NEW GENERATION HIGH PERFORMANCE CONDUCTORS - POWERGRID’S EXPERIENCE

Presentation by:

Rajesh Gupta
Power Grid Corporation of India Ltd.
Gurgaon, INDIA
With the growth in the Indian economy, the demand for power is increasing manifold.

Despite commendable growth in past decades with installed generation capacity crossing the 250,000 MW mark, there still exists the peak shortages.

Generation additions of more than 80,000 MW are envisaged in 12th Plan (2012-17) and 13th Plan (2017-22) periods alongwith commensurating transmission network. Around 100,000 ckt kms of transmission lines are envisaged to be added in the 12th Plan and 13th Plan.

11 nos. of High Capacity Transmission Corridors are under implementation. Various existing Transmission Corridors are envisaged to be re-conducted with higher capacity Conductor / upgraded at higher voltage level in the coming years.
Challenges in development of Transmission Lines

- **ROW constraints:** Lack of availability of corridors for construction of new transmission lines due to:
  - High Population Density
  - Infrastructure development
  - Forest/Ecology conservation

- **Time constraints:** Shorter time schedules for construction of transmission lines due to:
  - High demand growth
  - Transmission to match generation projects
How to meet the challenges?

- Adoption of **UHV levels** for construction of new transmission lines for transmission of bulk power through long distances.

- Adoption of **Multi-circuit towers** for Loop-in-loop-out (LILLO) of 400kV/220kV double circuit lines, at substation entry points & ecologically sensitive areas/forest stretches to minimize the environmental impact of transmission lines.

- **Upgradation** of transmission lines i.e. modifications in the existing transmission line to allow it to operate at a higher voltage.

- **Uprating** of transmission lines i.e. modifications in the existing transmission line to enable increased current flow limits.
Uprating of a Transmission Line

- Uprating of a transmission line by replacing the existing conductor with a high performance conductor has been found to be an effective way of enhancing the power capacity of the line.

- As it generally involves no modification in existing structure/ foundations, higher power transfer capability of the order of as much as 2 to 2.5 times can be achieved without any significant investment of time, effort & money vis-a-vis a new line.

- Due to high temperature operation (180-200 deg C), HTLS conductors offer much higher current carrying capacity (thermal rating) vis-à-vis eqvt size ACSR without appreciable increase in sag.
Adoption of HTLS conductor for LILO of double circuit lines on multi-circuit portion enable reduction of bundle conductors, thereby enabling use of towers with lower weight.

For new high capacity 400 kV EHV lines, twin bundle HTLS conductors can be used in place of quadruple bundle ACSR resulting in:
Material savings in tower & foundations
Reduced construction effort, time & cost
Usage of HTLS conductor in place of conventional ACSR conductor is limited due to following reasons:-

- In Long lines, power flow is limited by Surge Impedance Loading (SIL) and not by thermal limits.

- Replacing quad bundle ACSR conductors with twin bundle HTLS of equivalent size result into effective increase in resistance and hence, the line losses. In long lines, the percentage losses are too high.

- The high cost of HTLS conductor do not offset the saving in the structures and construction costs.

- Non-conventional method of stringing : Requirements of Special tools and Skilled manpower for stringing and O&M.

- Careful handling of softer annealed aluminium conductors and composite core

- Concern regarding Material behaviour, Long Term performance and Life expectancy.
1. LILO of one circuit of 400 kV D/C (Quad) Dadri-Ballabgharh transmission line at Maharani Bagh with INVAR type HTLS conductor

- The LILO (approx. 30 kms line length) was to cross Yamuna river (requiring number of special/pile foundations) and also was to be routed through very narrow corridor close to a bird sanctuary & park.
- Twin bundle INVAR type HTLS conductors were used for this LILO in place of conventional quad bundle ACSR conductors aiming to reduce environmental impact, construction efforts & overall cost.
- With use of HTLS conductors it was also possible to use 400 kV D/C pole type towers.
- No construction or maintenance problem encountered.
POWERGRID's Experience

400 kV D/C Line with Invar type HTLS conductor & Pole Structures near Bird Sanctuary
2. **Reconductoring of 400 kV D/C Siliguri-Purnea transmission line with GAP type HTLS conductor**

- In this project, GAP type HTLS conductor is being used for reconductoring of existing 400 kV D/C Siliguri-Purnea transmission line (approx. 170 km line length) to double the power transmission capacity.

