



**BHARAT HEAVY ELECTRICALS LIMITED  
TRANSMISSION BUSINESS GROUP  
ENGINEERING MANAGEMENT**

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TB-350-316-007			Name	MM	DKM	RS
Type of Document	<b>TECHNICAL SPECIFICATION</b>		Sign	<i>M. M. M.</i>	<i>D. K. M.</i>	<i>R. S.</i>
Title	<b>GI Shield Wire</b>		Date	5-3-14	05/03/14	5/3/14
			Group	TBEM		
Customer	<b>NABINAGAR POWER GENERATION CO. LTD.</b>					
Projects	400/132/33 kV s/s at Nabinagar STPP (3x660 MW)					

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**Note: Offers without checklist will not be considered**

Rev No.	Date	Altered	Checked				
<b>Distribution</b>							

**PROJECT: 400/132kV Switchyard at Nabinagar STPP**  
**CUSTOMER: Nabinagar Power Generating Company Ltd.**

**Technical Specification for GI Shield Wire** **TB-350-316-007**  
**Section-1: Scope, Specific Technical Requirements & Quantities**

## SECTION – I

### SCOPE, SPECIFIC TECHNICAL REQUIREMENT AND QUANTITIES

#### 1.0 SCOPE

This technical specification covers the requirements of design, manufacture, testing at works, packing and dispatch of 7/3.66 mm GI SHIELD WIRE/ earthwire.

The Equipment is required for the following projects

**Name of Customer :** Nabinagar Power Generation Co. Pvt. Ltd. (JV between NTPC and Bihar State electricity Board)

**Name of Project :** 400/132 kV Switchyard at Nabinagar STPP and extn. at 400 kV Nabinagar TPP (BRBCL)

#### 1.1 SPECIFIC TECHNICAL REQUIREMENT

a)	Number of strands	7 of steel
b)	Strand diameter	3.66 mm
c)	Overall diameter	10.98 mm
d)	Weight	583 kg/km
e)	Ultimate Tensile Strength	68.4 kN minimum
f)	Total cross-sectional area	73.65 sq. mm
g)	Calculated dc resistance	2.5 ohms/km at 20 deg. C
h)	Direction of lay of outer layer	Right Hand
i)	Protective coating for storage	Boiled linseed oil to avoid wet storage strains

The earthwire shall be of preformed and postformed quality.

#### 1.2 BILL OF QUANTITY

Item	Unit	Qty
GI Shield wire	meters	22 km

#### 1.3 TYPE TESTS

Bidder shall submit valid type test reports of the tests (as per relevant IS/IEC) carried out within last ten years from the date of bid opening i.e. **29.06.2011**. These reports should be for the tests conducted on the equipment similar to those proposed to be supplied under this contract and test (s) should have been either conducted at an independent laboratory or should have been witnessed by a client. The owner reserves the right to waive conducting of any or all the specified type

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test(s) under this contract. In case type tests are waived, the type test charges shall not be payable to the bidder.

All acceptance and routine tests as per the specification and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price

The type test reports once approved for any projects shall be treated as reference. For subsequent projects of NTPC, an endorsement sheet will be furnished by the manufacturer confirming similarity and "No design Change". Minor changes if any shall be highlighted on the endorsement sheet.

In case type test reports are more than 10 years old (from the date of bid opening i.e. 29.06.2011) OR the reports of type tests are found to be technically unacceptable, the type test shall be conducted without cost and delivery implication to BHEL/NTPC.

**SECTION – II**

**STANDARD SPECIFICATION**

**2.0 GENERAL**

This section covers the standard technical specification for GI Shield Wire.

**TECHNICAL REQUIREMENTS:**

As per Section-1

**2.1 EQUIPMENT SPECIFICATION**

This section covers the general technical requirements of the Galvanised Steel Wire. In case of any discrepancies between the requirements mentioned in this section and those specified in other sections of this specification, this shall prevail after Section 1 and shall be treated as binding requirements.

