REPORT OF THE COMMITTEE ON TECHNICAL ASPECTS OF CHARGING INFRASTRUCTURE FOR ELECTRIC VEHICLES

New Delhi

March 2018

Central Electricity Authority

Ministry of Power

Government of India

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1. BACKGROUND

A meeting was held under the Chairmanship of Additional Secretary (SP), Ministry of Power regarding Electric Vehicles on 2nd January, 2018, wherein it was decided to set up the following two committees to address the issues and draw the roadmap for setting up charging infrastructure:

i. **Committee on Technical Aspects**

Terms of reference of the committee are as follows:

- Regulations/Standards to be framed for charging infrastructure set up
- Infrastructure

ii. **Committee on Policy, Planning and Regulatory/Tariff related issues**

Terms of reference of the committee are as follows:

- Regulatory aspects and Policy interventions
- Tariff Issues
- Ownership structure to be adopted for the charging infrastructure
- Subsidies/Incentives for promotion required
- Planning of roll-out

Out of the above mentioned two committees, the first **Committee on Technical Aspects** is chaired by Member (Planning), CEA, with concerned stakeholders.

2. INTRODUCTION OF THE COMMITTEE

Ministry of Power vide OM No. 12/20/207-UMPP dated 31st January, 2018 **(Annexure-IV)** constituted a Committee on Technical aspects of Charging Stations for electric Vehicles to address the technical aspects and draw a road map for setting up charging infrastructure. The committee is chaired by Shri Pankaj Batra, Member (Planning), CEA.

2.1 Composition of the Committee:

• Member(Planning), CEA	Chairman
• *Joint Secretary (Distribution)	Member
• Director (Distribution)	Member
• Representative from EESL	Member
• Representative from POSOCO	Member
• Representative from State of Karnataka	Member
• Representative from BSES	Member
• Representative from NTPC	Member
• Representative from PGCIL	Member
• Representative from ARAI	Member
• Representative from BEE	Member
• Representative from Department of Heavy Industries	Member
• Representative from DST	Member
• Representative from IIT Delhi	Member

* Later, Joint Secretary (Distribution) was deputed in the second Committee on Policy, Planning and Regulatory/Tariff related issues.

Chief Engineer (R&D), CEA, the dealing Division for Electric Vehicle in CEA, was made the Member Secretary of the Committee.

2.2 Terms of Reference of the Committee

The Terms of Reference of the Committee on Technical Aspects of Charging Stations for electric vehicles is given below:

i. Regulations/Standards to be framed for charging infrastructure set up.

a. Regulations regarding connectivity with grid such as power factor, load factor, harmonics, voltage deviations etc.

b. Safety standards required for connection to the grid,

c. Standards/specifications of equipment/products to be used in charging infrastructure considering the interoperability of the device and the agency responsible for it.

- Specifications for fast and slow chargers (Level 1 to Level 5) and AC/DC chargers.

d. Testing and verifications of equipment w.r.t Standards.

e. Assessment and strengthening of capacity of sub-transmission/distribution network to supply the load of electric vehicles.

f. Energy Performance Standards for Chargers.

ii. Infrastructure

a. Identification of suitable location and density/penetration of charging infrastructure.

b. Concentration of slow chargers and fast chargers based on suitability of locations and utility.

c. Land requirement:

- Capacity/number of charging stations being set up.
- Availability of suitable land/location.

2.3 Meetings Held

The first meeting of the Committee was held on 12th February 2018 in Sewa Bhawan, New Delhi. The detailed discussion points and arguments pertaining to the terms of the reference of the Committee meeting are given in **Annexure I - Minutes of the 1st Meeting of the Committee**.

A Draft Report was prepared by CEA and circulated among the members on 9th March 2018.

The second meeting of the Committee was held on 14th March 2018 in Sewa Bhawan, New Delhi. A presentation was made by the R&D Division CEA, highlighting the recommendations of the Committee, corresponding to the Terms of Reference of the Committee, and the members were requested to give their inputs regarding each of the recommendations. The discussions held and modifications suggested by the members in the Draft Report during the meeting is given in **Annexure II - Minutes of the 2nd Meeting of the Committee.**

The detailed discussion points of the meetings, various data and associated arguments, related regulations and protocols, etc. with respect to the Terms of the Reference of the Committee is presented in **Section 3-Discussions With Respect To Terms of Reference.**

The main conclusions and recommendations of the Committee based on the discussions of both the meetings corresponding to the Terms of the Reference of the committee are given in **Section 4- Main Recommendations of the Committee.**

DISCUSSIONS
WITH RESPECT TO
THE TERMS OF REFERENCE

3. DISCUSSIONS WITH RESPECT TO THE TERMS OF REFERENCE

The details of the discussion points of the meeting corresponding to all the Terms of the Reference of the Committee, along with the associated regulations/protocols/standards are presented below:

3.1 Technical and Infrastructure related Issues:

3.1.1 Regulations/Standards to be framed for charging infrastructure set up.

a) Regulations regarding connectivity with grid such as power factor, load factor, harmonics, voltage deviations etc.

The Standards under the exclusive control of CEA are: Grid Connectivity Standards for Charging Stations. These include keeping harmonics, Flicker, DC Injection, etc. into the Grid under control, as well as preventing voltage imbalance. The same provisions exist in CEA's Technical Standards for connectivity of Distributed Generation Resources to the Grid. These Standards are being extended for Electric Charging Stations also.

Draft amendments are already proposed for the same and are likely to be put for public comments by the end of March 2018. Vehicle to Grid (V2G) is also being included in the above regulations. Study of the stability and adequacy of the network, with which the charging stations are to be connected by the licensee is also being included in the grid connectivity regulations.

b) Safety standards required for grid

CEA already has safety standards for Safety of Supply i.e. CEA (Measures relating to safety and electric supply) Regulations, 2010. These are being amended to incorporate safety w.r.t. Charging Stations.

The charging stations need to comply with the safety requirements of the following IEC 61851 standards:

(i) IEC 61851-1: Part 1: General Requirements

(ii) IEC 61851-21: Part 21: Electric Vehicle Requirements for conductive connection to AC/DC supply

(iii)IEC 61851-22: Part 22: AC Electric Vehicle Charging Stations

(iv)IEC 61851-23: Part 23: DC Electric Vehicle Charging Stations

(v) IEC 61851-24: Part 24: Digital connection between a DC EV Charging Station and an Electric Vehicle for control of DC Charging.

c) Standards/specification of equipment/ products to be used in charging infrastructure considering the interoperability of the device and the agency responsible for it.

(i) Specification for fast and slow chargers (level 1 to 5) and AC and DC chargers.

Technical Standards for **Electric Vehicles** come under the purview of Ministry of Road Transport and Highways and are governed by AIS Standards, which have been issued by them since 2002. The AIS standards for Electric/Hybrid vehicles are given in Annexure III.

