

SMED Report No 132 2013



Manual for SMED:s Quality System in the Swedish Air Emission Inventories

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SMED is short for Swedish Environmental Emissions Data, which is a collaboration between IVL Swedish Environmental Research Institute, SCB Statistics Sweden, SLU Swedish University of Agricultural Sciences, and SMHI Swedish Meteorological and Hydrological Institute. The work co-operation within SMED commenced during 2001 with the long-term aim of acquiring and developing expertise within emission statistics. Through a long-term contract for the Swedish Environmental Protection Agency extending until 2014, SMED is heavily involved in all work related to Sweden's international reporting obligations on emissions to air and water, waste and hazardous substances. A central objective of the SMED collaboration is to develop and operate national emission databases and offer related services to clients such as national, regional and local governmental authorities, air and water quality management districts, as well as industry. For more information visit SMED's website www.smed.se.

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1. Introduction

This manual describes the QA/QC procedures applied in the work with the annual preparation of the Swedish air emission inventories submitted to the UNFCCC, to EU Monitoring Mechanism, to the EU NEC directive and to CLRTAP. This manual is a part of the Swedish National System¹, and is in accordance with the quality manual for the Swedish national system for inventory and reporting according to the Kyoto Protocol and decisions within EU², and with SMED's overall quality system³.

The inventory system currently used in Sweden is presented in Figure 1. The Swedish Ministry of the Environment has the overall responsibility and submits the inventory to the European Commission and to the UNFCCC secretariat. The Swedish Environmental Protection Agency is co-ordinating the necessary activities to develop the inventory, and is also responsible for the final quality control and quality assurance of the data before it is submitted.

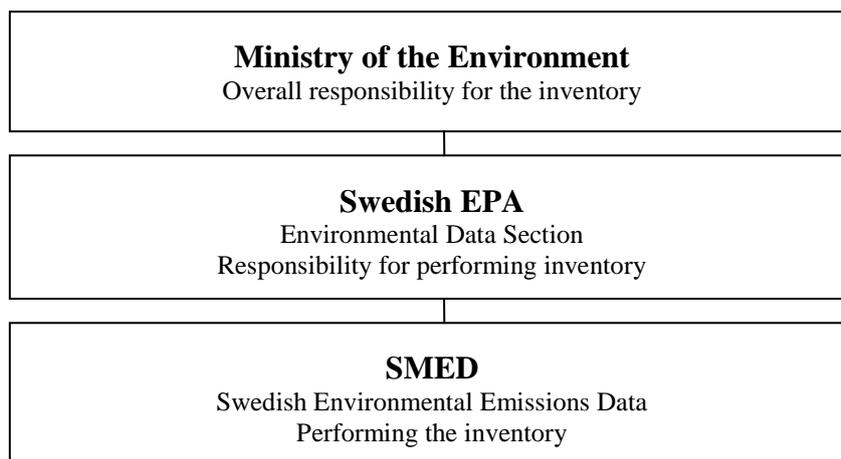


Figure 1. Current national inventory system

This document covers the activities performed by SMED and the connections between SMED and the Swedish Environmental Protection Agency. It briefly touches the QA performed by the Swedish Environmental Protection Agency.

The Swedish EPA in consultation with SMED is responsible for that this document is in compliance with the Kyoto protocol and related guidelines.

¹ Sveriges nationella system för inventering och rapportering enligt Kyotoprotokollet och beslut inom EU, Naturvårdsverket 2005.

² Kvalitetsmanual för Sveriges nationella system för inventering och rapportering enligt Kyotoprotokollet och beslut inom EU. Naturvårdsverket, Verksprotokoll Nr 138, 2005-10-07.

³ SMED's övergripande kvalitetssystem.

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2. Definitions

Important concepts and short definitions according to the IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (IPCC, 2000) are listed below.

Good Practice (Annex 3, IPCC 2000⁴) Good Practice is a set of procedures intended to ensure that greenhouse gas inventories are accurate in the sense that they are systematically neither over nor underestimated as far as can be judged, and that uncertainties are reduced as far as possible.

Key Sources/Key Categories (Annex 3, IPCC 2000) A key source or key category is one that is prioritised within the national inventory system because its estimate has a significant influence on a country's total inventory of direct greenhouse gases in terms of the absolute level, the trend, or the uncertainty in emissions and removals.

National system/national inventory system (Decision 20/CP.7) A national system includes all institutional, legal and procedural arrangements made for estimating anthropogenic emissions by sources and removals by sinks of all greenhouse gases not controlled by the Montreal Protocol, and for reporting and archiving inventory information.

QA/QC plan (Chapter 8.5, IPCC 2000) The QA/QC plan is an internal document to organise, plan and implement QA/QC activities. The plan should in general outline QA/QC activities that will be implemented, and include a scheduled time frame that follows inventory preparation from its initial development through to final reporting.

QA/QC system (Chapter 8.3, IPCC 2000) The major elements of a QA/QC system are:

- an inventory agency responsible for coordinating QA/QC activities,
- a QC/QA plan,
- general QC procedures (Tier1),
- source category-specific QC procedures (Tier 2),
- QA review procedures and reporting, documentation and archiving procedures.

Tier 1 QC procedures (General QC procedures) (Chapter 8.6, IPCC 2000) Tier 1 General Inventory Level QC procedures are checks that the inventory agency should use routinely throughout the preparation of the annual inventory. The focus of general QC techniques is on the processing, handling, documenting, archiving and reporting procedures that are common to all the inventory source categories.⁵

Tier 2 QC procedures (Source category-specific QC procedures) (Chapter 8.7, IPCC 2000) Source category-specific QC procedures (Tier 2), are directed at specific types of data used in the methods for individual source categories. The source category-

⁴ IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (IPCC, 2000)

⁵ Table 8.1 of the IPCC 2000 GPG lists the general QC procedures

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specific QC measures are focusing on key source categories and on source categories where significant methodological and data revisions have taken place. Tier 2 QC activities are in addition to the general QC conducted as part of Tier 1.⁶

Quality assurance (Chapter 8.1, 8.8, IPCC 2000). Quality assurance (QA) activities include a planned system of review procedures conducted by personnel not directly involved in the inventory compilation/development process to verify that data quality objectives were met, ensure that the inventory represents the best possible estimate of emissions and sinks given the current state of scientific knowledge and data available, and support the effectiveness of the quality control (QC) programme. QA activities include audits and expert peer reviews.

Quality control (Annex 3, IPCC 2000). Quality control (QC) is a system of routine technical activities, to measure and control the quality of the inventory as it is being developed. The QC system is designed to:

- Provide routine and consistent checks to ensure data integrity, correctness, and completeness;
- Identify and address errors and omissions;
- Document and archive inventory material and record all QC activities.

