पावर सिस्टम ऑपरेशन कॉरपोरेशन लिमिटेड
(पावरग्रिड की पूर्ण स्वामित्व प्राप्त सहायक कंपनी)
POWER SYSTEM OPERATION CORPORATION LIMITED
(A wholly owned subsidiary of POWERGRID)

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CIN: U40105DL2009GOI188682

Ref. POSOCO/CERC/ 781

Date: 17th October 2016

To,

Secretary
Central Electricity Regulatory Commission
3rd and 4th Floor, Chanderlok Building,
36, Janpath
New Delhi – 110001

Subject: Suggestions on Draft Central Electricity Regulatory Commission (Communication System for inter-State transmission of electricity) Regulations, 2016.

Ref.: CERC public notice no. L-1/210/2016/CERC dated 07th September 2016

Madam,

The comments/suggestions invited by Hon'ble CERC as mentioned in the point 2 of CERC public notice no. L-1/210/2016/CERC dated 07th September 2016 on draft Central Electricity Regulatory Commission (Communication System for inter-State transmission of electricity) Regulations, 2016 is enclosed on behalf of NLDC and RLDCs.

Delay in submission of comments may kindly be condoned.

Thanking you.

Yours faithfully,

(KVS Baba)
Executive Director, NLDC

Enclosed: As mentioned above.

Inputs on the Draft Central Electricity Regulatory Commission (Deviation Settlement Mechanism and related matters) (Third Amendment) Regulations, 2015

Hon'ble Central Electricity Regulatory Commission issued a draft regulation on Communication System for inter-State transmission of electricity, 2016 issued vide public notice with ref. no. L-1/210/2016/CERC dated 07th September 2016 and invited comments comments/suggestions/objections by 10th October 2016.

A list of suggestions/comments is given below.

1. **Inputs on the specific clauses of the amended Regulations**

- **Clause 2, (g) Definitions and Interpretations**

Proposed:

g) "communication system" is a collection of individual communication networks, relaying stations, tributary stations, terminal equipment usually capable of interconnection and interoperation to form an integrated whole. It also includes existing communication system of Inter State Transmission System, Satellite and Radio Communication System and their auxiliary power supply system etc. used for regulation of interstate transmission of electricity;

Suggestion:

g) "communication system" is a collection of individual **communication media, terminal equipment, relaying stations, tributary stations, usually capable of interconnection and interoperation to form an integrated communication backbone for Power Sector. It includes the Auxiliary power supply system along with battery banks used to cater to the power supply of the communication equipment.** It also includes existing communication system **of Inter State Transmission System, Satellite and Radio Communication System and their auxiliary power supply system etc.**

Rationale:

Definition change for bringing in further clarity in the regulations.

- **Clause 2, (h) Definitions and Interpretations**

Proposed:

h) "Communication network" means a combination of media from one node to another node, either directly or through intermediary node(s);

Suggestion:

h) "Communication network" means **an interconnection of communication nodes through a combination of media either directly or through intermediary nodes";**

Rationale:

Definition change for bringing in further clarity in the regulation.

- **Clause 2, (i) Definitions and Interpretations**

Proposed:
(i) "Data" means is a set of values of analogue and digital signal including a text, voice, video, tele-protection, alarm and weather, parameter of a machine or the power system.
Suggestion:
(i) "Data" means is a set of values of analogue and digital signal including a text, voice, video, tele-protection, alarm, **control signals, switching device status, phasors,** weather **parameters**, parameter of a machine or the power system.
Rationale:
Definition change to include details of parameter which will be communicated from user end to control centre.

- **Clause 2, inserting new point (i), Definitions and Interpretations**

i) "Communication channel" means a dedicated virtual path configured from one user's node to another user's node, either directly or through intermediary node(s) to facilitate voice, video and data communication and tele-protection system;
Rationale:
Suggested a new definition. Communication channel is the virtual link finally assigned to the user for data voice communication. The final aim is to have dedicated reliable communication channel for the users.

