

**WORLD METEOROLOGICAL ORGANIZATION**

**THIRD MEETING OF THE AMDAR PANEL**

**GENEVA, SWITZERLAND**

**19-22 September 2000**

**FINAL REPORT**



## TABLE OF CONTENTS

- 1. OPENING OF THE MEETING**
- 2. ORGANIZATION OF THE MEETING**
  - 2.1 Adoption of the Agenda
  - 2.2 Working arrangement and other organisational matters
- 3. WORKSHOP ON SCIENCE AND TECHNOLOGY**
- 4. AMDAR IMPLEMENTATION**
  - 4.1 Reports of the Chairman of the AMDAR Panel and the Technical Co-ordinator
    - 4.1.1 Report of the Chairman of the AMDAR Panel
    - 4.1.2 Report of the AMDAR Technical Co-ordinator (TC)
  - 4.2 Action items from the previous AMDAR Panel Meeting
  - 4.3 Status Report on AMDAR projects and plans for future activities
    - 4.3.1 Improvement of Data Exchange and Quality Control
    - 4.3.2 The AMDAR Panel Middle East pilot project
    - 4.3.3 The Australian AMDAR Programme
    - 4.3.4 AMDAR Activities in Germany
    - 4.3.5 The AMDAR Panel Southern Africa pilot project
    - 4.3.6 EUMETNET-AMDAR
    - 4.3.7 New Zealand AMDAR
    - 4.3.8 The United States AMDAR Programme
    - 4.3.9 ASDAR Operational Status
    - 4.3.10 The Canadian AMDAR Programme
    - 4.3.11 Report from the interim Chairman of the ASDAR Sub-Group
- 5. FINANCIAL AND ADMINISTRATIVE MATTERS**
  - 5.1 Status of the AMDAR Trust Fund and review of related contracts
  - 5.2 Future AMDAR work programme and budget
    - 5.2.1 Future AMDAR Programme
    - 5.2.2 Itemized future programme issues
    - 5.2.3 AMDAR Budget (2001-2002)
  - 5.3 Review of established rules and procedures
  - 5.4 Election of officers
- 6. ANY OTHER BUSINESS**
- 7. DATE AND PLACE OF NEXT MEETING OF THE AMDAR PANEL**
- 8. CLOSURE OF THE SESSION**

## **LIST OF ANNEXES**

- I** List of Participants
- II** Agenda
- III** Report of the Workshop on Science and Technology
- IV** Proposed content of an AMDAR Reference Manual
- V** ASDAR sub-group future work programme
- VI** ASDAR budget 2001/2002
- VII** AMDAR budget 2001/2002
- VIII** Revised Terms of Reference for the ASDAR Sub-group

## GENERAL SUMMARY OF THE MEETING

### 1. OPENING OF THE MEETING

1.1 The Third Meeting of the Aircraft Meteorological Data Relay (AMDAR) Panel was opened at 9:30 AM, 19 September 2000 in the WMO Secretariat, Geneva, by Mr M. Edwards (South Africa), Acting Chairman of the Panel. Mr Edwards asked the Assistant Secretary-General of WMO, Dr A. S. Zaitsev, to address the meeting. In welcoming the participants, Dr Zaitsev said how pleased he was to see an increased attendance of this Panel meeting which, he believed was a reflection of continued Members' interest and support to the AMDAR programme. He welcomed the representative of ICAO and pointed out that the active support and close co-operation between the aviation community and WMO was vital for the successful implementation of the AMDAR Programme. Recognizing the important role of WMO Technical Commissions in the functioning of the Panel, in particular CAeM and CBS, Dr Zaitsev expressed his pleasure in welcoming the president of CAeM, Dr. Gordon, and the president of CBS, Mr Mildner.

1.2 Turning his attention to advances made in implementing the AMDAR programme, Dr Zaitsev noted that, in May, globally there were about 78,000 AMDAR reports per day representing nearly 40% increase since the last Panel met in 1999. A number of factors had contributed to this increase in the availability of AMDAR data globally. He said that the Panel's effective technical support to national and regional AMDAR programmes and support to major Data Monitoring Centres, contributed to improve AMDAR data quality, reduced AMDAR data transmission errors and resulted in this significant increase in the availability of AMDAR data. Dr Zaitsev invited all Panel members to encourage their administrations to contribute to the AMDAR Trust Fund to ensure that the existing technical support was not disrupted and that the positive results so far achieved by the Panel were not compromised.

1.3 Dr Zaitsev expressed the appreciation of WMO to Australia, Austria, Germany, the Netherlands, New Zealand, the United Kingdom and the United States for their financial contributions to the AMDAR Trust Fund. He thanked South Africa and Saudi Arabia for supporting the costs for running the two Regional High Priority Pilot Projects at no cost to the AMDAR Trust Fund and the U.K. Met. Office for providing office and support facilities to the AMDAR Technical Co-ordinator (TC) without charge. Furthermore, he expressed the appreciation of WMO to the United Kingdom and the United States for providing additional funds to support respectively the services of the consultant on data exchange and quality control and the costs of AMDAR data transmissions for the Southern Africa High Priority Pilot Project.

1.4 Dr Zaitsev urged the meeting to continue to focus its work on the goal of the Panel to enhance the upper-air component of the WWW Global Observing System (GOS). He said that it was vital that closer interactions with various CBS Expert Teams, and in particular the CBS Expert Team on the Redesign of the GOS, be enhanced. He informed the meeting that the Executive Council session in May 2000 urged the Panel to ensure that collected AMDAR data were made available to Members. He noted with pleasure that steps were being taken by the Panel to ensure that GTS centres transmit available AMDAR data to national meteorological centres. Dr Zaitsev invited the Panel to continue to address the issue of AMDAR data availability to meteorological centres that could promote greater interest and involvement of WMO Members for the AMDAR Programme.

1.5 Dr Zaitsev concluded his remarks by wishing the meeting every success in its deliberations, a rewarding and enjoyable stay in Geneva, and a safe and pleasant journey home. The list of participants is given in Annex I.

1.6 Mr Edwards thanked Dr Zaitsev for the Secretary-General's support to the meeting and thanked participants for attending this third Meeting of the AMDAR Panel.

1.7 Dr Gordon, President of CAeM, passed on best wishes from Mr C. Sprinkle for a successful meeting. Dr Gordon paid tribute to the significant contribution that Mr Sprinkle had made nationally and internationally through some 42 years of service until his retirement in August. In particular, the Panel owed a great deal to Mr Sprinkle for getting the AMDAR Panel off to a flying start through his involvement in establishing it, and serving as its first Chairman up to his retirement.

## **2. ORGANIZATION OF THE MEETING**

### **2.1 Adoption of the agenda**

The provisional agenda was adopted by the meeting. The agenda is shown in Annex II.

### **2.2 Working arrangements and other organisational matters**

The meeting approved working arrangements and various organisational aspects necessary for the efficient conduct of the session.

## **3. WORKSHOP ON SCIENCE AND TECHNOLOGY**

The Workshop on Science and Technology was held on 19 September 2000. The Workshop addressed a wide range of scientific and technical issues related to observation requirements and data management, AMDAR impact studies, performance specifications and development, meteorological sensors and measurements and codes matters. The Workshop provided a forum for the presentation of information on the status of various projects, results of impact experiments and some insight and direction for the development of new AMDAR programmes. Information was also given on future observing systems in the context of the composite observing system of the WMO World Weather Watch Programme. Relevant aspects of the workshop had been summarised and included in the Panel Future Work Programme that can be found under agenda item 5.2 and a report on the Workshop contained in Annex III to this report.

## **4. AMDAR IMPLEMENTATION**

### **4.1 Reports of the Chairman of the AMDAR Panel and the Technical Co-ordinator**

#### **4.1.1 *Report of the Chairman of the AMDAR Panel***

4.1.1.1 The Acting Chairman, Mr M. Edwards (South Africa) chaired the meeting and presented the report since the Chairman of the Panel Mr C. Sprinkle (United States) retired from the US National Weather Service (NWS) in August this year. Mr Edwards paid tribute to Mr Sprinkle for the able leadership that he had provided as Chairman of the AMDAR Panel since 1998 and also as President of the Commission for Aeronautical Meteorology (CAeM) from 1990 to 1999. In view of Mr Sprinkle's commendable contribution to the establishment and the work of the Panel, the meeting unanimously agreed that a letter of appreciation be sent to Mr Sprinkle, thanking him for his contribution to the work of the WMO AMDAR Panel, wishing him well and an excellent retirement.