Technical Standards for charging stations and connectors are given below:

(1)Technical Standards for Charging Stations already exist under IEC Standards. These are as follows:

(i) IEC 61851-1: Part 1: General Requirements

(ii) IEC 61851-21: Part 21: Electric Vehicle Requirements for conductive connection to AC/DC supply

(iii)IEC 61851-22: Part 22: AC Electric Vehicle Charging Stations

(iv)IEC 61851-23: Part 23: DC Electric Vehicle Charging Stations

(v) IEC 61851-24: Part 24: Digital connection between a DC EV Charging Station and an Electric Vehicle for control of DC Charging.

These set of standards (IEC 61851-23 and IEC 61851-24) also list out in Annexes, three types of Charging Connection Protocols used by three different countries of manufacturers i.e. Japan, China, Europe/USA. The IEC documents lay down standards for all these types of Charging protocols and do not mention whether one has to be preferred over the other. Each of these Charging protocols have linked connectors from concerned IEC documents.

(2)Technical Standards for Connectors are covered in IEC 62196. These are listed below:

(i) IEC 62196-1: Definitions

(ii) IEC 62196-2: AC Connector

(iii)IEC 62196-3: DC Connector

IEC Standards deal with the type of charging, i.e. whether AC or DC, and provides for protection against electric shock, fault protection, conditions of connection between the Charging Infrastructure and the electric vehicle, details of charging cable assembly, ambient temperature, etc. These Standards also deal with metering of electricity, electrical safety.

All these Standards can be adopted as they are, except for ambient temperature conditions. The ambient temperature conditions as mentioned in the IEC documents are: -25 C to + 40 C for outdoor as well as indoor units. For Indian conditions, they should be able to withstand temperature, at the higher end, upto +55 C. Hence it is proposed that the ambient temperature conditions should range from 0 C to +55 C. This is in line with the ambient temperature conditions used in Bharat EV Charger Specifications. (Above this temperature, de-rating would be allowed)

Communication Protocols which are required for communication and control between electric vehicle, charging station (also known as Electric Vehicle Supply Equipment EVSE), and a Central Management System(CMS) are given below**:**

(1) Standard for Communication between EVSE and CMS

Communication between Electrical Vehicle Supply Equipment(EVSE) and Central Monitoring System (CMS) located at power utility company is required to enable maximum charging rate to be controlled depending upon availability of power in the grid. This will enable metering at different rates based on time-of-use. This is required as whenever there is a shortage in the grid, the grid would restrict supply. This will also enable reservation of chargers by users. **The communication protocol used will be Open Charge Point Protocol (OCPP)**. As the world has converged upon OCPP as a standard communication protocol to be used for EVSE-CMS communication, a standardization committee set up by Department of Heavy Industry has adopted this without any variation. Communication using OCPP is carried on the Internet, using wired media or wireless (Wi Fi or GPRS or 3G/4G wireless). OCPP is encrypted and therefore reasonably safe from hacking.

(2) Standard for Communication between Electric Vehicle and EVSE

There are three types of charging infrastructure categories:

i. Low Voltage<120V
ii. Medium Voltage >120V but <500V
iii. High Voltage>500V

Various standards for the above mentioned categories are explained below:

Low Voltage Category:

For low voltage category, Indian standards are already in place. Department of Heavy Industry constituted a Committee under the Chairmanship of Prof. Ashok Jhunjhunwala to finalize the protocol for charging infrastructure for different combination of voltage and speed of charging. The Committee has come out with

recommendations in the form of specifications for AC and DC chargers namely **Bharat EV Charger AC-001 and Bharat EV Charger DC-001**. AC-001 is the AC charger specification providing the supply voltage of 230 V, which is a single phase charger, whereas the DC-001 specifications provides an DC output voltage of 48/ 60/ 72 V DC, which is not considered fatal. These specifications are intended to cater to the immediate need of existing and announced electric 2 wheelers, electric 3 wheelers and passenger cars/vehicles having battery voltage less than 100 V.

AC Charging : Bharat Charger AC-001 can charge three different vehicles simultaneously, where input is 415 V nominal voltage and output of each of the charger is a single-phase AC at 230V and a 15A current. The charge-rate for each of the three vehicles is limited to 3.3 kW. The committee has also recommended an AC-002 standard to be specified in future. AC-002 is expected to have either 6.6 kW or 13 kW or 21 kW power-output. It requires 3-phase AC inputs and may be termed as AC FAST CHARGERS.

DC Charging : In Bharat Charger DC-001, the input would be three-phase 415 V nominal voltage that is presently used widely in India and the output would have 48V or 60V or 72V DC with maximum current as 200A (implying 15 kW output).

Even though standards for Low Voltage AC Charging (AC-001) have been specified as Bharat Standards, a single uniform standard could be adopted for all the categories of vehicles. However, keeping in view the vehicles already manufactured, this could be done for future vehicles. The currently defined AC electric vehicle supply equipment may not be adequate, since IEC 60309 and ISI marked plug/industrial plug were not originally meant for thousands of mating cycles.

Medium and Heavy Voltage Category:

For medium and heavy voltage category, there are three standards mainly used worldwide, which are as follows:

i. **CHAdeMO** – Japanese

ii. **GB/T-27930** – Chinese

iii. **Combined Charging System(CCS)** – European

The general consensus is being built around CCS because of the following reasons:

(i) CCS has a single connector inlet for both the AC and DC charging types at the vehicle end, thus reducing space requirements in the vehicle, where as GB/T and CHAdeMO require two different inlets of AC and DC.

(ii) DC charging power in CCS is up to 350 kW with one charging gun, while other standards require dual guns for this amount of power as of now available commercially. The charging voltage is up to 1000V and current up to 350 A, using liquid cooled cables and connectors. For DC Fast charge, CHAdeMO provides for voltage up to 500 V DC and current upto 125 A. GBT has defined a connector which can be used for up to 200A of DC current. The specifications mentioned here are according to the ones commercially available, as of now.

(iii)For communication, CCS uses Control Area Network (CAN) physical network within the vehicle, but, unlike ChadeMO and GBT, it uses Power Line Carrier Communications (PLCC) for physical communication between vehicle and charging station i.e. Electric Vehicle Supply Equipment(EVSE). PLCC link can support higher data-rate as compared to that by CAN.

(iv) Majority brands follow CCS standards. Out of top 20 brands in 2016 by volume, 12-follow CCS protocol, 3- follow CCS+ChadeMO, 3-follow ChadeMO and rest two are still open. This will help India in future exports and imports of e-vehicles.

The present Bharat EV Standards (for battery voltages less than 100 V) essentially follows GB/T standards. However, GBT is proposed to be redesigned in a few years. Because of this reason and its lower range compared to CCS, it may not be suitable to adopt GB/T as of now.

It is recommended to make CCS mandatory at each charging stations however charging stations can also install other charging standards. It is similar to the instruction of the European Parliament on 22nd October 2014, which issued the directive that DC High

Power Charging shall be equipped, for interoperability purposes, at least with connectors of the CCS type.

