

Power Grid Corporation of India Limited

MAINTENANCE PLAN

for the
Digital Microwave System
(Telecommunication Package II)
for
System Co-Ordination and Control Project
for the
Northern Region

Fortum Engineering Ltd

Approved
13/9/02

1. INTRODUCTION

1.1. Purpose

The purpose of this Maintenance Plan is to clarify the mode of operation of the Contractor during the first and second year of POWERGRID digital microwave (MW) network operation. This maintenance plan details the activities to be performed by the Contractor during the first one year period known as "Guaranteed Availability Period" and the consecutive one year under an "Extended Maintenance Contract". During the "Extended Maintenance contract" the scope of maintenance support would be extended to the Wide-band Network Equipment, including the Fibre Optical Terminal Equipment delivered by Fujitsu.

The Maintenance Plan describes the Contractor's activities and procedures towards the POWERGRID's MW network. It also defines specific responsibilities required from both POWERGRID and the Contractor in order to successfully maintain the network.

This Maintenance Plan is prepared by Nokia in co-operation with Fortum Engineering Ltd. The Maintenance Plan is a working document and should be reviewed and updated regularly to reflect changes in personnel, procedures and the network.

The first year of maintenance plan will commence after the completion of GSAT and issuance of Operational Acceptance Certificate (OAC) of system by POWERGRID. In case POWERGRID desires to avail of the system maintenance services beyond the completion of the second year, the same will be agreed with mutual consultation between the parties 3 months prior to the completion of the second year period.

1.2. Scope

The scope of this document is to provide the maintenance plan, which covers ONE plus ONE year period starting from issue of Operational Acceptance Certificate (OAC). The maintenance plan shall comply with the contract requirements for the first year and the second year respectively as specified in the Clauses 6.3.1, 6.3.2 and Clause 6.3.3 of the Technical Specification (TS) in the Contract Agreement No C-11701-S859-1/542/III. The responsibilities of the Contractor and POWERGRID have been defined in this document.

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1.3. Executive Summary

Maintenance services offered by the Contractor are provided using Contractors extensive experience on Operation & Maintenance (O & M) of communication networks. The services provided in O & M phase are called by the Contractor as "Care Services". Contractor Care aims at ensuring network user's system availability and improving network performance. Care starts after the network user has accepted the network delivery (OAC), and continues for the Year-1 and Year-2 unless the Employer executes the option for continuing the contract for the Year-3.

The objective of this Maintenance Plan is to ensure the implementation of Contractor Care Services for the POWERGRID MW System. All Contractor's personnel involved with Maintenance activities shall be familiar with the contents of this document to ensure common understanding of POWERGRID's expectation and to deliver the agreed level of service and performance.

The objectives of the Maintenance Plan during Year-1, the Guaranteed Availability Period, are as per the clause 6.3.1 of Technical Specification (TS) in the Contract Agreement No C-11701-S859-1/542/III:

- Support establishing good working practises for Operation & Maintenance of POWERGRID MW Radio transmission network delivered by the Contractor
- Supporting the O&M competence transfer from the Contractor to POWERGRID
- Demonstrate the guaranteed availability of POWERGRID MW Radio transmission network delivered by the Contractor.

The objective of the maintenance plan during Year-2, the Extended Maintenance Contract, are (Refer to Clauses 6.3.2 and 6.3.3 of TS of the Contract Agreement No. C-11701-S859-1/542/III):

- Continue supporting the O&M competence transfer from Contractor to POWERGRID
- Support maintaining high network availability of POWERGRID wide-band transmission.

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2. NETWORK BRIEF

POWERGRID has awarded the contract for the supply of PDH transmission system for Northern Region Digital Microwave System (Telecommunication Package II) to Fortum Engineering Ltd, Finland. Fortum Engineering subcontracted the supply of network components along with NMS/100 Network Management System to Nokia Networks Ltd. The network spans over seven different states of India.

Simultaneously, to complete their wide-band network, POWERGRID established a number of fibre-optic links throughout the region by way of another contract with a third party (Telecommunication Package I).

The PDH transmission system is primarily composed of Primary order multiplexers along with Channel units, Digital Cross Connect equipment and DMR 2000 Microwave Radios. In order to monitor all these network elements, Contractor's NMS/100 Network Management System is supplied.

Consequent upon the operational acceptance the system Guaranteed Availability Period of ONE year will begin. During this period continuous availability of the system as per contract document will be maintained.