Quality Objectives (Chapter 8.1, IPCC 2000). The objectives of QA/QC activities on national greenhouse gas inventories are to improve transparency, consistency, comparability, completeness, accuracy, confidence and timeliness⁷.

- **Transparency** means that the assumptions and methodologies used for an inventory should be clearly explained to facilitate replication and assessment of the inventory by users of the reported information.
- **Consistency** means that an inventory should be internally consistent in all its elements over a period of years. An inventory is consistent if the same methodologies are used for the base year and all subsequent years and if consistent data sets are used to estimate emissions or removals from sources or sinks.
- **Comparability** means that estimates of emissions and removals reported by Parties in inventories should be comparable among Parties.
- **Completeness** means that an inventory covers all sources and sinks as well as all substances required.
- **Accuracy** is a relative measure of the exactness of an emission or removal estimate. Estimates should be accurate in the sense that they are systematically neither over nor under true emissions or removals, as far as can be judged, and that uncertainties are reduced as far as practicable.
- **Confidence** is used to represent trust in a measurement or estimate. Having confidence in inventory estimates does not make those estimates more accurate or precise; however, it will eventually help to establish a consensus regarding whether

⁶ More specific information is provided in the sector specific chapters of the IPCC GPG

⁷ The objective of timeliness and confidence is introduced in the EC QA/QC programme and not part of the IPCC GPG.

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the data can be applied to solve a problem. This usage of confidence differs substantially from the statistical usage in the term confidence interval.

- **Timeliness** means submission of a complete inventory on time.

Definitions in this Manual:

- *Project specification* is a description of a suggested project, submitted by SMED for review and approval by the Swedish EPA.
- *Project agreement*. A signed agreement between Swedish EPA and SMED to carry out a project according to the project specification.
- *Activity plan*. A detailed internal SMED document with a time schedule for the project, developed based on the project specification.
- *Development project*. A project concentrating on an issue aimed at improving the inventory.
- *TPS*. Technical Production System. A web-based interactive platform developed for the National system, used for data transfer, SMED quality control, and quality assurance by the Swedish EPA and the national independent reviewers (NOG).

3. SMED

SMED, Swedish Environmental Emissions Data (SMED), is a consortium constituting of Statistics Sweden (SCB), the Swedish Meteorological and Hydrological Institute (SMHI), the Swedish Environmental Research Institute (IVL) and the Swedish University of Agricultural Sciences (SLU).

SMED is organised as presented in figure 2. There is a steering group with one member from each organization in the consortium. The steering group has the final responsibility versus the Swedish EPA. There is also a program management group, consisting of one member from each organization. In the group there are program co-ordinators, one for air, one for water, and one combined for waste and hazardous substances. Each co-ordinator is responsible for coordinating all projects and activities within each program, and for the final quality control of all deliverables before they are passed to the steering group, which is responsible for the final approval before delivery to the Swedish EPA.

SMED is working with the collection of data and calculations of emissions for the sectors Energy, Industrial Processes, Solvent and Other Product Use, Agriculture, Land Use Land Use Change and Forestry, and Waste in the Swedish air emission inventory. SMED also compiles the major parts of the official inventory documents. Statistics Sweden performs most of the work in the sectors Energy, Agriculture and Waste, the Swedish Environmental Research Institute performs most of the work in the sectors Industrial processes and Solvent and Other Product use and the Swedish University of

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Agricultural Sciences performs most of the work in the sector Land Use, Land Use Change and Forestry. The role of the Swedish Meteorological and Hydrological Institute (SMHI) is to carry out calculations for geographical distribution and normal year correction. They are also involved in the quality control of the inventory.

In the work with the Swedish air emission inventories SMED is using data from a number of Swedish authorities associated to the National System. Those authorities are listed in figure 2.

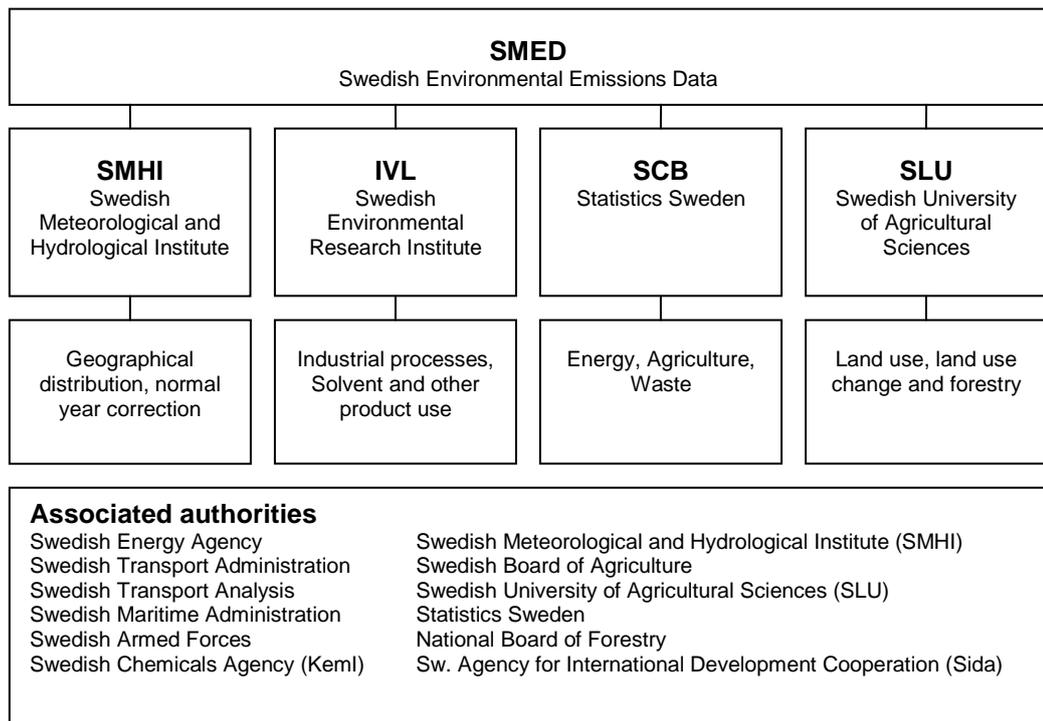


Figure 2. Current organisation of SMED, main responsibilities in the air emission inventories and authorities concerned in the National System.

In the emission inventory SMED has contacts with the above-mentioned authorities in their role as data providers, which is regulated in the National System. The authorities also provide additional background information in discussions with inventory experts in SMED when needed. SMED also uses information and input data from other contacts, such as trade associations, individual industrial facilities and experts.

