W O R L D M E T E O R O L O G I C A L O R G A N I Z A T I O N

COMMISSION FOR BASIC SYSTEMS

OPAG ON INTEGRATED OBSERVING SYSTEMS

EXPERT TEAM ON SURFACE BASED OBSERVATIONS SUB-GROUP MEETING ON WIGOS REGULATORY MATERIAL

Geneva, Switzerland

24-28 November 2014

FINAL REPORT

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GENERAL SUMMARY

1 OPENING AND ORGANIZATION OF THE SESSION

The WMO Commission for Basic Systems (CBS) Expert Team on Surface Based Observations (ET-SBO), Sub-Group on WIGOS Regulatory Material (SG-RM) Meeting opened at 10am on 24 November 2014 in Geneva, Switzerland by the Chair of ET-SBO and the Meeting, Mr Stuart Goldstraw.

Mr Goldstraw welcomed the participants to the meeting, which were formed from a combination of members of ET-SBO and invited WMO Member experts on various observing systems. The list of participants is provided within Annex I. Mr Goldstraw thanked all participants for agreeing to take part in the meeting and for the input of their experience and expertise towards assisting WMO and its Technical Commissions to develop much needed regulations and guidance on observing systems.

The participants were welcomed on behalf of WMO by Mr Miroslav Ondras, Chief of the Observing System Division. Mr Ondras briefly addressed the Meeting on the requirements for developing WIGOS regulatory material and how such material developed by the Sub-Group might eventually be integrated into either the new Manual on WIGOS, currently under review by WMO Members, or else into the current Manual on GOS (WMO-No. 544) or Guide to the GOS (WMO-No- 488) through the normal CBS and WMO approval processes. However, the Meeting was advised that the eventual repository for the new material should not be of great concern to the Sub-Group and that the Meeting should focus on developing new, required material that might be useful to WMO Members in the operation of their observing networks in support of the operation of WIGOS and the GOS. Mr Ondras informed the Meeting that there was a great need for new regulations and guidance on the operation and use of automated systems, particularly for remote sensing systems such as weather radar and radar wind profiler systems.

The Chair outlined the provisional agenda (Document 1.2), provisional meeting schedule (Document 1.3) and working arrangements for the meeting, which were agreed to by the meeting participants without change. It was agreed that a large component of the meeting would be spent working in drafting teams, actively working on the drafting of new and improved regulations that would be consolidated within the final report of the meeting, after which ET-SBO would assume responsibility for revision, refinement and eventual submission of the resulting regulatory materials to CBS through the Implementation and Coordination Team on Integrated Observing Systems (ICT-IOS) and the CBS Inter-Programme Expert Team on WIGOS Framework Implementation Matters (IPET-WIFI).

2 REVISION OF PREPARATORY WORK OF THE ET-SBO SUB-GROUP ON REGULATORY MATERIAL

The Chair made a presentation to the Meeting on the current status of the wider WIGOS regulatory material being developed under the coordination of the WMO Executive Council Inter-commission Coordination Group on WIGOS (ICG-WIGOS) and its Task Team on WIGOS Regulatory Material and also on the activities and work plan of ET-SBO in supporting the implementation of the framework for WIGOS. It was explained to the Meeting that the activity being undertaken by the Sub-Group of ET-SBO was effectively addressing two areas of the expert team's work plan, defined under its Terms of Reference within items b) and h):

(b) Develop and update relevant elements of the Manual and the Guide to the GOS in the context of WIGOS, with initial priority on weather radar and AWSs;

(h) Provide advice and support to the Chairperson of OPAG-IOS on the implementation of the WIGOS framework and its operational aspects.

While the Sub-Group was to focus on ensuring that it developed material that was consistent with the approach that has been undertaken in the development of the WIGOS framework and the Manual on WIGOS, it was also important that it addressed a real and pressing need to provide new and additional regulations and guidance in the operation and best practice for operation of WIGOS

observing systems in support of the WMO World Weather Watch Programme. In this regard, the initial priority for ET-SBO, its Sub-Group on Regulatory Material (SG-RM) and the meeting would be to direct attention towards the development and compilation of materials for automated systems: automatic weather station (AWS), weather radar and wind profiler radar (WPR) systems.

The meeting was reminded that an important consideration and point of reference for observing system technology was the CIMO guidance materials, including the Guide to Meteorological Instruments and Methods of Observation, WMO-No. 8., for which the 2014 edition had recently been approved at the Commission for Instruments and Methods of Observations Sixteenth Session.

In the lead-up to the meeting, ET-SBO had selected three leaders for each of the above technology areas who were requested to coordinate efforts to assemble reference documents and potential guidance materials that might be used by the Sub-Group in the process of developing regulatory and guidance materials. The technology leads (Leads) were:

Mr Karl Monnik, Australia – AWS

Mr Dominique Ruffieux, Switzerland - RWP

Mr Daniel Michelson, Sweden – Weather Radar

Unfortunately, Mr Michelson was unable to attend the meeting due to personal reasons.

The Secretariat had assisted Leads in compiling the references and documents within a repository on the WMO wiki resource.

3 PRESENTATION OF DRAFT REGULATORY MATERIAL

The Chair and the Leads presented the Meeting with a summary of the documents and regulatory material that had been compiled in the lead-up to the meeting and advised on how best to utilise the materials in the drafting process to be undertaken.

3.1 Proposals for Update to the Manual on WIGOS

The Chair outlined the guidance that had been provided to the Leads and the meeting participants regarding how to structure the draft materials. To ensure that the drafted regulations were in keeping with the draft regulatory framework for WIGOS, the Meeting was requested to consider regulations for the technology areas that might be included in Chapters 3 or 7 of the draft Manual on WIGOS:

> 3 COMMON ATTRIBUTES SPECIFIC TO THE SURFACE-BASED SUB-SYSTEM OF WIGOS
>
> 7 GLOBAL OBSERVING SY STEM (GOS) OF WWW

Additionally, participants were requested to consider regulations related chiefly to the following categories:

- General requirements
- Observing Practices
- Quality Control
- Data and Metadata Reporting
- Incident Management
- Change Management
- Maintenance
- Inspection & Supervision
- Calibration procedures

3.2 Proposals for Update of Regulatory Material on AWS

Mr Karl Monnik presented a document that described the past and more recent preliminary work on regulations and guidance that had been commenced and developed in CBS and in the lead up to the meeting. The existing sources of material that were to be considered included:

- Manual on the Global Observing System, Volume I – Global Aspects, WMO-No. 544.
- Guide to the Global Observing System, WMO-No. 488.
- Final reports and documents previously submitted to CBS, Expert Team on Automatic Weather Stations (ET-AWS).

It was suggested that existing regulations concerning surface observations stations was strongly focused on manual observations with only limited inclusion of AWSs. However, many countries had transitioned to networks which are largely automated, with support from human observations. Therefore, the new documentation should address this change in emphasis.

3.3 Proposals for Update of Regulatory Material on RWP

Mr Dominique Ruffieux presented the Document 3.3 that he had submitted which outlined the various reports and documents that had been compiled on RWP for consideration during the meeting. The Meeting was advised that there are currently three primary sources of regulations and guidance materials for WMO Members on the operation of wind profiler radar systems in contributing to the WMO Global Observing System:

1) WMO-No. 79, Operational aspects of wind profiler radars.
2) WMO-IOM No 110, Experience of the Japan Meteorological Agency with the Operation of Wind Profilers.
3) WMO-No. 8, Guide to Meteorological Instruments and Methods of Observation (Provisional 2014 Edition).

Reports and documents on RWP from a range of WMO Members and related sources had also been compiled which would be used to assist in the development of regulations and of which some might be considered in the development of best practice guidance.

3.4 Proposals for Update of Regulatory Material on Weather Radar

In the absence of Mr Michelson, who had been responsible for some of the work leading up to the meeting, the Secretariat presented Document 3.4, outlining the relevant regulatory materials and documents that might be considered by the Meeting in drafting regulations and guidance on weather radar systems.

Apart from the current manuals and guides relevant to the GOS, it was recommended that the Meeting might also consider the relevance of existing guidance currently published as CIMO Instruments and Observing Methods (IOM) technical reports, including:

1) IOM 88 (TD 1308), Training Material on Weather Radar Systems, E. Büyükbas, O. Sireci, A. Hazer, I. Temir, A. Macit, C. Gecer (all Turkey), 2006
2) CIMO, IOM 69 (TD 874), Weather Radars used by Members T. Mammen (Germany), 1998
3) IOM 52 (TD 571), Results of the Working Group on Weather Radars, Part I: G.G. Shchukin (Russian Fed.), and Part II: Hisao Ohno (Japan), 1993.

Some draft regulations adapted from NOAA internal documents on weather radar systems by Mr Wissman were also presented.

4 REVISION OF DRAFT REGULATORY MATERIAL

Over days two to five of the meeting, the participants were arranged into three drafting groups and worked diligently on drafting regulations relating to the three technology areas. Over days two

and three of the meeting, the drafting groups were requested to draft regulations that might be considered for inclusion in the Manual on the GOS. On days four and five, the groups were then asked to consider both existing guidance materials and new guidance materials needing to be developed that would be required to be referenced in support of the proposed draft regulations. The drafting sessions were punctuated by plenary sessions in which the meeting participants summarized progress made and discussed concepts and interests of mutual consideration.

From this process, the teams formulated three sets of draft materials for each of the 9 categories outlined in section 3.1.

The draft regulations for AWS are provided in Annex II, for RWP in Annex III and for weather radar in Annex IV.

Annex V contains a tabulated list of documents that were submitted and considered by the meeting to be potentially useful as future WMO guidance or best practice materials, given suitable generalizing and/or updating.

Future actions related to the refinement, review and approval of the draft material are provided in section 6 below.

5 ANY OTHER BUSINESS

No additional business was identified for discussion or action.

6 FINAL REPORT OF THE SESSION

The Meeting agreed on the following actions and outcomes of the meeting to be documented in the final report of the session:

1. The draft regulations from the meeting are to be provided within annexes to the final report of the meeting.
2. The Chair should provide a final revision of all drafts regulations to Leads by 5 December 2014.
3. Regulations concerning action to be taken when interference to radio frequency transmission of RWP and WR systems is encountered it to be included in draft materials by SG-RM Leads.
4. The Chair SG is to request IPET-OSDE to consider development of network design guidance to take account of member economic capability, particularly in relation to requirements for more expensive automated systems.
5. SG-RM Leads to finalise revised drafts by 19 December.
6. Chair and Secretariat to circulate drafts (Action 4) to ET-SBO and ICT-IOS-MG in early January 2015.
7. Updated versions of draft regulations from Action 5 to be completed by end of 2nd week February 2015. [Action: ET-SBO]
8. Chair to report to ICG-WIGOS-4 on draft regulations in 3rd week of February 2015.
9. Chair and Secretariat to provide draft regulations to IPET-WIFI in February 2015.
10. Next SG-RM meeting was proposed to occur in November 2015, possibly covering regulations and guidance on radiosonde systems, lightning systems and manned surface stations. [Action: Chair-ET-SBO, Secretariat]
11. ET-SBO to take responsibility for coordination of actions relating to development of new guidance identified during the meeting.

12. ET-SBO work plan to be updated to include a new task to develop and finalise the potential new guidance materials. [Chair-ET-SBO]

It was agreed that the Secretariat would coordinate the drafting and finalization of the final report of the Meeting with a view to publishing the report by early January 2015.

7 CLOSURE OF THE SESSION

The meeting session was closed at around 3pm on 28 November 2014.