4.1.1.2 Mr Edwards suggested that the Panel set short and long term objectives for the AMDAR programme not just to increase the volume of the aircraft reports but also to meet the requirements of the World Weather Watch (WWW) GOS. Mr Edwards said that the

Panel needed to develop an AMDAR implementation strategy, set up milestones to be reached, monitor progress being made, and when necessary, provide technical support where needed. Mr Edwards said that, although the AMDAR Panel had good exposure with the Executive Council, there was a need to market what the Panel was doing to get better exposure and financial support in the future. He said that the decision of the E-AMDAR project to earmark funds to support the AMDAR data transmission costs over data sparse areas of the world was an excellent decision that should be commended. He said that there was a need for continued contacts and discussions with major communication providers, i.e, SITA and ARINC, to reduce AMDAR data transmission costs. He concluded by saying that there was a need for the Panel to better know who AMDAR data users were in order to address their real needs.

#### **4.1.2 Report of the AMDAR Technical Co-ordinator (TC)**

4.1.2.1 The meeting noted that the TC first 12-month contract with WMO was completed on 31 March 2000. Due to insufficient financial resources, his contract was extended for only five months followed by a further contract extension of seven months until 31 March 2001 that was made possible by increased contributions to the Trust Fund later in the year.

4.1.2.2 The TC informed the meeting that sound working relationships had continued to develop with many different groups including local staff at the Met. Office, managers of AMDAR Panel projects, and leaders of national and regional AMDAR programmes. The meeting noted with appreciation that the Met. Office had continued to provide excellent support with computing and office facilities to the TC since he started his work in the UK. The meeting was grateful to the Met. Office for funding the services of a consultant to assist with the project to improve data exchange and quality control, in addition to its normal contribution to the AMDAR Trust Fund. Mr D. Painting (UK) who was hired to carry out this task on a half time basis for 18 months, started his assignment 1 April 2000.

4.1.2.3 The meeting noted with satisfaction that, as decided by the previous Panel meeting, a quarterly report on AMDAR activities started being published in the first quarter of 2000. Comments on the usefulness, style, and content of these reports from all interested parties were welcome. As requested by the previous Panel meeting, the TC also assumed responsibility for the technical aspects of the ASDAR operational programme. In this regard, the meeting noted with appreciation the substantial support provided by the Met. Office ASDAR Centre with system and engineering management and data quality monitoring. Although the development of the AMDAR Web site had commenced and remained a high priority, efforts were still needed to produce tangible results. When completed, the Web site would constitute a necessary element for providing information and feedback to members and interested groups and an essential component for data quality monitoring and reporting. In this regard, it was suggested that the Panel consider funding the services of a consultant to develop the AMDAR Web site.

4.1.2.4 The TC highlighted the most significant areas that required and obtained his assistance. These included, among others, implementation of the Southern Africa high priority project and the planning for the Middle East project, support to the E-AMDAR programme, assistance to the Canadian project, development of an AMDAR programme in the Caribbean, Gulf of Mexico and Central America Region. Continued support was also given to the US, New Zealand and Australian national AMDAR Programmes. The TC maintained close working relationships with major monitoring centres to improve data quality, direct involvement with avionics and sensor manufacturers as well as airlines. The TC assisted with the reduction of the number of poor quality or duplicated AMDAR observations on the GTS. He reviewed the availability, exchange and quality of ICAO ADS meteorological reports and presented a report at the ICAO METLINK Study Group meeting held in Washington DC, in February.

4.1.2.5 Since the second meeting of the Panel, the TC had attended 21 meetings most of these held in the UK with, among others, Met. Office staff, Matra Marconi, E-AMDAR Manager, ECMWF, and the ASDAR sub-group. Other meetings the TC attended were held in the USA, Canada, France, Belgium, the Netherlands and Switzerland. The TC attended 3 important WMO meetings particularly relevant to AMDAR programme. These included the Second Workshop on the Impacts of Various Observing Systems on NWP held in Toulouse (France) in March, the Coordination Group on the COSNA in August, and the CBS Implementation Coordination Team on the GOS in September.

4.1.2.6 The Panel recognised the excellent technical support provided by the AMDAR TC to all those AMDAR Stakeholders who needed his assistance and the excellent initiatives that he had taken to progress the AMDAR Programme on the national, regional and global scales. The Panel expressed its appreciation to the TC for his work.

## **4.2 Action items from the previous AMDAR Panel Meeting**

The meeting reviewed action items stemming from the previous AMDAR Panel meeting in 1999 listed in paragraph 9.3 of its report as well as action items compiled by the Secretariat from the report. The meeting noted with satisfaction that most of the items had been fully addressed while few others were on-going activities that the Panel would continue to address.

## **4.3 Status Report on AMDAR projects and plans for future activities**

### **4.3.1 *Improvement of Data Exchange and Quality Control***

4.3.1.1 The meeting noted with satisfaction the appointment of Mr D. Painting (UK), in April 2000 as a consultant to assist with the project on AMDAR data exchange and quality control. The meeting noted with interest that the development of an AMDAR reference manual was currently underway. This manual was expected to contain detailed measurement procedures, sources and impacts of errors on observations, information on various operational codes, data specification and standard downlink format. The proposed content is detailed in Annex IV. The meeting was informed that advice had been provided to several global monitoring centres to improve monitoring and reporting capabilities and that the unintentional insertion on the GTS of old AMDAR data by one satellite operator had been corrected following assistance from several centres. A number of large errors in wind and temperature observations had been identified by monitoring centres and traced for corrective action through the assistance of regional and technical focal points. In this regard, the meeting welcomed the good working relationships that had been established with monitoring centres at NCEP, ECMWF and the Met. Office, and the visits to these centres by the TC that produced mutually beneficial results. The meeting noted with satisfaction the strong links that had been established with NCEP, the Canadian Meteorological Centre (CMC), Australia's National Meteorological Operational Centre (NMOC), the NOAA Forecast System Laboratory (FSL) and the US Navy that made extensive use of AMDAR data in operational forecasting models. The meeting noted with interest that recently, the Royal Netherlands Meteorological Institute (KNMI) had been designated as the E-AMDAR data quality evaluation centre with daily reports provided automatically from all operational European AMDAR and ASDAR fitted aircraft. The meeting was informed that all these centres were aware that a global AMDAR focal point was available through the TC to whom matters could be raised concerning the exchange and quality of AMDAR observations.

4.3.1.2 With regard to quality monitoring and reporting structure, the meeting noted the general plan that consisted of four main components to monitor the quality of AMDAR observations and to report the results. The first included the global centres such as NCEP

and other major centres such as ECMWF, the Met. Office, KNMI, CMC, Australia's NMOC and the US Navy. The second component comprised regional centres such as KNMI for Europe, the Australian Bureau of Meteorology for Oceania, the South African Weather Bureau for Southern Africa, and NCEP for the US. The third component related the real time quality control of observations to identify and reject poor quality observations and the fourth component consisted of links between the various monitoring centres and the national focal points that had direct links to participating airlines.

4.3.1.3 The role of various monitoring centres including those monitoring AMDAR data was discussed. It was pointed out that WMO designated monitoring centres provided essentially statistics and periodic reports whereas AMDAR monitoring centres worked on a real or near real time basis, namely before and after the AMDAR data were transmitted to the ground as well as on non real time basis. It was suggested AMDAR data quality control should be formalised and that all AMDAR monitoring results should be put on the AMDAR Web site for easy access when fully established.

4.3.1.4 The meeting was informed that a focus for data exchange was on the large number of duplicate observations being placed on the GTS in different message formats. Other matters related to data exchange were several occurrences of incorrectly formatted messages which arose out of new systems coming on line with errors, or from existing systems with changes in coding software following an upgrade. The meeting noted with satisfaction that the responses and cooperation by national and regional AMDAR focal points and airlines had been particularly encouraging. The meeting noted the concern relating to the quality of raw wind data from B-777 aircraft, some of the ADS meteorological reports distributed to the two World Area Forecast Centres (WAFCs) and other regional and national forecasting centres. The meeting was pleased however that the distribution of these bad quality ADS meteorological reports had been discontinued through the cooperation of the UK NATS, NAV Canada, ARINC, CMC and the Met. Office. It was pointed out that the biggest issue to be addressed in coming months related to a CBS proposal to commence phasing out all alphanumeric codes from 2005. This move was expected to have considerable repercussions in some of the data sparse areas of the world that need AMDAR observations and could have serious impact on the internal distribution of AMDAR data provided by external airlines to local weather forecasting offices. Careful and serious consideration of the repercussions of the CBS proposal were needed before the implementation of the proposal. Other issues of concern related the inadequacies of existing alphanumeric codes to cope with new sensor developments and requirements for observations, and the need to continue with manual air reports in areas adequately covered by automated aircraft observations.