4. The SMED Quality System for Air Emission Inventories

4.1. Aim, structure and content of the Quality System

The overall aim of the quality system is to maintain and improve the quality in all stages of inventory work, in accordance with decision 20/CP.7 and corresponding decisions

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within EU. This manual describes the structure of the work in all aspects of inventory management and inventory preparation within SMED. It also describes communication with external parties and the role of SMED in the national inventory system.

This manual is a part of the SMED overall quality system that includes all programs for environmental reporting (air, water, waste and hazardous substances).

The quality system described in this manual is designed according to the PDCA-cycle (Plan, Do, Check, Act) presented in figure 3, which is a generally accepted model for pursuing a systematic quality work according to international standards, in order to ensure the maintenance and development of the quality system. This structure is in accordance with structures described in decision 20/CP.7 and in the IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (GPG). Chapter 8 in GPG, Quality Assurance and Quality Control, refers to ISO systems which are built upon the PDCA- cycle. The Quality system in the National system in Sweden is based on the same structure.

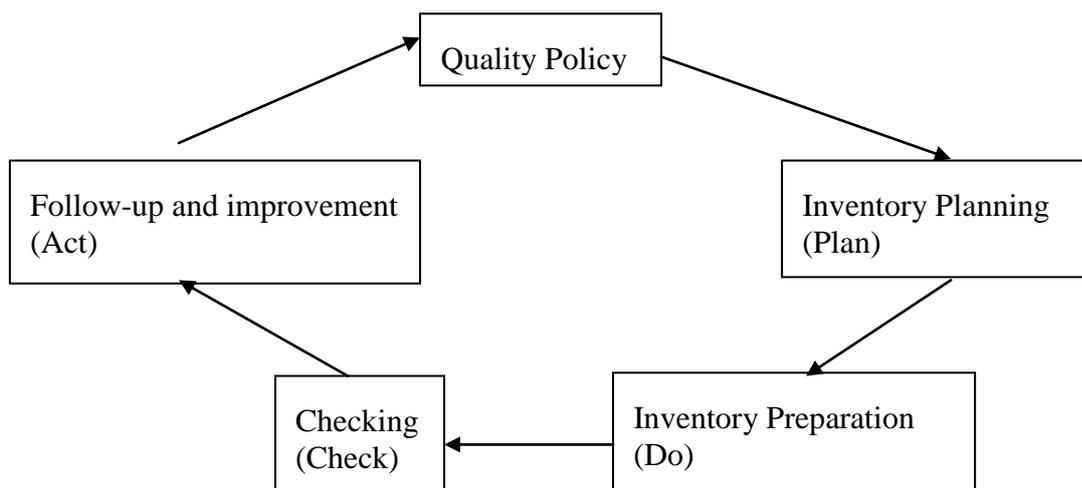


Figure 3. The PDCA cycle

In the following chapters the procedures in the different stages of the PDCA-cycle, applied by SMED for the Swedish air inventory, are described. In each chapter there are references to relevant documentation in order to make the quality system transparent for independent reviewers and other interested parties.

5. Quality policy

The policy within SMED, as described below, is in agreement with the quality objectives of the Swedish Environmental Protection Agency, and the overall quality

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policy and principles for quality and environmental work in SMED's overall quality system (see chapter 3.1). The quality policy is:

- To fulfil the quality objectives and requirements as laid down in the guidelines for inventory and reporting, both nationally and internationally
- To ensure transparent, consistent, comparable, complete and accurate reporting through this quality system.
- That the quality system shall include procedures to ensure that the quality requirements concerning development/research and investigational projects are met.
- To maintain a high standard as regards timely deliverables for Sweden's international reporting obligations.
- To contribute and cooperate actively with the Swedish EPA in order to prevent and minimize the risk of any deviation from defined quality requirements.
- To ensure sufficient resources with adequate competence that meets the requirements set by the Swedish EPA as regards fulfilling Sweden's international reporting obligations.
- To pursue a continuous development and improvement in inventory management and inventory preparation by actively developing internal quality procedures and competence.

6. Inventory planning (Plan)

6.1. Requirements, decisions and guidelines

This document is the main guidance document for the air emission inventory work within SMED, covering the inventory itself as well as development projects for inventory improvement.

It is the responsibility of the Swedish EPA to provide information to SMED regarding any changes in the reporting requirements. Such information is distributed to all persons concerned within SMED through the SMED air emission inventory project management team.

In all documents included in the work documentation (appendix 4) there are detailed references to appropriate individual chapters in guidance documents, governing the inventory work, for all sources and sinks.

Some of the most important guidelines governing the planning of the inventory are:

- Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories

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- IPCC, 2000. Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories
- IPCC, 2003. Good Practice Guidance for Land Use, Land-Use Change and Forestry.
- EMEP/CORINAIR Emission Inventory Guidebook 2007. (Air Pollutant Emission Inventory Guidebook - Technical Guidance to Prepare National Emission Inventories following the LRTAP Convention's Reporting Guidelines and the EU National Emission Ceilings Directive).
- EMEP/EEA air pollutant emission inventory guidebook 2009. Technical guidance to prepare national emission inventories
- Guidelines for EU Monitoring Mechanism "Monitoring Decision (280/2004/EC)"
- UNFCCC guidelines on reporting and review FCCC/CP/2002/8
- Guidelines for Reporting Emission Data under the Convention on Long-Range Transboundary Air Pollution, ECE/EB.AIR/2008/4.
- Annotated outline of the National Inventory Report including reporting elements under the Kyoto Protocol (decision 18/CP.8).

6.2. Quality objectives and quality program

The main quality objectives for SMED relating to the Swedish air emission inventories are to ensure that

- the objectives in the project agreements are met and that the Swedish EPA is satisfied with the delivered results,
- deadlines are met, and
- the work is conducted as efficiently as possible.

The quality program to meet these objectives is based on follow-up and improvement as discussed in chapter 9. Procedures for handling of non-conformity, corrective and proactive actions are described in chapter 8.9.

Customer satisfaction is evaluated by the amount and nature of comments on delivered results. If comments are received that indicate that the customer is not so pleased with some aspects of the delivered results, measures are taken to correct possible errors and prevent similar errors in the future (by reorganising the work and/or adjustments in future project specifications).

Deadlines should be met as specified in project specification. Economical fees for not meeting a deadline are specified in project specifications. If there are problems with

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meeting a deadline, the customer should be informed as soon as possible, including reasons for the delay and suggestions on revised deadline. If the delay causes troubles for the customer, SMED should do what is possible to minimize those troubles.

