

**Testing Requirements of Optical Cables  
Forming the PPC-NET Telecommunication System**

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## 1. Overview

### 1.1 Aim

These requirements set forth the testing and acceptance procedures relating to fibre-optic connections that make up PPC-NET Telecommunication System.

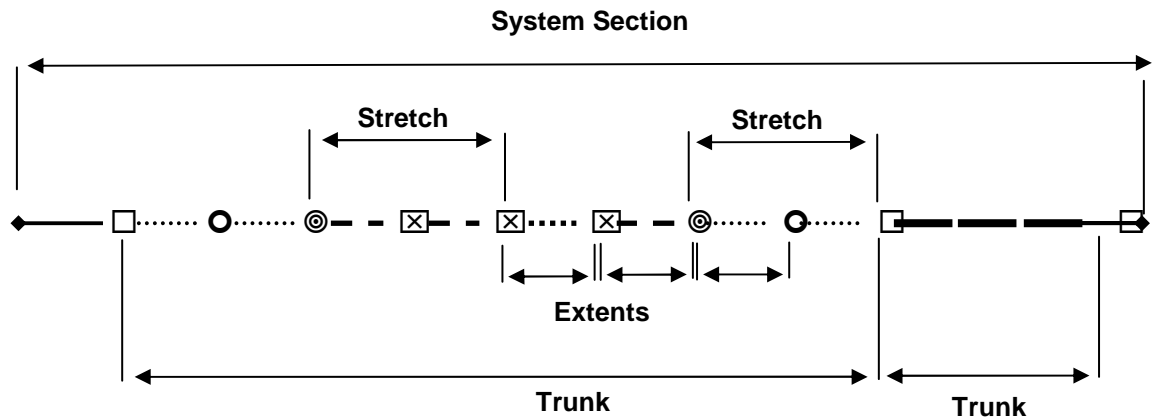
### 1.2 Definitions

- 1.2.1 **Extent** Optical connection element covering the distance between two splices or the distance between one splice and one termination;
- 1.2.2 **Stretch Optical** connection element characterised by homogeneity of the means of support of the optical cable;
- 1.2.3 **Trunk** Optical connection comprising one or more Stretch associated with a power line, unions between connection boxes and the two station unions (tails), if any, consisting of fibre-optic cables laid inside the electric systems;
- 1.2.4 **System Section** Optical connection consisting of one or more trunks terminated at both the edges by terminations; it is located between two sites fitted with telecommunication equipment housed in shelters and other appropriate rooms.

### 1.3 System Section Layout

The layout of a system section can be summarised as shown in the figure 3.1 below:

Figure 1.3.1



- |       |  |
|-------|--|
| ..... | Wire-wrap dielectric cable stretch   |
| - - - | Optical overhead ground wire stretch   |
| ..... | Dielectric cable stretch   |
| ◆—    | Monofibre with termination   |
| □     | Terminal connection  |
| ○     | Connection between dielectric cable stretches                                |
| ⊗     | Connection between optical overhead ground wire stretches                    |
| ⊙     | Connection between optical overhead ground wire and dielectric cable stretch |

## **2. System Section Testing**

### **2.1 List of tests**

The testing of each system section will entail the following measurements:

- total loss (dB);
- optical length of section (km);
- insertion loss of terminations (dB);
- reflection loss of terminations (dB).

The above measurements will be carried out on a bi-directional basis using the reflectometric method at wavelengths of 1310 and 1550 nm.

**Moreover is required the PMD test (Polarisation Mode Dispersion) at 1550 nm and 1625nm.**

With respect to each measurement, each graphic pattern and the event log must be stored on a floppy disk (1.44 MB). If the measurement (relating to the same system section) requires impulses of different length, then measurements pertaining to all impulses used must be stored individually.

### **2.2 Testing Procedure**

System section testing must be bi-directional.

Acceptance tests will be carried out by the CONTRACTOR, in presence of PPC and EVERGY Technicians.

The object of testing are the sections listed in Annex 1 with their relative acceptance value.