For low voltage vehicles (less than 120 V) also CCS proposal is expected soon.

d) Testing and verifications of equipment's w.r.t standards.

Testing and verification of all the components of Electric Vehicle and Charging Stations, like battery, motor, power electronics, etc should be done. It is proposed to have centers, which are geographically distributed all over India. The testing and verification facilities should be ready to accommodate the latest technological development and others advancements.

Testing and verification of equipments w.r.t standards are already being done by ARAI. They should also be done by other accredited laboratories, for example, ICAT Manesar, CPRI, GARC Chennai, VRDE Ahmednagar, etc.

e) Assessment and strengthening of capacity of sub transmission/distribution network to supply the load of electric vehicles.

It is proposed to select the public charging stations by state DISCOM in coordination with state transport department/urban development department.

The Grid may need higher capacity charger in the future with introduction of new cars intended for long distance travels, sports cars, heavy vehicles like busses, etc, having a high capacity chargers.

Study of the stability and adequacy of the network which the charging stations are to be connected is to be ensured by the licensee while granting connectivity. This is being included in the grid connectivity regulations.

f) Energy performance standards for chargers.

Energy performance standards for chargers shall be assessed by BEE. Energy standards for electric vehicles are already exits; however, energy standards for chargers are not yet established.

3.1.2 Infrastructure

a) Identification of suitable location and density/penetration of charging infrastructure.

Similar topic has also been included in the Terms of Reference of the **Committee on Policy, Planning and Regulatory/Tariff related issues**, viz. 'Ownership structure to be adopted for the charging infrastructure' and 'Planning of roll-out', as cited in Section 1. The suggestions of this Committee are given below. These may be considered by the Committee on Policy, Planning and Regulation /Tariff related issues.

There could be a phase wise approach to charging station allocations. Suitable locations of charging stations need to be identified. Initially Govt Buildings, Malls, Parking places could be used where land is already available. Later on, bidding process could be used.

Classification of charging points could be done between public charging, restricted public charging (for example in apartments and office parking lots, shopping malls, patrons of hotel or restaurant, etc) and inhouse/captive charging station. The permissions required for each of these types could be different. However, permission from DISCOM would be required for all. For public charging points, these would be identified by the DISCOM, State Road Transport Department and Urban Development Department of the State. These could initially be set up through support by the Government. When enough electric vehicles are on the road, then charging points could be bid out.

For setting up charging infrastructure for slow charging at residences, it was felt that the setting up of charging points should be mandated in the building code as per the requirement. This is being undertaken by Ministry of Housing & Urban Affairs.

For public places identified for setting up charging stations, land could be given on lease, as is done for petrol stations so as to reduce the service charge.

b) Concentration of slow chargers and fast chargers based on suitability of location and utility.

It is proposed that 80-90% of charging should be through slow chargers at residential, office,etc just as is done Internationally. Fast chargers to be optimally located considering traffic, distribution infrastructure, etc.

Slow Chargers- These could be located in residential areas mostly, because 7-9 hours of overnight charging could be done by flat owners. The ground floor of every upcoming multi-storey building should provide for charging points for e-vehicles. Municipal and/or community parking spaces could also have slow chargers.

Fast Chargers- These could be provided on highways, malls, parking lots, parking areas associated with open markets, etc. These will provide instant charging in 30-90 mins(depending upon battery and charging station capability). Fast chargers are suitable for locations where people will spend some time, for eg. in shopping complexes and malls. Petrol pumps already have a large network throughout the country, and their land resources could be shared for a fast top-up of electric recharge which could be in the range of 5-10 minutes. However, not many vehicles could be parked at the same time at a petrol pump for charging, hence petrol pumps could be viewed as a limited charging facility.

Combined- Office spaces should provide for a combination of slow and fast chargers. Official cars could be plugged in for longer charge times, and in case of urgent requirements, fast charging could be done. In official spaces, the number of slow chargers should be more than that of fast ones.

However, above classification is only suggestive in nature and there could be exceptions. For eg, the parking lots at the basement of malls could also house a few slow chargers.

c) Land requirement:

(i) Capacity/number of charging stations being set up.

(ii) Availability of suitable land/location.

Similar topic is also included in the Terms of Reference of the Committee on Policy, Planning and Regulatory/Tariff related issues, viz. 'Ownership structure to be adopted for the charging infrastructure' and 'Planning of roll-out', as cited in Section 1. The suggestions of this Committee are given below:

The capacity/number of charging stations may be decided as per the electric vehicles population density of the city/area.

As stated earlier, there could be a phase wise approach to charging station allocations. Suitable locations of charging stations need to be identified. Initially Govt Buildings, Malls, Parking places could be used where land is already available. Later on, bidding process could be used.

Classification of charging points could be done between public charging, restricted public charging (for example in apartments and office parking lots, , shopping malls, patrons of hotel or restaurant, etc) and inhouse/captive charging station. The permissions required for each of these types could be different. However, permission from DISCOM would be required for all. For public charging points, these would be identified by the DISCOM, State Road Transport Department and Urban Development Department of the State. These could initially be set up through support by the Government. When enough electric vehicles are on the road, then charging points could be bid out.

For setting up charging infrastructure for slow charging at residences, it was felt that the setting up of charging points should be mandated in the building code as per the requirement. This is being undertaken by Ministry Of Housing & Urban Affairs.

For public places identified for setting up charging stations, land could be given on lease, as is done for petrol stations so as to reduce the service charge.

MAIN RECOMMENDATIONS OF THE COMMITTEE

4. MAIN RECOMMENDATIONS OF THE COMMITTEE

In accordance with the discussions held in the meetings of the committee, following recommendations are made corresponding to the terms of the reference:

4.1 Technical and Infrastructure related Issues:

4.1.1 Regulations/Standards to be framed for charging infrastructure set up.

a) Regulations regarding connectivity with grid such as power factor, load factor, harmonics, voltage deviations etc.

For Supply of Quality of Power, it is essential that power factor, load factor, harmonics, voltage deviations etc. are kept within the prescribed limit as defined by Central Electricity Authority (Technical Standards for Connectivity of the Distributed Generation Resources) Regulations. Draft amendments are proposed for the same.

b) Safety standards required for grid

Safety standards required for grid are to be ensured through existing CEA regulations, viz., CEA (Measures relating to safety and electric supply) Regulations, 2010, which are being amended to incorporate safety w.r.t. Charging Stations.

The charging stations need to comply with the safety requirements of the following IEC 61851 standards:

(i) IEC 61851-1: Part 1: General Requirements

(ii) IEC 61851-21: Part 21: Electric Vehicle Requirements for conductive connection to AC/DC supply

(iii)IEC 61851-22: Part 22: AC Electric Vehicle Charging Stations

(iv)IEC 61851-23: Part 23: DC Electric Vehicle Charging Stations

(v) IEC 61851-24: Part 24: Digital connection between a DC EV Charging Station and an Electric Vehicle for control of DC Charging.

c) Standards/specification of equipment/ products to be used in charging infrastructure considering the interoperability of the device and the agency responsible for it.

