CAER QA/QC Phase 1 Project Team - Final Report

Contents

I. Project Overview

As part of the Combined Air Emission Reporting (CAER), the EPA and State, Local and Tribal (SLT) air programs are working together to identify opportunities to reduce redundancy, improve quality, and increase efficiency in the reporting of air emissions from facilities. One of the initial research areas identified by the Product Design Team (PDT) under CAER was to identify and evaluate a common set of emissions data quality assurance and quality control (QA/QC) procedures that could potentially be applied under a shared emission reporting system as envisioned under CAER. This project is the first phase in that effort, with the objective being to identify a 'common' or 'standard' set of QA/QC protocols, checks, and procedures and to evaluate/recommend their potential use and applicability for an electronically-based, shared system application under the CAER proposed future state. Consistent with priority goals of the overall CAER implementation plan, particular consideration was given to both automated QA/QC checks as emissions data are being submitted, as well as procedures that could improve and streamline post-submission QA/QC.

This project report, along with others related to research on the different components needed for developing a shared emissions system (e.g., the emissions reporting data model project; Toxic Release Inventory (TRI) program crosswalk study, greenhouse gas (GHG) mapping study, Source Classification Code (SCC) and emission factor study), will also provide the broader audience of SLT and EPA program offices involved with emissions reporting a deeper understanding of what type of activities are part of the overall CAER effort. The CAER team hopes this will prompt interest and further engagement to provide feedback and input to future phases of the projects.

Section II of this report describes the data collected for this project regarding in-use QA/QC procedures and checks that are applied in emissions reporting systems at both SLT and federal programs. The focus of this CAER QA/QC project team is on *emissions- related* data QA/QC checks;

facility data attribute checks (such as facility address and component identification) are being addressed separately by a separate facility data management project under the E-Enterprise Facility Integration Team (IPT). Also, for purposes of this compilation and review, there was no attempt to strictly define boundaries around what is considered "QA" versus what is considered "QC". We understand that these terms are sometimes defined separately, and strictly, according to specific program applications; however, this is often not the case as observed from the research conducted for this project, and to ensure the broadest consideration and review of program procedures, we refer to QA/QC checks in general terms of any procedures or data quality checks used to identify errors and improve the quality of the reported emissions.

Section II also includes summary information from a national survey conducted by state team members regarding in-use QA/QC procedures for emissions reporting programs, and presents a compilation of a common set of QA/QC procedures and checks resulting from the project team research and survey results.

Section III provides recommendations and suggested steps for the next phase of this project. Appendix A provides a listing of in-use QA/QC checks and procedures compiled as part of this project, and Appendix B provides a listing of SLT programs who provided input on the survey and the compilation of QA/QC checks.

II. Identification of a Common Set of In-Use QA/QC Procedures

a. Description of research to identify in-use QA/QC procedures

The CAER QA/QC project team prepared a 'starting point' compilation of QA/QC checks and procedures identified from the review of a small sample of state programs represented on the QA/QC project team (states of WY, VA, NC, SC, GA, and AZ), as well as EPA programs such as the Emissions Inventory System/National Emissions Inventory (EIS/NEI) system and TRI. The compilation of QA/QC checks and procedures were collected into two tables as described below and made available for review as part of the national QA/QC survey described in Section II.b:

Table 1. Routine Automated QA/QC Checks: This table contained what are typically automated, electronic checks built into existing emission inventory systems. The starting point for this table was the EIS and the State and Local Emission Inventory System (SLEIS) emissions reporting systems, complemented with additional checks identified by a review of a small sample of other SLT program systems represented on the project team. The table was further split into two pieces: one showing the automated checks done on the emissions or emissions calculation-related data elements, and the second showing the automated checks on non-emissions-related data elements such as required identifiers, valid codes, proper formats, etc. While necessary, these non-emissions-related data element checks were not a focus for this project team.

Table 2. Emissions Data Accuracy and Reasonableness QA/QC Checks: The QA/QC checks and procedures included in this table are often not broadly applied in an automated/electronic manner as part of emissions inventory systems. They are focused on the reasonableness, accuracy, and consistency

of the reported emissions values and associated inputs to the calculations (e.g., throughputs) or measurements used to prepare those reported emissions values. Often time these checks are performed as part of 'engineering review' or 'manual checks,' sometimes as part of a smaller subset of prioritized facility emission reports. These checks were identified from a small sample of state programs as represented on the project team, as well as EPA programs such as TRI and GHG RP.

In addition to development of the tables of QA/QC checks and procedures described above, SLT members of the project team developed appropriate survey questions to use as part of a national survey. The SLT members focused their questions on obtaining information from SLT programs on how they implemented their QA/QC checks and procedures as part of their emissions reporting system, the characteristics of their reporting system, and the extent and value to which automating certain QA/QC checks may improve their current QA/QC systems. When asking if automated checks are used, the survey stated that is was NOT referring to the standard, automated checks that are part of a program's EIS submittal to EPA, but, instead, to those front-end automated checks that have been implemented by a program, such as those that are part of an interface or submittal process for reporting facilities, or are implemented as part of an SLT's program review and processing of received emissions data. The specific questions and results of the survey are summarized in Section II.b below.

b. Summary of QA/QC survey findings

The following summarizes the findings from the state-led QA/QC survey, which was distributed to SLT organizations nationwide in spring 2017. The survey was conducted by the state team leads using an online survey platform, and it involved seven central questions. In total, there were 33 respondents to the national survey. The first two questions asked responders if they reviewed and added any additional QA/QC checks and procedures to the starting point tables of checks (Tables 1 and 2 described above and provided as part of the survey). The remaining questions asked responders about general characteristics of their QA/QC procedures that they use in their emissions inventory program.

The survey questions and a summary of responses are provided below, along with accompanying charts and specific participant comments. A high-level overview of findings suggested by the survey data is found at the beginning of this section. Also, regarding the survey questions related to Tables 1 and 2, while this section provides an overview of the responses to these questions, a more detailed review of these responses, and the revisions to our compilation of QA/QC checks and procedures resulting from our review of the suggested additions to Tables 1 and 2, are provided in Section II.c.

Overall Summary of Survey Findings

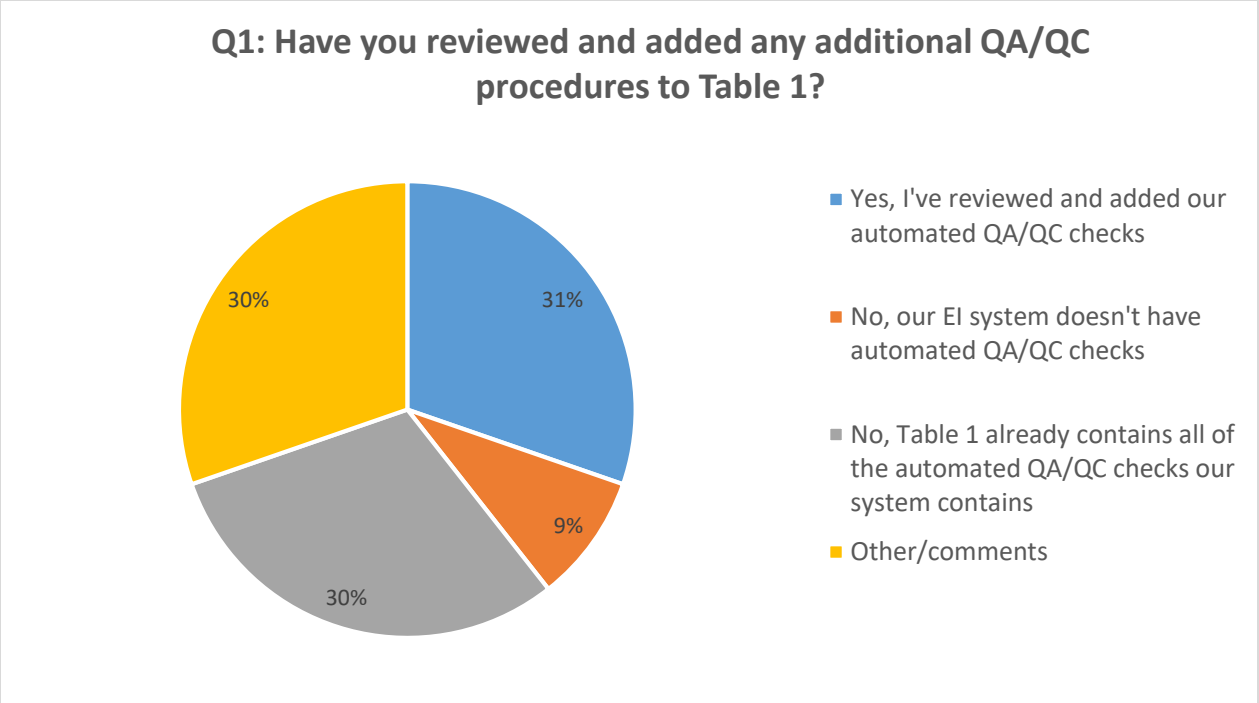
The following are salient findings from the QA/QC team survey that may help the QA/QC team in continued research and serve as helpful points of context for the broader PDT and CAER research efforts:

- Ten respondents (or approximately 30%) indicated that they added additional checks and procedures to the 'starting' point tables that were provided for review as part of survey. The other 70% indicated that the tables contained all the checks that they perform. This provides some indication that the starting point compilation was fairly representative of the types and range of checks currently in use.
- Nineteen participants (or almost 60% of responses) indicated that at least 75% of their reporting facilities used a web-based interface for reporting emission to their EI system. This gives some indication of the availability and possibility to build off such web-based platforms for various CAER components in the future.
- Ten participants (or approximately 30% of total respondents) indicated that at least 75% of their reporting facilities used a 'manual' reporting system via PDF, Excel, or hard-copy submittals. Along with the results regarding web-based electronic reporting and other methods, this is one indicator of the diversity in emissions reporting systems in place and an important consideration in future investigations of automating certain QA/QC procedures.
- Only one third of survey participants indicated that more than half of their QA/QC procedures are automated, which suggests that most participants' reporting systems do not have extensive automated QA/QC procedures and automation of these procedures may make sense as an area for continued research.
- Nearly all the survey participants indicated that they believe there is potential value in integrating automated QA/QC checks into their emissions reporting systems; however, there were a number of comments highlighting concerns over the cost-to-value ratio to implement, particularly modifications to existing systems.
- 85% of survey participants indicated that their EI and permitting systems are not currently integrated, indicating that QA/QC checks and procedures relying on such integration will be dependent on further progression in this area, including the fundamental pre-requisite of e-permitting systems. However, the potential for improved QA/QC implementation through permitting system/EI system integration is clearly a promising area for further investigation.

Summary of QAQC Survey Responses for Each Question

Text of Survey Question 1: Have you reviewed and added any additional QA/QC procedures to Table 1?

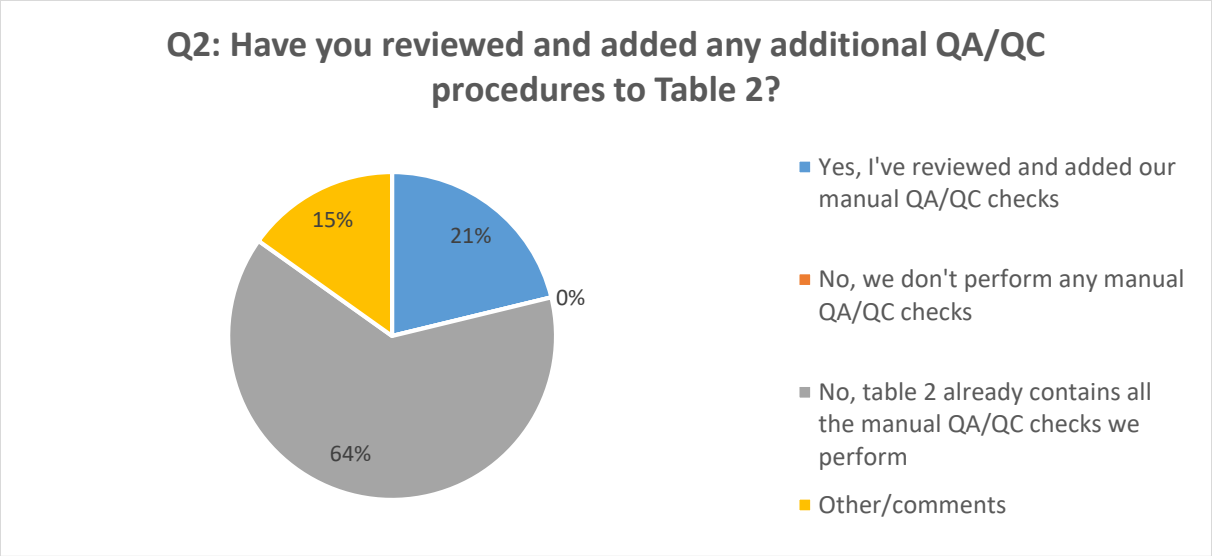
Summary of responses: When asked to add any additional QA/QC procedures to Table 1 nearly one third of participants indicated that they had added their additional procedures, and about the same amount indicated that their QA/QC procedures were already included in the list. Approximately 10% of participants indicated that their systems had no QA/QC checks beyond the standard EIS set. Comments related to Table 1 focused on clarifications of what they had added; none of these clarifications raised significant issues, instead serving to fine tune their additions and/or describe a nuance of their QA/QC system.



- **Survey participant comments regarding Question 1:**
  - Survey participant intends to start with a limited list of QA/QC upgrades this year and incorporate a long-term plan with upgrades over the next 12 months.
  - Survey participant added additional QA/QC procedures, but noted that they are manual rather than automated checks.
  - Survey participant organization's system has the same QA checks as the EIS with several additional ones for calculating method codes and hazardous air pollutants.
  - Survey participant's team uses SLEIS which has automated QA/QC checks that are equivalent to the EPA EIS business rules.
  - Survey participant noted that most of the "REQU DATA" elements in Table 1 are not actually required.

Text of Survey Question 2: Have you reviewed and added any additional QA/QC procedures to Table 2?

Summary of Responses: In contrast to Question 1 regarding Table 1, Question 2 responses show that more than two thirds of participants' manual QA/QC procedures were already included in Table 2. Only 21% of respondents indicated that they had added manual QA/QC checks to Table 2, versus 31% of respondents adding automated QA/QC checks as they indicated in responses to Question 1. Comments from survey participants focused primarily on clarifying their responses.



- **Survey participant comments regarding Question 2:**
    - Survey participant indicated that many of the post-submittal checks listed as "not able to automate" are handled in a post-submittal crystal report.
    - Survey participant's organization performs some ad-hoc analyses which overlap with some Table 2 checks.
    - Survey participant added a question of whether the proper/accepted control efficiencies are used in the emissions calculations where appropriate.

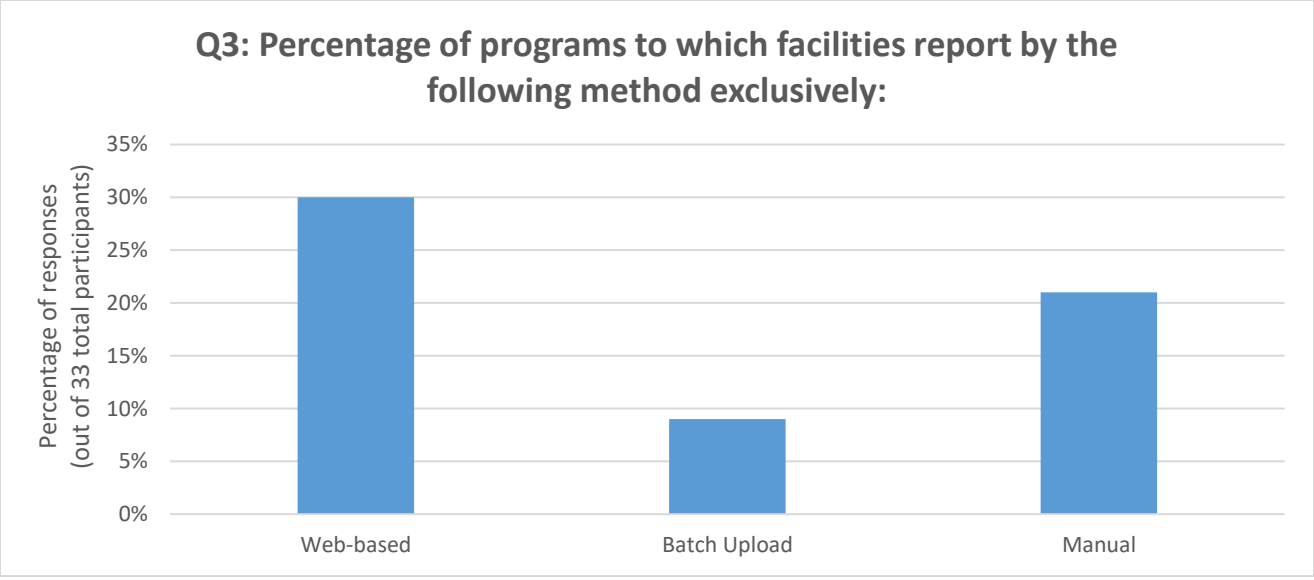
In addition to asking for respondents to review and provide input to the table compilations of QA/QC checks, the survey also posed the following questions regarding the general characteristics and implementation of QA/QC procedures as part of respondent's emission inventory system. The following summarizes those questions and responses.

Text of Survey Question 3: Indicate what percentage of your facilities use the following reporting methods:

- Web-based interface for electronic reporting
- Batch upload of emissions data via electronic reporting
- "Manual" reporting via PDF, Excel, or hard copy submittals
- Other

Summary of Responses: Survey participants expressed a varied range of reporting methods for facilities.