During the second year (Extended Maintenance Period) maintenance support of Fibre Optic Terminal Equipment shall be part of the scope of services.

2.1. Project Facts

The Northern Region power system interconnects the generation, transmission and distribution facilities of various constituents in 7 states as indicated below:

- New Delhi
- Himachal Pradesh
- Haryana
- Punjab
- Jammu & Kashmir
- Rajasthan
- Uttar Pradesh

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There are a total of 127 sites in these seven states and the network consists of the following systems/equipment.

Serial No	Type of System/Equipment	Quantity
01	MW/MW&FO/FO Stations	72/13/42
02	Microwave Antennas	204
03	Digital Microwave Radios (DMR-2000)	312
04	Primary Multiplex Equipment (DM2,DB2) along with channel units	186
05	Digital Cross-connect Equipment (DN2).	21
06	Fibre Optic Terminal Equipment	In accordance with E1 channel layout PGN - FA-SGENERAL-11/M5
07	Number of E1 channels	894
08	Number of channels (voice, sync data & async data circuits and management data channels)	963

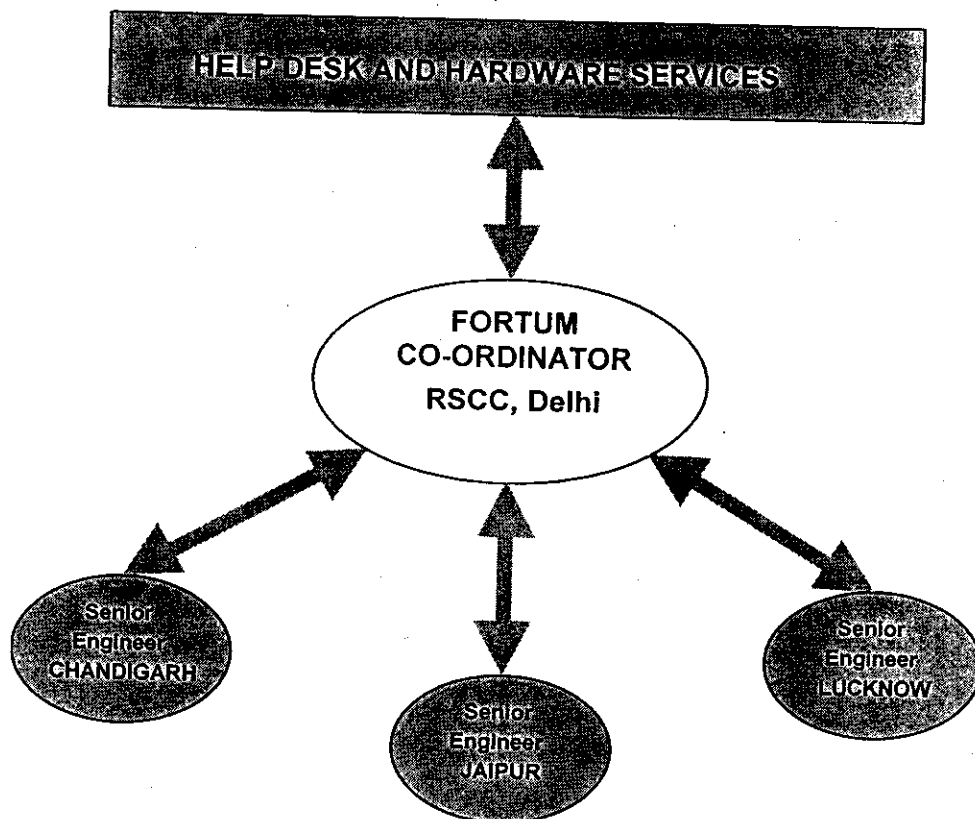
The Care activities for year-1 and processes described in this Maintenance Plan refer only to those network elements supplied by the Contractor. The complete network consists of a number of sites, which are spread across a number of states.

The vast expanse of network along with the substantial quantities of equipment demands proper placement of manpower in order to provide required system availability during the first year, the Guaranteed Availability Period. However it should be noted that Guranteed Availability Period of Year-1 is different from GSAT of 1000 hours in terms of scope and deliverables.

The manpower placement plan and implementation philosophy is described in detail in subsequent sections of this document.

