सत्यमेव जयते

TECHNICAL SPECIFICATIONS FOR BIRD FLIGHT DIVERTER

GOVERNMENT OF INDIA

MINISTRY OF POWER

CENTRAL ELECTRICITY AUTHORITY

January 2021

Technical Specifications for Bird Flight Diverter

Background

The electrocution and collision of Great Indian Bustard (GIB) and other birds with the overhead power transmission lines is one of the major causes of death of these birds. Great Indian Bustard, is one of the flagship bird species of India and State bird of Rajasthan, which is an endangered/near extinct species. Bird Flight Diverter, identified as one of the measures to avoid the chances of collision of birds with transmission lines, shall be placed in identified stretches as per the guidelines of the Forest Authority.

Bird Flight Diverter (BFD) designs available with different manufacturers in the market are not similar and it becomes difficult for the utilities to procure suitable diverters for their requirement meeting environmental conditions. Moreover, the size, color, operating temperature, grip strength & other construction features of Bird Flight Diverter, the installation and testing are some of the important features/parameters, which needs to be standardized. Keeping in mind difficulty being faced by the utilities, there is need for standardization of specifications of Bird Flight Diverter so that similar type of bird diverters are installed on the power transmission & distribution lines across the country.

The specification broadly covers general technical requirement, major design parameters, requirement of certification, type tests & test procedures and installation guide of Bird Flight Diverter etc.

The Bird Flight Diverter shall be placed in identified stretches as per the conditions stipulated by forest authority to avoid the chances of collision of birds with transmission lines.

1. General Technical Requirement

1.1 Bird Flight Diverter must be dynamic type and shall consist of warning disc and associated clamps & connectors. These diverters may or may not have solar powered LED. The dynamic solar powered LED type Bird Flight Diverter shall be preferred in areas where foggy/dusty weather persists or intensity of light is low or

the sections of the lines lying in the route of migratory birds. The requirement of solar powered LED may be decided by the utility.

1.2 Bird Flight Diverter shall be suitable for efficient working and shall retain good physical characteristics under all weather conditions.

1.3 Bird Flight Diverter (BFD) shall be designed for expected service life of at least 15 years.

1.4 BFD shall be suitable for installation on live line.

2. Design Parameters

2.1 For visibility of Bird Flight Diverter, warning disc shall be provided. Warning disc shall:

(a) have glow in dark feature. Glow in dark shall remain activated for at least 12 hours after exposure to sun light. If Glow in dark stickers are used, the same shall be laminated and suitable for all weather conditions.
(b) have contrasting coloured (combination of any two colours from Red, Yellow, Orange, White) retro-reflective surface with Sun and Moon light reflectors on both faces. Since, warning disc is to be designed to rotate, the colour change, while revolving, shall provide significant forewarning.
(c) swing, sway and rotate easily.
(d) be resistant to all weather conditions
(e) be aerodynamically stable so that diverter faces minimum amount of drag force which provide swing and rotation effect under medium/strong wind speed.
(f) be made of UV stabilized plastic. Bearing shall be made of stainless steel and should allow free spinning in minimum wind speed of 2 km/hour.
(g) have diameter not less than 150 mm for circular disc. If warning disc is quadrilateral or trapezoid or of any other shape, then shortest arm length shall not be less than 90 mm and total surface area of warning disc should not be less that 15,000 mm^2 (including air vents).
(h) have thickness of not less than 3 mm.

(i) not have less than 3500 mm^2 reflective area on each face of warning disc. Glow in Dark area also should not be less than 3500 mm^2.

2.2 Weight of Bird Flight diverter shall not be more than 800 gm. LED type bird flight diverter should not weigh more than 1000 gm.

2.3 Length of bird diverter, from connection point to end, should not be more than 430 mm.

2.4 **Clamp & Hardware:** The warning disc shall be suitable for hanging on conductor/earth wire (or OPGW), by means of clamp & hardware. Design details are as follows:

(a) The clamp for holding conductor/OPGW/earth wire shall be spring type and shall be made of UV stabilized engineered composite plastic (polymer) or metal and shall be suitable for live line installation by hot stick or drone.

(b) All metal hardware used in Bird Flight Diverter including bearing must be made of corrosion free material.

(c) All plastic (polymer) parts must be UV stabilized.

(d) Clamp must be suitable for gripping the conductor/OPGW/ earth wire strongly, otherwise due to aeolian vibrations/high wind speed diverters may shift and move from its original position and get collected at mid span (lowest sagging point). Rubber/polyurethane lining shall be used in gripping area of clamp as per requirement of conductor type.

(e) More than 50% of clamp gripping area shall be in contact with earth wire/OPGW/Conductor.