- **Specification for fast and slow chargers (level 1 to 5) and AC and DC chargers.**

Technical Standards for **Electric Vehicles** are issued by Ministry of Road Transport and Highways and are governed by AIS Standards.

(i)Technical Standards for **Charging Stations** exist under IEC Standards: 61851-1, 61851-21, 61851-22, 61851-23 and 61851-24. The set of standards (IEC 61851-23 and IEC 61851-24) also list out in Annexes, three types of Charging Connection Protocols used by three different countries of manufacturers i.e. Japan, China, Europe/USA.

(ii)Technical Standards for **Connectors** are covered in IEC 62196-1, 62196-2 and 61196-3. These shall be adopted except for ambient temperature conditions. The ambient temperature conditions mentioned in the IEC documents are: -25º C to + 40º C for outdoor as well as indoor units. For Indian conditions, it is proposed that the ambient temperature should range from 0º C to +55º C.

Standard for communication between Electrical Vehicle Supply Equipment(EVSE) and Central Monitoring System (CMS) will be Open Charge Point Protocol (OCPP).

Standard for Communication between Electric Vehicle and EVSE shall be as per DHI notification. For low battery voltage category(less than 120 V), Bharat EV Specifications- AC-001 and DC-001 already exist. For medium and heavy battery voltage category, the general consensus is being built around CCS. It is recommended to make CCS mandatory at each public charging stations, however charging stations can also follow other charging standards.

d) Testing and verifications of equipment's w.r.t standards.

Testing and verification of equipments w.r.t standards shall be done by ARAI and other accredited laboratories, for example, ICAT Manesar, CPRI, GARC Chennai, VRDE

Ahmednagar etc. It is proposed to have centers which are geographically distributed all over India.

e) Assessment and strengthening of capacity of sub transmission/distribution network to supply the load of electric vehicles.

Assessment and strengthening of capacity of sub transmission/distribution network to supply the load of electric vehicles is proposed to be carried out by state DISCOM. Study of the stability and adequacy of the network which the charging stations are to be connected is to be ensured by the licensee while granting connectivity. This is being included in the grid connectivity regulations.

f) Energy performance standards for chargers.

Energy performance standards for chargers shall be assessed by BEE. However, at present there are no IEC standards for reference.

4.1.2 Infrastructure

a) Identification of suitable location and density/penetration of charging infrastructure.

Classification of charging points could be done between public charging, restricted public charging and inhouse/captive charging station. The permissions required for each of these types could be different. However, permission from DISCOM would be required for all. For public charging points, these would be identified by the DISCOM, State Road Transport Department and Urban Development Department of the State. These could initially be set up through support by the Government. When enough electric vehicles are on the road, then charging points could be bid out.

b) Concentration of slow chargers and fast chargers based on suitability of location and utility.

Slow Chargers- In residential areas mostly. Municipal and/or community parking spaces could also have slow chargers. The ground floor of every upcoming multi-storey building should provide for charging points for e-vehicles.

Fast Chargers- These could be provided on highways, malls parking spots, petrol pumps, parking areas associated with open markets, etc. Land resources of petrol pumps could be shared for a fast top-up of electric recharge in the range of 5-10 minutes, however they could only be viewed as a limited charging facility.

Combined- Office spaces should provide for a combination of slow and fast chargers, where the number of slow chargers should be more than that of fast ones.

c) Land requirement:

(i) Capacity/number of charging stations being set up.

(ii) Availability of suitable land/location.

The capacity/number of charging stations may be decided as per the population density of the city/area. Classification of charging points could be done between public charging, restricted public charging (for example in apartments and office parking lots, shopping malls, hotel or restaurant parking, etc) and inhouse/captive charging station.

ANNEXURES

TO THE REPORT

ANNEXURE I

MINUTES OF THE 1ST MEETING OF THE COMMITTEE

ANNEXURE I

MINUTES OF THE 1ST MEETING OF THE COMMITTEE

Following are the minutes of the 1st meeting of the committee on technical aspects of charging infrastructure for electric vehicles held on 12th February 2018 at New Delhi:

1. Shri Pankaj Batra, Member (Planning) CEA, welcomed all the members to the meeting and informed that Ministry of Power vide OM No. 12/20/207-UMPP dated 31 January, 2018 has constituted a Committee on Technical aspects of Charging Stations for Electric Vehicles to address the technical aspects and to draw a road map for setting up charging infrastructure and also to address the issue of regulations/standards on the same. The list of participants is enclosed as **Annex-I.** He explained that three types of protocols which are mainly used worldwide based on IEC 61851 standard, which are as follows:

i. CHAdeMO – Japanese

ii. GB/T-27930 – Chinese

iii. Combined Charging System(CCS) – European

He introduced Shri. Sivam Sebasen, Managing Director at CharIN E.V, India and requested him to give a presentation on CCS standard.

1.1 Shri. Sivam Sebasen, gave a brief introduction of CharIN (Charging Interface Initiative), and informed the participants that CharIN is a non-profit organization promoting the CCS charging standard. It consists of 104 members, which includes Original Equipment Manufacturer (OEM) s, charger manufacturers and component suppliers. Out of top 20 brands in 2016 by volume, 12-follow CCS protocol, 3- follow CCS+ChadeMO, 3-follow ChadeMO and rest two are still open. The CCS protocol for high voltage charging is applicable for AC and DC charging both and have only one connector for both the charging types at the vehicle end, thus reducing space requirements in the vehicle. Two variants are available for different geographies:

i) CCS 1 – Typically 110-220 V, Single phase, used in USA, Canada and Korea

ii) CCS 2 – Typically 220-415 V, Three phase, used in Europe and rest of the world.

Compared to other standards, DC charging power in CCS is up to 350 kW with one charging gun, while other standards require dual guns for this amount of power. Charging voltage is up to 1000V and current up to 350 A, using liquid cooled cables and connectors. He further explained the differences between AC and DC charging.

The Chairman pointed out that 80-90% of charging should be of the slow charging, as it increases the life of battery and does not load the grid much. He further stated that no global consensus is being built for DC charging, unlike AC, where most of the countries follow Type 1(Single phase) or Type 2(Three phase). In Europe, for instance, they have declared a minimum of CCS and Type 2 AC standard.

Regarding Communication protocol, in all vehicles, the communication within the vehicle is using CAN (Control Area Network). CCS uses CAN link within the vehicle, but, unlike ChadeMo and GBT, it uses Power Line Carrier Communications (PLCC) for physical communication between vehicle and charging station. PLC allows secure communication using encrypted messages and the link can support higher data-rate as compared to that by CAN.

Regarding the cyber security issue, the Chairman requested Shri. Sajid Mubashir from Department of Science and Technology (DST) to verify from the cyber security cell of DST if sufficient safety checks are present in the standard or not.