ANNEX I

LIST OF PARTICIPANTS

Stuart GOLDSTRAW **(Chair)** **Proposed by: United Kingdom**	Met Office FitzRoy Road EX1 3PB EXETER Devon United Kingdom of Great Britain and Northern Ireland Fax: info not provided Tel: +44 1392 88 5603 Email: stuart.goldstraw@metoffice.gov.uk
Henry N. KARANJA **(Vice-chair)** **Proposed by: Kenya**	Kenya Meteorological Service Ngong Road P.O. Box 30259 00100 NAIROBI Kenya Fax: +25 4722 364 465 Tel: +25 4203 876 955 Email: hkaranja@meteo.go.ke , hkaranja2001@yahoo.com
Karl MONNIK **(Core member)** **Proposed by: Australia**	Bureau of Meteorology G.P.O. Box 1289 3001 MELBOURNE VIC Australia Fax: +(61 3) 9669 4168 Tel: +(61 3) 9669 4205 Email: k.monnik@bom.gov.au
Islam AMEEN **(Core member)** **Proposed by: Egypt**	Egyptian Meteorological Authority Koubry El-Quobba , 11784 CAIRO Egypt Email: islam_maher71@hotmail.com
Thomas KANE **(Invited expert)** **Proposed by: Australia**	Bureau of Meteorology 700 Collins Street 3008 Docklands VICTORIA Australia Tel: +613 9669 4386 Email: t.kane@bom.gov.au
Volker LEHMANN **(Invited expert)** **Proposed by: Germany**	Deutscher Wetterdienst Meteorologisches Observatorium Lindenberg, Am Observatorium 12 15848 Tauche OT Lindenberg Germany Fax: +49 69 8062 5710 Tel: +49 69 8062 5740 Email: volker.lehmann@dwd.de

Akihito UMEHARA **(Associate member)** **Proposed by: Japan**	Japan Meteorological Agency (JMA) 1-3-4 Otemachi, Chiyoda-ku 100-8122 TOKYO Japan Email: umehara_akihito@met.kishou.go.jp
Dominique RUFFIEUX **(Associate member)** **Proposed by: Switzerland**	MétéoSuisse Station Aérologique Case postale 316 CH-1530 PAYERNE Suisse Fax: +41 26 662 6212 Tel: +41 26 662 6247 Email: dominique.ruffieux@meteoswiss.ch
Al WISSMAN **(Invited expert)** **Proposed by: United States of America**	Chief, Maintenance Branch Office of Operational Systems National Weather Service United States of America Tel : (301) 713-835 x133 Email : al.wissman@noaa.gov
Charles PATERSON **(Invited expert)** **Proposed by: Canada**	Project Officer Surface Weather and Climate Networks Atmospheric Monitoring and Data Services Meteorological Service of Canada Environment Canada 4905 Dufferin St Downsview Ontario M3H 5T4 Canada Email: charles.paterson@ec.gc.ca
Dean Lockett **WMO**	Scientific Officer Aircraft and Remotely-sensed Observations Observing Systems Division Observing and Information Systems Department Telephone: + 41 22 730 83 23 Telefax: + 41 22 730 8021 Email: dlockett@wmo.int
Tim Oakley **WMO**	Tim Oakley GCOS Implementation Manager Tel.: +41 (0) 22 730 8068 (Geneva) Tel.: +44 (0) 775 388 0322 (UK) E-mail: toakley@wmo.int tim.oakley@metoffice.gov.uk

ANNEX II

Draft Regulations and Guidance Proposed for AWS

Proposal Identifier	ET-SBO-AWS-001 (Operations, General Requirements)
Proposal lead	Karl Monnik
Original Text	ET-SBO/SG-RM
Newly Proposed Text	Members shall nominate an AWS network manager who is responsible to ensure the network delivers to the user requirements. Observations reported shall meet the minimum requirements for all application areas associated with the station/network. Members shall develop and implement a life cycle management system to ensure AWS systems and sensors are operated and maintained in a manner that complies with requirements encompassing: • Quality management; • Resource efficiency; • Availability of supply; and • Continuity of operations. Staff shall be trained to the appropriate level of competency and/or certification for operation and maintenance of all AWS equipment. Members shall document the method of AWS observations practices, including quality management, maintenance, change management, incident management, inspection and calibration. AWS observation sites should have a lease to prolong the life of the station.
Rationale for inclusion of text	Required new section
To be included in which Manual / Guide	Manual on WIGOS
To be included in which section	Chapter 3 or Chapter 7, Operations, General Requirements (AWS)
Next action required	Review by ET-SBO-SG-RM
Status of Action	Initial proposal, 27-Nov-2014
Location information stored	

Comment [W1]: Note on Guidance: Guide to the GOS, Part III, Section 3.1.3.4 provides guidance on staff and staff tasks in relation to network management. Section 3.1.4.3 is directly relevant to AWS network management.

Comment [DL2]: NOTE: This clause likely needs a note of explanation. This could encompass a description of systems like ITIL, ISO 20000

Comment [DL3]: Note on Guidance: Brian Howe of EC may have a set of requirements for a LCM system for Env. Canada. Some guidance on what a LCM is and how it works would be useful to have.

Comment [W4]: Note on Guidance: May reference CIMO Guide Part II, Chapter I, Section 1.8 (Training). References:
ASOS Trainer's Tool Box
http://www.nws.noaa.gov/asos/toolkt.htm

IMOP Portal:
http://www.wmo.int/pages/prog/www/IMOP/WebPortal-AWS/Index.html

Competency requirements for a meteorological technician. WMO/ETR.

Comment [W5]: Note on Guidance: Documentation is a requirement of a QMS. Refer to : Guide to the Implementation of a Quality Management System for National Meteorological and Hydrological Services (WMO-No.1100, 2013 edition).

Proposal Identifier	ET-SBO-AWS-002 (Operations, Observing Practices)
Proposal lead	Karl Monnik
Original Text	ET-SBO/SG-RM
Newly Proposed Text	Members shall develop an AWS network operations plan including: • Description of the network • Primary purpose • Operational practices • Prioritisation • Network tiering. • Evolution of the network Members shall ensure that a permanent digital record of all reported AWS observations and associated metadata is maintained. To avoid the effect of small-scale fluctuations, the meteorological variable should be sampled continuously or repeatedly over a suitable time for the purpose of observing representative mean and extreme values. The averaging time should be short compared with the temporal

Comment [W6]: Note on guidance: This requires new guidance material to be developed.

Comment [W7]: Note on guidance: Clear requirement for further guidance but none identified.

Comment [KAM8]: Similar to WMO No. 544. 3.3.1.3.

	scale of such discontinuities as fronts or squall lines, which usually delineate air masses of different characteristics whilst removing the effects of small-scale disturbance. Members should ensure that sufficiently higher resolution measurements or observations, i.e. generally level 2 data, are archived so that reported observations can be retrieved, recreated or reconstructed. Note: More information on data processing and data levels is provided in the Guide to the GOS, Part V, Reduction of Level I Data. Observation reports shall be reported with reference to UTC time. AWS Observations shall be reported at least hourly. Observations generated routinely should be reported at uniform intervals aligned to the UTC hour. Observations should be reported more frequently for specific application areas such as high resolution NWP and nowcasting. Members shall locate sensors at a representative observation height for at each surface observing station or system. This should be recorded in the station metadata. Instrument exposure shall be assessed and the site classified according to the CIMO Site Classification System (require reference). This shall be documented as required within the WIGOS metadata. Observation reports shall have a time stamp indicating the time of measurement with a minimum temporal resolution of 1 minute with respect to UTC. The observations reported by an AWS should conform to the basic set of variables in accordance with the relevant Application Area(s) as detailed in Guide to GOS Part III, Appendix III.2 – Basic Set of Variables reported by AWS. The variables listed in the Guide to the GOS App III.1 Functional Specification for the AWS should be reported where requirements of relevant Application Areas dictate. Measurement characteristics should refer to relevant sections in the Guide to the GOS WMO No. 488 and the CIMO Guide WMHO No. 8. Members should consider requirements for other elements that might be measured by an AWS, see reference Guide to GOS Part III, Appendix III.1
Rationale for inclusion of text	Required new section
To be included in which Manual / Guide	Manual on WIGOS
To be included in which section	Chapter 3 or Chapter 7, Operations, Observing Practices (AWS)
Next action required	Review by ET-SBO-SG-RM
Status of Action	Initial proposal, 27-Nov-2014
Location information stored	

Proposal Identifier	ET-SBO-AWS-003 (Operations, Quality Control)

Comment [KAM9]: Similar to WMO No. 544. 3.3.1.4.

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Comment [W10]: This requires an explanatory note and link to guidance related to BUFR encoding (probably below under Data Reporting).

Comment [W11]: Note on Guidance: Require guidance that summarises the various requirements for Application Areas of RRR specifically for AWS.

MSC potentially can provide an example requirements document for high resolution AWS network to support a special event based at a city.

Comment [KAM12]: Similar to WMO No.-544. 3.3.3.2.

Comment [W13]: Note on guidance: Reference is CIMO Guide, Annex I.B .

Comment [W14]: Note on guidance: ???

Comment [W15]: Note: Guide to the GOS App III.2 should become an Attachment to the Manual on the WIGOS.

Comment [W16]: Note: Manual on the GOS 3.3 specifies many practices relating to measurements. It is thought that reference to the Guide to the GOS and CIMO guide are sufficient to replace these references. However this needs to be cross-checked.

Proposal lead	Karl Monnik
Original Text	ET-SBO/SG-RM
Newly Proposed Text	As a component of their Quality Management System, Members shall develop and implement policy and procedures for all aspects of quality control associated with the operation of their AWS systems and network. This shall consist of the following core elements as a minimum: • System design incorporates quality management. • Siting and exposure of systems and sensors. • Calibration of sensors. • System and network maintenance. • Fault management. • Data quality control • Training of staff for competency in operational procedures. Members shall ensure that the design of the AWS and the AWS network accommodates the necessary quality management principles and elements in order to meet user and applications requirements for data products. Siting and exposure of AWS systems should comply with any special requirements associated with the AWS application that impact on data quality. Siting and exposure of AWS systems should comply with CIMO Guide, Part II, Chapter 1, Section 1.4. Siting and exposure of AWS sensors should be in accordance generally with CIMO Guide, Part II, Chapter 1, Section 1.2.1 and, specifically be element, Part I. Note: In relation to provisions for Calibration see section ET-SBO-AWS-00~~X~~ below. Note: In relation to provisions for maintenance see section ET-SBO-AWS-007~~X~~ below. Note: In relation to provisions for fault and incident management see section ET-SBO-AWS-005 ~~X~~ below. Members should ensure that AWS comply with WMO No. 488, Guide to GOS, Part VI in relation to general requirements for data quality control of elements and to Part VI, Appendix VI.2 for specific quality control procedure for AWS. Members should ensure that staff are trained and competent in procedures associated with all aspects of quality control of AWS.
Rationale for inclusion of text	Required new section
To be included in which Manual / Guide	Manual on WIGOS
To be included in which section	Chapter 3 or Chapter 7, Operations, Quality Control (AWS)
Next action required	Review by ET-SBO-SG-RM
Status of Action	Initial proposal, 27-Nov-2014
Location information stored	

Proposal Identifier	ET-SBO-AWS-004 (Operations, Data & Metadata Reporting)
Proposal lead	Karl Monnik
Original Text	ET-SBO/SG-RM
Newly Proposed Text	Meteorological observations shall be reported via the WIS using

	specified BUFR Templates as defined in WMO-No 306. Note: The Manual on the GOS #544 section 3.3 has some specific requirements for calculating and reporting specific values, e.g. pressure, wind, humidity, precipitation. This should ideally be placed in an annex or CIMO guide. Members should maintain historical observational metadata for AWS networks and stations. Note: Requirements for reporting observational metadata according to the WIGOS Metadata Standard are provided in the Manual on WIGOS Chapter 2, Section ???. Metadata specified in the WIGOS Metadata Standard shall be reported as required. Members shall update metadata records in OSCAR as soon as possible and at least within one month of any change. Note: This provision is in lieu of an expectation that OSCAR will become the repository for all metadata required to be reported according to WMO-No. 9, Observing Stations and WMO Catalogue of Radiosondes.
Rationale for inclusion of text	Required new section
To be included in which Manual / Guide	Manual on WIGOS
To be included in which section	Chapter 3 or Chapter 7, Operations, Data & Metadata Reporting (AWS)
Next action required	Review by ET-SBO-SG-RM
Status of Action	Initial proposal, 27-Nov-2014
Location information stored	

Comment [W17]: Note on guidance: Guidance is required that will inform members regarding what constitutes changes that need to be reported.