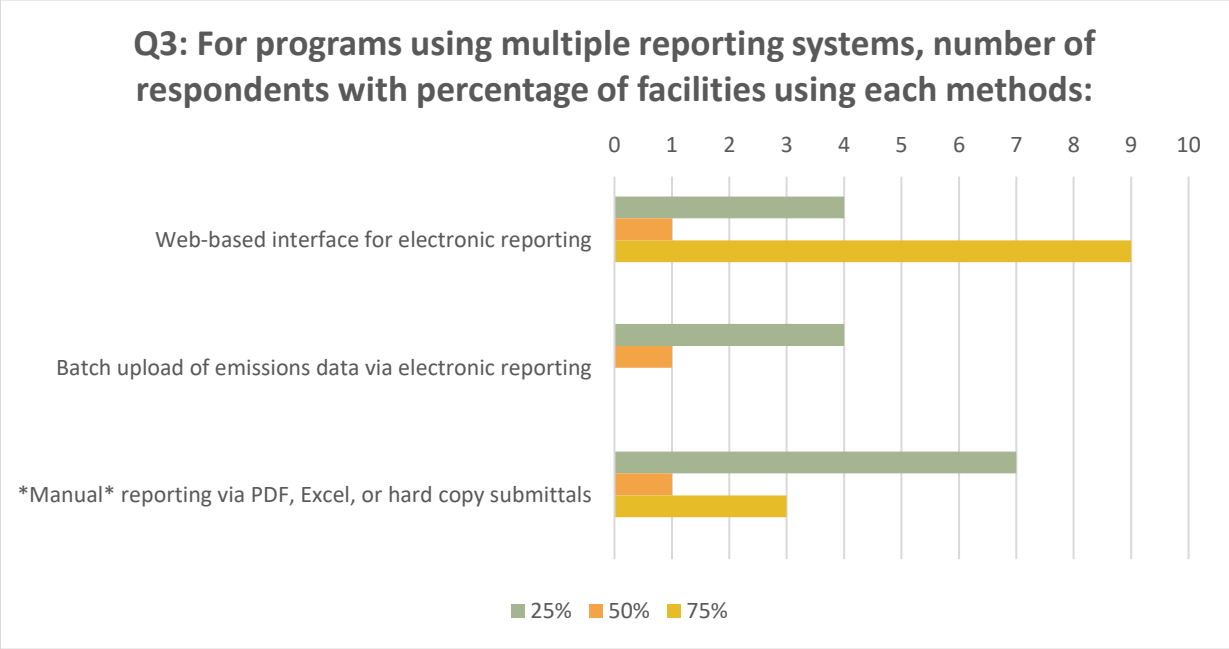
- 10 participants indicated that 100% of facilities used a web-based interface for electronic reporting, with 9 responding that 75% use it, one responding that 50% use it, and four responding that 25% use it – six responded that electronic reporting through a web-based interface was not applicable to their EI system.
- Four participants indicated that 25% of electronic reporting to their systems by facilities was conducted by batch upload, one indicated that 50% of the facilities used batch upload via electronic reporting to report, and four indicated that 100% of facilities used batch upload of emissions data via electronic reporting. Batch upload of emissions data via electronic reporting was the least applicable of all the facility reporting method options, with 16 survey participants responding that it did not apply to their EI systems.
- In terms of facilities using manual reporting (via PDF, Excel™, or hard copy submittals) for emissions data submittal, seven participants indicated that 100% of their reporting facilities use manual reporting, three participants indicated that 75% of facility reporting was done manually, one participant indicated that 50% of facility reporting was done manually, and seven participants indicated that 25% of facility reporting was done manually. Nine survey participants indicated that manual reporting was not applicable for their EI system.
- The two figures immediately below capture the reporting system variation noted in the responses. The first figure shows percentage of programs who responded that 100% of their reporting facilities use the reporting method shown. The second figure captures the respondents who had a mix of reporting methods.



There were many comments regarding this survey question. They are separated into two categories across the following two pages to reflect two central dynamics:

- Comments that focused on explaining other ways facilities can report to the EI system beyond web-based, batch upload and manual reporting; and
- Comments focused on clarifications of participants' submissions that did not fit perfectly within the 0-25%-50%-75%-100% division offered in the online survey structure.

In their comments, survey participants described ways that they are upgrading their systems to make more options available to facilities (e.g., including Excel files that can be directly uploaded by the facility) and specific ways that they assist facilities (e.g., in-person assistance at the regulatory organization's physical location). Several survey participants also noted 60-40 and 90-10 splits between how facilities reported, which were not presented as an option to them in the online survey platform.



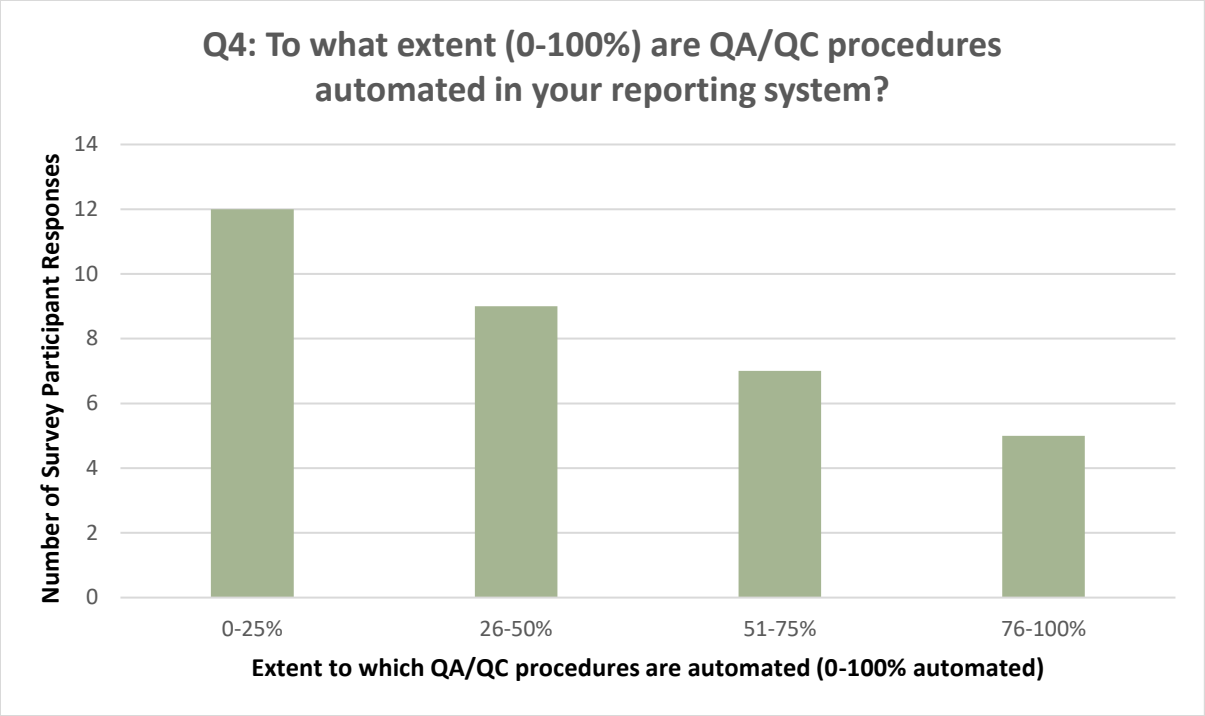
- **Survey participant comments regarding Question 3. The following list is made up primarily of responses regarding the request for explanations for the "If other please describe" prompt.**
    - Survey participant listed "Access Databases" as a reporting method they use that was not explicitly listed in the survey options.
    - Survey participant organization is currently upgrading system to include Excel files that can be directly uploaded by the facility.
    - Survey participant organization noted that some of their sources use batch upload, but that their system is not set up to report the number.
    - Survey participant noted that there are cases when their organization assists reporters in person at their physical location.
    - Survey participant noted that SLEIS does not document whether facility data is uploaded through the web-based interface or batch upload (via a comma separated variable (csv) file).

- Survey participant noted that batch uploads are included in their organization's web-based interface because they go through that system.
- Survey participant noted that they have a web-interface for Title V facilities only.
- Survey participant noted that facilities claiming confidential business information must also submit completed paper copies per their organization's policy.

- **Survey Participant clarifications regarding their submission (as shown in chart above):**
  - Survey participant noted that 60% of reporting happens via spreadsheet or Microsoft Access tables for manual batch upload (by survey participant's organization), and most of those 60% then do an official submission through a web-based interface. Approximately 39% report via web-based interface only, and the remaining 1% report using hard-copy submittals.
  - Survey participant indicated that the 50% web-based / 50% batch upload split is meant to relay the information that both are allowed, not the fraction of facilities that use either method.
  - Survey participant noted that they have approximately 90% of submittals from a web-based interface, and 10% of their submissions from batch upload rather than the 75% split that they indicated in their survey submission.
  - Survey participant noted that the actual split of EI submittals for CY 2015 is 90% web based / 10% hard copy.

Text of Survey Question 4: In your estimation, to what extent are QA/QC procedures automated in your reporting system (0-100%)?