- **Clause 4, Objective**

Proposed:
These regulations provide for planning, implementation, operation & maintenance and up-gradation of reliable communication system for all communication requirements including exchange of voice, video, data and tele-protection for inter-state transmission of electricity.
Suggestion:
These regulations provide for planning, implementation, operation & maintenance and up-gradation of reliable communication system for all communication requirements **in inter-state transmission of electricity** including exchange of **field data, phasors,** voice, video, data and tele-protection.
Rationale:
Field data and phasors are also required to be exchanged through the proposed communication links.

- **Clause 6, (i), Nodal Agency**

Proposed:

(i) The nodal agency for planning, and coordination for development of communication system for ISTS shall be the Central Transmission Utility (CTU).

Suggestion:

(i) The nodal agency for planning, and coordination for development of communication system for **Inter State Users** shall be the Central Transmission Utility (CTU).

Rationale:

The intent is to develop communication system for Inter State users who will be using the communication system for exchange of data.

- **Clause 6, (ii), Nodal Agency**

Proposed:

(ii) The nodal agency for planning, and coordination for development of communication system for intra state **transmission system** shall be the State Transmission Utility (STU).

Suggestion:

(ii) The nodal agency for planning, and coordination for development of communication system for intra State **Users** shall be the State Transmission Utility (STU).

Rationale:

More specific term shall be used to cover all users. The intent is to develop communication system for all Intra State users who will be using the communication system for exchange of data.

- **Clause 6, (iii) Nodal Agency**

Proposed:

(iii) Nodal agency for integration of communication system with SCADA, WAMS, VCS, AMR, EPABX, Tele-protection system shall be respective RLDC for ISTS and SLDCs for intra-State system.

Suggestion:

(iii) Nodal agency for integration of communication system with SCADA, WAMS, **Video Conferencing System**, **Automatic Meter Reading**, EPABX, Tele-protection system **at LDC end** shall be respective RLDCs **for Inter State system** and SLDCs for Intra state system.

Rationale:

Minor change suggested for bringing in further clarity in the regulations. The intent is to include all the control centres at regional and State level which includes Sub-LDCs / ALDCs RE developer's control centers.

- **Clause 7.1, (i), Role of CEA**

Proposed:

(i) CEA shall formulate communication planning criterion/ philosophy and guidelines for development of reliable Communication system for power system, duly considering requisite redundancy as well as requirements of smart grid and cyber security.

Suggestion:

(i) CEA shall formulate communication planning criterion/ philosophy and guidelines for development of reliable Communication system for power system, duly considering requisite **route** redundancy, **capacity, adequacy** as well as requirements of smart grid, **REMC/RE Generators (having capacity more than 50 MW)** and cyber security.

Rationale:

Route redundancy is important in case of communication failure in one path. Capacity requirements shall be taken care as in order to obtain desired bandwidth for data transfer. Communication planning for renewables, specially for RE generators for proposed implementation of control features, shall also be planned.

- **Clause 7.1, (iii), c, Role of CEA**

Proposed:

c. monitor and facilitate timely completion of schemes and projects for improving and augmenting the communication system along with transmission system in the power sector.

Suggestion:

c. monitor and facilitate timely completion of schemes and projects for improving and augmenting the communication system along with **existing and planned** transmission system in the power sector.

Rationale:

CEA shall consider communication system for both existing and planned transmission system.

- **Clause 7.2, (i) Role of CTU**

Proposed:

(i) The CTU shall in due consideration of the planning criteria/philosophy and guidelines formulated by CEA, be responsible for planning and coordination for development of reliable national backbone communication system among National Load Despatch Centre, Regional Load Despatch Centre(s) and State Load Despatch Centre(s) along with Central Generating Stations, ISTS Sub-Stations, UMPPs, inter-State generating stations, IPPs, renewable energy sources connected to the ISTS, Centralised Coordination/Control Centres for generation and transmission.