4.3.1.5 The meeting was informed that the revised FM42 AMDAR code, that included the day of the month with each observation, was slowly being implemented by meteorological switching centres. It was indicated that while this was a definite improvement over the previous version, there were still a number of areas that needed upgrading to allow users to cope with these high-resolution observations. Further changes to the code were needed to improve the time and position resolutions to avoid the current situation where different observations were being reported with the same time and position. The reporting of turbulence with Eddy Dissipation Rate likely to become available soon also needed to be addressed. Alternative ways of reporting water vapour may need to be considered. It was indicated that techniques were available to automatically sense and report icing and that research and development were under way to develop more sophisticated icing and super cooled water sensors.

4.3.1.6 The attention of the meeting was drawn to telecommunication aspects of AMDAR data as there continued to be a wide range, and in some cases, very high charging rates levied for the transmission of AMDAR observations. The meeting was informed about initial contacts and exploratory discussions held with the two main communications providers, SITA

and ARINC, with a view to establishing a universal system for AMDAR operators. The meeting noted with interest that the system would allow for the direct transmission of data to the participating national meteorological centres instead of getting the AMDAR data through the airlines. The new system would also establish a preferred and acceptable maximum charging rate for downlinking AMDAR data. The meeting was pleased to note that one company had already concluded that the proposal was technically possible and commercially of interest to explore further. It was indicated that additional meetings with the communications providers were planned in the next few months. The meeting noted with interest that several data compression techniques would be developed that may be able to provide a significant increase in cost effectiveness. The meeting was pleased to note that these techniques had been included in the latest KNMI/KLM AAA software specification.

4.3.1.7 A number of reports on the current status and future directions of the WMO AMDAR programme, and in particular, the quality and extent of AMDAR observations had been presented at meetings of CBS Expert Teams on the GOS and the Coordination Group for the Composite Observing System for the North Atlantic (CGC). It was suggested that these groups were likely to provide the most informative guidance material to help the Panel determine its goals for the future.

#### **4.3.2 *The AMDAR Panel Middle East pilot project***

4.3.2.1 The Panel recalled that the Meteorological and Environmental Protection Agency (MEPA) of Saudi Arabia, in cooperation with Saudi Arabian Airlines (SAUDIA), had kindly offered to take the lead for the implementation of the high priority Middle East pilot project. The TC provided advice and documentation to assist MEPA in planning and developing the project.

4.3.2.2 The meeting noted with satisfaction that agreement had been reached between MEPA and SAUDIA to proceed with the development of a trial system on one SAUDIA MD90 aircraft. Discussions with SITA, the communications provider, had led to the development of an appropriate communication infrastructure. The Panel expressed its appreciation to KNMI for having provided to MEPA a copy of the KLM AAA AMDAR processing software free of charge. The meeting noted that the software was being prepared to suit SAUDIA aircraft configuration before installation and testing and that a thorough test of the software on one MD90 aircraft and the overall AMDAR system would be made before proceeding to its installation across the fleet.

4.3.2.3 The Panel was informed that MEPA was considering receiving AMDAR data via the SITA network, conducting basic quality control checks, and then distributing the data for local use and on the GTS for international exchange. MEPA was further considering whether this arrangement would be expanded eventually to become the regional data processing and communication systems centre when airlines of other countries join the project. With regard to independently assessing the quality of aircraft observations, the meeting was informed that MEPA was planning to use a direct inter-comparison method with routine operational radiosonde soundings at local airports. The meeting noted with interest that this method had proven very successful in Australia but that the main problem would be the small number of coincidental flights achieved with radiosonde soundings. The meeting noted with appreciation the offer by E-AMDAR to investigate the feasibility of conducting initial data quality monitoring of data produced by aircraft operating in the area covered by the E-AMDAR monitoring system.

4.3.2.4 The meeting was pleased to note that two Middle East airlines, Emirates and Egypt Air, had expressed interest in joining the pilot project once the initial SAUDIA tests had been successfully completed. It was indicated that the three airlines would have an extensive coverage throughout the Middle East and beyond. However, the associated software installed on the hardware fitted to both Emirates and Egypt Air aircraft had only a very basic

meteorological reporting capability. An avionics manufacturer was negotiating with E-AMDAR to commence the development of an AMDAR software package. The meeting was informed that five participating European fleets, namely KLM, BA, Lufthansa, SAS and Air France, had some AMDAR system equipped aircraft flying to the Middle East. It was indicated that the main type of BA aircraft flying to the region was B777 aircraft that had no such software available. However the meeting noted with interest that arrangements were being made with Honeywell to agree on an appropriate specification and to develop the relevant software for these aircraft within about a year.

4.3.2.5 The meeting noted with satisfaction that MEPA and SAUDIA were focussing on the immediate task of ensuring that, by the end of this year, the software was correctly modified and installed, and that trials on one aircraft were successful. National meteorological services and airlines in the region would be encouraged to participate in the project. The meeting was informed that the TC would be asked to provide field assistance for planning the operational phase of the project and the Panel may consider funding some transmission costs for AMDAR data to be provided by foreign carriers during the impact assessment phase of the project.

4.3.2.6 The meeting was pleased to note the substantial progress made in getting the implementation of the Middle East pilot project started. It was suggested that perhaps milestones should be established to facilitate the monitoring of advances made in implementing this project.

### **4.3.3 *The Australian AMDAR Programme***

4.3.3.1 The Panel was informed that the number of Australian aircraft routinely reporting AMDAR data had not changed significantly since the previous Panel meeting in 1999 with an average of 40 to 45 aircraft reporting each month. Ansett and Qantas had remained the only airlines participating in the Australian AMDAR programme. The meeting noted that the number of AMDAR observations received had also remained fairly constant over the period at about 160,000 per month.

4.3.3.2 The meeting recalled that, at its second meeting in 1999, Australia indicated that quality monitoring was limited to comparisons with radiosonde data within specified space and time windows. The Panel noted with satisfaction that, since October 1999, inter-aircraft comparisons (for ascent and descent data only) were being performed providing a much more powerful means for the identification of aircraft that were producing erroneous data. The value of performing such comparisons was in the increased number of observation pairs available that made the data statistically more significant. The Panel noted with interest that near real-time comparisons with global NWP model data had commenced. These comparisons were available with information updated every 3 minutes as new AMDAR data arrived after first being checked for message transmission corruption.

4.3.3.3 With regard to AMDAR data impacts, the meeting was informed that, in the Australian context, AMDAR data had been useful for a number of areas. These included the development of climatological records of temperature inversions for air quality and aviation applications, aircraft accident investigation, forecasting of strong winds, turbulence, convection, sea-breeze onset, fog, validation of high resolution numerical models, interpretation of Doppler radar velocity imagery, turbulence validation and tropical cyclone forecasting. With regard to convection forecasting, the meeting noted with interest that AMDAR data was able to resolve the boundary layer wind profile that was critical in triggering the transition of an ordinary thunderstorm to a severe hailstorm that produced \$A1.7 billion of insurance claims over eastern Sydney in April 1999.

4.3.3.4 The previous Panel meeting noted with interest that Australia had developed an aerosonde robotic aircraft to provide economical meteorological and environmental observations with considerable flexibility of operation. The meeting was pleased to note that, during early 2000, further trials were commissioned using the aerosonde and that AMDAR data was produced and relayed in real-time to Bureau of Meteorology headquarters where it was subsequently available for operational use. The meeting was reminded that, in order to use AMDAR data for weather forecasting, it was necessary not only to ingest the data into numerical models but also to have interactive displays from which a forecaster could make inferences. In this connection, types of displays used by the Bureau of Meteorology workstations were shown to the meeting.

