ANNEX 8 QA/QC Procedures

8.1.   Background

The purpose of this annex is to describe the QA/QC procedures and information quality considerations that are used throughout the process of creating and compiling the U.S. Greenhouse Gas Inventory. This includes evaluation of the quality and relevance of data and models used as inputs into the Inventory; proper management, incorporation, and aggregation of data; and review of the numbers and estimates to ensure that they are as accurate and transparent as possible. Quality control—in the form of both good practices (such as documentation procedures) and checks on whether good practices and procedures are being followed—is applied at every stage of inventory development and document preparation. In addition, quality assurance occurs at two stages—an expert review and a public review. While both phases can significantly contribute to inventory quality, the public review phase is also essential for promoting the openness of the inventory development process and the transparency of the inventory data and methods.
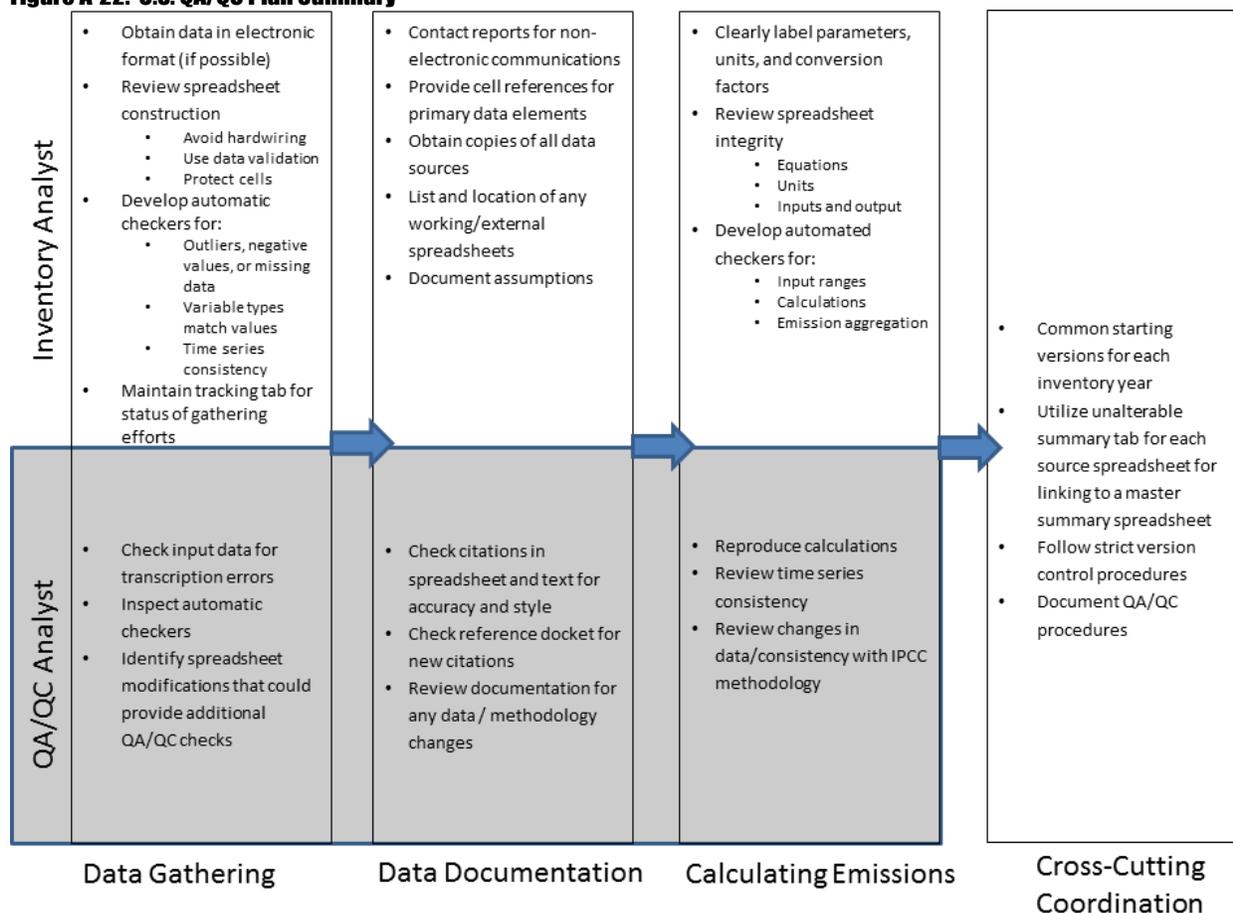
8.2.   Purpose

