

## **18.0 Inspection/Acceptance of Supplies and Consumables**

### **18.1 Purpose**

The purpose of this element is to establish and document a system for inspecting and accepting all supplies and consumables that may directly or indirectly affect the quality of the project. The MAEMU relies on various supplies and consumables that are critical to its operation. By having documented inspection and acceptance criteria, consistency of the supplies can be assured. This section details the supplies/consumables, their acceptance criteria, and the required documentation for tracking this process.

### **18.2 Critical Supplies and Consumables**

Each MAEMU is equipped with a certain amount of spare parts and consumables (Table 18.1). The individual who receives the supply is responsible for inspecting the product. If the item is delivered to Iowa State University, that person responsible is Dr. Hong Li. If the item is delivered to the site in Kentucky, the person responsible is Mr. John Earnest.

### **18.3 Acceptance Criteria**

If a spare is used to replace an existing part (pump, solenoid valve) or a consumable is used at the correct replacement interval (filters), the person performing the replacement must follow the correct inspection criteria outlined in Table 18.1. The same applies to usage of calibration equipment. Supplies are inspected immediately upon receipt, and returned to the vendor if found to be unusable. A supply of spare parts in working condition is maintained whenever possible in order to ensure continuous data collection. All supplies and consumables beyond the expiration dates will be returned or disposed.

### **18.4 Tracking and Quality Verification of Supplies and Consumables**

Tracking and quality verification of supplies and consumables have two main components. The first is the need of the end user of the supply or consumable to have an item of the required quality. The second need is for the purchasing department to accurately track goods received so that payment or credit of invoices can be approved. In order to address these two issues, the following procedures outline the proper tracking and documentation procedures:

1. Receiving personnel perform a rudimentary inspection of the packages as they are received from the courier or shipping company. Note any obvious problems with a receiving shipment such as crushed box or wet cardboard.
2. The package is opened, inspected and contents compared against the packing slip, if necessary an expiration date is labeled with tape on the product (in general any expiration date has been placed on the product by the supplier).
3. Supply/consumable is compared to the acceptance criteria in Table 18.1.
4. If there is a problem with the equipment/supply, note it on the packing list, notify the supervisor of the receiving area and immediately call the vendor.

5. If the equipment/supplies appear to be complete and in good condition, sign and date the packing list and send it to accounts payable so that payment can be made in a timely manner.
6. Notify appropriate personnel that equipment/supplies are available.
7. Stock equipment/supplies in appropriate pre-determined area.
8. For supplies, consumables, and equipment used throughout the project, document when these items are changed out. If available, include all relevant information such as model number, lot number, and serial number.

**Table 18.1. Supplies at Tyson 3-3 MAEMU and Tyson 1-5 MAEMU.**

| <b>Qty.</b> | <b>Description</b>                                                               | <b>Vendor</b>                          | <b>Inspection Criteria</b>                                                       | <b>Action for Unacceptance</b> |
|-------------|----------------------------------------------------------------------------------|----------------------------------------|----------------------------------------------------------------------------------|--------------------------------|
| 2           | Pump, 115 VAC, 16.4L/min, 1/4" NPT ports, Teflon diaphragm, Thomas               | Combined Fluid Products (847-540-0054) | Visual Inspection—no dents or cracks & Operational Check before data collection  | Return                         |
| 8           | Pump diaphragm rebuild w/ Teflon liner                                           | Combined Fluid Products (847-540-0054) | Visual Inspection—no dents or cracks                                             | Return                         |
| 4           | Valve, Teflon, solenoid operated, 12V, 1/8" NPT ports, normally closed (648T011) | Neptune Research (973-808-8811)        | Visual Inspection—no dents or cracks & Operational Check before data collection  | Return                         |
| 4           | Valve, Teflon, solenoid operated, 12V, 1/8" NPT ports, normally open (648T021)   | Neptune Research (973-808-8811)        | Visual Inspection—no dents or cracks & Operational Check before data collection  | Return                         |
| 2           | Cool Drive Board, voltage reducing (648D5X12)                                    | Neptune Research (973-808-8811)        | Visual Inspection—no dents or cracks & Operational Check before data collection  | Return                         |
| 4           | PFA-220-1-2, 1/8"NPT-1/8" OD                                                     | Swaglok (402-733-7636)                 | Visual Inspection—no dents or cracks                                             | Return                         |
| 4           | PFA-620-1-4, 1/4" NPT - 3/8" OD                                                  | Swaglok (402-733-7636)                 | Visual Inspection—no dents or cracks                                             | Return                         |
| 4           | PFA-620-2-4, 1/4" NPT - 3/8" OD elbow                                            | Swaglok (402-733-7636)                 | Visual Inspection—no dents or cracks                                             | Return                         |
| 4           | PFA 620-9, 3/8" OD elbow                                                         | Swaglok (402-733-7636)                 | Visual Inspection—no dents or cracks                                             | Return                         |
| 4           | NY 600-2-1, 1/8" NPT - 3/8" OD elbow                                             | Swaglok (402-733-7636)                 | Visual Inspection—no dents or cracks                                             | Return                         |
| 10          | fitting, 1/8" NPT - 3/8" OD, Nylon (NY-600-1-2)                                  | Swaglok (402-733-7636)                 | Visual Inspection—no dents or cracks                                             | Return                         |
| 2           | Power supply, 5V, 15W, 2A, switching (Z1151-ND)                                  | Digikey (800-344-4539)                 | Visual Inspection—no dents or cracks<br>Operational Check before data collection | Return                         |
| 2           | Power supply, 12V, 100W, 8.6A, switching (602-1045-ND)                           | Digikey (800-344-4539)                 | Visual Inspection—no dents or cracks & Operational Check before data collection  | Return                         |
| 10          | Induction style current switch, (CR9321-PNP)                                     | CR Magnetics (636-343-8518)            | Visual Inspection—no dents or cracks & Operational Check before data collection  | Return                         |
| 6           | 6-47-6 Teflon filter holder                                                      | Savilex (954-936-2295)                 | Visual Inspection—no dents or cracks & Operational Check before data collection  | Return                         |
| 15          | Filter (5, 20-30 micron) pkg. 10                                                 | Savilex (954-936-2295)                 | Visual Inspection—no dents or cracks                                             | Return                         |
| 1           | N <sub>2</sub> zero gas (99.999%)                                                | Matheson (800-416-2505)                | Of the bottle pressure & expiration date                                         | Return                         |
| 1           | NH <sub>3</sub> span gas (25ppm)                                                 | Matheson (800-416-2505)                | Of the bottle pressure & expiration date                                         | Return                         |
| 1           | CO <sub>2</sub> span gas (2000ppm)                                               | Matheson (800-416-2505)                | Of the bottle pressure & expiration date                                         | Return                         |
| 1           | CH <sub>4</sub> span gas (3 or 80 ppm)                                           | Matheson (800-416-2505)                | Of the bottle pressure & expiration date                                         | Return                         |
| 1           | Propane span gas (3ppm)                                                          | Matheson (800-416-2505)                | Of the bottle pressure & expiration date                                         | Return                         |
| 1           | H <sub>2</sub> S span gas (10ppm)                                                | Matheson (800-416-2505)                | Of the bottle pressure & expiration date                                         | Return                         |

## **19.0 Data Acquisition Requirements (Non-Direct Measurement)**

Not applicable.

## 20.0 Data Management

All original and final data is reviewed and/or validated by technically qualified staff and so documented in the program records. The documentation includes the dates the work was performed, the name of the reviewer(s), and the items reviewed or validated.

Corrections and additions to original data must be made as follows:

1. After correction, original entries must remain legible (for manual corrections) or intact (for computerized corrections).
2. The correction or addition must be readily traceable to the date and the staff who performed the correction or addition.
3. Corrections must be explained.

### 20.1 Background and Overview

This section describes the data management operations pertaining to air emission measurements for the MAEMU stations operated by ISU and UK personnel. This includes an overview of the mathematical operations and analyses performed on raw (“as-collected”) data. These operations include data recording, validation, transformation, transmittal, reduction, analysis, management, storage, and retrieval.

Data processing for air emissions data is summarized in Figure 20.1. Originally, all electronic data is collected automatically using a set of programs written in LabView 7, which resides on a machine running the Windows XP operating system. And, the data, which resides on a machine running the Windows XP operating system, is processed using a set of programs written in Windows Excel 2003. This machine is shown in the upper left of Figure 20.1.

