CGMS-XXXII
WMO WP-5
Prepared by WMO
Agenda item: D.1/D.2

CGMS WORKING GROUP ON CONTINGENCY PLANNING

(Submitted by WMO)

SUMMARY AND PURPOSE OF DOCUMENT

To consolidate previous CGMS and WMO discussions related to global contingency planning into the CGMS Global Contingency Plans

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ACTION PROPOSED

CGMS Members to note and approve the CGMS Global Contingency Plan as contained in the document and agree that it be included as part of the CGMS Consolidated Report.

Appendices:

A. EC Panel of Experts on Satellites, 8th Session (ECSAT-8), 6-10 November 1989
B. CGMS-XX, Tokyo, 27-31 January 1992
C. EC Panel of Experts on Satellites, 10th session, (ECSAT-10), 16-20 March 1992
D. EC-XLIV, 22 June – 4 July 1992
E. First WG meeting on Global Contingency Planning in Woods Hole, USA, October 1992
F. EC Panel of Experts on Satellites (Final Report), 9-10 March 1993
G. CGMS-XXI, Beijing, 19-23 April 1993, WG III
H. CBS Working Group on Satellites (CBS WGSAT -I) 7-11 March 1994
I. CGMS-XXII, Annapolis, Maryland, USA, 11-15 April 1994, WG III
J. CGMS XXIII, Darmstadt, Germany, 15-19 May 1995, WG III
K. CGMS XXV, St. Petersburg, Russian Federation, 2-6 June 1997
L. EC XLIX (June 1997)
M. EC-L (1998)
N. CGMS-XXVI, Nikko, Japan, 6-10 July 1998, WG IV
O. EC LII (2000)
P. CGMS XXIX, Capri, Italy, 22-25 October 2001, WG VI
Q. WG on Global Contingency Planning, Geneva, 20 February 2002
R. EC LIV (2002)
S. CGMS XXX, Bangalore, India, 11-14 November 2002, WG IV
T. CGMS-XXXI, Ascona, Switzerland, 10-13 November 2003

CGMS Global Contingency Plans

Background

For more than a decade and a half, the Coordination Group for Meteorological Satellites (CGMS) and the World Meteorological Organization have discussed global contingency planning. The results of the those discussions have been recorded in both reports for various CGMS meetings as well as within Expert Teams, Working Groups, Executive Council and Congress reports of the World Meteorological Organization (WMO). At the thirty-first session of CGMS, the following discussion and resulting action item were agreed with regard to global contingency planning:

> [CGMS] noted that while considerable progress had been made, both at [CGMS XXXI] and previous CGMS meetings, there was no consolidated description of the CGMS Global Contingency Plan. It agreed that such a description should be prepared and maintained. Thus, it proposed an action to consolidate CGMS discussions and agreements into a CGMS Global Contingency Plan that would reside as part of the CGMS Consolidated Report.
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> Action 31.39: CGMS Secretariat and WMO to assemble all materials related to Global Contingency Plans, including those found in CGMS and in WMO reports, and consolidate them into a CGMS Global Contingency Plan.

Relevant documentation and extracts from reports related to global contingency planning have been assembled in the following chapter and annexes. The report represents the CGMS Global Contingency Plans. In compiling and consolidating the various reports, the following format has been utilized. A chapter entitled the CGMS Global Contingency Plan Principles will be maintained in the first section of the report. It will contain major components of the CGMS Global Contingency Plans as well as reference to where the component originated. References, including all relevant text, will be contained as Annexes to the Plan in a chronological order, oldest first to newest. As discussions occur in the future, they will be recorded as new annexes and relevant principles will be inserted into the CGMS Global Contingency Plan Principles chapter.

CGMS Global Contingency Plan Principles

ECSAT-VIII (November 1989) (Appendix A)

- Continuity of Service: To achieve these purposes, the operational component must have the “staying power” of a programme that is essential for operational use, with assurance of continuity of service:

  - In support of the World Weather Watch, every reasonable effort should be taken to avoid breaks in service; but, at the same time, continued progress of remote-sensing capability should be encouraged to meet the increasing requirements of the basic programme of the WMO.

  - In support of the World Climate Programme, not only must every reasonable effort be taken to avoid breaks in service, but the evolution of remote-sensing capability must proceed in such a way as to assure long-term continuity of that data and associated instruments that are important to observe long-term climate change. (Appendix A, para 4.6)

ECSAT-X (March 1992) (Appendix C)

- The Panel felt that this "help your neighbour" policy was a good example of contingency planning. (Appendix C, para 11.5)

- ?? The Panel noted an analysis of the various possibilities for the "help your neighbour" policy which showed that full global and continuous coverage would be achievable. (Appendix C, para 11.14)

- ?? *WMO requirements for continuity of the space based portion of the GOS* (Appendix C, para 11.19)

EC-XLIV (June/July 1992) (Appendix D)

Annex III
Annex to paragraph 3.4.3
?? *WMO REQUIREMENTS FOR CONTINUITY OF THE SPACE-BASED PORTION OF THE GOS*

First CGMS WG meeting on Global Contingency Planning (October 1992) (Appendix E)

- ?? WMO further stated that contingency plans prepared by the satellite operators should take into account the duration of possible interruptions in the provision of data and services to the users. For short-term interruption of service, the internal contingency plans of each satellite operator would usually be sufficient to address the problem. However, for interruption of longer duration, cooperative contingency plans need to be developed by satellite operators. Such cooperative plans should include the consideration of measures to improve the compatibility of the various systems.

ECSAT - Final Report, (March 1993) (Appendix F)

- ?? Definition of contingency (Appendix F, para 2.3.2)

CGMS XXIII (May 1995) (Appendix J)

STRATEGY FOR GLOBAL CONTINGENCY PLANNING
Endorsed at CGMS XXIII

CGMS WG on Global Contingency Planning (February 2002) (Appendix Q), and
EC-LIV (June 2002) (Appendix R)

- ?? Secondly, the satellite operators would follow the principles of “help your neighbour” and be willing to be “helped by your neighbour”. Thirdly, nominal configurations for most satellite operators included either an “in-orbit spare” or an “on-demand launch”. The Working Group agreed that the set of regional contingency plans would constitute a global contingency plan in response to the WMO requirements. (Appendix Q, para 3.12)

- ?? It agreed in order to also meet WMO’s requirement for contingency planning that a constellation of four polar-orbiting satellites would be required, two in the AM orbit capable of serving as backup to the other and two in the PM orbit also capable of serving as backup to the other. (Appendix Q, para 3.14)

CGMS XXXI (November 2003) (Appendix T)

WG IV agreed that the GCOS Climate Monitoring Principles were valuable from the perspective of expected satellite system performances. With regard to calibration, the Working Group noted the recommendation from WMO that:

"A major issue for effective use of satellite data, especially for climate applications, is calibration. There should be more common spectral bands on GEO and LEO sensors to facilitate inter-comparison and calibration adjustments; globally distributed GEO sensors can be intercalibrated using a given LEO sensor and a succession of LEO sensors in a given orbit (even without the benefit of overlap) can be intercalibrated with a given GEO sensor. The advent of high spectral resolution infrared sensors will enhance accurate intercalibration."

?? The Working Group unanimously agreed in principle that ADM should be an integral part of all contingency planning.

EC Panel of Experts on Satellites, 8th Session (ECSAT-8), 6-10 November 1989

4. ASSURING CONTINUITY OF OPERATION OF SATELLITE SYSTEMS (Agenda item 4)

4.1 The Panel received presentations on the status of planning and operation of satellite systems. Presentations were made by EUMETSAT, Japan, USA, Brazil, USSR and ESA and can be found in Annex IV.

4.2 The Panel noted the following major facts:

- the planned development of a morning polar orbiting system by EUMETSAT
- the new GMS-4
- the new GOES-I launch in 1991
- the payload package on the European Polar Orbiting Platform
- the new satellite systems in Brazil
- the launch of GOMS in 1991

4.3 According to the US planning scenario, Europe would assume responsibility for the morning polar orbiting satellite with the European Polar Orbiting Platform (EPOP) series in 1997. Meanwhile, NASA would fly prototype operational instruments on the NASA Polar Orbiting Platform (NPOP) series. All series, EPOP, NPOP and NOAA-O would have common (standardized) interface instruments. The NOAA-O series instruments would include the AMSU, AMRIR and GOMR. The NPOP instrumentation includes an altimeter, scatterometer, passive microwave imager, ozone and trace gas limb scanner, AIRS and ERBI. NOAA intends to have near real-time data access from NASA but stressed that they would not depend on the NASA platform for operational data. The prototype operational instruments for NPOP will be designed as if flown at an altitude of 850;km although NPOP will fly at 705;km.

4.4 The Panel noted that the varied satellites so far discussed need a commitment by operators to assure continuity through compatibility. The Panel concluded that satellite operators must be strongly urged through voluntary participation to ensure compatibility of national satellite systems which are the space-based portion of the GOS in order to maximize continuity of service to the WMO Members. When discussing INSAT:

The Panel again stressed the urgency for implementing standard and routine dissemination of satellite data from INSAT.

4.5 The Panel discussed the issue of assuring continuity for polar orbiting satellites. Members reviewed the efforts for providing the morning polar orbiting satellite system by EUMETSAT. The costs are high for this new capability and firm commitments have not yet been established. The observer from ESA explained that there is full financial approval for one polar platform which will include an operational meteorological package and noted that follow-on satellites are implied. He confirmed that continuity is a current and supported issue at ESA.

The Panel pointed out that there is, so far, no firm European commitment to fly an operational meteorological package and encouraged EUMETSAT to provide a polar orbiting satellite within the GOS.

When discussing polar orbiting continuity:

The Panel strongly recommended that CGMS be requested to extend their scope and activities to cover polar orbiting satellite operators, including present, potential or those planning to operate; and that CGMS co-ordinate their planning and operation.

4.6 The Panel in summarizing the assurance of continuity of operations strongly felt it necessary to develop a general statement defining the evolution of the importance of satellite data and integration into all WMO programmes.

The definition proposed by the Panel defined the new system, its purpose, the continuity of service and organizational roles. The Panel recommended that this new definition should be taken into account by CBS in reviewing and revising the Manual of the GOS.

The definition is:

<u>THE OPERATIONAL SPACE-BASED OBSERVING SYSTEM</u>

The operational component of the Global Observing System (GOS) space-based sub-system, which is composed of polar orbiting and geostationary environmental observation satellites, has continuity assured through institutional commitment of resources for maintaining and improving the system.

<u>Purpose</u>: The operational component supports <u>all</u> WMO programmes, particularly:

- The World Weather Watch,
- The World Climate Programme

<u>Continuity of Service</u>: To achieve these purposes, the operational component must have the "staying power" of a programme that is essential for operational use, with assurance of continuity of service:

- In support of the World Weather Watch, every reasonable effort should be taken to avoid breaks in service; but, at the same time, continued progress of remote-sensing capability should be encouraged to meet the increasing requirements of the basic programme of the WMO.

- In support of the World Climate Programme, not only must every reasonable effort be taken to avoid breaks in service, but the evolution of remote-sensing capability must proceed in such a way as to assure long-term continuity of that data and associated instruments that are important to observe long-term climate change.

Organizational Roles:

the WMO Members, and particularly their national meteorological and operational satellite entities should be encouraged to maintain the necessary continuity of expertise and resources and give adequate priority to support the basic programmes of WMO.

- the national and international space research organizations should be encouraged to accept requirements from the meteorological **community stated through WMO** and give the requirements priority in their programmes through the development and testing of new earth observing instruments and supporting systems that is intended eventually to become a component of the GOS.

- in the allocation of resources by WMO Members a reasonable effort should be made to balance those resources devoted to space research and the space applications of the operational component of the space-based earth observing sub-system so as to assure that the purposes set forth above are achieved, with the development of new capabilities at the same time that long-term continuity of operation and continuous improvement of quality is assured.

4.7 The expert from Italy discussed the composition of the operational space-based system. He noted that the geostationary component should provide at least half-hourly imagery in the latitude belt between 50? S and 50? N. An image is considered "useful" if taken with less than 70? zenith angle. Frequent sounding is desirable for regional purposes. (Impact: 5 equi-spaced satellites are needed). He also noted that the polar component should provide useful sounding (i.e. at zenith angles not higher than 60?) at least four times per day, at least at all latitudes higher than 30? . (Impact: two satellites at orbital altitudes not less than 970;km, equatorial crossing time dephased possibly 6 hours). Useful imagery (i.e. at zenith angles not higher than 70?) must be available at least four times per day at all latitudes. (Impact: the height must be not less than 720;km). The acquisition range of any local read-out station must include at least 6000 (W-E) x 3000 (N-S);km^2 centred on the station. (Impact: the height must be not less than 900;km). Should the two satellites be de-phased for less than 6 hours, the minimum de-phasing needed to avoid conflicts in tracking operations should be 4.5 hours.

The Panel noted with interest the views expressed by the expert from Italy and asked the Secretariat to make the detailed information available to satellite operators and CBS.

4.8 The Panel recommended that the Secretariat draft detailed recommendations with reference to the new definition for the OPERATIONAL SPACE-BASED OBSERVING SYSTEM using seconded experts.

CGMS-XX, Tokyo, 27-31 January 1992

Concerning the setting up of a Working Group on Global Contingency Planning matters, the Senior Officials strongly supported the proposal and commented that this Group would address many wide ranging and somewhat political subjects. Members would have to carefully define its Terms of reference, discussion subject headings (Agenda) and longer term issues. It would also have to be decided if discussions should be held within the normal plenary sessions of CGMS or separately.

In the meantime it was proposed that a first planning meeting of this Group should take place in the October 1992 time-frame. This meeting would address, in particular, such matters as Terms of Reference, Agenda and a future work plan.

Satellite operators were already requested to consider options for long-term contingency planning which might be discussed at the October 1992 planning meeting.

The USA offered to host the planning meeting at a venue to be decide in due course.

Action 20.23 on Secretariat to arrange a planning meeting in USA in October 1992.

The Secretariat to arrange a planning meeting establishing a Working Group on Global Contingency Planning in the USA during October 1992, and to inform CGMS members accordingly.

EC Panel of Experts on Satellites, 10th session, (ECSAT-10), 16-20 March 1992

11. WMO CONTINGENCY PLANNING FOR USE BY SATELLITE OPERATORS (Agenda item 11)

11.1 The Panel recalled that the Eleventh WMO Congress had recognized the need to ensure the continuing operation of the environmental satellite systems. Congress had appealed to satellite operators to ensure continuity, quality and coverage of their satellite programmes in furthering Member's operational and research programmes. The Eleventh Congress also urged Members to develop contingency plans, where necessary.

11.2 When reviewing Resolution 5 (Cg-XI), the Panel noted that Congress had urged Members concerned to maintain the polar-orbiting and geostationary satellite systems to ensure the continuity of operation and to develop contingency plans to ensure the continued use and utility of satellite data and products.

11.3 The Panel was also aware, however, that the WMO itself does not have an overall contingency plan from which the Members may draw to aid them in developing their national, contingency plans.

11.4 The Panel then reviewed various reference materials which related to contingency planning. In the development of the "Guidance Document on Satellite Capabilities to 2000 for Meteorology and Hydrology, 1988", experts from India, Japan, Russian Federation, USA, EUMETSAT and WMO had prepared recommendations which the Panel considered important to the issue of contingency planning. Many of the report's recommendations have reoccurred in more recent documents and reports.

11.5 The Panel also discussed recent examples of contingency planning. For example, due to a possible gap in satellite coverage over the United States until the next generation geostationary satellite can be flown, NOAA/NESDIS and EUMETSAT have entered into bi-lateral discussions to formulate plans to move a European satellite over the United States while still controlling it from Darmstadt. The Panel felt that this "help your neighbour" policy was a good example of contingency planning.

11.6 The Panel recalled its own discussions of this topic. Chapter 4 "ASSURING CONTINUITY OF OPERATION OF SATELLITE SYSTEMS" from the eighth session of the EC Panel of Experts on Satellites had discussed the need for long-term continuity of satellite data and associated instruments.

11.7 The Panel agreed that the Co-ordination Group for Meteorological Satellites (CGMS) was an important group with which the WMO must interact and was pleased that CGMS had been invited to be represented at meetings of the EC Panel of Experts on Satellites as observers. The Panel was informed that the twentieth session of CGMS has been invited to prepare a document for contingency planning which would reflect the CGMS viewpoint.

11.8 The Panel discussed contingency planning noting that it was appropriate for the WMO to have a policy related to contingency planning. It noted that both long and short term contingency planning were proper components of any WMO policy related to contingency planning.