The *Quality Assurance/Quality Control and Uncertainty Management Plan for the U.S. Greenhouse Gas Inventory* (QA/QC Management Plan) guides the process of ensuring inventory quality by describing data and methodology checks, developing processes governing peer review and public comments, and developing guidance on conducting an analysis of the uncertainty surrounding the emission estimates. The QA/QC Management Plan procedures also stress continual improvement, providing for corrective actions that are designed to improve the inventory estimates over time.

Key attributes of the QA/QC Management Plan are summarized in Figure A-22. These attributes include:

- *Procedures and Forms:* detailed and specific systems that serve to standardize the process of documenting and archiving information, as well as to guide the implementation of QA/QC and the analysis of uncertainty

- *Implementation of Procedures:* application of QA/QC procedures throughout the whole inventory development process from initial data collection, through preparation of the emission estimates, to publication of the Inventory

- *Quality Assurance:* expert and public reviews for both the inventory estimates and the Inventory report (which is the primary vehicle for disseminating the results of the inventory development process)

- *Quality Control*: consideration of secondary data and source-specific checks (Tier 2 QC) in parallel and coordination with the uncertainty assessment; the development of protocols and templates, which provides for more structured communication and integration with the suppliers of secondary information

- *Tier 1 (general) and Tier 2 (source-specific) Checks:* quality controls and checks, as recommended by *IPCC Good Practice Guidance*

- *Record Keeping:* provisions to track which procedures have been followed, the results of the QA/QC, uncertainty analysis, and feedback mechanisms for corrective action based on the results of the investigations which provide for continual data quality improvement and guided research efforts

- *Multi-Year Implementation*: a schedule for coordinating the application of QA/QC procedures across multiple years

- *Interaction and Coordination:* promoting communication within the EPA, across Federal agencies and departments, state government programs, and research institutions and consulting firms involved in supplying data or preparing estimates for the Inventory. The QA/QC Management Plan itself is intended to be revised and reflect new information that becomes available as the program develops, methods are improved, or additional supporting documents become necessary.

In addition, based on the national QA/QC Management Plan for the Inventory, source-specific QA/QC plans have been developed for a number of sources. These plans follow the procedures outlined in the national QA/QC plan, tailoring the procedures to the specific text and spreadsheets of the individual sources. For each greenhouse gas emissions source or sink included in this Inventory, a minimum of a Tier 1 QA/QC analysis has been undertaken. Where QA/QC activities for a particular source go beyond the minimum Tier 1 level, further explanation is provided within the respective source category text.

Figure A-22: U.S. QA/QC Plan Summary

8.3. Assessment Factors

The U.S. Greenhouse Gas Inventory development process follows guidance outlined in EPA's *Guidelines for Ensuring and Maximizing the Quality, Objectivity, Utility, and Integrity, of Information Disseminated by the Environmental Protection Agency*[1] and *A Summary of General Assessment Factors for Evaluating the Quality of Scientific and Technical Information*.[2] This includes evaluating the data and models used as inputs into the U.S. Greenhouse Gas Inventory against the five general assessment factors: soundness, applicability and utility, clarity and completeness,

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[1] EPA report #260R-02-008, October 2002, available at <www.epa.gov/quality/informationguidelines>.