Each MAEMU has a compact Fieldpoint DAQ system. These DAQ systems continuously provide data collection at each site. The collected data is remotely acquired through a high speed satellite internet system.

Data tracking and chain of custody information is entered into the DAQ system at four main stages as shown in Figure 20.2. Project personnel are able to remotely view the real-time system display on status of site, fan status, sampling location and results of analyzer, etc. using the DAQ system. All users must be authorized by the QA Manager to log on to the DAQ system.

Different privileges are given to each authorized user depending on that person's need. The following privilege levels are defined:

**Data Entry Privilege**—The individual may see and modify only data that he or she has personally entered. After a data set has been "committed" to the system by the data entry operator, all further changes generate entries in the system audit trail.

**Reporting Privilege**—This privilege permits generation of data summary reports available under DAQ system. No data changes are allowed without additional privileges.

**Data Administration Privilege**—Data Administrators for the DAQ system are allowed to change data as a result of QA screening and related reasons. All operations resulting in changes to data values are logged to the audit trail. The Data Administrator is responsible for performing the following tasks on a regular basis merging/correcting the duplicate data entry files

- running verification and validation routines and correcting data as necessary
- generating summary data reports
- uploading verified/validated data to EPA

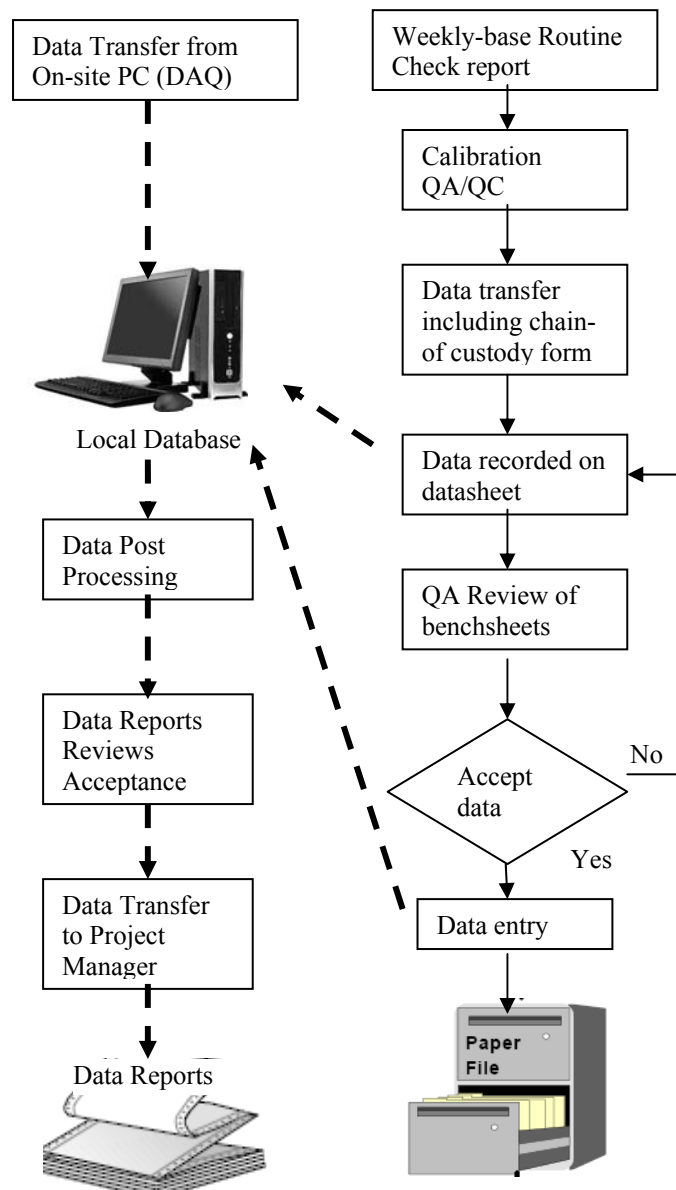


Figure 20.1. Data tracking and chain of custody information.

## 20.2 Data Recording

Any internal checks (including verification and validation checks) that are used to ensure data quality during data encoding in the data entry process are identified together with the mechanism for detailing and correcting recording errors. Examples of data entry forms and checklists are included in Appendix I.

Data entry, validation, and verification functions are all integrated in the routine report, DAQ system and Post Process. Bench sheets shown in Figure 20.1 are entered by laboratory personnel. Procedures for data recording and subsequent data entry are provided in SOPs listed in Table 20.1 and included in the corresponding Appendix.

Table 20.1. List of SOPs for data processing.

| SOP        | Title                                                                              | Description                                                          |
|------------|------------------------------------------------------------------------------------|----------------------------------------------------------------------|
| Appendix I | Data Management                                                                    | Describes the data processing operations, validation, and reduction. |
| Appendix J | Reporting and Calculation of Contaminant Concentrations, Ventilation and Emissions | Describes the procedures for data reporting and processing,          |

## 20.3 Data Validation

The details of the process of data validation and pre-specified criteria are documented in this element of the QAPP. This element addresses how the method, instrument, or system performs the intended function consistently, reliably, and accurately during data generation.

Data validation is a combination of checking that data processing operations have been carried out correctly and monitoring the quality of the field operations. Data validation can identify problems in either of these areas. Once problems are identified, the data can be corrected or invalidated, and corrective actions can be taken for field or laboratory operations. Numerical data stored in the DAQ system are never internally overwritten by condition flags. Flags denoting error conditions or QA status are saved as separate fields in the database so that it is possible to recover the original data.

The following validation functions are incorporated into the DAQ system to ensure quality of data entry and data processing operations:

**Duplicate Entry**—The following data are subjected to duplicate entry by different operators: QA/QC calibration and routine check data sheets. The results of duplicate entry are compared and errors are corrected at biweekly intervals. The method for entering the data is given in SOP Data Management.

**Range Checks**—Almost all monitored parameters have simple range checks programmed. For example, valid times must be between 00:00 and 23:59, summer temperatures must be between 10 and 50 degrees Celsius, etc. The data operator is notified immediately when data are out of range. The operator has the option of correcting the entry or overriding the range limit. The specific values used for range checks may vary depending on season and other factors. The currently used range values for data acceptance are provided in SOPs.

**Completeness Checks**—When the data is processed, certain completeness criteria must be met. For example, each air sample must have a start time, end time, average flow rate, temperature, relative humidity, and operator and technician name. The data entry operator is notified if an incomplete record has been entered before the record can be closed.

**Data Retention**—Raw data sheets are retained on file at ISU for a minimum of seven years, and are readily available for audits and data verification activities. After seven years, hardcopy records and computer backup media are cataloged and boxed for storage at ISU. Physical samples, such as litter samples, shall be discarded with appropriate attention to proper disposal of potentially hazardous materials.

**Statistical Data Checks**—Errors found during statistical screening are traced back to original data entry files and to the raw data sheets, if necessary. These checks are run on a monthly schedule and prior to any data submission to the project manager. Data validation is the process by which raw data is screened and assessed before it can be included in the main database.

**Data Validation**—Data validation, discussed in Section 24, associates flags that are generated by QC values outside of acceptance criteria. Data containing too many flags is rerun or invalidated.

Table 20.2. Validation check summaries.

| Type of Data Check                      | Manual Checks | Automated Checks |
|-----------------------------------------|---------------|------------------|
| Duplicate Entry                         | √             |                  |
| Range Checks                            |               | √                |
| Completeness Checks                     | √             | √                |
| Statistical Data Checks                 |               | √                |
| Date and Time Consistency               | √             | √                |
| Manual Inspection of Charts and Reports | √             |                  |

## 20.4 Data Transmittal

Data transmittal occurs when data is transferred from one person or location to another, or when data is copied from one form to another. Some examples of data transmittal are copying raw data from a notebook onto a data entry form for keying into a computer file and electronic transfer of data over a telephone or computer network. The SOP of Data Management (Appendix I)



describes each data transfer step and the procedures used to characterize data transmittal error and minimize information loss in the transmittal. Table 20.3 summarizes data transfer operations. The final data will be fully screened and validated and will be submitted to USEPA in both paper format and electronic format according to the reports schedule. The reporting periods and due dates are shown in the Table 22.1. Data will be maintained for a minimum of 7 years after the end of the project.