(f) Clamp shall be free from sharp ends or edges, abrasions, projections, grit or materials, and shall not cause chafing or damage to the conductor/earth wire/OPGW, during fitting or during continued operation.

(g) Parts of the clamp touching conductor must be able to withstand temperature range from -15 ^oC to +85 ^oC for conventional conductors. In case of installation on HTLS conductor, maximum operating temperature under emergency loading condition shall be specified by the utility.

(h) The clamp must be able to bear pulling load of at least 50 kg and it is to be tested on Universal Testing Machine by a NABL accredited laboratory.

(i) Grip retaining strength: The clamp shall have smooth and permanent grip to keep the Bird Flight Diverter in its original position on the conductor/earth wire/OPGW without damaging the strands or causing premature fatigue failure of the conductor/earth wire/OPGW due to clamping pressure. The clamp should not slip beyond permissible limit as specified in test procedure in **Annexure**, when pulled by a force of 25 Kg in the direction parallel to conductor/earth wire/OPGW.

(j) In case of metallic bird diverters, the parts of clamp, touching conductor/earth wire/OPGW must be made of material, which is bad conductor of electricity.

2.5 For solar powered LED type diverter, following additional requirement shall be fulfilled:

(a) LED shall be of Orange colour with adequate light intensity so that it is clearly visible to GIB/birds from a distance even during foggy/dusty weather/under low intensity of light.

(b) Battery shall be guaranteed for service life of 5 years and shall be suitable for at least 100 hrs of flashing operation by single charge.

(c) An automatic power cut-off electronics circuit shall be provided to improve battery life so that during day time (due to high intensity of light from sun), the circuit gets cut off & stops flashing and the circuit switches on automatically under low intensity light condition.

(d) Position of solar cell shall be such that it gets sunlight irrespective of direction of the diverter face and the dust & snow does not decrease its efficiency.

3. Tests & certifications:

I. Type Tests

The reports/certificates for following type tests conducted by any NABL or equivalent accredited laboratory shall be

submitted to the purchaser. All of the following tests shall be conducted on the same sample. However, No. of Samples for type tests shall be as per relevant standard or procedure specified in **Annexure**. Type test report shall be valid for 10 years from the date of successful completion of tests.

a) Mechanical Strength test (As per Annexure):

- Direct Pull Test (50 kg by Universal Testing Machine)
- Clamp Slip Test/Grip Retaining Strength Test (25 kg force)

b) Vibration test (As per Annexure)
c) Temperature cycle test (As per Annexure)
d) Heating cycle test (As per Annexure)
e) Radio Interference Voltage and Visual Corona Test (As per Annexure) (applicable for bird diverters for use on transmission lines at 220 kV and above)
f) Corrosion Resistance Test: Salt fog (at 5% salt solution) and Humidity test (at 90% Rh) as per procedure in accordance with MIL-STD 810F (method 509.4 and Method 507.4)
g) Ageing tests - solar radiation test & sand and dust test as per procedure in accordance with MIL-STD 810F (Method 505.4 proc II and 510.4 proc I)

Note: The Mechanical Strength Tests shall be carried out before and after Ageing Test.

II. Acceptance tests:

Following acceptance tests shall be carried out on at least 5 samples in presence of the representative of the purchaser:

a) Visual Examination Test (As per Annexure)
b) Verification of Dimensions (As per Annexure)
h) Mechanical Strength test* (As per Annexure):

- Direct Pull Test (50 kg by Universal Testing Machine)
- Clamp Slip Test/Grip Retaining Strength Test (25 kg force)

*Only one of the 5 samples shall be subjected to ultimate failing load.

4. **Warranty Period:** All the bird diverters should come with a warranty period of at least 5 years. The warranty shall cover all components of the diverter. Any defect/damage/failure, if noticed during the warrantee period, the diverter shall be liable for replacement.

5. **Installation Guide:** Bird Flight Diverter should be installed on all conductors and earth wire/ OPGW in identified stretches as per the requirement stipulated by forest authority or other appropriate authority to avoid the chances of collision of birds with transmission lines (single/multi-circuits). For Great Indian Bustard habitats and potential areas, as identified by WII/MoEF&CC, one bird flight diverter shall be installed at every 10 m on the earthwire/OPGW and one bird flight diverter shall be installed at every 15 m on phase conductors in a staggered way such that as a whole, the power line will have effectively one diverter at every 5m to 6m. In case of bundled conductors, bird flight diverters may be installed on the lower conductor of the bundle in staggered manner. This installation guide is for reference purpose only. Appropriate authority may be consulted before installation of bird diverters.

Annexure

Test Procedures

1. Visual Examination Test

Bird diverter assemblies shall be visually examined for general finish and good workmanship.