Proposal Identifier	ET-SBO-AWS-005 (Operations, Incident Management)
Proposal lead	Karl Monnik
Original Text	ET-SBO/SG-RM
Newly Proposed Text	Members shall develop and implement policy, procedures documentation and necessary training for identification of and response to faults associated with AWS networks. Information concerning AWS faults and their ongoing status should be communicated to users and relevant stakeholders. Fault existence, rectification and impacts on relevant data products and services should be adequately documented and recorded within metadata. The incident management system should be integrated with and across the entire AWS operational system, particularly including: monitoring, maintenance, change management and quality control. The incident management system should incorporate procedures for verification that faults have been rectified. Members should have an incident management system that incorporates the regular and routine analysis of system and sensor faults. The results should be utilised for continuous improvement of AWS networks as a component of the quality management system.
Rationale for inclusion of text	Required new section
To be included in which Manual / Guide	Manual on WIGOS
To be included in which section	Chapter 3 or Chapter 7, Operations, Incident Management (AWS)

Next action required	Review by ET-SBO-SG-RM
Status of Action	Initial proposal, 27-Nov-2014
Location information stored	

Proposal Identifier	ET-SBO-AWS-006 (Operations, Change Management)
Proposal lead	Karl Monnik
Original Text	ET-SBO/SG-RM
Newly Proposed Text	Members shall develop and implement a change management system for AWS networks incorporating policy, procedures documentation and necessary training. Aspects that should be addressed include: • Instruments and sensors; • Algorithms and methods; • Software and firmware; and • Siting and exposure. Members should give special consideration for the transition from manual to automated observations, including: • Sufficient overlap of observations • Change in parameters reported and the way that they are reported.
Rationale for inclusion of text	Required new section
To be included in which Manual / Guide	Manual on WIGOS
To be included in which section	Chapter 3 or Chapter 7, Operations, Change Management (AWS)
Next action required	Review by ET-SBO-SG-RM
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Comment [W18]: Note: Guidance material from ET-AWS should be made available in the WIGOS Guide.

Comment [W19]: Note on guidance: 2 ET-AWS document relating to transition to auto observations should be finalised and added to guidance materials.

Proposal Identifier	ET-SBO-AWS-007 (Operations, Maintenance)
Proposal lead	Karl Monnik
Original Text	ET-SBO/SG-RM
Newly Proposed Text	Members shall develop, implement and document policy and procedures for routine maintenance of the AWS network that will ensure requirements and standards for operational performance are maintained. Note: For guidance on maintenance of AWS networks see: • WMO-No. 8, Part II, Chapter, Section 1.6 Plans and procedures for routine maintenance should include provisions for maintenance of all AWS system components and sensors, related infrastructure and materials and local environmental elements. A centralised system for monitoring individual AWS or AWS network status and health and data products should be utilised and integrated as a component of the maintenance regime. Routine maintenance should be planned so as to minimally impact on provision of products and services, particularly during critical weather times and situations. Maintenance documentation should be made available to relevant users and stakeholders. Maintenance operations, their duration and interruptions to data or services should be recorded within the metadata record. Members should flag or remove as necessary observational data

Comment [W20]: Note on guidance: require more detailed guidance on AWS maintenance and maintenance systems.

	that is impacted by maintenance activities. The maintenance regime should be planned and adjusted as necessary to accommodate known or expected environmental, weather and climate factors. If fault rectification is to be undertaken during routine maintenance operations, then standard procedures for rectifying faults shall be followed and verification subsequently made.
Rationale for inclusion of text	Required new section
To be included in which Manual / Guide	Manual on WIGOS
To be included in which section	Chapter 3 or Chapter 7, Operations, Maintenance (AWS)
Next action required	Review by ET-SBO-SG-RM
Status of Action	Initial proposal, 27-Nov-2014
Location information stored	

Proposal Identifier	ET-SBO-AWS-008 (Operations, Inspections & Supervision)
Proposal lead	Karl Monnik
Original Text	ET-SBO/SG-RM
Newly Proposed Text	Members shall develop, implement and document policy and procedures for an inspection process for AWS networks. Note: Elements that might be included or addressed are: • Standards to which a station should be inspected/audited. • Metadata records accurately reflect the observations, instruments and siting and changes since the last Inspection. • The frequency of Inspections • The process of analysing and addressing non-conformance. • Documentation of inspection. Note: For further guidance on inspection standards see: WMO-No. 488, Guide to the GOS, Part III, Section 3.1.3.8. Inspectors should have the appropriate level of authority and experience to assess, audit and instigate corrective action. Frequency of inspections should be adequate so as to ensure a high probability of detection of issues that might impact on the integrity and quality of data products. Results of Inspections should be recorded in station metadata. Inspections should be undertaken at a frequency of at least two years. Members shall report non-conformance to this standard.
Rationale for inclusion of text	Required new section
To be included in which Manual / Guide	Manual on WIGOS
To be included in which section	Chapter 3 or Chapter 7, Operations, Inspections & Supervision (AWS)
Next action required	Review by ET-SBO-SG-RM
Status of Action	Initial proposal, 27-Nov-2014
Location information stored	

Proposal Identifier	ET-SBO-AWS-009 (Operations, Calibration Procedures)
Proposal lead	Karl Monnik
Original Text	ET-SBO/SG-RM
Newly Proposed Text	For those sensors for which it is possible and appropriate, the periodic comparison of AWS sensors with travelling standards shall be performed and recorded in accordance with WMO-No 8., Part III, Chapter 1, (Section 1.7).

	Recalibration or replacement of sensors should be undertaken as soon as possible after which tolerances for field verifications are exceeded. Wherever possible both AWS field sensors and travelling standards should be traceable to the primary international standard. Results of verification of calibration should be recorded in station metadata.
Rationale for inclusion of text	Required new section
To be included in which Manual / Guide	Manual on WIGOS
To be included in which section	Chapter 3 or Chapter 7, Operations, Calibration Procedures (AWS)
Next action required	Review by ET-SBO-SG-RM
Status of Action	Initial proposal, 27-Nov-2014
Location information stored	

ANNEX III

Draft Regulations and Guidance Proposed for Radar Wind Profiler

Proposal Identifier	Wind profiler – 7.4.1 General Requirements
Proposal lead	Dominique Ruffieux
Original Text	**From Vol 1 Part 1** **2.4 Operations** **2.4.1 General Requirements** 2.4.1.1 Members shall install, operate and maintain their WIGOS component observing systems in accordance with the *Technical Regulations* (WMO-No. 49, Volume I-IV), the *Manual on WIGOS* (WMO-No. XXXX). 2.4.1.3 Members shall ensure the continuity of operation and availability of observations generated by the observing systems under their responsibility. 2.4.1.4 Members shall ensure that proper safety practices and procedures for operation of observing systems are specified, documented and utilized. Note: Safety practices and procedures are those that are concerned with assuring the welfare of staff while promoting overall efficiency and effectiveness of the NMHS and responding to national laws, regulations and requirements for occupational health and safety. **From Manual on WIGOS** **2.4 Operations** **2.4.1 General Requirements** Note: Provision 2.4.1.1, Volume I, Part I applies. 2.4.1.1 WMO observing stations and platforms shall be uniquely identified by a WIGOS station identifier. Note: The structure of WIGOS station identifiers is specified in Attachment 2.1 2.4.1.2 Members shall issue WIGOS station identifiers for observing stations and platforms within their geographic area of responsibility that contribute to a WMO or co-sponsored programme and shall ensure that no WIGOS station identifier is issued to more than one station. Note: Members may issue WIGOS station identifiers for observing stations and platforms within their geographic area of responsibility that do not contribute to a WMO or co-sponsored programme, provided that the operator has committed to providing and maintaining WIGOS metadata. 2.4.1.3 Before issuing a station identifier, Members should ensure that the operator of a station or platform has committed to providing and maintaining WIGOS metadata for that station or platform and to conforming to relevant Technical Regulations. Note 1: In circumstances when a WIGOS identifier is required for a station or platform to support a WMO or co-sponsored programme and no Member is in a position to issue one (e.g. Antarctica), the Secretary-General may issue a WIGOS station identifier for that station or platform provided that its operator has committed to: (a) Providing WIGOS metadata; and (b) Conforming to relevant Technical Regulations. Note 2: In circumstances where a WIGOS identifier is required for a station or platform to support a WMO or co-sponsored programme and a Member

	is not able to issue a WIGOS identifier, the Secretary-General will work with the Member concerned to issue a WIGOS station identifier for that station or platform provided that its operator has committed to: (a) Providing WIGOS metadata; and (b) Conforming to relevant Technical Regulations. 2.4.1.4 Members shall make available to WMO the updated metadata each time a new station identifier is issued. 2.4.1.5 Members shall operate their observing systems with properly calibrated instruments and adequate observing and measuring techniques. Note 1: Detailed guidance on observing practices of meteorological observing systems and instruments is given in the *Guide to Meteorological Instruments and Methods of Observation* (WMO-No. 8). Note 2: Detailed guidance on observing practices of hydrological observing systems and instruments is given in the *Guide to Hydrological Practices* (WMO-No. 168); the Manual on Flood Forecasting and Warning (WMO-No. 1072), and the *Manual on Stream Gauging* (WMO-No. 519). Note 3: Detailed guidance on observing practices of GAW observing systems and instruments is given in the *Guide to Meteorological Instruments and Methods of Observation* (WMO-No. 8). 2.4.1.6 Members should address the requirements for uncertainty, timeliness, temporal resolution, spatial resolution, and coverage which result from the RRR process specified in section 2.2.4 of this Manual and in accordance with the details provided by other sections of this Manual as appropriate. 2.4.1.7 Members shall publish a handbook of national safety practices and procedures for operation of the observing systems that stresses precautions and practices specific to the conditions in the country concerned and satisfies country specific requirements regarding legal, health and safety codes. Note: Safety practices and procedures are those that are concerned with assuring the welfare of staff while promoting overall efficiency and effectiveness of the NMHS and responding to national laws, regulations and requirements for occupational health and safety. **3.4. Operations** **3.4.1 General Requirements** 3.4.1.1 Members operating surface-based observing systems shall follow the provisions of the section 2.4.1.
Newly Proposed Text	Provisions of 3.4.1 apply. Members should address, as a result of the RRR process, the need for wind profiles. Members should operate wind profilers, with networks being most beneficial. **Note**: Wind profilers are active remote sensing systems for continuous measurement of the upper-air wind. The need for upper-air wind measurements can be found i.e. in WMO-No.49. The main types of wind profilers are: - radar wind profilers, wind lidars,

