



Tata Power Delhi Distribution has designed a compact sub-station to overcome the space & safety constraints for expanding distribution infrastructure in metro cities.

THE CONTEXT



Rising commercial activity and residential density have increased the load on existing electrical assets in cities like Mumbai and Delhi, resulting in overloading, frequent tripping, higher technical losses and reduced equipment life. Hence, there is an urgent need to expand existing sub-stations and build new ones.

However, given the high cost of land, space is at a premium in these cities making land acquisition a huge challenge. This constraint affects the utility's performance parameters including distribution reliability measures such as the system average interruption frequency index and system average interruption duration index, the timelines for releasing new connections, and technical losses due to overloading.

THE INNOVATION



Tata Power Delhi Distribution made design changes in the conventional equipment of sub-stations so that it required less space for installation. The company adopted the following changes:

UNITISED SUB-STATION: A conventional transformer has high voltage (HV) and low voltage (LV) sides at opposite ends but the company designed a transformer with HV and LV on the same side. The HV and LV bushings were made in such a way that the switchgears are directly coupled with the transformer, thus eliminating the connecting HV and LV cables. This has reduced the space requirement by 71% from 6m x 5m to 3m x 2.9m.

FIVE-FEEDER RING MAIN UNIT (RMU): The RMU's SF6 gas tank was redesigned so as to accommodate an additional feeder by increasing the tank's length by just 0.35m.

VERTICAL TOWER SUB-STATION: The sub-station's layout was changed to accommodate the switchgear at the base and the transformer on a platform above it, reducing the space requirement by 65% from 6m x 5m to 3.5m x 3m.

• **COMPACT SUBSTATION:** The conventional transformer have terminal box/cable box on High voltage and low voltage side. In new design the switchgears integrated inside the cable box/terminal box of the transformer itself so eliminating the interconnecting cable requirement. Hence the space requirement reduced 68% from 6mx4m to 3mx 2.6m.

KEY CHALLENGES



TO ENABLE THE PROJECT AND OPERATIONS TEAM TO INSTALL AND MAINTAIN THE NEWLY DESIGNED EQUIPMENT AT THE SAME OR IMPROVED PACE AS THE CONVENTIONAL EQUIPMENT

The project and maintenance teams were given extensive training on the equipment and its features before installation. The supply restoration crew was also given hands-on training.

THE DESIGNING OF THE EQUIPMENT AND LAYOUT SUCH THAT ALL SAFETY REGULATION ARE ADHERED IN THE NEW SOLUTIONS

Various trials arrangements made in AutoCAD software for ensuring clearances and safety parameters. The possibilities of integration changes discussed with manufactures, the demo models made with 3D printer in engineering laboratory.



THE IMPACT



The compact design has reduced the space requirement for new sub-stations by 65% and also lowered technical losses by 38W given the fewer number of joints and cables. By facilitating capacity additions, it has also improved the time taken to release new connections besides allowing for speedier installation of new equipment.