The **efficiency of work performed** is evaluated at the follow-up meeting after each completed inventory (see chapter 6.3). Each organisation within SMED also evaluates the economical outcome of each project.

Evaluation of these three quality criteria and additional proposals from follow-up meetings and/or in the planning document (appendix 9) are combined and then considered in the planning of work for the next year (see chapter 6.3).

6.3. Project planning procedure

In the annual planning procedure, suggestions and issues for further consideration are derived from the work with the last inventory, including the audit of work documentation and QC-checklists by the QC-team, the final project evaluation meeting each year and issues from internal and external audits and reviews. All issues are documented in an annual planning document (appendix 9), archived at www.projektplace.com. See also chapter 8. From the annual planning document and other relevant priorities, the Swedish EPA assigns SMED to perform the necessary work to improve the inventory according to the Swedish EPA routines.

In the end of each year a planning meeting with SMED and the Swedish EPA is held to plan next year's work. Before this meeting, a preliminary version of the planning document (appendix 9) is compiled, based on comments from national and international reviews, including also new suggestions from inventory staff discussed at project meetings (appendix 8).

The planning of individual projects starts by developing a project specification, including a background, a detailed description of the planned work, a plan for follow-up of project progress by Swedish EPA and SMED, a plan for delivery of results and a budget for the project. The project specification is written by the project leader within SMED, audited by the program co-ordinator and approved by the steering group before it is submitted to the Swedish EPA in its final version. For all projects, a project agreement is signed by the Swedish EPA and SMED.

Usually project specifications are developed during the end of the year, for work to be performed during the next year.

Development projects are usually performed during the first part of the year, to be included in the inventory submission delivered to the Swedish EPA later the same year. Results from development projects are only included in the inventory if approved by the Swedish EPA. Time plans are developed individually for each project.

The activity plan for the annually performed inventory preparation and quality control is presented in Appendix 1.

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7. Inventory preparation (Do)

7.1. Organisation and responsibilities

The organisation of SMED, relating to air emission inventories, is presented in figure 4.

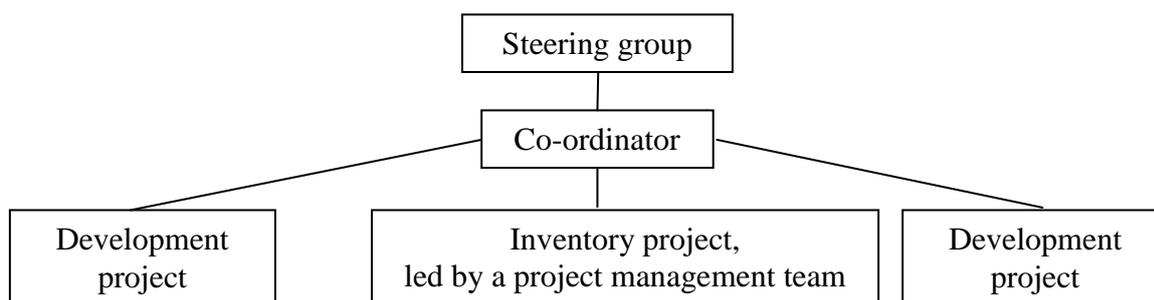


Figure 4. Organisation relating to air emission inventories in SMED

Statistics Sweden, IVL Swedish Environmental Research Institute, SLU and SMHI share the work with the inventory within SMED. Data are produced mainly by Statistics Sweden, IVL and SLU. The inventory is led by a team of four members, one from each organisation. One of them is the main project leader. The project management team is responsible for distributing tasks among the inventory staff, managing the inventory work during the year and distributing responsibilities for inventory staff quality control. Within SMED a co-ordinator for the air inventory program co-ordinates all air-related projects and relevant activities within the program.

A QC team performs an annual internal audit directed toward checking that all QC-procedures in the inventory project have been performed and documented. The co-ordinator is responsible for the internal audit of the Swedish air emission inventory, and of all air-related development projects. The steering group is responsible for the final approval, before the results are submitted to the Swedish EPA.

Roles and responsibilities are described in appendix 2, which is updated annually.

7.2. Education, awareness and competence

Within SMED, the steering group is responsible for maintaining an adequate staff of experts with suitable education and competence to perform the Swedish air emission inventories according to quality requirements.

Maintaining competence and awareness in the inventory work is achieved by ensuring that more than one person is sufficiently familiar with a specific area of work to be able to perform the work in accordance with quality requirements. All work is also described

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in detail in work documentation (appendix 4). In order to ensure high competence regarding all reporting categories, work with specific categories is exchanged between inventory staff members when appropriate regarding the need for ensuring competence. The work can be performed under supervision and support from a more experienced expert when needed, to fulfil this objective. At the annual start-up meeting for the inventory project, a specific planning for the distribution of work is made and documented in the annually updated appendix 2.

7.3. Internal and external communication

7.3.1. Internal communication

The program co-ordinator has an overview of all air-related projects and is the key point for internal communication in SMED as an organisation. The co-ordinator has close communication with the steering group and with the project leaders in all air related projects and participates when necessary in project and planning meetings.

The project leaders handle communication with the co-ordinator and the inventory staff. Within the project management team for the annual inventory project frequent contact is maintained by telephone and e-mail to manage the inventory project.

For each annual inventory cycle there is a start-up meeting in spring for the inventory project. Project meetings for all inventory staff are then held at least every second month during the inventory preparation. In the final five months of the inventory, meetings are held on average every month. The project management team have separate meetings between the project meetings. The frequency of the meetings depends on which phase the inventory project is in.

A final meeting with the project group members and the co-ordinator is held after one year's work has been completed. This meeting can be combined with the start-up meeting for next year's inventory work. At this meeting the project is evaluated regarding project organisation, efficiency and quality.

Most meetings are held as video- or telephone conferences since the inventory organisations are located in different parts of the country.

All meetings are documented in protocols stored at www.projectplace.com.

Ad-hoc communication is mainly by email.

The internal communication and frequency of project meetings regarding development projects is, apart from communication with the co-ordinator, dependent on duration of the project and the number of persons involved in the project.

7.3.2. External communication

Formal communication between SMED Air, represented by the co-ordinator and a steering group representative, and contact persons at the Swedish EPA is maintained by

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regular meetings, 4-5 times a year. These meetings are documented by signed protocols stored at www.projectplace.com. In matters directly relating to the actual project, the project leader or project management team communicates with the contact persons at the Swedish EPA.

Follow-up meetings with SMED Air and the Swedish EPA are held at least once a year to discuss all relevant SMED Air related projects. These meetings are attended by the contact persons from the Swedish EPA and the SMED co-ordinator, project leaders and if necessary other members of the staff. The meetings are documented in minutes, stored at www.projectplace.com.

