

ASSESSMENT OF THE PERFORMANCE OF FLOW MEASUREMENT INSTRUMENTS AND TECHNIQUES

**Addresses Expected Result 3: Enhanced capabilities of Members to provide
better hydrological forecasts and assessments**

AND

Contributes to Expected Results No 7*, 8* and 9*

SUMMARY

ISSUES TO BE DISCUSSED:

Recent advances by the Project for the Assessment of the Performance of Flow Measurement Instruments and Techniques and proposed future steps for its implementation

DECISIONS/ACTIONS REQUIRED:

Adoption of Resolution 3 (CHy-XIII) – Project for the Assessment of the Performance of Flow Measurement Instruments and Techniques

REFERENCE:

Abridged Final Report with Resolutions of the Twelfth Session of the Commission for Hydrology (WMO-No. 979)

CONTENT OF DOCUMENT:

Appendices for inclusion in the final report:

- A. Draft text for inclusion in the general summary of CHy-XIII
- B. Draft Resolution 3 (CHy-XIII) – Project for the Assessment of the Performance of Flow Measurement Instruments and Techniques

*ER 7: Enhanced capabilities of Members to provide and use weather, climate, water and environmental applications and services

*ER 8: Broader use of weather climate and water outputs for decision-making and implementation by Members and partner organizations

*ER 9: Enhanced capabilities of Members in developing countries, particularly least developed countries, to fulfil their mandate.

DRAFT TEXT FOR INCLUSION IN THE GENERAL SUMMARY OF CHy-XIII

7. ASSESSMENT OF THE PERFORMANCE OF FLOW MEASUREMENT INSTRUMENTS AND TECHNIQUES (*agenda item 7*)

7.1 The Commission was pleased to learn of the progress achieved in the implementation of the work plan of the Project for the Assessment of the Performance of Flow Measurement Instruments and Techniques.

7.2 The Commission agreed with its AWG on the desirability of establishing a Steering Committee (SC) for the project, noted the proposed terms of reference of the SC, and encouraged the Secretariat to accelerate the actions needed for its establishment.

7.3 As regards the recommendation of the AWG to task the SC to recommend to the Commission that it adopt the uncertainty analysis framework developed by the project, in view of the delay in the establishment of the SC and taking into account new developments related to the involvement of other WMO's technical commissions and the agreement with ISO recently signed by WMO, the Commission

7.4 The Commission adopted Resolution 3 (CHy-XIII) – Project for the Assessment of the Performance of Flow Measurement Instruments and Techniques.

DRAFT RESOLUTION

Res. 3 (CHy-XIII) – PROJECT FOR THE ASSESSMENT OF THE PERFORMANCE OF FLOW MEASUREMENT INSTRUMENTS AND TECHNIQUES

THE COMMISSION FOR HYDROLOGY,

Recalling that through Resolution 1 (CHy-XII) CHy had decided, as one of the activities under its Theme Area on Basic Systems (hydrometry and hydraulics), to “develop a proposal and implement a project to assess the performance of flow measurement instruments and techniques against WMO standards”,

Noting:

- (1) That a comprehensive proposal had been developed (see Annex I), and progress had been made in several tasks foreseen in the proposed work plan,
- (2) The report of the AWG member leading activities associated with the Basic Systems (hydrometry and hydraulics) theme of CHy (included in CHy-XIII/INF. 5),
- (3) The project work plan (see Annex II),

Noting further the approach taken of involving other technical commissions, such as CIMO, and external organizations such as IAHR, IAHS, ISO, HMEI, in the project,

Decides to continue with the implementation of the project during the next intersessional period;

Endorses the work plan for the remainder of the project as contained in Annex II authorizing the Steering Committee to modify the work plan as necessary based on the consideration of events that unfold during the intersessional period;

Requests:

- (1) The AWG to consider, at some stage in the future and subject to successful implementation of the first stages of the project, the possibility of extending the scope of the project to cover other hydrological measurements beyond those related to discharge;
- (2) The Secretariat to provide the necessary support to this important activity, in particular, by ensuring efficient linkages with the other participating organizations;

Urges members to participate actively in this project, in particular by responding to the online Survey on Field Discharge Measurement Instrumentation and Techniques used operationally by NHSs, and by contributing their national guidance material to the databases of the project,

Encourages the participating organizations to continue with their active involvement in the project, in particular by supporting their representatives in the steering committee, and promoting the initiative among their network of affiliates.