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Thus a total of 4 people will be deployed at 4 locations (One person each at New Delhi, Chandigarh, Lucknow and Jaipur). The central control and monitoring of transmission system will be performed from RSCC in New Delhi by means of the NMS. The other three locations will work under the control/instructions of the Co-ordinator located in New Delhi. The resource deployment shall be suitably optimised to ensure the required availability. The control and reporting philosophy will be as indicated below:



3.2. Monitoring

Network is monitored during the year-1 using the NMS at RSCC. POWERGRID's Network monitoring consists of Operation of the Network. Network Monitoring Team shall start action without unreasonable delays in order to remove the root cause of the failure or to restore Operated Network functionality in case of a service affecting failure. When POWERGRID's Network Monitoring teams are unable to resolve the problem the problem will be escalated to Contractor's maintenance Teams. On issuance of Event Report by Network Monitoring Team, the on-site corrective actions shall be carried out by maintenance personnel for rectification.

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The Network Monitoring Team shall co-ordinate and control any site visits to verify that Operated Network is operating with a minimum of disruptions during these visits. The Network Monitoring Team will inform the relevant POWERGRID organisations utilising the transmission network about Operated Network availability and performance issues in a proactive manner.

The Network Monitoring Team shall maintain an operational logbook (format is found in appendix A) of the faults as reported by the NMS, the maintenance personnel and users of POWERGRID transmission network. The Network Monitoring Team shall also generate and track the Event Reports (format is found in appendix A).

The main responsibilities of the Network Monitoring Team are:

- POWERGRID's network monitoring at RSCC by utilising the Network Management System.
- Detecting faults, prioritising them and taking immediate actions to correct the faults, either restoration by Network Monitoring Team or an escalation for on-line fault rectification as required.
- Follow up on corrective actions to verify that the agreed time frames are met.
- Record all faults in the fault record sheet.
- Co-ordinate all planned site visits to minimise disturbance of Services.
- Update status information of Operated Network to users of POWERGRID transmission network.

Responsibilities: POWERGRID shall establish the Network Monitoring Team which will be monitoring the Network status by utilising the NMS at RSCC, New Delhi and which will be responsible for all activities co-ordination with the Contractor. In case of any fault noticed in the network an Event Report will be generated and forwarded to Contractor for remedial action.

3.3. Maintenance

YEAR-1 Maintenance activities are either event based (corrective maintenance) or planned site visits. Planned visits are mainly carried out during Working Days. Event based work is to be carried out round the clock.

Planned site visits shall be carried out semi-annually at all the sites in the network. Thus, during the period of first year, two planned site visits will be undertaken.

The tasks during the planned site visits for the System include:

- Visual inspection of equipment
- Alarm measurement verification
- Status report of site
- Updating of log records
- Cleaning the equipment

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Corrective maintenance is a fault correction process for Network Elements according to escalation from the Monitoring Team. In order to maximise efficiency non-urgent on-site fault corrections shall be combined with planned site visits whenever possible. Histories of the site visits will be maintained by contractor. History will include site name, visit date, actions done and site condition.

The scope of corrective maintenance is as follows:

- Troubleshooting on a network element and its interfaces
- Diagnostics on interfaces to locate problems in network elements and/or plug-in units.
- Identification of the faulty hardware unit, replacing it.
- Performance of function verification in co-operation with the NMS operator.

In cases when the service cannot be restored to the pre-incident level, the Contractor Maintenance Team escalates the failure according to the escalation chart presented in Section 7.1 of this document.

In cases when escalation is needed for correction of equipment not delivered by the Contractor (e.g. Fibre Optical link fault, Power system failure, etc.) the escalation shall be made to the 3rd party maintenance team by POWERGRID.

bold → Responsibility during the Year-2:

POWERGRID will be responsible for all maintenance activities during the Year-2. During this period contractor will have a maintenance team consisting of two (2) field engineers expert in all SC&C Project wideband telecommunications network equipment provided under Package 1 and Package 2 Procurements including the Fibre Optic Terminal Equipment and Digital Microwave system TNMS. The maintenance team shall be stationed normally at RSCC, New Delhi and shall be available during office hours, from 9 AM to 5:30 PM, with 30 minute lunch break, on POWERGRID working days. After office hours and on holidays, the field engineers shall be available on-call and shall report at RSCC within four hours of notification as required. The field engineers shall be required to report at wideband telecom equipment installation sites all over the region in response to maintenance calls, as and when required. The response time for the calls, irrespective of holidays shall be 24 hours for SLDCs and 48 hours for SubLDCs and other locations. The response time stated above will be relaxed only when all the field engineers are on maintenance calls outside RSCC. POWERGRID will provide to the maintenance team, office space at RSCC.