Table 20.3. Data transfer operations.

| <b>Description of Data Transfer</b>              | <b>Originator</b>                        | <b>Recipient</b>          | <b>QA Measures Applied</b>              |
|--------------------------------------------------|------------------------------------------|---------------------------|-----------------------------------------|
| Calibration Data and Reports (hard copy)         | Field operators (hand-written data form) | Data processing personnel | Duplicate entry                         |
| Calibration Data and Reports (email attachments) | Field operators (Electronic data file)   | Data base computer        | Transmission protocols; duplicate entry |
| Audit Data                                       | Auditor                                  | Data base computer        | Entries are checked by QA Manager       |
| Electronic data transfer                         | (Between computers or over network)      |                           | Parity checking; transmission protocols |
| Data summaries                                   | Data processing operators                | Air quality supervisor    | Entries are checked by QA Manager       |

## 20.5 Data Reduction

Data reduction includes all processes that change the number of data items. This process is distinct from data transformation in that it entails an irreversible reduction in the size of the data set and an associated loss of detail. For manual calculations, the QAPP includes an example in which typical raw data is reduced. For automated data processing, the QAPP indicates how the raw data is to be reduced with a well-defined audit trail and provides reference to the specific software documentation.

Data reduction processes involve aggregating and summarizing results so they can be understood and interpreted in different ways. The monitoring regulations require certain summary data to be computed and reported regularly to U.S. EPA. Other data is reduced and reported for other purposes such as station maintenance. Examples of data summaries include:

- average air concentration and emissions for a station or set of stations for a specific time period
- accuracy, bias, and precision statistics based on accumulated data
- data completeness reports based on numbers of valid samples collected during a specified period

Post data processing is another important concept associated with data transformations and reductions. Post processing is a data structure that provides documentation for changes made to a

data set during processing. Typical reasons for data changes that would be recorded include the following:

- corrections of data input as a result of human error
- application of revised calibration factors
- addition of new or supplementary data
- flagging of data as invalid or suspect
- logging of the date and times when automated data validation programs are run

The DAQ post process is implemented as a separate table in the Microsoft Excel database. Post process records will include the following fields:

- operator's identity (ID code)
- date and time of the change
- table and field names for the changed data item
- reason for the change
- full identifying information for the item changed (date, time, site location, parameter, etc.)
- value of the item before and after the change

When routine data screening programs are run, the following additional data is recorded in the audit trail:

- version number of the screening program
- values of screening limits (e.g., upper and lower acceptance limits for each parameter)
- numerical value of each data item flagged and the flag applied

The post process is produced automatically and can only document changes; there is no "undo" capability for reversing changes after they have been made. Available reports based on the Post Process include:

- log of routine data validation, screening, and reporting program runs
- report of data changes by site for a specified time period
- report of data changes for a specified purpose
- report of data changes made by a specified person

Because of storage requirements, the System Administrator must periodically move old Post Process records to backup media.

## **20.6 Data Analysis**

Data analysis sometimes involves comparing analyzer readings with standard calibration gas. It frequently includes computation of summary statistics, standard errors, confidence intervals, and goodness-of-fit tests. This element briefly outlines the proposed methodology for data analysis and a more detailed discussion will be included in the final report.

ISU is currently implementing the data summary and analysis requirements, see Appendix A. It is anticipated that additional data analysis procedures will be developed. The following specific summary statistics will be tracked and reported for the network:

- Analyzer bias or accuracy (based on cal-gas routine check, flow rate performance audits, and sensor performance evaluations)
- Analyzer precision
- Data completeness

Equations used for these reports are given in Table 20.4.

Table 20.4 Report equations.

| Criteria                                                                                                                                                                             | Equation                                                                      | Reference                             |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------|---------------------------------------|
| Accuracy of analyzer-single gas Check ( $d_i$ ) $X_i$ is reference; $Y_i$ is measured                                                                                                | $d_i = \frac{Y_i - X_i}{X_i} \times 100$                                      | 40 CFR 58 Appendix A, Section 5.5.1.1 |
| Bias of a single check - Annual Basis ( $D_j$ ) - average of individual percent differences between sampler and reference value; $n_j$ is the number of measurements over the period | $D_j = \frac{1}{n_j} \times \sum_{i=1}^{n_j} d_i$                             | 5.5.1.2                               |
| Percent Difference for a Single Check ( $d_i$ ) - $X_i$ and $Y_i$ are concentrations from the primary and duplicate samplers, respectively.                                          | $d_i = \frac{Y_i - X_i}{(Y_i + X_i)/2} \times 100$                            | 5.5.2.1                               |
| Coefficient of Variation (CV) for a single Check                                                                                                                                     | $CV_{j,q} = \sqrt{\sum_{i=1}^{n_j} \frac{CV_i^2}{n_{j,q}}}$                   | 5.5.2.2                               |
| Completeness                                                                                                                                                                         | $\text{Completeness} = \frac{N_{\text{valid}}}{N_{\text{theoretical}}} * 100$ |                                       |

## 20.7 Data Flagging

A sample qualifier or a result qualifier consists of three alphanumeric characters, which act as indicators of the fact and the reason that the data value (a) did not produce a numeric result, (b) produced a numeric result, but it is qualified in some respect relating to the type or validity of the result or (c) produced a numeric result, but for administrative reasons is not to be reported outside the laboratory. Qualifiers are used both in the field and in the laboratory to signify data that may be suspect because of contamination, special events, or failure of QC limits. Some flags are generated by the sampling instrument. Appendix I contains a complete list of the data qualifiers for the field and laboratory activities. Qualifiers will be placed on field and bench sheets with additional explanations in free form notes areas. When the validation process runs (see Section 24), flags are generated. During the sample validation process, the flags are used to

decide on validating or invalidating individual samples or batches of data. Section 24 discusses this process.

## 20.8 Data Tracking

Data management includes tracking the status of data as it is collected, transmitted, and processed. The QAPP describes the established procedures for tracking the flow of data through the data processing system.

The DAQ contains the necessary input functions and reports necessary to track and account for the whereabouts of calibration and the status of data processing operations for specific data. Information about analyzer calibration is updated at distributed data entry terminals at the points of significant operations. The following input locations are used to track calibration location and status:

- Mobile Laboratory
  - Calibration gas checking on analyzers
  - Calibration data for analyzers
  - Fan calibrations
- Emailing and Shipping (calibration data is entered for both sending and receiving)
- Laboratory
  - Data entering
  - Post processing

In most cases, the tracking database and the monitoring database are updated simultaneously. For example, when the calibration checking and calibration data are entered into the monitoring database, the calibration time and location are entered into the tracking database. The personnel from University of Kentucky will generate an electronic file which contains the time, site name and calibration data for chain-of-custody tracking.

Tracking reports may be generated by any personnel with report privileges on the data acquisition system. The following tracking reports are available:

- Litter samples that have been taken, shipped and received
- Weekly routine calibration and check reports
- List of data that have been transmitted from onsite computers to ISU computers
- List of data that have been processed on the ISU computer

The QA manager and data operators are responsible for tracking samples, routine weekly reports, and data files status on a weekly basis.

## 20.9 Data Storage and Retrieval

The DAQ system consists of a PC and compact Fieldpoint (National Instruments Corporation, Austin, TX) which is a data acquisition and automation controller composed of rugged I/O modules and intelligent communication interfaces. Real-time DAQ program developed using LabView 7 software (National Instruments, Corporation, Austin, TX) is used to acquire data, automate sampling location control, display real-time data, and deliver data and system operation status. The DAQ program consists of two sub-programs: an embedded program running in the CFP-2020 network module for collecting raw signals and controlling sampling location and a PC-based program running in the on-site project computer for data post-processing and data publishing on the webpage. The embedded program can run stand-alone and send out data and alarm by email. All the real-time readings of the instruments are recorded and displayed on the front panel of the program. Using LabView 7, the front panel can be published as a web page and viewed in real-time, and it can be controlled from a remote location through the Internet. The recorded data are stored daily to the on-site PC and backed up by a remote computer via a satellite high-speed internet connection. The stored data are also automatically transmitted through an email sever on a daily basis to provide redundant data transfer.