ANNEX I

PROPOSAL FOR THE ASSESSMENT OF THE PERFORMANCE OF FLOW MEASUREMENT INSTRUMENTS AND TECHNIQUES¹

Abstract

1. Several new hydrometric instruments and measurement techniques have been developed over the last few decades, but National Hydrological Services², who have a responsibility to measure surface water characteristics, have not witnessed an equal growth in knowledge and practices pertaining to the procedural manuals and standards for the use of the newer instruments and techniques nor for establishing the uncertainty associated with the estimate of the measurement. The World Meteorological Organization's (WMO) Commission for Hydrology (CHy), in recognizing this deficiency, identified at its twelfth session in 2004 the need "to develop a proposal and to implement a project to assess the performance of flow measurement instruments and techniques". The proposed project and its implementation are expected to improve the understanding of the accuracy of various types of hydrometric instruments, thereby contributing to the management of water resources. This document provides the substance of the proposal and its implementation plan, and experts are invited to come forward to contribute to this worthwhile initiative.

Background

2. Existing WMO guidance pertaining to flow measurements include: the *Technical Regulations – Volume III Hydrology* (WMO, 2006); the *Guide to Hydrological Practices* (WMO, 1994) Chapters 10, 11, 12, and 13; and the *Manual on Stream Gauging* (WMO, 1980). These documents are intended to provide information ranging from general guidance to more specific details on stream gauging practices. They are not intended to provide detailed results of testing of flow measurement technology and measurement techniques.

3. The existing documents address the proper use of propeller type water-velocity meters, flumes, weirs, and dye dilution methods to measure discharge and the use of floats and bubbler (mercury manometer pressure measurement) systems to continuously measure water level. Automated data recording systems described in the documents were either paper chart recorders or paper punch tape, and the publications largely predate the use of strain-gauge type pressure systems for water-level measurements. These earlier publications also introduced newer methods for discharge estimation including the moving boat, ultrasonic and electromagnetic. However, since their initial publication, there have been significant advances in the "newer" technologies such as hydrometric acoustic and radar instrumentation, as well as remote sensing systems.

4. New instrumentation technologies for discharge measurements include acoustic Doppler current profilers (ADCPs), point acoustic velocity meters, surface-velocity radar, and large-scale particle image velocimetry (LSPIV). For water-level measurements, the new technologies include strain-type pressure sensor (submersible sensor and bubbler system), acoustic, radar and laser systems. For data recording, paper systems have been almost entirely replaced by largely automated electronic logging, analysis and data transmission systems.

¹ This version has been adapted from the version dated June 6, 2007 to make it compatible for presentation to CHy-XIII. The text of the original proposal can be found at:
http://www.wmo.int/pages/prog/hwrp/documents/Proposal_20070606.pdf

² For the sake of conciseness, the term National Hydrological Services is used throughout this document to indicate those organizations that deal operationally with flow measurement and/or with flow measurement instrument calibration, recognizing that in the case of many countries this will encompass several organizations of different affiliation.

5. The new instrumentation and methodologies may offer more and better quality data at a lower cost while being easier and safer to use. Acoustic velocity technologies can offer vector components of water velocity that allow improved measurement accuracy in situations of bi-directional flow. Surface velocity radar can make non-contact or non-intrusive measurements of water velocity during conditions that are too hazardous for instruments that need to be submerged in the water (Cheng et al., 2001). Some of the newer instrumentation for water level measurement also requires less installation effort than the older instrumentation.

6. However, the methodology used by surface velocity radar and ADCP instrumentation does not duplicate the methodology used by the older propeller and electromagnetic current meters. The newer water level instrumentation may be more sensitive to data aliasing due to sampling intervals. None of the existing WMO guidance and standards, or, for that matter, those of other international organizations, such as ISO, sufficiently address the newer instrumentation and methodologies for arriving at discharge measurements and their associated uncertainties. Information on the appropriate use and accuracy of these newer instruments and methodologies is needed.