**2.2 APPLICABLE STANDARDS**

The Galvanised Steel Wire shall strictly conform to the following Indian and International standards, as appropriate:

IS: 521	Method for tensile testing of steel wire
ISO/R89	
IS: 1778	Reels and drums for bare conductors
IS: 2629	Recommended practice for hot dip galvanizing on iron and steel.
IS: 2633	Method for testing uniformity of coating of zinc-coated articles
IS: 4826	Hot dip galvanized coatings on round steel wires
ASTMA-475-72a	
IS: 6745	Methods for determination of mass of Zinc coating on zinc-coated iron and steel articles
IS: 209	Zinc ingot
IS 398 (Parts-I to V):	Aluminium conductors for Overhead transmission purposes

Latest version of all standards shall be followed.

**2.3 TECHNICAL REQUIREMENT AND CONSTRUCTIONAL DETAILS**

**2.3.1** The galvanized steel stranded wire shall generally conform to the specification of ACSR core wire as mentioned in IS 398 (Part- II) except where otherwise Specified herein.

**2.4 WORKMANSHIP**

**2.4.1** All steel strands shall be smooth, uniform and free from all imperfections, such as spills and splits, die marks, scratches, abrasions and kinks after drawing and also after stranding.

- 2.4.2 The finished material shall have minimum brittleness as it will be subjected to appreciable vibration while in use.**
- 2.4.3 The steel strands shall be hot dip galvanized (and shall have a minimum zinc coating of 275 g/m<sup>2</sup>) after stranding of the uncoated wire surface. The zinc coating shall be smooth, continuous, of uniform thickness, free from imperfections and shall withstand three and a half dips after stranding in standard Preece test. The steel wire rod shall be of such quality and purity that, when drawn to the size of the strands specified and coated with zinc, the finished strands shall be of uniform quality and have the same properties and characteristics in ASTM designation B498-74.**
- 2.4.4 The earthwire shall be preformed and post-formed in order to prevent opening of strands while cutting or jointing of composite stranded wire. Care shall be taken to avoid damage to galvanization during pre-forming and post-forming operation.**
- 2.4.5 To avoid susceptibility towards wet storage stains (white rust), the finished material shall be provided with a protective coating of boiled linseed oil.**

## **2.5 JOINTS IN WIRES**

**There shall be no joint of any kind in the finished steel wire strand entering into the manufacture of the earthwire. There shall be no strand joints or strand splices in any length of the completed stranded wire.**

## **2.6 TOLERANCE**

The manufacturing tolerances to the extent of the following limits only shall be permitted in the diameter of the individual steel strands and lay length of the stranded wire:

	Standard	Maximum	Minimum
Diameter	3.66mm	3.75mm	3.57mm
Lay length	181mm	198mm	165mm

## **2.7 MATERIALS**

### **2.7.1 Steel**

The steel wire strands shall be drawn from high carbon steel rods and shall conform to the following requirements as to the chemical composition:

<b>Element</b>	<b>% Composition</b>
Carbon	Not more than 0.55
Manganese	0.4 to 0.9
Phosphorous	Not more than 0.04
Sulphur	Not more than 0.04
Silicon	0.15 to 0.35

**2.7.2 Zinc**

The zinc used for galvanizing shall be electrolytic High Grade Zinc of 99.95% purity. It shall conform to and satisfy all the requirements of IS: 209-1979

**2.8 STANDARD LENGTH**

**2.8.1 The stranded wire shall be supplied in standard drum lengths generally in the range of 2x2000 m. A tolerance of  $\pm 5\%$  on the standard length offered by the bidder shall be permitted. All lengths outside this limit of tolerance shall be treated as random lengths. Random lengths will be accepted provided no length less than 70% of the standard length and the total quantity of random lengths shall not be more than 10% of the quantity offered.**

**Bidder may offer two lengths in one drum**

**2.9 TESTS**

**2.9.1** The G.S. Wire should have been type tested as per IS and shall be subjected to routine and acceptance tests in accordance with applicable IS specifications/ ISO/ ASTMA recommendations. Type test reports of the tests conducted earlier (not more than ten years earlier) on similar material shall be submitted. If the valid type test reports are not available with the bidder then the tests shall be conducted by the bidder free of cost.