Electronic data will be recorded and stored on the on-site computer and will be downloaded daily at a scheduled time via a high-speed internet connection to a dedicated project computer at ISU. The data is backed-up weekly to CDs onsite by the UK personnel and to an external hard drive at ISU. To add data redundancy, the compact Fieldpoint stand-alone controller records the electronic raw data in a compact flash memory and sends the data out by email via a high-speed Internet connection (see Appendix G). For the precise data post process in the dedicated project computer, all the processed data will be stored in the computer and backed-up to the external hard drive. In addition to computer storage, raw tables or graphs are printed out and stored in loose-leaf notebooks.

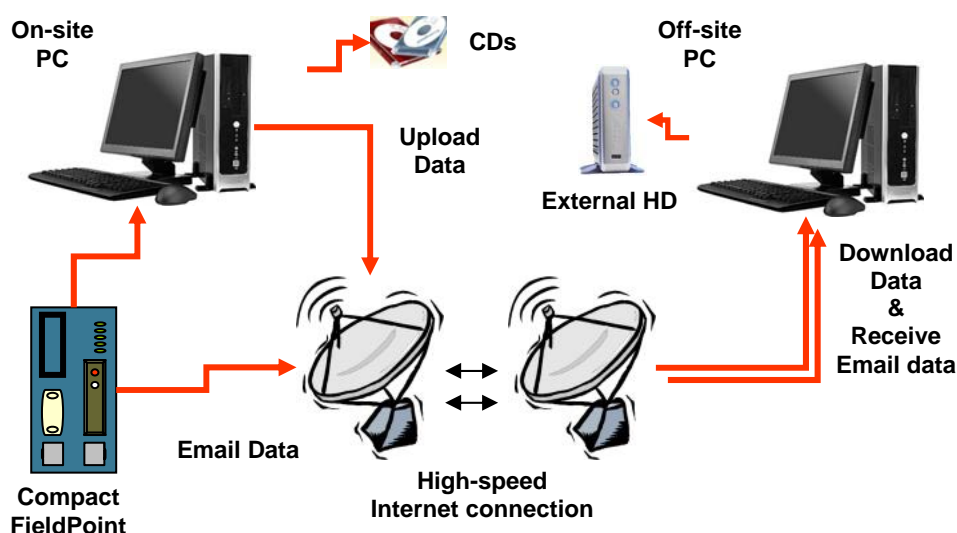


Figure 20.2. Flowchart of electronic data backup and storage.

Field test documentation and electronic data storage are maintained in accordance with standard operating procedures (see Appendix H), including storage of all raw electronic data in ASCII file format for later analysis using commercially-available spreadsheet and statistical programs (Appendix I). A large portion of the data is maintained electronically in the form of spreadsheets. All pollutants, temperature, pressure, RH and fan ON/OFF data is electronically stored and compiled in a manner that will facilitate computation of hourly and daily averages.

Accurate working files of all documentation including logbook entries, original data, data calculations, deviations from approved procedures, data uncertainties and assumptions, QA/QC results, external performance data, system audits, and system reviews, inspections, and validations are maintained by the principal investigators as appropriate until archived after the completion of the project. Project records are maintained in a systematic and logical form and adequately filed for rapid retrieval.

Data archival policies for the air emission data are shown in Table 20.5.

Table 20.5. Data archive policies.

| <b>Data Type</b>     | <b>Medium</b> | <b>Location</b> | <b>Retention Time</b>                                   | <b>Final Disposition</b> |
|----------------------|---------------|-----------------|---------------------------------------------------------|--------------------------|
| Laboratory Notebooks | Hardcopy      | Laboratory      | 7 years                                                 | Discarded                |
| Database             | Electronic    | Laboratory      | Indefinite (may be moved to backup media after 7 years) | Backup                   |
| Audit trail          | Electronic    | Laboratory      | 7 years                                                 | Discarded                |
| Samples              |               | Laboratory      | 1 year                                                  | Discarded                |

The air emission data resides on three IBM-PC compatible computers at the two research sites and at ISU. The two on-site computers are used to record and store raw data from analyzers and sensors. The data post processing program is run at the ISU computer which stores all raw data, processed data, and data handling programs. These computers have the following specifications:

- Processor: Pentium 2.8 GHZ
- Operating System: Windows XP
- Memory: 1 GB
- Storage: 200 GB
- Backup: Incremental backups daily; full backups weekly (750 MB CD-ROM)
- Network: Windows XP, 100 Mbps Ethernet network (Satellite internet connection via 196 kbps modem)
- Database Software: Microsoft Excel, Labview 7.0
- Security: Password protection on all PCs and internet connection; Additional password
- Protection applied by application software, internet connection with firewall.

Security of data in the air emission database is ensured by the following controls:

- Password protection on the data base that defines three levels of access to the data

- Regular password changes
- Independent password protection on internet connection
- Logging of all incoming communication sessions
- Storage of media including backup tapes in locked, restricted access areas

**20.10 Data Acquisition/Processing Software Validation**

The software being used in data acquisition and processing are validated. The data acquisition programs, running in the computers and Compact Fieldpoint and developed in Labview 7, are validated by comparing the reading from hardware and recorded data files. A macro data processing program, developed and running in Microsoft Excel, is validated by comparing with hand-calculations. A hand-calculation process is included in Appendix I SOP Data Management. Whenever the software are changed or upgraded, they will be documented and revalidated by following the same validation process.

Table 20.6. Data acquisition and processing software.

| Software Name                                                    | Location           | References |
|------------------------------------------------------------------|--------------------|------------|
| Microsoft Excel (2003)                                           | ISU computer       |            |
| Labview 7                                                        | All computers      | www.ni.com |
| CFP_embedded_XXX.vi                                              | Compact Fieldpoint | Appendix G |
| AMP(Client)_XXX.vi                                               | On-site computers  | Appendix G |
| Auto_Download_Tyson.vi                                           | ISU computer       | Appendix I |
| Data flagging & processing<br>(Macro in Microsoft Excel<br>2003) | ISU computer       | Appendix I |

## 21.0 Assessments and Response Actions

The principal investigators (PIs) are responsible for the initial assessment and evaluation of data in accordance with the validation procedures. Internal QA/QC audits of data collection and validation are conducted by the project QA Manager. The project PIs are responsible for initiating necessary actions in response to data assessment or internal audit findings. In the event that work must be stopped to conduct a response action required to comply with QAPP requirements or for other necessary reasons, the following project personnel have the authority to stop work: Mr. Kevin Igli and Mr. Steve Patrick with Tyson Foods (Funding Agency), Dr. Robert Burns and Dr. Hongwei Xin with ISU, Dr. Rich Gates with UK (Primary Project PIs) and Mrs. Lara Moody (Project QA Manager). The following assessment mechanisms, shown in Table 21.1, are implemented as part of the project quality assurance. As indicated Mrs. Lara Moody will serve as the Project Quality Assurance Manager. While Mrs. Moody is an employee of ISU she will not be under the supervision of any of the project PIs in regards to this project. Dr. Raj Raman is serving as Mrs. Moody's direct supervisor in regards to her duties as Quality Assurance Manager for this project. Mrs. Moody will report the results of her QA/QC activities on the project directly to Dr. Raman. Dr. Raman will review her findings and communicate the results and required actions to the project PIs.

Table 21.1. Quality assurance assessments and implementation frequency.

| Assessment Type                                           | Daily | Twice Weekly | Weekly | Every Flock | Twice | Once |
|-----------------------------------------------------------|-------|--------------|--------|-------------|-------|------|
| Remote System Observance                                  | X     |              |        |             |       |      |
| On-site System Inspection                                 |       | X            |        |             |       |      |
| Performance Evaluation Audits                             |       |              |        | X           |       |      |
| Internal Technical System Audits                          |       |              |        |             | X     |      |
| External Technical System Audit                           |       |              |        |             |       | X    |
| Data Completeness and Out of Range Data Flagging / Review | X     |              | X      |             |       |      |
| Flock Data Completeness & Emissions                       |       |              |        | X           |       |      |
| Audit of Data Quality                                     |       |              |        |             |       | X    |



### **21.1 Remote System Observance**

Remote observation of the monitoring system performance is a normal part of daily project activities and is conducted on a daily basis by ISU personnel (Hong Li) via a high-speed Internet connection to each MAEMU. Using a web-based remote interface all pollutant monitoring readings are viewed daily in real-time, as well as individual fan operational status, pressure differential, and temperature, relative humidity and dew point conditions at all four sampling points. The sample line heat trace temperatures are reviewed, as well as the GSS heat tape temperatures, GSS exhaust air flow, and the temperature inside each MAEMU.

