 58, Appendix A, Section 4. The DQA process is described in detail in *Data Quality Assessment - A Reviewer's Guide* (EPA QA/G-9R). Terminology associated with measurement uncertainty is found within 40 CFR Part 58, Appendix A.

Estimates of the data quality will be calculated on a quarterly basis by DAQ staff using the AQS AMP256 report, and are based on single monitors and aggregated to all monitors. The individual results of these tests are then reported to the EPA as part of the AQS AMP600 report.

## 19.2 Assessment Documentation

Audits shall be executed during this project at the frequency and quantity indicated. Network reviews shall be conducted by the DAQ Regional Chemist and Duke Energy personnel, assisted by site technicians, every year that the ambient air quality monitoring network is operational. TSAs shall be performed by Region 4 once during every three-year period that the $SO_2$ DRR ambient air quality monitoring networks collect data verifying compliance with the NAAQS. TSAs will also be performed by a DAQ Central Office Chemist on an annual basis for the duration of the $SO_2$ DRR monitoring project. Additional TSAs performed by DAQ shall be scheduled at the discretion of the DAQ's Ambient Monitoring Section chief. Performance evaluation audits shall be performed in accordance with the schedule established by EPA's NPAP, and annually by DAQ ECB personnel. Copies of all documentation of assessments will be retained by DAQ.

### 19.2.1 Assessment Personnel

The following individuals are responsible for executing audits, assessing findings, developing and implementing necessary corrective actions, preparing QA reports, evaluating their impact, and implementing follow up actions.

1. DAQ Ambient Monitoring Section Chief
   The Section chief administers and maintains overall responsibility for management and administrative aspects of the QA program.

2. DAQ Regional Chemists
   The Regional Chemists are responsible for assessing audit findings, issuing appropriate response/corrective actions, assigning response/corrective actions to specific personnel and assuring the completeness and efficacy of the work. The regional chemists are also responsible for assuring that the site operators, auditors and ECB technicians maintain their documentation as defined in the network plan (40 CFR Part 58, Appendix D) and for disseminating information appearing in audit reports and other quality-related documents to operations personnel.

3. DAQ Data Polling and Database Manager
   The DAQ data polling and database manager is responsible for coordinating the information management activities for $SO_2$ DRR data collection and dissemination to the DAQ Real-Time Ambient Monitoring Data webpage, AirNow, and AQS. This includes sites operated by both DAQ and Duke Energy. Specific activities related to audit execution include ensuring access to data for DQA and ADQ activities.

4. DAQ Central Office Chemists, Regional Chemists, and Regional Operators
   The DAQ central office chemists, regional chemists and regional site operators are responsible for implementing day-to-day QA activities for the SO2 DRR air quality monitoring program DAQ-operated sites, and assisting, if necessary, with data quality audits and other internal audits. They are also responsible for documenting the response to required corrective actions in response/corrective action reports.

5. DAQ Projects and Procedures Branch Supervisor
   The DAQ Projects and Procedures Branch supervisor is responsible for identifying problems, overseeing the corrective action and assuring that the appropriate documentation is

generated, distributed and filed. The Project and Procedures Branch supervisor will assist the Project and Procedures Branch chemists in preparing QA reports and summaries.

6. DAQ Electronics and Calibration Branch Supervisor and Technicians
   The DAQ Electronic and Calibration Branch supervisor and technicians are responsible for conducting annual performance evaluations on the $SO_2$ monitors, and maintaining documentation as required in the relevant SOPs.

7. Duke Energy
   The Duke Energy Monitoring Technicians are responsible for implementing day-to-day QA activities for the monitoring program for the Skyland and Semora sites, and assisting, if necessary, with data quality audits and other internal audits. They are also responsible for documenting the response to required corrective actions in response/corrective action reports.

# 20.0 Reports to Management

This section describes the quality-related reports and communications to management necessary to support $SO_2$ DRR network operations and the associated data acquisition, validation, assessment, and reporting.

Guidance for management report format and content is provided in reports developed by EPA's Quality Assurance Division and Office of Air Quality Planning and Standards. These reports are described in the following subsections.

## 20.1 Quality Assurance Annual Report

Assessments of data quality for the $SO_2$ DRR network is required to be reported to EPA. DAQ's QA annual report is issued to meet this requirement. This document describes the quality objectives for measurement data and how those objectives have been met. The QA annual report will incorporate the results of each monitor's internal TSA, internal performance audit results, and any data quality audits performed independently from the TSA. The results of these audits will help describe the quality of all collected data, and will help identify any changes that need to be made to the DAQ $SO_2$ DRR monitoring network.