	- weather radars, and - sodars. Refer to CIMO Guide (Part II, Chap 5.2 in preparation) for further details. Members should select the wind profiler technology and operating frequency based on the user requirements defined in the RRR Process. **Note** Physical constraints on selecting systems are described in WMO-No. 8, section 5.2. Height coverage of wind profiler data is strongly related to operating frequency. Members shall establish a wind profiler program manager as the lead focal point for all wind profiler administrative, configuration, quality assurance, operations and maintenance activities. Members using radar wind profilers and weather radars shall follow WRC Radio Frequency regulation defined in Use of radio spectrum for weather water and climate monitoring and prediction. WMO ITU 2008. If operating radar wind profilers, Members should use one of the three main frequency ranges as allocated by WRC ITU/R recommendation v.431/7, Nomenclature of frequency and wavelength bands used in telecommunication. Members shall obtain permission to operate radar wind profilers and weather radars by their national radiofrequency allocation body. Members shall operate properly calibrated and well maintained wind profilers using adequate observing and measuring techniques. Members shall consider life cycle elements such as programme supervision, supportable software, product availability requirements, maintenance/engineering and training costs, logistic support, configuration management, as well as inspection, quality control and assessment, and, if necessary, develop and implement Lifecycle Management Plans for operational wind profilers. Members should address the requirements for uncertainty, timeliness, temporal resolution, spatial resolution, and coverage for their wind profiler data which result from the RRR process. Members shall follow the national safety practices and procedures for operation of the wind profilers that stresses precautions and practices specific to the conditions in the country concerned and satisfies country specific requirements regarding legal, health

Comment [dcr21]: Must be realocated to Section 3

	and safety codes, especially in regard to the high voltages, radiation, laser emissions, and acoustic emissions associated with wind profilers.
Rationale for inclusion of text	Required new section
To be included in which Manual / Guide	Manual
To be included in which section	Chapter 7 Section 7.4.1 General Requirements – Wind Profilers
Next action required	Review by ET-SBO-SG-RM Members
Status of Action	Awaiting review
Location information stored	Unknown

Proposal Identifier	Wind Profiler – 7.4.2 Observing Practices
Proposal lead	Dominique Ruffieux
Original Text	**From Manual on WIGOS** **2.4.2 Observing Practices** 2.4.2.1 Members should ensure that their observing practices are adequate to comply with the observational user requirements. Note: Observing practices is inclusive of station operation, data processing practices and procedures, applied calculation rules, documentation on calibration practices and associated metadata. **3.4.2 Observing Practices** 3.4.2.1 Members shall ensure that the exposure, when applicable, of instruments for the same type of observation at different stations be similar in order that observations may be compatible. 3.4.2.2 Members shall determine a reference height for at each surface observing station or system. Note: A reference height is defined as follows: 1. Elevation of the station. It is the datum level to which barometric pressure reports at the station refer; such current barometric values being termed "station pressure" and understood to refer to the given level for the purpose of maintaining continuity in the pressure records; or 2. For stations not located on aerodromes: elevation of the ground (height above mean sea level of the ground on which the raingauge stands or, if there is no raingauge, the ground beneath the thermometer screen. If there is neither raingauge nor screen, it is the average level of terrain in immediate vicinity of station) in metres rounded up to two decimals; or 3. For stations located on aerodromes it is an official altitude of the aerodrome.
Newly Proposed Text	Provisions of 3.4.2 apply. **Note** Wind profilers provide extremely valuable high-resolution information in space and time. It allows to properly sample small-scale wind field phenomena for many applications such as short range weather forecast, air pollution dispersion modelling, volcanic ash dispersion. Members should site wind profilers to fulfil observational data needs and based on horizontal resolution

	requirements. **GUIDANCE** Members should consider locating wind profilers between radio-sounding sites and upstream of the area of interest (e.g. humid air flows generating heavy rain and snow, accidental chemical/nuclear release, volcanic eruption). Sites shall be identified with consideration to the reliability of power and communication. Sites shall be chosen to minimize potential sources of clutter targets and RF interferences. Members shall site wind profilers to fulfil site specific observational data needs and horizontal resolution requirements for wind observations. **Note** Information on required spatial and temporal resolution can be found in WMO-485 Manual on Global Processing System (2010), Table 1 to be updated. Measurement shall be aligned with UTC hours. Members shall operate wind profilers continuously to provide horizontal winds at least every hour. Members should operate wind profilers continuously to provide horizontal winds at 30 minutes. Vertical resolution of wind profiler data shall be consistent with members' requirements and frequency allocation regulations. **Note** Vertical resolution is dependent on the available band width. Members shall implement data sampling techniques that minimise the errors due to range and velocity aliasing in wind profiler operations. Members shall implement data processing techniques to enable clutter filtering and interference contamination suppression in wind profiler operations.
Rationale for inclusion of text	Required new section
To be included in which Manual / Guide	Manual
To be included in which section	Chapter 7 Section 7.4.2 Observing Practices
Next action required	Review by ET-SBO-SG-RM
Status of Action	Awaiting review
Location information stored	Unknown

Proposal Identifier	Wind Profiler – 7.4.3 Quality Control

Proposal lead	Dominique Ruffieux
Original Text	2.4.3 **Quality Control** 2.4.3.1 Members shall ensure observations provided through their WIGOS component observing systems are quality controlled. 2.4.3.2 Members shall implement real-time quality control prior to real-time exchange of observations via the WMO Information System. Notes 1: Quality control on a real-time basis also takes place in the Global Data-Processing and Forecasting System, prior to the use of the meteorological and climatological observational data in data processing (i.e. objective analysis and forecasting). Note 2: Recommended minimum standards of quality control at the level of the National Meteorological Centre are given in the Manual on the Global Data-processing and Forecasting System (WMO-No. 485), Volume I – Global Aspects, Appendix II-1, Table I. Note 3: Recommended practices and procedures for quality control of hydrological observations are given in the Manual on Flood Forecasting and Warning (WMO-No. 1072), Chapter 6 and the Guide to Hydrological Practices (WMO-No. 168). Note 4: Recommended practices and procedures regarding the quality of observations for GAW requirements are formulated in Measurement Guidelines through Data Quality Objectives. 2.4.3.3 Members shall also perform quality control of observations on a non-real-time basis, prior to forwarding the observational data for archiving. 2.4.3.4 Quality Control processes should be developed and implemented by Members as specified in the Manual on WIGOS. Note: Quality Control processes include (but not necessarily be limited to) where and as necessary the following processes or activities: 1. Testing of the validity of a data value against a standard reference value; 2. Testing of the validity of a data value against an alternative and representative data value; 3. Testing of the validity of a data value against scientifically derived data sample bounds; 4. Testing of the validity of a data value for temporal and spatial consistency; 5. Testing of the validity of metadata associated with data values; 6. Documentation of the results of tests applied to data values through the use of data flags, metadata parameters or other documentation; or the removal of invalid data from data products or messages. 3.4.3 Quality Control Note: Provisions of 2.4.3 apply
Newly Proposed Text	Provisions of 3.4.3 apply. Members should establish a Quality Assurance Programme in line with the guidance provided by WMO-8, Part III.

	Note As a minimum, wind profiler quality assurance should include system performance monitoring, system and test equipment calibration, hardware and software maintenance, technical instructions, and reporting. Real-time automatic quality control based on consistency, climatological, and temporal checks should be included into the processing software of the wind profiler and communicated to the users. **GUIDANCE** commonly used method is to integrate a quality flag into the message. Quality monitoring should be based on reference data such as NWP model data and results communicated to the users. **Note** The commonly used method is based on "observation minus background" statistics. Post-analysis quality control should be based on comparison with co-located upper-air wind measurements if available.
Rationale for inclusion of text	Required new section
To be included in which Manual / Guide	Manual
To be included in which section	Chapter 7 Section 7.4.3 Quality Control
Next action required	Review by ET-SBO
Status of Action	Awaiting review
Location information stored	Unknown

Comment [dcr22]: Reference: "A one year comparison of 482MHz radar wind profiler, RS92-SGP Radiosonde and 1.5 µm Doppler Lidar wind measurements" http://www.atmos-meas-tech-discuss.net/7/11439/2014/amtd-7-11439-2014.pdf

Comment [dcr23]: Reference : „Experience of the Japan Meteorological Agency with the Operation of Wind Profilers". WMO IOM 110

Comment [dcr24]: Reference: http://old.ecmwf.int/products/forecasts/d/charts/monitoring/conventional/prof/windspeed/o_windspeed_pilot__geo!TEMP!web_obstat_weekly!pop!latest!700-1000hPa!Number!Used%20Data!/

Proposal Identifier	Wind Profiler – 7.4.4 Data and Metadata reporting
Proposal lead	Dominique Ruffieux
Original Text	**WIGOS MANUAL** 2.4.4 **Data and Metadata Reporting** 2.4.4.1 Members shall report and make available observations in standard formats specified by Annex II to the Technical Regulations (Manual on Codes (WMO-No. 306)) or as advised by GAW data centres, in accordance with … (the ref. will come here to the Part of the Manual on WIGOS – observation requirements for international exchange). Note: Members are to report and make available up-to-date WIGOS core metadata as specified in Section 2.5.2. 3.4.4 Data and Metadata Reporting Note: Provisions of 3.4.3 apply

Newly Proposed Text	Provisions of 3.4.4 apply. **Note** Process of harmonizing wind profiler BUFR template is under review via IPET-DRMM-I / Doc. 3.2 (2). Members should make available raw data for network monitoring and special applications. **Note** Determination of the freezing level based on bright band detection and planetary Boundary Layer height are two examples among others. Members shall report metadata following the WIGOS Metadata Standard, 2014.
Rationale for inclusion of text	Required new section
To be included in which Manual / Guide	Manual
To be included in which section	Chapter 7 Section 7.4.4 Data and Metadata reporting
Next action required	Review by ET-SBO
Status of Action	Awaiting review
Location information stored	Unknown

Comment [dcr25]: Reference: Evaluation of WMO-CBS Wind Profiler SurveyWIGOS Technical Report, 2014-03.