### **21.2 On-Site System Inspection**

A complete on-site inspection of the monitoring system is conducted twice per week by UK personnel (John Earnest and Doug Overhults) who are located 30 minutes from each monitoring site. During a twice-weekly visit to each site, project personnel conduct a visual check on all system components including in-house sampling points, TEOMs and fans, the ambient monitoring point, and all instruments and components located inside the MAEMU. During one visit per week the paper element filters and the 20 micron *Teflon* filters are replaced. The TSP, PM<sub>10</sub> and PM<sub>2.5</sub> TEOM heads are also exchanged for clean heads during this visit (TEOM heads are exchanged twice per week because of the high dust conditions encountered in the broiler houses). A report detailing assessment observations and any required response actions is prepared by John Earnest following each visit and emailed to all team members the next business day following the site visit.

### **21.3 Performance Evaluation Audits**

The broiler houses are empty for approximately ten days following the removal of each flock of birds (each flock is in the house for ~ 52 days). During the ten day period between each flock, ISU and UK project personnel (Robert Burns, Hongwei Xin, Rich Gates, Doug Overhults, John Earnest and Hong Li) conduct a Performance Evaluation (PE) Audit at both Tyson 1-5 and Tyson 3-3. The audit includes a visual inspection of all system components and a flow check at each of the four sample points to confirm pump flows are maintaining a 15 L/min flow rate. A flow-audit is conducted on each TEOM during the audit. Leak checks of the GSS and supply lines are conducted by calibrating an additional INNOVA 1412 with the INNOVA 1412 located in the MAEMU, and then placing the second INNOVA 1412 at each sample point inside the broiler house and confirming matching ammonia readings. This provides a confirmation that no dilution air is entering the system, and that no leaks are present. The results of each PE Audit are documented and provided to the Program QA Manager for review.

### **21.4 Internal Technical System Audits**

A minimum of twice, the Project QA Manager (Lara Moody) will conduct a field oversight of sampling and analysis activities at each site as part of an Internal Technical System Audit (TSA). The TSAs will take place during two of the PE Audits, described above, during which

performance audit samples will be analyzed. During field oversight, the Project QA Manager will visually observe sample collection and analysis to verify that the procedures outlined in this QAPP are being followed and that any corrective action previously initiated is being continued. Field documentation of samples, calibration, QC measures, and corrective action will also be reviewed. In addition, the Project QA Manager will conduct a review of data and record management systems during the field monitoring period. During this review, the Project QA Manager will verify that the data management procedures are being followed. Reports from these two field assessments that document all issues identified during these reviews will be provided to Raj Raman and copied to Kevin Igli and Steve Patrick with Tyson Foods (Funding Agency), Robert Burns and Hongwei Xin with ISU, Rich Gates with the UK (Primary Project PIs) and the EPA Project Manager and the EPA Quality Officer. The project PIs will prepare an action plan that identifies how all items will be addressed and the schedule that the responses will be implemented in.

### **21.5 External Technical System Audits**

An external TSA team has been established and will conduct an audit following acceptance of the project QAPP. The audit team members are Dr. Larry Jacobson and Dr. David Parker, and EPA. Both are national recognized experts in AFO air emissions monitoring. Dr. Larry D. Jacobson is a Professor of Biosystems and Agricultural Engineering at the University of Minnesota located in St. Paul, MN. Dr. David B. Parker is an Associate Professor of Environmental Science and Engineering in the Division of Agriculture at West Texas A & M University located in Canyon, Texas, USA.

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An external TSA will be conducted once during the course of the study. External auditors will be asked to provide a field review of all monitoring system and data acquisition components to confirm that they have been installed in accordance with the QAPP. The project records including the notebooks that log all site visits and system calibrations, the twice-weekly On-site Visit Reports, the Internal TSA reports, the daily Data Completeness and Out of Range Data Flagging/Review reports, and the Flock Data Completeness and Emissions reports will be made available to the external auditors. The external audit team will be asked to review the above mentioned reports and emissions data to determine if the project data collection and management has been conducted in accordance with the project QAPP. The external auditors will provide a report that details their findings and any suggested changes in project execution as needed per their findings. This report will be distributed to EPA, Tyson Foods, ISU and UK project

personnel. Following the distribution and review of the report the project PIs will develop a plan to implement any required changes to data collection, management or analysis that are required as a result of the external audit findings. The project PIs will meet with the Project QA Manager, the EPA Project Manager, the EPA QA Officer and Tyson management to propose an implementation schedule that outlines each identified deficiency, the planned action, and the schedule for implementation.

### **21.6 Data Completeness and Quality Reviews**

As described in Section 24, a data processing program is run daily to process data collected on the previous day. This program calculates data completeness and automatically flags out of range data. ISU project personnel will review flagged data within two working days to confirm that the data is either invalid and cannot be used or valid and can be used. Only project PIs have the authority to validate flagged data following a review of the data. Flagged data that has not been validated will not be used in emissions calculations. A record of data review and any removal of data flags following review will be maintained. The response action to data flagged as out of range will be to investigate and document the reason that the data was flagged and to follow-up with a site visit if any data flags were the result of equipment malfunction and correct the problem.

### **21.7 Audit of Data Quality**

At the completion of the study, the Program QA Manager will perform an Audit of Data Quality. This audit will look at data from collection through final reporting, and it will address whether data was handled according to this QAPP and that results presented are accurately reflected by the data.

## 22.0 Reports to Management

During the project, the following reports will be prepared; Quarterly QA/QC Review Reports, On-Site System Inspection Reports, Performance Evaluation Audit Reports, Internal Technical System Audit Reports, External System Audit Reports, Daily Data Completeness and Validity Posting, Flock Data Completeness and Emissions Postings, Field Oversight Assessment Reports, Mid-Term Project Report and a Final Emissions Report. Table 22.1 provides the frequency, content, distribution and individuals responsible for the generation of each report.

Table 22.1. Reports to management.

| Report Type                             | Content                                                           | Frequency                                                                                           | Distribution                                                                                                                       | Responsible Person |
|-----------------------------------------|-------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------|--------------------|
| Quarterly QA/QC Review                  | Results of QA Managers review of project data management          | Quarterly                                                                                           | Dr. Raj Raman                                                                                                                      | Mrs. Lara Moody    |
| On-site System Inspection Reports       | Description of on-site visit & any identified issues              | Twice Weekly                                                                                        | All ISU and UK project personnel                                                                                                   | Mr. John Earnest   |
| Performance Evaluation Audit Reports    | Confirmation and results of each system check performed in audits | At the end of each flock (~ 52 days)                                                                | Mrs. Lara Moody<br>Dr. R.T. Burns<br>Dr. Hongwei Xin<br>Dr. Rich Gates<br>Dr. Steve Hoff<br>Dr. Doug Overhults<br>Mr. John Earnest | Dr. Hong Li        |
| Internal Technical System Audit Reports | Results of Internal Audit Findings                                | Twice—One during 4 <sup>th</sup> Quarter of 2006 and one during the 1 <sup>st</sup> Quarter of 2007 | Mrs. Lara Moody<br>Ms. Sharon Nizich<br>Mr. Joe Elkins<br>Dr. R.T. Burns<br>Dr. Hongwei Xin<br>Dr. Rich Gates<br>Dr. Steve Hoff    | Mrs. Lara Moody    |