4.3.3.5 The meeting was informed that current and future issues to be addressed by the Bureau of Meteorology included the increase in the number of AMDAR equipped aircraft and AMDAR data impact studies. In this regard, pricing arrangements with the airlines participating in the Australian AMDAR programme were expected to come under review this year. The meeting was further informed that the Bureau of Meteorology had no formal contracts with the airlines for supply of AMDAR data but informal cost-sharing arrangements. It was indicated that it was difficult to extend the programme markedly until humidity information was introduced as part of the AMDAR data stream. However, once that occurred, substantial cost savings could be realisable, through a possible reduction in the number of radiosondes released that could be diverted to the AMDAR programme. In this regard, it was indicated that Australia would like to see humidity sensors become operational. Finally, the meeting was informed that a proposal would be made to carry out impact studies on tropical cyclones to assess the impact of AMDAR data on track forecast accuracy from numerical models and on the performance of the Australian global model.

#### **4.3.4 *AMDAR Activities in Germany***

4.3.4.1 The Panel recalled that a contract had been set-up between Deutscher Wetterdienst (DWD) and Lufthansa (LH) Aeronautical Services (LIDO) to deliver AMDAR reports. Following a modification of the Allied Signal ACARS avionics equipment software to ARINC 620-3 specifications, AMDAR data from 12 selected Airbus aircraft had been reported beginning in November 1999. As a result, in addition to measurements at cruise level, ascent/descent measurements were made possible with higher resolution near the ground. Data were transmitted via VHF through the SITA network to the LIDO computing centre, converted to BUFR coded messages, delivered to DWD and then relayed to the GTS following quality control procedures. The meeting noted with interest that a simple trigger module enabled to activate AMDAR reporting and to set software parameters. The meeting noted with satisfaction that 36 Airbus aircraft flying national and European routes had been activated producing approximately 15,000 observations per day.

4.3.4.2 The meeting was informed that, in the extension phase of the project, the contract between DWD and LIDO included the development of a data optimisation system for the LH aircraft. During 2000 and 2001 a trigger software would be installed to allow the selection of aircraft to be activated for data transmission for pre-selected airports and routes on the basis of flight planning data. The trigger software would also allow to change parameters of the onboard software and to alter data requirements and parameters of the trigger software by remote control.

4.3.4.3 The meeting noted with interest that DWD had been selected as the responsible member for the E-AMDAR Data Optimisation System and that the solution to activate individual LH aircraft and the mechanism to control where and when AMDAR data would be generated should be expanded to all European AMDAR aircraft. An implementation strategy for the optimisation system had been developed that would allow more efficient use of the

available AMDAR fleet in Europe by avoiding unnecessary over-observing at main hub airports and allowing more desirable routes to be targeted.

#### **4.3.5 *The AMDAR Panel Southern Africa pilot project***

4.3.5.1 The meeting was informed about activities so far carried out and those planned to complete the implementation of the high priority Southern Africa AMDAR pilot project. The meeting noted with satisfaction that, by October 1999, detailed planning for the implementation of the project had been completed and that meteorological services of the Southern African region had been invited to participate. Most airlines operating into the region also had been contacted inviting their involvement. The meeting was further informed that Air Mauritius, B.A., KLM, and South African Airways (SAA) indicated that they could participate by contributing observations during the project period. The meeting noted with satisfaction that the AAA software was kindly provided by KNMI to SAA for installation on board SAA 747-400 aircraft, and that, as a result, the first AMDAR data was received during a SAA flight Johannesburg/Miami/Johannesburg on 22 February 2000. The AAA software package had been loaded on to other 747-400s.

4.3.5.2 Other important activities included making arrangements for funding the costs of AMDAR data transmissions from SAA aircraft and plans for the evaluation of the project by the Research Department of the South African Weather Bureau (SAWB). The meeting was informed that temperature and wind profiles from AMDAR data could be displayed and that negotiations were conducted with SAA to install AMDAR software on SAA's new domestic regional fleet of 21 B737-800 aircraft. The Panel was informed that the project started being implemented 1 September 2000 and would last until February 2001. During that period 14 to 18 flights per day were expected to provide AMDAR data over Southern Africa and the adjoining South Atlantic and South-western Indian Oceans. The meeting welcomed the commencement of AMDAR data from an Air Namibia B-747-400 of an operational AMDAR Programme. In addition to AMDAR data provided by the main participating airlines, Air Namibia and Qantas were also expected to provide AMDAR data to the project but on an irregular basis. The meeting was pleased to note that collected AMDAR data would be placed on the GTS for general use and that would include certain forecasting offices in the region. The SAWB would evaluate the impact of the collected AMDAR and ASDAR data on the quality of products generated from its regional NWP model.

4.3.5.3 The meeting expressed its satisfaction for the great efforts that South Africa was deploying to implement this AMDAR pilot project and for taking the lead in the application of AMDAR data. The meeting was informed that the next step would be to implement a self-sufficient Southern Africa AMDAR Programme starting with South Africa and Namibia and hopefully with other countries of the regions joining the programme later.

4.3.5.4 A suggestion was made that there could be benefit for South Africa and Saudi Arabia to mutually agree to share their respective AMDAR data through SAA and SAUDIA flights to their respective countries. It was pointed out however that AMDAR data collected by SAA were limited to areas south of the Equator because of transmission costs. However, since the AMDAR data collected for the Southern Africa project were being disseminated through the GTS, they were, in principle, available to other users including those in Saudi Arabia.

4.3.5.5 AMDAR data transmission from all aircraft commenced before the trial date to ensure that the data was of an acceptable standard of quality before its distribution through the GTS and to users. The meeting noted with interest that major monitoring centres including the US NCEP, ECMWF, and the Met. Office had also been informed of the trial so that several independent assessments of AMDAR data quality could be obtained. Furthermore, as requested by the WMO CGC Workshop on the Impact of Various Observing

Systems on NWP, additional relevant groups had been notified of the trial so that they would be able to conduct their own special impact studies.

4.3.5.6 The meeting welcomed the recognition of the importance of the AMDAR Programme by many airlines. The meeting noted that, in principle, airlines equipped with the proper communication systems had no problem to provide AMDAR data to users provided that funds were made available to pay the cost for AMDAR data transmission. It was suggested that the AMDAR Panel investigate possible options for funding the AMDAR data transmission cost for the Southern Africa pilot project.

#### **4.3.6 EUMETNET-AMDAR**

4.3.6.1 Turning its attention to the EUMETNET AMDAR (E-AMDAR) Programme, the meeting was informed about progress made on operational co-ordination, technical development and airline recruitment. With regard to operational co-ordination, the meeting noted with interest that probably the most significant development had been the successful activation of 36 Lufthansa aircraft since November 1999. The current status of the various AMDAR fleet showed that, out of the potential 456 aircraft, 109 were operational. The meeting noted with satisfaction the increase from approximately 60 to 100 in the number of operational E-AMDAR aircraft reporting since January 2000. The meeting was further informed that 39 additional aircraft were scheduled to be activated in the near future and that, by the end of this year, 147 aircraft would be operational.

4.3.6.2 It was pointed out that, to effectively co-ordinate operational activities and generate sufficient funding for data procurement, a so called Fleet Configuration Plan together with an 'Operational Funding Memorandum of Understanding' were implemented 1<sup>st</sup> June 2000 that formed the basis for the operational phase of the E-AMDAR programme. Typically E-AMDAR aircraft generated 24,000 observations including 650 profiles from about 110 airports per day. The meeting welcomed the planned activation of 25 BA B-747 aircraft that would significantly increase the quantity of AMDAR observations from global data sparse areas with a particular focus on Canada, South America, Mid and South Atlantic and South Africa. The meeting noted with satisfaction that additional SAS and Lufthansa aircraft would further boost the coverage of AMDAR system equipped aircraft over Europe.

4.3.6.3 The second main activity of the E-AMDAR Programme, namely technical development and airline recruitment, highlighted the development of a modern and flexible infrastructure and the recruitment of additional fleets/airlines and the further development of current systems to achieve better value for money. Plans adopted for the further development of current systems to provide better value for money would require further development of three distinct software applications. These included standard Honeywell software written to ARINC 620, a new version of the current Teledyne compatible software that would deliver 40-50% savings in data communication costs, and SFIM compatible software that would ultimately be available to a large number of aircraft not currently equipped with AMDAR capability. The meeting was informed that efforts were being made to recruit additional airlines to supplement the network where the current fleet could not provide adequate coverage, and that priority would be given to increased reporting between the hours 22Z-06Z and improved data coverage over poorly covered regions. In this connection, the meeting was informed that negotiations were continuing with Iberia, Air Portugal, Finnair and DHL, to augment the number of aircraft reports involved in the E-AMDAR programme. The meeting was informed that optimisation was the most challenging element of E-AMDAR and that DWD had been tasked to address this complex issue.