- Re-conductoring of the line passing through the narrow chicken neck area (having enormous space/ROW constraints) has avoided the need of constructing additional 400kV line thereby, making an efficient utilization of the precious corridor.

- Problem of availability of skilled gangs faced resulting in large delay in the completion of the line vis-à-vis the schedule.
POWERGRID’s Experience

Reconductoring of 400 kV D/C Siliguri-Purnea transmission line with GAP type HTLS conductor
3. **Common Forest Stretch for 400kV D/C Gaya-Koderma & Gaya-Maithon Transmission Line with GAP type HTLS conductor**

- In this case, the 400kV D/C (Quad) Gaya-Koderma & 400 kV D/C (Quad) Gaya-Maithon Transmission Lines under DVC & Maithon Right Bank – Additional Scheme, the transmission lines were passing through common forest stretch at Bihar-Jharkhand border for over 40 km route length.

- Construction of this common stretch on multi-circuit towers with quadruple bundle conductors would have involved substantial resources, efforts & cost.

- Therefore, twin bundle HTLS conductor have been adopted which resulted into substantive cost savings vis-à-vis cost of quad-quad multicircuit line.

- Problem of availability of skilled gangs faced resulting in delay in the completion of the line vis-à-vis the schedule.
POWERGRID’s Experience

Multicircuit Towers for 400kV D/C Gaya-Koderma & Gaya-Maithon Transmission Line with GAP type HTLS conductor
4. 220kV D/C Rangpo-New Melli transmission line with GAP type HTLS conductor

- The 220 kV D/C Rangpo- New Melli transmission line under Sikkim Part B transmission system is being constructed as a high capacity line.

- Being a high capacity line, ACSR Zebra conductor would not have been suitable for the transmission line. Thus a higher bundle conductor (such as twin Zebra may have been required). Accordingly, towers of commensurate strength would have been used.

- However, construction of this line with single HTLS conductor has enabled higher current carrying capacity while also saving on tower weights.
1. LILO of 400kV D/C (Triple Snowbird) Abdullapur – Sonepat line at Kurukshetra using twin INVAR type HTLS conductor on Multicircuit Tower

In this case also, HTLS conductor has been adopted for LILO of 400kV D/C (Triple Snowbird) line on multicircuit portion in order to reduce the number of bundle conductors and obtain techno-economic advantage through usage of light weight twin-twin configuration multicircuit towers.
Due to severe ROW issue near Yelahanka, at the outskirts of Bangalore, it was felt prudent to construct approx. 8 km stretch of 400kV D/C (Quad) Madhugiri–Yelahanka line with twin HTLS conductor on multicircuit towers of another parallel under construction line. This would enable expeditious completion of project & saving substantial efforts, cost & land usage.
3. Construction of 400 kV D/C Sagradighi-Behrampore Transmission Line under ERSS-X with INVAR type conductor

4. Re-conductoring of 400 kV D/C Farrakka-Malda Transmission Line with High Capacity Conductor under ERSS-XIII

5. Supply of high temperature low sag (HTLS) conductor for Neyveli TS-II to Neyveli TS-I expansion 400kV link under transmission system associated with contingency plan for evacuation of power from ILFS
1. Re-conductoring of 220 kV Transmission Lines of DTL with High Capacity Conductor – 3 nos.

2. Re-conductoring of 220 kV Transmission Lines of Bihar

3. New 400 kV lines under NCT of Delhi Project

4. New 400 kV lines under HVDC link through Bangladesh
**Expectation from Industry**

1. Development of Skilled Gangs of Trained Personnel for carrying out Stringing and Supervision.

2. Domestic participation of more players

3. R & D efforts to develop Composite core with Al. alloy conductor or stranded Composite core

4. Effective participation in tenders w.r.t providing complete details in the bids so as to facilitate faster evaluation and award.

5. Setting-up of indigenous facilities for carrying out the tests on conductor and core.
Thank you!