These acceptance value have been determined using the following parameters as shown in the table 2.2 below:

Table 2.2

|  |        | <b>G.652.B</b> | <b>G.655.B</b> |
|--|--------|----------------|----------------|
| Fibre loss                               | dB/km  | 0.26           | 0.28           |
| Fibre extent                             | km     | 2.5            | 2.5            |
| Individual splice connection loss (n<16) | dB     | 0.1            | 0.1            |
| Averaged splice loss (n>=16)             | dB     | 0.04           | 0.04           |
| Termination loss                         | dB     | 0.6            | 0.6            |
| Dielectric cable stretch average length  | km     | 0.5            | 0.5            |
| Stretching factor                        |        | 1.03           | 1.03           |
| Section margin                           | dB     | 0.5            | 0.5            |
| Maximum PMD <sub>Q</sub>                 | ps/√km | 0.5            | 0.5            |

Afterwards threshold values will be determined for each section beyond which the optical continuity of the section will be considered interrupted. These threshold values will be determined on the base of the span budget of the equipment.

Further information required is indicated in the Annex 2.

The test procedure will include a possible test of the section by PPC and EVERGY after the “fibre ready” communication from “CONTRACTOR”. In case of different results between two measurements is possible to require the test of the section by a third part. EVERGY, PPC and CONTRACTOR will be obliged to accept the result of the test by the third party.

A detailed description of the procedure and of the timing of the tests is shown in Annex 3.

### 2.3 Testing Report Sheets

Testing papers will comprise:

- System Section Test Sheet (Annex 4);
- System Test and Acceptance Report (Annex 5).

Prior to testing a system section, loss information pertaining to the trunks forming such section and the number of additional splices must be entered in the Test Sheet.

Based on this information, the reference value to be entered in the section Test Sheet must be determined.

During the system section test performing, both the “section Test Sheet” and “system Test and Acceptance Report” must be filled in. The Test Sheet of each section will comprise the information as outlined below:

- Contractor's name
- PPC territorial division and office in charge
- EVERGY division and office in charge
- Name of site 1
- Name of site 2
- Code of power lines forming the system section
- Test date
- Types of optical cable
- Types of installation (OPGW 10.8 or OPGW 13.0 or OPGW 20.3, OPPC, underground cable.
- Cable manufacturer
- Real length of system section.

With respect to each system section will also be required to be provided the following documents:

- Date of acceptance of fibre optics at factory;
- Report (on a floppy disk) of measurements performed at the time of installation.

### **3. Instruments**

To perform the checks and test measurements referred to above, it is advisable to be agreed between CONTRACTOR, PPC and EVERGY the choice of the instruments among those listed in the table 3.1 below:

Table 3.1

| <b>Manufacturer</b> | <b>OTDR</b>                  | <b>Mini OTDR</b>        | <b>PMD Instrument</b> |
|---------------------|------------------------------|-------------------------|-----------------------|
| ACTERNA             | HELIOS                       | MTS5200                 |                       |
| AGILENT             |                              | E6000                   |                       |
| ANDO                | AQ7140B<br>AQ7140D<br>AQ7210 | AQ7220                  |                       |
| ANRITSU             | MW9005<br>MW9040<br>MW9060   | MW9070A<br>MW9070B      |                       |
| EXFO                | FTB 7000B                    | FTB 100                 | FTB 5500              |
| GN NETTEST          |                              | MODEL 7500              | NEXUS                 |
| TEKTRONIX           | TPF2                         | TFS3031-I<br>TFS3031-II |                       |

**Annex 1**  
**List of the Sections**

**Annex 2**  
**Data ranking for acceptance tests**

In order to make homogeneous and able to process test data of optical cables making up the PPC-NET system it is mandatory to rank report relevant the tested system sections as following:

**General data**

- Contractor's name
- PPC territorial division and office in charge
- EVERGY division and office in charge
- Name of site 1
- Name of site 2
- Code of power lines forming the system section
- Test date
- Types of optical cable
- Types of installation (OPGW 10.8 or OPGW 13.0 or OPGW 20.3, OPAC, underground cable).
- Cable manufacturer
- # of optical fibres
- Length of power line.

**Measurements**

- Total optical length of system section
- Total loss carried out on a bi-directional basis at wavelengths of 1310, 1550 and 1625 nm
- Loss and distance of the splices on a bi-directional basis at wavelengths of 1310, 1550 and 1625 nm with splice/pylon association
- Termination insertion and termination reflection loss of the terminal connectors.