Finally, the SMED steering group has formal follow-up meetings with the Swedish EPA twice a year.

Communication between SMED and the Swedish EPA is regulated by the SMED overall quality system.

Communication with other authorities in their role as data providers is regulated in the National System.

Regular external communication is also maintained with providers of data and information, other than authorities concerned in the National System. These external contacts include trade associations, individual industrial facilities and national experts.

External communication with contacts abroad include inventory experts in the Nordic countries by participation in joint projects and informal exchange of information, the UNFCCC by participation in the UNFCCC review program, and the UNECE Task Force on Emission Inventories and Projections (TFEIP).

7.4. Documents and documents control

7.4.1. Documents and documents control in the inventory

The documentation relating to the national air emission inventory is rich. In Table 1 the most important documents are listed and classified as procedures (P) or records (R). These documents are mainly updated annually. Version and date is given, as well as information on if the document is a draft or a final version. When the annual inventory has been approved externally the main project leader makes the archiving of documents and tables at www.projectplace.com. Archives are kept for each submission.

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Table 1. Documentation in the air emission inventories

Document	Type of document	Written by	Reviewed by	Approved by	Updating
Planning document	P	Inventory staff, co-ordinator	Co-ordinator, SEPA		Annually
Project specification for inventory project	P	Project leaders and inventory staff	Co-ordinator and steering group	SEPA	Annually
Project specification for development projects	P	Project leaders and inventory staff	Co-ordinator and steering group	SEPA	Each project
Activity plan	P	Project management team			Annually
Activity plan, filled	R	Project management team			Annually, living document
Manual for quality system	P	Project management team	Co-ordinator and steering group	SEPA	Annually
Roles and responsibilities	P	Project management team	Co-ordinator		Annually
Documentation of databases and models	R	Inventory staff	Co-ordinator		When needed (seldom)
Work documentation	P	Inventory staff			Annually
QC checklists	P	Inventory staff			Annually
QC team checklist	P	QC-team, inventory staff	Co-ordinator		Annually
QC team checklist, filled	R	QC-team, inv. staff	Co-ordinator		Annually
Official inventory reports (NIR/IIR)	R	Inventory staff	Co-ordinator and steering group	SEPA	Annually
Reporting databases (TPS/CRF reporter)	R	Inventory staff	Co-ordinator	SEPA	Annually
Uncertainty estimates	R	Responsible for uncertainties	Co-ordinator	SEPA	Annually
Expert protocols for uncertainty estimates	R	Inventory staff		SEPA	Annually
Key Category analysis	R	Responsible for key categories	Co-ordinator	SEPA	Annually
Documented internal audits	R	Co-ordinator			Annually
External review response documents	R	Inventory staff	Project leader	SEPA	Each external review
Protocols from internal and external meetings	R	One participant	All participants		Each meeting
Project reports from development projects	R	Project leader	Co-ordinator and steering group	SEPA	Each project

7.4.2. Documents and documents control in development projects

All development projects aim at improving the annual inventory in all or some of the aspects relating to accuracy, comparability, completeness, transparency and consistency. The objectives of development project may also be to e.g. increase efficiency in the inventory work.

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The results of development projects are, if approved by the Swedish EPA, included in the annual work with the inventory and documented in the regular documenting and QC system (Table 1). Additionally, a project report is in most cases compiled, audited by the co-ordinator, approved by the SMED steering group and then submitted to the Swedish EPA for final review and approval. The project reports are archived at www.projectplace.com.

7.5. Quality plan (Plan for inventory preparation and quality control)

Figure 5 gives an overview of the annual inventory process, after a project agreement has been signed and the initial project planning procedures have been performed, according to the description in chapter 6.3. For each step in the process a number of QA or QC procedures are performed. From February, when the collection of data starts, and during the calculation and compilation phases until October, appropriate Tier 1 QC⁸, and for some categories Tier 2 QC, are performed and documented, as described in chapters 8.1 to 8.7. During September-November, the procedures for internal SMED audit take place before delivery of tables and reports to the Swedish EPA (chapter 8.8.1). During two weeks from the middle of October until the beginning of November a QA procedure by independent reviewers of the EU Monitoring Mechanism and UNFCCC submission takes place, which is the responsibility of the Swedish EPA (chapter 8.8.2).

⁸ Table 8.1. in IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories.

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Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
Development projects											
start of inventory project											
UNFCCC											
Collection of data, calculations											
QC											
15/10 Delivery to SEPA											
Compiling NIR											
Compiling databases and tables											
SMED internal QA											
QA independent review											
15/12 Delivery to Ministry											
15/1 Delivery to EU											
15/4 Delivery to UNFCCC											
Initial check											
S&A											
UNFCCC review											
Comments draft review reports											
CLRTAP											
Collection of data, calculations											
QC											
Compiling IIR											
Compiling databases and tables											
SMED internal QA											
Repdab											
1/12 Delivery to SEPA											
15/1 Delivery to ministry											
15/2 Delivery to CLRTAP											
CLRTAP stage 1&2 review											
CLRTAP centralized review every 5th year											
Comments draft review reports											

Figure 5. The inventory process. Plan for the inventory

The annual inventory cycle and QA/QC is governed by an activity plan, appendix 1. The activity plan is derived from the project agreement with the Swedish EPA and specifies when all activities (QA/QC and other activities) must take place in order to maintain timeliness and high quality in delivered data and reports.

All inventory preparation is described in detail in the work documentation (appendix 4).

7.5.1. Plan for development projects

Development projects are approved by the Swedish EPA, based on a project specification. The specification includes a time schedule for the different project steps, for contacts with the Swedish EPA and for final delivery of results.

8. Checking (Check)

The objective of the quality control and quality assurance steps and procedures outlined in this and the following chapters is to ensure that the inventory is as comparable, consistent, complete, transparent and accurate as possible, given the resources and expertise available.

This chapter describes the routines for quality control and quality assurance that shall be performed during the inventory process by the inventory staff when gathering data and

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calculating and compiling the emission inventory. The process involves all steps from initial gathering of underlying data until the CRF Reporter Database and NFR reporting tables are completed. It also involves the compilation of inventory documentation, from internal work documentation to the official inventory reports (National Inventory Report to UNFCCC and the Informative Inventory Report to CLRTAP).

8.1. Data quality control procedures

8.1.1. Data quality control, General procedures, Tier 1

The general QC-procedures (Tier 1) (IPCC, 2000) are to be performed regardless of reporting sector or type of data. Table 8.1 in Good Practice Guidance and Uncertainty Management in Greenhouse Gas Inventories, chapter 8 (IPCC, 2000) specifies the Tier 1 general inventory level QC procedures.