7. Analyses of uncertainty of data measured with the older and newer instrumentation and methodologies are also needed to quantify the uncertainty in hydrological measurements. Some uncertainty analyses, such as ISO 1983 and 1993 are available. However, few if any uncertainty analyses are available for the newer instrumentation and methodologies. These analyses are of fundamental importance to the application of risk management procedures and sustainable water resources management, by ensuring that the methodology and instrumentation selected for a task will deliver the accuracy that is needed. These analyses would also enable investments in hydrological instrumentation in the most cost-effective manner. Guidance on uncertainty analysis is available from several sources including the US National Institute of Standards and Testing (NIST), the United Kingdom Accreditation Service, the International Organization for Standardization (ISO) and the American Institute of Aeronautics and Astronautics (AIAA). Existing WMO guidance and standards documents do not sufficiently address the computation of the uncertainty of these newer hydrological measurements.

8. A new edition of the *Guide to Hydrological Practices* is currently in the final stages of preparation and should be published in 2008. Even if it will contain sections addressing new instrumentation technologies, those sections will likely reflect the experiences of a small group of experts and currently available literature. A concerted effort by the international community as reflected in this proposal could greatly advance our current state of practice.

Objectives and Approach

9. The main objective of this project is to help make information and standardized test results on hydrometric instrumentation and measurement methodologies generally available to National Hydrological Services (NHSs) by providing a website as a forum for the exchange of instrumentation and measurement methodology test results and information. A secondary objective of this project is to encourage and solicit the testing of the newer hydrometric instrumentation and methodologies.

10. Many NHSs test the performance of hydrological instrumentation and are developing or testing new flow measurement methodologies. Some NHSs are also involved in field studies comparing the newer methodologies with the older methodologies. Mueller (2003) provides an example of an existing report on field testing of new flow measurement methodology for boat-mounted acoustic Doppler instruments used to measure streamflow. Sharing such test results would be advantageous for the NHSs as the large number of new instruments and testing costs limit the number of instruments and methodologies that any one NHS laboratory can test.

11. Typically instrumentation test results, especially for commercially available instruments, are internally circulated within an NHS. This existing source for instrumentation test results could be made available to the project. For example, the United States Geological Survey routinely writes

internal reports on the testing of commercially available hydrometric instrumentation and could be a source of testing information. NHSs would be encouraged to submit their instrument test results in a standardized test format that would facilitate comparisons between similar instruments. The NHSs would also be encouraged to use a standard uncertainty analysis when reporting test results for various instrumentations. Test results would be made available to NHSs on a website maintained by the project.

12. Flow measurement methodology test results are frequently published by NHSs in technical journals or conference proceedings as well as in internal documents. NHSs would be encouraged to make such documents available on the website maintained by the project. The NHSs would also be encouraged to investigate the uncertainty of the methodology using a standard uncertainty analysis for experiments (see, for example, Coleman and Steele, 1999) and to make such analyses available on the website. Examples of uncertainty analysis for acoustic Doppler current profiler discharge measurements are provided by Dongsu et al. (2005) and Muste et al. (2006).

13. The project would compile a list of existing information on the newer and older instrumentation, the existing and new methodologies for flow measurement and of NHS standards for hydrometric measurements with the help of staff from contributing NHSs. The compilation would be used to help revise and update WMO guidance manuals and measurement standards and to identify WMO testing requirements.

14. The project would encourage and solicit testing by contributing NHSs of the newer instrumentation and methodologies. The project would solicit loans of instrumentation and/or funding from instrumentation manufacturers and contributions from NHSs of personnel, equipment and test facilities in order to test newer instrumentation and methodologies identified by the contributing NHSs. Contributing NHSs would participate in writing and reviewing test plans, and contributing manufacturers would participate in reviews of test plans. In special cases, the WMO may consider providing supplemental funding for testing by a NHS of new methodologies for discharge measurement. Contributing NHSs would provide their written test results. Manufacturers and NHSs would contribute to an independent-peer review of results. Test results, including uncertainty analyses, would be disseminated on the project web site and would be used to help develop WMO measurement standards for existing and newer technologies and methodologies.