**2.9.2** If the purchaser insists to carry out the type test(s) afresh, the same shall be conducted on chargeable basis, for that the bidder shall submit the test charges in the price bid.

**2.9.3 TYPE TESTS**

In accordance with the stipulation of the specification the following type tests shall be conducted on the stranded wire.

- a) UTS test ) As per Clause 2.10.1
- b) DC resistance test ) As per Clause 2.10.2

**2.9.4 ACCEPTANCE TESTS**

- a) Visual check for joints, scratches etc. and length of stranded wire (As per Clause 2.10.3)
- b) Dimensional check(As per Clause 2.10.5)
- c) Galvanizing test (As per Clause 2.10.7)
- d) Lay length check (As per Clause 2.10.6)
- e) Torsion test (As per Clause 2.10.4)
- f) Elongation test (As per Clause 2.10.4)
- g) Wrap test
- h) DC resistance test ( IS 398(Part-III))1976
- i) Breaking load test ( IS 398(Part-III))1976
- j) Chemical Analysis of steel ( IS 398(Part-III))1976)

### **2.9.5 ROUTINE TESTS**

- a) Check that there are no cuts, fins etc. on the strands.
- b) Check for correctness of stranding.

### **2.9.6 TESTS DURING MANUFACTURE**

- a) Chemical analysis of zinc used for galvanizing (As per Clause 2.10.8)
- b) Chemical analysis of steel (As per Clause 2.10.9)

### **2.9.7 SAMPLE BATCH FOR TYPE TESTING**

The Contractor shall offer material for sample selection for type testing, only after getting quality assurance program approved by the Owner. The samples for type testing shall be manufactured strictly in accordance with the quality Assurance Program approved by the Owner.

## **2.10 TESTING PROCEDURE FOR STRANDED GALVANISED STEEL WIRE**

### **2.10.1 UTS Test**

Circles perpendicular to the axis of the stranded wire shall be marked at two places on a sample of stranded wire of minimum 5 m length suitably compressed with dead end clamps at either end. The load shall be increased at a steady rate up to 34 kN and held for one minute. The circles drawn shall not be distorted due to relative movement of strands. Thereafter, the load shall be increased at a steady rate of 68.4 kN and held for one minute. The stranded wire sample shall not fail during this period. The applied load shall then be increased until the failing load is reached and the value recorded.

### **2.10.2 D.C Resistance Test**

On a stranded wire sample of minimum five metres length, two contact clamps shall be fixed with a pre-determined Bolt torque. The resistance shall be measured by a Kelvin double-bridge by placing the clamps initially zero meter and subsequently one meter apart. The test shall be repeated at least five times and the average value recorded. The value obtained shall be corrected to the value at 20<sup>0</sup>C shall conform to the requirements of this specification.

### **2.10.3 Visual Check for Joints, Scratches etc. and length of Stranded wire**

Stranded wire drums shall be rewound in the presence of the inspector. The inspector shall visually check for scratches, joints, etc. and see that the stranded wire generally conforms to the requirements of this specification. The length of stranded wire wound on the drum shall be measured with the help of counter meter during rewinding.

### **2.10.4 Torsion and Elongation Tests**

The test procedures shall be as per relevant clause of IS 398 (Part V). The minimum number of twists which a single steel strand shall withstand during torsion test shall be eighteen for a length equal to 100 times the standard diameter of the strand. In case the test sample length is less or more than 100 times the standard diameter of the strand, the minimum number of twists will be proportionate to the length and if number comes in the fraction then it will be rounded off to next higher whole number. In elongation test, the elongation of the strand shall not be less than 64% for a gauge length of 200 mm.