The QA annual report also reviews the $SO_2$ DRR systems on an annual basis to determine if the systems meet the monitoring objectives defined in 40 CFR Part 58, Appendix D. Such review identifies needed modifications to the network such as termination or relocation of unnecessary stations or establishment of new stations.

## 20.2 Network Reviews and Network Plans

Following the requirements in 40 CFR Section 58.10(a) the DAQ prepares and submits to the regional administrator an annual monitoring network plan. The plan provides for the establishment and maintenance of an air quality surveillance system consisting of a network of SLAMS monitoring stations and will include the $SO_2$ DRR monitoring sites. The annual monitoring network plan is made available for public inspection for at least 30 days before submission to EPA. As part of the network plan, annual network reviews of each site are conducted by the site operators. The network review determines if a system meets the siting requirements and monitoring objectives defined in 40 CFR Part 58, Appendix D. The review identifies needed modifications to the site and network including termination or relocation of unnecessary stations or establishment of new stations.

As required by 40 CFR Part 58, Appendix A, Section 5.1, DAQ provides a list of all monitoring sites and their AQS site identification codes to EPA Region 4 each year in the network plan. DAQ keeps AQS up-to-date by creating site data records with the date a site was established and other pertinent info. DAQ also sends any appropriate data to AirNow Tech. Whenever there is a change in this list of monitoring sites or in a reporting organization between network plans, DAQ reports this change to EPA Region 4 via electronic mail and to AQS and AirNow Tech by updating the appropriate site records.

## 20.3 Quarterly Reports

Each quarter, DAQ reports to AQS the results of all valid precision, bias, and accuracy tests it carried out during the previous quarter. The quarterly reports are submitted consistent with the data reporting requirements specified for air quality data as set forth in 40 CFR Part 58, Appendix A, Section 5.

Required annual performance evaluation and 1-pt QC check data are reported on the same schedule as quarterly monitoring data submittals.

Air quality data submitted for each reporting period will be edited, validated, and entered into the AQS using the procedures described in the AQS Data Coding Manual. A DAQ Project and Procedures Branch staff member will be responsible for preparing the data reports, which will be reviewed by the chief of the Ambient Monitoring Section before they are transmitted to EPA.

## 20.4 Response/Corrective Action Report

Whenever a problem is found, such as a safety defect, an operational problem, or a failure to comply with procedures, a response/corrective action process will take place.

- Identify the problem
- Identify why the problem occurred
- Identify a process in which it can be prevented from reoccurring
- Follow up after the process has been put into place

The four steps above will be documented within the electronic site visit logbook from the date of the original problem or infraction.

The response/corrective action report procedure will be followed whenever a problem is found such as a safety defect, an operational problem, or a failure to comply with procedures. A separate report will be required for each problem identified. The response/corrective action report is one of the most important ongoing reports to management because it documents primary QA activities and provides valuable records of QA activities that can be used in preparing other summary reports. Copies of response/corrective action reports will be distributed twice: first when the problem has been identified and the action has been scheduled, and second when the correction has been completed. Duke Energy will also follow a similar approach to corrective actions. The regional chemist or technician assigned will generate the response/corrective action reports. The report will be distributed to the appropriate supervisor and the DAQ Ambient Monitoring Section Chief.

# 21.0 Data Validation and Usability

## 21.1 Sampling Design

Sampling network and monitoring site selection must comply with:

- 40 CFR Part 58, Appendix A - Quality Assurance Requirements for SLAMS, SPM, and PSD Air Monitoring
- 40 CFR Part 51, Subpart BB – Data Requirements for Characterizing Air Quality for the Primary $SO_2$ NAAQS
- 40 CFR Part 58, Appendix E - Probe and Monitoring Path Siting Criteria for Ambient Air Quality Monitoring
- $SO_2$ NAAQS Designations Source-Oriented Monitoring Technical Assistance Document

Additional guidance is provided in *Guidance for Choosing a Sampling Design for Environmental Data Collection* (EPA QA/G-5S).

Any deviations from the minimum siting criteria (e.g., shelter location, probe placement, and/or monitor sight path requirements) shall be thoroughly documented in the site's QC documentation. Examples of deviations include, but are not limited to, insufficient distance from roadways (i.e., marginal terrain criteria) and insufficient distance from influencing objects (e.g., dripline of an adjacent tree or a cell phone tower that was installed after the monitoring site was established).