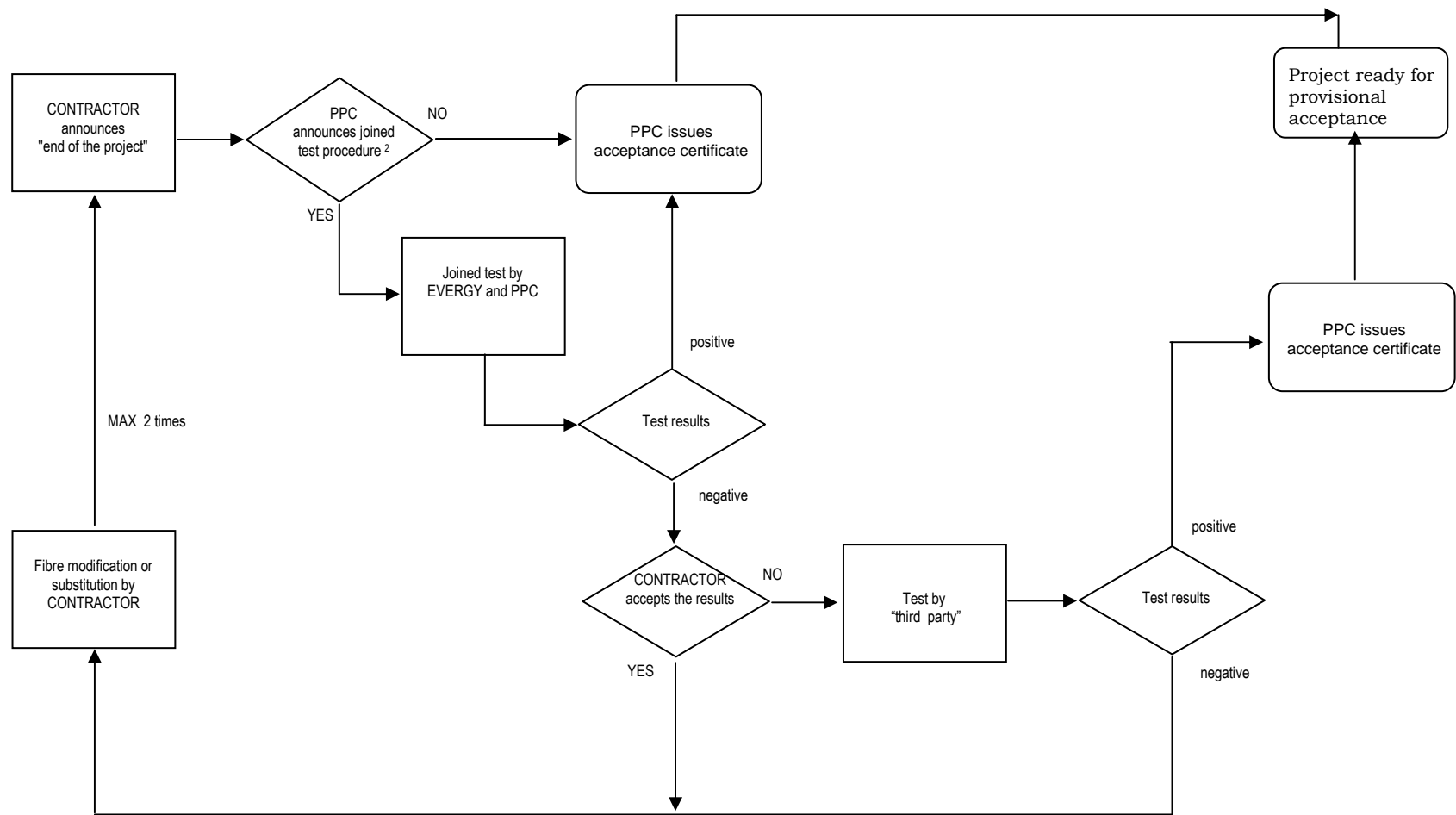
For each measurement carry out is required to provide the following data:

- Date
- Fibre position in the cable: tube or groove, colour.

With respect to each measurement, each graphic pattern and the event log must be stored on a floppy disk (1.44 MB) in duplicate. If the measurement (relating to the same system section) requires impulses of different length, then measurements pertaining to all impulses used must be stored individually.