<ul style="list-style-type: none"> - Assumptions and criteria for selection of activity data and emission factors are documented - Transcription errors in data input and references - Calculations are made correctly - Units and conversion factors are correct - Integrity of database files - Consistency in data between source or sink categories - Correct movement of inventory data between processing steps - Uncertainties estimated or calculated correctly - Review of internal documentation - Recalculations checked and documented - Completeness check - Comparison of last submission's estimates to previous estimates

Most QC procedures are performed during the inventory process, and those performed by the inventory staff during the inventory process can be summarised to include the following checks.

<ul style="list-style-type: none"> - Transcription errors in data input - Calculations are made correctly - Units and conversion factors are correct - Integrity of database files - Consistency in data between source or sink categories - Correct movement of inventory data between processing steps - Recalculations, checked and documented - Completeness check - Comparison of last submission's estimates to previous estimates - Documentation of changes that may influence uncertainty estimates
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Tier 1 checks are documented in code- or source/sink specific QC-checklists (appendix 5). The remaining Tier 1 checks are described in chapters 8.4 and 8.5.

8.1.2. Data Quality control, Specific procedures, Tier 2

For some sources there are requirements on Source Category-specific QC Procedures, Tier 2, according to Good Practice Guidance (IPCC, 2000). These are included, specified and described, for the codes and sources concerned, in the QC-checklists (appendix 5) and in the work documentation (Appendix 4).

Tier 2 Quality Control procedures are introduced into the annual work plan only after approval by the Swedish EPA.

8.2. QC-procedures for development projects

QC procedures during a development project may vary according to the nature of the project. In all cases when results from development projects are included in the inventory, they undergo the same procedures regarding QC, internal audits, documentation, archiving and QA as described for inventory data. The co-ordinator always audits, and the steering group always approves all deliveries to the Swedish EPA.

The aim of development projects is to improve the inventory by providing data and methodology that are in accordance with Good Practice Guidance and that reflect national circumstances. In the development projects a thorough analysis of data are made, including verification where possible, in order to ensure that the best input data and methodology practicable are included in the annual inventory, given scientific knowledge, national circumstances and resources available.

8.3. QC-procedures for data gathering and emission calculations in the inventory

In the Swedish inventory system the responsibilities for performing and documenting the QC procedures during the inventory process rest upon the inventory staff, as given in Appendix 2.

8.3.1. QC-checklists

Throughout the working process, the inventory staff shall document the QC procedures performed in the appropriate QC checklist (Appendix 5). Matters that need further attention or action are also documented in the QC-checklist.

There is one QC-checklist for each source/sink, code or set of codes depending on the type of underlying data, and how the inventory work is shared between the organisations in SMED. The aim is to achieve the most rational and unambiguous division according to the actual inventory procedures. In the QC-checklist there is a general list of checks to be performed (Tier 1), and specifications are added where

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necessary. Source or sink category-specific checks, Tier 2, are included and specified in the list for codes concerned, see also chapter 8.1.2. Checks that are not applicable for a specific code do not need to be filled in. They are shaded or removed. The checklists are under continuous development to make them as rational as possible. This implies that the layout will evolve between submissions, however keeping the main functions intact.

In the QC-checklists, besides documenting QC procedures performed, there is also space available to note matters that need further action. This includes:

- changes or corrections to perform before submission of present inventory
- changes or corrections that must be documented elsewhere e.g. NIR and work documentation
- changes that may influence the uncertainty estimates (to be considered and evaluated in the annual uncertainty assessment)

When all matters that have been noted to need further action are performed, these are signed in the list. The QC-checklists are thus the basis for keeping track of changes and the flow of information in the inventory work.

8.3.2. Work documentation

Documentation of the inventory is made in separate work documentation (Appendix 4), either by reporting category or other relevant division according to the underlying data or calculation methods. The inventory staff is responsible for working in accordance with, and also for updating the work documentation.

The documentation is often separated according to the same system as the QC-checklists (sector, category, group of categories etc). The work documentation and the QC checklist are complementary to each other. The work documentation is intended as a manual and working material for the inventory staff, in order to ensure consistency, but is also used as a basis for inventory improvement and is available for external review. The work documentation is in Swedish.

Chapter 1 and 2 consists of procedures. The first chapter in the work documentation is an overview of the category, national circumstances, and references to relevant guidelines, general information on choice of methods, emission factors and activity data, information on completeness, consistency, uncertainties and QA/QC. Chapter 2 gives the procedures for the inventory staff. Chapter 2 includes references to underlying data and necessary files, how to collect data, how to perform calculations, and any specific QC-procedures. Chapter 1 and 2 are updated when needed (seldom).

Chapter 3-6 are records and updated annually. Chapter 3 is for suggestions on improvements from SMED. Chapter 4 is for suggestions on improvements from reviews. Chapter 5 covers any comments or notes concerning the inventory work and chapter 6 covers records on recalculations.

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Some work documentations are not yet converted to this structure. If so, chapters 3-5 are records. Chapter 3 covers recalculations and changes and is updated annually. Chapter 4 is for suggestions on improvements. Chapter 5 is updated annually with any comments or notes concerning the inventory work.

8.4. Checking inventory estimates

After data collection and calculations are completed, data are fed into the TPS database, and from there exported to the CRF-reporter database. The inventory staff performs checks on the time-series trends in CRF-reporter or for NFR-data by special trend graphs. Any corrections that can be done immediately are made, and a new set of corrected input data tables is fed into the TPS database. In the case of the need of more extensive corrections that cannot be dealt with in time to be included in the present submission, they are documented in the appropriate working document and /or in the improvement list (Appendix 8 to be included in the planning of the following inventory (planning document, appendix 9).

8.5. Checking reporting database and tables

8.5.1. UNFCCC CRF Reporter database

Additional checks to the inventory estimates described above concern sectoral background data and other supporting information in the CRF reporting system. The checks are “Consistency checks in time series”, “Recalculation check” and “Completeness check” and these checks are made to ensure that all required information is correctly completed. The responsibility for checking the CRF Reporter database lies with the project management team (according to Appendix 2).

8.5.2. UNECE/CLRTAP Nomenclature For Reporting (NFR)

In addition to the check of inventory estimates as described above, the format of NFR reporting tables are checked. Before submission of NFR data to the Swedish EPA, the RepDab-tool provided by EMEP is used by the co-ordinator (<http://www.ceip.at/reporting-instructions/repdab/>). The RepDab-tool provides a table formats check, checks for internal consistency and completeness. The responsibility for the NFR table checks lies with the co-ordinator (according to Appendix 2).