Proposal Identifier	Wind Profiler – 7.4.5 Incident Management
Proposal lead	Dominique Ruffieux
Original Text	**WIGOS Manual** 2.4.5 **Incident Management** 2.4.5.1 Members should implement incident management to detect, identify, record, analyze and respond to any incident for restoring a normal observing system operation as quickly as possible, minimizing the negative impact, and preventing a future re-occurrence. 2.4.5.2 Members shall implement procedures to detect, analyze and respond to system faults and human errors at the earliest stage possible. 2.4.5.3 Members should record and analyze incidents as appropriate. 3.4.5 Incident Management Note: Provisions of 3.4.5 apply
Newly Proposed Text	Provisions of 3.4.5 apply Members shall establish an Incident Management Program **Note** An Incident Management Program should define the coordination, guidance, and uniformity to ensure data compatibility in observational networks, reduce cost and minimize equipment downtime, and ensure an effective, safe, and secure wind profiler operational and maintenance program. Roles and responsibilities should be established throughout the organization to assure wind profiler maintenance program is carried out

	and reported, and maintenance activities are accomplished by performing periodic engineering quality program reviews as established in the quality assurance program. Members should assign an Incident Manager to execute the Incident Management Program **Note** The Incident Manager should provide for hardware, software, system analysis, data quality analysis, ancillary systems, system calibration, depot maintenance alert, troubleshooting, technical explanations and technical research support on a tiered approach. Restoration time requirements should be based on specific criteria (e.g.: importance of data to mission, type of failure). The Incident Manager shall be notified when maintenance staff have conducted repairs. **GUIDANCE** Incident Management should provide around-the-clock operations, monitoring, and maintenance support for wind profilers. This Incident Management program should provide monitoring and maintenance tasks include acting as the single point-of-contact (POC) for wind profiler maintenance status; providing near real-time monitoring of wind profiler system products; managing equipment specific and site-specific data; initiating corrective maintenance action; providing remote maintenance diagnostic capability; and tracking and documenting wind profiler malfunctions. When a wind profiler site malfunctions, the Incident management should investigate the malfunction by remote access when practical. Procedures should be established to address unique conditions when the Incident Management can remotely clear faults and failures. Otherwise, the Incident Management should notify the maintenance staff designated to resolve the malfunction. Restoration time requirements should be established based on specific criteria (importance of data to mission, type of failure). When the maintenance staff has conducted repairs the Incident Manager should be notified. If a wind profiler is inoperative and the malfunction is not restored to service within established policy, help from the Incident Manager should be called upon, to provide the necessary troubleshooting assistance until the problem is resolved or the next level of technical assistance is required which may include other wind profiler maintenance technicians, engineers. etc. The mission is to analyse inoperative systems with complex malfunctions.
Rationale for inclusion of text	Required new section
To be included in which Manual / Guide	Manual
To be included in which section	Chapter 7 Section 7.4.5 Incident Management
Next action required	Review by ET-SBO
Status of Action	Awaiting review
Location information stored	Unknown

Proposal Identifier	Wind Profiler – 7.4.6 Configuration Management
Proposal lead	Dominique Ruffieux
Original Text	**WIGOS Manual** 2.4.6 **Change Management** 2.4.6.1 Members should carefully plan and control changes to ensure continuity and consistency of observations and record any modification related to the observing system. Note: This requirement relates to any change in the observing system, including an observing station, observing programme, instruments, methods of observation, etc. 2.4.6.2 In the case of significant changes in instruments or methods of observation used or the location in which observations are made, Members should ensure for a sufficiently long period (to capture all expected climatic conditions) of overlap with dual operation of old and new systems to identify biases, inconsistencies and inhomogeneities. 3.4.6 Change Management Note: Provisions of 3.4.6 apply
Newly Proposed Text	Provisions of 3.4.6 apply. Members shall establish wind profiler Configuration Management Plan. The Configuration Management Plan shall include hardware, software, firmware, and documentation management. Configuration Management plan should contain a data management process. Configuration management plan should establish a configuration identification process. Configuration management plan should establish configuration change control process. Configuration management plan should establish configuration status accounting process. Configuration management plan should establish configuration audit process. **GUIDANCE** The components that should be considered for the wind profiler Configuration Management process are the hardware, software, firmware, and documentation (mainly specifications and drawings). These describe the wind profiler at every particular reference point as it evolves through its life cycle. Specifically, the Configuration Management Plan identifies those requirements necessary to record, control and communicate the functional and physical characteristics of the wind profiler to ensure the requirements effectively: (a) satisfy operational needs, and (b) maintain system requirements aligned with requirements. The purpose, structure, roles, and responsibilities should be identified including the dependencies and interactions of Configuration Management organizations and system life cycle support functions. The Configuration Management plan identifies the decision/approval authority of each organization and each organization's role in accomplishing Configuration Management (Data Management, Configuration Identification, Configuration Change Control, Configuration Status Accounting, and

	Configuration Audits). Configuration Management planning should include eleven functional area disciplines that will support the wind profiler Configuration Management process throughout the system lifecycle. While each area focuses on a particular aspect of support, they share the common goal of supporting and maintaining a viable, coherent, and effective program. The configuration management function is responsible for the coordination and integration of all the other elements to ensure that configuration management principles are followed and all necessary documentation is generated for Configuration Control Board consideration. Specifically, configuration management has the primary responsibility for configuration identification, control, status accounting, and reviews and audits. Its mission is to maintain the integrity of the baseline for the wind profiler system. The eleven functional areas that support the Configuration Management process are: Plans/Modernization, Budget, Systems Engineering, System Documentation, Hardware Maintenance/Field Test, Supply Support, Training, Contract Support/Administration, Support Equipment, Safety, and Quality Assurance. Data Management process should establish data requirements, and the methods and processes for implementing changes to technical data requirements. Data acquisition and management is the process of applying policies, systems, and procedures for: (a) identification and control of data requirements; (b) timely and economic development of data; and (c) ensuring the adequacy of such data for full compliance with the contract and for its intended use. This includes, where necessary, early application of contractual remedies needed to correct defective data products; (d) distribution of the data to the point of use; and (e) analysis of the data's suitability for intended use. Configuration Identification is the selected documents which comprise the baseline for the wind profilers and its Configuration Items, and the numbers and identifiers affixed to the items and documents. Configuration Item is "an aggregation of hardware and software that satisfies an end-use function and is designated for separate configuration management". The approved documents which identify and define a Configuration Item's functional and physical characteristics are in the form of specifications, drawings, parts lists, interface control documents, and associated documents. The configuration identification of a wind profiler should be developed and maintained through three distinct evolutionary levels of increasing detail, each used to establish a specific baseline. The three levels of configuration identification are: 1) Functional configuration identification which is comprised of the current approved technical documentation for a configuration item which prescribes: a) all necessary functional characteristics; b) the verification required to demonstrate achievement of specified functional characteristics; c) the necessary interface characteristics with associated Configuration Items; d) Configuration Item key functional characteristics and lower level Configuration Items, if any; e) design constraints, such as component standardization, Integrated Logistic Support policies, dimension, etc. 2) Allocated configuration identification which is comprised of performance oriented specifications governing the development of Configuration Items. Each specification: a) defines the functional characteristics that are allocated from those of the system or higher level Configuration Item; b) establishes the verification required to demonstrate

	achievement of its allocated functional characteristics; c) delineates necessary interface requirements with other associated Configuration Items; d) specifies design constraints, such as component standardization, Integrated Logistic Support policies, dimension, etc. 3) Product configuration identification which is comprised of the current approved technical documentation which defines the configuration of a Configuration Item during the production phase of its life cycle and which prescribes: a) all necessary physical or form, fit and function characteristics of a Configuration Item; b) the selected functional characteristics designated for production acceptance testing; c) the production acceptance test requirements. Interface Management is the functional and physical characteristics required existing at a common boundary. Interface Management should identify the responsibilities for establishing, documenting, and maintaining wind profiler interface requirements. It also should described the process and responsibilities for requesting changes to existing wind profiler interfaces; coordinating and conducting tests for interface compatibility; and certifying hardware and software components to be wind profiler compliant. Interface Management should also provide information on interface agreements, and groups that facilitate control and management of wind profiler interface requirements and certification. Procedures should be implemented for maintaining configuration control. Configuration Control is the systematic proposal, justification, evaluation, coordination, approval or disapproval of proposed changes, and the implementation of approved changes to a Configuration Item that is part of a formal configuration baseline. Configuration Control should also prescribes the phasing and provides target Configuration Management processing time from the receipt of a change request until approval for implementation of a change to the wind profiler baseline. Configuration Status Accounting requirements should be established and procedures to meet those requirements. Configuration Status Accounting is the recording and reporting of information needed to effectively manage configuration. A primary objective of Configuration Status Accounting is to provide information on system hardware, software baseline configurations, and communications configurations. The information shall be accurate and in sufficient detail to support management decisions regarding engineering, logistics, and supportability of all fielded system configurations. The Configuration Status Accounting system should be established to be able to provide detailed information in the following areas: a. A history of all approved and in-process configuration documentation. b. The status of proposed changes, deviations, and waivers to the baseline configuration. c. The implementation status of approved changes. d. The configuration of all units of the configuration item in the operational inventory. Plans should be established for performing Functional Configuration Audits (FCA) and Physical Configuration Audit (PCA) for newly developed hardware and software system enhancements.
Rationale for inclusion of text	Required new section
To be included in which	Manual

Manual / Guide	
To be included in which section	Chapter 7 Section 7.4.6 Configuration Management
Next action required	Review by ET-SBO
Status of Action	Awaiting review
Location information stored	Unknown

Proposal Identifier	Wind Profiler – 7.4.7 Maintenance
Proposal lead	Dominique Ruffieux
Original Text	**WIGOS Manual** 2.4.7 **Maintenance** 2.4.7.1 Members shall ensure that each observing system is rigorously maintained. 2.4.7.2 Members shall perform regular preventive maintenance of their observing systems including their instruments. Note: Well organized preventive maintenance of all system components is recommended to minimize corrective maintenance and to increase the operational reliability of an observing system. 2.4.7.3 Members shall determine the frequency and timing (schedule) of the preventive maintenance taking into account the type of the observing system, environmental and climate conditions of the observing site, and the instrumentation installed. 2.4.7.4 Members shall perform corrective maintenance in case of observing system component fault as soon as practically possible once the problem has been detected. 2.4.7.5 Members shall employ adaptive maintenance that satisfies the requirements for stability, continuity and consistency of observations through time. Note: Detailed guidance on maintenance of observing systems and instruments is given in the Guide to Meteorological Instruments and Methods of Observation (WMO-No. 8) including all of the GAW measurement guides as referenced in Chapter 16, the Guide to Hydrological Practices (WMO-No. 168) and the Manual on Stream Gauging (WMO-No. 1044). 3.4.7 **Maintenance** 3.4.7.1 Members should ensure that each observing system is rigorously maintained. 3.4.7.2 Observing sites and instruments should be maintained regularly so that the quality of observations does not deteriorate significantly between station inspections. 3.4.7.3 Members should perform regular preventive maintenance. Note: Well‑organized preventive maintenance of all system components is recommended to minimize corrective maintenance and to increase the performance of an observing system. 3.4.7.4 The frequency and timing (schedule) of the preventive maintenance should be determined taking into account the type of the observing system, environmental and climate conditions of the observing site, and the instrumentation installed. 3.4.7.5 Members should perform corrective maintenance in case of observing system component fault as soon as possible after detection of

	the problem. 3.4.7.6 Adaptive maintenance should consider the requirements for stability, continuity and consistency of observations through time. Note: Detailed guidance on maintenance of observing sites, observing systems and instruments is given in the Guide to Meteorological Instruments and Methods of Observation (WMO-No. 8), the Guide to Hydrological Practices (WMO-No. 168, 2008) and the Manual on Stream Gauging (WMO-No. 1044, 2010).
Newly Proposed Text	Provisions of 3.4.7 apply. Members shall establish a wind profiler Maintenance Program to ensure wind profiler system and wind profiler ancillary equipment operate at the highest availability and within the technical specifications to provide the highest quality of wind observations. Members shall ensure that wind profiler systems are rigorously maintained. Members shall determine the frequency, timing and extent of the regular preventative maintenance activities, with consideration given to manufacturer guidelines, where available. Members shall perform responsive maintenance as soon as possible once a problem has been detected. Members should, where possible, implement monitoring systems to allow for remote diagnostics to be performed. Members should maintain wind profiler sites such that the equipment will be unaffected by non-system issues (e.g.: vegetation). Members should establish wind profiler maintenance program to include administrative and telecommunications systems, equipment and software, including local and wide area networks. The wind maintenance program should include operating and maintenance training. The wind profiler maintenance program should include a logistic supply process. The wind profiler program should include a maintenance depot. The wind program should include the necessary documentation to conduct corrective, preventive field maintenance. Corrective and preventive maintenance completed on a

	wind profiler should be recorded and documented. Wind profiler maintenance analysis reports should be generated regularly to determine failure analysis, performance, effectiveness of maintenance personnel and maintenance process.
Rationale for inclusion of text	Required new section
To be included in which Manual / Guide	Manual
To be included in which section	Chapter 7 Section 7.4.7 Maintenance
Next action required	Review by ET-SBO
Status of Action	Awaiting review
Location information stored	Unknown