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3.4. Hardware Services (YEAR-1)

In case of any failure or malfunction discovered, the Network Monitoring Team or the Maintenance team shall identify the problem, replace the faulty Product with a spare unit and ship the faulty Product to the Contractor's designated premises for repair. Each faulty unit shall be returned with an accompanying, correctly filled-out Event Report. These forms will be provided by Contractor.

POWERGRID is responsible for the management of its spare part sets. Contractor shall effect the repair or replacement of the faulty products to POWERGRID's warehouse in accordance with the agreed turnaround time of 16 weeks (12 weeks for repairs + 4 weeks for overseas logistics and customs clearance). The turnaround time starts from arrival of the faulty unit with the Event Report at Contractor's Customer Service Centre, New Delhi, until the repaired unit has left the Contractor's premises for the POWERGRID stores.

In the event of a product being damaged beyond reasonable cost of repair the Contractor shall not be obliged to repair such a product but shall offer to POWERGRID a replacement product with a report describing the reasons for not to repair the faulty product.

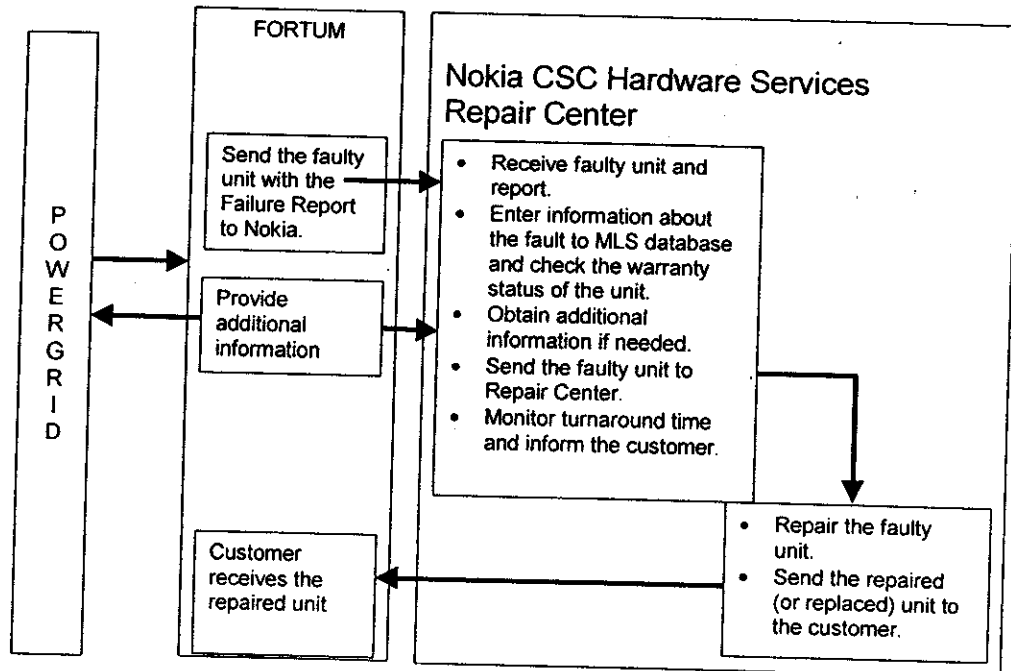
Contractor's obligation to repair or replace products does not cover any defects arising out of or in connection with any improper handling or use by POWERGRID or by external reasons, such as (but not limited to) excessive physical force, water or humidity or other detrimental environmental or operation conditions beyond the limits specified in the contract for each product, or having been modified or incorrectly repaired by an unauthorised party. In these cases the Contractor shall offer to POWERGRID a replacement product at an additional price with a report setting out the reasons for not to repair the defective product.

The HW repair warranty period is for one year from the date of operational acceptance of MW Radio system from the date of operational acceptance of the system by POWERGRID.