11.9 The Panel recalled that the space-based sub-system of the Global Observing System (GOS) required five geostationary satellites and that the positions of the five satellites were noted in a high-level WMO statement of general requirements for the space-based sub-system of the Global Observing System developed by the ninth session of the EC Panel of Experts on Satellites and approved by the forty third session of the WMO Executive Council.

11.10 The high-level statement stated that the recommended core mission for geostationary satellites shall be continued with at least the following instruments:

- IR/VIS imagers for measuring the development and motions of clouds and in the case of GOES, sounders to observe atmospheric thermal and moisture structure;

- Data collection systems to relay data from platforms in support of environmental missions;

- Communication facilities to transmit the instrument output to the ground and distribute pre-processed images and other information to the users;

- Space environment monitors for space flight safety and diagnosis of instrument behaviour in-orbit.

11.11 The high-level statement also noted that the geostationary satellite component of the WMO Global Observing System should continue with an array of geostationary satellites at an altitude of 36,000 km and located above the equator at the following approximate positions:

Meteosat	0°		
INSAT	82°	E	
GMS	140°	E	
GOES	135°	W	
GOES	75°	W	
GOMS	76°	E	(planned)

11.12 The Panel reviewed an analysis prepared by the Satellite Officer which had been performed to determine the extent to which these positions provide full coverage over the globe. It felt that positional contingency planning, as described in the analysis, was one type of short-term contingency planning. The Panel thanked the Satellite Officer for the excellent analysis and manner of presentation.

11.13 With regard to long-term contingency planning, the Panel discussed replacement philosophies in the event that a satellite suffers a major failure. Replacement philosophies discussed assumed that the positions stated in the high level WMO statement of general requirements for the space-based sub-system of the Global Observing System were in-violate. One replacement philosophy which could insure continuity of data would be for each of the five positions to have an on-orbit spare. The Panel noted that, in fact, it was the on-orbit spare policy of EUMETSAT which has allowed them to provide the Atlantic Data Coverage.

11.14 The Satellite Officer discussed and the Panel noted that the on-orbit spare philosophy would also have varying degrees of complexity. For instance, five on-orbit spares would insure full continuity of data. Another scenario involved the non-availability of a position's primary satellite <u>and</u> its on-orbit spare. One replacement philosophy for such a scenario would be to "help your neighbour". In this case a satellite operator should have the capability to control two satellites from his ground station. By moving his second satellite (the on-orbit spare) east or west 55 degrees, he would be able to cover part of his neighbour's area. The Panel noted an analysis of the various possibilities for the "help your neighbour" policy which showed that full global and continuous coverage would be achievable.

11.15 The Satellite Officer noted and the Panel discussed other variations of the replacement philosophy to determine how many total on-orbit spares would be required. For instance, it was obvious that five on-orbit spares would ensure success. It was also shown that four on-orbit spares (positions 0?, 140? E, 82? E and one for both 75? /135? W) would also provide the necessary coverage. Two on-orbit spares would be sufficient if two sets of operators could control a satellite over his neighbour's position such as being established with the "bent pipe" process for the Extension of the Atlantic Data Coverage. For example, two pairs of satellite operators could be considered. Each would have to make long term commitments to develop the necessary communications systems to be able to control his satellite over another area completely out of his normal view. The last possibility and possibly the most complex to establish initially and the most cost effective after implementation would be one on-orbit spare. This could be accomplished through long term planning and agreement whereby all satellites would be identical in their command and control system such that any operator could control any satellite within its view.

11.16 The Panel noted that CGMS, at its twentieth session, had discussed Global Contingency Planning while strongly supporting a proposal to set up a Working Group on Global Contingency Planning. The Panel was of the opinion that CGMS members would have to carefully define the terms of reference for the new Working Group, agenda items and longer term issues. CGMS would also have to decided if discussions should be held within the normal Plenary sessions of CGMS or separately. The Panel was pleased to note that CGMS had proposed that a first planning meeting of the Working Group in the October 1992 time-frame. The October meeting would address, in particular, such matters as terms of reference, agenda and a future work plan. Meanwhile, CGMS had requested that the satellite operators consider options for long term contingency planning which might be discussed at the October 1992 planning meeting. At CGMS, the USA had offered to host the planning meeting at a venue to be decided in due course.

11.17 After the presentations, the Chairman noted that the goal of the Panel should be to develop a WMO paper for contingency planning. He continued by noting that the satellite operators would develop the detailed specifications for contingency planning and thus WMO should concentrate in providing a WMO requirement for continuity of the space-based portion of the GOS. He also informed the Panel of his own experiences of frustration when he sought a document with which he could refer and was unable to find anything. The Panel agreed that such a paper was necessary. The Panel also felt it appropriate to include the new WMO requirement for continuity of the space based portion of the GOS as part of the consolidated report from the Panel.

11.18 The Chairman then convened a subgroup to further discuss this matter taking into consideration the various points made during the general discussions of the Panel.

11.19 The subgroup developed a draft WMO requirements for continuity of the space based portion of the GOS. The draft had three sections, namely Introduction, Satellite Mission Service Requirements and Guidance as shown below:

WMO requirements for continuity of the space based portion of the GOS

I. Introduction

The purpose of this document is to provide guidance to the satellite operators who support the space-based sub-system of the GOS in the preparation of their contingency plans.

WMO's Eleventh Congress "urged Members concerned to maintain the polar-orbiting and geostationary satellite systems to ensure the continuity of operation, and the data dissemination and distribution services of those satellite systems ...".

Ensuring continuity in this context refers to minimizing any interruption in WMO required environmental satellite missions services due to a failure in the space-based portion of the GOS. The GOS space segment operators have developed internal contingency plans to provide substitute products and services in the event of a service outage. Many of these internal plans draw upon the data and products of other space segment operators. In addition, the satellite operators of the space-based portion of the GOS have through a policy of "help your neighbour" worked together to help each other in the event of such a failure. The most recent example of this being the willingness of EUMETSAT to make available a METEOSAT spacecraft for coverage over the Atlantic. This event highlights the importance of co-operation contingency planning amongst the operators.

CGMS has long served as a forum for addressing the WMO Executive Council Panel of Experts concern regarding ensuring continuity of the meteorological satellite services and will continue to be the focus for continuity planning.

II. Satellite Mission Service Requirements

The WMO general requirements for the space-based sub-system of the Global Observing System have been stated at the ninth session of the EC Panel of Experts on Satellites (see ECSAT-IX report, annex IV). All of the current operational mission requirements of WMO should be addressed in the contingency plans of the satellite operators. The most urgent attention of the operators should be directed to the key missions listed below.

(a) For geostationary satellites:

- the imagery mission
- the capability to produce winds
- the capability to broadcast data to local users
- the capability to collect and relay in situ data;

(b) For polar satellites:

- the sounding mission
- the imagery mission
- the capability to broadcast data to local users
- the capability to collect and relay in situ data.

The importance of the continuity of direct services such as APT, WEFAX and DCS must be considered.

In the case of geostationary satellites, contingency actions should be taken if the number of operating satellites and/or their location are not suitable to ensure that the primary missions listed below are met.

(a) Images taken under a zenith angle not higher than 70 degrees are available over all latitudes lower than 50 degrees (for higher latitudes, the polar satellites provide frequent images);

(b) The image quality is such that winds can be produced up to a zenith angle of 60 degrees over all latitudes lower than 40 degrees ;

(c) The capability to distribute data and possibly perform other telecommunication functions (e.g., data collection) must be exploited up to the latitude of at least 70 degrees;

In the case of polar satellites, contingency actions should be taken if the number of operating satellites and/or their orbital parameters and/or the instrument swaths are not suitable to ensure that the primary missions listed below are met.

(a) The sounding observations under a zenith angle not higher than 60 degrees are available four times per day over all latitudes higher than 30 degrees;

(b) Global coverage from images is available four times per day, any site being observed under a zenith angle not higher than 70 degrees;

(c) Any direct readout station is able to acquire direct read-out data with a coverage area of at least 6,000 km (W-E) by 3,000 km (N-S).

III. Guidance

Contingency plans prepared by the satellite operators should take into account the duration of the possible interruption of data and services and the requirements of the user community.

For short-term interruption of service, the internal contingency plans of satellite operators will usually be sufficient to address this problem. In this case, the loss of a critical sub-system may result in loss of the associated critical mission service for a short time, assuming a replacement satellite is available.

For a longer term interruption, the matter can be considered one of major programme continuity. It is considered that in an operational programme, the operator has in principle the capacity to integrate and launch a new satellite.

In the event of an extended satellite outage where no standby satellite is available, co-operative contingency plans developed by the operators would be essential. The satellite operator should explore a wide range of contingency strategies involving for example spacecraft, ground systems, alternative products, etc. The satellite operators should also explore measures to improve the commonalities amongst their various systems.

Section II outlined the mission requirements that are considered critical by WMO. The contingency plans of satellite operators should ensure coverage of those regions of the world where severe weather conditions (e.g., cyclones, tornadoes, etc.) develop. The importance of direct broadcast services such as APT, WEFAX, HRPT continuity should also be considered. To ensure the continued availability of high resolution data, standardization of transmission links and formats should be considered. Contingency planning of this nature must be a continuing dialogue between the satellite operators and their user representatives in order to develop practical cost effective contingency alternatives which respond to the needs of the user communities.

EC-XLIV, 22 June – 4 July 1992

3.4.3 The Executive Council reviewed a draft statement of WMO requirements for continuity of the space-based portion of the GOS and stressed the importance of continuity of satellite data for all WMO Members. It noted that the satellite operators would develop detailed specifications for contingency planning and that it was thus appropriate for WMO to articulate its requirement for continuity of the space-based portion of the GOS. The Council felt it important that contingency plans, including long-term (ten years), should be developed by the satellite operators. The Executive Council endorsed the statement of requirements which is given in the Annex III to this report.

Annex III
Annex to paragraph 3.4.3
WMO REQUIREMENTS FOR CONTINUITY OF THE SPACE-BASED PORTION OF THE GOS

I. Introduction

1. The purpose of this statement is to provide guidance to the satellite operators who support the space-based sub-system of the GOS in the preparation of their contingency plans.

2. The Eleventh Congress of WMO "urged Members concerned to maintain the polar-orbiting and geostationary satellite systems to ensure the continuity of operation, and the data dissemination and distribution services of those satellite systems ...".

3. Ensuring continuity in this context refers to minimizing any interruption in WMO-required environmental satellite missions services due to a failure in the space-based portion of the GOS. The GOS space segment operators have developed internal contingency plans to provide substitute products and services in the event of a service outage. Many of these internal plans draw upon the data and products of other space segment operators. In addition, the satellite operators of the space-based portion of the GOS have through a policy of "help your neighbour" worked together to help each other in the event of such a failure. The most recent example of this being the willingness of EUMETSAT to make available a METEOSAT spacecraft for coverage over the Atlantic. This event highlights the importance of cooperation contingency planning amongst the operators.

4. CGMS has long served as a forum for addressing the concern of the WMO Executive Council Panel of Experts regarding ensuring continuity of the meteorological satellite services and will continue to be the focus for continuity planning.

II. Satellite mission service requirements

5. The WMO general requirements for the space-based sub-system of the Global Observing System were endorsed at EC-XLIII which requested that they be used by WMO when stating overall WMO satellite requirements (see report of the EC Panel of Experts on Satellites, ninth session) All of the current operational mission requirements of WMO should be addressed in the contingency plans of the satellite operators. The most urgent attention of the operators should be directed to the key missions listed below:

(a) For geostationary satellites:

- The imagery mission;
- The capability to produce winds;
- The capability to broadcast data to local users;
- The capability to collect and relay in situ data;

(b) For polar satellites**:**

- ?? The sounding mission;
- ?? The imagery mission;
- ?? The capability to broadcast data to local users;
- ?? The capability to collect and relay in situ data.

6. The importance of the continuity of direct services such as APT, WEFAX and DCS must be considered.

7. In the case of geostationary satellites, contingency actions should be taken if the number of operating satellites and/or their location are not suitable to ensure that the primary missions listed below are met:

(a) Images taken under a zenith angle not higher than 70 degrees are available over all latitudes lower than 50 degrees (for higher latitudes, the polar satellites provide frequent images);

(b) The image quality is such that winds can be produced up to a zenith angle of 60 degrees over all latitudes lower than 40 degrees;

(c) The capability to distribute data and possibly perform other telecommunication functions (e.g. data collection) must be exploited up to the latitude of at least 70 degrees.

8. In the case of polar satellites, contingency actions should be taken if the number of operating satellites and/or their orbital parameters and/or the instrument swaths are not suitable to ensure that the primary missions listed below are met:

(a) The sounding observations under a zenith angle not higher than 60 degrees are available four times per day over all latitudes higher than 30 degrees;

(b) Global coverage from images is available four times per day, any site being observed under a zenith angle not higher than 70 degrees;

(c) Any direct readout station is able to acquire direct read-out data with a coverage area of at least 6,000 km (W-E) by 3,000 km (N-S).

III. Guidance

9. Contingency plans prepared by the satellite operators should take into account the duration of the possible interruption of data and services and the requirements of the user community.

10. For short-term interruption of service, the internal contingency plans of satellite operators will usually be sufficient to address this problem. In this case, the loss of a critical sub-system may result in loss of the associated critical mission service for a short time, assuming a replacement satellite is available.

11. For a longer term interruption, the matter can be considered one of major programme continuity. It is considered that in an operational programme, the operator has in principle the capacity to integrate and launch a new satellite.

12. In the event of an extended satellite outage where no standby satellite is available, cooperative contingency plans developed by the operators would be essential. The satellite operator should explore a wide range of contingency strategies involving for example spacecraft, ground systems, alternative products, etc. The satellite operators should also explore measures to improve the compatibility of their various systems.

13. Section II outlines the mission requirements considered critical by WMO. The contingency plans of satellite operators should ensure coverage of those regions of the world where severe weather conditions (e.g., cyclones, tornadoes, etc.) develop. The importance of the continuity of direct broadcast services such as APT, WEFAX, HRPT should also be considered. To ensure the continued availability of high resolution data, standardization of transmission links and formats should be considered.

14. Contingency planning of this nature requires a continuing dialogue between the satellite operators and their user representatives in order to develop practical cost-effective contingency alternatives which respond to the needs of the user communities.

First WG meeting on Global Contingency Planning in Woods Hole, USA, October 1992

INTRODUCTION

Following actions number 20.23 and 20.24 from the 20th CGMS Plenary Meeting, a CGMS meeting concerning Global Geostationary Contingency Planning was held. The Secretariat of CGMS, EUMETSAT, and the host of the meeting, NOAA, convened the meeting in Woods Hole, Massachusetts, 12-14 October 1992. The meeting was held at the Woods Hole Marine Laboratory of the NOAA Northeast Fisheries Center. The purpose of the meeting was to prepare the creation of a working group of CGMS charged with Global International Contingency Planning.

The meeting was opened by Dr John Pearce, Deputy Director, NOAA's Northeast Fisheries Center. Dr Pearce expressed his satisfaction at being able to h ost a CGMS meeting and welcomed the participants. Dr Pearce then provided an historical and programmatic summary of the activities of the Center with particular notice given to the application of satellite technology by the Center.

2. WORKING GROUP OBJECTIVES

The Working Group noted that Global Geostationary Contingency Planning includes consideration of past cooperation, current back-up activities and the development of a plan for cooperation in the future. The Group further noted that while Contingency Planning includes polar orbiting and geostationary satellites, the focus of this meeting will be geostationary satellites. JMA suggested that any consideration of this nature must also include a consideration of the budgetary aspects.

2.1 Draft Terms of Reference are presented at Annex IV to be considered for adoption by CGMS.

3. CONTINGENCY OBJECTIVES

The discussion on the general objectives of international cooperation in contingency planning started with a discussion of WMO Working Paper 1.

WMO explained that the WMO Executive Council endorsed a statement prepared by the WMO EC Panel of Experts/CBS Working Group on Satellites on the "WMO requirements for Continuity of the; space-based portion of the Global Observing System".

The WMO statement referred to both Geostationary and Polar Orbiting Satellites and contained an introduction, a section on mission service requirements and a final section providing guidance for discussions on Global Contingency.

The WMO statement identified a number of key missions which required the urgent. attention of satellite operators in their contingency planning.

It was agreed that the missions listed in the WMO document represent the minimum that the discussions on long term contingency should concentrate on the listed basic missions.