### **Annex 3**

#### **Flow-chart of the test procedure**



## **Annex 4**

### **System Section Test Sheet**

#### Annex 4 - System Section Test Sheet

|   |              |  |  |
|---|--------------|--|--|
| SYSTEM SECTION - TEST SHEET (1/3)       |              |  |  |
| Place A                                 |              |  |  |
| Place B                                 |              |  |  |
| Place of measurement                    |              |  |  |
| Date                                    |              |  |  |
| Contractor                              |              |  |  |
| PPC Division/Office in charge           | Transmission |  |  |
|   |              |  |  |
|   |              |  |  |
|   |              |  |  |
|   |              |  |  |
|   |              |  |  |
|   |              |  |  |
|   |              |  |  |
|   |              |  |  |
|   | Distribution |  |  |
|   |              |  |  |
|   |              |  |  |
|   |              |  |  |
|   |              |  |  |
|   |              |  |  |
|   |              |  |  |
|   |              |  |  |
|   |              |  |  |
|   |              |  |  |
|   |              |  |  |
|   |              |  |  |
|   |              |  |  |
| EVERGY – Territorial Division in charge |              |  |  |
|   |              |  |  |
|   |              |  |  |
|   |              |  |  |
| Line Codes                              |              |  |  |
|   |              |  |  |

|                                    |  |                   |  |
|------------------------------------|--|-------------------|--|
|                                    |  |                   |  |
| Type of optical cable              |  | 24-fibre          |  |
|                                    |  | 48-fibre          |  |
|                                    |  | 100-fibre         |  |
|                                    |  |                   |  |
|                                    |  |                   |  |
| Type of installation               |  | OPGW 10.8         |  |
|                                    |  | OPGW 13.0         |  |
|                                    |  | OPGW 20.3         |  |
|                                    |  |                   |  |
|                                    |  | OPPC              |  |
|                                    |  | Underground cable |  |
|                                    |  |                   |  |
| Real length of system section (km) |  | SUPPLIER 1        |  |
|                                    |  | SUPPLIER 2        |  |
|                                    |  | SUPPLIER 3        |  |
|                                    |  |                   |  |
|                                    |  |                   |  |
|                                    |  |                   |  |
|                                    |  |                   |  |

| SYSTEM SECTION – TEST SHEET (1/3) |      |                 |                               |                           |                                  |        |                                   |        |
|-----------------------------------|------|-----------------|-------------------------------|---------------------------|----------------------------------|--------|-----------------------------------|--------|
| Station A                         |      |                 |                               |                           |                                  |        |                                   |        |
| Station B                         |      |                 |                               |                           |                                  |        |                                   |        |
| Place of measurement              |      |                 |                               |                           |                                  |        |                                   |        |
| N°                                | Type | Total Loss (dB) | Average connections Loss (dB) | Total Optical Length (km) | Terminations Insertion Loss (dB) |        | Terminations Reflection Loss (dB) |        |
|                                   |      |                 |                               |                           | Side A                           | Side B | Side A                            | Side B |
| Ref                               |      |                 |                               |                           | 0.6                              | 0.6    | 40                                | 40     |
| 1                                 |      |                 |                               |                           |                                  |        |                                   |        |
| 2                                 |      |                 |                               |                           |                                  |        |                                   |        |
| 3                                 |      |                 |                               |                           |                                  |        |                                   |        |
| 4                                 |      |                 |                               |                           |                                  |        |                                   |        |
| 5                                 |      |                 |                               |                           |                                  |        |                                   |        |
| 6                                 |      |                 |                               |                           |                                  |        |                                   |        |
| 7                                 |      |                 |                               |                           |                                  |        |                                   |        |
| 8                                 |      |                 |                               |                           |                                  |        |                                   |        |
| 9                                 |      |                 |                               |                           |                                  |        |                                   |        |
| 10                                |      |                 |                               |                           |                                  |        |                                   |        |
| 11                                |      |                 |                               |                           |                                  |        |                                   |        |
| 12                                |      |                 |                               |                           |                                  |        |                                   |        |
| 13                                |      |                 |                               |                           |                                  |        |                                   |        |
| 14                                |      |                 |                               |                           |                                  |        |                                   |        |
| 15                                |      |                 |                               |                           |                                  |        |                                   |        |
| 16                                |      |                 |                               |                           |                                  |        |                                   |        |
| 17                                |      |                 |                               |                           |                                  |        |                                   |        |
| 18                                |      |                 |                               |                           |                                  |        |                                   |        |
| 19                                |      |                 |                               |                           |                                  |        |                                   |        |
| 20                                |      |                 |                               |                           |                                  |        |                                   |        |
| 21                                |      |                 |                               |                           |                                  |        |                                   |        |
| 22                                |      |                 |                               |                           |                                  |        |                                   |        |
| 23                                |      |                 |                               |                           |                                  |        |                                   |        |
| 24                                |      |                 |                               |                           |                                  |        |                                   |        |