4.3.6.4 A question was posed about the future of the E-AMDAR Programme after 2001 when the current pilot project would be completed. It was indicated that all would depend on the

level of interest of EUMETNET members and also on the availability of funds to support the continuation of the programme.

#### **4.3.7 New Zealand AMDAR**

4.3.7.1 The meeting was given an update on the status of the Meteorological Service of New Zealand Limited (MetService) AMDAR programme. As reported at the previous meeting, the Panel recalled that, under a formal agreement with Air New Zealand, AMDAR reports from selected Air NZ B737-300 series aircraft flying primarily trans-Tasman between New Zealand and Australia were delivered to MetService and relayed to the GTS. The meeting further recalled that a trigger logic software had been specified to initiate reports within a geographical box 155°E to 180° and 25°S to 50°S, at pressure levels nominally the same as reported in FM 42-XI AMDAR code. A compressed version of this code was used and six AMDAR reports were combined into one message for transmission by VHF radio to the nearest SITA remote ground station. The message header enabled the reports to be routed from the SITA hub in Singapore to MetService Wellington on an AFTN circuit. Following MetService quality control procedures, NZ AMDAR reports were disseminated through the GTS. The Panel noted with satisfaction that, currently, some 13,500 AMDAR observations per month were transmitted on the GTS from this source.

4.3.7.2 The meeting noted with interest that Air New Zealand was bringing additional B737-300 aircraft into service on domestic routes within New Zealand and that discussions were underway to install AMDAR software and obtain additional observations from one or more of these aircraft. The meeting recalled that MetService had a cost-sharing arrangement with the Australian Bureau of Meteorology for Qantas AMDAR generated data in the box Equator to 50°S and longitude 160°E through 180° to 160°W. The meeting noted with appreciation that the New Zealand contribution enabled about 10,000 AMDAR observations per month to be made available to the international community via the GTS.

4.3.7.3 Automated Dependent Surveillance (ADS) observations from the Auckland Oceanic FIR were being received from Airways Corporation of New Zealand since around December 1999, during the testing of ICAO CNS/ATM. The ADS reports were being distributed in AIREP code as received. It was pointed out however that AIREP was not the ideal code for use because it implied different error characteristics of the data. Currently around 6,000 reports per month were transmitted on the GTS from this source. The meeting noted with pleasure that these ADS reports from New Zealand were the first in the world to be routinely supplied to the two WAFCs, London and Washington.

#### **4.3.8 The United States AMDAR Programme**

4.3.8.1 The meeting was informed that the US was receiving currently about 70,000 automated aircraft reports per day. Over one half of these reports were obtained at level flights. However an increasing number of reports were being obtained during ascent and descent phases of flights. The data were distributed via the GTS in WMO standard BUFR format. The meeting noted with interest that the AMDAR system would be upgraded later this year to include water vapour data from more than 20 aircraft and EDR turbulence data from about 70 aircraft. In addition flight level and ascent descent data would be obtained from Federal Express freight aircraft primarily at night. A calibration/validation experiment was also scheduled for May 2001 to assess the accuracy and statistical characteristics of the new humidity data.

4.3.8.2 The NWS had submitted an initiative to substantially enhance its current AMDAR programme beginning in late 2001. The meeting was informed that new airlines would be added to the programme, including regional carriers. The enhancement would also include the reimbursement to the airlines of the data communication costs, the installation of a substantial

number of WVSS-II humidity sensors and the establishment of a real-time quality control capability before data were distributed via the GTS. Two other activities would also begin, namely, a NWS plan to facilitate a study of the feasibility of obtaining AMDAR data over the Caribbean and Central America, and a NASA programme to acquire automated low-level wind, temperature and moisture data from general aviation aircraft as part of an effort to improve flight safety.

#### **4.3.9 ASDAR Operational Status**

4.3.9.1 The meeting was informed about significant changes that had occurred to the management and operations of the ASDAR programme since the previous meeting of the AMDAR Panel in 1999. As agreed by the second Panel meeting, the responsibility for the operational programme was transferred to the AMDAR Panel and an ASDAR Sub-Group. (ASG) was established under the interim chairman, Mr. A. T. F. Grooters (the Netherlands). As requested by the Panel, the balance of funds held in the ASDAR Trust Fund was transferred to the AMDAR Trust Fund on 31 December 1999 under the responsibility of the AMDAR Panel.

4.3.9.2 The meeting noted that the ASDAR programme peaked early in 1999 with 21 operational systems. The large contribution by BA to the pioneering WMO ASDAR programme over the past 10 years had been most appreciated. The meeting noted however a substantial reduction in the size of the ASDAR programme since the previous Panel meeting. Seven ASDAR units on board BA B747 aircraft were decommissioned by June 2000 in addition to the three units on BA DC10s removed between October 1998 and March 1999. The 10 decommissioned units would be checked and made available as spares to support the 12 remaining ASDAR equipped aircraft.

4.3.9.3 The meeting noted that the number of ASDAR reports per day received from any one unit could be as high as 267, however on the average the number was about 110 reports. The average number of units reporting per day was 9.9 for April to June 2000 while the typical coverage was predominately within or between Europe and North America. Some aircraft carrying ASDAR unit were also flying in Asia, Africa, Australia and South America.

4.3.9.4 It was pointed out that very old ASDAR and AMDAR observations with current date stamp that found their way on the GTS resulted in considerable data assimilation difficulties and caused concern at major weather centres. In addition, large temperature biases of between two and four degrees were shown to have occurred after scheduled major maintenance of 2 aircraft of Aerolineas and one SAUDIA aircraft.

4.3.9.5 The meeting noted with interest that although the ASDAR programme was in decline, there were several ASDAR units which were seen to have a priority and should be kept operating for a few more years as they would still form the main source of aircraft observations in critical areas. These included units on aircraft from Air Mauritius (2), KLM (3), Aerolineas (2) and SAA (2). SAA units as well as the 2 ASDAR units operated by SAUDIA would eventually be replaced by AMDAR systems. ASDAR systems were favourably cost effective to operate compared with equivalent AMDAR systems because the airlines did not charge carriage costs and the communications in all areas including the data sparse areas of the world were effectively free.

4.3.9.6 The ASDAR Programme priorities were reviewed by the meeting in light of changes during the past year and the continued support from the ASDAR Centre operated by the Met. Office. A proposal was made to renew the routine maintenance contract with Astrium Limited (formally Matra Marconi Space UK Limited) for a further 24 months from 1 January 2001 to be reviewed before the end of the first year. This contract was intended to provide ongoing routine liaison and maintenance services with participating carriers to

support the remaining operational ASDAR units. The decision of the Panel regarding this proposal can be found under agenda item 5.2, Future AMDAR work programme and budget.

#### **4.3.10 The Canadian AMDAR Programme**

4.3.10.1 The meeting was informed that the Meteorological Service of Environment Canada commissioned a study in December 1999 to build a business case for developing and implementing an AMDAR System in Canada. The study examined the requirements for an AMDAR system, its associated costs and its potential benefits followed by a workshop held in March 2000 on the results of the study. Documents on the Canadian AMDAR Programme submitted to this meeting included the Canadian AMDAR Business Case study, the Terms of reference of the Canadian AMDAR Programme Implementation Team, the Implementation Plan as well as the AMDAR air/ground software specifications.

4.3.10.2 The meeting noted with interest that the AMDAR Business Case study and Workshop laid down the foundation for detailed planning and implementation of a national Canadian AMDAR Programme. The Canadian AMDAR Implementation Team (CAPIT) was formed in April 2000 consisting of representatives from the Meteorological Service of Canada, national (Air Canada) and regional airlines (Air Nova), NAV Canada, and experts including the WMO AMDAR TC. The meeting noted that CAPIT should operate over a 6-year period, i.e. from FY 00/01 to FY 05/06, when the Canadian AMDAR Programme was expected to be fully implemented.