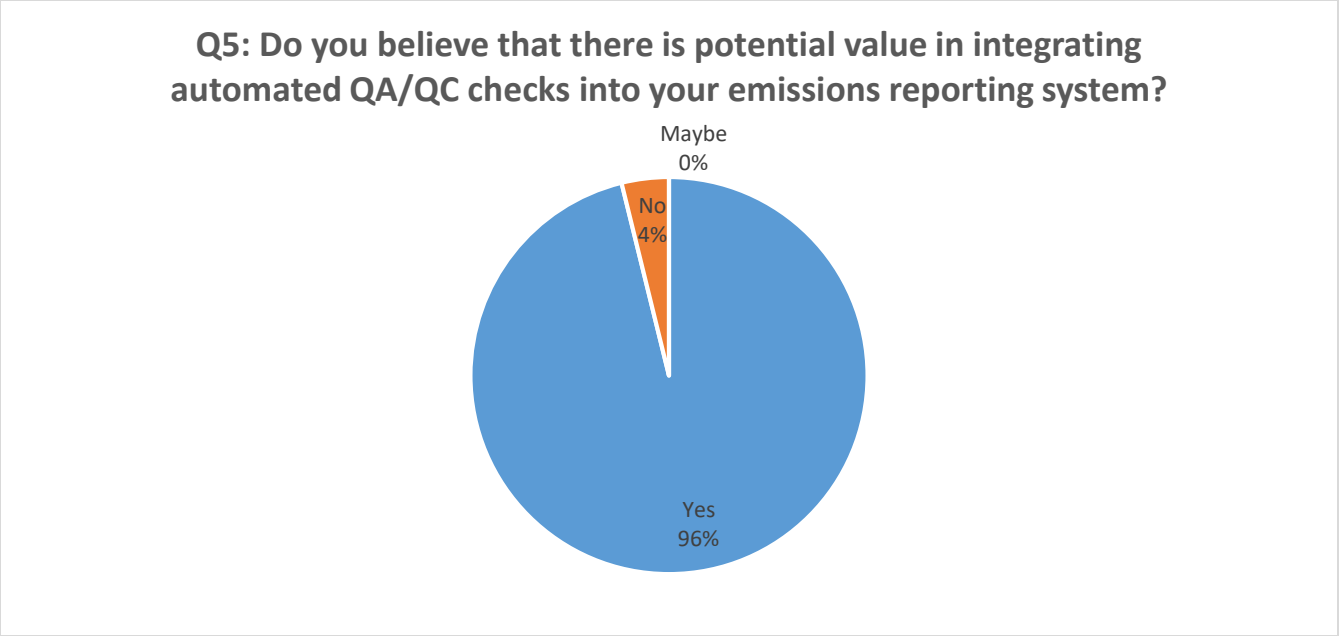
Summary of responses: 12 survey participants indicated that 25% or less of their QA/QC procedures are automated in their reporting system, with 9 responding that only between 26% and 50% of their QA/QC procedures are automated. Even fewer (7 participants) indicated that between 51% and 75% of their QA/QC procedures are automated. Only 5 participants indicated that at least 76% of their QA/QC procedures are automated. These data show that most participants' reporting systems do not have extensive automated QA/QC procedures.



- **No comments.**

<u>Text of Survey Question 5</u>: Do you believe that there is potential value in integrating automated QA/QC checks into your emissions reporting system?

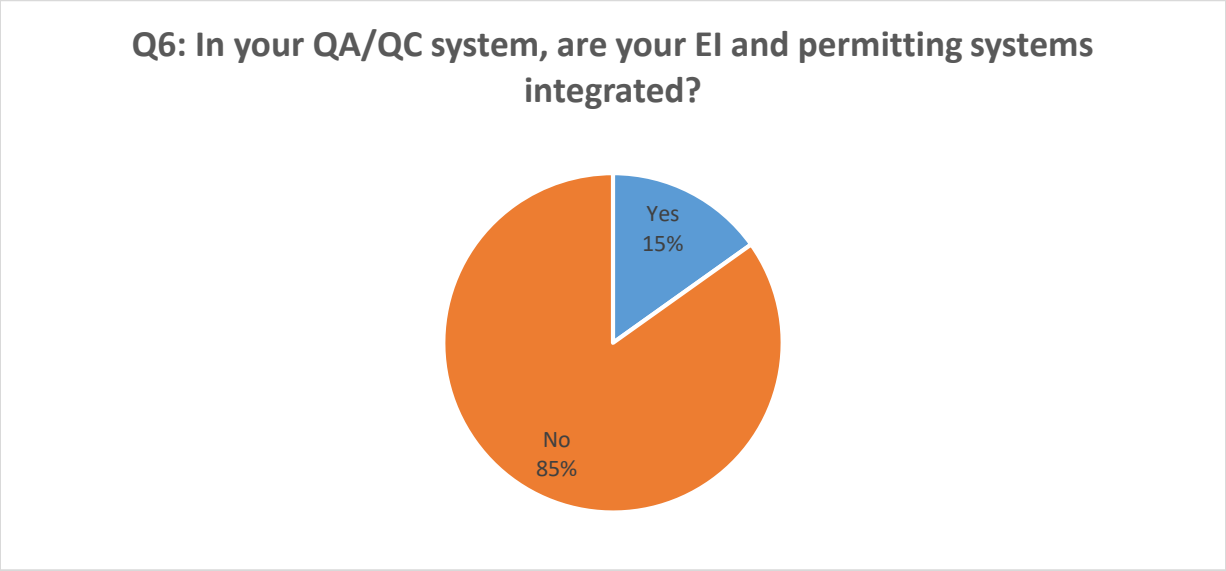
Summary of responses: Nearly all (96%) of survey participants indicated that they believe there is potential value in integrating automated QA/QC checks into their emissions reporting systems, with only 4% of participants indicating they did not believe there was much potential value in doing so. Several comments from survey participants focused on reasons why their systems may not benefit from integrating automated QA/QC checks (e.g., not worth time/resources required to implement them), but others provided clarifications as to what types of automated QA/QC checks might be especially beneficial (e.g., review that includes multi-year trend and statistical feedback to help identify emission outliers).



- **Survey participant comments regarding Question 5:**
  - Survey participant's organization already has some checks, and they believe automated checks wouldn't justify time spent on them.
  - Survey participant's data system is not sophisticated enough to accommodate this and they believe it would require substantial funding to get there.
  - Survey participant believes automated QA/QC checks would be great, but they are unable to make updates to their system currently.
  - Survey participant believes that adding upfront QA to a system usually presents a favorable Cost-Benefit scenario.
  - Survey participant would recommend considering a broadening of the review to include multi-year trend and statistical feedback to help identify emission outliers (e.g., absolute magnitude, emission factor). The participant noted that their organization has done this with post-processing, but that an integrated tool would be very helpful.
    Survey participant noted that their system doesn't generate data in the Operating Details table, which is where they believe that most of these checks appear to apply.

Text of Survey Question 6: In your QA/QC system, are your EI and permitting systems integrated?

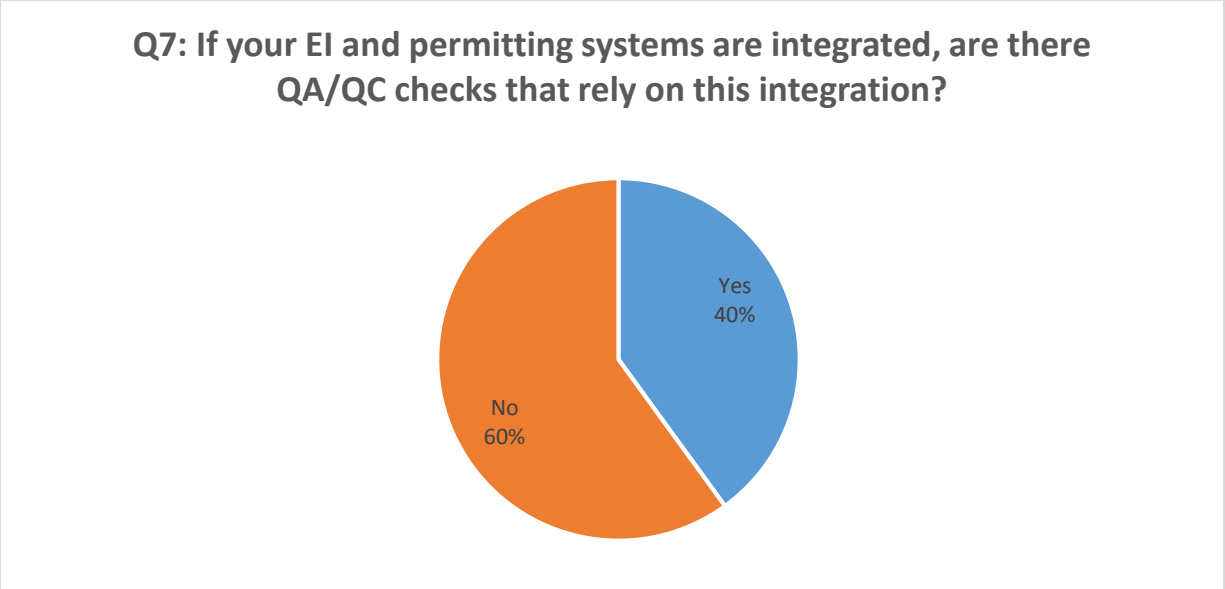
Summary of responses: 85% of survey participants indicated that their EI and permitting systems are not integrated, and the remaining 15% indicated that they are integrated. There were no comments related to this question.



- **No comments**

Text of Survey Question 7: If your EI and permitting systems are integrated, are there QA/QC checks that rely on this integration?