Expected Outputs

15. Six outputs are expected from the project:

- (1) A summary of field discharge measurement instrumentation and techniques, where “techniques” includes methodologies and procedures for field measurements. This would include, for example, site selection, vertical velocity distribution models, and algorithms for the determination of discharge. This includes instruments and techniques used or for potential use by NHSs;
- (2) Collection of international and national standards and guidelines regarding field discharge measurement instrumentation and techniques identified using the structure under 1) above;
- (3) Framework for the assessment of uncertainty in discharge measurement and guidelines for its implementation, including:
 - standardized approaches to uncertainty analysis;
 - uncertainty analysis implementation examples;
 - guidance in the form of decision-aid tools;
 - uncertainty analysis database (information on uncertainties acquired with the standardized approach);

- uncertainty analysis outcomes/inferences (recommendations for optimization of instrument configuration, operation and algorithms);

Note that the last three items would initially be limited to two examples of velocity instruments (profilers and point current meters) to help facilitate the overall design of the framework and to illustrate its utility;

- (4) Guidelines for conducting and reporting results of instrument calibration and performance tests on instruments and techniques;
- (5) Collection of test reports on the performance of instruments and techniques, including:
 - manufacturer specifications;
 - multiple instrument comparisons;
 - reports of tests performed under laboratory conditions;
 - reports by NHSs;
 - contact details of institutions where testing is conducted;
 - other relevant information;
- (6) Overall website design to disseminate all of the above for promoting the exchange of information and fostering the use of common standards in testing and presentation of results.

16. A summary of the field discharge measurement techniques and instrumentation would describe selected techniques and instrumentation and include verification results. It would also estimate and compare the effort and costs associated with use of each technique/instrument. The uncertainty of the data collected with the technique/instrument would also be included when possible. Standard techniques for computing and reporting the uncertainty of measurements have been adopted by various organizations such as the American Society of Mechanical Engineers (ASME), AIAA, NIST, and ISO. The intent would be to develop or adopt standard techniques for use by all NHSs.

17. A summary of current instrumentation standards (and policy) of WMO and those used by member NHSs would be compiled. The summary could be used by instrumentation manufacturers as guidance for instrumentation development. The compilation would be helpful for reviewing and revising WMO standards. NHSs could use the compilation to help develop or revise their instrumentation standards, flow measurement techniques or as guidance in developing instrumentation test plans. Entries in the compilation, for example, could include reference material on test facilities such as tow tanks to help ensure credibility of test results.

18. Guidance would be developed on verification testing to manufacturer specifications and NHS/WMO standards and manuals. An early output of this project would be the development and adoption of a prototypical test report format and recommendations on the technique used to develop and compute uncertainties of the collected test data. The test report format would allow easy comparisons among tested instrumentation and techniques.

19. A central website for the distribution of NHSs laboratories tests of hydrological instrumentation would be developed. The website would facilitate communication of instrumentation testing among NHSs.

Expected Results

20. The proposed project is expected to improve planning and management of water resources by: (1) improving the understanding and knowledge of the accuracy of various types of hydrometric instruments; (2) encouraging the development of instrumentation that meets the measurement needs for water planning and management; (3) encouraging the standardization of

hydrometric measurements and the computation of estimates of measurement uncertainty, leading to improved quality of data and their comparability; and (4) improving cooperation amongst NHSs.

Specific Activities

21. Several specific activities for the project are needed to accomplish the proposed outputs. The identified specific activities include reviews of: (1) flow measurement standards and manuals of NHSs, (2) existing instrumentation and techniques used for flow measurement, and (3) existing NHS testing facilities and measurement standards. Other identified specific activities are (4) guidance for testing instrumentation and techniques to a known standard, (5) development of a reporting format for documenting instrument and technique test results, (6) adoption of a technique to use for estimating the uncertainty of hydrological measurements, and (7) the development of a central website for sharing hydrometric instrumentation information.

Potential Linkages

22. The proposed project has potential linkages with several international and national hydrological organizations. For example, the American Society of Civil Engineers/ Environmental Water Resource Institute (ASCE/EWRI) has a workgroup, which is part of the Committee on Hydraulic Measurements & Experimentation that is investigating uncertainty analyses for hydraulic measurements. Such a group would be an excellent resource for contributing to the development of the uncertainty methodology. WMO's Commission for Instruments and Methods of Observation (CIMO) has experience with a website that presents information on meteorological instrumentation that could be useful to the project (see <http://www.wmo.int/pages/prog/www/IMOP/WebPortal-AWS/Index.html>).

A few of the potential linkages are listed below:

- WMO Commission for Instrumentation and Methods of Observation (CIMO)
- WMO Regional Associations' Working Groups on Hydrology
- UNESCO International Hydrological Programme (IHP)
- International Association of Hydraulic Engineering and Research (IAHR)
- International Association of Hydrological Sciences (IAHS)
- ASCE/EWRI
- International Organization for Standardization (ISO)
- The Association of Hydro-Meteorological Equipment Industry (HMEI)

Other Potential Contributions

23. WMO CHy is seeking additional participation of experts from national laboratory testing facilities, National Hydrological Services, international organizations and associations, manufacturers, industry and academia that would be willing to contribute to this international initiative.