## 21.2 Sample Collection Procedures

Sample collection procedures are outlined in Section 11 of this QAPP. Potentially unacceptable data points are routinely identified in the database through the application of error flags. Each flag is associated with a unique error. These error flags are routinely reviewed as part of the data validation process. This activity assists in identifying suspect (potentially bad) data points that could invalidate the resulting averaging periods. A compilation of the error flags applicable to $SO_2$ monitoring is presented in Table 21.1.

Any deviation from the established sample collection plan must be documented in the appropriate logbook or data sheet. Accurate and complete documentation of any sample collection deviations will assist in any subsequent investigations or evaluations. Investigations and evaluations may be necessary to determine whether the data obtained from a particular site may qualify as a baseline or indicator for other sites.

**Table 21.1. Qualifier Code Description and Type**

| Flag | Flag Description | Flag Qualifier Type | Purpose |
|---|---|---|---|
| IS | Volcanic Eruptions | Informational Only | To provide information on events that influenced the measured values. |
| IT | Wildfire-U. S. | Informational Only | |
| J | Construction | Informational Only | |
| AA | Sample Pressure out of Limits | Null Data Qualifier | Void the data and submit the code in its place. |
| AB | Technician Unavailable | Null Data Qualifier | |
| AC | Construction/Repairs in Area | Null Data Qualifier | |
| AD | Shelter Storm Damage | Null Data Qualifier | |
| AE | Shelter Temperature Outside Limits | Null Data Qualifier | |

**Table 21.1. Qualifier Code Description and Type**

| | | | |
|---|---|---|---|
| AF | Scheduled but not Collected | Null Data Qualifier | Void the data and submit the code in its place. |
| AH | Sample Flow Rate out of Limits | Null Data Qualifier | |
| AJ | Filter Damage | Null Data Qualifier | |
| AK | Filter Leak | Null Data Qualifier | |
| AL | Voided by Operator | Null Data Qualifier | |
| AM | Miscellaneous Void | Null Data Qualifier | |
| AN | Machine Malfunction | Null Data Qualifier | |
| AO | Bad Weather | Null Data Qualifier | |
| AP | Vandalism | Null Data Qualifier | |
| AQ | Collection Error | Null Data Qualifier | |
| AS | Poor Quality Assurance Results | Null Data Qualifier | |
| AT | Calibration | Null Data Qualifier | |
| AU | Monitoring Waived | Null Data Qualifier | |
| AV | Power Failure | Null Data Qualifier | |
| AW | Wildlife Damage | Null Data Qualifier | |
| AX | Precision Check | Null Data Qualifier | |
| AY | Q C Control Points (zero/span) | Null Data Qualifier | |
| AZ | Q C Audit | Null Data Qualifier | |
| BA | Maintenance/Routine Repairs | Null Data Qualifier | |
| BB | Unable to Reach Site | Null Data Qualifier | |
| BC | Multi-point Calibration | Null Data Qualifier | |
| BE | Building/Site Repair | Null Data Qualifier | |
| BF | Precision/Zero/Span | Null Data Qualifier | |
| BJ | Operator Error | Null Data Qualifier | |
| BK | Site computer/data logger down | Null Data Qualifier | |
| BL | QA Audit | Null Data Qualifier | |
| BM | Accuracy check | Null Data Qualifier | |
| BR | Sample Value Below Acceptable Range | Null Data Qualifier | |
| DA | Aberrant Data (Corrupt Files, Aberrant Data) | Null Data Qualifier | |
| DL | Detection Limit Analyses | Null Data Qualifier | |
| SA | Storm Approaching | Null Data Qualifier | |
| ST | Calibration Verification Standard | Null Data Qualifier | |
| XX | Experimental Data | Null Data Qualifier | |
| 1 | Deviation from a CFR/Critical Criteria Requirement | Quality Assurance Qualifier | Flag indicating the quality of the data. In some cases, the data may not meet all of the criteria but is still valid. |
| 2 | Operational Deviation | Quality Assurance Qualifier | |
| 3 | Field Issue | Quality Assurance Qualifier | |
| 5 | Outlier | Quality Assurance Qualifier | |