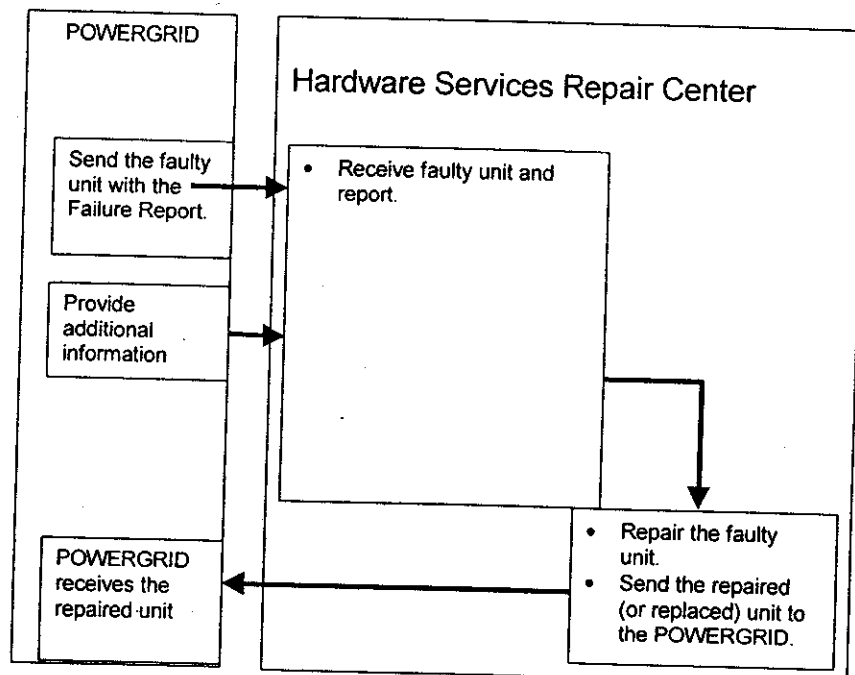
Contractor's hardware services also covers support for the HP hardware and operating system software supplied to POWERGRID. Contractor has tied up with HP for providing warranty support for Year-1. HP support shall be available same day at Delhi site and the next day for all other outstation sites after logging in of the faults.

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The following diagram outlines the hardware repair process provided by the Contractor during first year (the repair/replacement is part of warranty under off-shore contract).



The following diagram outlines the hardware repair process during second subsequent years. The hardware repair will be taken care by POWERGRID with equipment manufactures.



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Responsibilities:

Contractor will carry out the following tasks (Year-1):

- The logistics co-ordinator in Contractor Customer Service Centre (CSC) shall receive faulty units and check to ensure that the Event Report is properly completed.
- Monitor turnaround time and inform POWERGRID regarding the status of repair.
- Send the repaired unit to POWERGRID
- Replace faulty units from POWERGRID's own spares stock.
- Send faulty units to CSC with the correctly completed Failure Report with site information and symptoms of failure.
- POWERGRID shall follow any instructions and procedures with regard to unit or sub-unit shipment notified by Contractor

POWERGRID will carry out the following tasks second and subsequent years:

- Replace faulty units from POWERGRID's own spares stock.
- Send faulty units to manufactures CSC with the correctly completed Failure Report with site information and symptoms of failure.
- Provide information to Contractor regarding the replacement unit currently in operation.
- POWERGRID shall follow any instructions and procedures with regard to unit or sub-unit shipment notified by Contractor

POWERGRID has to furnish the following documents for enabling export of faulty units to Contractor Repair Centre:

- Original Bill of Entry documents.
- Invoice copy
- Authorisation letter to export faulty units.
- Fault Report duly filled

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4. MAINTENANCE SERVICES SUMMARY

The Care Services are summarised below.

4.1. Maintenance Services during Year 1

Period	One year
HARDWARE SERVICES	
Services	Repair and Return
Turnaround time	12 Weeks + 4 weeks for logistic & Custom clearance
ON-SITE SUPPORT / MAINTENANCE	
Scope	Four Engineers, including co-ordinator
Availability	5 days a week during the office hours. After office hours/Holidays Duty Phone to be contacted (with co-ordinator)
Tasks	Troubleshooting & Fault rectification
MAINTENANCE CORRECTIVE	
Equipment scope	Transmission equipment delivered by the Contractor
Service scope	Corrective Maintenance only
Availability	On-Call basis
Planned site visits	
Equipment scope	Transmission system delivered by the Contractor
scope	Visual inspection of equipment, Alarm measurement verification, Status report of site, Updating of log records, Cleaning the equipment
Availability	Semi-annual planned visits

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4.2. Maintenance Services during Year 2 (Extended Maintenance Contract)
(Subject to Agreement with POWERGRID and Contractor)