Japan stated that not only the basic missions needed consideration but also other products. It was agreed by all present that a list of global and regional products should be considered as a second order of business.

ACTION 1 WMO indicated that a list of global satellite data requirements was being developed in WMO and offered to provide the participants with copies.

WMO further stated that contingency plans prepared by the satellite operators should take into account the duration of possible interruptions in the provision of data and services to the users. For short term interruption of service, the internal contingency plans of each satellite operator would usually be sufficient to address the problem. However, for interruption of longer duration, cooperative contingency plans need to be developed by satellite operators. Such cooperative plans should include the consideration of measures to improve the compatibility of the various systems.

It was agreed that the WMO statement would be attached to the report of this meeting in view of its possible discussion and endorsement at the next CGMS plenary meeting. (see AnnexV)

4. CURRENT PLANS

The Chairman invited the participants to indicate their launch schedules and current national contingency plans.

4.1 USA current geostationary system and contingency plans

The first presentation was made by NOAA. The presentation was supported by the viewgraphs at Annex VI.

NOAA started by explaining its baseline configuration and current situation. NOAA's present problem was caused by a launch failure of GOES-G in May 1986 and the delay of the launch of GOES-I due to technical difficulties in the development of the GOES-next satellites. Such problems show that a relatively conservative satellite delivery schedule, a robust launch policy, and adequate funding do not always ensure continuity.

NOAA's primary contingency plan in the event of a single satellite failure is to reposition its remaining operational satellite to a single-GOES configuration and to maximize the use of conventional and polar satellite data. In addition, NOAA has recently pursued short-term and long-term cooperation with EUMETSAT. This cooperation is reflected in the Atlantic Data Coverage (ADC), Extended ADC (XADC) activities and the draft Agreement on the Backup of Operational Geostationary Satellites.

NOAA further presented a list of Meteosat-3 products being generated by NOAA in support of a one-GOES and a no-GOES scenario. The list was established principally to give some priority to US user community requirements given funding limitations.

WMO explained how many of the products listed also fulfil global requirements of the WMO. It was emphasized that some of .the products having a lower priority in the US were considered important to the global meteorological community.

The participants concluded that product lists should be created which take into account national, regional and global requirements. Participants noted that this in some cases may require a sharing of the burden for product development and distribution for these products between the guest and hosting satellite operators, and possibly other partners, during contingency situations. Also, WMO indicated that in those cases where globally useful products were not generated due to lack of funding, addition.a1 funding from user communities may be necessary to maintain data for international programs.

ACTION 2 Satellite operators and WMO to provide such lists of required products to the other participants.

NOAA continued its presentation by expressing its gratitude: for the successful cooperation with EUMETSAT and ESA on ADC and XADC.

It was further explained how the ADC activities led to the idea of advanced .contingency plans, as the current NOAA situation shows that it is better to initiate discussions in advance of emergencies.

The discussions "on long-term back-up held between EUMETSAT and NOAA during the last ten months were explained. These discussions have led to the setting up of a draft Agreement between EUMETSAT and NOAA "on Back-up of Operational Geostationary Meteorological Satellite Systems". The draft Agreement, which has been submitted to the US State Department for final Clearance, and which will be presented to the EUMETSAT Council for approval in November 1992, is attached hereto as Annex VII.

The back-up agreement between EUMETSAT and NOAA defines the terms of long-term cooperation in order to reduce the risk to both parties of losing system coverage by providing each other with emergency back-up coverage.

The Agreement is designed to apply in emergency situations only and is not intended to change the balance of responsibilities for" geographic coverage of any of the parties. The Agreement, to be based on reciprocity and no exchange of funds, will start once the parties are on equal footing, i.e. once NOAA has restored its two-satellite baseline configuration.

It was stressed by EUMETSAT that the draft Agreement did not create a "perfect system", which would have been unaffordable, but that it addressed the problem of possible "no-satellite" situations on either side. The Agreement constituted an attempt to balance the aspects of system reliability and cost savings.

With regard to Data Policy, it was explained that agreement had been reached to apply the data distribution practices of the host (i.e. the receiving satellite operator) of a satellite during emergency situations. The reason for doing this was to ensure continuity of the service provided both by NOAA and EUMETSAT during the normal operation of their satellites, and to avoid any or both parties having to enter into separate agreements with the other party's users during a limited emergency situation.

WMO congratulated both EUMETSAT and NOAA on such an Agreement. The draft Agreement was considered well-balanced and could constitute. an important precedent for cooperation on contingency with other international partners. WMO proposed to use the draft Agreement as a "master-agreement" for further discussions on long term contingency at CGMS.

NOAA continued its presentation by explaining that also JMA was providing valuable support to the US. A gap in the GOES DCS coverage for the Western Pacific occurred due to a GOES-2 inclination problem and GOES-6 fuel exhaustion. JMA generously offered to use the DCS on the GMS-4 satellite to provide this coverage. This cooperation between NOAA and JMA Japan began in September 1992 and was subject to an exchange of letters.

WMO congratulated JMA for the support provided and stressed that, by helping NOAA, JMA was also supporting general WMO programmes. WMO encouraged JMA to support other WMO programmes related to DCS.

EUMETSAT added to the presentation made by NOAA that the ADC/XADC activities and the DCS support by JMA were not the first occasion of cooperation between operators of meteorological satellites. Already in 1978, GOES-1 was moved over the Indian Ocean, and the GOES-4 DCS was used by EUMETSAT between 1985 and 1988.

4.2 Japan current geostationary system and contingency plans

JMA and NASDA jointly presented the current system and contingency plans in Japan. A working document on this issue was circulated (Annex VIII).

The baseline in Japan is to operate one geostationary meteorological satellite (GMS) at 140 degrees East. The basic missions of the GMS are imagery, 0. broadcast and DCP collection and relay.

Highest priority is given to the continuity of services according to the WMO requirements. (see Annex V). In this context, efforts are being made to launch successive satellites before the end of the design life-time of the current satellite.

For occasions where a spare satellite is available in orbit, the back-up satellite is kept at 120 degrees East. In case of serious malfunction of the operational satellite, operations would be switched to the back-up satellite.

The current operational satellite, GMS-4, was launched in September 1989 to replace GMS-3. GMS-3 was located at 120 degrees East and has been kept as an in-orbit spare. It is planned to launch GMS-5 in early 1995, and GMS-6 in about 1999.

Japan explained that, in cases of contingency where no Japanese in-orbit spare was available, the cooperation with other satellite operators would have to be sought.

Japan is also prepared to consider using a GMS back-up satellite as a potential contribution to the global contingency plans.

JMA and NASDA finished their presentation by describing their activity of temporary DCP data collection via GMS-4 in the Western Pacific. The activity, already mentioned in the NOAA presentation, is described in Annex IX.

4.3 EUMETSAT current geostationary system and contingency plans

EUMETSAT normally operates one Meteosat at zero degrees longitude. There is a capability to control two satellites simultaneously in order to use selective systems from the two satellites in order to support the equivalent of a single satellite mission. In addition, as a special effort EUMETSAT supports the so called Atlantic Data Coverage (ADC) mission with a satellite at 50 degrees west. This is a temporary mission to support NOAA following the failure of GOES-6. This mission will be extended (X-ADC) to permit the satellite to move to 75 degrees West as necessary from early 1993.

EUMETSAT provided copies of a working document describing the transition from ADC to X-ADC (not attached to the Report).

The current satellite status is as follows:

Meteosat-3, launched March 1988, is being used for ADC/XADC
Meteosat-4, launched June 1989, is the primary operational satellite
Meteosat-5, launched March 1991, is the in-orbit back-up for Meteosat-4
Meteosat-6, is scheduled for launch in late 1993
Meteosat-7, is scheduled for launch in late 1995/1996

There are various options for a Meteosat-8 to be launched when necessary after 1995, although these options are not yet funded. The new generation of satellites, Meteosat Second Generation (MSG), is scheduled for first launch in the year 2000. Meteosat-3-7(8) are essentially all of the same design, although Meteosat-3 does not carry the new Meteorological Data Distribution (MDD) mission.

Meteosat-3 has only one dissemination channel left (from 2) and is expected to exhaust its hydrazine fuel and suffer reduced electrical power during 1994.

Meteosat-4 and 5 are fully operable. They each have a design life of 5 years and fuel for at least six years. The primary EUMETSAT Contingency Plan is to keep an in-orbit spare always ready for use. The secondary EUMETSAT Contingency Plan is cooperation with international partners, which will become increasingly important as the switch is made between satellite generations.

4.4 The discussions on Agenda item 4 were concluded by the general agreement that the three satellite operators around the table (Japan, EUMETSAT and NOAA) should initiate discussions on contingency planning. It was felt by all participants that, although the CIS, the PRC and India might not be able to actively contribute to such discussions at this early stage, they should still be informed of such an initiative. In addition, it was agreed that any discussed long term contingency scheme should be flexible enough to ensure the possible participation of other satellite operators in due course.

5. DISCUSSION OF OPTIONS

The Chairman started this agenda item by stating that this meeting was the first of its kind and that the group could not hope to consider all options at this 'time. Rather, he suggested that the Working Group first reviewed the existing systems of those CGMS members present and explored how a global contingency based on these systems could be developed.

Japan opened the discussion with the presentation of the Japanese Working Document No.3 (Annex X).

In response to questions, Japan clarified that it expects to be able to control both the operational satellite and a back-up satellite following the launch of GMS-5. However, additional resources would be required to generate routine services and products from the back-up satellite. Upon availability of such resources, Japan could operate a back-up GMS satellite between 70 degrees East and 150 degrees West.

The Chairman thanked Japan for its contribution. Dr Mohr expressed appreciation for Working Document No.3.

The Chairman noted that having seen the planned cooperation between Europe and the USA this paper was a good step towards addressing how Japan could participate in this cooperation.

He suggested to proceed by seeking to answer two basic questions: How can Japan help the other two operators, and how can the other two operators help Japan should emergency back-up be required?

The US agreed that repositioning a GMS satellite to 150 degrees West and a Meteosat to 50 degrees West would provide coverage of the United States. NOAA also noted that if the United States had two satellites and Europe had a failure, movement of a back-up GMS to 150 degrees West could allow the United States to help Europe by moving one of its GOES eastward without a great loss of coverage.

The US also stated that it could control and exploit a GOES as far west as 140 degrees West should Japan require back-up support. Any repositioning further West than this would require a "bent pipe" relay since NOAA operates its GOES satellites from the East coast. From 140 degrees West only part of GMS coverage would be achieved.

EUMETSAT indicated that it could move a Meteosat as far as 70 degrees East, but recognized that this too does not provide Japan with adequate contingency coverage. Neither the United States nor EUMETSAT are able to extend their coverage closer than 70-80 degrees from

Japan. This means that in order for Europe or the US to help Japan in an emergency situation, a bent pipe arrangement similar to that being used with the XADC would be required. NOAA noted that use of a GMS in some circumstances would also require a bent-pipe capability.

ACTION 3 **The US and EUMETSAT agreed to explore the technical and cost requirements for bent pipe operation of GOES and Meteosat respectively for contingency use and provide the results of their studies to Japan for consideration. On receipt of the studies made by the US and EUMETSAT, Japan would make an equivalent study related-to GMS.** The studies should include ground equipment, telecommunication requirements, coverage limitations, bent-pipe ground equipment placement, use of existing equipment, reliability issues, possible redeployment of available equipment, future generation satellite requirements, and cost aspects. The studies should be done for the time period beginning in 1995.

ACTION 4 **The US, EUMETSAT and Japan agreed that they would analyse and respond to the reports provided to each other in response to the previous action.**

ACTION 5 **It was further agreed that Japan would provide budgetary estimates to the other participants on the cost involved in a simultaneous operation of two Japanese satellites as soon as possible.**

Japan suggested that a meeting at technical level might be necessary to review the results of the studies carried out under Actions 3, 4 and 5. Japan offered to explore hosting such a meeting in Tokyo.

ACTION 6 **Japan to propose date (target: February 1993) and venue of this technical meeting.**

The Working Group felt that a diagram showing the geographic coverage areas of the geostationary satellites would be useful in preparing these studies. WMO and EUMETSAT both indicated that they have such a diagram.

ACTION 7 **WMO and EUMETSAT to provide diagrams showing geographic coverage zones of the geostationary meteorological satellites from the existing CDA stations to the other participants.**

There was some discussion about a possible shifting of the baseline deployment positions. The consensus of the Group was that while global coverage could be enhanced in this way, the national interests of the satellite operators would preclude changes of this nature in the near term. The Working Group agreed that only emergency repositioning should be considered at this time, but that the attention of the CGMS Plenary should be drawn to this issue.

The Working Group moved to a discussion of scenarios that would require contingency support involving Japan. The Chairman noted that a similar discussion had already taken place in the context of NOAA/EUMETSAT discussions and that similar considerations could be extended to situations involving Japan. Some three-way contingency scenarios are explored in Annex XI.

6. SYSTEM STANDARDIZATION

The Chairman invited the participants to discuss the need and prospects for system standardization in view of future contingency plans.

While USA expressed some doubt that standardization will occur at the satellite/ground system interface, the delegation was optimistic that further standardization can occur in the area of products and pre-products. Examples of this in the past have been the WEFAX, APT, DCS, LRPT and LRIT standards. The experiments planned for late 1993, for example, using Meteosat-3 to produce winds using both the USA and EUMETSAT data processing systems and algorithms should lead to both improved wind determination accuracies and a common EUMETSAT/NOAA algorithm.

All participants noted that the data exchange standards adopted by the Consultative Committee for Space Data Systems (CCSDS) and proposed for adoption by CGMS for LRIT and LRPT seemed flexible enough to be employed for high resolution data transmissions by future geostationary satellites.

The adoption of such standards would facilitate receipt and use of the data by users of a geostationary satellite - whether at its nominal or a contingency location. Thus discussion of such standards within CGMS might bear fruit on a global basis after the year 2000 and perhaps between operators of similar (e.g., spin-stabilised) satellites earlier than that.

As an example of additional progress being made now the US has installed a commandable Data Collection Platform Receiver which allows for 400 KHZ band width selected about 401.9 MHZ and 402.2 MHZ. In the 401.9 MHZ mode, the receiver covers the US domestic frequency from 401.7 to 402.0 MHZ, as well as the international band 402.0 to 402.1 M:HZ.

In the 402.2 MHZ mode the spacecraft will cover the international band 402.0 to 402.1 MHZ as well as the European/Japanese domestic bands by 402.1 to 402.4 MHZ.

It was noted that the above discussion would tend to lead to the conclusion that only "bent-pipe" contingency operations may be foreseen in the medium. term. To this conclusion was added the observation that even this conclusion may apply only to Meteosat because the Meteosat ground station (whether the Odenwald or the "bent-pipe" station) is automatic. Even a "bent-pipe" would be more complex for either NOAA or JMA due to the more labour-intensive concept for their ground stations.

CONCLUSIONS AND RECOMMENDATIONS

1. The group noted that provision for continuity of satellite data and services on a global scale was not without high cost and risk. No single operator could expect to provide against all possible contingencies at all times. However each operator has available, albeit not always on a continuous basis, resources which could be used to help other operators. Thus, joint contingency planning is both essential and likely to increase the efficiency and effectiveness of the global meteorological satellite system.

2. The group welcomed the identification by WMO of 4 distinct services, or missions, for geostationary meteorological satellites for which 'priority attention has to be given. These missions are:

- The imagery mission;
- The capability to produce winds;
- The capability to broadcast data to users;
- The capability to collect and relay in situ data.

3. The satellite operators present endorsed the importance of these missions and confirmed that they not only support these missions during normal operation but have already, through bi-lateral arrangements demonstrated their ability to provide emergency contingency cover for neighbouring satellites. Examples to date include:

- Use of GOES-1 over the Indian Ocean in support of the FGGE in 1978
- GOES-4 support of the Meteosat Data Collection System m 1985-1988
- Meteosat-3 provision of Atlantic Data Coverage (ADC) in 1991-1992

- Meteosat-3 provision of extended ADC (XADC) from 1992
- GMS support of the GOES Data Collection System from 1992

4 Notwithstanding these bi-lateral arrangements in support of the four primary missions, the group noted that preparations for continuation of derived products could take a year or more in the case of emergency use of a neighbouring satellite. Therefore, it recommends that the operators and WMO prepare detailed prioritised lists of derived products needed nationally, or on a regional or global basis. Such lists would be considered when defining or implementing, contingency plans so that the satellite operators and possibly other partners can make proper provision for continuity of essential products.