Vehicle Identification Number (VIN): Shri. Sebasan informed that CCS can do vehicle identification. Shri Anand Deshpande from ARAI informed that in China, vehicle identification is done and data is collected for surveying and for formulation of policies. Shri. Sebasan informed that most of the customers do not prefer vehicle identification to be inbuilt, because it will lead to privacy issues. In addition, it would delay the implementation of e-Vehicles owing to an additional software addition. Software addition requires manpower and a six-month verification cycle. The Chairman stated that we need to follow what is best for the country and this point needs further discussion.

Regarding royalty/fees, Shri. Mubashir requested Shri. Sebasan to inform whether any fees needs to be paid for joining CharIN or for any additional feature addition. To this, Shri. Sebasan answered that there is no such fee. Even if one does not joins, one can still follow CCS standard.

Shri Manasvi Sharma from Tata Power, asked Shri Sebasan whether OEMs are members of CharIN or regulatory bodies are members too? To this, Shri. Sebasan replied that regulatory bodies are not the members of CharIN but OEM's are members barring few.

1.2 Shri. Sajid Mubashir, Scientist 'G' from Department of Science and Technology (DST), who is currently heading the Bureau of Indian Standards (BIS) Committee ETD-51 to develop standards for e-mobility, stated that since we already have Bharat Charging Standards, viz. AC-001 and DC-001, in place for low/light end vehicles, we need to focus on medium and heavy vehicle category, especially buses in public transport. In his opinion, GBT and CCS were both good standards, however, CCS could be preferable owing to its higher range coverage. GBT is proposed to be redesigned in a few years, hence is not suitable to adopt now. ChadeMo is costlier to implement. Further AC and DC standards for 3 wheelers, like auto rickshaw, need to be adopted. He was of opinion that battery swapping could be an option.

Regarding charging of e-Buses, he explained that there are two possible ways:

(i) Depot Charging/Conductive - Here multiple buses can be charged simultaneously and they can cover larger distances, but then they require larger batteries as well.

(ii) On route Charging/Inductive – Here buses are charged while in service in the route. Infrastructure like overhead pantograph needs to be installed for charging. Even though battery size would reduce in this case, the range of bus shortens for a given charge. Also, this is a fast charging procedure and the common battery type available (Lithium, NMC batteries) cannot charge so fast. Some other battery types are available, which can charge at a faster rate, but they come at a much higher cost.

Shri Sharma asked if both facilities could be built onto the same bus. To this, the Chairman replied that we need to discuss pros and cons of both types of charging.

1.3 Shri Anand Deshpande, Deputy Director & Head Automotive Electronics Department ARAI, intimated the committee that Automotive Industry Standards(AIS) related to e-vehicles and charging systems have been prepared by ARAI, which are as given below:

(i) AIS 138 (Part 1): Electric Vehicle Conductive AC Charging System.

(ii) AIS 138 (Part 2): Electric Vehicle Conductive DC Charging System.

Part 1 was released in February 2017 and Part 2 is in the final draft stage and is displayed on the website of Ministry of Road Transport & Highways (MoRTH) for general public. AIS 138(Part 2) has provision for all the three common DC standards: GBT in Type B, ChadeMo in Type A and CCS in Type C. He intimated that the AIS standards are derived from IEC 61851 and cover requirements of safety, environmental, EMC, tolerance to harmonics, etc. Some modifications are made to suit the different Indian conditions, as given below:

Parameters	**IEC Standards**	**AIS Standards**
Ambient Temperature	- 25 ºC to 40 ºC	20 to 30 ºC
Humidity	5 to 95%	5 to 95%
IP class for outdoor use	IP44	IP54

Shri Deshpande also suggested that self -certification should be allowed to save time.

1.4 Shri. D.G. Salpekar, General Manager (e-Vehicle) EESL, stated that CCS would not be compatible with their current fleet of vehicles because they are all less than 120 V, while CCS deals with voltages higher than this limit. EESL will follow Bharat Charging Standards for their fleet.

Shri Mubashir stated that we do not have standards for 2/3 wheeler vehicles and it would be convenient if CCS too could be used for this category. The Chairman requested Shri. Sebasan to come up with a CCS proposal for smaller vehicle since it will be needed soon.

1.5 Chairman stated that charging stations points should be identified by the Discom's, MoRTH and Ministry of Urban Development and all the charging stations bid out together through competitive bidding by an identified government agency. These should be set up in a phased manner.

For setting up charging infrastructure for slow charging at residences, it was felt that the setting up of charging points should be mandated in the building code as per the requirement.

For public places identified for setting up charging stations, land could be given on lease, as is done for petrol stations so as to reduce the service charge.

1.6 Shri. Anil Kaushik, AGM NTPC Limited, said that electricity in India is highly regulated business. Discoms, Ministry of road transport and highways (MoRTH) and Ministry of Housing and Urban Development should come together for setting up efficient charging infrastructure. He said that in China, GBT standard is strictly enforced, even foreign companies selling vehicles there modify their charging inlets as per GBT. Similarly, whatever standard is adopted by India, whether CCS or ChadeMo or GBT, it should be one and uniform throughout the nation. He also stated that bidding for setting up of charging stations should be allowed only from EV suppliers, Generators and other people connected to the subject of electric charging.

1.7 Shri Manasvi Sharma, Head – Strategy (Mumbai Operations), Tata Power, said that clear distinction should be made between Self Use and Residential Use tariffs. He was of opinion that uniform tariff cannot be imposed.

1.8 Mrs. M. Janaki, Deputy Secretary (UT) from Ministry of Housing & Urban Affairs, gave the example of India's first electric bus in Himachal Pradesh, that has officially made its commercial debut and is now available for public transport. Himachal Roadways has flagged off Goldstone's electric bus that will travel between Kullu-Manalli-Rohtang Pass in Himachal Pradesh.

1.9 Chairman informed that as far as grid connectivity standards for charging stations are concerned, draft amendments to CEA regulations on distributed generation to incorporate charging stations with respect to adverse effects on grid like harmonics, D.C. injection, flicker etc.

1.10 The Chairman suggested the following participants to be co-opted for the next committee meeting:

(i) Other concerned divisions from CEA

(ii) Representative from Society of Indian Automobile Manufacturers (SIAM)

(iii) Representative from NITI Aayog

(iv) Representative from International Center for Automotive Technology(ICAT)

(v) Representative from Himachal Pradesh Transport Department

2. The following points were decided:

(a) Which standard has to be adopted: CCS v/s GBT v/s ChadeMO

The consensus in being built around CCS, since it covers all medium to heavy vehicles categories. It has additional layer of security in terms of PLC.

(b) Vehicle Identification

We can proceed without vehicle identification number (VIN) as of now.

(c) Any inputs/documents related to development of E-vehicle standards shall be provided by respective members of the committee to the Member Secretary, which would be subsequently mailed to everyone.

The chairman stated that we would bring out a draft report before the next meeting which would be circulated in advance, so that the same could be discussed.

