ANNEX II

WORLD METEOROLOGICAL ORGANIZATION

QUALITY MANAGEMENT SYSTEM
FOR
NATIONAL METEOROLOGICAL AND HYDROLOGICAL SERVICES

September 2004

QUALITY MANAGEMENT SYSTEM FOR NATIONAL METEOROLOGICAL AND HYDROLOGICAL SERVICES

NMHSs are asking …

- *Should my NMHS spend time and money on implementing a certified Quality Management System?*
- *Is there a quick and painless solution for my NMHS to implement ISO 9001 Quality Management System?*
- *Are there other solutions to fulfil the QMS needs of my NMHS?*

Introduction

Quality Control is a concept very familiar to National Meteorological and Hydrological Services (NMHS) as a tool to achieve data consistency. Quality Management System (QMS) is a business tool used by organizations to achieve efficiency and effectiveness, and improve relationship with customers. Only recently QMS came to the attention of NMHSs.

Traditionally established as non-profit governmental-based organizations, NMHSs in general have been reluctant to embrace developments originated in the business environment and as a result only a limited number of them have implemented commercial practices and tools. This situation, however, may be changing as more NMHSs are implementing or seeking to implement ISO 9001 Quality Management Systems (QMS) to improve their overall visibility and performance.

The reluctance of Members both in developed and developing countries to embrace QMS seems to result from the fact that the perceived benefits of a QMS are not yet obvious. They still need answers and justifications to such basic questions as those above.

This document intends to address these and similar questions as well as other QMS issues with a view to providing some practical advice on the basic steps to be followed by NMHSs attempting to gain ISO 9001 certification. The third question will not be addressed in this paper. There may be a positive response to this question, but the ultimate decision will probably be demand driven. NMHSs customers/users will indicate what type of QMS they are ready to accept. Almost certainly the trend points towards a QMS already well established and supported by the business community.

Annexes A to D provide practical information based on the experience of a medium size NMHS that has undergone certification and recertification processes with a broad scope covering the Headquarters, regional centres, observation and telecommunication networks.

The term organization is being used to denote any entity seeking ISO 9001 certification, including NMHSs.

Benefits, Risks and Misconceptions

Customer satisfaction, efficiency and effectiveness are central concepts of modern business. These attributes are also the essence of any QMS, which main objectives are to ensure customers a consistent commitment to improving products and services, obtain efficiency and effectiveness through careful planning and standardisation of processes and ensure that resources needed for continuous improvement are supplied.

Though frequently associated with heavy bureaucracy, a well designed QMS may help management to improve bureaucracy, by eliminating unnecessary approvals and inefficient operating methods. It may also help to improve the quality of services and increase customer satisfaction by handling customer complaints in a systematic way and making staff work more confidently and cooperatively as a result of well defined responsibility and authority. Suppliers and partners benefit from increased stability and mutual understanding as part of the QMS.

In principle, there is no need to be formally certified to ISO 9001 QMS Standard to achieve customer satisfaction, efficiency and effectiveness. Any serious internal management system would suffice. However, there are many situations in which organizations need to formally demonstrate capacity to external customers. In this case, they have to engage an accredited certification body to audit and certify that the implemented quality management system complies with the requirements of ISO 9001:2000. The necessity for certification may arise as a result of contractual requirements, customer preference, regulatory requirements, staff motivation, etc.

When there is no need to show conformance through ISO 9001 certification, any organization may continue to work toward self improvement by internally implementing the guidelines of ISO 9001, supplemented by ISO 9004:2000 that provides a good methodology for improvement.

It is important to mention that the benefits of implementing ISO 9001, or any other QMS, are not without risk. There is always a possibility to over-document the procedures, significantly increasing the cost of the whole system and making the overall system inflexible. There are risks that organizations may place more focus on the documentation than on the work to be done. It must always be clear that an effective QMS is a management tool to help identifying the organization needs and clarifying how it operates, but not an objective in itself. Just get a certificate on the wall would certainly be waste of time and money.

The interpretation of ISO 9001 has lead to well-known misunderstandings. The Standard is always confused with a product quality control standard and there is a widespread notion that its implementation has to be complex and over bureaucratic. While it is true that the complexity of ISO 9001 QMS is frequently overstated, probably for commercial gains, there are examples, including in the meteorological community, where simpler and cheaper implementation can be achieved.

The alleged misconceptions normally result from the fact that ISO 9001 is a generic standard applicable to any type or size of organization. Rather than a limitation, this should be perceived as its main strength because it enables the organization seeking certification to define the level of complexity required to its particular situation. While there is no one solution that fits all similar organizations, the prescribed implementation methodology is defined by the Standard and well understood.