Proposal Identifier	Wind Profiler – 7.4.8 Inspection and Supervision
Proposal lead	Dominique Ruffieux
Original Text	**WIGOS Manual** 2.4.8 **Inspection** Members shall arrange periodic inspection of their observing systems. Note: Such inspection could be undertaken directly or remotely as necessary to monitor correct functioning of observing platform and instruments. 3.4.8 **Inspection and Supervision** 3.4.8.1 Each Member [shall/shall for hydrological observations] arrange for its surface observing site/station/system to be inspected at sufficiently frequent intervals to ensure that a high standard of observations is maintained; instruments and all their indicators are functioning correctly; and the exposure, when applicable, of the instruments has not changed significantly. Note 1: Reference is made to the Parts 5-8 of this Manual for the frequency intervals specified for the several types of WIGOS surface observing stations. Note 2: Detailed guidance on the inspection including the frequency is given in the Guide on WIGOS (WMO-No. YYYY), Guide to Meteorological Instruments and Methods of Observation (WMO-No. 8). Note 3: Reference is made to the Technical Regulations (WMO-No. 49), Volume II for guidance on the inspection of aeronautical meteorological stations including the frequency of inspections. 3.4.8.2 Members [shall/should for hydrological observations] ensure that inspection is performed by qualified and adequately trained staff. Members should ensure that: (a) The siting, selection and installation, as well as exposure when applicable, of instruments are known, recorded and acceptable; (b) Instruments have approved characteristics, are in good order and regularly verified against relevant standards; (c) There is uniformity in the methods of observation and in the procedure

	for reduction of observations. Note: Detailed guidance on inspection and supervision of observing systems and sites is given in the Guide to Meteorological Instruments and Methods of Observation (WMO-No. 8) including all of the GAW measurement guides as referenced in Chapter 16, the Guide to Hydrological Practices (WMO-No. 168) and the Manual on Stream Gauging (WMO-No. 1044).
Newly Proposed Text	Provisions of 3.4.8 apply. Wind profiler program manager should establish policies and standards at the national level which need to be in compliance with the WMO wind profiler regulations. Wind profiler program manager should establish a wind profiler life cycle Integrated Logistic Support Plan. **GUIDANCE** The wind profiler Integrated Logistic Support Plan should include field- and depot-level maintenance, maintenance training, supply support, facilities engineering, technical data including documentation, transition planning, support and test equipment (including calibration); performs system analyses and recommends replacements for all nationally supported systems and equipment. The wind profiler program manager should establish procedures for planning and conducting program reviews for appraising the quality or the wind profiler operations and maintenance program. The wind profiler program manager shall ensure maintenance and quality policies are followed for the wind profiler systems and equipment. The wind profiler program manager shall ensure the normal site management review process includes and encourages close coordination and review of the wind profiler maintenance program. The wind profiler program manager shall ensure that staff participate and support the QA Program. The wind profiler program manager shall ensure that a timetable has been established to correct quality inconsistencies requiring action and that they are corrected in a timely manner. The wind profiler program manager shall take reasonable actions to ensure that operation and maintenance staff is adequately trained. The wind profiler program manager shall review the completed QA Program checklist as defined in the

	Members Quality Assurance Plan established in 4.7.3.
Rationale for inclusion of text	Required new section
To be included in which Manual / Guide	Manual
To be included in which section	Chapter 7 Section 7.4.8 Inspection and Supervision
Next action required	Review by ET-SBO
Status of Action	Awaiting review
Location information stored	Unknown

ANNEX IV

Draft Regulations and Guidance Proposed for Weather Radar

Proposal Identifier	Weather Radar – 7.4.1 General Requirements
Proposal lead	Daniel Michelson
Reference Text	**8 FROM WMO NO. 544 MANUAL ON THE GOS (2010)** 2.12.2 Weather radar stations General 2.12.2.1 Members should establish an adequate network of weather radar stations, either nationally or in combination with other Members of the Region, in order to secure information about areas of precipitation and associated phenomena and about the vertical structure of cloud systems, for both operational meteorology and research. Location and composition 2.12.2.2 Weather radars shall be located in such a manner as to minimize interference from surrounding hills, buildings and electro-magnetic sources, so as to provide good coverage of population centres and geographic features affecting stream and river flows, major thoroughfares and other facilities of importance. Frequency and timing of observations 2.12.2.3 As a minimum, observations should be taken and reported at hourly intervals. Observations should be more frequent when heavy convective activity or heavy widespread precipitation is occurring. **9 FROM WMO NO. 488 GUIDE TO THE GOS (2010)** 3.9.2.1 Weather radar stations 3.9.2.1.1 General Weather radar stations are in many cases colocated with surface or upper‑air stations of the basic synoptic network. Such stations should be established and equipped to carry out radar observations in order to obtain information about areas of precipitation and associated phenomena, and the vertical structure of cloud systems. The information obtained from radar stations is used for operational purposes in synoptic meteorology—forecasting and warning of dangerous weather phenomena such as tropical cyclones, the generation of numerical analyses and guidance, aeronautical meteorology and hydrology, and research. WMO Technical Note No. 181, Use of Radar in Meteorology (WMO‑No. 625), contains useful guidance on the types of radar available, their possible usage, methods of operation and the practical aspects of siting and maintenance. Chapter 9, Part II, of the Guide to Meteorological Instruments and Methods of Observation (WMO‑No. 8) provides further

	information. 3.9.2.1.2 Site selection Several principles to be considered when selecting a site for a radar station are as follows: (a) The location should be free of natural or man-made obstructions interfering with the radar beam. Local construction plans should be examined to identify future potential interference. Fixed targets should be as few as possible or at least not higher than 0.5° above the level of the radar aerial; (b) Many national regulations require a survey to ensure that people living in the area surrounding the station site are not influenced by the microwave energy emitted; (c) A licence for operating the radar at the planned site must be obtained from the radio-telecommunication authorities concerned in order to avoid interference with any other installation. See 9.7.1, Chapter 9, Part II, of the Guide to Meteorological Instruments and Methods of Observation (WMO-No. 8) for more details. 3.9.2.1.3 Observing programme Radar observations have been found most useful for the following tasks: (a) Severe weather detection, tracking and warning; (b) Surveillance of synoptic and mesoscale weather systems; (c) Estimation of precipitation amounts; (d) Wind shear detection. Further information can be found in 9.1.3, Chapter 9, Part II, of the Guide to Meteorological Instruments and Methods of Observation (WMO-No. 8). 3.9.2.1.4 Organization A radar meteorological observation is a manual or automated "evaluation" of the radar echoes received from meteorological targets, coded as a message and transmitted to various meteorological centres and other users at regular intervals. The distance between two stations in an operational weather radar network should be a function of the effective radar range. In the case of a radar network intended primarily for synoptic applications, radars in mid-latitudes should be located at a distance of approximately 150 to 200 km from each another. The distance may be increased in latitudes closer to the Equator, if the radar echoes of interest frequently reach high altitudes. Narrow-beam radars yield the best accuracy for precipitation measurements. Radar networks have a routine observing schedule. Each radar station may, however, increase its observation times or take continuous observations according to the current

	weather situation. A list of measurements and products can be found in 9.1.4, Chapter 9, Part II, of the Guide to Meteorological Instruments and Methods of Observation (WMO-No. 8). There should be at least one principal weather radar station or a national weather radar centre which is responsible for receiving radar observational data from local stations and synthesizing this data into a large-scale echo pattern for the entire network. The national weather radar centre should also be responsible for regular inspection and quality control of network data. 3.9.2.1.5 Operations An up-to-date directory of weather radar stations should be maintained by each Member within its territory, giving the following information for each station: (a) Name, geographical coordinates and elevation; (b) Type of radar and some characteristics of the equipment used, such as wave length or maximum transmitting power; (c) Routine observing schedule. A minimum radar network should consist of at least two radars together covering most of the service area. Where necessary, individual radar can operate in conjunction with others in neighbouring countries to form a network. Ground-level precipitation estimates from typical radar systems are made for areas of typically 2 km2, successively for 5–10 minute periods. A growing number of meteorological offices, governmental agencies, commercial users and water authorities receive either the composite images or graphics produced at the weather radar centre or single radar images directly from the radar sites. 3.9.2.1.6 Communications Regular radar data are coded in code forms FM 20-VIII RADOB, found in the Manual on Codes (WMO-No. 306, Part A, Volume I.1) or FM 94 BUFR, in the Manual on Codes (WMO-No. 306, Parts B and C, Volume I.2) and disseminated in a timely fashion through the national or regional telecommunication network. The type of communications equipment needed for disseminating data depends on the temporal resolution of the data, the processing level and the quality of communications available (telephone lines and the like). 3.9.2.1.7 Personnel Weather radar personnel requirements with regard to category and number depend on the type of equipment used, the level of automation and the number of observations required. Maintenance and technical personnel responsible for the weather radar station or the entire network must have

	specialized training in the maintenance and operation of equipment used and a basic understanding of electronics and radar techniques. A station supervisor is needed to carry out periodic checks of the calibration and the interpretation methods used in manual or semi-automatic observations. 3.9.2.1.8 Quality standards The relationship between surface rainfall and radar echo strength is unfortunately not fixed or geographically universal. In addition, there are often significant echoes caused by ground clutter and anomalous propagation that are not due to rainfall. The difficulty of correcting the calculation of surface rainfall estimates objectively in real time is one factor that should be taken into account when designing an interactive display system and interpreting radar images. In addition to the quality control of radar observations, a combined digital satellite and radar interactive system may enable its operators to use geostationary satellite data to extend the surface rainfall analyses beyond the radar coverage area. This involves subjective judgement and the use of algorithms that relate surface rainfall to cloud brightness and temperature. Alternatively, real-time calibration of radar echoes with rainfall data from rain-gauges can also be carried out when analysing rainfall data and estimating rainfall from radar echoes.
Newly Proposed Text	Note: Weather radars are active remote sensing systems for continuous atmospheric measurement, which provides valuable information on a broad range of meteorological phenomena and weather scenarios (i.e. Clear air, Stratiform rain, winter weather, heavy rain fall, convective storms and tropical cyclones). Weather radars are a critical component of the weather data observing systems that supports weather, water, and climate data, and forecasts and warnings for the protection of life and property and enhancement of the economy by increasing warning lead times for high-impact events (e.g., tornados, flash floods, severe thunderstorms); Reduce warning false alarms without degrading probability of detection; Promote comprehensive weather situational awareness; Improve weather decision services and convey uncertainties associated with data and products. The Weather Radar comprises Doppler radars, telecommunications, computer data communications, data processing hardware and software, display and data entry equipment, documentation, and certain facilities and support capabilities required to detect, process, distribute, and display weather information. Further details on Weather Radar systems can be found in WMO-No.8 (Part II, Ch. 9) Members shall establish a network of weather radars adequate to provide measurements to meet, at least, the requirements of WMO-No. 49 (Vol I and II)

	Members should operate weather radars within the following frequency bands: S- Band (2700 to 3100) MHz C- Band (5250 to 5850) MHz X- Band (9300 to 9500) MHz Note: Characteristics of each of these systems can be found in WMO-No.8 (Part II, Ch. 9) Weather radars shall be capable of transmitting and receiving horizontally polarised signals. Weather radars should be capable of transmitting and receiving vertically polarised signals. Members shall establish a Weather Radar program manager as the lead focal point for all Weather Radar administrative, configuration, quality assurance, operations and maintenance activities. Members should the use of radar weather radar in three main frequency ranges as allocated by WRC ITU/R recommendation v.431/7, Nomenclature of frequency and wavelength bands used in telecommunication. Members shall obtain permission to operate Weather Radars from their national radio frequency allocation body. Weather Radars shall provide observations of the Reflectivity of the sample volume. Weather Radars should provide the following observations of the sample volume: - Radial velocity - Spectrum Width Weather radars with dual-polarisation capability should provide the following observations of the sample volume: - Differential phase - Correlation coefficient Members should implement weather radars based on coverage, spatial resolution, sensitivity, maximum unambiguous velocity and range requirements. Note: these parameters vary in an inter-related manner with the radar's transmitted power, wavelength of the transmitted signal, beamwidth, and radar waveform including pulse length and PRF. Members shall maximize the accuracy of the reflectivity and other radar variables, through calibration, scanning strategies and radar specific adaptable parameters.