| SYSTEM SECTION – TEST SHEET (2/3) |      |                 |                               |                           |                                  |        |                                   |        |
|-----------------------------------|------|-----------------|-------------------------------|---------------------------|----------------------------------|--------|-----------------------------------|--------|
| Station A                         |      |                 |                               |                           |                                  |        |                                   |        |
| Station B                         |      |                 |                               |                           |                                  |        |                                   |        |
| Place of measurement              |      |                 |                               |                           |                                  |        |                                   |        |
| N°                                | Type | Total Loss (dB) | Average connections Loss (dB) | Total Optical Length (km) | Terminations Insertion Loss (dB) |        | Terminations Reflection Loss (dB) |        |
|                                   |      |                 |                               |                           | Side A                           | Side B | Side A                            | Side B |
| Ref                               |      |                 |                               |                           | 0.6                              | 0.6    | 40                                | 40     |
| 25                                |      |                 |                               |                           |                                  |        |                                   |        |
| 26                                |      |                 |                               |                           |                                  |        |                                   |        |
| 27                                |      |                 |                               |                           |                                  |        |                                   |        |
| 28                                |      |                 |                               |                           |                                  |        |                                   |        |
| 29                                |      |                 |                               |                           |                                  |        |                                   |        |
| 30                                |      |                 |                               |                           |                                  |        |                                   |        |
| 31                                |      |                 |                               |                           |                                  |        |                                   |        |
| 32                                |      |                 |                               |                           |                                  |        |                                   |        |
| 33                                |      |                 |                               |                           |                                  |        |                                   |        |
| 34                                |      |                 |                               |                           |                                  |        |                                   |        |
| 35                                |      |                 |                               |                           |                                  |        |                                   |        |
| 36                                |      |                 |                               |                           |                                  |        |                                   |        |
| 37                                |      |                 |                               |                           |                                  |        |                                   |        |
| 38                                |      |                 |                               |                           |                                  |        |                                   |        |
| 39                                |      |                 |                               |                           |                                  |        |                                   |        |
| 40                                |      |                 |                               |                           |                                  |        |                                   |        |
| 41                                |      |                 |                               |                           |                                  |        |                                   |        |
| 42                                |      |                 |                               |                           |                                  |        |                                   |        |
| 43                                |      |                 |                               |                           |                                  |        |                                   |        |
| 44                                |      |                 |                               |                           |                                  |        |                                   |        |
| 45                                |      |                 |                               |                           |                                  |        |                                   |        |
| 46                                |      |                 |                               |                           |                                  |        |                                   |        |
| 47                                |      |                 |                               |                           |                                  |        |                                   |        |
| 48                                |      |                 |                               |                           |                                  |        |                                   |        |

**SYSTEM SECTION – ACCEPTANCE REPORT**

Date .....

In the presence of the representatives of PPC, Messrs:

.....  
and EVERGY, Messrs :

.....

Tests were performed with respect to system section of:

Place A.....

Place B.....

Based on the tests and measurements as performed, the aforesaid system section is accepted by PPC and EVERGY

YES     ☐

NO     ☐

Signed by PPC

Signed by EVERGY

.....

.....

Representatives of CONTRACTOR Messrs:

.....

declare:

- ☐ accept the result of the test
- ☐ do not accept the result of the test, requiring in case the test has had a negative value the test
- ☐ by a “third party” or consultant

Signed by PPC

Signed by EVERGY

.....

.....