5. The group welcomed the draft long term agreement between NOAA and EUMETSAT and hoped that this could serve as a model for further bi-lateral or multi-lateral agreements.

6. The group welcomed the initiatives of Ja pan, in supporting GOES DCS and in considering other potential exchanges of mutual benefit in the future. A number of actions were defined which would clarify the technical implications of Japan moving a back-up satellite to support other operators, and of NOAA or EUMETSAT moving a satellite to support Japan. The scenarios described in Annex XI of this report illustrate some possibilities that will be explored further.

7. The group expressed the wish that, although only the three operators of dedicated meteorological satellites could be present at the meeting, there was a strong Wish for the same principles to be considered by other satellite operators in due course.

8. The group considers that the Woods Hole meeting should be regarded as a preparatory meeting and that further meetings will be necessary. Draft Terms of Reference have been prepared. The group considers that it could continue its discussions, normally meeting as a separate working group for one day during the CGMS plenary meetings with ad ditional meetings (Joint, bi-lateral or technical) as necessary.

9. The group noted that the four principal missions identified by the WMO are currently provided routinely by three satellite operators over a considerable portion but that these services are not yet generally available over the Indian Ocean, This is a glaring omission which causes difficulties for both operational meteorology and global climate research.

Solution of this problem is outside the scope of the working group but the members nevertheless urge the CGMS to give its attention to this matter.

10. The group expressed its gratitude to NOAA for hosting the meeting and in particular to the local organisers who did so much to help the work of the meeting and ensure its success.

11. The group noted the benefits of improved compatibility between the satellites prepared by different operators, particularly as regards user interfaces. Considerable degrees of compatibility have been achieved in several areas but more attention could be given to the high resolution data formats in particular.

12. The group developed Terms of Reference and a Working Plan for the Working Group on Contingency Planning for the review arid possible , endorsement by the Plenary.

13. With regard to date and pla ce of a next meeting of the Working Group on Contingency Planning, it was suggested to hold it as a splinter meeting during the next CGMS plenary.

List of Annexes to the Final Report of the Planning Meeting for Global Geostationary Contingency Planning

EC Panel of Experts on Satellites (Final Report), 9-10 March 1993

A CONSOLIDATED REPORT BY THE EC PANEL OF EXPERTS ON SATELLITES

The Consolidated Report of the EC Panel of Experts on Satellites summarizes the major findings and recommendations including top-level principles and new definitions proposed by the EC Panel during its time of existence (1974-1993) in which it conducted ten sessions. The Consolidated Report should act as a transition phase between the present satellites now operational and those expected to fly by the end of this decade. It would also carry the heritage of ECSAT to the new CBS Working Group on Satellites. It is anticipated that the primary user of this document will be satellite operators and other organizations outside the WMO structure who have a need to know the requirements of the WMO.

Although the ten sessions of the EC Panel of Experts on Satellites had discussed many and varied topics related to satellite matters, not all items considered by the Panel are included in the Consolidated Report. The main emphasis is on the space segment for which ECSAT had a major role and had considerable competence. For instance, education and training, data processing, assessment of the level of data use, publications, etc., also were extensively considered within ECSAT, and gave rise to specific initiatives, some still ongoing; but the resulting recommendations can be found in the various session reports from ECSAT. Education and Training has been dealt with separately and its recommendations can be found in section 3 of this Final Report.

2.3 Contingency planning

The purpose of this section is to provide guidance to the satellite operators who support the space-based sub-system of the GOS in the preparation of their contingency plans.

WMO's Eleventh Congress "urged Members concerned to maintain the polar-orbiting and geostationary satellite systems to ensure the continuity of operation, and the data dissemination and distribution services of those satellite systems ...".

Ensuring continuity in this context refers to minimizing any interruption in WMO required environmental satellite missions services due to a failure in the space-based portion of the GOS. The GOS space segment operators have developed internal contingency plans to provide substitute products and services in the event of a service outage. Many of these internal plans draw upon the data and products of other space segment operators. In addition, the satellite operators of the space-based sub-system of the GOS have through a policy of "help your neighbour" worked together to help each other in the event of such a failure. The most recent example of this being the willingness of EUMETSAT to make available a METEOSAT spacecraft for coverage over the Atlantic and North American continent. This event highlights the importance of co-operation contingency planning amongst the operators.

CGMS has long served as a forum for addressing the WMO Executive Council Panel of Experts concern regarding ensuring continuity of the meteorological satellite services and will continue to be the focus for continuity planning.

2.3.1 *Definition of the basic missions*

The WMO general requirements for the space-based sub-system of the Global Observing System have been stated at the ninth session of the EC Panel of Experts on Satellites (see ECSAT-IX report, annex IV). All of the current operational mission requirements of WMO should be addressed in the contingency plans of the satellite operators. The most urgent attention of the operators should be directed to the key missions listed below.

(a) For geostationary satellites:

- the imagery mission
- the capability to produce winds
- the capability to broadcast data to local users
- the capability to collect and relay in situ data

(b) For polar satellites:

- the sounding mission
- the imagery mission
- the capability to broadcast data to local users
- the capability to collect and relay in situ data

The importance of the continuity of direct services such as APT, WEFAX and DCS must be considered.

2.3.2 *Definition of contingency*

In the case of geostationary satellites, contingency actions should be taken if the number of operating satellites and/or their location are not suitable to ensure that the primary missions listed below are met.

(a) Images taken under a zenith angle not higher than 70 degrees are available over all latitudes lower than 50 degrees (for higher latitudes, the polar satellites provide frequent images);

(b) The image quality is such that winds can be produced up to a zenith angle of 60 degrees over all latitudes lower than 40 degrees ;

(c) The capability to distribute data and possibly perform other telecommunication functions (e.g., data collection) must be exploited up to the latitude of at least 70 degrees;

In the case of polar satellites, contingency actions should be taken if the number of operating satellites and/or their orbital parameters and/or the instrument swaths are not suitable to ensure that the primary missions listed below are met.

(a) The sounding observations under a zenith angle not higher than 60 degrees are available four times per day over all latitudes higher than 30 degrees;

(b) Global coverage from images is available four times per day, any site being observed under a zenith angle not higher than 70 degrees;

(c) Any direct readout station is able to acquire direct read-out data with a coverage area of at least 6,000 km (W-E) by 3,000 km (N-S).

2.3.3 *Guiding principles*

Contingency plans prepared by the satellite operators should take into account the duration of the possible interruption of data and services and the requirements of the user community.

For short-term interruption of service, the internal contingency plans of satellite operators will usually be sufficient to address this problem. In this case, the loss of a critical sub-system may result in loss of the associated critical mission service for a short time, assuming a replacement satellite is available.

For a longer-term interruption, the matter can be considered one of a major programme continuity. It is considered that in an operational programme, the operator has in principle the capacity to integrate and launch a new satellite.

In the event of an extended satellite outage where no standby satellite is available, co-operative contingency plans developed by the operators would be essential. The satellite operator should explore a wide range of contingency strategies involving for example spacecraft, ground systems, alternative products, etc. The satellite operators should also explore measures to improve the commonalities amongst their various systems.

Sections 2.3.1 and 2.3.2 outline the mission requirements that are considered critical by WMO. The contingency plans of satellite operators should ensure coverage of those regions of the world where severe weather conditions (e.g., cyclones, tornadoes, etc.) develop. The importance of direct broadcast services such as APT, WEFAX, HRPT continuity should also be considered. To ensure the continued availability of high resolution data, standardization of transmission links and formats should be considered.

Contingency planning of this nature must be a continuing dialogue between the satellite operators and their user representatives in order to develop practical cost-effective contingency alternatives which respond to the needs of the user communities.

CGMS-XXI, Beijing, 19-23 April 1993, WG III

- EUM-WP-07 at CGMS XXI
- Review of Draft ToR, Discussion on Bent-pipe operations
- Plans to produce a draft global contingency concept plan taking into account all technical inputs.
- Need to continue efforts to establish a global contingency plan, Indian Ocean gap, increase compatibility.
- Action: EUMETSAT to prepare a doc on GCP based on Woods Hole Concept before end of July 1993

The first meeting of Working Group III – Global Contingency Planning elected Mr J. Morgan (EUMETSAT) as Chairman and Mr J. Lafeuille (EUMETSAT) as Rapporteur. The Group agreed the following Agenda:

III/1 To review the draft terms of reference provided in the report of the Woods Hole meeting.

III/2 To review the Action list established at the Woods Hole planning meeting.

III/3 To discuss the results of the Woods Hole Action 3, concerning the possibility of bent-pipe operations by GOES, Meteosat or GMS.

III/4 To review the conclusions and recommendations of the Woods Hole meeting.

III/5 To prepare a report for the plenary session.

III/1 Draft Terms of Reference

The group reviewed the draft Terms of Reference (TOR) provided in the report of the Woods Hole meeting, and suggested minor modifications, also adding the provision that the Group should normally conduct its business on the occasion of full meetings of CGMS, supplemented by correspondence and essential ad hoc meetings as necessary.

III/2 Review of Action from the Woods Hole meeting

The Working Group reviewed the action list established by the Woods Hole meeting, with the following conclusions:

Action WH1: WMO to provide a list of global satellite data requirements.
Status: **Completed**

Action WH2 Satellite operators and WMO to provide lists of products needed on national, regional and global scales as a check list for consideration during implementation of contingency actions (for example, to help determine possible providers of such products during contingency situations.
Status: **Continuing, to be adopted as a CGMS action.**

Action WH3: The USA, EUMETSAT and Japan to explore technical and cost requirements for bent/pipe operations of GOES, Meteosat and GMS respectively.
Status **This action is discussed under agenda 3 below and is closed.**

Action WH4: The USA, EUMETSAT and Japan to analyse and respond to the reports provided under Action WH3.
Status: **Continuing, discussed under agenda item 3 below and to be adopted as a CGMS action.**

Action WH5: Japan to provide budgetary estimates of the cost involved in simultaneous operation of two GMS satellites.

Status: **Closed. Japan provided this information to the planning meeting in Tokyo and this is recorded in the report of that meeting in EUM-WP-7 presented to CGMS XXI.**

Action WH6: Japan to propose a date for a technical planning meeting.

Status: **Closed. The Technical Planning Meeting took place in Tokyo on 17-18 February 1993.**

Action WH7: WMO and EUMETSAT to provide coverage diagrams from the existing CDA stations.

Status: **Closed.**

III/3 Bent-Pipe operations with GMS, GOES or Meteosat

The Group discussed the possibility of bent-pipe operations with GMS, GOES or Meteosat satellite systems. In the case of GOES and Meteosat this had been documented by the report of the meeting in Tokyo on 17-18 February 1993, while the GMS situation had been documented in Japan paper CGMS/Contingency WG:WP-01. The Group concluded that in each case there is a technical possibility although costs had not been established in detail and that the processing elements (including meteorological products and Data Collection) need further clarification. The Group wished to recommend that this concept be studied further as a basis for a global contingency plan for meteorological satellite operations.

It was stressed that the establishment of joint contingency plans requires a definition of the baseline plans of each operator. This would help to ensure that all participants in an agreement could potentially contribute as well as benefit from the arrangements made. In this context, PRC made the point that its systems were still in an experimental stage and that participation in contingency arrangements would only be considered when their satellites had achieved a high reliability. The Group agreed that this was coherent with the concept of contingency planning for operational systems.

It was agreed that the next steps would be to provide a draft global contingency concept plan taking into account all technical inputs which had been received and for the satellite operators to consider that draft from political and financial perspectives. This should be established by appropriate actions formulated by the plenary session of the CGMS.

III/4 Conclusions and Recommendations of the Woods Hole meeting

The Group reviewed the conclusions and recommendations of the Woods Hole meeting. It endorsed all of the items and identified a number of points, additional to those discussed above, which needed further discussion at future meetings of the Group and during the CGMS Plenary. There are:

- The need for continuing efforts to establish a global contingency plan;
- The absence of essential data coverage over the Indian Ocean. This had already been discussed by CGMS-XXI, resulting in an Action which should be followed-up as necessary.
- The need for improved compatibility between satellites so as to ease contingency plans.

III/5 Preparation of the report for the plenary session

The WG reviewed and agreed the contents of this report to the CGMS plenary.

ACTION 21.30 EUMETSAT to prepare and distribute a document on a Global Contingency Plan based on the "Woods Ho le Concept" before the end of July 1993.

CBS Working Group on Satellites (CBS WGSAT-I) 7-11 March 1994

1. WMO CONTINGENCY REQUIREMENTS FOR USE BY ALL SATELLITE OPERATORS (*Agenda item 8*)

1.1 The working group discussed contingency requirements for the space-based portion of the Global Observing System. It reviewed the WMO statement of requirements for continuity developed at the WMO EC Panel of Experts/CBS Working Group on Satellites meeting held in Geneva, from 16 to 20 March 1992 and endorsed by the forty-fourth Executive Council.

1.2 The working group learned that the CGMS Working Group Meeting on Global Contingency Planning had agreed to consider and study contingency planning that could provide continuity of data necessary to WMO Programmes. The twenty-first session of the Co-ordination Group for Meteorological Satellites (CGMS) had agreed that the WMO requirements as stated form the basis for CGMS global contingency planning.

1.3 The working group noted that CBS-X had requested that it should further refine the WMO global requirements including the requirements for satellite services.

1.4 In responding to a request from CGMS-XXI, the working group agreed to establish minimum requirements for products and services needed on national, regional and global scales and that such activities would occur within Sub-group on Satellite Data, Products and Service Requirements.

1.5 The working group noted that the Final Report of the EC Panel of Experts on Satellites contained a comprehensive description of the space-based portion of the Global Observing System. The description was based on discussions and recommendations occurring at previous meetings of the EC Panel of Experts on Satellites. The working group noted that the description formed a basis for a reference system and that the Sub-group on Satellite Data, Product and Service Requirements should use it during appropriate sub-groups activities. The working group also agreed that the comprehensive description should be presented to CGMS to learn if it provided a necessary and sufficient description of WMO contingency requirements. If CGMS agreed, then the sub-group would develop an appropriate input for submission to the Working Group on Observations for inclusion in the Guide and Manual of the GOS.

<u>United States - Europe Mutual Backup Agreement for Geostationary Satellites</u>

1.6 The working group noted that in 1993 the United States and Europe took a major step consistent with the WMO requirement for continuity of meteorological satellite data and the corresponding requirement for global contingency planning. On 20 August 1993, the United States National Oceanic and Atmospheric Administration (NOAA) and the European Organisation for Exploitation of Meteorological Satellites (EUMETSAT) signed a long-term agreement for mutual backup of their geostationary weather satellites. Both parties have aided each other in the past.

1.7 This agreement will become effective when both parties have baseline systems in place, expected by late 1995. If a satellite failure occurs, NOAA has agreed to reposition an operable GOES eastward to ensure European coverage while EUMETSAT has agreed to reposition an operable Meteosat westward to ensure U.S. coverage.

1.8 The working group noted that the signing of the Mutual Backup Agreement culminated a long and concerted effort by the two parties and that it has already had a dramatic impact on the availability of satellite data in WMO Region III and IV. The working group expressed its deep appreciation and asked the Chairman to indicate this at the forthcoming CGMS meeting.

CGMS-XXII, Annapolis, Maryland, USA, 11-15 April 1994, WG III

III/1 Approval of the Terms of Reference

In EUM WP-17, EUMETSAT presented a revised draft Terms of Reference for the CGMS Working Group on Technical Measures for Global Contingency Planning.

The Working Group unanimously recommended the Terms of Reference to the Plenary session for adoption.

Participants agreed that the Working Group would meet during full sessions of the CGMS, although separate meetings may also be convened as necessary.

III/2 Review of Actions from CGMS XXI

EUMETSAT presented a review of actions from CGMS XXI and reported on recent developments in global contingency planning. Actions 21.28 through 21.31 had been completed, with the satellite operators and WMO to continue work on Action 21.32 (see section III/4).

III/3 Bent Pipe Operations with GMS, GOES, or Meteosat

EUMETSAT and NOAA informed the group of the two agencies' 1993 signature of a Long-Term Mutual Backup Agreement, which formalized the long-term contingency plans for their geostationary meteorological satellite coverage. The plan will come into effect upon both agencies' establishment of their baseline satellite configurations. This baseline should be established after GOES-J's successful launch and check-out, which should be completed by autumn 1995. Satellite operators and the WMO welcomed this agreement as an important step toward more comprehensive global contingency planning efforts.