Summary of responses: It's important to note that participants responding to Question 7 were only those who responded yes to Question 6 (5 participants), therefore the pool of respondents to this question is limited compared to other questions (more than 30). Still, 60% (3 participants) noted that no QA/QC checks rely on EI and permitting system integration, with 40% (2 participants) indicating that they did. Comments from survey participants provided detailed explanations of EI and permitting system integration.



- **Survey participant comments regarding Question 7:**
  - Survey participant indicated that emission inventories are geared to reflect the permit, but it is their experience that there are times when the EIQ hasn't been updated appropriately.
  - Survey participant indicated that their EI system checks permitted limits only in the context of generating emissions fee invoices, because some emissions (PM) are billed based on permitted limits, not actual emissions. However, their system does not auto-flag actual emissions that exceed permitted limits or max throughput.
  - Survey participant indicated that their organization has a web-based reporting system, but that they also have a separate internal permitting database. Although the two programs are not reliant upon each other, they do exist within the same database structure and are used during manual QC checks. The participant and her team have considered requirements for integrating the two programs and have found the different perspectives precluded many automated checks – which may have been an outcome of the organization's system structure.

c. Compilation of a common set of QA/QC procedures

Based on feedback from the national survey described above, including suggested additions and modifications from twelve SLT programs, the starting point compilations of QA/QC checks and procedures contained in Tables 1 and 2 were revised. Appendix A provides a consolidated listing of the common set of QA/QC checks based on these revisions. For preparing the revised compilation table presented in Appendix A, the two starting point tables were combined into one listing as it became evident from the survey responses and further review that there was both duplicity evident in the two tables and that the differentiation between 'automated' and 'manual' checks was not always consistent, or absolute, such as to negate the need to have two separate tables.

Based on suggested additions received from the national survey on the starting point tables of QA/QC checks, we added 34 additional checks from the original starting point tables, for a total of 148 checks in the consolidated table in Appendix A. It is worth noting that out of 33 state and local program respondents to the survey, twenty-three programs, or about 70%, indicated that the tables contained all the checks that they perform. Many of the additions suggested for the tables reflected slight variants of checks and procedures shown on the starting point tables. With these variants added, we think the consolidated table shown in Appendix A reflects a fairly comprehensive set of the most commonly applied QA/QC checks and procedures that are in use by various SLT and EPA emissions reporting programs. The Appendix A table is not intended to reflect every possible check or procedure in use by different programs, particularly ones that are specifically unique to the certain process flow or functionality of a program's reporting system. The intent was to collect the most common QA/QC procedures in use across different emissions reporting systems and which could be readily used as both a reference to supplement an existing program's QA/QC procedure, or in the case of the CAER proposed future state, to provide the basis for constructing a type of application for QA/QC that could be integrated with a common emissions platform. Both of these uses and possible applications are described in more detail in Section III.

It is evident from the comments provided on certain QA/QC procedures provided in the starting point tables that there is significant variation in how different SLT programs implement their QA/QC procedures. For example, some programs rely to a great extent on specific post-submission checks and reviews performed at the program office in combination with routine checks performed within the EIS system upon submittal to EPA as part of NEI. Other programs have integrated automated, up-front checks implemented upon the preparation/submittal phase by industry reporters. Different programs also use a variety of 'prioritization' schemes to identify a smaller sample set of industries and/or emissions data for more in-depth or follow-up review. Also, as noted in the responses to the survey questions and summarized in Section II.b, the level of automation varied significantly amongst responders and was often tied to the extent to which the reporting system itself was electronic-based, in terms of both submittal process for reporters and the post-submittal processing steps. In many cases, state and local programs expressed that automated enhancements to the existing QA/QC capabilities would be very helpful.

In the starting point Table 2 that was included with the survey, there was a qualitative indicator provided regarding the potential for readily automating a particular check or procedure. The characteristic of 'readily automated' attempted to represent whether the particular check can be incorporated through an electronic, automated step as part of the inventory reporting and data processing system. It became evident upon review of the comments from the survey, that it was not always a straightforward determination on whether any given check or procedures could be "readily automated." Some clearly can be automated and already are by some programs, such as checks related to comparing current and historic emission levels, emission rates, and other parameter trend analyses. Also, many, if not most, of the checks could, in theory, be automated in some fashion such that building the application and logic was not necessarily an impediment; however, there were three common remarks about automation:

- Recognition of the need for, and associated cost, to adopt, build-out, or modify an electronic reporting system to implement the automated checks;

- Question whether there was significant value added relative to the cost in attempting to automate some of what are normally run as 'manual type' checks;
- Concern about increasing the number of "false warnings" resulting from certain automated checks, particularly where such checks were associated with the preparation and submittal phase and thus could 'desensitize' reporters or possibly delay submission and cause unnecessary burden upon the reporter and regulatory program reviewer.

There were also some comments regarding what phase (e.g., preparatory, submittal by industry reporter to SLT program office, post-submittal by SLT regulatory agency, submittal by regulatory agency to another SLT or federal program office, etc.) of the emissions reporting process that QA/QC checks could be applied and be most effective. One commenter expressed that providing QC, especially certain range checks, to companies when reporting reduces the likelihood of finding non-compliance via inventory reports later in the process. The same commenter expressed the importance in differentiating between those checks/procedures exposed to reporters while completing reports and those available to regulators.

A number of commenters confirmed the need for establishing program system connections and interactions in order to allow certain checks to be used as part of their emissions reporting systems. For example, many of the commenters recognized the potential value in checks that utilize permitting information for a facility; however, in many of these cases it was recognized that the emissions reporting and permitting systems are not fully integrated such that the pertinent information for running the related QA/QC checks cannot be readily cross-walked and automated. It was evident that many SLT programs are indeed using permit information as part of their manual, in-depth reviews for priority facilities and some expressed interest in eventually being able to apply that information as part of the general QA/QC procedures.

Another example of necessary pre-requisites are checks relying on cross-comparisons with TRI data. Although a number of SLT programs recognized value in using such data in performing QA/QC checks, specifically on hazardous air pollutant (HAP) and volatile organic compounds (VOCs) emissions data, they also pointed out the necessity to build the linkages and facility matches between the TRI program and SLT programs in order to implement such procedures. Other examples included QA/QC checks on SCC and expected pollutants and the use of stack test data. A listed check involving expected pollutants based on the facility and emissions source types would be dependent on an accurate and updated x-walk of facility/process types/SCCs and expected pollutants, including the effect of controls on expected pollutants. Another listed check for the timeliness of stack test data using cross-walks to the Compliance Emissions Data Reporting Interface/Emissions Reporting Tool (CEDRI/ERT) database was questioned in that the stack test data currently entered in ERT is a modest subset of all stack tests performed and that for the foreseeable future there are going to be stack tests not reported to ERT (i.e., those not required by fed regulations / permits). Lastly, checks on the use of "best available" emission factors for different processes where emissions are calculated would require up-to-date tables of SCCs and emission factors in order to set-up appropriate comparisons.

III. Recommendations and Considerations for Next Steps

The QA/QC project team identified both an immediate and a longer term use of the results of this project, which are described below. These include the near term, direct use of the results for QA/QC program comparisons followed by recommended steps for a next phase of this project to apply and integrate the results of this effort with the broader CAER project development efforts for developing a shared emissions system, including use of these QA/QC procedures as part of a "common emissions form" approach.

a. Distribution of compiled checks for QA/QC program comparisons

In regards to near-term use of the results of this project, the consolidated list of QA/QC checks that has been compiled and refined as described above in Section II, and included in Appendix A, will be shared with all SLT emissions data managers through distribution of this final report. We anticipate that data managers will find real value having in one place this national-level collection of common QA/QC procedures, along with contact information for the SLT data managers who are implementing these procedures that is contained in Appendix B.

The value of this compiled list can manifest itself in several ways for current and future SLT data managers:

- It provides an opportunity to see if there are quality checks, approaches or procedures in use by other SLT programs that might help to improve a current program QA/QC system. There are possibly approaches and checks that might not have been considered by a given program. This will be especially useful for a program that has a less-developed data management system or is currently in the process of developing one.
- This compilation will help facilitate communications and information-sharing among SLT data managers that might not have occurred up to this point. Knowing who to contact and what they are doing differently is a valuable time-saver. The comments, questions and explanations offered by survey respondents provide additional context to system managers.
- In addition to being used as a foundation for building a set of automated QA/QC procedures into the envisioned electronic, shared emissions reporting system, this comprehensive listing of QA/QC checks can potentially be posted online along with EPA's existing set of emissions reporting guidance documents as a permanent QA/QC reference source, similar to the SCC Codes table, reportable pollutants, etc. Procedures for maintenance and version control of this QA/QC reference list would need to be established for such use.