#### **2.10.5 Dimensional Check**

The individual strands shall be dimensionally checked to ensure that they conform to the requirements of this specification.

#### **2.10.6 Lay Length Check**

The lay length shall be checked to ensure that they conform to the requirements of this specification.

#### **2.10.7 Galvanizing Test**

The test procedure shall be as specified in IS: 4826-1968. The material shall conform to the requirements of this specification.

#### **2.10.8 Chemical Analysis of Zinc used for Galvanizing**

Samples taken from the zinc ingots shall be chemically/spectrographically analyzed. The same shall be in conformity to the requirements stated in this specification.

#### **2.10.9 Chemical Analysis of Steel**

Samples taken from the steel ingots/coils/strands shall be chemically/ spectrographically analyzed. The same shall be in conformity to the requirements stated in this specification.

**2.11** Following drawings/ documents shall be submitted for approval/ information for each project:

- i) Guaranteed and other technical particulars
- ii) Drum Drawing
- iii) Type, Acceptance, sample and routine test reports

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# SECTION- 3

## PROJECT DETAILS & GENERAL TECHNICAL REQUIREMENTS

### 3.0 GENERAL

This section stipulates the General Technical Requirements under the Contract and will form an integral part of the Technical Specification.

The provisions under this section are intended to supplement general requirements for the materials, equipment and services covered under other sections of tender documents and are not exclusive. However in case of conflict between the requirements specified in this section and requirements specified under other sections, the requirements specified under respective sections shall prevail.

### 3.1 PROJECT INFORMATION:

	Particular	Details		
a)	Customer	<b>Nabinagar Power Generating Company Ltd. (NPGC)</b> (A joint venture of NTPC Ltd. and Bihar State Electricity Board)		
b)	Project Title	400/132 kV Switchyard including 400 kV & 33 kV Transmission Lines for Nabinagar Super Thermal Power Project (3X660 MW) at Nabinagar Bihar and extension of two line bays at 4X250MW Nabinagar TPP.		
c)	Location	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%;"><b>Nabinagar STPP</b> (i.) Place : Nabinagar (ii) District :Aurangabad (iii.) State :Bihar</td> <td style="width: 50%;"><b>Nabinagar TPP (BRBCL)</b> (i.) Place : Nabinagar (ii) District :Aurangabad (iii.) State :Bihar</td> </tr> </table>	<b>Nabinagar STPP</b> (i.) Place : Nabinagar (ii) District :Aurangabad (iii.) State :Bihar	<b>Nabinagar TPP (BRBCL)</b> (i.) Place : Nabinagar (ii) District :Aurangabad (iii.) State :Bihar
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d)	Nearest Road Head	National Highway-2 (Approximately 25 kms from National highway)		
e)	Nearest Rail Head	Dehri-On-Sone (Approximately 30 kms from Railway Station)		
<b>SITE CONDITIONS</b>				
a)	Max. ambient air temp.	50°C		
b)	Min. ambient air temp.	0°C		
c)	Max. design ambient temp.	50°C		
d)	Design reference RH	100 %		
e)	Altitude	<500 MSL		
f)	Pollution Severity	High Pollution level (25mm/kV)		
g)	Seismic Zone	Zone-III		
<b>WIND DATA</b>				
a)	Basic Wind speed	47m/sec		
b)	The risk co-efficient (K1)	1.07		
c)	Category of terrain	Category-2		

**PROJECT: 400/132kV Switchyard at Nabinagar STPP**  
**CUSTOMER: Nabinagar Power Generating Company Ltd.**

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d)	Maximum wind pressure on steel members	1500 N/m <sup>2</sup>
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**SECTION – IV**