III/4 Global Contingency Planning Approach

EUMETSAT discussed recent efforts to develop a comprehensive technical strategy to expand existing contingency plans. Japan stated that while the MTSAT program may restrict its ability to participate in a long-term contingency plan, it would be possible to develop a medium-term contingency planning and a technical approach which could be formalized in the event of an urgent need for back-up support. All satellite operators therefore agreed to formulate a CGMS technical strategy which could include Japan or other satellite operators in a three-way approach. The Working Group recommended to the Plenary that a general technical strategy be developed within the CGMS context, and that Working Group III begin an initial outline. Pending Plenary approval, EUMETSAT agreed to coordinate a dialogue on this issue, with the aim of developing an outline for a CGMS technical strategy. A completed version would be provided by Working Group III for consideration by the Plenary at CGMS XXIII. This technical strategy could be regularly reviewed and incorporated into the next publication of the CGMS Consolidated Report. The strategy could also be provided to WMO for incorporation into the Guide and Manual for the Global Observing System (see discussion under Agenda Item D.2.)

ACTION 22.30 EUMETSAT to continue to coordinate the dialogue with Japan and the USA in order to develop an approach for a medium- and long- term global contingency strategy compatible with the plans and constraints of all satellite operators. The first draft of this strategy will be completed and forwarded to CGMS participants for comments by 30 October 1994.

ACTION 22.31 CGMS Members to review and comment on this draft global contingency strategy in advance of CGMS XXIII

CGMS XXIII, Darmstadt, Germany, 15-19 May 1995, WG III

The working group comprised representatives of the three satellite operators - EUMETSAT, Japan, USA - which have fully operational geostationary satellites systems, together with a representative of the WMO. It was chaired by John Morgan, assisted by Jérôme Lafeuille as Secretary.

III/1 Review of Actions from the CGMS XXII

The working group reviewed CGMS Action 22.30, in which EUMETSAT was to coordinate a dialogue with Japan and the USA concerning a global contingency plan. EUMETSAT recalled that there were practical examples of a joint contingency actions between the USA and EUMETSAT, and a long term agreement on joint contingency planning. This had demonstrated the practical and political possibilities for such joint actions when appropriate. Discussions had taken place between Japan and the other partners on this issue. There was a sincere wish on each side to find a joint solution, but it had not yet proved possible to define any practical initiatives before an actual contingency situation would occur.

Although in principle technical solutions exist and have been demonstrated (the "bent-pipe" Atlantic Data Coverage contingency operation), there are two main obstacles to a common CGMS wide solution. The first is the lack of financial resources. Like any other country, Japan would find it difficult to make financial provision for unexpected failure. The second is more technical, arising from the new dual-function MTSAT satellite concept, in which spare satellites need to be kept available at specific geographical locations for back-up support of essential national services.

In the light of this discussion, the working group recommended to close Actions 22.30 and 22.31.

III/2 Global Contingency Strategy

The working group nevertheless determined that there is a strong motivation amongst participants to keep open all possibilities for mutual support during contingency situations. The working group proposed that this motivation should be formalised through a non-binding CGMS declaration of good will and support to the extent possible when the occasion arises. Such a statement should be modelled on the existing EUMETSAT-USA Agreement, taken into account recent experience and lessons learned which the working group felt should be recorded for future reference. This should address both the requirements of the respective satellite operators as well as, to the extent possible, the wider WMO requirements.

The proposed form of the declaration was:

CGMS Members noted that one of the primary objectives of an operational satellite system is data continuity. Satellite and launch technology is still a high risk business and individual satellite operators may not always be able to maintain sufficient spare satellite capacity to cover all possible contingencies. However, because of the need to prepare for contingency situations, satellite operators may, during some periods, have reserve capacity in orbit which is not being utilised with the same priority as its primary systems.

Accordingly, the CGMS may base its joint contingency strategy on the possible use, through bi-lateral arrangements, of any spare capacity available to other CGMS satellite operators, on a "Help your neighbour" principle. It is agreed that a contingency arises if a satellite operator is no longer in a position to provide priority satellite based services, or expects that such a situation will arise in the near future. In this context, priority satellite based services includes key missions such as image generation and dissemination, the data collection system and the global distribution of products used in NWP, such as Cloud Track Winds.

In accordance with this principle, any CGMS satellite operator faced with a contingency situation, whereby priority satellite based services cannot be supported, should immediately discuss the situation with the other satellite operators. All CGMS satellite operators undertake to discuss possible options in good faith, without prior commitment, to try to help solve the problem in the most effective way. There is no general obligation of any Member to help another on an ad-hoc basis without exchange of funds, although this is the basis of the Long Term Agreement between EUMETSAT and the USA, which assumes a long term balance of obligations. The possible financial aspects will be discussed on a case by case basis, but CGMS satellite operators will try to minimise any possible financial impact on either party to a contingency action.

A possible technical solution, which might be evaluated in future contingency events, is for a satellite operator, having a spare capacity in orbit beyond its priority needs, to move a spare satellite to support the operator having a contingency situation. The baseline is that the owner of the satellite will continue to operate the satellite in question, to avoid duplication of expensive control facilities, while the host operator makes all necessary provision for the regional utilisation of the satellite. Where possible, direct control of the satellite will be implemented. When this is not feasible, indirect control, through some form of "bent-pipe" telecommunications relay, may be used.

To provide the best possible level of services in a contingency situation it is essential that the satellite operator and the host operator come to an early agreement concerning their respective responsibilities. In order to provide guidance for such arrangements, it is suggested that the following guidelines, based on practical experience, shall be followed:

a) The satellite owner shall:

- Continue to own and operate the spare satellite so as to generate and disseminate imagery within available resources, in accordance with the normal standards of the satellite owner,

- Use the satellite to the extent possible in support of the International Data Collection System as a priority and the Regional Data Collection System if possible,

- Continue to support international programmes such as ISCCP and GPCP through the continued production of standard products based on data from the spare satellite,

- Continue the global distribution of key products used in NWP, such as Cloud Track Winds.

- Seek to operate the satellite in accordance with the data policy of the host operator, in order to minimise any impact on third parties.

b) The host operator shall:

- Make efforts to ensure that its users continue to be provided with services, such as access to image data, through a combination of the services provided by the satellite owner and those provided by the host,

- Seek to provide specialised support for the Regional Data Collection System where facilities permit,

- Continue to take responsibility, as far as possible, for specialised regional and other requirements not addressed by the satellite operator.

- Make every effort to restore normal service as soon as possible through the successful launch of a replacement satellite.

III/3 Preparation of Working Group Report

In compiling this report, the working group recommended that the above text be incorporated in the Report of CGMS XXIII and that, in due course, it be added to the Consolidated CGMS Report as a standard CGMS Strategy.

Furthermore, the working group recommended that it was no longer necessary to maintain a permanent working group on this subject, but that the topic should be discussed at the plenary level during each meeting of the CGMS.

STRATEGY FOR GLOBAL CONTINGENCY PLANNING
Endorsed at CGMS XXIII

One of the primary objectives of an operational satellite system is data continuity. Satellite and launch technology is still a high risk business and individual satellite operators may not always be able to maintain sufficient spare satellite capacity to cover all possible contingencies. However, because of the need to prepare for contingency situations, satellite operators may, during some periods, have reserve capacity in orbit which is not being utilised with the same priority as its primary systems.

Accordingly, the CGMS may base its joint contingency strategy on the possible use, through bi-lateral arrangements, of any spare capacity available to other CGMS satellite operators, on a "Help your neighbour" principle. It is agreed that a contingency arises if a satellite operator is no longer in a position to provide priority satellite based services, or expects that such a situation will arise in the near future. In this context, priority satellite based services includes key missions such as image generation and dissemination, the data collection system and the global distribution of products used in NWP, such as Cloud Track Winds.

In accordance with this principle, any CGMS satellite operator faced with a contingency situation, whereby priority satellite based services cannot be supported, should immediately discuss the situation with the other satellite operators. All CGMS satellite operators undertake to discuss possible options in good faith, without prior commitment, to try to help solve the problem in the most effective way. There is no general obligation of any Member to help another on an ad-hoc basis without exchange of funds, although this is the basis of the Long Term Agreement between EUMETSAT and the USA, which assumes a long term balance of obligations. The possible financial aspects will be discussed on a case by case basis, but CGMS satellite operators will try to minimise any possible financial impact on either party to a contingency action.

A possible technical solution, which might be evaluated in future contingency events, is for a satellite operator, having a spare capacity in orbit beyond its priority needs, to move a spare satellite to support the operator having a contingency situation. The baseline is that the owner of the satellite will continue to operate the satellite in question, to avoid duplication of expensive control facilities, while the host operator makes all necessary provision for the regional utilisation of the satellite. Where possible, direct control of the satellite will be implemented. When this is not feasible, indirect control, through some form of "bent-pipe" telecommunications relay, may be used.

To provide the best possible level of services in a contingency situation it is essential that the satellite operator and the host operator come to an early agreement concerning their respective responsibilities. In order to provide guidance for such arrangements, it is suggested that the following guidelines, based on practical experience, shall be followed:

a) The satellite owner shall:

- Continue to own and operate the spare satellite so as to generate and disseminate imagery within available resources, in accordance with the normal standards of the satellite owner,

- Use the satellite to the extent possible in support of the International Data Collection System as a priority and the Regional Data Collection System if possible,

- Continue to support international programmes such as ISCCP and GPCP through the continued production of standard products based on data from the spare satellite,

- Continue the global distribution of key products used in NWP, such as Cloud Track Winds.

- Seek to operate the satellite in accordance with the data policy of the host operator, in order to minimise any impact on third parties.

b) The host operator shall:

- Make efforts to ensure that its users continue to be provided with services, such as access to image data, through a combination of the services provided by the satellite owner and those provided by the host,

- Seek to provide specialised support for the Regional Data Collection System where facilities permit,

- Continue to take responsibility, as far as possible, for specialised regional and other requirements not addressed by the satellite operator.

- Make every effort to restore normal service as soon as possible through the successful launch of a replacement satellite.

CGMS XXV, St. Petersburg, Russian Federation, 2-6 June 1997

Operational Continuity and Reliability

WMO expressed its appreciation to the satellite operators with respect to the status and plans of CGMS Members, including prospects of several satellites to be launched in a very near future. At the same time it invited them to give further consideration to the issue of contingency plans.

WMO recalled that the recommendation to develop contingency plans had been endorsed by the WMO Congress in 1991 and that CGMS had subsequently developed a contingency strategy based on the "help-your-neighbour" concept. This strategy assumes that each satellite operator tries with its best efforts to maintain its nominal configuration, in accordance with its own constraints. WMO underlined the importance for the user community of any indication that CGMS may express on possible additional global or regional contingency arrangements.

EC XLIX (June 1997)

7. With regard to operational continuity and reliability of the space-based sub-system of the GOS, the twenty-fourth session of the Co-ordination Group for Meteorological Satellites (CGMS-XXIV) noted that the meteorological community was deeply concerned over the availability of images and products from the geostationary orbit over the Indian Ocean area. It was stressed that the operational coverage of the Indian Ocean is recognized as an essential WMO requirement. In particular, it is expected to be an essential input for global numerical weather forecasting and for the operation of World Meteorological Centres in general, through the generation of wind vectors over this area of the globe. In addition, the Tropical Cyclone Committee of RA I recalled the importance of real-time availability of satellite imagery over the Indian Ocean for the monitoring of tropical cyclones.

8. CGMS-XXIV, bearing in mind these essential requirements and aware of the major step already achieved in launching GOMS-1, strongly encouraged the Russian Federation to pursue its efforts to bring GOMS-1 to an operational status, to operationally disseminate images and products, to operate the DCP mission using channel 401-403 MHZ, and to ensure the launch of GOMS-2 around 76? E in order to provide continuity of the GOMS system.

9. CGMS-XXIV also recalled the contingency strategy adopted at CGMS-XXIII in response to the need expressed by the forty-fourth Executive Council of WMO to increase the reliability of the space-based global observation system. EUMETSAT reported that the long-term back-up agreement between the USA and Europe had entered into force and now provided a clear contingency plan for the western longitudes. CGMS-XXIV identified a similar need for contingency planning for the eastern longitudes and noted that the current plans of the Russian Federation, of China, of Japan and of EUMETSAT should allow this issue to be addressed in an efficient way.

10. CGMS-XXIV was informed that EUMETSAT and the Russian Federation had initiated preliminary discussions on future bilateral back-up arrangements. CGMS-XXIV also noted that the Chinese experimental satellite FY-2, at 105° East, will be located at an intermediate position between GOMS and GMS, and that it could be considered as a potential back-up satellite in the event that contingency measures were required in this area.

EC-L (1998)

Relocation of Meteosat-5

The European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT) has decided to move its spare satellite Meteosat-5 to a location around 67 degrees East over the Indian Ocean. This was decided by EUMETSAT in response to a request from the Programme Team of the Indian Ocean Experiment (INDOEX) in order to provide assistance to this experiment in 1998 and 1999. Thus, with effect from 14 January 1998, Meteosat-5 started to drift eastwards from its present position and was expected to arrive on station in May 1998.

The following standard range of Meteosat meteorological and climate products will be produced at the EUMETSAT Mission Control Centre (MCC) in Darmstadt: cloud motion winds, sea surface temperature, cloud analysis, upper tropospheric humidity, high resolution visible winds, clear sky radiances, climate data set*, ISCCP data* and GPCP data*. With the exception of those products marked with an asterisk, all remaining products will be distributed via the GTS. Some products may, eventually, also be made available through Internet access.

It is also planned to provide an image dissemination service from Meteosat-5, containing High Resolution Image (HRI) formats on channel A2 (1694.5 MHz). Except for 6-hourly data, the HRI formats will be encrypted to prevent unauthorised access. The authorisation to access this data can be requested from EUMETSAT, in accordance with the provisions of its Data Policy.

In addition to the image dissemination from Meteosat-5, there will be a three hourly-unencrypted dissemination of INDOEX imagery in a special X-format from the nominal Meteosat at 0 degrees. Further information on this format can be obtained from EUMETSAT.

It should be noted that users who wish to receive image data from both Meteosat satellites simultaneously at 0 degrees and 67 degrees East, will require two separate PDUS each with its own Meteosat Key Unit (MKU.

CGMS-XXVI, Nikko, Japan, 6-10 July 1998, WG IV

REPORT OF WORKING GROUP IV - GLOBAL CONTINGENCY PLANNING

The Working Group, under the Chairmanship of Dr T Mohr, EUMETSAT, comprised representatives of the satellite operators EUMETSAT, India, Japan, PRC, Russia and USA together with representatives of WMO.

The Chairman recalled the joint contingency actions between EUMETSAT and USA and the long term agreement between these two satellite operators. He added that, more recently, discussions had been initiated with Russian Federation with a view to investigating possibilities for the use of Meteosat-5 at 63°E to relay Russian Federation DCP messages and to provide a temporary WEFAX image dissemination service.

The Working Group expressed great interest in the Plenary presentations addressing regional contingency planning from Japan and PRC (JAPAN WP-4 and PRC WP-5) and were pleased to note that preliminary discussions were already in progress on this subject between the two satellite operators.

Japan informed the Group that there was currently no funding foreseen to provide a back-up capability for the MTSAT satellites. Japan added that there was already approximately a 70% overlap in the fields of view of GMS/MTSAT and FY2 which, in effect, provided a limited imaging backup capability.

Responding to a comment from USA that there might be some scope for a small relocation of either MTSAT or FY2 (e.g. 5-10°) in order to improve the level of overlap, Japan indicated that because MTSAT was a multi-functional satellite, providing telecommunications and aviation services in addition to the meteorological mission, there was no possibility to relocate the satellite.

Noting that each satellite operator had to respond to both national and international requirements, the Chairman commented that it may be appropriate for each operator, in the event of a major system failure, to provide backup in areas such as product generation.

Confirming its desire to meet both national and international requirements and indicating its intention to continue the FY2 meteorological satellite programme, PRC informed the Group that it was already studying possibilities for regional back-up operations. WMO noted the existing requirements for the space-based Global Observing System and contingency planning.

In view of the above comments, the Group suggested that Japan and PRC study possibilities for back-up of product generation and inform the next CGMS of progress in their discussions.

WMO noted the existing requirement for continuous observation from 76° East from GOMS in geostationary orbit and agreed to reconfirm this requirement through correspondence with ROSHYDROMET and the Russian Space Agency.

India informed the Group that its INSAT series of satellites were also multi- functional, providing telecommunication, broadcast and meteorology missions. The Working Group was pleased to note that INSAT image data was now freely available to all external users. The exchange of image data was normally agreed via bilateral agreements. The Group welcomed this and encouraged India to actively promote its use throughout the Indian Ocean region. In response, India agreed to forward such encouragement to higher authorities.