8.6. QC procedures for uncertainty estimates

The general QC-procedures (Tier 1) (IPCC, 2000) are to be performed regardless of reporting sector or type of data. Table 8.1 in Good Practice Guidance and Uncertainty Management in Greenhouse Gas Inventories, chapter 8 (IPCC, 2000) specifies the Tier 1 general inventory level QC procedures. Those applicable for uncertainty assessment and analysis can be summarised to include the following checks:

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- Review of new information in internal documentation (uncertainty parts in QC checklist and work documentation)
- Changes that may influence uncertainty estimates
- Uncertainties estimated
- Correct movement of data between processing steps
- Uncertainty estimates calculated correctly
- Internal review of uncertainty documents (Expert protocols for uncertainty estimates)
- Comparison of estimates to previous submission's estimates

Emission data for the uncertainty estimates are taken from the TPS database to ensure complete and accurate compilation. Uncertainties are calculated using the SAS software.

General procedures for the Swedish quantitative greenhouse gas uncertainty assessment are described in detail in a separate report prepared by SMED⁹ and briefly in the work documentation for Uncertainties.

8.6.1. Annual quality control for uncertainty analysis

During the inventory process, the inventory staff documents changes that may influence uncertainty assessment in the appropriate QC-checklist and work documentation. If needed, the uncertainty estimates in the associated Expert protocols (www.projectplace.com) are also updated before the annual uncertainty assessment is performed.

8.7. QC procedures for Key Source/Key Category analysis

The general QC-procedures (Tier 1) (IPCC, 2000) are to be performed regardless of reporting sector or type of data. Table 8.1 in Good Practice Guidance and Uncertainty Management in Greenhouse Gas Inventories, chapter 8 (IPCC, 2000) specifies the Tier 1 general inventory level QC procedures. Those applicable for key source/key category analysis can be summarised to include the following checks:

- Transcription errors in data input
- Calculations are made correctly
- Units and conversion factors are correct
- Correct movement of inventory data between processing steps
- Completeness check
- Comparison of last submission's estimates to previous estimates

General procedures for the Swedish key source/key category analysis are described in the work documentation for Key Source Analysis (Appendix 4) where also documentation of the annual key source/key category analysis is made.

⁹ Gustafsson, T. 2005, Improved structures for uncertainty analysis in the Swedish Greenhouse Gas Emission Inventory. SMED report 2005

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8.7.1. Annual quality control for Key Source/Key Category analysis

After the SMED internal QA is completed emission data are extracted from the TPS database and fed into the SAS software to perform the complete Tier 1 and Tier 2 key category/source analyses. This minimizes the risk for transcription errors and ensures complete and accurate repetitive compilation. The SAS software programmed QC procedures for key source/key category analyses focus on to ensure that all relevant data is transferred, that appropriate GWP values are used for converting emissions to CO₂-equivalents and that aggregation of sources or sinks are done correctly.

8.8. Quality Assurance (QA)

Within the consortium SMED there is an overall quality system, with an independent quality organisation. The responsibility of the independent quality group is to audit and review that the QA/QC work within SMED is conducted according to the SMED overall quality manual and to this specific manual for SMED Air. The independent quality group establishes annual revision plans, performs audits according to these plans, and reports the results to the SMED steering group.

8.8.1. SMED Air internal audit

This chapter describes the procedures for quality control and review that are performed within SMED Air after completion of the inventory compilation. These procedures are undertaken prior to the submission of the annual inventory databases/tables (TPS database, CRF Reporter database and NFR tables) and the official inventory documents (NIR and IIR) to the Swedish EPA.

Checking inventory estimates

The QC-team and the co-ordinator review the data with the help of specially developed tools to review time series consistency and unexpected deviations from last year's submission. Suspected errors are documented and reported back to the project leader and relevant person in the inventory staff for handling or explanation. If an anomaly represents an actual error and it is possible to correct it right away, this is done by the inventory staff. If an error cannot be resolved by the inventory staff immediately, it is reported to the project leader. If an error has to be considered in the planning of next year's submission it is noted in the QC-checklists and the work documentation (Appendix 4 and 5).

Checking official inventory reports, NIR and IIR

The co-ordinator is responsible for the SMED-internal audit of official inventory documents before submission to the Swedish EPA. Specific matters of concern are that:

- All recalculations are accounted for and properly explained

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- Coming improvements are properly mentioned
- The required substances are covered in the document
- All out-dated information has been removed
- Tables and figures are updated

Checking uncertainties and key source analysis

The co-ordinator is also responsible for an annual audit concerning:

- Estimated uncertainties
- Key Source/Key category analysis

8.8.2. QA by independent reviewers

National QA by independent reviewer

The national QA is regulated in the National System. The national independent review (NOG) covers the Swedish air emission inventories submitted to the UNFCCC and to EU Monitoring Mechanism and is performed by national independent reviewers. SMED submits official inventory documents and all relevant work documentation to the Swedish EPA and the Swedish EPA makes these documents and the TPS database available to the national independent reviewers.

In the national independent review the reviewers may comment on and make suggestions for any part of the information including data, NIR or work documentation.

The Swedish EPA returns any comments or findings from national QA by independent reviewers to the co-ordinator within SMED. The project leader is responsible for necessary corrective actions and the co-ordinator for submission of corrected documents to the Swedish EPA.

The inventory staff is available for questions and comments from the Swedish EPA and other authorities involved during the national QA.

All final comments from NOG are recorded in List of possible improvements (Appendix 8). This is an excel list in Swedish containing all comments from national (NOG) and international (ERT) reviews including records on how these comments are handled. The document belongs to the Swedish EPA. Records are filled by SMED and the Swedish EPA. Records are distributed to the Swedish EPA and NOG. The list is updated annually and archived at www.projektplace.com.

Relevant suggestions from the list of possible improvements are included in the Planning document and evaluated when planning projects for the following year (see chapter 9 and 6.3).

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International reviews

Reviews are performed annually within the UNFCCC, EU and the CLRTAP. The SMED inventory staff is available for questions and comments from the review teams during international reviews. Questions from the review teams during the review are received by the Swedish EPA and forwarded to the project management team which distributes the work in commenting and answering questions, compiles the answers and sends them back to the Swedish EPA for further transmission to the relevant body.

The draft reports of these reviews are received by the Swedish EPA and forwarded to the co-ordinator for comments. The project management team distributes the work in commenting and answering issues from the review reports and compiles the answers and sends them, via the co-ordinator, back to the Swedish EPA for further transmission to the relevant body.