|                                         |                                                                                     |                                             |                                                                                                                                                                           |                                                                       |
|-----------------------------------------|-------------------------------------------------------------------------------------|---------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------|
| External Technical System Audit Reports | Results of External Audit Findings                                                  | Once during 4 <sup>th</sup> Quarter of 2006 | Mrs. Lara Moody<br>Ms. Sharon Nizich<br>Mr. Joe Elkins<br>Dr. R.T. Burns<br>Dr. Hongwei Xin<br>Dr. Rich Gates<br>Dr. Steve Hoff<br>Dr. Doug Overhults<br>Mr. John Earnest | Dr. David Parker<br>Dr. L. Jacobson                                   |
| Data Completeness and Validity Posting  | Data completeness & validity determination for daily environmental & emissions data | Daily                                       | All ISU and UK project personnel via web                                                                                                                                  | Dr. Hong Li                                                           |
| Flock Data Completeness & Emissions     | Data completeness & validity determination for flock emissions data                 | Each flock (~ 52 days)                      | All ISU and UK project personnel via web                                                                                                                                  | Dr. Hong Li                                                           |
| Field Oversight Assessment Reports      | Assessments of Internal Technical System Audits Execution                           | Twice during project                        | Dr. Raj Raman                                                                                                                                                             | Mrs. Lara Moody                                                       |
| Mid-Term Project Report                 | Project and milestone completion status                                             | 3 <sup>rd</sup> Quarter 2006                | Mr. Kevin Igli<br>Mr. Steve Patrick<br>Ms. Sharon Nizich                                                                                                                  | Dr. Robert Burns                                                      |
| Final Emissions Report                  | Emissions results                                                                   | 3 <sup>rd</sup> Quarter 2007                | Mr. Kevin Igli<br>Mr. Steve Patrick<br>Ms. Sharon Nizich<br>Mr. Joe Elkins                                                                                                | Dr. R.T. Burns<br>Dr. Hongwei Xin<br>Dr. Rich Gates<br>Dr. Steve Hoff |

## **23.0 Data Review, Verification, and Validation Requirements**

For this project, data review is the examination of data to ensure that the information has been recorded, transmitted, and processed correctly; including checking for errors pertaining to data entry, transcription, calculation, reduction and transformation. Data review for the gaseous and particulate matter sampling includes 1) quality control information as described in Section 15: Quality Control Measures (i.e., instrument setup, calibration, and accuracy and bias check data), 2) instrument testing and maintenance information as described in Section 16: Instrument/Equipment Testing, Inspection and Maintenance (i.e., online and on-site inspection and maintenance data), 3) instrument calibration and frequency records and described in Section 17: Instrument/Equipment Calibration and Frequency (i.e., calibration dates, instrument calibration offsets from standards, and corrective measures), and 4) generated gaseous, particulate matter, fan flow and environmental condition data used for emission rate calculations. Data review for the litter analysis includes 1) quality control information as described in Section 14: Analytical Methods (i.e., spiked matrices and triplicate analyses), 2) records verifying litter sample collection and handling methods as described in Sections 12 and 13 describing Sampling Methods, Handling and Custody, and 3) nutrient concentration data generated through litter sample analysis.

Data verification is the process for evaluating the completeness, correctness and conformance of a data set against the collection methods specifications. For the gaseous and particulate matter sampling, this means insuring the data sets are 75% complete and that daily emission rates meet the Measurement Performance Criterion of less than 10% uncertainty as per the DQO stated in Section 7: Quality Objectives and Criteria for Measurement Data, and insuring that individual concentration and fan flow data falls within the ranges specified for the equipment and the project as described in Section 7: Quality Objectives and Criteria for Measurement Data. For the litter analyses, data verification means insuring the standard deviations between replicated samples and generated data are acceptable for the methods described in Section 14: Analytical Methods. Data validation extends beyond data verification and is to determine the quality of the data for end use. Data validation for both gaseous and particulate matter sampling and litter sampling will occur throughout the project. Data is compared to other data already available in the literature to determine if it is within the expected range. Data verification and validation are described below in additional detail.

All UK and ISU project personnel who perform work on-site have a responsibility to report any deviation from the SOPs established for the project. Any deviations from the SOPs that occur during twice-weekly on-site visits conducted by UK personnel will be recorded in the On-Site System Inspection Reports. Any deviations from standard SOPs that occur during the Internal System Audits will be documented and explained in the Internal System Audit Report generated following the audit visit.

### **23.1 Gas and Particulate Matter Sampling System**

Section 11: Sampling Process Design describes the sampling system design for this project; including emission rate calculations, sampling equipment selection, in-house sample locations, and data collection frequency. The objective of the sampling design is to determine air emissions representative of broiler houses and to ensure adequate levels of spatial and temporal resolution. It is the responsibility of the project PIs to ensure that the sampling systems function properly and the responsibility of the Project Quality Assurance Manager to confirm that appropriate data quality checks and documentation are implemented to confirm the final quality of collected data. During twice weekly on-site inspections, UK project personnel confirm through visual inspection that the sampling system conforms to the sampling system design specifications. A weekly sampling line leak check is performed to ensure the specifications and representativeness of each sampling line in Figure 15.5. The full performance of the sampling system is confirmed during Performance Evaluation Audits conducted between each flock of birds (approximately every 52 days).

#### Verification

Verification of individual fan flow rates will occur at the end of each flock removal from the broiler houses. Following bird removal from the houses and prior to fan calibration, each fan is visually inspected to confirm that it has been pressure washed and that belts (on belt driven fans) are adjusted to the correct tension. During the between flock checks, all aspects and parts of the fan calibration will be checked and verified by following the QAPP. Verification of the sampling system occurs through twice-weekly and between flock checks. The twice-weekly checks inspect the functioning of sampling instruments. The sample lines and data lines are checked weekly. A weekly leak check is required for all sampling lines. (The output from all instruments and operation of the sampling system components are checked daily). During the between flock checks, all aspects and parts of the sampling system are checked and verified by following the QC.

#### Sampling System Validation

The data from routine visit and between flock audits will be used to validate the sampling system and to ensure that the sampling system meets the objective of the project as described in Section 6: Project Task Description. The field event and corrective actions for the sampling system will be documented and comments will be added to the data table for the data validation.

### **23.2 Analytical Procedures**

Section 12, 13, 14 and 15 detail the requirements for the analytical methods.

#### Verification

The Quality Assurance Manager conducts audits to ensure proper procedures were followed during all aspects of litter sample handling, including collection and analysis. The Chain of Custody form requires a signature by the sampler verifying they used the proper methods and includes a comment section that can be completed in the case of a deviation. The QA Manager will review these COCs to verify or note deviations from the planned procedures. The analytical method specifications mentioned in the QAPP are being followed. Deviations will have been reviewed and accepted by the PIs and noted as such in comments added to the data records.

Deviations from the analytical procedures will also be noted in audit finding forms and corrected using the procedures described in Section 21.

#### Validation

Similar to the validation of sampling activities, the review of data from lab blanks, calibration checks, laboratory duplicates and other laboratory QC that are described in Sections 15 and 16 can be used to validate the analytical procedures. Acceptable precision and bias in these samples indicate that the analytical procedures are adequate. Any data that indicates unacceptable levels of bias or precision or a tendency (trend on a control chart) will be flagged and investigated. Any discovery of inappropriate analytical procedures will trigger corrective action.

### **23.3 Quality Control**

For each specified QC check, the procedure, acceptance criteria, and corrective actions are specified in Table 16.1 and 16.2. During each field visit, a QC report will be completed and each QC check departure or corrective actions will be documented by field personnel. In addition, comments will be included in the electronic data file that note when any corrective action was required such that it is linked with the impacted data.

#### Verification

As mentioned in the above sections, both internal and external audits will be performed to ensure the QC method specifications mentioned in the QAPP are being followed. All QC data from field reports and lab data processing will be verified by QA manager and PIs.

#### Validation

Validation activities of many of the other data collection phases mentioned in this subsection use the quality control data to validate the proper and adequate implementation of that phase. Therefore, validation of QC procedures requires a review of the documentation of corrective actions taken when QC samples fail to meet acceptance criteria, and the potential effect of the corrective actions on the validity of the routine data should be noted.

### **23.4 Calibration**

When calibration problems are identified, data produced between the suspect calibration event and any subsequent recalibration will be flagged to alert data users. Sections 16 and 17 detail the calibration activities and requirements for the critical pieces of equipment for the air emission monitoring. The linearity of gas analyzers was checked and confirmed in the lab. Two-point calibration (zero and span) will be performed for the gas analyzers. The span calibration standards will cover 80% of the normal gas's concentration range (e.g. 25 ppm NH<sub>3</sub> calibration standard is used when the house NH<sub>3</sub> concentration is around 30 ppm). The calibration standard is shown in Table 15.1.