Planned site visits performed by POWERGRID as per contractor's guidelines		
	Equipment scope	Transmission system
	Scope	Visual inspection of equipment, Alarm measurement verification, Status report of site, Updating of log records, Cleaning the equipment
	Availability	Semi-annual planned visits to the sites which are not visited
ON-SITE SUPPORT / MAINTENANCE		
	Scope	Two Engineer's at Delhi as per Amendment (Appendix-1) to clause 6.3.3 of the contract document.
	Availability	6 days a week during office hours After office hours/Holidays Duty Phone to be Ccontacted (with Fortum co-ordinator)
	Tasks	Corrective maintenance On-Call basis. (POWERGRID to identify, diagnose the fault and inform Contractor for the required corrective actions)

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5. CALCULATION OF NETWORK AVAILABILITY

5.1. Introduction

This section describes the system availability calculation during the 1st year of operation – the "Guaranteed Availability Period" (GAP).

5.2. Performance

The performance is monitored by POWERGRID. During the GAP the availability of the channels will be observed by following up the status of various network components and, in case of fault of equipment by determining whether or not the fault affects the operation of channels.

Contractor will maintain record of events during the GAP.

The performance requirement shall be addressed only to the equipment provided by the Contractor under the Package II. Faults in the components not belonging to scope of Package II, or being not provided by Contractor, shall not be taken into account.

5.3. Repair

The representatives of POWERGRID participates in trouble shooting, change of unit etc. in every event case.

5.4. Conditions

During the GAP, no configuration changes shall be made to the system.

By mutual agreement any period of running with faulty equipment or any part of the network may be regarded as not part of the availability calculation.

Outage due to force major condition or outage due to failure or non-availability of other equipment (not provided by Fortum Engineering), i.e. SCADA network, power system equipment (or AC/DC) and other relevant equipment provided under separate packages shall not be taken into availability calculations.

Outage time definition:

An outage time refers to period in which loss of communication is detected on any part of the telecommunication network/equipment belonging to the scope of Package II contractor. The outage time starts at the time of event reported to the contractor and continues until the fault is cleared by taking into account conditions listed below.

- a) The time of unavailability excludes the transportation time to a faulty site average of twelve (12) hours and the time to get authorisation for access to the telecommunication room and to the equipment.

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- b) An event can not be considered as failure when the system features allow to continue the data/voice transmission subject to the following: For radio equipment when a component switches to standby on failure of redundant component, the down time will not be counted.
- c) Any failure in one category can not affect any other category, i.e. no reverberations to be considered (the failure of E1 will be counted as such and therefore no consequential lower level channel failure shall be accounted for).
- d) In case the loss of communication is detected in system of third party and no corresponding alarm is detected in TNMS. The event will be jointly studied with the parties and plan/schedule of fault finding will be made. In case during the fault finding other event occurs, travelling time of will not be calculated. In case the failure is in Package II equipment the actual fault rectification time will counted as down time.
- e) Average of the events, which are not equipment faults (AENF) will be calculated from GSAT result and adjusted to the GAP. This covers all outages, which are not equipment faults. The AENF average will be taken directly to outage calculation. During the GAP only event, which is resulted by fault accumulates the outage time.

If it is needed to pinpoint a fault, it is allowed to disconnect/loop circuits for trouble shooting. This testing time shall not be counted in the outage time calculations. However, interruption time for healthy channel should not exceed 30 minutes.

5.5. Documentation of GAP

Events shall be recorded by using of event form. The forms shall be filled in duly dated, timed and signed by representatives of both the parties. Absence of one or the other party's representative shall not render the record invalid but assumes only that such representative signs the record at his earliest convenience.

The initial situation in the system shall be recorded on the **Start Status** -form to constitute a reference for later events.

Any and all events, such as incoming and existing alarms, fault occurrences, actions taken for remedies, etc. shall be recorded in the **Event Report** -forms.

If a unit is replaced or repaired, both the new and the replaced or repaired unit is to be recorded in the Event Report -form.

5.6. Progress in brief

The following describes the task to be carried out during the GAP.

5.7. Start of GAP

Record the existing alarm status to Start Status -form.

Record other environmental or system status factors, if any, which may have effect on the system performance during the period.

5.8. GAP Period

Monitor the status of system components.

Locate faulty and malfunctioning system components, investigate reasons for them and decide actions to be taken for remedy.

Record faults to Event Report -form.