The Standard itself presents only few mandatory requirements. The organization, rather than the Standard, is responsible for deciding its own needs and directions, and how complex its QMS should be. Complexity in the QMS context depends more on the characteristics of the staff and processes than on size of the organization. Highly skilled people require processes only to be generally defined while more working instructions must be provided to less skilled people.

Basic Structure of the ISO 9001 QMS

The ISO 9001 standard defines the requirements for an organization to set up a QMS. A central component of the QMS is its structured documentation showing how the organization works. In most cases the hierarchy of this documentation is presented in three levels, as follows:

- Quality Policy, Quality Manual, Quality Objectives (Strategic level)
- Documented Procedures (Tactical level)
- Working Instructions, Guides, Records (Operational level)

The model of documentation used depends on the size and structure of the organization and the Standard does not specify sizes or specific formats for these documents. The documentation requirements identified in the ISO 9001 Standard detailed in the following paragraphs include:

- Statement of a Quality Policy and Quality Objectives
- A Quality Manual
- Six Documented Procedures
- Other documents needed by the organization to ensure effective planning, operation and control of its processes
- Records as required by the standard

The *Quality Policy* defines commitment to quality by top management of the organization and provides a framework for setting quality objectives. All staff should be made aware of the Quality Policy and what is required by this policy. (Annex A – paragraph 2)

The *Quality Objectives* are performance indicators to measure the degree of satisfaction with the quality system (Annex A-paragraph 10 contain examples)

The *Quality Manual* defines the scope of the QMS and outlines documentation related to the Standard. It includes or references documented procedures and describes how processes interact to form the QMS. The Quality Manual may be either a high level document with little detail on how the work is done, or it may include considerable detail and combined with System Procedures (Annex B provides an outline of a Quality Manual developed by a NMHS).

Only six *Documented Procedures* are mandatory to meet the requirements of ISO 9001. They are:

- Control of Documents
- Control of Records
- Internal Audit
- Control of Nonconforming Products
- Corrective action
- Preventive action.

Other procedures may be needed to explain the work that needs to be done. Documented procedures need to be referenced in the Quality Manual and authorized by management prior to distribution. Organizations use different methods of documenting their procedures. Procedures may be detailed in a text instruction, a flow chart, checklist or a form with an explanation of how it should be completed (Annex C provides an example of a documentation system and Annex D provides an outline of procedure implemented by a NMHS).

The *Working Instructions* can be operating manuals, guides, forms, specifications and reference books may all be brought into the system without change. They should be reviewed to ensure they are current.

The *Records* are documents that result from use of the system. They must be legible, readily identified, stored, protected, readily retrievable, with defined retention time and disposition.

One important requirement of the standard is the Internal Audit. The initial audits should be carried out by an experienced QMS auditor to ensure the overall system meets the requirements of the standard and that the documented procedures are being followed. Audits may constitute opportunities for improvement.

Another important requirement stated by ISO 9001 Standard relates the definition of management responsibility. Top management must show evidence of its full commitment to the development and implementation of the QMS and continually improving its effectiveness by communicating the importance of meeting customer requirements. Management must also establish the quality policy and the quality objectives, conducting management reviews and ensure the availability of resources.

Roadmap to Certification

As certification is not a mandatory requirement of the ISO 9001 Standard, a decision must be made from the outset to define the position of the organization. Should ISO 9001 QMS be implemented as an internal improvement instrument or as an external business tool?

To help in making the right decision, the organization has to clarify that the certification to the ISO 9001 Standard makes good sense for itself, by evaluating the real benefits it will gain having a formal QMS. This can be done by monitoring the needs for certification in the market segment it works, verifying if its customers are asking for certification, monitoring potential competitors, and checking if its own Government is promoting ISO 9001 certification. In addition, the organization must evaluate the need to improve the quality of its products and services as a result of perceived customer dissatisfaction.

After being fully convinced that ISO 9001 certification is appropriate, the path to certification requires full commitment and support from top management as well as a deep understanding of what the Standard requires from the organization. Understanding the ISO 9001 will not be a very difficult task thanks to the large quantity of didactic material readily available, including on the Internet.

The next step is to define the goals to be achieved with the implementation of the QMS, such as to be more efficient, more profitable, obtain more customer satisfaction, increase market share, improve communications in the organization, reduce costs, etc. The goals must include clear identification of what customers, end users, employees, suppliers, other stakeholders and the society in general expect from the organization.