**Table 21.1. Qualifier Code Description and Type**

| | | | |
|---|---|---|---|
| 6 | QAPP Issue | Quality Assurance Qualifier | Flag indicating the quality of the data. In some cases, the data may not meet all of the criteria but is still valid. |
| EH | Estimated; Exceeds Upper Range | Quality Assurance Qualifier | |
| NS | Influenced by nearby source | Quality Assurance Qualifier | |
| QX | Does not meet QC criteria | Quality Assurance Qualifier | |
| SX | Does Not Meet Siting Criteria | Quality Assurance Qualifier | |
| V | Validated Value | Quality Assurance Qualifier | |
| RS | Volcanic Eruptions | Request Exclusion | Flags data influenced by an exceptional event that will be excluded. |
| RT | Wildfire-U. S. | Request Exclusion | |

## 21.3 Quality Control

Section 14 specifies the QC checks that are to be performed during sample collection and analysis. These include the analysis of daily 1-point QC checks, which provide indications of the quality of data being produced by specified components of the measurement process. The procedure, acceptance criteria, and corrective action (and changes) should be specified for each quality control check. Data validation should document the corrective actions that were taken, which $SO_2$ sampling days or hours were affected, and the potential effect of the actions on the validity of the data. Further information about 1-point QC checks can be found in the applicable SOPs.

## 21.4 Calibration

Section 14 addresses the calibration of the $SO_2$ analyzer, along with the information that should be presented to ensure that the calibrations are performed correctly, and the results are acceptable. When calibration problems are identified, any data produced between the suspect calibration event and any subsequent recalibration should be flagged to alert data users. Further information about calibrations can be found in the applicable SOPs.

## 21.5 Data Reduction and Processing

As mentioned in the above sections, both internal and external TSAs will be performed to ensure the data reduction and processing activities mentioned in the QAPP are being followed. Data will be reviewed on a monthly basis to ensure that associated flags or any other data qualifiers have been appropriately associated with the data and that appropriate corrective actions were taken.

# 22.0 Validation and Verification Methods

Data verification is the process of evaluating the completeness, correctness, and conformance of a specific data set against the method, procedural, or contractual requirements, as specified in both the SOPs and 40 CFR Part 58. Data validation is a routine process that extends the evaluation of data beyond method, procedural, or contractual compliance (i.e. data verification) to ensure that reported values meet the quality goals of the environmental data operations and that the data can be utilized for its intended use.

## 22.1 Validating and Verifying Data

The validation and verification procedures that will be employed for this operation shall conform to the validation SOPs that are listed in Table 11.2. Verification and validation issues are also discussed at length in Guidance on Environmental Verification and Validation, (EPA QA/G-8). The regions and their designated support staff, along with the Duke Energy EIDM office staff, shall perform all verification activities. The central office shall provide additional support through a final review of all data reconciling any anomalies through discussions with the regional offices or Duke Energy. Following the final review, the central office will provide a final validation of all data. The central office will also provide other QC/QA support.

The data under evaluation should be compared to actual events as specified in the applicable SOPs. However, exceptional field events may occur, they may negatively affect the integrity of samples. In addition, it is expected that some of the QC checks will indicate that the data fail to meet the acceptance criteria. Data identified as suspect, or does not meet the acceptance criteria, shall be flagged as indicated in Table 21.1.

The review of the routine and the associated QC data will be verified and validated on a sample batch basis. The sample batch is the most efficient entity for verification/validation activities. The hypothesis is that if measurement uncertainty can be controlled at a batch level, then the overall measurement uncertainty will be maintained within the precision and bias DQIs.

## 22.2 Verification

After a sample batch is compiled, a thorough review of the data will be conducted for completeness and accuracy. Once the data are entered into the database, the data will be reviewed for routine data outliers and conformance to acceptance criteria. Unacceptable or questionable data will be flagged appropriately. All flagged data will be verified again to ensure that the values were entered correctly and that the data are acceptable for use.

## 22.3 Validation

Validation of measurement data requires two stages, one at the measurement value level and another at the batch level. Records of all invalid data shall be retained in the appropriate database. Information shall include a brief summary of why the sample was invalidated along with the associated flags. Logbook notes and field data sheets shall have more detailed information regarding the reason a sample was flagged. These documents shall remain with the field operators and/or at the monitoring site.

Data should be bracketed by 1-pt QC checks or manual calibration checks before and after any invalidated period. This helps to ensure that the $SO_2$ monitors were in proper operating condition before and after the incident.

Data validation occurs on a monthly basis. The review, verification, and validation process is outlined below. Specific roles are labelled within the organizational chart in Figure 4.1.