For those programs that were not able to respond directly during the QA/QC survey window, we will establish a communication mechanism whereby they can have another opportunity to provide additions and comments after reviewing the revised QA/QC compilation. Initially, we anticipate this being done through posting this final report, with the compilation contained in Appendix A, on the CAER public website and thus available for individual comments to be sent via email to CAER@epa.gov.

b. Using the common set of QA/QC procedures as part of a 'Common Emissions Form' approach within CAER

As part of the proposed future state under CAER, one of the possible approaches to combining emission reporting and sharing emissions data across different reporting programs involves the use of what has been referred to in conceptual illustrations as a 'common emissions form" or CEF. Initial thoughts on how a CEF could work evolved out of a September 2016 workshop where staff from four state and four EPA program offices investigated different emission reporting workflows as representative by the participating programs, and the possible design and application of a CEF as a means to collect and share emissions data across different programs. As part of that workshop, participants discussed the concept of a centralized database of QA/QC routines which could eliminate duplicative effort. They discussed the possible overlay of automated QA/QC checks and standardized protocols as part of a CEF-based workflow, potentially utilizing shared services or applications to facilitate implementation of the QA/QC routines and allowing for tracking and resolution of data discrepancies between two or more programs. The QA/QC routines would have assignments as to who was responsible for completing the check on the particular data. Participants agreed that QA/QC should be pushed as far forward as possible in the emission reporting systems, such as running checks at the time that the facility is submitting data instead of data being checked downstream by SLT or EPA regulatory program review.

Participants identified potential next steps for the CAER PDT to investigate how and in what form could functionality be built into whatever approach that a CEF evolves into. The participants outlined a few basic steps to further investigate and develop this concept:

i. Research QA/QC procedures currently in use
ii. Bring together common/standard procedures and checks in centralized area
iii. Canvas for other recommendations
iv. Put together QA/QC protocols /business rules
v. Develop uniform, automated QA/QC implementation on a CEF or web-based shared service.

This current project has focused on the first three steps listed above, in terms of researching and collecting the types of QA/QC checks and procedures that are in use at existing emission reporting systems and identifying an initial listing of common QA/QC checks and procedures that are used. Successive phases of this project should continue the basic steps as outlined above, and the following sections describe the recommendations and suggestion of this project team as how best to pursue those next steps.

In considering a possible development path forward for integrating a uniform or standard set of QA/QC procedures within the framework of a shared, common emissions reporting platform such as envisioned under the concept of a CEF approach, the QA/QC project team extended and elaborated on the basic steps identified above. The following describes a suggested path forward and associated steps for a phase 2 of the QA/QC project, building on the goals, objectives, and information provided thus far by various program participants and survey responders.

Suggested next steps for a Phase 2 of QA/QC Project

***Step 1**. Match CAER CEF workflow scenarios to possible options for applying common set of QA/QC procedures.*

The CAER PDT, and specifically the Emissions Data Model project team, are investigating the possible workflows that could be associated with the use of a CEF approach. The workflow scenarios range from an SLT program fully adopting the CEF as its reporting interface along with direct distribution to different reporting programs and their databases, to an SLT program that retains essentially all aspects of its existing reporting interface and emissions database management but where the pertinent emissions data is pushed to a CEF working in a background application to allow distribution of data to relevant programs. There are hybrid scenarios that fall within these ranges, all of which are being further investigated and defined as part of the next phase of the Emissions Data Model team.

In order to pursue the basic objective to overlay a common set of QA/QC procedures as part of a CEF-based approach, one of the first areas to research will be the possible integration and connectivity options as they relate to the different defined workflows. For example, one identified workflow as currently defined, and described above, is the scenario where an SLT program fully adopts the CEF for emissions reporting purposes. Under such a scenario, one possibility might be to embed the standard set of QA/QC checks and routines directly into the CEF as part of its construction. Alternatively, under a CEF workflow scenario where an SLT program wishes to maintain its existing reporting system as is, with CEF running as a 'background' application to which data is pushed, a better approach might be to build a QA/QC shared service that the SLT interface can 'call up' and run upon entry and submittal through the SLT's own reporting system. Defining these basic scenarios for implementing a common, uniform set of QA/QC procedures would help identify the most viable options based on the particular CEF-based workflow, the unique QA/QC system needs of the SLT program, and also point to potential constraints or issues for those options.

As a next step, the team recommends using the information and findings coming out of the CAER Emissions Data Model team regarding the types of possible workflow scenarios involving the CEF. That team is conducting a broad survey and further research to define these user stories. The QA/QC system profiles obtained from this first phase of the QA/QC project can then be cross-walked to the potential CEF workflow scenarios to construct possible options for modifying, building out and expanding QA/QC implementation as it relates to those particular workflows.

***Step 2.** Match-up recommended set of common automated checks to CEF data fields.*

As differentiated from the first step described above, this step would go beyond defining the general process constructs that are possible for different workflows, and focus on identifying and applying specific QA/QC checks collected during this first phase research to the data elements as defined for use in a pilot/prototype CEF construction resulting from the Emissions Data Model team. This step will require direct coordination with results of the CAER Emissions Data Model Design team as it moves from its first phase research to further development of a defined construct for the CEF. A starting point for this step would be the list of emissions data elements that result from that effort. From that point, a matching exercise would be undertaken to associate pertinent QA/QC checks and procedures with the prototype CEF data elements.

Attributes of the checks should be tagged or assigned as part of the matching exercise, and should reflect or incorporate the findings from the QA/QC survey where possible. For example, the

results of the QA/QC survey indicated that programs have an interest in increasing the number and type of automated checks. As a result, one priority should be to identify QA/QC checks and procedures that are or can be reasonably expected to be applied through automated/electronic procedures (and, as a by-product, identify procedures that cannot be readily automated and would still rely on 'manual' implementation). Also, results of the first phase of this project regarding value assessments of checks should be used to construct a preferred matching, such that procedures or checks for which there is uncertain, limited or even negative perceived value (i.e., unacceptably high rate of false warnings) are not used or are tagged differently to convey proper usage.

Other attributes to include in the matched sets should indicate the most appropriate and/or effective implementation point for applying the checks (e.g., upfront upon preparation/entry/submittal of data by reporter, or post-submission at regulatory program). This would answer the question of when is the QA/QC check or procedure being applied in the reporting process, and thus, who is receiving the results or feedback. As noted in views of many of the participants from the Quick Start workshop described earlier, there appears to be a desire to move QA/QC procedures up-front as much as possible in the process to avoid downstream errors and rejection/return of data to the submitter for corrections.

Lastly, any logic, procedures, or supporting information necessary for applying checks within the CEF should be defined for each QA/QC procedure and check that is matched to a CEF data element. Depending on the particular check or procedure, this could be one of the more resource-intensive parts of this step. For example, if it turns out that one of the recommended QA/QC procedures that is matched to a CEF data element relies on a supporting dataset in order to implement the procedure (e.g., an SCC/EF crosswalk table), this supporting table would need to be accessed or, possibly, newly constructed for the purpose of running the check. Alternatively, this could be a simpler procedural definition for a check, such as defining reasonable bounds for what constitutes an 'outlier' or 'significant change' in an emissions compared to a previous year. The main objective of this step would be to properly define and construct the functionality of each check and procedure, along with the necessary supporting information, so that it could directly applied for the particular CEF data element for which it is matched.

***Step 3**. Pilot demonstration to incorporate QA/QC checks as part of CEF*

This last step would incorporate applicable workflow and QA/QC checks and procedures identified from steps 1 and 2 above as part of a broader effort under CAER to implement a pilot scale application of a CEF for emissions data reporting and sharing. As of the date of this report, that CAER CEF pilot had not yet been designed and scoped out so it is not certain which CAER CEF workflow scenario will be represented in the pilot, although preliminary planning by the PDT has identified an SLT program direct adoption of a CEF as a preferred candidate type for a pilot demonstration. Regardless, by proceeding through steps 1 and 2 above, in coordination with the Emissions Data Model team, this should set-up the necessary prerequisites to proceed to Step 3.

This step would entail the build-out of a standard set of QA/QC routines resulting from Step 2 above as part of the software approach associated with implementing the CEF for the prototype. The

approach for integrating QA/QC routines as part of the CEF workflow could take the form of directly embedding the list of standard checks and procedures as part of the CEF, or it could take some form of a shared service type platform (possibly web-based) as an implementation mechanism. The choice of how to integrate the 'standard' QA/QC checks into the CEF should be part of the overall design and functionality requirements for the CEF prototype, such that they are fully consistent with the emissions data workflows, the program's data quality objectives and any QA/QC plan that is in place.

As part of the pilot demonstration, proper business rules and governance for the implementation of QA/QC checks would need to be established along with the functional aspects of the QA/QC system. For example, would certain checks and procedures be the responsibility of the reporter to respond to in terms of corrections or explanations? Which checks would be applied post-submission and part of the regulatory program review and thus subject to their interpretation and follow-up to results? The business and governance rules regarding assignments and responsibility for documenting results and possible remediation steps need to be defined as part of the prototype. Also, as part of the design specifications for the prototype software, effective report options need to be developed to match the needs established by the business and governance rules.