	Members shall provide in an official WMO agreed format data and metadata to users Note: see WMO WIS document on formats Members shall ensure that their weather radars are calibrated, and well maintained. Members shall consider life cycle elements such as programme supervision, supportable software, product availability requirements, maintenance/engineering and training costs, logistic support, configuration management, as well as inspection, quality control and assessment. Members shall ensure that proper safety procedures are specified, documented and utilised at all weather radar sites. Typically, safety hazards for Weather Radars include high voltage, radiation exposure, working in confined spaces and climbing and working at heights.
Rationale for inclusion of text	Required new section
To be included in which Manual / Guide	Manual
To be included in which section	Chapter 7 Section 7.4.1 General Requirements
Next action required	Review by ET-SBO
Status of Action	Awaiting review
Location information stored	Unknown

Proposal Identifier	Weather Radar – 7.4.2 Observing Practices
Proposal lead	Daniel Michelson
Original Text	**From Manual on WIGOS** **2.4.2 Observing Practices** 2.4.2.1 Members should ensure that their observing practices are adequate to comply with the observational user requirements. Note: Observing practices is inclusive of station operation, data processing practices and procedures, applied calculation rules, documentation on calibration practices and associated metadata. **3.4.2 Observing Practices** 3.4.2.1 Members shall ensure that the exposure, when applicable, of instruments for the same type of observation at different stations be similar in order that observations may be compatible. 3.4.2.2 Members shall determine a reference height for at each surface observing station or system. Note: A reference height is defined as follows: 1. Elevation of the station. It is the datum level to which barometric pressure reports at the station refer; such current barometric values being

	termed "station pressure" and understood to refer to the given level for the purpose of maintaining continuity in the pressure records; or 2. For stations not located on aerodromes: elevation of the ground (height above mean sea level of the ground on which the raingauge stands or, if there is no raingauge, the ground beneath the thermometer screen. If there is neither raingauge nor screen, it is the average level of terrain in immediate vicinity of station) in metres rounded up to two decimals; or 3. For stations located on aerodromes it is an official altitude of the aerodrome.
Newly Proposed Text	Note: Operational weather radar functionality typically offers control over certain scan strategy parameters such as PRF, antenna beam scanning speed, and elevations and azimuths processed. These choices are used to create preset scan strategies (also termed Volume Coverage Patterns) to achieve reasonable tradeoffs among volume update time, maximum unambiguous velocity, maximum unambiguous range, coverage, spatial resolution and clutter mitigation for different weather scenarios. Dynamic tuning of parameters for specific scanning sectors, such as modifying the PRF to mitigate range folding, is used to further enhance performance in the vicinity of significant storms. Selection of the proper scanning strategy and dynamic tuning of adaptable parameters are critical to achieving accurate estimates of radar variables. Even with high quality radar hardware design and calibration, and with appropriate selection of scan strategy parameters, real world weather returns present significant challenges to accurate estimations of radar variables. Weather, insects, birds, anomalous propagation and ground targets contribute to a complex radar return signal in many different weather scenarios. The distribution, intensities and velocities of precipitation areas may exceed the sampling and signal processing capabilities for mitigating range and velocity ambiguities. The strength and velocity of a storm may vary significantly within a single sample volume, especially for the larger sample volumes at longer ranges. Precipitation areas may fall partially, or wholly, below the lowest beam of a scanning strategy, or may be obstructed by terrain or man-made objects. For certain radar variable estimates, such as Differential Reflectivity, the radar estimate may be accurate but the scientific association with a type of precipitation (e.g., snow) may be problematical due to the variability of the weather target compared to other meteorological data (e.g., temperature). Given a well-designed and calibrated radar, operations with appropriate scanning parameters and signal

	processing techniques, and an understanding of the complexities of weather radar estimations of radar variables, the final test of a radar's accuracy is the usefulness of its data for support to operational forecasts and warnings. Members should select the weather radar technology and operating frequency based on the user requirements defined in the RRR Process. Note: Physical constraints on selecting systems are described in WMO-No. 8, Part II, Chapter 9. Members shall site weather radar to fulfil observational data needs and based on horizontal resolution requirements. Members should locate weather radar based on coverage requirements. When members are implementing multiple weather radars, weather radars should be located to provide overlapping coverage. Members should locate weather radars with minimal topographical and structure blocking. Members should locate weather radars to satisfy environment impacts including frequency allocation constraints. Weather radars should be located with consideration of power, communication, and access as well as the life cycle cost of these elements. Weather radars should be located to avoid potential sources of clutter targets and RF interferences. Weather radars should be located where climatological records define where there is significant threat of hazardous meteorological conditions exist. Weather radars should be sited to ensure a clear view in the prevailing direction from which damaging weather approaches. Members shall generate a user Interface Control Documents that defines the product format of weather radars. At a minimum, members shall provide the reflectivity, mean radial velocity, and radial velocity spectrum data displayable as an image and formatted as a data array. Members should provide echo tops information, vertical cross section of reflectivity or mean radial velocity data, and Velocity Azimuth Display Algorithm derived wind speed and direction.

	Weather radar products shall include metadata and shall be permanently archived so that products recreated or reconstructed. Weather radars should continuously distribute weather radar products. Note: For definition of latency, see WMO WIGOS Metadata Standard.
Rationale for inclusion of text	Required new section
To be included in which Manual / Guide	Manual
To be included in which section	Chapter 7 Section 7.4.2 Observing Practices
Next action required	Review by ET-SBO-SG-RM
Status of Action	Awaiting review
Location information stored	Unknown

Proposal Identifier	Weather Radar – 7.4.3 Quality Control
Proposal lead	Daniel Michelson
Original Text	N/A
Newly Proposed Text	Members shall establish a quality assurance programme in line with the guidance provided by WMO-8, Part III. Note: As a minimum, weather radar quality assurance should include system performance monitoring, test equipment and system calibration, hardware and software maintenance, technical instructions, and reporting. Real-time quality control checks should be included in the processing software of the system.Note: For example, clutter filtering of the spectra Post-analysis quality control should be performed. Users shall be informed of the quality status of the equipment.
Rationale for inclusion of text	Required new section
To be included in which Manual / Guide	Manual
To be included in which section	Chapter 7 Section 7.4.3 Quality Control
Next action required	Review by ET-SBO
Status of Action	Awaiting review

Comment [TK26]: Possibly guidance material

Location information stored	Unknown

Proposal Identifier	Weather Radar – 7.4.4 Data and Metadata reporting
Proposal lead	Daniel Michelson
Original Text	N/A
Newly Proposed Text	Members shall provide in an official WMO agreed format product data and metadata to users. Note: Refer to WIS manual on data formats Members shall provide real-time meta-data regarding calibration, timing, beam position/pointing, and other system settings to users. Members should make available raw data for network monitoring and special applications. For Metadata reporting, Members shall refer to the WIGOS Metadata Standard, 2014.
Rationale for inclusion of text	Required new section
To be included in which Manual / Guide	Manual
To be included in which section	Chapter 7 Section 7.4.4 Data and Metadata reporting
Next action required	Review by ET-SBO
Status of Action	Awaiting review
Location information stored	Unknown

Comment [TK27]: Possibly other references based on OPERA/ODIM formats

Proposal Identifier	Weather Radar – 7.4.5 Incident Management
Proposal lead	Dominique Ruffieux
Original Text	N/A
Newly Proposed Text	Incident Management program should be established. It defines the coordination, guidance, and uniformity to ensure data compatibility in observational networks, reduce cost and minimize equipment downtime, and ensure an effective, safe, and secure weather radar operational and maintenance program. Roles and responsibilities should be established throughout the member's organization to assure weather radar maintenance program is carried out and reported, and maintenance activities are accomplished by performing periodic engineering quality program reviews as established in the quality assurance program.

	Members should assign an Incident Manager to execute the Incident Management Program. The Incident Manager should provide support for hardware, software, system analysis, data quality analysis, ancillary systems, system calibration, depot maintenance alert, troubleshooting, technical explanations and technical research. If a weather radar is inoperative and the malfunction is not restored to service within established policy, help from the Incident Manager should be called upon, to provide the necessary troubleshooting assistance until the problem is resolved or the next level of technical assistance is required which may include other weather radar maintenance technicians, engineers. etc. The objective is to analyze inoperative systems with complex malfunctions. Note: Incident Management should provide around-the-clock operations, monitoring, and maintenance support for weather radars. This Incident Management program should provide monitoring and maintenance tasks include acting as the single point-of-contact (POC) for weather radar maintenance status; providing near real-time monitoring of weather radar system products; managing equipment specific and site-specific data; initiating corrective maintenance action; providing remote maintenance diagnostic capability; and tracking and documenting weather radar malfunctions. When a weather radar site malfunctions, the Incident management should investigate the malfunction by remote access when practical. Procedures should be established to address unique conditions when the Incident Management can remotely clear faults and failures. Otherwise, the Incident Management should notify the maintenance staff designated to resolve the malfunction. Restoration time requirements should be established based on specific criteria (importance of data to mission, type of failure). When the maintenance staff has conducted repairs the Incident Manager should be notified.
Rationale for inclusion of text	Required new section
To be included in which Manual / Guide	Manual

To be included in which section	Chapter 7 Section 7.4.5 Incident Management
Next action required	Review by ET-SBO
Status of Action	Awaiting review
Location information stored	Unknown

Proposal Identifier	Weather Radar – 7.4.6 Configuration Management
Proposal lead	Daniel Michelson
Original Text	N/A
Newly Proposed Text	Members shall establish Weather Radar Configuration Management Plan. The Configuration Management Plan shall include hardware, software, firmware, and documentation management. Configuration Management plan should contain a data management process. Configuration management plan should establish a configuration identification process. Configuration management plan should establish configuration change control process. Configuration management plan should establish configuration status accounting process. Configuration management plan should establish configuration audit process. Note: The components that should be considered for the weather radar Configuration Management process are the hardware, software, firmware, and documentation (mainly specifications and drawings). These describe the weather radar at every particular reference point as it evolves through its life cycle. Specifically, the Configuration Management Plan identifies those requirements necessary to record, control and communicate the functional and physical characteristics of the weather radar to ensure the requirements effectively: (a) satisfy operational needs, and (b) maintain system requirements aligned with requirements. The purpose, structure, roles, and responsibilities should be identified including the dependencies and interactions of Configuration Management organizations and system life cycle support functions. The