The Working Group also recalled the established CGMS principles with regard to contingency planning. In response to these principles, India also agreed to transmit to higher authorities the need for regional contingency planning in the Indian Ocean region.

NOAA/NESDIS reminded the Group that although the risk of a failure of a launcher or satellite was always present, it could not be anticipated when preparing budgets for satellite systems. Recalling that a replacement satellite launch would normally take well in excess of 6 months and frequently much longer, the need for a regional backup capability from neighbouring satellite operators was paramount. NOAA/NESDIS added that the eventual procurement of back-up facilities became easier once effective back-up measures (e.g. GOES DCP support to EUMETSAT and EUMETSAT support to the GOES programme through the use of Meteosat-3) had been demonstrated.

In closing, the session, the Chairman recorded the following actions generated by the Working Group:

Action 1) Japan and PRC to study the possibilities for back-up of product generation and inform the next CGMS of progress in their discussions.

Action 2) WMO to reconfirm the requirement for a Russian Federation geostationary satellite at 76 degrees East over the Indian Ocean through correspondence with ROSHYDROMET and the Russian Space Agency

Action 3) India to study possibilities for supporting the CGMS principles on regional contingency planning and transmit them to higher authorities.

Action 4) India to actively promote the use of INSAT data throughout the Indian Ocean region and inform the next CGMS indications of such use.

EC LII (2000)

3.3.9 EUMETSAT informed the Council of the present status of its satellite systems; Meteosat-7 was the primary operational satellite at 0 degrees longitude, Meteosat-5 was in support of the Indian Ocean Data Coverage mission at 63 degrees East and Meteosat-6 was in standby. With regard to the new Meteosat Second Generation (MSG) programme, the first satellite in the series was now scheduled for launch in mid-2001.

3.3.16 In regard to contingency planning, the Council noted that while it was necessary to ensure continuity of services it involved many other factors including financial commitments by both the satellite operators and user communities. The Council was please to note that such planning was discussed on a regular basis at meetings of the Coordination Group for Meteorological Satellites (CGMS).

CGMS XXIX, Capri, Italy, 22-25 October 2001, WG VI

The report from Working Group IV, on Global Contingency Planning, was presented under this agenda item. The Working Group was convened and chaired by Dr Tillmann Mohr, Director-General, EUMETSAT, and Dr Donald Hinsman, WMO, served as Rapporteur. Representatives from all CGMS satellite operators participated.

The Working Group (WG) reviewed the status of the current contingency plans existing amongst the satellite operators. It noted that a formal contingency agreement existed between EUMETSAT and NOAA/NESDIS that could be activated when both satellite operators were in a defined nominal configuration. The WG noted that other plans, similar to contingency plans, existed between some other CGMS satellite operators. The WG also recalled that in 1991, the forty-fourth Executive Council of WMO recommended the development of contingency plans by satellite operators to increase the reliability of the space-based global observation system. WMO considered that space segment contingency planning was the core of the statement of WMO requirements for system continuity. It was anticipated that CGMS would continue its role of coordination and standardisation, such that ground receiving equipment would be able to receive and process services from any contingency satellite provided by another operator, e.g. by accessing standardised down-link broadcasts and data formats.

In 1992, the statement of WMO requirements for continuity was, subsequently, endorsed by the satellite operators who then established a CGMS Working Group on Global Contingency Planning. The satellite operators also noted that they were presently processing and disseminating other satellite operators' imagery and products and thus they relied on each other to maintain a global satellite system. A main strength in such a system was through contingency and reliability. It also acknowledged that the concept of "help your neighbour" also implied that a satellite operator would be willing to be "helped by its neighbour". The duality of the concept, i.e. to help and be helped, would allow sets of regional contingency plans to be the foundation for a global contingency plan for both the geostationary and polar-orbits.

Each satellite operator indicated a willingness to discuss regional contingency plans with its neighbours and within CGMS. With regard to the polar-orbiting satellites, a global plan should be developed with respect to the morning and afternoon orbits. It also agreed that a nominal configuration should be a basis for the activation of any regional contingency plan.

Thus, the WG suggested that it reconvene for regular discussion at future CGMS meetings. Furthermore, in preparation for CGMS XXX, a WG meeting should be held to discuss the structure and content for regional contingency plans in more detail. WMO offered to host the first meeting of the WG immediately following the second session of the WMO Executive Council Consultative Meetings on High Level Policy on Satellite Matters. The tentative dates and venue for the session are 18-19 February 2002 in Geneva. Additionally, satellite operators agreed to continue discussions on regional contingency plans, as appropriate, after the February 2002 WG meeting.

Action 29.11 WMO to host a meeting of the CGMS Working Group on Global Contingency Planning, in February 2002 following the Consultative Meeting on High Level Policy, in preparation for further discussions at CGMS XXX.

WG on Global Contingency Planning, Geneva, 20 February 2002

3. GLOBAL CONTINGECY PLANNING

BACKGROUND

3.1 The Working Group recalled that the CGMS Consolidated Report contained the following information related to Global Contingency Plans:

> *In 1991, the forty-fourth Executive Council of WMO recommended the development of contingency plans by the satellite operators to increase the reliability of the space-based global observation system. WMO considered that space segment contingency planning was the core of the statement of WMO requirements for system continuity. It was anticipated that CGMS would continue its role of coordination and standardisation such that ground receiving equipment would be able to receive and process services from any contingency satellite provided by another operator, e.g. by using standardised down-link broadcasts and data formats. In 1992, the statement of WMO requirements for continuity was subsequently endorsed by the satellite operators, who subsequently established a CGMS Working Group on Global Contingency Planning.*
>
> *However, at the first meeting of this Working Group in October 1992, CGMS concluded that no single satellite operator could be expected to guarantee satellite availability in all circumstances and that the establishment of joint contingency plans was essential in order to achieve a reliable global system at a realistic cost. A proposal for a contingency concept, which could meet global needs, was thus established. This concept was based upon a philosophy of assisting neighbouring satellite operators by using data transfer techniques similar to that already developed for the Europe-USA Extended Atlantic Data Coverage scheme mentioned above.*
>
> *In 1994, the CGMS Working Group on Global Contingency Planning agreed a technical strategy based upon the "help your neighbour" concept. This strategy assumes that each satellite operator tries, with its best efforts, to maintain its nominal configuration, in accordance with its own constraints. Any CGMS satellite operator faced with a contingency situation, whereby priority satellite based services cannot be supported, should immediately discuss the situation with other satellite operators who, in good faith, should try to find a solution.*
>
> *In 1997, CGMS considered that it would be beneficial for the user community to develop similar arrangements to cover unexpected contingencies affecting services provided by the satellite operators.*
>
> *In 1998, Japan and China looked into possible contingency arrangements to support each other's services. The GMS and FY-2 satellite systems have a high level of compatibility with regard to area of the globe covered and transmission characteristics. However, it was decided that long-term contingency arrangements could only be considered if respective launch schedules allowed sufficient in-orbit redundancy. A constraint to the provision of a back-up of MTSAT or FY-2 was the incomplete overlap (70%) in the fields of view of GMS/MTSAT and FY-2.*
>
> *Bearing this in mind, the Working Group on Global Contingency Planning considered that in the event of a major system failure, back-up in areas such as product generation might be an appropriate solution. As a consequence, the satellite operators are currently actively studying such possibilities for support to product generation using data from neighbouring satellite systems.*

Additionally, in 1998, discussions were initiated between EUMETSAT and the ROSHYDROMET with a view to investigating possibilities for the use of Meteosat-5 at 63°E to relay ROSHYDROMET DCP messages and provide a temporary WEFAX image dissemination service in the region.

Also in 1998, India agreed to transmit to its higher authorities the need for regional contingency planning as stipulated in the CGMS Contingency Strategy. To this end, EUMETSAT has concluded an Agreement with ISRO for the possible relay of some INSAT imagery and products via the Meteosat system. In return, India will have access to imagery provided by Meteosat-5 located at 63°E.

3.2 The Working Group also recalled that at CGMS-XXIX (October 2001), the Working Group on Global Contingency Planning had convened and discussed the need to further develop CGMS contingency plans.

3.3 The Working Group (WG) at CGMS-XXIX had reviewed the status of the current contingency plans existing amongst the satellite operators. It had noted that a formal contingency agreement existed between EUMETSAT and NOAA/NESDIS that could be activated when both satellite operators were in a defined nominal configuration. The WG had noted that other plans, similar to contingency plans, existed between some other CGMS satellite operators. The WG also had recalled that in 1991, the forty-fourth Executive Council of WMO had recommended the development of contingency plans by satellite operators to increase the reliability of the space-based global observation system. WMO had considered that space segment contingency planning was the core of the statement of WMO requirements for system continuity. It was anticipated that CGMS would continue its role of coordination and standardization, such that ground receiving equipment would be able to receive and process services from any contingency satellite provided by another operator, e.g., by accessing standardized down-link broadcasts and data formats.

3.4 In 1992, the statement of WMO requirements for continuity was, subsequently, endorsed by the satellite operators who then established a CGMS Working Group on Global Contingency Planning. At CGMS-XXIX, the satellite operators also noted that they were presently processing and disseminating other satellite operators' imagery and products and thus they relied on each other to maintain a global satellite system. A main strength in such a system was through contingency and reliability. It also acknowledged that the concept of "help your neighbour" also implied that a satellite operator would be willing to be "helped by its neighbour". The duality of the concept, i.e., to help and be helped, would allow sets of regional contingency plans to be the foundation for a global contingency plan for both the geostationary and polar-orbits.

3.5 At CGMS-XXIX, each satellite operator indicated a willingness to discuss regional contingency plans with its neighbours and within CGMS. With regard to the polar-orbiting satellites, a global plan should be developed with respect to the morning and afternoon orbits. It also agreed that a nominal configuration should be a basis for the activation of any regional contingency plan.

DISCUSSION

3.6 The Working Group then agreed that it would be appropriate to structure the present meeting in two parts, geostationary contingency planning and polar-orbiting planning. In doing so, the Working Group agreed that it would be appropriate to take into consideration the recent discussion at the second session of the Consultative Meetings on High-Level Policy on Satellite Matters on equator crossing times for polar-orbiting satellites since that discussion was also relevant to contingency planning. It recalled the second session of the Consultative Meetings had stressed that WMO should formally articulate its requirements for satellite data for climate purposes as contained in the GCOS principles. Since the requirements were relevant to both geostationary and especially polar-orbiting satellites and could involve significant resources to meet, it would be appropriate if such requirements could be formulated as a resolution at the highest level within WMO preferably by the WMO Congress.

GEOSTATIONARY CONTINGENCY PLANNING

3.7 In following the CGMS agreed philosophy to "help your neighbour", the Working Group noted that there were six CGMS geostationary satellite operators and considerable progress had already been achieved towards the development of regional contingency plans. The Working Group noted the already established contingency plan between NOAA/NESDIS and EUMETSAT. It also recalled that a bilateral cooperation agreement existed between EUMETSAT and the ROSHYDROMET part of which related to contingency planning.

3.8 NOAA/NESDIS and JMA have begun discussions of a short-term back up agreement whereby NOAA/NESDIS will be in a position to move the GOES-9 satellite to back up GMS-5 if required prior to the launch of JMA's MTSAT-1R. Concurrently, NOAA/NESDIS and JMA will begin discussions on a long-term contingency back up agreement. Such a long-term agreement would take effect once both agencies had established their planned baseline configuration. This baseline configuration, planned to be in place sometime in the next decade will provide for a robust national programme and will also have some capability to back up the other agency's programme in an emergency situation.

3.9 CMA noted that it currently had three registered positions (86, 105 and 123 degrees East longitude) that it intended for use by the FY-2 series. At present, it intended to launch FY-2C by the end of 2003 with plans that it would become operational by March 2004 before the monsoon season. Meanwhile, FY-2B would remain operational except during the eclipse seasons. CMA's intentions were to launch a geostationary satellite every three years but would have the capability to launch a satellite, if required, with only one year's notice. It noted that this form of contingency was an "on-demand launch" instead of an "in-orbit spare". CMA noted that if the lifetime of the satellites could be extended, then it planned to maintain a nominal two satellite configuration, one at 86 and one at 105 degrees East longitude with the contingency to use an "on-demand launch" if required. Its ground segment would allow simultaneous operation of two geostationary satellites. Thus with its present launch schedule, it was possible that CMA could achieve its full nominal configuration by 2006 or partial nominal configuration by 2003.

3.10 ROSHYDROMET noted that it will maintain its nominal one geostationary satellite configuration at 76 degrees East longitude. ROSHYDROMET indicated that GOMS N2 was an approved programme with a planned launch date in 2005. The imager, MSU-GS, on GOMS N2 would be similar in capabilities to SEVIRI on the MSG series of EUMETSAT satellites. The data will be disseminated in standard HRIT, LRIT, WEFAX formats.

3.11 CMA, JMA and ROSHYDROMET will start discussions on development of regional contingency plans to be implemented when achieving a nominal configuration for their geostationary satellite systems.

3.12 The Working Group felt that a major milestone had been achieved in the discussions on geostationary contingency planning. First, most CGMS satellite operators had either in place, were developing or would consider when nearing nominal configuration, regional contingency plans. Secondly, the satellite operators would follow the principles of "help your neighbour" and be willing to be "helped by your neighbour". Thirdly, nominal configurations for most satellite operators included either an "in-orbit spare" or an "on-demand launch". The Working Group agreed that the set of regional contingency plans would constitute a global contingency plan in response to the WMO requirements.

3.13 In order to have a complete overview of all CGMS satellite operator plans, the Working Group suggested that the CGMS Secretariat contact India to obtain its latest plans for geostationary orbit. Furthermore, the Working Group noted that t would meet again at the next

CGMS Plenary to review the status of contingency planning and that such reviews should occur at all future meeting of Plenary. Finally, it suggested that the next CGMS Plenary consider the issue of geostationary positions especially over the Indian Ocean as the present plans indicated the potential for radio frequency interference between satellites.

POLAR ORBITING CONTINGENCY PLANNING

3.14 With regard to polar orbiting contingency planning, the Working Group first discussed the principles for such plans. It noted that the basic WMO requirement for the polar orbit was for two satellites - one in the AM and one in the PM orbit. It agreed in order to also meet WMO's requirement for contingency planning that a constellation of four polar-orbiting satellites would be required, two in the AM orbit capable of serving as backup to the other and two in the PM orbit also capable of serving as backup to the other.

3.15 The Working Group recalled the discussions at the second session of the Consultative Meetings on equator crossing times. It noted that at present four satellite operators (EUMETSAT, CMA, NOAA/NESDIS and ROSHYDROMET) had plans to fly satellites in the AM orbit while only one satellite operator (NOAA/NESDIS) had plans to fly in the PM orbit.

3.16 The Working Group was pleased to note that both ROSHYROMET and CMA, taking into account their respective national requirements, would be willing to consider the possibility of using the PM orbit for their future Meteor 3M and FY-3 series to assure the necessary redundancy in order to meet contingency requirements. The Working Group recalled that ROSHYDROMET and CMA had already made preliminary indications at CGMS-XXIX of such a willingness and looked forward to future CGMS meetings for progress in this area.

Climate requirements

3.17 With regard to climate applications, the Working Group noted that there were several issues to be considered for the utility of data from polar-orbiting satellites and their continuity. There was compelling evidence that the climate is changing. The Working Group agreed that one could argue about the degree, nature and cause of the climate variations and whether there was in fact a change, but the only way to settle these arguments would be with solid information. This required improved global observations of the state variables and the forcings, the means to process these and understand them, and the ability to set them in a coherent physical (and chemical and biological) framework with models. Meanwhile, the information that helped settle these arguments and reduce uncertainties was also extremely valuable for many other practical applications for business, industry, government, and the general public. The implications are given for the climate observing system. The Working Group noted the word "system" meant a comprehensive approach that included:

> Climate observations from both space-based and *in situ* platforms that were taken in ways that addressed climate needs and adhered to the ten principles outlined by the National Research Council (NRC, 1999).

3.18 The Working Group noted that a major effort would be required to produce satisfactory climate data records from operational data. Over the past decade a number of basic principles had been developed for the delivery of long-term data with minimal space- and time-dependent biases (NRC, 1999) including:

> Continuity of Purpose: Maintain a stable, long-term commitment to the observations, and develop a transition plan from serving research needs to serving operational purposes.