Suggestion:

(i) The CTU shall in due consideration of the planning criteria/philosophy and guidelines formulated by CEA, be responsible for planning and coordination for development of reliable national backbone **(along with appropriate protection path)** communication system among National Load Despatch Centre, Regional Load Despatch Centre(s), State Load Despatch Centre(s) **and REMCs** along with Central Generating Stations, ISTS Sub-Stations, UMPPs, inter-State generating stations, IPPs, renewable energy sources connected to the ISTS, Centralised Coordination/Control Centres for generation and transmission **using a latest technology.**

Rationale:

Generally communication path is provided with protection path (separate communication channel). In case of failure of the main channel / path, the data flow is automatically shifted to the protection path configured. This provides the reliability in the communication. The communication system should be

planned in such a manner such that sufficient capacity is available to provide protection path through physically separate route.

- **Clause 7.2, (iv) Role of CTU**

Proposed:
(iv) The CTU shall discharge the above function in consultation with the CEA, State Transmission Utilities, ISGS, IPPs, Regional Power Committees, NLDC and RLDCs.
Suggestion:
(iv) The CTU shall discharge the above function in consultation with the CEA, State Transmission Utilities, ISGS, IPPs, Regional Power Committees, NLDC, RLDCs **and SLDCs**.
Rationale:
Consultation with SLDCs shall also be done.

- **Clause 7.2, adding (v), (vi) and (vii), Role of CTU**

(v) CTU shall provide access to its communication node to interface the wideband network being implemented by State Transmission Utilities to have a single interconnected network and shall coordinate with State Utility for the interface requirement.

(vi) CTU shall be the Nodal Agency for supervision of communication system in respect of Interstate communication system and will implement centralized supervision for quick fault detection and restoration.

(vii) The CTU shall in consultation with STUs carry out the integrated planning for development of backbone communication systems providing interfaces to wideband communication networks of STUs at interface nodes.

Rationale:
CTU shall coordinate with STUs in order to have better integrated planning, reliable interfacing and effective supervision.

- **Clause 7.4, (i), Role of NLDC**

Proposed:
(i) The National Load Despatch Centre (NLDC) shall prepare and issue guidelines on the interfacing requirements in respect of terminal equipment, RTUs, SCADA, PMUs, Automatic Generation Control (AGC), AMI, etc. and for data communication from the User's point to the respective control centre(s) based on technical standards issued by CEA as mentioned in para 6.1 herein earlier. Till the time technical standards are framed by CEA, NLDC shall adopt necessary standards.
Suggestion:

(i) The National Load Despatch Centre (NLDC) shall prepare and issue guidelines on the interfacing requirements in respect of terminal equipment, RTUs, SCADA, PMUs, Automatic Generation Control (AGC), **Automatic Meter Reading**, etc. and for data communication from the User's point to the respective control centre(s) based on technical standards issued by CEA as mentioned in para 6.1 herein earlier. Till the time technical standards are framed by CEA, NLDC shall adopt necessary standards.

Rationale:

Minor change suggested by mentioning "Automatic Meter Reading" in place of "AMI".

- **Clause 7.4, (ii), Role of NLDC**

Proposed:

(ii) The National Load Despatch Centre shall be responsible for integration of the Communication system at NLDC end for monitoring, supervision & control of Power System and adequate data availability in real-time.

Suggestion:

(ii) The National Load Despatch Centre shall be responsible for integration of **their equipment to be used for monitoring, supervision &control of Power System and adequate data availability in real-time and Video Conferencing System, Automatic Meter Reading, EPABX, Tele-protection system at NLDC with Communication system provided to NLDC with necessary assistance from CTU.**

Rationale:

Detailing of equipment to be integrated using communication system shall be done.

- **Clause 7.5, (i), Role of RLDCs**

Proposed:

(i) The Regional Load Despatch Centre shall be nodal agency for integration of Communication system at RLDC end for monitoring, supervision & control of Power System and adequate data availability in real time.

Suggestion:

(i) The Regional Load Despatch Centre shall be nodal agency for integration of **their equipment to be used for monitoring, supervision &control of Power System and adequate data availability in real-time and Video Conferencing System, Automatic Meter Reading, EPABX, Tele-protection system at NLDC with** Communication System **provided to RLDC with necessary assistance from CTU/STU.**

Rationale:

Detailing of equipment to be integrated using communication system.