**GUARANTEED AND TECHNICAL PARTICULARS OF STRANDED G. S.WIRE**

S. No.	Description	Unit	Particulars
1.	<b>Name &amp; Address of manufacturer</b>		
2.	<b>Particulars of raw materials</b>		
2.1	Aluminium		
	a) Minimum Purity of Aluminium	%	
	b) Maximum Copper Content	%	
2.2	Steel wires/Rods		
	a) Carbon	%	
	b) Manganese	%	
	c) Phosphorous	%	
	d) Sulphur	%	
	e) Silicon	%	
2.3	Zinc		
	a) Minimum purity of Zinc	%	
3.	<b>STEEL STRANDS BEFORE STRANDING</b>		
3.1	Diameter		
	a) Nominal	mm	
	b) Maximum	mm	
	c) Minimum	mm	
3.2	Minimum breaking load of strand	kN	
3.3	Maximum Resistance of 1 M Length of strand of 20°C	Ohm	
4.0	<b>STEEL STRANDS AFTER STRANDING</b>		
4.1	a) Nominal Diameter	mm	
	b) Maximum Diameter	mm	
	c) Minimum Diameter	mm	
4.2	Minimum breaking load of strand	kN	
4.3	Galvanising		
	a) Min. weight of zinc coating of uncoated wire surface	g/ m <sup>2</sup>	
	b) Min. number of one minute dips that the galvanised strand can withstand in the standard Preece test	Nos.	
	c) Min. No. of twists in gauge length equal to 100 times the dia of wire which the strand can withstand in the torsion test	Nos.	
5.	<b>COMPLETED STRANDED WIRE</b>		
5.1	UTS of stranded wire	kN	
5.2	Lay length of outer steel layer	mm	
5.3	DC resistance of stranded wire at 20°C	Ω/km	
5.4	Direction of lay of outer layer	-	
5.5	Linear mass of earth wire		
	a) Nominal	Kg/km	
	b) Maximum	Kg/km	
	c) Minimum	Kg/km	
6.0	Is drum as per I.S	Yes/No	
5.6	Standard length of stranded wire in the drum	m	

**SECTION - V**  
**QUALITY PLAN**

Bidder shall follow approved quality plan of BHEL/NTPC.

**SECTION-VI**

**CHECKLIST**

**FOR GI SHIELD WIRE**

Put a tick mark on 'YES' if the specified requirement is met, or put a tick mark on 'NO' if the specified requirement is not met and give comments in the remark column.

**1. TECHNICAL REQUIREMENTS**

Sl. No.	PARAMETERS	DETAILS	YES/NO	REMARKS
1.	Stranding and wire diameter	7/3.66 mm steel	YES/NO	
2.	Strand Arrangement			
	a) Steel core	1	YES/NO	
	b) Outer Steel Layer	6	YES/NO	
3.	Total sectional area	73.65 sq mm	YES/NO	
4.	Overall diameter	10.98mm	YES/NO	
5.	Approximate weight	583 kg/km	YES/NO	
6.	Calculated d.c. resistance at 20 <sup>0</sup>	2.5 ohms/km	YES/NO	
7.	Minimum ultimate tensile strength	68.4 kN	YES/NO	
8.	Direction of lay of outer layer	Right hand	YES/NO	
9.	Applicable standard	IS:398 (part-II): 1976 <i>2A</i>	YES/NO	
10.	Minimum Zinc coating on hot dip galvanized steel strands	275 g/m <sup>2</sup>	YES/NO	
11.	Standard length (2x2000m)	As specified in section-II	YES/NO	
12.	Tolerance	As specified	YES/NO	
13.	Material composition	As per IS	YES/NO	

**2. TYPE TESTS**

Whether Type test reports of the tests conducted earlier (not more than five years earlier) on similar material submitted. **YES/NO**

If type test report submitted, indicate report number.

If the valid type test reports are not available with the bidder then the following tests shall be conducted by the bidder free of cost **YES/NO**

SI No.	TESTS	REPORT NO.	YES/NO	REMARK
A	Type tests			
	a. UTS test			
	b. DC resistance test			

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