After setting the objectives, the organization has to determine the discrepancies between its current working practices and the requirements of ISO 9001:2000. This analysis may be carry out internally or through the assessment of external accredited consultancy. If a NMHS already has an organized system to distribute/sell products and services and has established effective working procedures and instructions to deal with customer complaints, etc., it will be much easier and cheaper to obtain certification, as the costs for external consultancy would be minimised.

However, if no organized system is in place or the organization has an immature QMS, much more effort will be required to become compliant with ISO 9001 and the certification will be more expensive because more external consultancy services will be required to assist in the preparation for the assessment.

A NMHS searching certification has to take certain steps to identify and implement a minimum number of processes that are needed to supply products or services to the customers, and undergo periodic internal and external assessment in order to be certified by an accredited

third party. As a summary, the following steps are typical of an implementation process that complies with the requirements of ISO 9001:

- Get a copy of the Standard and study it to understand what is needed to transform the its requirements into day to day working language.

- Entrust a senior person responsible for the development of the QMS. Be sure this person receives adequate training.

- Form a small task force and consider the need for external help to join the task force to evaluate the adequacy of the current procedures and the need of new procedures based on the requirements of ISO 9001.

- Top management to publish the Quality Policy, Quality Objectives and Action Plan for the implementation of the QMS.

- Promote the development of internal leadership to create and sustain employee awareness and motivation by involving Involve staff in developing and improving the system.

- Document the organizational structure by identifying competencies needed at the organization.

- Develop the documented Procedures describing how the organization carries out its work. Flowcharts may be used to describe core and support processes. Keep these procedures under constant review and train staff to implement them.

- Develop and publish the Quality Manual describing the overall system at a high level. Keep it simple and distribute it to customers, every employee and suppliers. The quality manual must include a description of the system to control documents.

- Launch the QMS and continually audit and improve it as preparation for the certification assessment.

- Establish review mechanisms to verify whether the organization is complying with all requirements set by the Standard.

- Establish corrective as well as preventive action systems to prevent problems from recurring and a system to measure customer satisfaction, process, and product conformity.

- Select and hire a recognized and respected certification body to carry out the certification assessment;

- Start the certification assessment.

These actions could take from 12 to 18 months depending on the scope of the certification, complexity of processes, staff skills and workload, availability of resources and, above all, the degree of management commitment. Efforts must continue to maintain the certification subsequently.

There are other important considerations to be taken into account during the implementation of the steps described above. Staff must have access to the documentation that will be used in its everyday work and become familiar with new requirements. Normally, resistance to change appears at all levels within the organisation and management should show good

leadership by following the established procedures and seizing the opportunity to review the system and make improvements.

Usually, an organisation undergoes two to three internal audits before proceeding to the external audit for the certification assessment. The outcome of the audits may result in a number of non-conformances that should be corrected. In this process, an auditor would indicate what is wrong and together with management would set a timeframe for correcting the identified problems. When a considerable number of non-conformances are found, the certifying body will not issue a certificate stating that the organization complies with the requirements of the ISO 9001 standard.

Only accredited bodies are allowed to issue certificates attesting that an organization meets the requirements of the ISO 9001 standard. The selection of the certification body deserves a careful attention and must be decided early in the process to enable the organization to know in detail what is required before granting a certificate.

While the certification requirements are well defined in the Standard there may be different interpretations by certifying bodies. For this reason it is advisable to have a comprehensive audit before the certification assessment starts to detect any discrepancy between the work being performed and the requirements of ISO 9001. The certificate typically expires after three years. The certification process typically requires surveillance audits at six months intervals to maintain the currency of the certificate.

Conclusion

A properly designed and implemented QMS can improve efficiency and effectiveness and may help NMHSs to demonstrate that they are highly performing organizations that place great importance on the level quality of service they provide to users. In some countries, there is an urgency in moving the NMHS in this direction because many users and governments are demanding certification of NMHS. Non compliance with such demand could lead to budget reduction.

The investment in Quality is not always risk free, but it can also pay back. The cost of certification depends on the way the NMHS is currently doing its work and on the scope of certification being sought. As each certificate is accompanied by a definition of its Scope, this allows an implementation focused on the main areas of interest, such as Aeronautical Meteorology, etc. The identification of suitable companies to perform the certification audits may also have a significant impact on the actual implementation costs.