4.3.10.3 The meeting was informed that although Air Canada would not upgrade its current aircraft to AMDAR capacity unless major upgrading of the avionics was required, all new aircraft were being specified to include AMDAR. The meeting noted with interest that Air Canada planned to purchase 100 to 110 new aircraft in the next 10 years, a significant proportion of which would be AMDAR fitted. It was indicated that, by 2010, 50% of Air Canada's fleet could be AMDAR equipped and most of the fleet (70 to 80% of this) would be in domestic service and that the first new AMDAR fitted aircraft could possibly be in service by the middle of 2001

4.3.10.4 Interest was shown for ACARS data programming on Air Nova DASH-8s recently approved by ARINC and the FAA, and for the final testing on the datalink held on 10 August 2000. AMDAR air/ground software specifications had been recently completed by CAPIT and passed to Universal Avionics software developers for their review before work on developing the AMDAR capacity on the Air Nova's DASH8s could begin. These Canadian specifications were based on the ARINC Specification 620-4 and the EUMETNET AMDAR – AAA AMDAR specifications, Version 3. The first AMDAR reports from 26 AIR Nova's DASH8s were expected to be available this winter. Regional carriers were purchasing new aircraft that, if equipped with a data-link system, would be candidates for AMDAR. Talks would proceed with other regional carriers of the world, including those from the US where 3 regional carriers had ACARS capability.

4.3.10.5 The meeting recalled that a project to report the US data on an operational Tephigram programme was to be completed by the end of March 2000. An evaluation of the Tephigram portion of the new ACARS programme was made in March-April 2000. The evaluation concluded that most ACARS Tephigrams in the new format were in very good agreement with the data from the FSL website and that they were reasonably close to the soundings nearby.

4.3.10.6 The meeting noted with satisfaction that the Canadian Programme had benefited from the international AMDAR community, especially from the AMDAR Panel and its TC, from NAOS and the E-AMDAR Programme and its Manager. It was pointed out that,

although the Canadian AMDAR Programme was being developed primarily to meet national requirements, its broader international obligations under the WMO World Weather Watch Programme were recognised. A useful Canadian contribution to the international meteorological community would likely be automated aircraft observations from the Pacific Ocean and Arctic regions. The meeting welcomed that this had been recognised in the Canadian AMDAR software specifications.

4.3.10.7 A most interesting aspect of the Canadian AMDAR programme was that, regional airlines would be involved using smaller aircraft (Dash 8), in addition to the conventional jets of the national carrier. Dedicated software was being developed with the potential of being made available to regional airlines in other countries operating similarly configured aircraft. Observations from the regional aircraft would be obtained from remote parts of Canada and from a lower part of the atmosphere. Results provided at the WMO/CGC observing system impact workshop held in March 2000 showed that the Canadian AMDAR observations would have significant short term impact on NWP forecasts for the USA, the North Atlantic and down stream as far as Eastern Europe.

4.3.10.8 The Canadian Meteorological Centre (CMC) had evaluated the use of available AMDAR data (wind data only) in their forecast models and found that there had been benefits in forecasting winds in regions where there were AMDAR data (e.g., the United States). The CMC had continued developments associated with the assimilation of AMDAR data. AMDAR data assimilation experiments were conducted by combining AMDAR data and those using satellite radiances obtained from TOVS/ATOVS instruments on board NOAA satellites. Results were characterized as very impressive, with a very large reduction (when tested against radiosonde data) of short term forecast error in winds at the jet level. Based on these results, it was decided to proceed toward the operational implementation of TOVS/ATOVS and AMDAR data in the CMC global data assimilation system.

4.3.10.9 The meeting noted with interest upcoming developments in the Canadian AMDAR programme. In addition to the use of only AMDAR wind data so far, AMDAR temperature data would also be used. At the same time, CMC would replace its usage of geopotential data from radiosondes by the significant level temperature data from radiosondes. This would be accompanied by a major revision of the CMC quality control algorithms that were based on a previous version of CMC's Optimum Interpolation data assimilation algorithm. The new quality control scheme would combine a test against a background field (a 6-hour forecast) and a variational quality control algorithm within the 3D-Var. This could represent a significant advance in quality control and help better identify the poorer quality data that sometimes had negative impacts on the data assimilation systems.

4.3.10.10 In the coming months, CMC would improve its usage of the AMDAR data, both in the vertical and horizontal with better data selection algorithms and improved the usage of cloud motion winds from geostationary satellites (SATOBS data). Other activities planned included the performance of data impact studies using AMDAR data from Canadian carriers, the operational monitoring of the quality of the Canadian AMDAR data and feedback of any problem to the data producers. Significant impacts were expected when Canadian AMDAR data would become available, particularly over the data sparse areas of Canada and adjacent oceans.

#### **4.3.11 *Report from the interim Chairman of the ASDAR Sub-Group***

4.3.11.1 The ASDAR Sub-Group (Germany, the Netherlands, Saudi Arabia, United Kingdom and the United States) met on 18 September 2000 at WMO, Geneva to review the operational status of the ASDAR programme, the status of the ASDAR line in the AMDAR Trust Fund and to make recommendations to the AMDAR Panel on the future of the ASDAR operational

programme. The meeting elected Mr J. Dibbern (Germany) to serve as the Chairman of the ASDAR Sub-Group until the next meeting of the Sub-Group.

4.3.11.2 The meeting noted that action had been taken by the Secretariat regarding the transfer of the ASDAR Trust Fund in a separate budget line under the AMDAR Trust Fund effective 1 January 2000. The meeting was informed about the renewal of the routine maintenance contract with MATRA Marconi Space UK Ltd. for a further 12 months until 31 December 2000. The meeting noted with satisfaction that the remaining 12 ASDAR units were continuing to provide data from data sparse areas including South America, the South Atlantic, Africa, the Indian Ocean and the Middle East. The meeting expressed its appreciation to the UK Met. Office for the continued provision of services in system performance monitoring, operational support and maintenance through the ASDAR Centre.

4.3.11.3 The meeting reviewed the financial statement provided by the Secretariat and noted with satisfaction that the total available funds were £137.1k as at 1 January 2000. The total of the unliquidated obligations at 31 August amounted to £81.2K. An amount of £55.9K remained available to support ASDAR operations. With regard to the ASDAR operational programme budget, the main thrust of the future bi-annual programme was the continued support of the ASDAR operational activities. The meeting made a number of recommendations that were included in the report under the AMDAR Panel future work programme (Agenda item 5.2). The meeting agreed on its future work programme as given in Annex V to the Report and on an annual budget submitted to the full meeting of the Panel as given in Annex VI to the Report.

4.3.11.4 The meeting decided to have its next formal meeting in conjunction with the 5<sup>th</sup> Meeting of the AMDAR Panel in 2002. Also there will be a small working session in conjunction with the 4<sup>th</sup> AMDAR Panel meeting in 2001 to review the operational status of the ASDAR Programme.

## **5. FINANCIAL AND ADMINISTRATIVE MATTERS**

### **5.1 Status of the AMDAR Trust Fund and review of related contracts**

5.1.1 The meeting noted with satisfaction that as of 31 July 2000, thanks to the financial contributions received since 1 January 2000 from Australia, Austria, Germany, the Netherlands, New Zealand, the United Kingdom and the United States, the AMDAR Trust Fund income amounted to SFr 245,027 in addition to the advanced US contribution for 2000 that was part of the amount of SFr 258,717 brought forward 1 January 2000. As of 31 July 2000, the balance of the AMDAR Trust Fund without interest amounted to SFr 351,662. In line with the wishes of the Panel, an ASDAR budget line was created within the AMDAR Trust Fund and as of 31 July 2000, the ASDAR budget line showed a balance of £ 193,744 in cash when assets and liabilities were included. The Swiss member of the Panel informed the meeting that Switzerland intended to re-direct annual funds formally used for operations of three ASDAR units, namely, SFr. 50,000, at some level yet to be decided, to support both the AMDAR Trust Fund and the E-AMDAR Operational Fund.

5.1.2 In addition to their regular annual contribution to the AMDAR Trust Fund, the UK provided £ 25,000 and the US, US\$ 10,000 to fund respectively the service of a consultant on data exchange and quality control and the costs of AMDAR data transmissions for the Southern Africa AMDAR pilot project.