[2] EPA report #100/B-03/001, June 2003, available at www.epa.gov/stpc/assess.htm, and Addendum to: A Summary of General Assessment Factors for Evaluating the Quality of Scientific and Technical Information, December 2012, available at <http://www.epa.gov/stpc/pdfs/assess3.pdf>.

uncertainty and variability, evaluation and review. Table A- 292 defines each factor and explains how it was considered during the process of creating the current Inventory.

Table A- 292: Assessment Factors and Definitions

General Assessment Factor	Definition	How the Factor was Considered
Soundness (AF1)	The extent to which the scientific and technical procedures, measures, methods or models employed to generate the information are reasonable for, and consistent with, the intended application.	The intended application is to provide information regarding all sources and sinks of greenhouse gases in the United States for the Inventory year, as required per UNFCCC Annex I country reporting requirements. The underlying data, methodology, and models used to generate the U.S. Greenhouse Gas Inventory are reasonable for and consistent with their intended application. The U.S. emissions calculations follow IPCC Guidelines developed specifically for UNFCCC inventory reporting. They are based on the best available, peer-reviewed scientific information, and have been used by the international community for over 20 years. When possible, Tier 2 and Tier 3 methodologies from the IPCC Guidelines are applied to calculate more accurate United States emissions.
Applicability and Utility (AF2)	The extent to which the information is relevant for the Agency's intended use.	The Inventory's underlying data, methodology, and models are relevant for their intended application because they generate the sector-specific greenhouse gas emissions trends necessary for assessing and understanding all sources and sinks of greenhouse gases in the United States for the Inventory year. They are relevant for communicating U.S. emissions information to domestic audiences, and they are consistent with IPCC Guidelines developed specifically for UNFCCC reporting purposes of international greenhouse gas inventories.
Clarity and Completeness (AF3)	The degree of clarity and completeness with which the data, assumptions, methods, quality assurance, sponsoring organizations and analyses employed to generate the information are documented.	The methodological and calculation approaches applied to generate the U.S. Greenhouse Gas Inventory are extensively documented in the IPCC Guidelines. The U.S. Greenhouse Gas Inventory report describes its adherence to the IPCC Guidelines, and the U.S. Government agencies providing data to implement the IPCC Guidelines approaches. Any changes made to calculations, due to updated data and methods, are explained and documented in the report consistent with UNFCCC reporting guidelines.
Uncertainty and Variability (AF4)	The extent to which the variability and uncertainty (quantitative and qualitative) in the information or in the procedures, measures, methods or models are evaluated and characterized.	In accordance with IPCC Guidelines, the uncertainty associated with the Inventory's underlying data, methodology, and models was evaluated by running a Monte-Carlo uncertainty analysis on source category emissions data to produce a 95 percent confidence interval for the annual greenhouse gas emissions for that source. To develop overall uncertainty estimates, the Monte Carlo

		simulation output data for each emission source category uncertainty analysis were combined by type of gas, and the probability distributions were fitted to the combined simulation output data where such simulated output data were available. The evaluation of uncertainties for the underlying data is documented in an Uncertainty section of the Annex to the U.S. Greenhouse Gas Inventory.
Evaluation and Review (AF5)	The extent of independent verification, validation and peer review of the information or of the procedures, measures, methods or models.	The majority of the underlying methodology, calculations, and models used to generate the U.S. Greenhouse Gas Inventory have been independently verified and peer reviewed as part of their publication in the IPCC Guidelines. In cases where the methodology differs slightly from the IPCC Guidelines, these were independently verified and validated by technical experts during an annual expert review phase of the Inventory report. For the data used in calculating greenhouse gas emissions for each source, multiple levels of evaluation and review occur. Data are compared to results from previous years, and calculations and equations are continually evaluated and updated as appropriate. Throughout the process, inventory data and methodological improvements are planned and incorporated. The Inventory undergoes annual cycles of expert and public review before publication. This process ensures that both experts and the general public can review each source of emissions and have an extended opportunity to provide feedback on the methodologies used, calculations, data sources, and presentation of information.