Conclusions

24. Estimating uncertainty and developing standards associated with newer hydrometric instruments and measurement techniques is quite challenging. Enhancing our understanding of uncertainty and making its estimation available to practitioners by water monitoring organizations would be a significant contribution to the state-of-the-practice and would result in significant benefits to society. In order to achieve this, a concerted collaborative effort is required at both the national and international levels to address this limitation. This document provides a path forward to achieving this. Working together offers the greatest potential for success.

References

- American Institute of Aeronautics and Astronautics, (1995), Assessment of wind tunnel data uncertainty, AIAA Standard S-071-1995, AIAA New York.
- Cheng, R.T., Costa, J.E., Haeni, F.P., Melcher, N.B., and Thurman, E.M., (2002), "In search of technologies for monitoring river discharge", in Advances in Water Monitoring Research, Water Resources Publications, LLD.
- Coleman, H.W., and Steele, W.G. Jr., (1999), Experimentation and uncertainty analysis for engineers, John Wiley & Sons, Inc., New York.
- Dongsu, K., Muste, M., Gonzalez-Castro, J., and Ansar, M., (2005), Graphical user interface for ADCP uncertainty analysis, EWRI/ASCE World Water and Environmental Congress 2005.
- International Organization for Standardization (ISO), (1983), ISO Standards Handbook 16, Measurement of liquid flow in open channels, ISBN 92-67-10077-7, ISO Geneva.
- International Organization for Standardization (ISO), (1993), Guide to the expression of uncertainty in measurement, ISBN 92-67-10188-9, ISO Geneva.
- Mueller, D.S., (2003), Field evaluation of boat-mounted acoustic Doppler instruments used to measure streamflow, IEEE Current Measurement Technology Conference.
- Muste, M., Gonzalez-Castro, J., Yu, K., and Kim, D.-S., (2006) Standardized Uncertainty Analysis Framework for Acoustic-Doppler-Current Profilers Measurements, ISO TC 113/SC.
- Taylor, B.N., and Kuyant, C.E., (Sept 1994), Guidelines for evaluating and expressing the uncertainty of NIST measurement results, NIST technical note 1297, National Institute of Standard and Technology, Gaithersburg, MD.
- United Kingdom Accreditation Service, (1997), First edition, The expression of uncertainty and confidence in measurement M3003, December, Feltham, England.
- WMO, (2007), Exploratory meeting on CHy's Proposal for the Assessment of the Performance of Flow Measurement Instruments and Techniques, April 25-27, Geneva (available at: <http://www.wmo.int/pages/prog/hwrrp/FlowMeasurement.html>)
- WMO, (2006), Technical Regulations, Volume III Hydrology, WMO-No. 49, Geneva.
- WMO, (2004), Commission for Hydrology - Twelfth Session, Abridged final report with resolutions and recommendations, October 20-29, 2004, WMO No. 979, Geneva.
- WMO, (2003), Basic Documents No.1, WMO-No.15, Geneva.
- WMO, (1994), Guide to Hydrological Practices, Fifth Edition, WMO-No. 168, Geneva.
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ANNEX II

PROJECT FOR THE ASSESSMENT OF THE PERFORMANCE OF FLOW MEASUREMENT INSTRUMENTS AND TECHNIQUES

Work Plan³

1. At the meeting of experts (WMO, 2007), a work plan for the “**Project for the Assessment of the Performance of Flow Measurement Instruments and Techniques**” was established for each of the outputs of the project with the roles of specific experts and the estimated amount of time to complete certain tasks. The material provided below is adapted from the output of the meeting of experts.

2. The tables provided below list the specific tasks that need to be accomplished, with overall efforts being prioritized. It is recognized that on-going or planned activities of partners in the project and some other institutions may be leveraged to help achieve the overall results. For example, there are currently on-going efforts to update the *Manual on Stream Gauging*, while the *Technical Regulations Volume III – Hydrology* and the *Guide to Hydrological Practices* undergo a continuous revision process. At the same time, ISO has projects geared to developing and issuing standards on, for example, ADCPs and other new technologies. All of these efforts require the documentation of modern technologies and measurement techniques, which may prove a valuable source of material for input to task 1(a), and these efforts would potentially benefit from the implementation of this proposal.