ANNEX A - EXAMPLE OF A CERTIFICATION PROCESS

(Undergone by a NMHS)

1. A short history

The manager of the meteorological observation network, who is a member of the Quality team, wrote:

"We started to write the documents related to the operation and maintenance of the surface observation network, the quality procedures, working instructions and other operational documents for these areas. Upon conclusion of these documents the training started for the concerned staff at the headquarters and regional centres. The observers received general training on the Quality Policy section, which was included in the Observation Manual.

As a starting point for the evaluation of the quality and availability of the collected information, an action plan was prepared calling for immediate visit and technical inspections at observation stations for calibration of thermometers and barometers. The result of the inspections constituted the basis for the preparation of a preventive maintenance plan to be carried out by each regional centre.

The systematic implementation of this plan allowed us to monitor the status of the observation network and ensure good performance of the instruments and the station yards. The site inspections, technical reports and records helped to evaluate the work of the observers. The general conditions of the stations are monitored every three months. Every calendar year each national centre sends to the HQ a report containing a critical analysis of the performance of the observation network under its area of responsibility and an annual report about the programmed and accomplished preventive maintenance.

In order to keep the Certificate, internal and external audits are carried out every six months at the Headquarters, regional centres and station sites not very far from the regional centres. All processes from installation, maintenance, data collection, transmission and storage, to the commercialization of products and services are evaluated. Auditing reports are generated for the top management for analysis and decisions concerning the nonconformities and search of continuous improvement."

This case study is based upon the experience of a NMHS that has undergone all certification process and had the certification re-issued three years after the first certification. The case is generalised to suppress information that are very specific to a particular country. What follows is a summary, which describes the rationale and the steps taken during the first certification.

2. Summary of the statement of Mission, Vision and Quality Policy

- Mission: To provide reliable meteorological information to the society contributing positively in the decision making process associated with the development of the country.
- Vision: To be a major contributor to the development of the knowledge and use of meteorology and climatology at both national and international levels through innovation and partnership with social and productive sectors of the society.
- Quality Policy: Search for recognition, trust and high level of satisfaction of users through the efficient monitoring of meteorological conditions, use of modern weather forecast tools, and timely delivery of the products and services required.

3. The stated reasons to implement a QMS

- Get national recognition through the ISO certification;
- Search excellence through continuous improvement of activities, processes, products, services and customer satisfaction;
- Use and expand the knowledge of Meteorology;
- Involve staff in all processes, from data collection to realization of products;
- Have an integrated view of the organization

4. Understanding QMS

- Standardization and implementation of documented procedures for the development of the end activities;
- Based on the government regulations, WMO standards and the national ISO 9001:2000 standard;
- Structuring of the processes/services oriented to customer satisfaction and continuous improvement;
- Management of processes through the indicators of quality objective and the continuous monitoring of activities

5. Perception of what needed to be done to fulfil the requirements of ISO 9001

- Commitment and involvement of top management
- Statement of a Quality Policy, Mission and Vision
- Writing a Quality Manual
- Writing and implementing Procedures, Instructions and Manual/Guides
- Management review of the QMS twice a year
- Internal and external auditing twice a year

6. How it was done

- Hiring of a national consultancy firm, a National Association of Quality Control, that is a non-profit organization;
- Definition of a high level Quality Committee;
- Designation of a Quality representative
- Creation of a Quality Control section
- Preparation of the documentation through multifunctional group
- Training of trainers
- Certification through an international accredited company
- Recertification 3 years later

7. The level of the Documentation

- Strategic – The Quality Manual, including the statement of Mission, Vision and Quality Policy
- Tactic – Documented Procedures
- Operational – Working instructions

8. The staff structure

- Quality representative of the top Management at the headquarters
- Head of the Quality section at HQ

- Internal auditor(s) at HQ
- Lead auditor(s) at HQ
- Quality Engineer
- Quality representative at each regional centre

9. Number of Quality Procedures

- Fourteen Documented Procedures were implemented, including the six mandatory ones

10. Examples of Quality Indicators

- Number of hours of staff training per year
- Success index of the weather forecast per region of the country
- Provision of meteorological data
- Measure of success of the model output
- Availability of the climatological data base
- Number of messages received
- Availability of telecommunication lines
- Number of stations inspected

11. Monitoring forms and tools

- Daily reports of nonconformity or report of trouble detection
- Monthly reports covering nonconformities
- Semester: Internal and external audits; Request of preventive and corrective actions; meeting of the high level Quality committee.