Maintain Outage Time Record.

5.9. END GAP

Determine the system availability.

When the GAP period is started, the telecommunication system is working normally.

5.10. Availability calculation formula

The system availability shall be calculated as follows:

$$A = \frac{T_t * Ch_t - \sum_{n=1}^{E_t} Ch_n * t_n}{T_t * Ch_t} 100\% - AENF$$

Where

A	=	System Availability [%]
T _t	=	Total test time [h], i.e. one year, (8760 h)
Ch _t	=	Total number of channels
E _t	=	Total number of events during the test
Ch _n	=	Number of channels affected by event E _n
t _n	=	Outage time of event E _n
AENF	=	Average of events not equipment fault, calculated from GSAT result.

5.11. Availability requirement

The availability of communication system shall be measured in categories as below:

- a) Channels (voice, sync data & async data circuits and management data channels)
- b) E-1 level channels

The availability requirement for E-1 level channels is 99.9% and availability requirement for other channels is 99.8%.

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6. CARE MANAGEMENT PRACTICES

6.1. Meeting Practices

Regular meetings between POWERGRID and the Contractor are vital for the communication and information flow between these two organisations.

6.1.1. Care Meeting

The purpose of the Care Meeting is to tackle the essential issues concerning the Care Services and network performance. The suggested schedule for Care Meetings is once every two month.

The meeting agenda shall be decided together with POWERGRID, and could for example consist of the following issues:

- Care Services and network performance according to the Care Report
- Review of Emergency Situation
- Status of Hardware Repair
- Action plan
- Next Care Meeting

The Contractor shall issue Minutes of the meeting.

The following participants should be present at this meeting:

- Co-ordinator (Contractor)
- Members of the Care team as needed (Contractor)
- Co-ordinator (POWERGRID)
- Operation and Maintenance staff as designated to attend (POWERGRID)

6.1.2. Emergency Meeting

Whenever a major outage occurs in any part of the network, an emergency meeting will be held. In the meeting, the outage will be discussed in the context of cause, correction, and prevention. The meeting is based on the emergency report generated by Contractor.

6.2. Reporting procedures

6.2.1. Care Report

The purpose of the Care Report is to summarise the Care activities performed during the reporting period. The Care Report provides information on the performance of Care Services and describes the current status of the network.

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The Care Report is a monthly report from Contractor to POWERGRID. The Care Report shows the trends in the network and in Services provided. By analysing the Care Report data, management and experts both at POWERGRID and Contractor are able to focus attention on the areas where further improvement is needed.

6.2.2. Other reports

Emergency reports

Contractor reports to POWERGRID every time the Emergency Call-Up or Call-Out service is invoked. In these cases, on termination of the emergency, all details of the fault and clearance information are submitted to POWERGRID within 5 working days.

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7. INTERFACES BETWEEN POWERGRID AND CONTRACTOR

7.1. Contractor Interfaces

The practical interface through which all problems identified by POWERGRID are to be reported to Contractor via Duty Phone.

Description	New Delhi	Chandigarh	Jaipur	Lucknow
Name				
Telephone				
Fax				
Email				

Co-ordinator:

Telephone:

Fax:

(Details to be provided later)

7.2. Contacts in POWERGRID

Name	Responsibility	Phone number Office Mobile	Fax number E-mail address

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APPENDIX A

REPORT FORMS

Guaranteed Availability Period

INDEX:

Start Status Form
Event Report Form
Outage Time table
Operation logbook

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START STATUS FORM

Page ____ / ____
Report No. ____

Start: Date ____ Time ____

System fully operable except for the following descriptions:

	Station	Description
1	_____	_____
2	_____	_____
3	_____	_____
4	_____	_____
5	_____	_____
6	_____	_____
7	_____	_____
8	_____	_____
9	_____	_____
10	_____	_____

Special test conditions or actions:

Attachments:

Initials:

POWERGRID _____ Contractor _____

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EVENT REPORT FORM

Event report No _____

Affected path:

Fault description: _____

A) Event start time date _____ time _____

HOLD TIME PERIOD

B) Failure within Contractor system

Yes _____ No _____

(If No then, date _____ time _____)

C) Entrance to site and room for rectification date _____ time _____

D) Rectification start time by Contractor

date _____ time _____

E) Fault fixed

date _____ time _____

Comments: _____

Initials: _____

Date _____

POWERGRID _____

Contractor _____

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