APPENDIX A. Compiled List of QA/QC Emission Data Checks

Data Elements	Check type	Check Description
EmisFactor&related	REQU DATA	Emission Calculation Method Code must be reported
EmisFactor&related	CONDITIONAL REQU	An entry into the "Comments" field should be required when Calculation Method does not utilize an Emission Factor
EmisFactor&related	REQU DATA	Emission Factor must be reported
EmisFactor&related	CONDITIONAL REQU	Emission Factor is required when Calculation Method utilizes an Emission Factor
EmisFactor&related	RANGE	Emission Factor reported as "1"
EmisFactor&related	RANGE	Emission Factor must be greater than zero
EmisFactor&related	CONDITIONAL REQU	Emission Factor is not allowed when Calculation Method DOES NOT utilize an Emission Factor
EmisFactor&related	CONDITIONAL REQU	If the emission factor is reported, then the emission factor numerator unit of measure is required
EmisFactor&related	CONDITIONAL REQU	If the emission factor is reported, then the emission factor denominator unit of measure is required
EmisFactor&related	CONDITIONAL REQU	Emission Factor UOM is not allowed when Calculation Method DOES NOT utilize an Emission Factor.
EmisFactor&related	REQU DATA	Emission Factor Material usage units is required
EmisFactor&related	REQU DATA	Emission Factor Material type is required
EmisFactor&related	REQU DATA	Emission Factor Regulatory Class not found
EmisFactor&related	CONSISTENCY	If the Calculation Method utilizes an AP42/WebFIRE EPA emission factor, the Emission Factor from the SLEIS emission factor must be utilized
EmisFactor&related	RANGE	Data Analysis Rating cannot exceed 10
EmisFactor&related	CONDITIONAL REQU	If an emission factor is entered and there is a control system, the user must indicate whether the emission factor is before or after controls
Thruput & related	REQU DATA	Annual Throughput is required
Thruput & related	REQU DATA	Annual Throughput is required when Calculation Method utilizes Emission Factor
Thruput & related	CONSISTENCY	If a Calculation Method utilizes an Emission Factor, the Annual Throughput UOM must match the Emission Factor UOM
Thruput & related	RANGE	Annual Throughput must be greater than or equal to zero

APPENDIX A. Compiled List of QA/QC Emission Data Checks

Data Elements	Check type	Check Description
Thruput & related	RANGE	Process rate reported as "1"
Thruput & related	RANGE	Annual Thruput greater than permit thruput limit
Thruput & related	CONDITIONAL REQU	Thruput, Thruput UoM, Thruput Material, and Thruput Type must all be reported together
Thruput & related	REQU DATA	Throughput Material is required
Thruput & related	CONDITIONAL REQU	Throughput Material is required when Annual Throughput is specified
Thruput & related	REQU DATA	Throughput Type is required
Thruput & related	CONDITIONAL REQU	Throughput Type is required when Annual Throughput is specified
Supplemental Calculation Parameter	REQU DATA	Ash content % is required
Supplemental Calculation Parameter	REQU DATA	Sulfur % is required
Supplemental Calculation Parameter	REQU DATA	Heat Content % is required
Supplemental Calculation Parameter	RANGE	Percent ash content must be between 0.01 and 30
Supplemental Calculation Parameter	RANGE	Percent sulfur content must be between 0.01 and 10
Supplemental Calculation Parameter	RANGE	Heat Content % must be >= 0 and <= 1,000,000
Controls	CONSISTENCY	PM 2.5 control efficiency greater than PM 10 control efficiency
Controls	CONSISTENCY	Pollutant control efficiency inconsistent with control type
Controls	CONSISTENCY	Emissions reported where control = 100%
Controls	CONSISTENCY	Control Efficiency cannot be 100%
Controls	RANGE	Out of range control efficiencies
Controls	CONDITIONAL REQU	% control efficiency required if EF and controls reported
Controls	CONDITIONAL REQU	% control efficiency required for PM-based pollutants (i.e. PM10, metallic HAPs, Pb) if PM controls reported

APPENDIX A. Compiled List of QA/QC Emission Data Checks

Data Elements	Check type	Check Description
Emissions	CONDITIONAL REQU	No emissions can be reported if the facility site or the emission unit operating status is Shutdown
Emissions	CONSISTENCY	Emissions cannot be reported for both a specific species and the aggregate total for defined groups of pollutants
Emissions	EMISS COMPARISON	Facility Emissions Difference from previous Year too large
Emissions	EMISS COMPARISON	If large discrepancy noted in emissions change from previous year, check if there is accompanying and consistent change in throughput if applicable.
Emissions	EMISS COMPARISON	facility reported emissions delta from inventory calculated emissions GT 1 ton
Emissions	EMISS COMPARISON	facility reported emissions greater than permitted amount, at site level
Emissions	EMISS COMPARISON	Check if the reported facility emissions exceed thresholds established by Major/minor status. (PSD/Title V thresholds)
Emissions	EMISS COMPARISON	Check that facility's reported inventory emissions are consistent with 'billed' emissions for permit fee collection
Emissions	EMISS COMPARISON	Annual emissions should not be greater than the typical threshold for the SCC
Emissions	EMISS COMPARISON	Annual emissions cannot be greater than the maximum threshold for the SCC
Emissions	EMISS COMPARISON	Emission rate Threshold analysis of actual, allowable, and potential emissions
Emissions	CONSISTENCY	If the Throughput is zero and the emissions method code is CEMS the emissions data entered must be zero
Emissions	CONSISTENCY	If the Throughput is zero and the emissions method code is TANKS, the emissions data entered can be non-zero
Emissions	EMISS COMPARISON	PM10 Filterable should not exceed PM10 Primary
Emissions	EMISS COMPARISON	PM2.5 Filterable should not exceed PM2.5 Primary
Emissions	EMISS COMPARISON	PM Condensable should not exceed PM10 Primary
Emissions	EMISS COMPARISON	PM Condensable should not exceed PM2.5 Primary
Emissions	EMISS COMPARISON	PM10-FIL + PM-CON must equal PM10-PRI
Emissions	EMISS COMPARISON	PM25-FIL + PM-CON must equal PM25-PRI
Emissions	EMISS COMPARISON	PM2.5 Primary should not exceed PM10 Primary
Emissions	EMISS COMPARISON	PM2.5 Filterable should not exceed PM10 Filterable

APPENDIX A. Compiled List of QA/QC Emission Data Checks

Data Elements	Check type	Check Description
Emissions	EMISS COMPARISON	Sum of individual VOC species emissions cannot be more than "VOC" emissions value
Emissions	EMISS COMPARISON	The Sum of Photochemically active HAP emissions must be less than or equal to the reported VOC emissions for the process.
Emissions	EMISS COMPARISON	The sum of PM HAPs (also PM-VOC HAPs may be in the sum total as well) must be less than or equal to the reported PM25-PRI emissions for the process
Emissions	EMISS COMPARISON	Fluorides/16984488 value must be greater than or equal to HF/7664393
Oper Schedule	REQU DATA	Operations Start Time is required
Oper Schedule	CONDITIONAL REQU	Operations Start Time is required when Annual Throughput is specified
Oper Schedule	REQU DATA	Operations Stop Time is required
Oper Schedule	CONDITIONAL REQU	Operations Stop Time is required when Annual Throughput is specified
Oper Schedule	REQU DATA	Average Hours/Day is required
Oper Schedule	CONDITIONAL REQU	Average Hours/Day is required when Annual Throughput is specified
Oper Schedule	RANGE	Average Hours Per Day must be between 0.1 and 24
Oper Schedule	REQU DATA	Average Days/Week is required
Oper Schedule	CONDITIONAL REQU	Average Days/Week is required when Annual Throughput is specified
Oper Schedule	RANGE	Average Days Per Week must be between 0.1 and 7
Oper Schedule	REQU DATA	Average Weeks/Year is required
Oper Schedule	CONDITIONAL REQU	Average Weeks/Year is required when Annual Throughput is specified
Oper Schedule	RANGE	Actual Weeks Per Year must be between 1 and 52
Oper Schedule	REQU DATA	Actual Hours/Year is required
Oper Schedule	CONDITIONAL REQU	Actual Hours/Year is required when Annual Throughput is specified
Oper Schedule	RANGE	Actual Hours Per Year must be between 1 and 8784
Oper Schedule	CONSISTENCY	Actual Hours/Year is invalid based on Average Hours/Day, Days/Week, and Weeks/Year (+/- ~.5%)
Oper Schedule	REQU DATA	Actual Days/Year is required
Oper Schedule	CONDITIONAL REQU	Actual Days/Year is required when Annual Throughput is specified
Oper Schedule	CONSISTENCY	Actual Days/Year is invalid based on Average Days/Week and Weeks/Year (+/- ~.5%)
Oper Schedule	REQU DATA	Operations % by month is required