- **Clause 7.5, adding (iii) and (iv), Role of RLDCs**

(iii) RLDCs shall certify the availability of communication equipment based on the data furnished by CTU and shall report to the Commission on monthly basis.

(iv) RLDCs shall approach the Commission in case of repeated non-compliance of the regulation and non-availability/intermittency of data.

Rationale:
Availability of communication system shall be certified by RLDCs. Non-compliance shall be reported to the Commission.

- **Clause 7.6, Role of SLDCs**

Proposed:
The State Load Despatch Centres shall be nodal agency for integration of Communication System in the STU network and shall be responsible for interfacing the telemetry system at SLDC end for monitoring, supervision & control of Power System and adequate data availability in real time.
Suggestion:
(i) The State Load Despatch Centres shall be nodal agency for integration of **their equipment with** Communication System in the STU network and shall be responsible for interfacing the telemetry system at SLDC end for monitoring, supervision & control of Power System and adequate data availability in real time.
Rationale:
Minor change suggested for bringing in further clarity in the regulations.

- **Clause 7.6, adding point (ii), Role of SLDCs**

(ii) SLDCs shall also be responsible for appropriate coordination for O&M with CTU / STU of all control center end communication equipment so that it remains healthy round the clock.

Rationale:
SLDCs shall participate in coordination of O&M related to communication equipment with CTU and STU.

- **Clause 7.7, (i), Role of STUs**

Proposed:
(i) The STU shall be responsible for planning and coordination for development of reliable backbone communication for data communication within a State among State Load Despatch Centres, DISCOM control centres along with Generating Stations in the State, STU Sub-Stations, IPPs, and renewable energy generators within State system.
Suggestion:
(i) The STU shall be responsible for planning and coordination for development of reliable backbone **/ protection** communication **system** for data communication within a State among State Load Despatch Centres **(Main, Back-up and Area/Sub-LDCs)**, DISCOM control centres along with Generating Stations in the State, STU Sub-Stations, IPPs, and renewable energy generators within State system.
Rationale:

Protection path is important in case of communication failure in main path. In case of LDCs, all hierarchical main and backup control centres.

- **Clause 7.8, (i), Role of Users and Requesters**

Proposed:
(i) The Requesters and Users including renewable energy generators shall be responsible for provision of compatible equipment for un-interrupted communication with the concerned control centres and shall be responsible for successful integration with the communication system provided by CTU/STU for data as per guidelines issued by NLDC.
They will be responsible for appropriate O & M arrangement along with time to time up gradation of their end equipment for keep it healthy so that SLDC/RLDC gets stable telemetry data etc. and vice versa.
Suggestion:
(i) The Requesters and Users including renewable energy generators shall be responsible for provision of compatible equipment **along with appropriate interface** for un-interrupted communication with the concerned control centres and shall be responsible for successful integration with the communication system provided by CTU/STU for data **and voice** communication as per guidelines issued by NLDC.
They shall be responsible for appropriate O & M arrangement along with time to time up gradation of their end equipment for keep it healthy so that SLDC/RLDC gets stable telemetry data etc. and vice versa.
Rationale:
Users shall be made responsible for interface equipment also. Voice communication shall also be provided by Users. Users shall be made responsible for O&M and necessary upgradation of equipment from time to time.

- **Clause 7.8, (iii), Role of Users and Requesters**

Proposed:
(iii) The Users shall also be responsible for expansion /up gradation as well as operation and maintenance of communication equipment at their terminal.
Suggestion:
(iii) The Users shall also be responsible for expansion /up gradation as well as operation and maintenance of communication equipment **owned by them, if any,** at their terminal **end, interface ends and LDC end.**
Rationale:
Minor change suggested for bringing in further clarity in the regulations.

- **Clause 7.8, adding (iv), Role of Users and Requesters**

(iv) The requesters and users shall be responsible for successful integration of data, voice and video at LDC system.

Rationale:
The users shall be held responsible for its corresponding integrating data, voice and video to the respective LDCs.