5.1.3 As already indicated in the report of the TC (agenda item 4.1), the TC first 12-month contract with WMO was completed on 31 March 2000. Because of insufficient financial resources, his contract was extended for only five months followed by a further contract extension of seven months until 31 March 2001 as a result of increased contributions to the

Trust Fund later in the year. The meeting noted that the Executive Council session in May expressed concern that the activities of the Panel could be curtailed unless adequate contributions to the AMDAR Trust Fund were forthcoming. In opening the meeting, Dr A. Zaitsev, the Assistant Secretary-General, had invited Panel members to encourage their administrations to continue to contribute to the AMDAR Trust Fund to ensure that the existing technical support is not disrupted and that positive results so far achieved by the Panel were not compromised. In this regard, the meeting welcomed the information provided by the Canadian member of the Panel who indicated that his administration would contribute SFr 10,000 this year. Furthermore, the Saudi Arabia Panel member informed the meeting that his country would contribute US\$ 10,000 next year. The US member indicated that the US would continue to support the AMDAR Programme and contribute to the AMDAR Trust Fund. He said however that he could not guarantee that the current level of financial contribution to the Fund would be maintained in the future until final NWS budget allocations had been approved.

5.1.4 The meeting spent considerable time discussing ways to improve the resources of the Trust Fund. Views ranged from marketing and undertaking a public relation exercise on what the Panel was accomplishing, to addressing letters to WMO Members with brochures or/and graphics attached explaining the goal of the AMDAR operational programme, and highlighting cost effectiveness of this data source. It was suggested that the future AMDAR Web site could help publicise what the Panel was accomplishing in terms of making available valuable, high quality and timely cost effective upper air data particularly over data void areas of the world. In this regard, the meeting welcomed Dr Ralph Petersen's offer to investigate the development of a brochure assisted by other Panel members

## **5.2 Future AMDAR work programme and budget**

### **5.2.1 Future AMDAR programme**

5.2.1.1 The TC presented a comprehensive list of potential activities for consideration by the Panel. Substantial discussions on some items ensued to determine project and work programme priorities. The meeting concluded that the main focus still remained the high priority pilot projects for Southern Africa and the Middle East as well as the data improvement and coordination projects. The meeting considered the position concerning project team leaders and members were encouraged to consider accepting responsibility in this regard and to assist with project work.

5.2.1.2 The Southern African project was expected to pass from being an AMDAR Panel project to a full self sufficient operational AMDAR programme by mid 2001. A seminar was proposed to be held for weather services of other countries to encourage them to join the new AMDAR programme with the Panel assisting for the preparation of this seminar.

5.2.1.3 During discussions, the leader of the Middle East project presented an outline of activity for 2001 involving Saudia. It was anticipated that operational testing from the first aircraft would commence early in 2001 and data should be available on the GTS by mid year 2001. The remainder of the MD90 aircraft fleet would be equipped in the latter part of 2001. Plans were provided on the evaluation of data quality with possible assistance of the E-AMDAR. Attempts to extend the project to become an operational regional programme would commence in 2002 once the national programme was completed.

5.2.1.4 The Panel would continue to support a range of existing programmes and new initiatives under the project on Coordination of National and Regional Programmes. In addition to the two high priority pilot projects, the Panel would continue to support the E-AMDAR programme at a lower level given that it was beginning to reach a mature operational phase. The Panel would also continue to support the implementation of the

developing Canadian programme. The Panel considered other potential new projects including the proposed project in the Caribbean, Gulf of Mexico and Central America and others in the Asian - West Pacific region. It was anticipated that the Panel's role in the former project could simply be in the form of technical advice and the case of the latter, a facilitating role to assist other Panel members as they advise individual countries wishing to establish new national programmes. Some level of technical assistance would be provided to other countries wishing to establish national programmes.

5.2.1.5 The means to use targeted AMDAR observations, particularly profiles, was discussed in the context of providing upper air data for countries that otherwise would have little or no conventional upper air programmes. These countries would also be unable to develop their own AMDAR systems. The TC will provide some level of technical support to help coordinate such cooperative arrangements where appropriate and will continue to raise the matter at CBS IOS meetings, particularly in relation to the provision of operational funding.

5.2.1.6 An issue that attracted considerable discussion related to the ability of the Panel to promote the availability and potential operational use of AMDAR data. A range of activities and options were agreed including:

- the preparation of a glossy 2-page "flyer" containing attractive pertinent graphics and text;
- the preparation and circulation of a letter to WMO members by the Secretariat drawing attention to the work of the Panel and including the "flyer";
- seeking a possible opportunity to make a presentation to the next session of the Executive Council;
- encouraging all members to take whatever opportunities that may arise when visiting or being visited by representatives of appropriate countries, to discuss and promote the availability and application of AMDAR data;
- ensuring the Panel web site is kept to date with relevant information.

5.2.1.7 Support would continue to be provided to address ICAO ADS Meteorological reports data distribution and quality mainly through the active role of WMO as the member to the METLINK Study Group.

5.2.1.8 The TC would continue to explore means of obtaining cheaper communications costs and a coordinated approach to data collection from aircraft through the major communications providers with the assistance of the representative from the Netherlands and the E-AMDAR manager. Effort would continue in the development of contacts and cooperation with industry in order to develop uniform software specifications and new onboard software. Appropriate meetings would be attended to help promote the AMDAR programme. Similarly, contacts would be extended with sensor developers to try to improve the quality of onboard data before transmission and the development of new sensing systems such as the water vapour sensor, turbulence and icing. The ASDAR Sub-Group would continue to support its operational programme at least for up to 2 years.

5.2.1.9 The consultant, Mr. Painting, would continue his work on the project, Improvement in Data Exchange and Quality Control. Mr Painting would also complete the preparation of the AMDAR Reference Manual by the beginning of the second quarter of 2001. Subsequently, the Manual would be distributed to Panel members for review. A new

international software specification would be completed and presented for consideration by the AEEC Datalink Users Forum.

### **5.2.2 Itemized future programme issues**

#### **Project teams and leaders**

- (a) Project Teams and in particular team leaders to increase support for the work of the Panel;
- (b) A second person to assist the Coordination project leader in his work;
- (c) Panel members to assist on project teams, and if possible, to take on a leadership role.

#### **Project 1: Coordination of National and Regional Programmes**

- (a) Continue to support national and regional AMDAR programmes, i.e., the high priority pilot projects for Southern Africa, the Middle East as well as the E-AMDAR and the Canadian AMDAR programmes;
- (b) The Panel to assist Members unable to establish their own AMDAR systems, develop co-operative arrangements with other countries to access AMDAR data provided from carriers from these countries.

#### **Developments in the Asia/west Pacific Region**

- (a) Support an investigation into the formation of a coordinated programme in the ASIA/Pacific region under the leadership of a Member from that part of the world;
- (b) The Panel to offer technical support through the AMDAR TC.

#### **Caribbean, Gulf of Mexico and Central America**

- (a) The Panel to provide technical guidance on the establishment and operation of an AMDAR programme in the Caribbean, Gulf of Mexico and Central America

#### **ICAO ADS Met**

- (a) The Panel to continue to work closely with ICAO on matters relating to the measurement and reporting of turbulence and on coding issues.

#### **Aircraft-to Ground-Communications**

- (a) Address the need for obtaining acceptable low communication costs for AMDAR data on a global scale perhaps assisted through WMO acting as the sole representative of all Members in any data agreement with communication providers;
- (b) If such an arrangement were worked out with communication providers, each weather service to obtain cooperation and agreement of its participating airlines in order to put the special arrangement in place.

#### **Contacts and Cooperation with Industry**

- (a) Monitor and encourage the development of a single international specification for onboard software for B777 aircraft ;
- (b) The AMDAR TC, the leader of the Co-ordination project and the E-AMDAR Manager to attend additional meetings as necessary and make relevant proposals to the Panel.

#### **AMDAR Technology Development**

- (a) Discussions and exchange of views to continue to help resolve matters relating to the development of temperature and water vapour sensors and the quality of data obtained from these sensors;
- (b) The Panel to encourage Dr Fleming with the testing and certification of the new generation water vapour sensor if resources permit;
- (c) Address the review and amendment of existing codes to take into account the reporting of data, such as turbulence, water vapour and icing;
- (d) The Panel to continue to monitor developments and discussions with CBS concerning means of reporting AMDAR observations.

#### **ASDAR Operational Programme**

(a) In accordance with past decisions by the OCAP Programme Board and the AMDAR Panel, the principal task is to provide continued support for the operational ASDAR programme for the next 2 years. The rationale for this decision is documented in detail in the records of meetings of the two bodies, but briefly, it is recognised that the remaining 12 ASDAR units provide cost effective upper air observations in data sparse regions of the world. These data will continue to be the major source of automated aircraft observations in these parts of the world over the next two years.