APPENDIX A. Compiled List of QA/QC Emission Data Checks

Data Elements	Check type	Check Description
Seasonal thruputs	CONSISTENCY	If the Summer % is > 0 AND annual throughput is > 0 then Summer Days Use (throughput) must be > 0.
Seasonal thruputs	CONSISTENCY	Summer day throughput must be less than or equal to annual throughput
Seasonal thruputs	CONSISTENCY	If Average Weeks/Year > 39 then all Season %'s are required to be > 0%
Seasonal thruputs	CONSISTENCY	If Average Weeks/Year > 26 then at least three Season %'s are required to be > 0%
Seasonal thruputs	CONSISTENCY	If Average Weeks/Year > 13 then at least two Season %'s are required to be > 0%
Seasonal thruputs	CONSISTENCY	The seasonal percentages must either all be reported or none be reported
Seasonal thruputs	RANGE	The sum of seasonal percentages must be between 99.5 and 100.5
Seasonal thruputs	REQU DATA	Spring Season % is required
Seasonal thruputs	CONDITIONAL REQU	Spring Season % is required when Annual Throughput is specified
Seasonal thruputs	REQU DATA	Summer Season % is required
Seasonal thruputs	CONDITIONAL REQU	Summer Season % is required when Annual Throughput is specified
Seasonal thruputs	REQU DATA	Fall Season % is required
Seasonal thruputs	CONDITIONAL REQU	Fall Season % is required when Annual Throughput is specified
Seasonal thruputs	REQU DATA	Winter Season % is required
Seasonal thruputs	CONDITIONAL REQU	Winter Season % is required when Annual Throughput is specified
non-annual days	CONSISTENCY	If the Summer % is > 0 then the Total Ozone Season Days must be > 0
Non-annual days	CONSISTENCY	If the Spring % is not > 0 and Summer % is not > 0 and Fall % is not > 0, the Total Ozone Season Days cannot be > 0
Non-annual days	CONSISTENCY	If the Summer % is > 0 then the Total Summer Season Days must be > 0
Non-annual days	CONSISTENCY	If the Summer % is not > 0 the Total Summer Season Days cannot be > 0
Non-annual days	CONSISTENCY	If the Winter % is > 0 then the Total CO Season Days must be > 0
Non-annual days	CONSISTENCY	If the Winter % is not > 0 the Total CO Season Days cannot be > 0
Non-annual days	REQU DATA	Total Ozone Season Days is required
Non-annual days	RANGE	Total Ozone Season Days must be >= 0 and <= 153
Non-annual days	REQU DATA	Total Summer Season Days is required
Non-annual days	RANGE	Total Summer Season Days must be >= 0 and <= 92

APPENDIX A. Compiled List of QA/QC Emission Data Checks

Data Elements	Check type	Check Description
Non-annual days	REQU DATA	Total CO Season Days is required
Non-annual days	RANGE	Total CO Season Days must be >= 0 and <= 91
Various	Prioritize facilities for in-depth review	Prioritize facilities based on emission level (threshold levels could be established for specific pollutants, such as ozone precursors, etc.)
Various	Prioritize facilities for in-depth review	Prioritize facilities based on their SIC code (i.e., industry type)
Various	Prioritize facilities for in-depth review	Prioritize facilities based on their SCC code(s) (i.e., source types)
Various	Prioritize facilities for in-depth review	Prioritize facilities based on their location (e.g., nonattainment areas)
Various	Prioritize facilities for in-depth review	Prioritize facilities based on 'high profile' sources (e.g., those subject to consent decrees, penalties, etc.)
Various	Prioritize facilities for in-depth review	Check for facilities that reported large quantities of volatile organic chemicals on-site but reported small quantities of air releases
Various	Prioritize facilities for in-depth review	Prioritize 'new facilities' (e.g., new Title V permit or PSD permit)
Various	Prioritize facilities for in-depth review	Prioritize facilities according to potential health risks associated with pollutant emissions (e.g., TRI uses Risk-Screening and Environmental Indicators (RSEI) software to rank facilities for further in-depth review)
Various	Prioritize facilities for in-depth review	A weighted scoring based on an aggregate of all of the automated checks could provide a ranking for a list of facilities that could be "audited"
Various	Review emissions rates	Check for significant emission factor deviation--for each pollutant--from facility's specific historical emission factor values. (need to define: what constitutes a ‘significant change' or establish an 'outlier' threshold AND what prior years are included for 'historical' comparisons).
Various	Review emissions rates	For processes with a combustion process SCC, calculate and compare both pre- and post-control emission factors in units of lb/MMBTU based on reported emissions, calculated throughput in MMBTU, and process control information (if available).

APPENDIX A. Compiled List of QA/QC Emission Data Checks

Data Elements	Check type	Check Description
Various	Review emissions rates	Check if facility's emission rates (including both pre- and post-control emission factors for processes with combustion process SCCs) are inconsistent with those from similar industry/sector facilities in the inventory (check could be done for both present year comparison and trend in that industry/sector)
Various	Review emissions rates	At the process level (SCC) determine the effective emission factor (emissions/thruput) and determine if it is an outlier compared to other reported identical SCCs from current or previous years.
Various	Review reported emissions	Check if the facility reported the same emissions value for multiple years (e.g., TRI program checks if same number reported for more than 2 years to identify potential error)
Various	Review reported emissions	Check if the facility reported the same emissions value for a process in the reporting year, and the same value for a different process in a historical year (use case was to catch mis-match of what should have been a valid, repeated emission value, but assigned to wrong process)
Various	Review reported emissions	Check that the appropriate pollutant emissions are reported for the facility (e.g., expected pollutants are reported based on the facility type)
Various	Review reported emissions	Check if facility reported no emissions for a pollutant that it has reported in prior years
Various	Review reported emissions	Check if a pollutant is listed in the facility permit that is valid during the reporting period but is not reported in the emission inventory.
Various	Review reported emissions	Check if pollutants reported for a given SCC and control combination match expected list of pollutants for that SCC and control combination.
Various	Review reported emissions	Compare emission totals by source category. Explain large/significant discrepancies in emissions.
Various	Review reported emissions	Check that emissions reported reflect current permit conditions and updates/changes to permit (e.g., operating hours, fuel changes, etc.)
Various	Review reported emissions	Check facility's permitted potential to emit (PTE) values for pollutants to see if they have switched from having to report every 3 years to every year or vice versa for NEI purposes
Various	Review estimation inputs	Research the accuracy of the emissions data, including activities such as reviewing published and unpublished studies on the emissions from the facility or sector in question (e.g., studies indicates pollutants emitted but which are not reported for facility in question)

APPENDIX A. Compiled List of QA/QC Emission Data Checks

Data Elements	Check type	Check Description
Various	Review estimation inputs	Check that reported emissions have been calculated with most accurate methods available (i.e., where multiple methods available, has best available method been used?)
Various	Review estimation inputs	For each process, verify that SCC is correct
Various	Review estimation inputs	For each process, verify that throughput data is reasonable (order of magnitude checks)
Various	Review estimation inputs	For each process, verify that any applicable throughput supplemental data is correct (ash, sulfur or heat content of fuel)
Various	Review estimation inputs	Check that the proper/accepted control efficiency was used in calculating emissions
Various	Review estimation inputs	Check that a correct emission factor has been used if applicable (i.e., the emission factor matches the process/source)
Various	Review estimation inputs	Check that, where emission factors are used, the most current factors have been used
Various	Review estimation inputs	If stack test results are used as basis for an emission factor, verify the timeliness of stack test date(s) (e.g., less than three years old).
Various	Review estimation inputs	For each pollutant in each process, if emissions are based on CEMS data, verify that the correct data was used
Various	Review estimation inputs	For each pollutant in each process, if emissions are manually calculated (no factor from table), verify that calculations and data entry are correct.

APPENDIX B. SLT Responders to State-led QA/QC System Survey

Name	Title and State
Peter Lloyd	Program Manager, Forsyth County NC
Tim Burns	QC Tech II, Nebraska
Deborah Basnight	Unit Manager - GA EPD
Tom Shanley	Supervisor, Michigan
Ralph Patterson	Emission Inventory Team Leader, Wisconsin
Benjamin Way	Emissions Inventory Section Supervisor, Wyoming
Paul Mairose	Chief Engineer, Southwest Clean Air Agency, Washington
Kathy Pendleton	Sr. Tech Specialist, Texas
Ann Spitz	Kansas Dept. of Health and Environment
Jennifer DeMay	Engineer II, Olympic Region Clean Air Agency
Carrie Schroeder	Emission Inventory Manager, Oklahoma
Kristen Turmelle	Environmental Specialist, Maine DEP
Travis Miller	Environmental Health Supervisor, City of Albuquerque
Nathan O'Neil	Data Management Unit Chief, Missouri DNR
Jacquelyn Cuneo	Engineer, Delaware
Roslyn Higgin	Environmental Engineer, NM
Eric Dahlgren	Systems Analyst, State of Montana
Jing Wang	Environmental Engineer III, Georgia
Michael Smith	Emission Inventory Coordinator, Minnesota
Steven Potter	Connecticut Department of Energy and Environmental Protection
Keith McFall	Environmental Engineer, Hawaii
Anna Watkins	Environmental Scientist Senior, State of Alabama
Gary Reinbold	Emission Inventory Program Manager, Idaho
Dave McClard	Emissions Inventory Section, South Carolina
Tammy Manning	Environmental Senior Specialist, NC
Christopher Wheeling	Regulatory and Compliance Engineer Senior, Maryland
Steve Tune	Environmental Program Coordinator, Arkansas
Deborah McMurtrie	Environmental Scientist – Utah
Gary Fischman	Engineer 3, Allegheny County, PA
Dave Thayer	Public Health Engineer, Colorado
Chuck Greco	AQ Supervisor, Mecklenburg County, NC
Jay Koch	Senior Environmental Manager/Indiana
Mark Houser	Chief of Air Information Management, PA