- **Clause 8.2, Boundary of the ISTS communication system**

Proposed:
In addition to the above, the wideband communication systems shall be planned prospectively considering the expected nodes by the respective agencies and all Grid station including polling stations may be considered for Broad Band Communication system in consultation with standing Committee to be constituted by CEA.
Suggestion:
In addition to the above, the wideband communication systems shall be planned **comprehensively and** prospectively considering the expected **upcoming** nodes by the respective agencies and all Grid station including pooling stations may be considered for Broad Band Communication system in consultation with standing Committee to be constituted by CEA.
Rationale:
Minor change suggested for bringing in further clarity in the regulations.

- **Clause 9, Access to Communication System**

Proposed:
Access to the communication system shall be allowed to the requester in line with the standards and guidelines issued under the Regulations.
Suggestion:
Access to the communication system shall be allowed to the requester in line with the standards and guidelines issued under the Regulations.
All CTU/STU/User/SLDC/RLDC shall share/give access to their infrastructure/space/network for common cause.
Rationale:
Sharing access by CTU/STU/RLDC/SLDC and Users is important to carry out the integration work effectively and in time.

- **Clause 10, (i) Periodic testing of the Communication System**

Proposed:
(i) All users that have provided the communication systems shall facilitate for periodic testing of the communication system as per the standards and guidelines issued under these regulations.

Suggestion:

(i) All users that have provided the communication **channels** shall facilitate for periodic testing of the communication system as per the standards and guidelines issued under these regulations.

Rationale:

Minor change suggested for bringing in further clarity in the regulations.

- **Clause 10, (ii) Periodic testing of the Communication System**

Proposed:

(ii) Testing process for communication network security should also be included even for third party system if exists.

Suggestion:

(ii) Testing process for communication network security should also be included even for third party system if exists.

Appropriate O & M arrangement / policy /procedure must be adopted for all communication equipment, in accordance with the guidelines to be prepared by CTU under these Regulations.

Rationale:

CTU shall prepare guidelines for O&M and all shall follow it as best practices for quality maintenance.

- **Clause 11, (i) Fault Reporting**

Proposed:

(i) RLDC and SLDC in case of outage of telemetered data, or communication failure shall inform the respective user so that the user can lodge complaints for failure of the communication to the communication system owner for quick restoration.

Suggestion:

(i) RLDC and SLDC in case of outage of telemetered data, or communication failure shall inform the respective user so that the user can **check its RTU/SAS/PMU and terminal communication equipment. In case outage pertains to communication system fault, the user shall** lodge complaints for failure of the communication **with** the communication system owner for quick restoration.

Rationale:

LDCs shall be able to check communication of its terminal equipment with RTU/SAS/PMU, etc. In case any failure is noticed then it shall lodge complaint with the communication system owner.

- **Clause 11, (iii) Fault Reporting**

Proposed:

No separate charges shall be paid for such route diversion or channel reallocation. However such rerouting shall be discontinued once the original channel restored.

Suggestion:

(iii) No separate charges shall be paid for such route diversion or channel reallocation. However such rerouting shall be discontinued once the original channel is restored.

Rationale:

Minor change suggested for bringing in further clarity in the regulations.

- **Clause 12, Communication System Availability**

Proposed:

The owner of communication system shall maintain the channel availability up to 99.9%.

Suggestion:

The owner of communication system shall maintain the **individual communication** channel availability of at least 99.9%.

The owner of communication system shall maintain the availability of all communication equipment at the respective nodes of at least 99.9%.

The owner of the communication system shall maintain the availability of the communication media of at least 99.9%.

The owner of the communication system shall maintain the availability of the auxiliary power supply of at least 99.9 %.

The mechanism for calculation of availability shall be detailed in the procedure to be prepared by NLDC and amended from time to time.

The availability thus calculated shall have suitable implications while determining the tariff as per Terms and Conditions of Tariff Regulation for communication system.

The communication system shall be restored within 4 hours of reporting the fault to the concerned service provider i.e. CTU/STU. However service provider shall also have centralized monitoring for detection of fault and failure for quick restoration of the communication system.

