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Technical  
Specification

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Cable Cooling  
Systems

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## CABLE COOLING SYSTEMS

### FOREWORD

*This Specification forms part of a suite of documents which define The National Grid Company plc (NGC) requirements for new plant. The Level 2 Specifications for cable, NGTS 2.5, covers major requirements and there is a series of Level 3 Specifications covering various specific requirements.*

### 1 SCOPE

This document is a Level 3 Specification giving the requirements for separate pipe cable cooling systems.

### 2 REFERENCES

|             |                                                                                                                                                                                                                                                 |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| BSI 2782    | Methods of Testing Plastics Part II Method 1101A: Measurement of Dimensions of Pipes                                                                                                                                                            |
| BSI 4728    | Determination of the Resistance to Constant Internal Pressure of Thermoplastic Pipe                                                                                                                                                             |
| BSI 5556    | General Requirements for Dimensions and Pressure Ratings for Pipe of Thermoelastic Materials                                                                                                                                                    |
| IEC 60050   | International Electrotechnical Vocabulary                                                                                                                                                                                                       |
| NGTS 1      | Ratings and General Requirements for Plant, Equipment, Apparatus and Services for The National Grid System and Direct Connections to It.                                                                                                        |
| NGTS 2.5    | 132 kV, 275 kV and 400 kV Single Core Cable                                                                                                                                                                                                     |
| NGTS 3.5.9  | Cable Oil Pressure Monitoring                                                                                                                                                                                                                   |
| NGTS 3.12.1 | 48 Volt D.C. Supplies                                                                                                                                                                                                                           |
| WIS 4-32-13 | Specification for blue higher performance polyethylene HPPE/PE100, pressure pipes (Stewarts & Lloyds Plastics EXCEL), nominal size 90 mm - 100 mm, for underground or protected use for the conveyance of water intended for human consumption. |

### 3 DEFINITIONS

#### 3.1 General

The terms used in this document are specified in IEC 60050 with the following additional definitions:

#### 3.2 Go and Return Pipes and Cooling Station

Cable circuits used by NGC normally consist of three single phase cables laid in flat formation. Cable cooling systems normally involves pumping cold water down two Go Pipes laid between the centre and outer cables and returning it back to the heat exchanger via a Return Pipe which is laid directly above each of the two outer cables. The length of cable circuit cooled by the cooling loops is called a Cooling Section. The Go and Return pipes are manifolded together at what is known as the turn round position.

For this type of system the term Cooling Station refers collectively to the heat exchangers, water pumps and control equipment associated with each cooling section.

A building may house more than one Cooling Stations.

## 4 GENERAL REQUIREMENTS

The rating of a naturally cooled cable system is dependent upon the rate by which heat generated in the cable can be discharged into the ground. Where natural heat dissipation is insufficient it will be necessary to either increase the heat dissipation by the use of water cooling or to use more than one cable per phase.

### 4.1 Pipe Scaling

To prevent scaling of the pipes the ph value of the cooling water shall not be allowed to fall below 9.0.

### 4.2 Water Additives

The use of any anti-corrosive or anti-freeze additives shall be subject to prior approval by NGC.

### 4.3 Water Cooling Pipes

#### 4.3.1 Dimensions

The outside diameter of the cooling pipe shall be in accordance with the dimensions given in BSI 556 Table 1.

Pipe lengths shall be agreed with NGC.

#### 4.3.2 Appearance and Surface Condition

The internal and external surfaces of the pipe shall be smooth and free from any defects which might impair the performance and/or life of the cooling system.

The end of the pipe shall be cut cleanly and square to the axis of the pipe to within the tolerances given in Table 1.

**Table 1 - Tolerances for Cut Ends**

| Nominal Outside Diameter (mm) | Maximum Tolerance (mm) |
|-------------------------------|------------------------|
| 50                            | 1.00                   |
| 63                            | 1.25                   |
| 75                            | 1.50                   |
| 90                            | 2.00                   |
| 125                           | 3.00                   |
| 140                           | 3.50                   |

#### 4.3.3 Storage

The ends of the pipe shall be plugged or covered.

Unless otherwise agreed all pipes supplied shall be extruded onto a drum comprising of a rigid framed reel with a supporting centre core to which the pipe is anchored. Whilst on the drum the pipe shall be protected against contamination, the effects of the weather and mechanical damage.



Each drum shall be capable of taking a round centre spindle and shall bear a distinguishing number secured to the outside of one flange. Branding or legibly chiselling are acceptable methods of marking.

The direction for rolling the drum shall be indicated by an arrow.

The particulars of the pipe such as the type, length and weight shall be legibly secured to one flange of the drum.

#### 4.3.4 Induced Voltage Effects

The underground water cooling pipes shall contain no metallic component.

#### 4.3.5 Identification Marking

The pipes shall be marked longitudinally at intervals not greater than 1 m along two strips on opposite sides of the pipe.

The marking shall not prejudice the performance of the pipes and shall remain legible following installation and throughout the required working life of the pipes.

The height of the characters shall be at least 3 mm for pipe sizes 90 mm or 110 mm outside diameter and at least 5 mm for pipe size 125 mm outside diameter and above.