#### Verification

As mentioned in the above sections, both internal and external technical systems audits will be performed to ensure the calibration specifications and corrective actions mentioned in the QAPP are being followed. Deviations from the calibration procedures will be noted in the routine field



reports and the data summary table. The corrective action will be applied and a recalibration will be introduced.

#### Validation

Similar to the validation of sampling activities, the review of calibration data described in Sections 15 and 16 can be used to validate calibration procedures. Calibration data within the acceptance requirements would lead one to believe that the sample collection measurement devices are operating properly. Any data that indicates unacceptable levels of bias or precision or a tendency (trend on a control chart) will be flagged and investigated. Validation would include the review of the documentation to ensure corrective action will be taken as prescribed in the QAPP.

### **23.5 Data Reduction and Processing**

When calibration problems are identified, any data produced between the suspect calibration event and any subsequent recalibration will be flagged to alert data users. Sections 16 and 17 detail the calibration activities and requirements for the critical pieces of equipment for the air emission monitoring.

#### Verification

As mentioned in the above sections, both internal and external technical systems audits will be performed to ensure the data reduction and processing activities mentioned in the QAPP are being followed. The procedure for data reduction and processing is in Section 20. The duplicate data entry method is used to ensure quality of data entry and data processing.

#### Validation

As part of the audits of data quality, a percentage of sample IDs (5%), daily data files (5%) and summary files (15%) will be identified (chosen at random). All raw data files, including the following will be selected:

- Electronic data (recorded by DAQ system and computer)
- Routine check
- Calibration -the calibration information represented from that sampling period
- Sample handling/custody
- Corrective action

The raw data will be reviewed and final emissions will be calculated by hand to determine if the final values submitted to EPA compare to the hand calculations. The data will also be reviewed to ensure the associated flags (Table 24.1) or any data comments have been appropriately associated with the data and that appropriate corrective actions were taken.

## 24.0 Verification and Validation Methods

Many of the processes for verifying and validating the measurement phases of the emission data collection have been discussed in Section 23. If these processes, as written in the QAPP, are followed, the DQOs should be achieved. However, exceptional field events may occur, and it is expected that some of the QC checks will fail to meet the acceptance criteria.

Information on problems that could affect the integrity of data is identified in the form of flags (Appendix I). It is important to determine what caused these out of range indications in the data. In some cases there may be a unique event occurring and the data may truly represent measured parameters and simply be outside of the expected range. In other cases, out of range data may be the result of equipment that is out of calibration or that has failed. The review of this raw data and the associated QC data will be verified and validated in a routine report on the basis of calibration data. The routine report and calibration data is the most efficient entity for verification/validation activities. It is assumed that if measurement uncertainty can be controlled within acceptance criteria, at calibration level, then the overall measurement uncertainty will be maintained within the precision and bias DQOs.

### 24.1 Verification

After a one-day data set is downloaded to the ISU computer, a review will be conducted for completeness, correctness, conformance/compliance of the environmental and concentration data against the QC standard, instrument operational conditions and broiler house normal operating conditions. All data is evaluated using a program specifically developed for this task (MAEMU v1.2, developed by using Visual Basic) and is running on an ISU computer for this project. The program reviews the data for data outliers and data outside of acceptance criteria. These data are flagged appropriately. The acceptance criteria, listed in Table 24.1, are set up in the program and are used to determine if individual data or data from a particular instrument has been flagged. In some cases, the flagging criteria vary because of variations in expected data ranges such as seasonal differences and bird growth. Verification of measurement data is conducted in three parts, one for the environmental condition measurement value, the second for the air sample measurements, and the third for fan operational parameters.

Temperature, relative humidity, barometric pressure and static pressure readings are inspected first. Any reading outside of the normal operation range is flagged appropriately; then UK field personnel are notified and asked to make an on-site inspection to determine the reason for out of range data (e.g., malfunction of sensors or true out of range reading). When the cause of flagged data is confirmed in an on-site visit, the needed corrective action will be taken and documented. During the on-sight visits, the following checks are also conducted. As indicated below, if an out of range reading is found during these checks, it will result in data from the last correct field check being flagged through the current date.

- The gas analyzers (INNOVA, API 101E, and VIG) are routinely challenged (weekly) with calibration gases. If the reading of one gas does not meet the QC standard, the data collected

between current site visit and the last site visit where the unit met the QC criteria will be flagged. For example, the NMHC reading is 2.8 ppm when 3 ppm propane cal-gas is injected, the difference, 0.2 ppm is larger than 5% of cal-gas concentration (0.15 ppm). In this case all NMHC readings since the last calibration will be flagged with “CVN”. In addition, the gas-concentration will be flagged if the reading is out of the analyzer operation range. For instance all NMHC data would be flagged with “OVN” if the NMHC reading exceeds 10 ppm.

- The TSP, PM<sub>10</sub> and PM<sub>2.5</sub> operational readings from TEOMs are reviewed based on the routine leak test and operation range. If the main flow rate of TEOM with a TSP head is not in the range, 0.98 to 1.02 L/min, a flag “OTF” will be recorded.

A separate flag data set will be created and flags of individual data will be filed. Based on the data flags, the daily completeness of each variable will be derived using following equation:

$$\text{Completeness} = \frac{N_{\text{total}} - N_{\text{flag}}}{N_{\text{total}}} \times 100$$

After calculating completeness and data flagging, the program will create a daily verification form to summarize the flags and completeness for environment variables, air pollutants and fan operation data. The flagged data will not be used for daily air emission calculation.

Daily emissions for each pollutant are calculated based upon the data flag status (i.e. only data that has not been flagged is used) and a daily emission report is generated; this includes a summary table for individual gas emission, flags, and completeness of the pollutant. If any flag is detected by the program, a flag notification email will be sent to all PIs for addressing and solving the problem(s). This daily report will be posted on a secured web-site and PIs (Burns, Xin, Gates or Hoff) will review it within 2 working days. All the data points with flags are inspected and the reason addressed. Also, the verified daily emission data is summarized on a flock basis.

## 24.2 Validation

Data is internally validated by the Quality Assurance Manager (Lara Moody), data processing operators (Hong Li) and all PIs. The daily air emission reports are reviewed as well as the other routine reports, field calibration data and lab record.

The data validation includes the following four steps:

- Review all the routine field visit reports and calibration report to ensure QC standard is met, if not the corresponding data will be invalidated.
- Review data verification records, including data flags, and daily emission reports; if the flagged data meets the QC standard, these data points will be revalidated and the data processing program will be rerun.
- Summarize data and QC deficiencies if the data quality was not met and evaluate the impact on overall data quality
- Develop data validation reports quarterly.

A checklist of criteria and items to evaluate during each stage of data review is listed in Table 24.1. In cases where any of the criteria and checks can be automated using the post processing program, random checks should still be performed to ensure that the auto-check is working properly. If errors or problems are identified through any of the following checks, corrective action, appropriate to the problem, should be taken (e.g., reanalysis, data qualification, troubleshooting, or documentation).

Table 24.1. Verification and Validation data flags and action.