	Configuration Management plan identifies the decision/approval authority of each organization and each organization's role in accomplishing Configuration Management (Data Management, Configuration Identification, Configuration Change Control, Configuration Status Accounting, and Configuration Audits). Configuration Management planning should include eleven functional area disciplines that will support the weather radar Configuration Management process throughout the system lifecycle. While each area focuses on a particular aspect of support, they share the common goal of supporting and maintaining a viable, coherent, and effective program. The configuration management function is responsible for the coordination and integration of all the other elements to ensure that configuration management principles are followed and all necessary documentation is generated for Configuration Control Board consideration. Specifically, configuration management has the primary responsibility for configuration identification, control, status accounting, and reviews and audits. Its mission is to maintain the integrity of the baseline for the weather radar system. The eleven functional areas that support the Configuration Management process are: Plans/Modernization, Budget, Systems Engineering, System Documentation, Hardware Maintenance/Field Test, Supply Support, Training, Contract Support/Administration, Support Equipment, Safety, and Quality Assurance. Data Management process should establish data requirements, and the methods and processes for implementing changes to technical data requirements. Data acquisition and management is the process of applying policies, systems, and procedures for: (a) identification and control of data requirements; (b) timely and economical development of data; and (c) ensuring the adequacy of such data for full compliance with the contract and for its intended use. This includes, where necessary, early application of contractual remedies needed to correct defective data products; (d) distribution of the data to the point of use; and (e) analysis of the data's suitability for intended use. Configuration Identification is the selected documents which comprise the baseline for the weather radars and its Configuration Items, and the numbers and identifiers affixed to the items and documents. Configuration Item is “an aggregation of hardware and software that

	satisfies an end-use function and is designated for separate configuration management". The approved documents which identify and define a Configuration Item's functional and physical characteristics are in the form of specifications, drawings, parts lists, interface control documents, and associated documents. The configuration identification of a weather radar should be developed and maintained through three distinct evolutionary levels of increasing detail, each used to establish a specific baseline. The three levels of configuration identification are: 4) Functional configuration identification which is comprised of the current approved technical documentation for a configuration item which prescribes: f) all necessary functional characteristics; g) the verification required to demonstrate achievement of specified functional characteristics; h) the necessary interface characteristics with associated Configuration Items; i) Configuration Item key functional characteristics and lower level Configuration Items, if any; j) design constraints, such as component standardization, Integrated Logistic Support policies, dimension, etc. 5) Allocated configuration identification which is comprised of performance oriented specifications governing the development of Configuration Items. Each specification: e) defines the functional characteristics that are allocated from those of the system or higher level Configuration Item; f) establishes the verification required to demonstrate achievement of its allocated functional characteristics; g) delineates necessary interface requirements with other associated Configuration Items; h) specifies design constraints, such as component standardization, Integrated Logistic Support policies, dimension, etc. 6) Product configuration identification which is comprised of the current approved technical documentation which defines the configuration of a Configuration Item during the production phase

	of its life cycle and which prescribes: d) all necessary physical or form, fit and function characteristics of a Configuration Item; e) the selected functional characteristics designated for production acceptance testing; f) the production acceptance test requirements. Interface Management is the functional and physical characteristics required existing at a common boundary. Interface Management should identify the responsibilities for establishing, documenting, and maintaining weather radar interface requirements. It also should described the process and responsibilities for requesting changes to existing weather radar interfaces; coordinating and conducting tests for interface compatibility; and certifying hardware and software components to be weather radar compliant. Interface Management should also provide information on interface agreements, and groups that facilitate control and management of weather radar interface requirements and certification. Procedures should be implemented for maintaining configuration control. Configuration Control is the systematic proposal, justification, evaluation, coordination, approval or disapproval of proposed changes, and the implementation of approved changes to a Configuration Item that is part of a formal configuration baseline. Configuration Control should also prescribes the phasing and provides target Configuration Management processing time from the receipt of a change request until approval for implementation of a change to the weather radar baseline. Configuration Status Accounting requirements should be established and procedures to meet those requirements. Configuration Status Accounting is the recording and reporting of information needed to effectively manage configuration. A primary objective of Configuration Status Accounting is to provide information on system hardware, software baseline configurations, and communications configurations. The information shall be accurate and in sufficient detail to support management decisions regarding engineering, logistics, and supportability of all fielded system configurations. The Configuration Status Accounting system should be established to be able to provide detailed information in the following areas:

	e. A history of all approved and in-process configuration documentation. f. The status of proposed changes, deviations, and waivers to the baseline configuration. g. The implementation status of approved changes. h. The configuration of all units of the configuration item in the operational inventory. Plans should be established for performing Functional Configuration Audits (FCA) and Physical Configuration Audit (PCA) for newly developed hardware and software system enhancements.
Rationale for inclusion of text	Required new section
To be included in which Manual / Guide	Manual
To be included in which section	Chapter 7 Section 7.4.5 Incident Management
Next action required	Review by ET-SBO
Status of Action	Awaiting review
Location information stored	Unknown

Proposal Identifier	Weather Radar – 7.4.7 Maintenance
Proposal lead	Daniel Michelson
Original Text	N/A
Newly Proposed Text	Members shall establish a Weather Radar Maintenance Program to ensure Weather Radar system and ancillary equipment operate at the highest availability and provide highest quality observations. Members shall ensure that Weather Radar systems are rigorously maintained. Members shall determine the frequency, timing and extent of the regular preventative maintenance activities, with consideration given to manufacturer guidelines, where available. Members shall perform responsive maintenance as soon as possible after a problem has been detected. Members should, where possible, implement monitoring systems to allow for remote diagnostics to be performed. Members should maintain Weather Radar sites such that the equipment will be unaffected by non-system issues (e.g.: vegetation). Members should establish Weather Radar maintenance program to include administrative and telecommunications

	systems, equipment and software, including local and wide area networks. The Weather Radar maintenance program should include operating and maintenance training. The Weather Radar maintenance program should include a logistic supply process. The Weather Radar Maintenance Program should include a maintenance depot. The Weather Radar Maintenance Program should include the necessary documentation to conduct corrective, preventive field maintenance. Corrective and preventive maintenance completed on Weather Radars shall be recorded. Weather radar maintenance analysis reports should be generated regularly to determine failure analysis, performance, effectiveness of maintenance personnel and maintenance process.
Rationale for inclusion of text	Required new section
To be included in which Manual / Guide	Manual
To be included in which section	Chapter 7 Section 7.4.7 Maintenance
Next action required	Review by ET-SBO
Status of Action	Awaiting review
Location information stored	Unknown

Proposal Identifier	Weather Radar – 7.4.8 Inspection and Supervision
Proposal lead	Daniel Michelson
Original Text	N/A
Newly Proposed Text	Weather radar program manager should establish policies and standards at the national level, which needs to be in compliance with the WMO weather radar regulations. Weather radar program manager should establish a weather radar life cycle Integrated Logistic Support Plan. Note: Integrated Logistic Support Plan should include field- and

	depot-level maintenance, maintenance training, supply support, facilities engineering, technical data including documentation, transition planning, support and test equipment (including calibration); performs system analyses and recommends replacements for all nationally supported systems and equipment. The weather radar program manager should establish procedures for planning and conducting program reviews for appraising the quality or the weather radar operations and maintenance program. The weather radar program manager shall ensure maintenance and quality policies are followed for the weather radar systems and equipment. The weather radar program manager shall ensure the normal site management review process includes and encourages close coordination and review of the weather radar maintenance program. The weather radar program manager shall ensure that staff participate in and support the QA Program. The weather radar program manager shall ensure that a timetable has been established to correct quality inconsistencies requiring action and that such corrections occur in a timely manner. The weather radar program manager shall take reasonable actions to ensure that operation and maintenance staff are adequately trained. The weather radar program manager shall review the completed QA Program checklist as defined in the Members Quality Assurance Plan established in 4.7.3.
Rationale for inclusion of text	Required new section
To be included in which Manual / Guide	Manual
To be included in which section	Chapter 7 Section 7.4.8 Inspection and Supervision
Next action required	Review by ET-SBO
Status of Action	Awaiting review
Location information stored	Unknown

Proposal Identifier	Weather Radar – 7.4.9 Calibration procedures

Proposal lead	Daniel Michelson
Original Text	N/A
Newly Proposed Text	Members operating Weather Radars shall follow the provisions of the section 2.4.9. Members shall implement a weather radar calibration program. Members shall calibrate the weather radar and ancillary equipment in accordance with the supplier's requirements. Members shall calibrate weather radar and ancillary equipment within the specified time identified by the supplier. Calibration completed on a weather radar should be recorded.
Rationale for inclusion of text	Required new section
To be included in which Manual / Guide	Manual
To be included in which section	Chapter 7 Section 7.4.9 Calibration procedures
Next action required	Review by ET-SBO
Status of Action	Awaiting review
Location information stored	Unknown

ANNEX V

List of Potential Guidance Materials

Obs. System	Item name	Link	Description	Status & Requirements for use
Radar wind profilers	IOM report No. 79	http://www.wmo.int/pages/prog/www/IMOP/publications/IOM-79/WindProfilers.pdf	based on the COST-76 final report on radar wind profilers in Europe	this is a bit outdated and needs some modification, but still contains useful material, e.g. frequency regulations
Radar wind profilers	IOM report No. 110	http://www.wmo.int/pages/prog/www/IMOP/publications/IOM-110_JMA-Wind-Profilers/IOM-110_JMA-Wind-Profilers.pdf	Information about the JMA radar wind profiler network	an excellent example of an operational network, should be quite up-to-date
Radar wind profilers	EVALUATION OF WMO-CBS WIND PROFILER SURVEY	http://library.wmo.int/opac/index.php?lvl=notice_display&id=16117	General information on the status of radar wind profiler in the World	Already published as WIGOS Technical Report 2014-3.
Ground-based remote sensing systems	Final report of COST EG-CLIMET	http://cfa.aquila.infn.it/wiki.eg-climet.org/index.php5/Final_Report#mm-Wavelength_Radar	General information on various ground-based remote sensing systems: radar wind profilers, microwave radiometers, ceilometers, cloud radars, and lidars	Maybe too focused on European needs
Radar wind profilers	Ishihara M, et al. Characteristics and performances of the operational wind profiler network of the Japan Meteorological Agency, 2006.	https://drive.google.com/folderview?id=0BzxikZnpIaTbRFlHelh0Z2hkLTg&usp=drive_web	Description of the Japanese radar wind profiler network and impact on weather forecasting	Focused on Japan, but nice example of operational network

Radar wind profilers	IOM 104 - Lehmann V. Use of radar wind profilers in operational networks.	http://www.wmo.int/pages/prog/www/IMOP/publications/IOM-104_TECO-2010/2_Keynote_2_Lehmann.pdf	Nice description of how a wind profiler operates	
Staffed Observations/AWS	Manual of Observations (MANOBS)	http://ec.gc.ca/Publications/default.asp?lang=En&xml=1F0AEEAB-EEF5-4382-BE97-E102F8615061 (available in French and English)	Long-term observing manual geared mainly to aviation but also primary climate stations. Mainly geared to staffed observations.	Officially published and maintained for purpose but requires major revisions to be truly applicable to AWS.
AWS	MSC Maintenance Standards for RCS Autostations, MSC Installation Standards, site checklist, etc.	Internal links only (available in French and English)	Manuals and guidelines for technicians to use when inspecting, installing, and maintaining AWS sites, actually used in field	Never externally published, but are the “bread and butter” publications in use in the MSC. Copies already made available by e-mail.
AWS	Doc_11(2)_ET-AWS-7_AdvanceAWS-Third_Party_Warne_RAed.doc		Useful description of a process to evaluate the value and benefit of external (non-NHMS) data sources.	Planned to be published as a WIGOS Technical Report.