The Chairman thanked all the members for their valuable suggestions.

Annex-I

LIST OF PARTICIPANTS OF THE 1ST MEETING

S.No.	Name	Organization/ Office
1	Sh. Pankaj Batra	CEA, Chairman
2	Mrs. Seema Saxena	CE(R&D), CEA Member Secretary
3	Mrs. Vandana Singhal	CE(TPM), CEA
4	Sh. Dinesh Chandra	CE(GM), CEA
5	Sh.Vikram Singh	Director(GM), CEA
6	Sh. Krishna Nand Pal	AD(R&D), CEA
7	Ms .Sonam Srivastava	AD(R&D), CEA
8	Sh. Manasvi Sharma	Tata Power
9	Sh. Sajid Mubashir	DST/BIS
10	Sh. Debasis De	NRLDC, POSOCO, Delhi
11	Sh. Shivam Sabesan	CharIN
12	Sh. Sameer Pandita	BEE
13	Sh. Rajeev	BEE
14	Sh. Naveen Nagpal	DGM -Renewables BSES Rajdhani Power Ltd. New Delhi
15	Sh. Anil Koushik	NTPC NOIDA
16	Sh. Deepak Paliwal	NTPC, NOIDA

17	Mrs. M. Janaki	Ministry Of Housing & Urban Affairs
18	Sh. D.G. Salpekar	EESL
19	Sh. Sanjay Kumar Sharma	(Join Dir.) DERC
20	Sh. Anand Deshpande	ARAI
21	Sh. Abhishek Ranjan	BSES Rajdhani Power New Delhi

ANNEXURE II

MINUTES OF THE 2nd MEETING OF THE COMMITTEE

ANNEXURE II

MINUTES OF THE 2nd MEETING OF THE COMMITTEE

Following are the minutes of the 2nd meeting of the committee on technical aspects of charging infrastructure for electric vehicles held on 14th March 2018 at New Delhi:

1. **Shri Pankaj Batra, Member (Planning) CEA**, welcomed all the members to the meeting and gave a brief background of the Committee, which was constituted to address the technical aspects and to draw a road map for setting up charging infrastructure and also to address the issue of regulations/standards on the same. List of participants is enclosed as **Annex-I.** He stated that after the first meeting of the Committee, held on 12th February, 2018, a draft Report was prepared by CEA and circulated to the members on 9th March, 2018. The Report contained detailed discussions pertaining to all the Terms of Reference of the Committee and the main recommendations of the committee.

1.1 **Shri. Sajid Mubashir, Scientist 'G' from Department of Science and Technology (DST**), who is currently heading the Bureau of Indian Standards (BIS) Committee ETD-51 to develop standards of charging stations for e-mobility, stated that all the 3 commonly used standards, viz. Combined Charging System(CCS), GB/T-27930 and CHAdeMO, used for communication between Electric Vehicle(EV) and Electric Vehicle Supply Equipment(EVSE), are a part of the IEC standards only. The Bharat EV Charger Specifications, viz. AC-001(slow AC charging) and DC-001(slow DC charging), also refer to the IEC standards, since they are derived from GB/T standards. He pointed out that while there is a provision of dedicated communication between EV and EVSE in DC-001, there is no such communication in case of AC-001. He was of opinion that even in the case of AC charging, communication protocols should be implemented.

Shri. Saurabh Rohilla, Deputy Director SIAM, explained why Bharat EV Charger Specifications, which are for low voltage category vehicles <100 V, decided to exclude dedicated communication for AC-001. DC chargers were expected to be placed in public charging stations for fast charging. To monitor these stations via a Central Management System(CMS), communication was made mandatory between EV and EVSE for collection

of data and framing of future policies required for optimum distribution and usage of public charging stations. On the other hand, AC chargers, since they were slow and required 7-9 hours of charging, were expected to be installed at homes and residential areas.

Shri. A. B. Mulay, General Manager ARAI, stated that in AC charging, the EVSE communicates with the on-board charger in the EV. However, in DC charging, the EVSE directly connects with the battery pack(including the Battery Management System(BMS)), hence specific communication was provisioned.

1.2 Regarding **Vehicle Identification Number(VIN),** Shri. Mulay stated that Bharat EV Charger Specification for DC, ie DC-001, collects data such as Vehicle Identification Number(VIN), number of cycles, etc.

Shri. Polash Das, from EESL, informed that they put the provision of VIN specifically in their tender for DC chargers, because they wanted to identify vehicles and to develop telematics since DC chargers were supposed to be public chargers.

Shri Manasvi M. Sharma, from Tata Power, stated that collection of VIN is not required for battery management.

Shri. Sivam Sebasen, Managing Director at CharIN E.V, India, informed that collection of VIN is not yet incorporated in CCS standard. However it can be done if required.

1.3 Shri. Sebasen, from CharIN, stated that **Vehicle to Grid(V2G) Connectivity** is possible with DC chargers technically, but it may not be possible for AC Charging. V2G is only possible for bidirectional connections like DC. In a typical AC charger, there is a convertor, which converts AC from supply to DC for the battery pack, but there is no invertor to convert DC from battery back to AC.

The Chairman enquired whether V2G could be achieved through modifications in the AC on-board charger. **Shri. Anil Kaushik, AGM NTPC Limited**, stated that currently it is not being done anywhere. **Shri Goutam Roy, Chief Engineer(CEI) from CEA**, stated that V2G may not be required since when the EV is charged, there will be some losses. When the EV discharges, it will supply power to the grid lesser than what it has taken.

The Chairman stated that keeping in mind long term view, we should not completely discard V2G for AC and should keep V2G provision for DC as well as AC alive, considering future technological developments.

1.4 Shri. Mulay, from ARAI, informed that whether it is AC charging or DC charging, EVSE to CMS communication is provisioned through Open Charge Point Protocol (OCPP) in Bharat EV Charger Specifications. ARAI has done end-to-end testing of this communication between EVSE and CMS using dummy central server at IIT Madras; however it is not yet operationalized owing to the absence of a fully functional Central Management System(CMS).

Regarding **billing and payment**, the Bharat EV Charger Specifications have adopted – Direct debiting of the funds to user's equipment based on Vehicle Identification Number(VIN). Alternately, a mobile application could be defined, which will allow a user to charge using BHIM or Bharat QR code or other digital payment schemes specified by Indian Government, to be used both for AC as well as DC chargers.

Shri. Mulay further informed that currently for home private chargers, the billing is part of home metering. As per the Bharat EV Charger Specifications, this will be continued till a policy evolves to charge home users differently for EV use. However, inclusion of Residual Current Devices(RCD) should be ensured.

Shri. Abhishek Ranjan, from BSES Rajdhani, suggested that for multi storey buildings, since parking area is already available, the charging points for EV owners could be linked to a common meter like in case of a common roof top solar. Shri. Kaushik stated that since a single AC charger, which can charge up to 3 EVs, costs about Rs. 30,000 currently, the cost could be shared between 3 EV owners.