- (b) The work programme consists of the following tasks:
  - Renew the current maintenance support contract and resolve out-standing technical issues;
  - Continue to monitor the health and viability of the system and liaise with owners and operators to ensure operational needs are met;
  - As appropriate, assist with the replacement or decommissioning of ageing units;
  - Maintain through the ASDAR Centre ongoing system performance monitoring and coordinating appropriate action where units fail to meet operational performance standards;
  - Manage the ASDAR line in the AMDAR Trust Fund to ensure resources are appropriately dispersed in accordance with the wishes of the ASG and the AMDAR Panel;
  - Continue to liaise with and advise the operators of meteorological satellites and the WMO satellite coordinating centre of relevant matters of operational interest.

#### **Project 2 – Improvement of Data Exchange and Quality Control**

- (a) Need to develop by early 2001 an appropriate document that describes the work of the Panel and the requirements to establish an operational programme;
- (b) Give priority to the development of an international standard AMDAR software specification to commence once the document referred to in (a) is completed;
- (c) Support the improvement of the quality of AMDAR observations onboard aircraft before they are transmitted to the ground;
- (d) The Panel to continue to monitor, and where possible, encourage the development and certification of a reliable operational water vapour sensor and give due attention to matters such as coding;
- (e) With regard to Eddy Dissipation Rate, address onboard software and downlink coding issues as well as interpretation, validation, data exchange codes and operational applications;
- (f) Address the need for amending existing codes to include additional items for reporting water vapour and icing as well as the need for accommodating higher resolution of AMDAR data in time and 3 dimensional space;
- (g) Explore with CBS the implications of the CBS proposal to phase out all alphanumeric codes that would start by 2005;
- (h) Continue to address the AMDAR data exchange issue through the use of a "quality" notice board on the future AMDAR web site;
- (i) Each AMDAR region to establish its operational monitoring centre to address the specific regional needs in addition to the existing major global monitoring centres;
- (j) Address the need to use AMDAR data in all scales (global, regional and national), especially to assist users in Regional Associations I, II and III. It was concluded that this matter should be raised with the relevant OPAG groups of CBS, in particular IOS and ISS.

#### **Pilot Project for Southern Africa**

- (a) Try to convince other countries in the region to join in implementing a regional operational AMDAR programme following the successful completion of the pilot project, South Africa being the focal point;
- (b) AMDAR TC to continue to provide technical support to the pilot project;
- (c) Consider replacing the existing ASDAR systems by AMDAR;
- (d) Find ways to provide ongoing financial support for AMDAR data transmission costs perhaps through the WMO VCP.

#### **Pilot Project for the Middle East**

- (a) Undertake a joint visit by the TC and a KLM engineer to Saudi Arabia to progress the installation of the KLM AAA avionics software on SAUDIA Aircraft and to assist with future planning and coordination;

- (b) The AMDAR TC to continue to provide advice and additional documentation if required to expand the AMDAR project to include the full SAUDIA MD90 aircraft fleet;
- (c) Provide some assistance later on to extend the pilot project to a fully-fledged regional AMDAR programme.

The meeting next discussed additional targets. Broad agreement was reached on the following:

<b>Programmes /Projets/Activities</b>	<b>Future Activities</b>
1 E-AMDAR	- Cooperation and collaboration
2 CANADIAN AMDAR	- Monitoring activities and some technical support
3 SOUTHERN AFRICA PILOT PROJECT	- Monitoring activities/ Project to be fully implemented by end 2001 and transformed into a regional AMDAR Programme by 2002
4 MIDDLE EAST PILOT PROJECT	- TC support for data monitoring/ quality control - E-AMDAR to provide facility to help by June 2001
5 Ex USSR area	- Secretariat to explore and encourage Russia interest and report to next meeting - TC to perform preliminary survey of basic capabilities
6 CARRIBBEAN and CENTRAL AMERICA	- Following completion of feasibility study, US to assist supporting Com costs during implementation - Panel to advise and play the role of channel between US and the airlines
7 ASIA/PACIFIC	- Panel members to encourage the formation of national AMDAR activities - TC to coordinate activities - TC, Secretariat and Panel members to continue to provide information and support to develop Hong Kong, China AMDAR activities - Envisage a seminar or presentations at RAs meetings - Dr H. Puempel offered to publicize in the coming months
8 AMDAR REFERENCE MANUAL	- To be completed by March 2001 for review by the Panel
9 COOPERATION WITH THE INDUSTRY	- Contacts and cooperation with industry to continue
10 SUB-GROUP ON IMPACTS/APPLICATION AND INTEGRATION OF AMDAR DATA	- Dr Petersen agreed to be focal point - Dr Petersen to coordinate development of a brochure and liaise with the TC on other activities

### **5.2.3 AMDAR Budget (2001-2002)**

5.2.3.1 The TC provided a draft budget of anticipated income and expenditure for the biennium 2001/2002 noting the downward trends in the carryover of funds from year to year and the noted decline in annual contributions to the AMDAR Trust Fund. The draft budget was based on the annual contributions for 2000, assuming a future 12 months contract for the TC, the continued contract of the consultant on data exchange and quality control currently funded by the Met Office. Other items taken into account in the budget included some costs for AMDAR data transmissions, software development, the cost for visiting consultants and cost for the development of the AMDAR Web site.

5.2.3.2 New elements in the proposed budget included a budget item to support three software development projects namely, the KLM/KNMI AAA software upgrade, SFIM and Honeywell software development projects although it was indicated that the Honeywell software development could be funded from alternative sources. The Honeywell software development project would be undertaken specifically for B 777 aircraft that had no AMDAR software. This would provide a valuable opportunity to extend AMDAR to this rapidly growing modern fleet of long haul aircraft. A budget item for a new base-level maintenance contract with ASTRIUM to support the ASDAR operational programme for the next two years was also include in the budget for 2001/2002. The meeting noted with satisfaction that E-AMDAR would continue to use up to 20% of its annual budget to procure targeted observations from long haul aircraft in support of AMDAR Panel priority projects and the World Weather Watch Global Observing System. The meeting noted that the selection of targeted regions outside of Europe's immediate area of interest would be co-ordinated with the TC and that, in line with this arrangement, KLM and BA flights were being targeted to support the Southern Africa Pilot Project.

5.2.3.3 The development of a special web site for Panel activities was considered to be a high priority and an additional item of 10,000SF for development was established to reflect this view.

5.2.3.4 The distinct mismatch between the anticipated contributions and proposed expenditure indicating a generally disturbing situation by the end of 2002 was discussed. The meeting decided that no changes would be made to the proposed budget items at this stage but that steps would be taken to broaden the base of members making contributions to the AMDAR Fund.

5.2.3.5 Following discussions of the budget proposal, the meeting agreed on a budget for 2001/2002 found in Annex VII to this report. The meeting agreed that this budget should be reviewed next year by the Panel Chairman, the vice-chairman, the TC and the representative of the Secretariat and that proposals would be submitted to the Panel.

### **5.3 Review of Established Rules and Procedures**

The Panel was aware that its second meeting reviewed and subsequently endorsed the rules and procedures that the Panel agreed to follow in implementing the WMO AMDAR Programme up to this meeting. A proposal by the Chairman of the meeting to move from the yearly meeting to a bi-annual meeting with a Sub-Group to meet during the interval period did not get general support by the meeting. Therefore, the meeting concurred that the current Membership and Operating Procedures of the Panel should be maintained until the next meeting of the Panel. However, the Panel endorsed the proposal from the ASDAR Sub-group

for alterations to its Terms of Reference to make them more generic. The amended Terms of Reference are contained in Annex VIII.

#### **5.4 Election of Officers**

The meeting endorsed the proposals from the floor nominating Mr A.T. F. Grooters (the Netherlands) and Mr M. Edwards (South Africa) to be respectively the Chairman and Vice-Chairman of the Panel until the next meeting of the panel.

#### **6. ANY OTHER BUSINESS**

There was no issue raised by the participants at this meeting under this point of this agenda item.

#### **7. DATE AND PLACE OF NEXT MEETING OF THE AMDAR PANEL**

It was suggested that the next meeting be held in Melbourne, Australia, in September 2001 subject to confirmation by Australia.

#### **8. CLOSURE OF THE SESSION**

After the customary exchange of courtesies, the meeting was closed at 13:30 hours on Friday, 20 September 2000.

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