

## **Observations made by ISGF Experts during the Visit to the Electric Bus Charging Depot in Bhekerai Nagar, Pune on 03/Oct/2019**

### **1. Background:**

Pune Mahanagar Parivahan Mahamandal Ltd (PMPML) procured electric buses on Gross Cost Contract (GCC) model from M/s OLECTRA, the Indian associates of BYD, China. First batch of 45 buses were inaugurated on 15<sup>th</sup> August 2019. Charging facilities for majority of these buses were created at the PMPML Bus Depot in Bhekerai Nagar, Hadapsar, Pune. Under the GCC model, operation of the buses including charging of the buses are in the scope of the contractor, OLECTRA. For installation of charging facilities and day to day charging operations OLECTRA has appointed their group company M/s Trinity Cleantech Pvt Ltd. On 28<sup>th</sup> August 2019 there was an electrical fault in the bus depot and two distribution transformers (DTs) were damaged which hampered the operation of the buses. This caused considerable media attention and public criticism. Maharashtra Electricity Distribution Company Ltd (MSEDCL), a member of India Smart Grid Forum (ISGF) and ISGF decided to study the cause of failure of the DTs. Primary objective of this study is to find out the reasons for the incident and issue appropriate guidelines to Electricity Distribution Utilities (DISCOMs) and Electric Bus Operators so that such incidents do not recur in future. Electric buses are new in India and under FAME-II program about 5900 electric buses are allotted to different cities in the country. Sharing of experiences with deployment of the buses will help all stakeholders and the public as well as protect the assets of the electric grid and the electric buses.

### **2. Electrical Connection Details:**

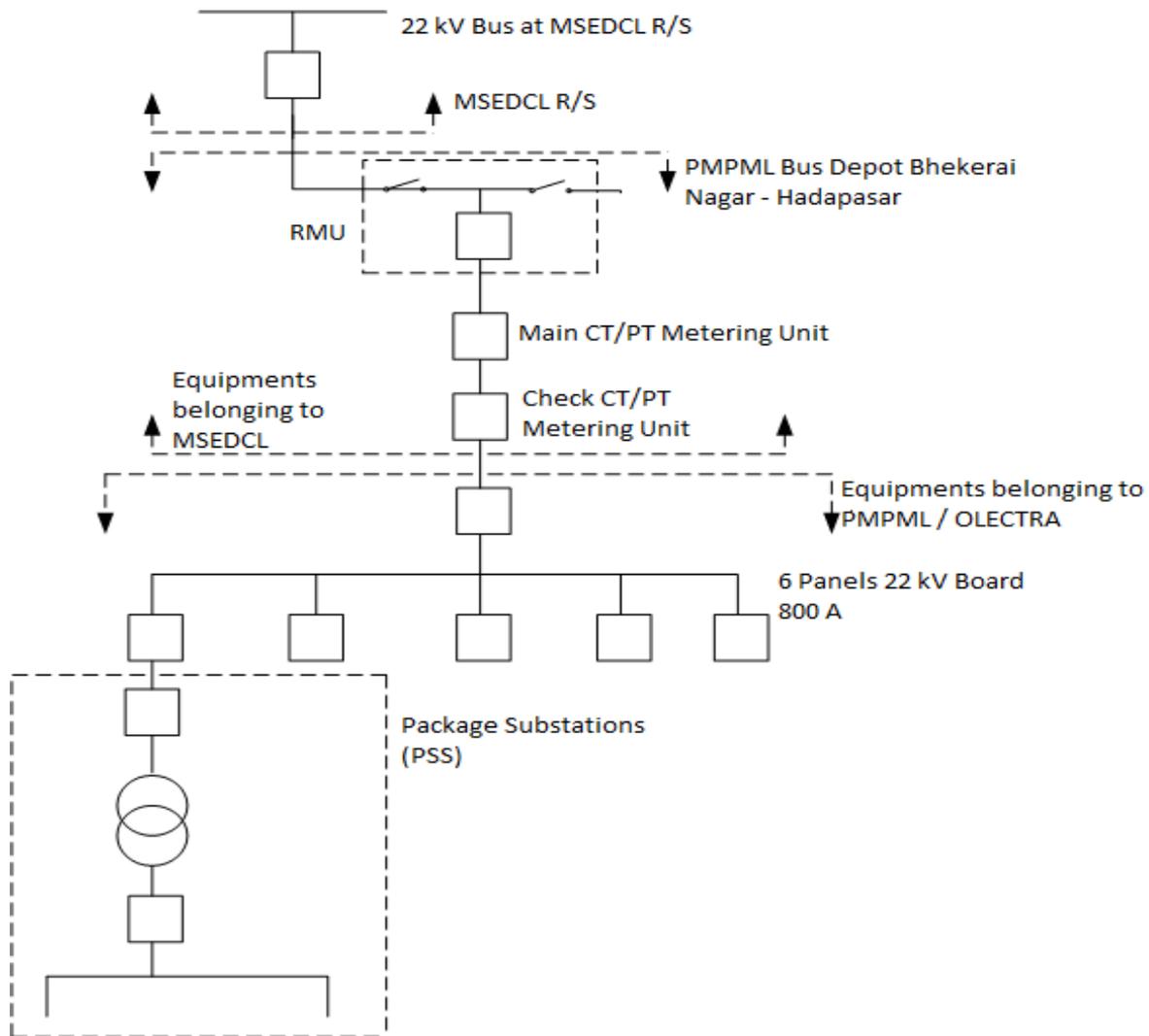
PMPML and OLECTRA have taken a 22kV connection from MSEDCL in the Bhekerai Nagar Bus Depot. The electrical works inside the bus depot was carried out by Trinity Cleantech. They commissioned 3 package substations (PSS) of 1250kVA capacity in the bus depots. Each of these PSS have 22kV/0.433kV DTs of 1250kVA. Another 2 such PSSs are under installation. The PSSs are supplied by M/s C&S Ltd and the DTs are from M/s Kotsons, both reputed companies.