1.5 The Chairman enquired whether grid can regulate rate of charging depending on grid conditions i.e. meeting demand response and whether OCPP facilitates this. He stated that since generation from renewables is possible, which India is moving towards, is highly intermittent, hence charging station control is required by the grid operation. Shri. Mulay informed that Bharat EV Charger Specifications do not provide for such controls as there is no throttle to change wattage. Shri Ranjan stated that there should be a provision of

throttling for varying load. It is already being done in UK. The Chairman requested Shri. Mulay to enquire whether OCPP can facilitate this.

2. Discussions regarding the modifications in Draft Report:

A presentation was made by the R&D Division, the dealing Division for Electric Vehicle in CEA, elucidating the recommendations of the Committee corresponding to the Terms of Reference of the Committee. Copy of the presentation is enclosed as **Annex-II.** The members were requested to give their inputs regarding each of the recommendations.

The full Terms of Reference of the Committee are given below in Section 2.1. Section 2.2 below mentions only those Terms of Reference where responses were received or modifications were suggested in the Draft Report.

2.1 <u>The Terms of Reference of the Committee are reproduced below for ready reference:</u>

i. Regulations/Standards to be framed for charging infrastructure set up.

a. Regulations regarding connectivity with grid such as power factor, load factor, harmonics, voltage deviations etc.

b. Safety standards required for connection to the grid,

c. Standards/specifications of equipment/products to be used in charging infrastructure considering the interoperability of the device and the agency responsible for it.

o Specifications for fast and slow chargers (Level 1 to Level 5) and AC/DC chargers.

d. Testing and verifications of equipment w.r.t Standards.

e. Assessment and strengthening of capacity of sub-transmission/distribution network to supply the load of electric vehicles.

f. Energy Performance Standards for Chargers.

ii. Infrastructure

a. Identification of suitable location and density/penetration of charging infrastructure.

b. Concentration of Slow chargers and fast chargers based on suitability of location and utility.

c. Land requirement:

- Capacity/number of charging stations being set up.
- Availability of suitable land/location.

2.2 Modifications suggested in the Draft Report corresponding to the Terms of Reference

This section lists specifically those Terms of References of the Committee where modifications were suggested in the contents of Draft Report. The discussion about the topic, the previous version in the Report and the proposed updated version has been mentioned against each point.

1) Under **Section 3.1.1, Point (a) Regulations regarding connectivity with grid such as power factor, load factor, harmonics, voltage deviations etc.**

Discussion:

Regarding the amendments proposed in Distributed Generation Resource(DGR) regulations for connectivity **below 33 KV**, Shri Kaushik informed that NTPC has set up charging stations in Jabalpur at 33KV, hence the category for **33 KV and above** should also be included. The Chairman concurred with the preposition.

Previous Version:

For connectivity below 33 KV, Distributed Generation Resource(DGR) regulations for charging stations are proposed to be amended so as to include Charging stations applicants.

Proposed Updated Version:

For connectivity **below 33 KV**, Distributed Generation Resource(DGR) regulations for charging stations are proposed to be amended so as to include Charging stations applicants. Draft amendments are also proposed in the grid connectivity for bulk consumers connected at **33 KV and above**.

2) Under **Section 3.1.1, Point (c) Standards/specification of equipment/ products to be used in charging infrastructure considering the interoperability of the device and the agency responsible for it.**
Specification for fast and slow chargers (level 1 to 5) and AC and DC chargers.

Discussion (i):

Regarding Technical Standards for Electric Vehicles, which are governed by AIS standards, Shri Mubashir was of the view that the specific AIS standards' numbers should also be mentioned, like IEC standards' numbers are mentioned in the Report.

Previous Version:

Technical Standards for Electric Vehicles come under the purview of Ministry of Road Transport and Highways and are governed by AS Standards, which have been issued by them since 2002.

Proposed Updated Version:

Technical Standards for **Electric Vehicles** come under the purview of Ministry of Road Transport and Highways and are governed by AIS Standards, which have been issued by them since 2002. The AIS standards are given in Annex-III.

Discussion (ii):

Regarding the IEC standards (61851, 62196), which for Indian conditions, are proposed to be adopted for 0º C to 60º C as given in Draft Report, Shri Kaushik stated that most of the charging equipments used by NTPC are designed and tested up to 50º C only. Above 50º C temperature, derating is allowed. He further stated that several other electronics and electrical equipments used in India are designed for temperature up to 50º C. Shri Mulay

stated that Bharat EV Charger Specifications uses ambient temperature range of 0º C to 55º C. The Chairman stated that India generally has higher temperatures, and it will continue to rise in future. Keeping in mind the current scenario, as well as future readiness, it was suggested to keep the higher end of temperature range at 55º C.

Previous Version:

For Indian conditions, they should be able to withstand temperature, at the higher end, upto +60º C.

Proposed Updated Version:

For Indian conditions, they should be able to withstand temperature, at the higher end, upto +55º C. Hence it is proposed that the ambient temperature conditions should range from 0º C to +55º C. This is in line with the ambient temperature conditions used in Bharat EV Charger Specifications. (Above this temperature, de-rating would be allowed)

Discussion (iii):

Regarding Standard for Communication between EVSE and CMS using OCPP and the control of metering rates, it was suggested that rates should be based on time-of-use rather than time-of-day.

Previous Version:

This will also enable metering at different rates based on time-of-day.

Proposed Updated Version:

This should also enable metering at different rates based on time-of-use.

Discussion (iv):

Regarding the reasons mentioned behind adoption of CCS, where the different current and voltage levels of CCS, ChadeMO and GBT were mentioned, Shri Mubashir pointed out that the values may alter in near future as these standards are continuously evolving.

Previous Version:

DC charging power in CCS is up to 350 kW with one charging gun, while other standards require dual guns for this amount of power. Charging voltage is up to 1000V and current up to 350 A, using liquid cooled cables and connectors. For DC Fast charge, CHAdeMO provides for voltage up to 500 V DC and current upto 125 A. GBT has defined a connector which can be used for up to 200A of DC current.

Proposed Updated Version:

DC charging power in CCS is up to 350 kW with one charging gun, while other standards require dual guns for this amount of power as of now commercially. Charging voltage is up to 1000V and current up to 350 A, using liquid cooled cables and connectors. For DC Fast charge, CHAdeMO provides for voltage up to 500 V DC and current upto 125 A. GBT has defined a connector which can be used for up to 200A of DC current. The specifications mentioned here are according to the ones commercially available, as of now.

Discussion (v):

Regarding the statement that Power Line Carrier Communications (PLCC) is being used in CCS for secure communication, Shri. Mulay stated that other standards like GBT and ChadeMO are also secure, however they use different mechanisms. Shri Mubashir was also of the similar view.

Previous Version:

PLC allows secure communication using encrypted messages and the link can support higher data-rate as compared to that by CAN.

Proposed Updated Version:

PLCC link can support higher data-rate as compared to that by CAN.