Review reports and the replies to the review reports are archived at www.projectplace.com.

All final comments from reviews are recorded and handled in the same way as described above concerning comments from the national review.

8.8.3. Participation in Swedish EPA audits of the Quality system

SMED participates actively in audits of this quality system when initiated by the Swedish EPA. An audit may cover the entire quality system as described in this manual, or parts of the system. An audit is initiated by a request from Swedish EPA to the SMED co-ordinator. The co-ordinator is responsible for involving relevant experts, depending on the coverage and extent of the audit.

8.9. Nonconformity reporting, corrective and proactive actions

In the Swedish QA/QC system, the aim is to solve any problems at lowest possible level. For problems or mistakes that are discovered by the inventory staff, and which can be corrected immediately, no formal non-conformity reporting is made. Other needs for corrections or other changes are documented in the QC checklists and the work documentation by inventory staff. Desirable or required changes, not already dealt with are then collected to the planning document (Appendix 9) to be taken into consideration in the inventory planning procedure.

In order to fulfil the quality objectives in chapter 6.2, the procedures followed for non-conformity reporting, mechanisms for corrective actions and for proactive actions are as described below.

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8.9.1. Non conformity reporting

Information concerning the need for changes or improvements may arise from four different documented stages of the Swedish inventory process, according to the QC system.

- From issues brought up at project meetings or at follow-up meetings with the Swedish EPA. Documented by meeting minutes at www.projectplace.com.
- From the inventory staff by documented findings in the QC checklist or in the annually updated chapters of the work documentation. All QC checklists and work documents are stored at www.projectplace.com.
- Findings in the different steps of SMED internal audit. Internal audits are documented at www.projectplace.com.
- Comments and suggestions from external reviews. External review reports are archived at www.projectplace.com.

8.9.2. Mechanisms for corrective actions

Corrective actions that are documented in the QC-checklists and the work documentation are attended to be included in the submission as soon as possible. This may be in the present submission or at the latest in the following submission, depending on in what stage of the inventory process the need for corrections is revealed.

Corrective actions which involve more extensive changes and improvements are first noted in QC-checklists and/or in the work documentation, and then collected and documented in the planning document (Appendix 9) to be considered in the annual planning of upcoming inventories. An annual audit is made of the QC-checklists, all work documentation and of documented comments from internal and external review activities. The collection of suggestions to the planning document is the responsibility of the co-ordinator (according to Appendix 2).

Needed or desired improvements and changes noted in the planning document are communicated to the Swedish EPA. Through the regular follow-up meetings with SMED and the Swedish EPA, the Swedish EPA is also informed of, and may also introduce, any issues that may be considered as important for future improvement actions.

8.9.3. Proactive actions

In order to prevent mistakes to be repeated any discovered non-conformity or need for changes of any kind are discussed at all project meetings. A decision on how to proceed with the issue is made, which may be to solve it within SMED according to the procedures described above, or if it needs to be presented to the Swedish EPA for further consideration. If it is a major issue it will be regulated and solved in upcoming project agreements.

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At the annual start up meeting for the inventory project a risk analysis (Appendix 3) is made and the results are taken into consideration in the planning as appropriate.

9. Follow-up and improvement (Act)

As noted in chapter 6.3, a final meeting with the project group and the co-ordinator is held after each year's work has been completed. At this meeting the project is evaluated regarding project organisation, efficiency and quality. Besides documentation in minutes, all relevant ideas for improvement of the inventory are noted in the planning document. From the planning document (Appendix 9) issues that need to be addressed by the Swedish EPA are presented for further consideration.

Suggestions for changes that are noted in the planning document are discussed with the Swedish EPA at follow-up meetings, documented by meeting minutes stored at www.projectplace.com. Changes that are prioritised by the Swedish EPA after discussion with SMED are included in the work with the next submission, either in the inventory or in development projects.

SMED also pursues regular improvement work in relation to data providers not regulated by the National System. This work is primarily undertaken at the annual regular contacts asking for input data to the inventory. At those instances inventory experts discuss possibilities in improving and providing suitable datasets that are quality controlled and quality assured.

Any needs for organisational changes within SMED are handled by the SMED steering group.

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10. Appendices

Appendix 1 Activity plan (Aktivitetsplan)

The activity plan is a time schedule for the regular annual inventory preparation within the inventory project. It is used throughout the annual work cycle. The activity plan is located at www.projectplace.com

Appendix 2 Roles and responsibilities (Roller och ansvar)

A document describing the division of responsibilities within SMED. The document is used during the work with the annual inventory. It is located and annually archived at www.projectplace.com.

Appendix 3 Risk Analysis (Riskanalys)

Annually updated document identifying and addressing all major issues that may affect the work with the annual inventory. The document is used during the work with the annual inventory and when relevant in meetings with the Swedish EPA. It is located at www.projectplace.com.

Appendix 4 Work documentation (Arbetsdokumentation)

Annually updated documentation in Swedish of the work with the inventory with one document for each code or group of codes, one for uncertainty estimates and one for key source/key category analysis. The documents are used during the work with the annual inventory and are located at www.projectplace.com. The documentations for uncertainties and key source/key category analysis are used in the final stages of the inventory and after inventory submission. When the annual inventory is completed the documentation is archived at www.projectplace.com.

Appendix 5 QC checklist (QC-checklista)

QC-checklists are in Swedish. There is one checklist for each code/group of codes. The QC-checklists are used during the inventory, at the end of the inventory, and during reviews. They are annually archived at www.projectplace.com.

Appendix 6 QC team checklist (Checklista QC-team)

This excel file is used as a checklist for the QC-team review of QC-checklists and working documentation in the final stages of the inventory. The document is in Swedish and is located and annually archived at www.projectplace.com.

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Appendix 7 Documentation of databases and models

Documentation in English on databases and models used in the inventory including references to other specific documentation when such documentation exists. The documentation is used as background information and during reviews. It is located at www.projectplace.com.

Appendix 8 List of possible improvements (förbättringsförslagslista)

Excel list in Swedish containing all improvement suggestions from SMED and the Swedish EPA, comments from national (NOG) and international (ERT) reviews including records on how these comments are handled. The document belongs to the Swedish EPA. Records are filled by SMED and the Swedish EPA. Records are distributed to the Swedish EPA and NOG. The list is updated annually and archived at www.projectplace.com.

Appendix 9 Planning document (Bruttolista avtalsplan)

The planning document is updated annually and covers all issues where changes or improvements are desired or necessary. The document is used as a basis for planning improvements in inventory work. The document is in Swedish and is located and annually archived at www.projectplace.com.