The marking shall show the following:

- (i) The manufacturer's identification.
- (ii) The nominal size (outside diameter) and minimum wall thickness.
- (iii) Type of raw material used.

The words "NATIONAL GRID COMPANY WATER PIPE" shall be repeated at 1 m intervals along the length of the pipe.

#### 4.3.6 Pipe Joints

Preference will be given to pipe systems which can be welded together using butt-welding or electrofusion techniques.

#### 4.3.7 Environment

The Supplier shall ensure that the pipes are suitable for use in the cable backfill.

### 4.4 Cooling Stations

#### 4.4.1 Electricity Supplies

Main and backup a.c. electricity supplies shall be provided, these may be derived from NGC auxiliary supplies, another utility or standby generator.

Where there are main and standby a.c. supplies the following facilities shall be provided.

- (i) In the event of a permanent failure of the selected main supply when selected to automatic changeover, the cooling station shall automatically switch-over to the back-up supply.
- (ii) A lockable selector switch shall be provided to enable the main and standby supplies to be manually changed over.

- (iii) Interlocking shall be provided between the main and back-up supplies to ensure that the two supplies can not be accidentally connected.
- (iv) When selected to automatic changeover the cooling station shall automatically revert to the main supply as soon as it is restored.

#### 4.4.2 A.C. Cabling

Where mains cables are laid with the main power cables to provide cooling station M.V.A.C supplies, the cable armouring/sheath shall not be bonded to the Cooling Station local earth. Instead a special cable box of insulating material shall be provided which will ensure that the armouring/sheath of the incoming and outgoing cables are connected via removable links and insulated from the local earth to withstand 15 kV for 1 minute.

#### 4.4.3 Auxiliary Cables

Where NGC pilot circuits are to be used then the special precautions described in NGTS 3.5.9 shall be adopted at each termination in order to protect both equipment and personnel against the possible effects of induced voltages.

#### 4.4.4 Pumps

In order to maximise the availability of the system the circulating water pumping arrangements shall be duplicated. Each of the arrangements shall be capable of meeting 100% of the required duty. A two position selector switch shall identify which of the two pumping arrangements is the duty and which is the standby. Selection of one pump as the duty pump will automatically select the other to standby operation.

Auto changeover facilities shall be provided to start the standby pump in the event of failure of the duty pump.

Each pump shall either be self draining or have a drain valve fitted and be self priming.

Guards shall be fitted over all exposed couplings or shafts.

All motors are to be of the squirrel cage induction type and suitable for direct-on-line starting.

#### 4.4.5 Earthing

All exposed metal work within the buildings including heat exchangers, expansion tanks and pipework shall be solidly bonded together and connected to a local earth.

#### 4.4.6 Fans

The cooling fans shall be provided with automatic start and stop facilities initiated via water inlet temperature, cable temperature or load current sensors.

#### 4.4.7 48 Volt D.C Supplies

48 V d.c. supplies shall be used for alarm and indication purposes.

The technical requirements for 48 V d.c. supplies are specified in NGTS 3.12.1.

Where main and backup mains supplies can not be provided then a 48 V battery and charger arrangement shall be supplied. The batteries shall have sufficient capacity to provide standby supplies for 10 hours in the event of a failure of the charger supplies.

#### 4.4.8 Expansion Tanks

An expansion tank fitted with a water level gauge shall be provided in each cooling circuit to allow for the thermal expansion and contraction of the water in the pipes. Where the expansion tank is pressurised both main and standby pressure supplies shall be provided with auto changeover facilities in the event of a failure of the main supply.

Pressurised expansion tanks shall be fitted with gas and water pressure gauges and a gas bleed valve.

All tanks shall be fitted with a suitable drain valve and a manhole access.

### 4.5 System Design Requirements

#### 4.5.1 Gas Bleed Points

Gas bleed points shall be fitted to each manifold in the turn round kiosk and any other position where gas could collect and impede the flow of water.

#### 4.5.2 Pressure Relief Valves

Pressurised tanks and route pipes shall be provided with over pressure protection.

#### 4.5.3 Water Expansion Tanks

The system shall not prevent the cable being operated at the conductor temperatures which are detailed in NGTS 2.5 Clause 4.1.

#### 4.5.4 Frost Protection

Water in the coolers, radiators and station pipe work shall be protected against freezing. This protection can include:

- (i) The provision of a special dribble/anti-freeze pump supplied from a secure electrical feed. Where batteries are used to provide this supply it shall have sufficient capacity to drive the pump for a minimum of ten hours continuous operation.
- (ii) Operating the duty pump for as long as the low ambient conditions persist.

### 4.6 Installation Requirements

#### 4.6.1 Location of Pipe Spacers

Spacers shall be located at the following intervals in order to retain the pipes in their correct positions relative to the cables.

| Location                          | Spacer Intervals (m) |
|-----------------------------------|----------------------|
| Straight Sections                 | 4.5                  |
| Radius of Bend of Curved Sections |                      |
| Greater than 15 m                 | 4.5                  |
| Between 15 and 13 m               | 3.5                  |
| Between 12 and 9 m                | 2.5                  |
| Between 9 and 6 m                 | 1.5                  |
| Less than 6 m                     | 1.0                  |