Single Line Diagram (SLD) based on the discussions held at site<sup>1</sup> with representatives of MSEDCL, PMPML, OLECTRA and Trinity Cleantech is given below (next page).

- The 22kV connection from MSEDCL is terminated on a 22kV Board with 6 panels (800 Amps).
- As of now 3 PSS of 1250kVA are commissioned.
- Each PSS have 12nos outgoing feeders (at 433 Volts) for 80 kW Chargers (100 Amps) and 2 number of outgoing feeders (at 433 Volts) for 150 kW chargers.
- These 3 PSS are now supplying electricity to 39 chargers of 80 kW and 01 number of 150 kW charger.

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<sup>1</sup> SLD was not available at PMPML Depot when the visit took place. Need to get detailed information from OLECTRA/Trinity office in Hyderabad.



### 3. Sequence of Events on 28/09/2019

- Tripping of one DT occurred on 28/09/2019 at 16.53Hrs.
- Relay action at PMPML Depot is not known as both the RMU's (RMU on the incoming feeder before PMPML connection which is Lucy make; and the RMU after PMPML metering cubicle which is ABB make) trip relays were bypassed on 24/08/2019 by PMPML/PMC due to inadequate capacity.
- The MSEDCL breaker at their R/S tripped along with the incomer breaker at PMPML Depot, the O/G breaker feeding the PSS and also the PSS HT panel tripped. Magnitude of fault current recorded at Trinity O/G breaker panel VCB log was of 6.43kA. Voltage fluctuations not recorded.

- Electrical maintenance team at site checked and noticed that one of the cable was disconnected at 22kV overhead line. This was informed to MSEDCL and PMPML. MSEDCL Line-men attended and noticed the same. After rectification, they energized the line and reported that the breaker in main substation, Phursungi tripped.
- Then MSEDCL Line-men isolated entire line after the Bhekrai Nagar connection and reenergized the main line and it was observed that the line withstood.
- Site Electrical staff powered on the incoming RMU of MSEDCL and given power to Olectra HT incoming panel.
- Under instructions from the site engineer of OLECTRA/Trinity, the feeder was test charged from MSEDCL Substation - no inspection was carried out on the PSS.
- The feeder was test charged OK up to the incomer breaker at the PMPML Depot. On closing the incomer breaker and corresponding outgoing breaker of the PSS, there was a flash and transformer tank got ruptured and all the breakers tripped once again. Heavy oil leakage was observed from one of the Radiator fins towards HT side
- Based on the discussions held at site, it appears that the PSS was test charged the second time on fault.
- Load profile of the DTs is not recorded on real time basis.
- Power Quality Meters (PQMs) are not installed in the PMPML Depot.
- The key investigation area is whether the high magnitude fault current which appeared in the circuit can be withstood by the associated equipment<sup>2</sup>.
- Standard Operating Procedures (SOP) need to be framed so as to ensure safe and correct operation between MSEDCL and PMPML/OLECTRA/Trinity Engineers.

#### **4. General Recommendations**

##### **A. For DISCOMS:**

##### ***For HT (11kV/22kV/33kV) connections to Bus Depots and other Public Charging Stations:***

1. The detailed engineering drawings along with equipment sizing calculations (of the electricity distribution arrangements with in the Bus Depot/Public Charging Stations including the Chargers) must be verified and approved by the DISCOMs before sanctioning HT connections.
2. All electrical equipment installed inside the Bus Depots and Public Charging Stations must conform to relevant BIS and IEC standards which must be checked by the DISCOM Engineers.
3. The Site Engineer in-charge of the charging stations should coordinate with the DISCOM Engineers at the respective substations from where the HT connection is given; and must have minimum trainings on operation of numerical relays and protection systems.
4. Where ever possible, the DISCOM must explore the possibility of providing a dedicated feeder to these kinds of facilities which is a totally new kind of load on the grid.
5. Power Quality Meters (which can record voltage and harmonic profiles) must be installed in all EV Charging Stations and the history of the recordings must be maintained for a mutually agreed time period.

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<sup>2</sup> ISGF will conduct detailed studies on this matter once we have the equipment sizing details

**B. For Bus Operators:**

1. To the extent possible, should minimize the concentration of chargers at one location. This will help in having chargers in multiple bus depots which could service buses in case there are any faults in one location.
2. Distributing the charging load on different locations (feeders) will reduce the harmonics effects on the grid equipment<sup>3</sup>.
3. The PSS and Bus Chargers must be located far away from the passenger boarding locations
4. Standard Operating Procedures (SOP) must be prepared and get it approved by the respective DISCOMs.
5. Load profile of the PSS should be recorded and must be maintained for a mutually agreed time period.
6. The Site Engineers and Operators in the Charging Stations must be given training on PSS, numerical relays and protection scheme.
7. It is a practice that in case of transformer or a cable faults, no re-energization is carried out without clearing the fault. It could kill the equipment.
8. Chargers must be installed on pedestals high enough to protect from flooding. Also should ensure



that water does not go inside the chargers which could lead to faults.

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<sup>3</sup> ISGF is presently conducting modelling studies on the impact of harmonics from EV Chargers. The study report will be published in November/December 2019.