3.19 Hence for space-based platforms, climate monitoring requirements could be more stringent than weather requirements. As a consequence the following were recommendations from the climate communities:

- Satellites intended for monitoring should be launched into stable orbits designed to minimize drift in time of observation to within 2 hours over the lifetime of the satellite, or boosters are required to stabilize the orbit;
- Sufficient satellites should be operating to enable the diurnal cycle to be adequately sampled;
- Satellites should be launched on schedule, rather than on failure of the previous mission, as is the case today, to ensure overlap of measurements which is essential for the climate record;
- All instruments must be calibrated and extensive ground truth validation should be sustained.

3.20 In recalling that it had requested WMO to seek formal statements of the requirements for climate in this area, the Working Group felt it appropriate to suggest that future CGMS meetings include an appropriate agenda item where climate issues could be discussed.

3.21 The Working Group, in recognizing the need to keep WMO informed of progress for contingency planning, requested WMO to inform its next Executive Council of the important progress made by CGMS satellite operators as recorded in this report.

EC LIV (2002)

Global Contingency Planning for the space-based component of the GOS and equator crossing times

The Executive Council was informed that the second session of the Consultative Meetings had discussed the issue of equator crossing time planning as presented by the Coordination Group for Meteorological Satellites (CGMS). The CGMS presentation had included the current status of planning for operational polar-orbiting satellites, and their data formats and frequency.

3.3.1 The Executive Council noted the complexity of the issue and that more in-depth analyses would need to be performed. However, an optimized equator crossing time plan based on the totality of user requirements was essential. Such an optimization would also allow the development of contingency plans for the polar orbit. With regard to equator crossing times, the Executive Council agreed that the WMO Congress be informed of the need to formally articulate system requirements for an optimized equator crossing time plan. It also felt it very important that the direct broadcast service from all satellite operators should strive to have standardization in terms of frequency, data format and content where possible and thus allow commonality amongst ground receiving stations.

3.3.2 The Executive Council was informed that a meeting of the CGMS Working Group on Global Contingency Planning had occurred immediately following the second session of the Consultative Meetings. Since WMO requirements for satellite data for climate purposes as contained in the GCOS principles, were relevant to both geostationary and especially polar-orbiting satellites and could involve significant resources to meet, the CGMS Working Group felt it would be appropriate if such requirements could be formulated as a resolution by the WMO Congress. The Executive Council agreed and requested the Global Climate Observing System (GCOS) Programme to prepare the necessary draft resolution for consideration by the Fourteenth WMO Congress.

Geostationary Contingency Planning

3.3.9 JMA informed the Council that on 10 May 2002 the governments of Japan and the United States of America exchanged diplomatic notes for the implementation of a procedure to backup GMS-5 with GOES-9, if required, starting in the second quarter of 2003. JMA has provided all WMO Members in the service area for GMS-5 with more detailed information concerning the backup. Concurrently, NOAA/NESDIS and JMA intended to begin discussions on a long-term contingency back up agreement. Such a long-term agreement would take effect once both agencies had established their planned baseline configuration. This baseline configuration, planned to be in place sometime in the next decade would provide for a robust national programme and would also have some capability to back up the other agency's programme in an emergency situation.

3.3.10 The Executive Council was informed that the China Meteorological Administration (CMA) intended to launch FY-2C by the end of 2003. CMA's intentions were to launch a geostationary satellite every three years but would have the capability to launch a satellite, if required, with only one year's notice. CMA noted that it planned to maintain a nominal two satellite configuration, one at 86 and one at 105 degrees East longitude with the contingency to use an "on-demand launch" if required.

3.3.11 The Executive Council also noted that ROSHYDROMET intended to maintain its nominal one geostationary satellite configuration at 76 degrees East longitude. ROSHYDROMET indicated that GOMS N2 was an approved programme with a planned launch date in 2005. The imager, MSU-GS, on GOMS N2 would be similar in capabilities to SEVIRI on the MSG series of EUMETSAT satellites.

3.3.12 The Executive Council agreed that a major milestone had been achieved in the discussions on geostationary contingency planning. First, most CGMS satellite operators had either in place, were developing or would consider when nearing nominal configuration, regional contingency plans. Secondly, the satellite operators would follow the principles of “help your neighbour” and be willing to be “helped by your neighbour”. Thirdly, nominal configurations for most satellite operators included either an “in-orbit spare” or an “on-demand launch”. The Executive Council noted that the set of regional contingency plans would constitute a global contingency plan in response to the WMO requirements.

Polar orbiting contingency planning

3.3.13 With regard to polar orbiting contingency planning, the Executive Council noted that the CGMS Working Group had first discussed the principles for such plans. The CGMS Working Group had noted that the basic WMO requirement for the polar orbit was for two satellites - one in the AM and one in the PM orbit. The CGMS Working Group had agreed that in order to meet WMO’s requirement for contingency planning a constellation of four polar-orbiting satellites would be required, two in the AM orbit capable of serving as backup to the other and two in the PM orbit also capable of serving as backup to the other.

3.3.14 The Executive Council was pleased to note that both ROSHYDROMET and CMA, taking into account their respective national requirements, would be willing to consider the possibility of using the PM orbit for their future Meteor 3M and FY-3 series to assure the necessary redundancy in order to meet WMO’s contingency requirements.

CGMS XXX, Bangalore, India, 11-14 November 2002, WG IV

WORKING GROUP IV: GLOBAL CONTINGENCY PLANNING

Working Group IV (WG IV) on Global Contingency Planning met during CGMS XXX and discussed activities since CGMS XXIX. It discussed matters relevant to global contingency planning including:

- the WMO Executive Council's reaction to results from the CGMS Working Group on Global Contingency Planning meeting held in February 2002;
- a review of the current status of contingency planning for both geostationary and polar-orbits;
- the concept that a set of regional contingency plans would constitute a global contingency plan;
- the need for a "standardised" regional contingency plan;
- the status of CGMS satellite operators' plans for geostationary satellites over the Indian Ocean in the 2005 timeframe; and
- implications of WMO's redesign of the space-based component of the GOS with regard to current contingency planning.

WG IV recalled that CGMS XXIX had agreed that WMO would host a meeting of the CGMS Working Group on Global Contingency Planning in February 2002 following the second session of the Consultative Meetings on High Level Policy on Satellite Matters in preparation for further discussions at CGMS XXX. A meeting of the CGMS Working Group on Global Contingency Planning was held at the WMO Headquarters, Geneva, Switzerland on 20 February 2002. The meeting of the Working Group had reviewed the background to global contingency plans and also had reviewed and discussed geostationary contingency planning; polar-orbiting contingency planning and climate requirements.

WG IV recalled that at the meeting it had requested a report to be made to the fifty-fourth session of the WMO Executive Council (EC-LIV) held in June 2002 concerning CGMS satellite operators' contingency planning for both geostationary and polar-orbiting satellites. WG IV noted that EC-LIV, in response to the results of the February meeting, had agreed that a major milestone had been achieved in the discussions on geostationary contingency planning. Firstly, most CGMS satellite operators had either in place, were developing or would consider when nearing nominal configuration, regional contingency plans. Secondly, the satellite operators would follow the principles of "help your neighbour" and be willing to be "helped by your neighbour". Thirdly, nominal configurations for most satellite operators included either an "in-orbit spare" or an "on-demand launch". EC-LIV had noted that the complete set of regional contingency plans should constitute a global contingency plan in response to the WMO requirements. With regard to polar-orbiting contingency planning, EC-LIV had noted that the CGMS Working Group had first discussed the principles for such plans. The February meeting had noted that the basic WMO requirement for the polar orbit was for two satellites - one in the AM and one in the PM orbit. It had agreed that in order to meet WMO's requirement for contingency planning a constellation of four polar-orbiting satellites would be required, two in the AM orbit capable of serving as back-up and two in the PM orbit, again capable of serving as back-up. EC-LIV was pleased to note that both Roshydromet and CMA, taking into account their respective national requirements, would be willing to consider the possibility of using the PM orbit for their future Meteor-3M and FY-3 series to assure the necessary redundancy in order to meet WMO's contingency requirements.

The February meeting had also suggested that CGMS XXX discuss the set of regional contingency plans that could be consolidated into a global contingency plan. It had indicated that CGMS XXX should consider the development of the outline of the content for a "standard" regional plan. Such an outline should identify all possible aspects of the space and ground segment back-ups to assist the user community in making its necessary preparations. Finally, it had suggested that CGMS XXX consider the issue of geostationary positions especially over the Indian Ocean as the present plans indicated the potential for radio frequency interference between satellites. According to satellite operators' plans, the possibility existed for six geostationary satellites over the Indian Ocean in 2005 (Meteosat, METSAT, INSAT-3A, GOMS N-2, FY-2, and GIFTS/IOMI).

WG IV then reviewed the current status for contingency planning for both geostationary and polar-orbits. With regard to the geostationary orbit, EUMETSAT noted that the long-term geostationary back-up agreement, agreed upon in 1995 with NOAA/NESDIS, was now in effect since both satellite operators are in their baseline configuration. For EUMETSAT, the baseline configuration is one operational satellite at its nominal position and one satellite in an in-orbit spare. For NOAA/NESDIS, the baseline configuration is two operational satellites at their nominal positions and one in-orbit spare. EUMETSAT and NOAA/NESDIS continued to hold regular bilateral meetings to include discussions on contingency planning. JMA described its contingency GMS-5/GOES-9 plan with NOAA/NESDIS. With regard to long-term contingency planning, JMA and NOAA/NESDIS have continued discussions and exchange of information at the technical level. JMA noted that for the short-term GMS-5/GOES-9 plan NOAA/NESDIS would move GOES-9 to 155ºE longitude to provide a back-up capability for GMS-5. JMA plans to start back-up operations in mid-April 2003. JMA will announce the details of the back-up arrangements as soon as they have been formalised. NOAA/NESDIS plans that GOES-9 will provide operational geostationary coverage and services (imagery and sounding) for the Western Pacific.

WG IV, together with WMO, thanked JMA and NOAA/NESDIS for this major contribution to WMO members dependent on the space-based component of the GOS and to global contingency planning. EUMETSAT noted the cooperation agreement with Roshydromet and mentioned that it was providing a spare satellite, Meteosat-5, as back-up to the nominal GOMS satellite position over the Indian Ocean. The EUMETSAT Council had already agreed to continue this back-up until at least 2005 with the possibility for further extension depending on the situation with available EUMETSAT satellites at that time. EUMETSAT noted that it expected its Council in March 2003 to review a proposal for further contingency back-up of the nominal Indian Ocean position. WG IV and WMO noted with appreciation this continuing effort beyond its present contribution to maintain the nominal coverage for the Indian Ocean. Roshydromet also discussed the cooperation with EUMETSAT whereby information for some DCS channels were received in Moscow for processing. These data were from DCPs contributing to the World Weather Watch. Once GOMS N2 became operational, it was planned that Roshydromet would assume responsibility for processing those DCPs. Thus the cooperation with EUMETSAT allowed new Russian Federation DCPs to be installed, as well as provided Roshydromet with the experience to establish the required infrastructures to process DCP information. Roshydromet indicated its desire to establish a similar arrangement in the eastern portion of its country with JMA and its GMS-5. NOAA/NESDIS indicated that once the back-up of GMS-5 by GOES-9 had been implemented in April 2003 it also would be possible for Roshydromet to utilise some GOES-9 DCS channels.

ACTION 30.35 Roshydromet, JMA and NOAA/NESDIS to discuss usage of some DCS channels on GMS-5 and/or GOES-9 for processing by Roshydromet with the expectation that the DCPs would be part of the World Weather Watch and processing would eventually be resumed by GOMS N2. WMO to assist. (Deadline: 1 January 2003 for discussions and exchange of information.)

WG IV noted CMA's plan to launch FY-2C by the end of 2003 with plans that it would become operational by March 2004 before the monsoon season. It recalled that CMA, at the February meeting, had indicated it had three registered positions (86, 105 and 123ºE longitude) intended for use by the FY-2 series. Meanwhile, FY-2B would remain operational except during the eclipse seasons. CMA's intentions had been to launch a geostationary satellite every three years with the capability to launch a satellite, if required, with only one year's notice. It had noted that this form of contingency was an "on-demand launch" instead of an "in-orbit spare". CMA had noted that if the lifetime of the satellites could be extended, then it planned to maintain a nominal two satellite configuration, one at 86 and one at 105ºE longitude with the contingency to use an "on-demand launch" if required. Its ground segment would allow simultaneous operation of two geostationary satellites. Thus, with its present launch schedule, it would be possible that CMA could achieve its full nominal configuration by 2006 or partial nominal configuration by 2003. India reaffirmed that while INSAT and METSAT are primarily domestic systems, currently there are bilateral arrangements for processed data dissemination such as the arrangements with NASA/NOAA. Also, the processed data, in the form of imagery are available on the Internet (http://www.imd.ernet.in/). Derived products such as CMVs are also being disseminated on the GTS.

With regard to polar-orbit, WG IV recalled the WMO requirement for two polar-orbits - one in the AM and one in the PM. In order to meet WMO's requirement for contingency planning four polar-orbiting satellites would be required, two in the AM orbit capable of serving as back-up to the other and two in the PM orbit also capable of serving as back-up to the other. Roshydromet indicated that in accordance with the current Russian Space Programme that continues up to 2005 its revised Meteor-3M programme planned to launch Meteor-3M N2 in 2005. The next satellite in the series, Meteor-3M N3, was proposed to be developed and launched in the 2007–2010 timeframe. Meteor-3M N2 and N3 will be comparable to the NOAA/Metop series. Roshydromet recalled that at the February 2002 meeting of WG IV it had agreed to consider the possibility of using the PM orbit. Thus, it was pleased to inform WG IV that equator crossing times will be coordinated with CGMS members taking into account WMO's requirement for contingency planning. With regard to CMA's plans for the polar-orbit, WG IV agreed to the following action.

ACTION 30.36 CMA to confirm its plans for polar-orbiting satellites and in particular its willingness to consider the possibility of using the PM orbit while taking into account its respective national requirements. (Deadline: 1 January 2003)

WG IV requested that WMO inform both CBS at its 2002 session in Cairns, Australia and the WMO Congress in May 2003 of the recent new developments in contingency planning by CGMS satellite operators.

ACTION 30.37 WMO to inform CBS at its 2002 session in Cairns, Australia and the WMO Congress of the recent new developments in contingency planning by CGMS satellite operators. (Deadline: 7 December 2002 and May 2003, respectively).

WG IV also considered the premise that the complete set of regional contingency plans would constitute a global contingency plan in response to WMO requirements. It noted that a complete set of regional contingency plans did not yet exist, but that CGMS satellite operators were striving to develop such a complete set. However, it felt that the premise was too restrictive as presently defined. In particular, CGMS satellite operators also felt that each regional contingency plan should take into account the needs of the global satellite system as defined in WMO requirements as well as its neighbour's other contingency plans. It requested that this description be included in the report for CGMS XXX and be available for all regional contingency plans. With regard to a "standard" regional contingency plan, WG IV agreed that contingency plans always aimed to achieve complete back-up of all data, product and services. However, there was a multitude of possible back-up scenarios depending on the dynamics of the particular situation and to have a "standard" plan would not be practical. Thus, while a "standard" regional contingency plan was not practical, it would be useful to define the "goal". Therefore, WG IV requested WMO to develop a detailed description of the goal for data, product and services expected from each of the nominal positions for both polar and geostationary orbits.

ACTION 30.38 WMO to develop a detailed description of the goal for data, product and services expected from each of the nominal positions for both polar and geostationary orbits for use in contingency planning. (Deadline: CGMS XXXI).

WG IV then discussed the status of CGMS satellite operators' plans for geostationary satellites over the Indian Ocean in the 2005 timeframe. It recalled that there were tentative plans in the 2005 timeframe for at least six geostationary satellites (Meteosat, METSAT, INSAT-3A, GOMS N-2, FY-2 and GIFTS/IOMI). EUMETSAT noted that if another CGMS satellite operator were to provide coverage over the Indian Ocean in support of WMO requirements, it would not provide Meteosat coverage. WG IV also noted that GIFTS/IOMI was an R&D mission and only a demonstration project and would not be located over the Indian Ocean until 2007. With regard to R&D satellites in general, WG IV noted the proposal by WMO to expand CGMS membership to include appropriate R&D agencies. However, until the expansion was approved and accepted by the R&D agencies, it would be premature to include R&D satellite missions in contingency planning discussions. Additionally, WMO would have to define what the contingency requirements for the R&D constellation would be, if at all.