Rationale:

Availability percentages are defined at different level of requirements to ensure reliability.

- **Clause 13, (ii), Cyber Security**

Proposed:

(ii) **NLDC,** shall monitor case of cyber security-incidences and discuss them at RPC level and take necessary action as deemed fit.

Suggestion:

(ii) **CTU** shall monitor case of cyber security-incidences and discuss them at RPC level and take necessary action as deemed fit.

Rationale:

A nodal agency needs to be designated for cyber security monitoring. Since, CTU will be having major communication network owned by it, they will have knowledge and experience to oversee this activity and, hence it shall be responsibility of CTU to handle cyber security incidences.

- **Clause 13, adding point (iii), Cyber Security**

(iii) Third party cyber security audits shall be conducted annually and appropriate measures shall be implemented to comply with the findings of the audits.

Rationale:

Conducting third-party cyber security audits and implementing its findings is a must for securing system from vulnerability.

- **Clause 14, Guidelines to be issued by NLDC**

Renamed as Clause 14 (i) Guidelines to be issued by NLDC

- **Clause 14, (i), Guidelines to be issued by NLDC**

Proposed:

(i) Subject to the provisions of these regulations, NLDC shall submit the Guidelines for Interfacing Requirements to the Commission for approval within 60 days of notification of these regulations in the Official Gazette:

Provided that prior to submitting the guidelines to the Commission for approval, NLDC shall make the same available to the public and invite comments by putting the draft on its website and giving a period of one month to submit comments; Provided further that while submitting the detailed procedure to the Commission, NLDC shall submit a statement indicating as to which of the comments of stakeholders have not been accepted by it along with reasons thereof.

Suggestion:

(i) Subject to the provisions of these regulations, NLDC shall submit the Guidelines for Interfacing Requirement **between different communication equipment at individual nodes, calculation of availability of the communications equipment i.e. MUX, Media, Power supply equipment etc., and individual communication channel** to the Commission for approval within 60 days of notification of these regulations in the Official Gazette:

Provided that prior to submitting the guidelines to the Commission for approval, NLDC shall make the same available to the public and invite comments by putting the draft on its website and giving a period of one month to submit comments; Provided further that while submitting the detailed procedure to

the Commission, NLDC shall submit a statement indicating as to which of the comments of stakeholders have not been accepted by it along with reasons thereof.

Rationale:

Minor change suggested for bringing in further clarity in the regulations.

- **Adding a new clause 14 (ii) titled "Guidelines to be issued by CTU"**

Subject to the provisions of these regulations, CTU shall submit the Guidelines for O&M of communication system, detailing the procedure routine maintenance, fault reporting and rectification process to the Commission for approval within 60 days of notification of these regulations in the Official Gazette:

Provided that prior to submitting the guidelines to the Commission for approval, CTU shall make the same available to the public and invite comments by putting the draft on its website and giving a period of one month to submit comments; Provided further that while submitting the detailed procedure to the Commission, CTU shall submit a statement indicating as to which of the comments of stakeholders have not been accepted by it along with reasons thereof.

Rationale:

O&M guidelines shall be made by CTU and submitted to Commission within 60 days for approval.

- **Clause 17, Power to remove difficulty**

Proposed:

If any difficulty arises in giving effect to the provisions of these regulations, the Commission may, by order, make such provision with the provisions of the Act or provisions of other regulations specified by the Commission, as may appear to be necessary for removing the difficulty in giving effect to the objectives of these regulations.

Suggestion:

If any difficulty arises in giving effect to the provisions of these regulations, the Commission may, by order, make such provision **consistent** with the provisions of the Act or provisions of other regulations specified by the Commission, as may appear to be necessary for removing the difficulty in giving effect to the objectives of these regulations.

Rationale:

Minor change suggested for bringing in further clarity in the regulations.