ANNEX B - OUTLINE OF A NMHS QUALITY MANUAL

NMHS.QM.001
10/08/2004-Rev. 00

NMHS QUALITY MANUAL

1. Introduction

This Section contains an introduction of the QMS, historical facts of the NMHS and describes the objectives and the structure of the Quality Manual and the mechanisms to control and make appropriate revision of the QMS documents.

2. Scope

This section describes the scope of the Quality Manual and includes the statement of the Mission, Vision and Quality Policy of the organization. It also includes a flowchart of the organization and make reference to pertinent government regulations and provides a list of products and services available to users.

3. Responsibility

The responsibilities of top management, including the Director, the Representative of Quality, the head of Quality Section, ttechnical Divisions, Administration Division and Heads of regional centres and concerned staff, with respect to the QMS are included in this section.

4. Structure of the QMS

This constitutes the main section of the Quality Manual. It includes a general description the QMS requirements and flowcharts depicting processes. It also includes the description of the activities related to the following headings:

4.1 Documentation requirements, including Quality Manual, Quality procedures, Quality Instructions, Guides, Manuals, Records, Control of documents and Control of records.
4.2 Management responsibility, customer focus, quality policy and objectives, planning process, internal communication and the mechanisms for management review.
4.3 Resource management
4.4 Product realization
4.5 Measurement, Analyses and Improvement
4.6 Correlation Matrix indicating the responsibility of each section/division with sections of the standard
4.7 History of reviews of the document

Prepared by Chief of Laboratory	Approved by Chief of Division

ANNEX C – EXAMPLE OF A NMHS DOCUMENTATION SYSTEM

Procedure	Code	Objective
Control of documents	ADMN.QP.001	Establishes the criteria for the control of the QMS documents, including those of external origin
Control of Records	ADMN.QP.003	Establishes the guidelines for identification, storage, protection, retrieve, retention time and disposal manner
Internal Audit	ADMN.QP.004	Establishes a system for planning, coordination and execution of the internal quality audits.
Corrective and Preventive actions	ADMN.QP.005	Establishes a system for implementation of corrective and preventive actions with a view to eliminating actual and potential nonconformity causes
Control of non-conform products	ADMN.QP.006	To ensure that products and services non compliant with the requirements be identified and controlled to avoid their use or non intentional delivery
Meteorological products and Services	FOREC.QP.001	Establishes the basic guidelines for the coordination, execution, monitoring and process control for the products and services provided by the NMHS
Installation and maintenance of equipment and instruments	OBSER.QP.001	Establishes the basic guidelines for coordination, execution and process control of the of installation and maintenance of equipments and station instruments
Data collection, transmission and storage of meteorological data	TELEC.QP.001	Establishes the basic guidelines for coordination, execution and process control of the data collection and transmission
Observation instruction	OBSER.QI.001	Establishes the instructions for calibration of barometers
Telecommunication instruction	TELEC.QI.001	Establishes the instruction for compilation of meteorological bulletins for transmission
Measurement and Monitoring	INSTRUM.QP.001	To establish a systematic control of all meteorological measurement and monitoring devices used by the NMHS with a view to ensuring their adequate use.

ANNEX D - EXAMPLE OF QUALITY PROCEDURE

INSTRUM.QP.001
10/08/2004 – Rev.00

Control of Measurement and Monitoring Devices

1.0 Objective

To establish a systematic control of all meteorological measurement and monitoring devices used by the NMHS with a view to ensuring their adequate use.

2.0 Definitions

This section contains definitions of terms related to instruments and methods of observation, such as Measurement and monitoring devices, Calibration, Calibration Standard, Inspection Standard, Management Calibration System, etc.

3.0 General Principles

This section provides general guidance about the quality and accuracy required, the traceability of calibrated instruments, the conditions for outsourcing calibration and measurements, the rejection of uncalibrated instruments, the care with handling the instruments, etc.

4.0 Responsibilities

The responsibilities of concerned staff are indicated in this section, including those of the Director, Division and Section chiefs, Laboratory chief and staff, concerned staff at the regional centres, etc.

5.0 Description of the Procedures

This is the main section of the document. It provides details of the work processes of the Central Laboratory, Regional Laboratories, Calibration Management system, and also the instructions for calibration of the instruments of the observation stations.

6.0 Flowchart Description of the Procedures

Graphical description of the procedures to facilitate understanding.

7.0 Annex

Includes forms and models of identification tags containing information about the current status of the instruments.

8.0 Reviews of The Document

Includes the history of reviews of this document according to the adopted procedure of controlling documents to ensure the correct version is used.

_____	_____
Prepared by	Approved by
Chief of Laboratory	Chief of Division