2. Verification of Dimensions

The dimensions of the bird diverter assembly, including area of warning disc, reflective area and glow-in-dark area, shall be checked against approved drawings and requirements given in the technical specification.

3. Vibration Test

The tests shall be conducted in a laboratory set up with a minimum effective span length of 30 m for conductor, earthwire and OPGW separately. The conductor/earthwire/OPGW shall be tensioned at 25% of its Ultimate Tensile Strength (UTS). Constant tension shall be maintained within the span by means of lever arm arrangement. The span shall be equipped with vibration inducing equipment suitable for producing steady standing vibration. The inducing equipment shall have facilities for stepless speed control as well as stepless amplitude arrangement. Equipment shall be able to measure the frequency, cumulative number of cycles and amplitude of vibration at any point along the span.

Four number of Bird Diverters shall be clamped to the conductor /earthwire/OPGW in and around the middle of the test span. These bird diverters shall be free to vibrate and shall not be re-torqued or adjusted between the tests. The frequency of vibration is so chosen as to get an odd number of loops. The shaker shall be positioned at least two loops away from the test specimens to allow free movement of the conductor /earthwire/OPGW close to the test specimens. The conductor /earthwire/OPGW shall be connected to the shaker and vibrated to an amplitude such that

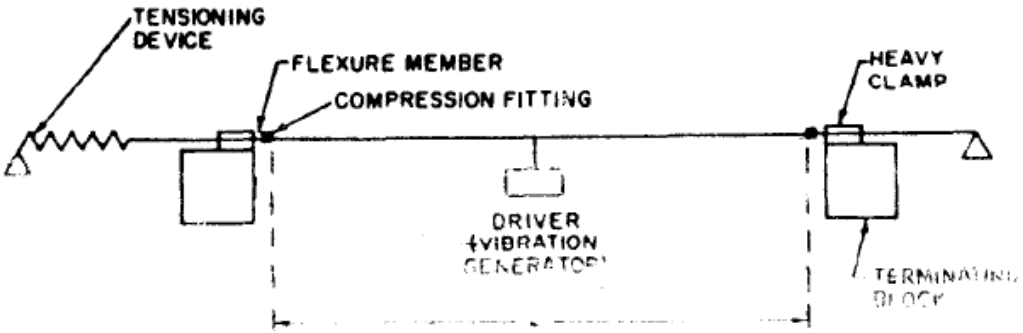
$f^{1.8}\ Y_{max} > 1000$ mm/sec.

Where Y_{max} being the antinode displacement (mm) and f is the test frequency (Hz).

The test frequency shall be greater than 24 Hz and the total number of cycles shall be more than 10 million. The bird diverter shall withstand the vibration test without slipping on the conductor/earthwire/OPGW, loosening, damage or failure of component parts.

After the completion of test, the same bird diverter shall be subjected to mechanical strength test (direct pull test & clamp slip test) as per the procedure given and the sample shall be able to withstand the tests without damage/deformation.

A representative diagram of test assembly is given below.



4. Temperature Cycle Test

The complete bird diverter assembly shall be quickly and completely immersed, without being placed in an intermediate container, in a water bath maintained at a temperature of 85°C and left submerged at this temperature for 15 minutes. The sample then shall be withdrawn and quickly & completely immersed, without being placed in an intermediate container, in the cold water bath maintained at a temperature of -15°C where it shall remain for 15 minutes. The sample shall be subjected to 10 such cycles.

The time taken to transfer from either bath to the other shall be as short as possible and never exceed 30 seconds. The quantity of water in the test tanks shall be sufficiently large for the immersion of the samples so as not to cause a temperature variation of more than ±5°C in the water.

After completion of 10 cycles, the sample shall be examined to verify that the sample has not deformed/damaged.

5. Heating Cycle Test

The heating-cycle test shall be carried out on an assembly of conductor & bird diverters and heated by passing a current through the assembly. The conductor shall be tensioned at 20 percent of its Ultimate Tensile strength (UTS) and shall be erected indoors so that the conductor is roughly horizontal. Air shall be able to circulate freely around the assembly which shall not however be exposed to draughts.

The sample shall be connected on the conductor in accordance with the manufacturer's recommendations. The minimum length of conductor used for determining this current shall be 2 m. The test current shall be that power frequency current which raises the surface temperature of the conductor to the specified maximum operating temperature of the conductor and maintains the temperature at a steady value. The test current shall be passed continuously through the assembly for a period of 30 min or such longer period as may be necessary to bring the reference conductor to the specified maximum operating temperature of conductor ±2.5 °C. The current shall then be interrupted and the conductor shall be allowed to cool to within 5 °C above the ambient temperature. The conductor temperature shall be measured near the centre of the test length.