With regard to WMO's redesign of the GOS, WG IV agreed that it would be appropriate to wait for the approval by the CBS session in 2002 and subsequent review and approval by the WMO Congress. Thus, WG IV agreed to further discuss contingency planning for the redesigned space-based component of the GOS at CGMS XXXI.

CGMS-XXXI, Ascona, Switzerland, 10-13 November 2003

WORKING GROUP IV: CGMS GLOBAL CONTINGENCY PLANNING

Working Group IV on Global Contingency Planning (WG IV) met during CGMS XXXI and discussed activities since CGMS XXX as summarised in WMO-WP-05. The Working Group also discussed WMO-WP-18 that presented several recommendations that guided the deliberations of the Working Group with regard to equator crossing time coordination for sun-synchronous satellites, geostationary satellite positions and satellite instrumentation.

In WMO-WP-05, WG IV reviewed activities related to global contingency planning. It noted that the WMO baseline space-based component of the GOS had changed. In particular, with regard to the geostationary orbit, there was a new WMO requirement for at least six geostationary satellites. With regard to the polar orbit, there was a new WMO requirement for at least four polar-orbiting satellites, two in the AM and two in the PM orbit. Additionally, the Working Group recognised that while R&D satellite missions did not require contingency planning themselves, they could provide back-up to operational meteorological satellite missions. The Working Group also recalled that it had reviewed Climate Monitoring Principles (CMPs) submitted by the Global Climate Observing System at CGMS XXX and that updated CMPs had been approved by the Fourteenth WMO Congress. The Working Group was also informed of CNES' formal commitment to WMO for the altimetric mission on Jason-1 and that it now formed part of the space-based component of the GOS within the R&D constellation. In anticipation that the now approved Jason-2 Ocean Surface Topography Mission (OSTM) – a four way joint mission with participation by CNES, NASA, NOAA and EUMETSAT – would also become part of the space-based component of the GOS, the Working Group agreed to discuss the need for contingency planning for operational oceanographic satellites within the space-based component of the GOS.

WG IV agreed to use the following as an agenda in its discussions on global contingency planning:

the revised GOS baseline for six geostationary satellites;
a revised CGMS Global Contingency Plan for geostationary orbit;
the revised GOS baseline for four polar-orbiting satellites;
the need for a CGMS contingency plan for operational oceanographic satellites;
the recently adopted GCOS Climate Monitoring Principles; and
the use of Alternative Dissemination Methods (ADM) in contingency planning.

WMO-WP-18 summarised current plans for both polar-orbiting satellite equator crossing times as well as planned geostationary satellite coverage for the next two decades. The Working Group was informed of instrument characteristics for those systems as well as the approved WMO CBS vision for the space-based component of the GOS (Cairns, 2002) that included: a constellation of at least four sun-synchronous satellites states that should be optimally spaced in time with multispectral imager (MW/IR/VIS/UV), all with sounder (MW), three with hyperspectral sounders (IR), all with radio occultation (RO), two with altimeters and three with conical scanning MW or scatterometer; and, at least six equally spaced geostationary satellites that include imagery, data collection, data dissemination and sounding (for some). WMO-WP-18 presented several recommendations that guided a further discussion by the Working Group in following its agreed-upon agenda with regard to equator crossing time coordination, geostationary satellite positions and satellite instrumentation.

WMO-WP-18 pointed out that the space-based component of the World Weather Watch's Global Observing System (GOS) for meteorological satellites currently included approximately 15 satellites in geostationary orbit and approximately 16 in sun-synchronous orbit, including operational and back-up satellites. Because many of those satellites were spaced closely together, the WMO system requirement with respect to aerial coverage or sampling time between observations was not fully satisfied, i.e. geostationary positions (for GEO) and LST (Local Solar

Time) for LEO should be regularly spaced; each satellite in the geostationary or polar orbit should have comparable instrument suites or should be able to provide comparable data content;

Table 5: Polar-orbiting satellite equator crossing times
(as of 13 November 2003)

Satellite	Service	Start	EOL	Eq. Cross-time	Freq (MHz)	BW MHz	Data rate (Mb/s)
Metop-1	LRPT	2006	2011	0930	137.9125	.150	.072
Metop-2	LRPT	2010	2015	0930	137.9125	.150	.072
Metop-3	LRPT	2015	2020	0930	137.9125	.150	.072
Metop-1	AHRPT	2006	2011	0930	1701.3	4.5	3.5
Metop-2	AHRPT	2010	2015	0930	1701.3	4.5	3.5
Metop-3	AHRPT	2015	2020	0930	1701.3	4.5	3.5
Metop-1	GDS	2006	2011	0930	7800	63	70
Metop-2	GDS	2010	2015	0930	7800	63	70
Metop-3	GDS	2015	2020	0930	7800	63	70
NPP	HRD	2006	2010	1030D	7812	TBD	15
NPP	SMD	2006	2010	1030D	8212.5	375	300
NPOESS-	LRD	2009	2015	0930D	1706	8.0	3.88
NPOESS-	LRD	2011	2018	1330A	1706	8.0	3.88
NPOESS-	LRD	2013	2019	0530D	1706	8.0	3.88
NPOESS-	LRD	2015	2021	0930D	1706	8.0	3.88
NPOESS-	LRD	2018	2024	1330A	1706	8.0	3.88
NPOESS-	LRD	2019	2025	0530D	1706	8.0	3.88
NPOESS-	HRD	2009	2015	0930D	7812/7830	30.8	20
NPOESS-	HRD	2011	2018	1330A	7812/7830	30.8	20
NPOESS-	HRD	2013	2018	0530D	7812/7830	30.8	20
NPOESS-	HRD	2015	2021	0930D	7812/7830	30.8	20
NPOESS-	HRD	2018	2024	1330A	7812/7830	30.8	20
NPOESS-	HRD	2019	2025	0530D	7812/7830	30.8	20
NPOESS-	SMD	2009	2015	0930D	25650	300	150
NPOESS-	SMD	2011	2018	1330A	25650	300	150
NPOESS-	SMD	2013	2019	0530D	25650	300	150
NPOESS-	SMD	2015	2021	0930D	25650	300	150
NPOESS-	SMD	2018	2024	1330A	25650	300	150
NPOESS-	SMD	2019	2025	0530D	25650	300	150
NOAA-15	APT	1998	2001	0730	137.5 – 137.62	0.034	.017
NOAA-15	HRPT	1998	2001	0730	1702.5	2.66	.665
NOAA-15	GAC	1998	2001	0730	2247.5	5.32	2.66
NOAA-16	APT	2000	2004	1400	Failed	0.34	.017
NOAA-16	HRPT	2000	2004	1400	1698	2.66	.665
NOAA-16	GAC/LA	2000	2004	1400	1698/1702.5/1707	5.32	2.66
NOAA-17	APT	2002	2005	1000	137.50 – 137.62	0.34	.017
NOAA-17	HRPT	2002	2005	1000	1698	2.66	.665
NOAA-17	GAC/LA	2002	2005	1400	1698/1702.5/1707	5.32	2.66
NOAA-N	APT	2004	2008	1330	137.50 – 137.62	.034	.072
NOAA-N	HRPT	2004	2008	1330	1698/1707	2.66	.665
NOAA-N	GAC/LA	2004	2008	1330	1698/1702.5	5.32	2.66
NOAA-N'	APT	2008	2012	1330	137.50 – 137.62	.034	.017
NOAA-N'	HRPT	2008	2012	1330	1698/1707	2.66	.665
NOAA-N'	GAC/LA	2008	2012	1330	1698/1702.5/1707	5.32	2.66
FY-1C	CHRPT	1999	2001	0830	1698-1710	5.6	1.3308
FY-1D	CHRPT	2002	2004	0900	1698-1710	5.6	1.3308
FY-3A	AHRPT	2004	2007	1010	1698-1710	5.6	4.2
FY-3B	AHRPT	2006	2009	1010	1698-1710	5.6	4.2
FY-3C	AHRPT	2008	2011	1010	1698-1710	5.6	4.2

Satellite	Service	Start	EOL	Eq. Cross-time	Freq (MHz)	BW MHz	Data rate (Mb/s)
FY-3D	AHRPT	2010	2013	1010	1698-1710	5.6	4.2
FY-3E	AHRPT	2012	2015	1010	1698-1710	5.6	4.2
FY-3A	MPT	2004	2007	1010	7750-7850	35	18.2
FY-3B	MPT	2006	2009	1010	7750-7850	35	18.2
FY-3C	MPT	2008	2011	1010	7750-7850	35	18.2
FY-3D	MPT	2010	2013	1010	7750-7850	35	18.2
FY-3E	MPT	2012	2015	1010	7750-7850	35	18.2
FY-3A	DPT	2004	2007	1010	8025-8215 / 8215-	120	93
FY-3B	DPT	2006	2009	1010	8025-8215 / 8215-	120	93
FY-3C	DPT	2008	2011	1010	8025-8215 / 8215-	120	93
FY-3D	DPT	2010	2013	1010	8025-8215 / 8215-	120	93
FY-3E	DPT	2012	2015	1010	8025-8215 / 8215-	120	93
Meteor 3M	Raw	2001	2004	0915	466.5	3	0.080
Meteor 3M	Raw	2001	2004	0915	1700	2	0.665
Meteor 3M	Raw	2001	2004	0915	8192	32	15.36
Meteor 3M	LRPT	2004	2008	1030	137.89 / 137.1	0.15	0.064
Meteor 3M	HRPT	2004	2008	1030	1700	2	0.665
Meteor 3M	Raw	2004	2008	1030	8192	2	15.36

WG IV then discussed in detail items related to the agenda and as highlighted below.

Military satellite systems

The Working Group discussed the issue of the use of military satellite systems and their associated data and products in contingency planning. It agreed that it would only be appropriate to include systems such as the Defense Meteorological Satellite Program (DMSP) satellites if there were a formal commitment to WMO to include them in the space-based component of the GOS. NESDIS noted however, that depending on the outcome of NOAA N' recovery efforts, both R&D satellite missions as well as military missions could be included in its national contingency planning. Thus, the Working Group indicated that the DMSP systems could be included in its future contingency planning activities if they became part of US contingency plans. The Working Group noted the potential benefits from the use of R&D data and products by operational entities in anticipation of contingency plan implementation as well as the benefits from such data streams as a precursor of future operational satellite systems.

Geostationary satellite contingency planning

The Working Group noted that several satellite operators had already formalised contingency planning for their geostationary satellites in following the CGMS principle to "help your neighbour". EUMETSAT, NESDIS, JMA and the Russian Federation had already agreed-upon plans to assure continuity of data, products and services with their neighbouring satellite operator. At the present, three such plans existed and two were being implemented due to difficulties experienced with satellite systems that were providing less-than-optimal performance. CGMS was informed by WMO of the deep appreciation expressed by WMO Members at the recent WMO Congress for this strong willingness by satellite operators to voluntarily meet WMO contingency requirements. CGMS satellite operators were also appreciative of the satellite neighbours' commitment to ensure continuity.

Comparable data content from geostationary satellites

The Working Group discussed the recommendations that: all geostationary imagers should be upgraded to at least the level of SEVIRI by the 2015 timeframe; and frequent IR sounding should be made by spectrometers within the same timeframe. The Working Group unanimously endorsed those two recommendations in noting the goal to have comparable data content from comparable instrumentation with common spectral bands from all geostationary satellites. It agreed that as an action each CGMS satellite operators should inform CGMS XXXII on its plans to achieve that goal within the 2015 timeframe.

Action 31.36 CGMS satellite operators to inform CGMS XXXII on plans to achieve the goal that all geostationary imagers should be upgraded to at least the level of SEVIRI by the 2015 timeframe; and frequent IR sounding should be made by high resolution spectrometers within the same timeframe. Deadline: CGMS XXXII

International Geostationary Laboratory

The Working Group briefly discussed the concept of an International Geostationary Laboratory (IGL). IGL would be a joint undertaking to provide a platform for demonstrations from geostationary orbit of new sensors and capabilities. While the Working Group agreed that the IGL concept was not an issue for contingency planning, it could prove to be of high value to CGMS Members. Thus, EUMETSAT, NESDIS and WMO accepted a request to prepare a paper on IGL for consideration at CGMS XXXII with a goal towards agreement by all CGMS satellite operators. Within the same discussion, ESA accepted a request to report on its activities about a MW sounder from geostationary orbit. EUMETSAT noted that a MW sounder in geostationary orbit had been studied within MSG follow-on activities and found to contain sufficient uncertainties to warrant further research and development such as being considered by ESA.

Action 31.37 EUMETSAT, NESDIS and WMO to prepare a paper on the International Geostationary Laboratory (IGL) that would be a joint undertaking to provide a platform for demonstrations from geostationary orbit of new sensors and capabilities. Deadline: CGMS XXXII

Action 31.38 ESA to report to CGMS XXXII on its activities related to a MW sounder from geostationary orbit. Deadline: CGMX XXXII

Low Earth Orbit satellite contingency planning

The Working Group noted the less-than-optimum equator crossing time plan by CGMS satellite operators. As expressed in previous CGMS meetings, both Roshydromet and CMA reconfirmed their willingness to consider placing their satellite missions in the afternoon orbit with a view of optimising temporal coverage of the globe. In particular, CMA noted that if FY-3A (tentatively scheduled for launch in late 2006) was successful, it would consider launching FY-3B into an afternoon orbit, tentatively scheduled for 2008. Roshydromet indicated with the difficulties being experienced with the meteorological payload on Meteor 3M N1, Meteor 3M N2 could be launched in 2005 into a morning orbit. With a launch date in 2008, Roshydromet expressed a willingness to consider placing Meteor 3M N3 into an afternoon orbit. The Working Group noted that with these possible shifts from AM to PM orbit near the end of the decade, the equator crossing time plan would approach more optimal spacing. WG IV noted the large gap in the early morning orbit contained in the existing satellite operators plans and that NESDIS was the only satellite operator at present seeking to reduce the gap. Given the existing plans, the large gap would only be reduced in 2013.

Altimetric satellite mission contingency planning

The Working Group was of the opinion that the present plans for altimetric missions were sufficiently uncertain to warrant the development of contingency planning. However, it did agree in principle with the need for contingency planning once there were sufficiently mature plans.

GCOS Climate Monitoring Principles

WG IV agreed that the GCOS Climate Monitoring Principles were valuable from the perspective of expected satellite system performances. With regard to calibration, the Working Group noted the recommendation from WMO that:

"A major issue for effective use of satellite data, especially for climate applications, is calibration. There should be more common spectral bands on GEO and LEO sensors to facilitate inter-comparison and calibration adjustments; globally distributed GEO sensors can be intercalibrated using a given LEO sensor and a succession of LEO sensors in a given orbit (even without the benefit of overlap) can be intercalibrated with a given GEO sensor. The advent of high spectral resolution infrared sensors will enhance accurate intercalibration."

The Working Group was of the opinion that the paper to be prepared by EUMETSAT, NESDIS and WMO (see action 31.37) could address the value of the IGL with regard to calibration requirements as expressed above.

Alternative Dissemination Methods (ADM)

WG IV recalled that a new CGMS Working Group on ADM, Working Group V on Integrated Strategy for Data Dissemination from Meteorological Satellites, had been established. The use of ADM was already being implemented by some satellite operators and the capabilities were developing rapidly. The Working Group unanimously agreed in principle that ADM should be an integral part of all contingency planning. WG IV encouraged all satellite operators to develop the capability to deliver satellite data and products by ADM. Such systems allowed for the exchange of satellite information and in this way helped to facilitate contingency planning. NESDIS noted that it was already investigating means to further exploit ADM that could benefit WMO Members in Regions III and IV.

CGMS Global Contingency Plan

The Working Group noted that while considerable progress had been made, both at this and previous CGMS meetings, there was no consolidated description of the CGMS Global Contingency Plan. It agreed that such a description should be prepared and maintained. Thus, it proposed an action to consolidate CGMS discussions and agreements into a CGMS Global Contingency Plan that would reside as part of the CGMS Consolidated Report. The Working Group also noted the valuable information contained in the tables found in WMO-WP-18 and requested that the tables be updated as a new CGMS Permanent Action.

Action 31.39 CGMS Secretariat and WMO to assemble all materials related to Global Contingency Plans, including those found in CGMS and in WMO reports, and consolidate them into a CGMS Global Contingency Plan.

New Permanent Action 11 CGMS Members to update the table on polar- orbiting satellite equator crossing times, as well as the table on coverage from geostationary satellites.