3. During the meeting of experts (WMO, 2007), it was also noted that the authorship of the publications and documents associated with this project that are made available on the website or are published in any other form by WMO should be acknowledged, given the importance of recognition by contributors.

4. Where appropriate, each major project output has an associated table where the tasks needed for each output have been identified along with the responsible expert(s); the estimated time required for each aspect; and a tentative completion date for each aspect.

(I) Summary of field discharge measurement instrumentation and techniques

Task	Expert(s)	Estimated Time (months)	Tentative Completion Date
(a) Prepare structure of summary form and populate it	J. Fulford	2	Completed
(b) Upload form on web and request contributions to fill gaps	WMO Secretariat	2	Completed on 11/06/08
(c) Notify NHSs by circular letter	WMO Secretariat	2	Completed on 11/06/08
(d) Synthesis of results	J. Fulford, Z. Buzas	2	31/10/08 (depends on receipt of responses)

³ As it is common in the implementation of any project, since the original conception of the Project Document in April 2007, slight amendments had to be made to the original work plan. This version is the most up-to-date as of August 2008. It reflects slight changes in the scope and expected deadline of individual tasks, agreed by the core groups of experts in the process of implementing the project.

(II) Collection of international and national standards and guidelines regarding field discharge measurement instrumentation and techniques identified using the structure under 1). [*Requested documents could be in "pdf", link to websites or hardcopy (identifying the source, issuing authority, and copyright restrictions). Documents would be limited to those in one or more of the 6 official languages of WMO.*]

Task	Experts	Estimated Time (months)	Tentative Completion Date
(a) In circular letter under output 1(b), include a request for standards and guidelines.	WMO Secretariat	See 1(c)	Completed on 11/06/08
(b) Upload collection on the website and request additional contributions	WMO Secretariat	See 1(d)	31/12/08

(III) Framework for the assessment of uncertainty in discharge measurement and guidelines for its implementation.

Task	Experts	Estimated Time (months)	Tentative Completion Date
(a) Literature review of existing uncertainty analysis framework approaches	M. Muste & J. Fulford	8	30/09/08
(b) Synthesis of recommended standardized approach to uncertainty analysis for discharge measurements (draft for review on web)	M. Muste & J. Fulford	8	30/09/08
(c) Developing implementation examples of the uncertainty analysis (draft for review on web)	M. Muste & J. Fulford	8	30/09/08
(d) Development of decision-aid tool prototype and associate uncertainty analysis database for proof of concept and demonstration purposes of point and profiling velocity instruments and multiple techniques (draft for review on the web)	M. Muste, J. Fulford, J. Le Coz	20	31/12/09
(e) Development of examples of the utility of prototype for improvement of measurement approaches and processes (draft for review on the web)	M. Muste & J. Fulford	20	31/12/09

(IV) Guidelines for conducting and reporting results of instrument calibration and performance test on instruments and techniques.

Task	Experts	Estimated Time (months)	Tentative Completion Date
(a) Establishment of protocols/specifications for instrument calibration and testing and verification of performance characteristics of instruments and techniques (draft for review on the web)	P. McCurry & J. Fulford, J. Le Coz	20	31/12/08
(b) Develop sample format for reporting testing and verification results (draft for review on the web)	P. McCurry & J. Fulford	8	31/12/08

(V) Collection of test reports on the performance of instruments and techniques

Task	Experts	Estimated Time (months)	Tentative Completion Date
Request instrument comparison reports as part of the letter in 1	WMO Secretariat	See output 1	See output 1
Request reports and specifications from manufacturers	HMEI	See output 1	See output 1
Request reports of laboratory tests of instruments	WMO Secretariat & IAHR	See output 1	See output 1
Add new reports developed using guidelines under 4 (draft for review on the web)	WMO Secretariat	18	After 31/12/08

(VI) Overall web site design to disseminate all of the above. The contents of the website should include:

- Output of Tasks I to V
- Forum/chat-room facility
- Search engines
- News feature
- Guidance on targeting community involvement

5. The WMO Secretariat would be responsible for the web design. The working website was launched in test mode in May 2008, and linked to the WMO website in August 2008.