| Requirement                    | Data Range                  | Acceptance Criteria | Flag                                          | Action                                                                                             |
|--------------------------------|-----------------------------|---------------------|-----------------------------------------------|----------------------------------------------------------------------------------------------------|
| Temperature                    | 32°F ~ 105°F                | > 105°F<br>< 32°F   | OET<br>(Temperature over range)               | Reanalysis/ Confirmation by on-site visit / calibrate / replace Thermocouple/document              |
| Relative Humidity              | 0~100%                      | >100%<br>< 0        | OEH<br>(RH over range)                        | Reanalysis/ Confirmation by on-site visit / calibrate / replace RH Sensor/document                 |
| Barometric Pressure            | 900~1050 kpa                | >1050<br>< 900      | OEB<br>(Baro pressure over range)             | Reanalysis/Confirmation by on-site visit / calibrate / replace Barometric pressure sensor/document |
| Static Pressure                | -0.05 ~ 0.5 inch Water      | >0.25<br>< -0.02    | OEP<br>(Static pressure over range)           | Reanalysis/Confirmation by on-site visit / calibrate / replace Static pressure sensor/document     |
| Fan Current Switch             | ON/OFF                      | OFF (all the time)  | FCS<br>(Switch malfunction)                   | Reanalysis/Confirmation by on-site visit / replace Fan Current Switch/document                     |
| Temperature                    | <±1°F (Checking)            | >±1°F               | OCT<br>(Thermocouple needs recalibration)     | Reanalysis/Confirmation by on-site visit / replace Thermocouple/document                           |
| Relative Humidity              | <±5% of Standard (Checking) | >±5%                | OCH<br>(RH needs recalibration)               | Reanalysis/Confirmation by on-site visit / Calibration/document                                    |
| Barometric Pressure            | <±5% of Standard (Checking) | >±5%                | OCB<br>(Baro pressure needs recalibration)    | Reanalysis/Confirmation by on-site visit/ Calibration/document                                     |
| Static Pressure                | <±5% of Standard (Checking) | >±5%                | OCP<br>(Static pressure needs recalibration)  | Reanalysis/Confirmation by on-site visit / Calibration/document                                    |
| NH <sub>3</sub>                | <±5% of Standard            | >±5%                | CIA<br>(Ammonia needs recalibration)          | Data qualification<br>Reanalysis/Confirmation by on-site visit / Calibration/document              |
| CO <sub>2</sub>                | <±5% of Standard            | >±5%                | CIC<br>(CO <sub>2</sub> needs recalibration)  | Data qualification<br>Reanalysis/Confirmation by on-site visit / Calibration/document              |
| H <sub>2</sub> S               | <±5% of Standard            | >±5%                | CHS<br>(H <sub>2</sub> S needs recalibration) | Data qualification<br>Reanalysis/Confirmation by on-site visit / Calibration/document              |
| Non-Methane Hydrocarbon (NMHC) | <±5% of Standard            | >±5%                | CVN<br>(NMHC needs recalibration)             | Data qualification<br>Reanalysis/Confirmation by on-site visit / Calibration/document              |

|                                     |                                     |                                  |                                                     |                                                                                                   |
|-------------------------------------|-------------------------------------|----------------------------------|-----------------------------------------------------|---------------------------------------------------------------------------------------------------|
| Methane                             | <±5% of Standard                    | >±5%                             | CVM<br>(CH <sub>4</sub> needs recalibration)        | Data qualification<br>Reanalysis/Confirmation by on-site visit / Calibration/document             |
| Total Hydrocarbon (THC)             | <±5% of Standard                    | >±5%                             | CVT<br>(THC needs recalibration)                    | Data qualification<br>Reanalysis/Confirmation by on-site visit / Calibration/document             |
| H <sub>2</sub> S Measurement Range  | 0~100 ppb                           | > 100<br>< 0                     | OHS<br>(H <sub>2</sub> S over range)                | Reanalysis/Confirmation by on-site visit / Calibration/document                                   |
| NMHC Measurement Range              | 0-10 ppm                            | > 10<br>< 0                      | OVN<br>(NMHC over range)                            | Reanalysis/Confirmation by on-site visit / Calibration/document                                   |
| Methane Measurement Range           | 0-100 ppm                           | > 100<br>< 0                     | OVM<br>(CH <sub>4</sub> over range)                 | Reanalysis/Confirmation by on-site visit / Calibration/document                                   |
| THC Measurement Range               | 0-100 ppm                           | > 100<br>< 0                     | OVY<br>(THC over range)                             | Reanalysis/Confirmation by on-site visit / Calibration/document                                   |
| TSP Flow                            | 0.98~1.02 LPM<br>(<0.15 leak check) | > 1.02<br>< 0.98<br>(>0.15 leak) | OTF<br>(TSP flow over range)                        | Data qualification<br>Reanalysis/Confirmation by on-site visit / Leak check & correction/document |
| TSP Measurement Range               | 0~100 mg/m <sup>3</sup>             | > 100<br>< 0                     | OTR<br>(TSP concentration over range)               | Reanalysis/Confirmation by on-site visit / Instrument Inspection                                  |
| PM <sub>10</sub> Flow               | 0.98~1.02 LPM<br>(<0.15 leak check) | > 1.02<br>< 0.98<br>(>0.15 leak) | OPF<br>(PM <sub>10</sub> flow over range)           | Data qualification<br>Reanalysis/Confirmation by on-site visit / Leak check & correction/document |
| PM <sub>10</sub> Measurement Range  | 0~50 mg/m <sup>3</sup>              | > 50<br>< 0                      | OPR<br>(PM <sub>10</sub> concentration over range)  | Reanalysis/Confirmation by on-site visit / Instrument Inspection/document                         |
| PM <sub>2.5</sub> Flow              | 0.98~1.02 LPM<br>(<0.15 leak check) | > 1.02<br>< 0.98<br>(>0.15 leak) | OMF<br>(PM <sub>2.5</sub> flow over range)          | Data qualification<br>Reanalysis/Confirmation by on-site visit / Leak check & correction/document |
| PM <sub>2.5</sub> Measurement Range | 0~20 mg/m <sup>3</sup>              | > 20<br>< 0                      | OMR<br>(PM <sub>2.5</sub> concentration over range) | Reanalysis/Confirmation by on-site visit / Instrument Inspection/document                         |

## 25.0 Reconciliation with User Requirements

Section 7: Quality Objectives and Criteria for Measurement Data describes the DQOs set forth for this project to assure data representativeness, completeness, comparability, and accuracy. Section 23: Data Review, Verification, and Validation Requirements and Section 24: Verification and Validation Methods describe the requirements and methods used in this project to determine the data representativeness, completeness, comparability, and accuracy that will aid in meeting the DQOs. The DQO for data completeness is to obtain valid emissions data for no less than 75% of the scheduled sampling for each pollutant. As explained in section 7, the ER uncertainty is a complex function of multiple variables. As such the DQO uncertainty cannot be described as a single value. As explained in section 7, the ER uncertainty is expected to much less than 10%. Figure 7.1 provides an upper bound on the ER uncertainty of 10% when fan flow is at 20,000 cfm, all instruments having a 5% uncertainty, calibration gases having a 50% uncertainty (3% error rather than 2%) and fans having a 10% uncertainty. The purpose of the QAPP is to ensure that these component uncertainties do not exceed allowable values. The values used in the ER analysis in section 7 either equal or exceed the limits set in the QAPP for these values. As such it is expected that the ER uncertainty for this study will typically be less than 10%. Given the ER uncertainty decreases as fan flow rate increases, Figure 7.1 indicates that the upper bound on ER uncertainty will approach 6% during high ventilation rates and approach 4% uncertainty under expected sampling conditions during higher fan flow rates. As such the DQO sets the Measurement Performance Criterion for daily emission rates at an uncertainty of no more than 10%. The emission rate uncertainty for each pollutant is calculated as per section 7.4 at the end of each flock.

The steps to perform the Data Quality Assessment are provided below:

1. Review the DQOs provided in Section 7 and the sample design process detailed in Section 11: Sampling Process Design
2. Conduct a preliminary review of the data
  - a. Uncover potential limitations to using the data, to reveal outliers, and to explore the basic structure of the data (processing, reviewing, and sharing the preliminary data included in Section 24)
  - b. Look for anomalies in recorded data, missing values, and any deviation from standard operating procedure
3. Perform statistical analysis of the preliminarily accepted data
  - a. Base statistical test selection on the primary objective (to determine representative broiler house gaseous and particulate emission rates ( $\text{kg bird}^{-1} \text{ day}^{-1}$ ))
4. Verify assumptions of the statistical tests
  - a. Assumptions include those associated with the development of the DQOs
    - i. DQO is based on performance criteria and component error analysis
    - ii. Data used for the statistical computation of an emission rate must meet the 75% completeness standard defined in the DQOs (Section 7)
5. Draw conclusions from the data
  - a. Determine if an statistical assumptions were violated
  - b. Use the statistical analysis to determine representative emission rates

Data is provided to the end users (Tyson and EPA decision makers) in the Final Emissions Report delivered in the 4<sup>th</sup> quarter of 2007. The report will include a section describing the steps taken to meet the DQOs and descriptions of the data provided. Data provided will include all raw data and the statistical analysis used to draw conclusions about the results. Possible limitations to the data will be described in the report. The report will also provide a description of the facilities where the data was collected. This information will help end users in understanding the systems for which the data collected and reported during this study are representative.

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