This sequence of operation shall be repeated so that 250 cycles of heating and cooling are applied. The sample shall not be tightened or adjusted during the test. The sample shall afterwards be opened and there shall be no sign of local heating, burning or fusing of any part of the sample or of the conductor, as a result of the test.

6. Mechanical Strength Test

Following Mechanical Strength Tests shall be carried out on the bird diverter after completion of Vibration Test, Temperature Cycle Test, Heating Cycle Test, Corrosion Resistance Test and Ageing Test.

a) Direct Pull test:

The clamp of the completely assembled Bird diverters shall be subjected to a load equal to 50% of the specified load of 50 kg (using Universal Testing machine) which shall then be increased at a steady rate to 67% of the specified load. The load shall be held for five minutes and then removed. After removal of the load, the assembly and its components shall not show any visual

deformation and it shall be possible to disassemble them. The clamp shall then be reassembled and loaded to 50% of specified load. The load shall be further increased at a steady rate to the maximum load of 50 kg and shall be held for one minute. No damage /deformation should occur during this period. The applied load shall then be gradually increased until the failing load is reached and the value shall be recorded.

b) Clamp Slip Test/Grip retaining strength test:

The test shall be carried out as per IEC 61854 (Fig. 1a). The tests shall be performed separately using conductor, earthwire, and OPGW. The conductor/earthwire/OPGW, free of any defects or damage, shall be tensioned to 20% of its rated tensile strength. By means of a suitable device (see fig. 1a of IEC 61854), load shall be applied to the clamp along the axis of the conductor/ earthwire/OPGW and shall be gradually increased (not faster than 100 N/s or 10 Kgf/s) until it reaches the specified minimum slip load of 250 N or 25 Kgf. The load shall be kept constant for one minute. The movement of the clamp relative to its original position on the conductor/ earthwire/OPGW shall be observed. The clamp should not slip more than 10 mm and there should not be any damage / deformation of the bird diverter and the conductor/earth wire/OPGW. Thereafter, the load shall be increased gradually in steps of 25 N or 2.5 kgf and shall be kept constant for one minute at each step. The slippage at each step shall be recorded. The process shall be continued till the slippage is observed to be more than 10 mm from its previous position and the corresponding load shall be recorded.

7. Corona Extinction Voltage Test (Dry)

The sample, when subjected to power frequency voltage, shall have a corona extinction voltage of not less than that stipulated in the Table below. The test shall be carried out as per IEC: 61284. The atmospheric condition during testing shall be recorded and the test results shall be accordingly corrected with suitable correction factor as stipulated in IEC 60060-1.

8. Radio Interference Voltage Test (Dry)

Under the conditions as specified above, Radio Interference Voltage (RIV) level of the sample shall be less than the values stipulated in the Table given below. The test procedure shall be in accordance with IEC 61284.

Sl. No.	Voltage level	Minimum Corona Extinction Voltage (kV)	Maximum radio interference voltage (at 1 MHz under dry condition (micro volts)
1	**765kV**	508	1000 (at 508 kV rms)
2	**400kV**	320	1000 (at 320 kV rms)
3	**220kV/230kV**	156	1000 (at 156 kV rms)

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To,
As per attached list.

विषय / Subject: Technical Specifications for Bird Flight Diverter(BFD)-Reg.

You may be aware that electrocution and collision of Great Indian Bustard (GIB) and other birds with the overhead power transmission & distribution lines is one of the major cause of death of these birds. Bird Flight Diverter (BFD), identified as one of the measures to avoid the chances of collision of birds with transmission & distribution lines, shall be placed in identified stretches as per the guidelines of the Forest Authority.

Bird Flight Diverter designs available with different manufacturers in the market are not similar and it becomes difficult for the utilities to procure suitable diverters for their requirement meeting environmental conditions. Keeping in mind the difficulty being faced by the utilities, Central Electricity Authority in consultation with manufacturers, utilities, WII, MOEF&CC, POWERGRID, CPRI etc. has prepared Standard Technical Specification for Bird Flight Diverter to be installed in Power Transmission & Distribution lines by power utilities across the Country. The specification broadly covers general technical requirement, major Design parameters, requirement of certification, type tests & test procedures and installation guide of Bird Flight Diverter etc.

The Bird Flight Diverter shall be placed in identified stretches as per the conditions stipulated by forest authority to avoid the chances of collision of birds with transmission & distribution lines.

The Technical Specification for BFD along with test procedures for various tests is enclosed herewith for information and necessary action. The specification is available at CEA website at the link: https://cea.nic.in/wp-content/uploads/pse td/2021/01/Technical Specifications for Bird Flight Diverter.pdf

Signature Not Verified

Digitally signed by BHANWAR SINGH MEENA
Date: 2021.02.01 16:07:00 IST

Yours Faithfully

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