- **Adding Clause 18, Computation and Payment of Communication Asset Charge for Inter-State Communication System**

(1) The fixed cost of the communication system forming part of the communication backbone network shall be computed on annual basis, in accordance with norms contained in these regulations, aggregated

as appropriate, and recovered on monthly basis as Communication charge from the users, who shall share these charges in the manner specified in this regulations.

(2) The Communication charge payable for a calendar month for Communication system or part shall be:

a) For CAFM < 99.9%

AFC x (NDM/NDY) x (CAFM/99.9%)

b) For CAFM: 99.9%≤ CAFM ≤ 100.00%

AFC x (NDM/NDY) x 1.0

where,

AFC = Annual Fixed Cost specified for the year in Rupees
NACAF = Normative annual Communication availability factor, in per cent
NDM = Number of days in the month
NDY = Number of days in the year
CAFM = Communication System availability factor for the month, in percent computed in accordance with ***Appendix I***.

Rationale:
Methodology for computation of availability linked annual changes is proposed in line with transmission tariff.

- **Adding relevant appendices for Clause 18, Computation and Payment of Communication Asset Charge for Inter-State Communication System**

Appendix-I

Procedure for Calculation of Communication System Availability Factor for a Month
Communication system availability factor for a calendar month (CAFM) shall be calculated by the respective Communication licensee, got verified by the concerned RLDC and certified by the Member-Secretary, Regional Power Committee of the region concerned, separately for each Communication system and grouped according to sharing of Communication charges. Communication System Availability shall be calculated separately for each Regional Communication System. For the purpose of calculation of CAFM:

i) Communication fibre: Each communication fibre optic cable / OPGW between two consecutive nodes shall be considered as one element.

ii) Multiplexing Unit (MUX) : Each MUX shall form one element.

iii) Transmitter / Receiver of Microwave link : Each pair of Transmitter/Receiver shall form one element

iv) Repeater Station : Each repeater station shall be considered as one unit

v) EPABX Unit : Each EPABX system will be considered as one unit

vi) Communication channel : Each communication channel configured more than 2 mbps shall be considered as one unit

2. The Availability of Communication system shall be calculated as under:

% CAFM for Communication system

$$= \frac{o \times AVo + p \times AVp + q \times AVq + r \times AVr + s \times AVs + t \times AVt}{o + p + q + r + s + t} \times 100$$

Where

o = Total number of Fibre optic cable.
AVo = Availability of o number fibre optic cable.
p = Total number MUXs
AVp = Availability of p number MUX
q = Total number of Transmitter/Receiver
AVq = Availability of q number Transmitter/Receiver.
r = Total number of EPABX Unit
AVr = Availability of r number of EPABX Unit
s = Total number of Repeater Station
AVs = Availability of s number of Repeater Station
t = Total number of Communication channel
AVt = Availability of t number Communication channel

3. The weightage factor for each category of communication elements shall be as under:

a) For each fibre optic cable : the no. of fibre within the cable
b) For each MUX : the multiplexing order i.e. STM – 4 / STM - 16
c) For repeater station : the multiplexing order
d) For each communication channel : the bandwidth i.e. 2/4/8/... mbps
e) For exchange : No of subscribers as per design

4. The availability for each category of Communication elements shall be calculated based onthe weightage factor, total hours under consideration and non-available hours for each element of that category. The formulae for calculation of Availability of each category of the transmission elements are as per **Appendix-II**.

W_k = Weightage factor for k_{th} repeater station

Wl = Weightage factor for l_{th} communication channel

Wm = Weightage factor for m_{th} EPABX

T_i, Tj, T_k, T_l, T_m, - The total hours of i_{th} Fibre Optic Cable, j_{th} MUX, k_{th} Repeater, l_{th} Communication channel, m_{th} EPABX

T_{NAi} ,T_{NAj} , T_{NAk} T_{NAl}, T_{NAm} - The non-availability hours (excluding the time period for outages

, not attributable to Communication provider taken as deemed availability) for i_{th} Fibre Optic Cable, j_{th} MUX, k_{th} Repeater, l_{th} Communication channel, m_{th} EPABX.

Rationale:

Relevant appendices related to methodology for computation of assets charges.