Composite Insulated Cross Arms: A New Trend in Electric Power Transmission

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ABSTRACT – Growing urbanisation, stringent rules & regulations, difficulty in obtaining ROW and awareness in public in general has forced engineers to develop more stringent solid ways to lay transmission lines in overall techno-economic and with efficient & reliable manner. Such demand has also been fulfilled by development of CICA (Composite Insulated Cross Arms).

Keywords— CICA — Composite Insulated Cross Arms, ROW – Right Of Way, HVDC – High Voltage Direct Current

I. INTRODUCTION

With development in technological innovations in pace with fast growing society, need has emerged to come up to innovate new technologies to meet stringent rules and regulations, public awareness, growing ROW and meeting with highest standards of reliability in power systems for public at large. New technology has emerged in a very techno cum economic cum long life factor.

II. CICA DEFINITION

It is called as Composite Insulated Cross Arms. It replaces conventional porcelain, polymer long rod insulators and steel cum lattice type cross arms in use for the last so many years or we can say since inception of power transmission lines. Let us under anatomy of a power transmission line structure.

A normal conventional steel lattice type tower consists of members fabricated and erected to form a tower in complete. It mainly is divided in to 4 parts.

1. Tower body
2. Cross arms
3. Peak
4. Cage
5. Insulators

In a CICA type towers. Cross arms and insulators are replaced by CICA as seen below in figure 1.
III. HISTORY

It started a way back in 2008 in China as due to problem of growing population and fast pace of infra structure development. In India it was developed by Sintex Plastics, Pioneer in reinforced plastic industry. It was produced by them as per the standards of REC (Rural electrification Corporation, India) standards for use at large in Rural and Urban development in power distribution networks. Many other manufacturers also exit who are pioneer in this type of product.

![Composite insulated cross arms](image)

Figure 2.

IV. TECHNICAL SPECIFICATIONS

Technical Specifications are same as that of Long rod fibre glass polymer insulators. For example

1. Nominal/Highest KV
2. Minimum dry/wet impulse voltage
3. Power Flow
4. Earth system
5. Configuration -- Unequal /Equal Triangle, Vertical/Horizontal
6. KN Value --- Suspension & Tension
7. Creep Distance ---- mm/kv
8. Max. Span
9. Sectional length
10. Conductor Type & Weight per meter
11. Pollution Type ---- Industrial/oceanic
12. Pollution level
13. Max/Min. Temp Around Year
14. Relative Humidity
15. Altitude/Elevation
16. Wind speed data
17. Safety factor
18. Profile parameters as per IEC 60815(S/P ratios etc.)
19. Receding water angle
20. Life expectancy
21. Colour Specific

![Composite insulated cross arms](image)

Figure 3.

V. MERRITS OF CICA OVER NORMAL POLYMER & PORCELAIN INSULATORS

- Reduces load on tower ie reduction in tonnage of steel
- Reduces ROW due to less cross arm dimensions
- Reduces overall height of tower, keeping ground clearances same as per standards
- No chances of Guana/Pollution flash overs
- No frequent replacement of insulators
- No swings due to high speed winds, hence no flash overs
- Tower appear to be slender

VI. TYPES OF FRAMES DEVELOPED

Development of frames depends upon type of configurations of tower and load on CICA. Few are exhibit below.

![Composite insulated cross arms](image)
VII. CONSTRUCTION OF INSULATOR
Main components of insulators are (Refer fig. below)

- Both ends fittings
- Weather shields/Petticoats for creep
- Fibre rod for strength
- Core housing & hardware interphase

VIII. DEVELOPMENT SO FAR

From 33kv to 800kv (HVDC) CICA has been developed for single as well as double circuits for normal lattice type steel tower. Efforts have been made in China to develop complete tower of fibre glass and only of main tension members. It is under trial and has limitations of sustainability during

- Fire in nearby area
- During lightning strikes to pass on earth/fault currents
- Behaviour during heavy storms.
- Weakening at junctions of cross members.

IX. SPACE SAVINGS

<table>
<thead>
<tr>
<th>Foot Dimensions</th>
<th>Overall Height</th>
</tr>
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<tbody>
<tr>
<td>KV</td>
<td>M. Sq.</td>
</tr>
<tr>
<td>110</td>
<td>39</td>
</tr>
<tr>
<td>220</td>
<td>45</td>
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<td>400</td>
<td>47</td>
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<tr>
<td>500</td>
<td>53</td>
</tr>
<tr>
<td>765</td>
<td>61</td>
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<tr>
<td>800</td>
<td>=</td>
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</tbody>
</table>

*These are tentative figures. However finally depends upon transmission construction/design/power flow parameters.
XI. LIMITATIONS

CICA has a limitation of using in suspension type towers. It can be at the maximum used up to 4 to 6 degrees deviations. Hence for B/C/D type locations, normal steel towers have to be used. Deflections in arms is noticed in long run, hence require in large scale study on load pattern w.r.t. span, winds etc. particularly in area where intermittent high speed winds takes place.

XII. DEVELOPMENT WORLD WIDE

- China has developed such arms in big way up to 765 AC & 800kv (HVDC)
- Spain developed up to 132kv
- Italy also developed rotating type CICA on experimental basis.
- France developed CICA up to 90kv for normal as well as pivoted type towers
- Japan has done extensive studies to use in heavy ice loading transmission lines.
- Pacific Corp, USA modified/upgraded 2 lines due to Row & and increase (46kv to 138kv, 220kv to 345kv)
- Manitoba Hydro, Canada upgraded line from 115kv to 230kv
- COPEL, Brazil modified line from 138kv to 230kv.
- Puget Energy North America constructed new line of 230kv.
- Queensland Electricity Commission, Australia constructed new line of 275kv.

CONCLUSION/REMARKS - Development of any system for smooth and trouble free service to society has to continue and that is way world goes on.

XIII. REFERENCES

[1] Jiangsu Shemar Electric Co. Ltd, China

X. OVERALL BENEFIT

Power flow Vs CICA Vs HTLS Vs Traditional
Considering a 220kv S/c Line of traditional conductor (200mw)
Height savings = 50/30 = 1.6, Thus 0.6 is the height of tower saved.
Power Flow with HTLS = 2.5/1 – 2.5, thus increase in power flow 1.5 times.
Over all benefit ratio with combination of CICA, HTLS & Height = 1.5+0.6=2.1 times.
These are tentative values and depend upon various other parameters.