Level 0 Review

- Review on a daily basis for anomalies and completeness, and acquire missing data if available
- Invalidate data that were collected during an hour where the temperature was not within the acceptable range
- Evaluate automated nightly calibration checks (zero/precision/span) and take appropriate action if necessary
- Review minute data
- Verify maximum daily values for validity and take appropriate action if necessary
- Review the hourly $SO_2$ values for any exceedances and take appropriate action if necessary
- Apply necessary validation codes for hours in which maintenance or calibrations were occurring

Level 1 Review (Verification)

- Review site records (operator logbook, site data sheets)
- Review operator checks (leak checks and filter change)
- Assess data for values or outliers outside of the acceptable ranges
- Compare pollutant data with wind direction data
- Determine if any irregularities are caused by source specific emissions
- Flag data as necessary for their investigation

Level 2 Review (Verification)

- Ensure that consistent reasons for data invalidation are being used throughout monitoring period to indicate calibrations, audits, etc.
- Resolve any inconsistencies, anomalies or systemic issues
- Verify that all daily precision checks fall within acceptable ranges

Level 3 Review (Validation)

- Ensuring the proper null codes are utilized
- Ensuring that all invalidated data is bracketed with the appropriate void codes and the correct checks of analyzer accuracy
- Ensuring that the correct maximum 5-minute values are reported, and only for valid hours
- Ensuring that all data falls within the acceptable ranges as stated in the MQO's
- Ensuring that all data is acceptable and can be utilized for its intended use
- Adding informational AQS flags (from Table 21.1) to describe data that is out of the ordinary but may be considered 'valid'
- Provide final validation signature

Level 2 review will be complete within 20 days from the end of the monitoring month. Level 3 review will be done by the end of the following month.

## 22.4 Validating Exceedances

In the event of an $SO_2$ exceedance at an $SO_2$ DRR monitor, an exceedance report will be filled out.

If an exceedance is recorded, the DRR facility will be notified. Operator personnel will then retrieve the most recent calibration data (prior to the exceedance), along with the two 1-pt QC checks that surround the hour of $SO_2$ exceedance. In addition, the operator will retrieve the logbook from the most recent filter change and leak check. The facility may be contacted to determine if the facility was operating and if a malfunction or unusual incident caused the exceedance. All of these data will show that the monitor was in good operating condition, and that the exceedance was truly valid.

The operator (from DAQ or from Duke Energy) will have 10 business days following the exceedance to provide all required documentation to the DAQ Central Office. The Central Office will have 5 business days to review the documentation and validate the exceedance.

Specific instructions and a copy of the form can be found in the SOPs listed in Table 11.2.

## 23.0 Reconciliation with Data Quality Objectives

The objectives of this $SO_2$ monitoring program are described in Section 5. The DQO's for the $SO_2$ DRR monitoring project are described in Section 7.

The AQS AMP256 and AMP600 reports are automated reports based off of data that has been entered into AQS. These reports provide summary statistics for the $SO_2$ DRR data collected.

The DAQ will analyze the results of both the AQS AMP256 and AMP600 reports to ensure that all monitoring stations are meeting the required DQO's. If and when the data from at least one of the monitors violates the DQI bias and/or precision limits, then the DAQ Central Office will conduct an investigation to uncover the cause of the violation. If all of the monitors in the network of a similar type or pollutant violate the DQI, the cause may be at the agency level (operator training) or higher (problems with method designation). If only one monitor or site violates the DQI, the cause is more likely specific to the site (particular operator, problem with the site). Tools for determining the cause include reviewing:

- Data from a collocated network (Local Program, nearby reporting organizations, national)
- Data from performance audits (DAQ or NPAP)
- QC trails.

Once a cause has been identified, an appropriate corrective action can be implemented. Some particular courses of action include:

- Determining the level of aggregation at which DQOs are violated: The DQA process tells which monitors are having problems, since the DQOs were developed at the monitor level. To determine the level at which corrective action is to be taken, it must be determined whether the violations of the DQOs are unique to one site, multiple sites, or a network of similar monitors, or are caused by a broader problem. The AQS generates QA reports summarizing bias and precision statistics at the national and reporting organization levels by method designation. Examination of these reports may assist in determining the level at which the DQOs are being violated.
- Communicating with EPA Region 4: If a violation of the bias and precision DQIs are found, DAQ will remain in close contact with EPA for both assistance and for communication.
- Extensively reviewing quarterly data until DQOs are achieved: The ambient monitoring chief will continue to extensively review the quarterly QA reports and the QC summaries until the bias and precision limits are attained.