3) Under **Section 3.1.1, Point (d) Testing and verifications of equipment's w.r.t standards**

Discussion (i):

Regarding testing and verification facilities, it was suggested by several members that more organizations, apart from ARAI, should be allowed. Organizations like ICAT, CPRI and other government recognized laboratories, which are geographically distributed thoughout India, should be encouraged and given permission for the same.

Previous Version:

Testing of all components of Electric Vehicle, like battery, motor, power electronics, etc should be done. ARAI has adequate testing and verification facilities.

Proposed Updated Version:

Testing and verification of all the components of Electric Vehicle and Charging Stations, like battery, motor, power electronics, etc should be done. It is proposed to have centers, which are geographically distributed all over India. The testing and verification facilities should be ready to accommodate the latest technological development and others advancements.

Testing and verification of equipment's w.r.t standards shall be done by ARAI and other accredited laboratories, for example, ICAT, CPRI, etc.

4) Under **Section 3.1.1, Point (a) Identification of suitable location and density/penetration of charging infrastructure**

Discussion (i):

Regarding the identification of charging points by DISCOMs, State Road Transport Department and Ministry of Urban Development of the State, Shri. Sharma, from Tata Power, stated that the charging places should be classified as Open Access/Public charging and Restricted Access/Private Charging. For private charging points, these could be approved by the DISCOMs. A private service provider should have the option to suggest

the DISCOM where he wants installation and then DISCOM could do the verification, etc. Shri. Kaushik stated that the statement seems to mean that charging station service providers need to take permission from all the three bodies mentioned above for setting up a charging facility. It would take quite a lot of time and might delay the project. He was of opinion that permission of State Road Transport Department and Ministry of Urban Development State was a burden. The Chairman stated that for public chargers, permission from all these three departments are essential, since they are responsible for road maintenance and urban development planning. In any case, permission will be required from the DISCOM to install charging stations.

Previous Version:

The charging stations points could be identified by the DISCOMs, State Road Transport Department and Ministry of Urban Development of the State.

Proposed Updated Version:

Classification of charging points could be done between public charging, restricted public charging (for example in apartments and office parking lots, as well as shopping malls, etc) and inhouse/captive charging station. The permissions required for each of these types could be different. Permission from DISCOM would be required for all though. For public charging points, these would be identified by the DISCOM, State Road Transport Department and Urban Development Department of the State. These could initially be set up through support by the Government. When enough electric vehicles are on the road, then charging points could be bid out.

5) Under **Section 3.1.1, Point (c) Land requirement:**

- **Capacity/number of charging stations being set up.**
- **Availability of suitable land/location.**

Discussion:

Same Discussion as in point mentioned before.

3. Conclusion

The Chairman requested the members present to provide any additional inputs/comments/suggestions related to the Terms of Reference of the Committee, which may be useful for improving the report in 2 days. It may be communicated by mail to the Member Secretary.

He thanked all the members for their valuable suggestions.

Annex-I

LIST OF PARTICIPANTS OF THE 2nd MEETING

Sl. No.	Name & Designation	Organization /office address
1.	Sh. Pankaj Batra	Member(Planning), CEA Chairman
2.	Mrs. Seema Saxena	CE(R&D), CEA Member Secretary
3.	Sh. Dinesh Chandra	CE(GM), CEA
4.	Mrs. Vandana Singhal	CE(TPM), CEA
5.	Sh.Vikram Singh	Director (GM),CEA
6.	Sh. Surata Ram	Director(R&D), CEA
7.	Sh. Sudhir Jain	D.D. (R&D),CEA
8.	Sh. Krishna Nand Pal	AD(R&D), CEA
9.	Ms .Sonam Srivastava	AD(R&D), CEA
10.	Sh. Goutam Roy	CE(CEI),CEA
11	Sh.A.K. Rajput	CE(RESD), CEA
12	Sh. R.K. Meena	DD(CEI), CEA
13	Sh. Manasvi M. Sharma	Tata Power
14	Sh. Abhishek Ranjan	BSES Rajdhani
15	Sh. Diwit Prajapati	SIAM
16.	Sh. Shivam Sabesan	CharIN
17.	Sh. Saurabh Rohilla	Deputy Director SIAM
18.	Sh. R.K. Jaiswal	DHI
19.	Sh. Sajid Mubashir	DST/BIS
20.	Mrs. M. Janaki	Ministry of Housing & Urban Affairs
21.	Sh. Sameer Pandita	BEE
22.	Sh. Polash Das	EESL
23.	Sh. Naveen Nagpal,	DGM -Renewables BSES Rajdhani Power Ltd. New Delhi
24.	Sh. Chetan Pathak	Renewables BSES Rajdhani Power Ltd.
25.	Sh.A.B.Mulay	GM,ARAI
26.	Sh. Deepak Paliwal	NTPC Limited, NOIDA

27.	Sh. Debasis De	NRLDC,POSOCO
28.	Sh. Anil Koushik	NTPC NOIDA
29.	Sh. Rajeev	BEE
30.	Sh. Enoch Eapen	Dy. Manager ICAT Manesar
31	Sh. S. Victor P.Selvakumar	Powergrid

CEA Presentation on 14th March, 2018

2nd MEETING OF THE COMMITTEE
ON
TECHNICAL ASPECTS OF CHARGING INFRASTRUCTURE
FOR ELECTRIC VEHICLES

BY:
R&D DIVISION,
CENTRAL ELECTRICITY AUTHORITY

Background

- Regarding Electric Vehicles, Ministry of Power has set up the following two committees to address the issues and draw the roadmap for setting up charging infrastructure:

1) Committee on Technical Aspects

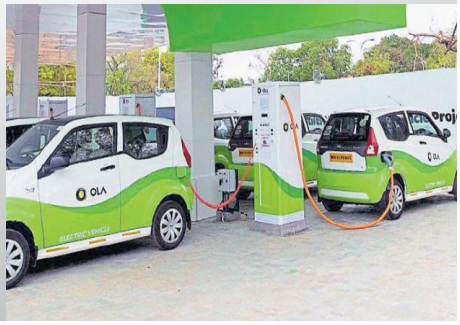
Terms of reference:

- Regulations/Standards to be framed for charging infrastructure set up
- Infrastructure

2) Committee on Policy, Planning and Regulatory/Tariff related issues

Terms of reference:

- Regulatory aspects and Policy interventions
- Tariff Issues
- Ownership structure for charging infrastructure
- Subsidies/Incentives for promotion required
- Planning of roll-out



Committee on Technical aspects of Charging Stations for electric Vehicles

- The committee is chaired by Shri Pankaj Batra, Member (Planning), CEA.
- **Composition of the Committee:**

Member(Planning), CEA	Chairman
*Joint Secretary (Distribution)	Member
Director (Distribution)	Member
Representative from EESL	Member
Representative from POSOCO	Member
Representative from State of Karnataka	Member
Representative from BSES	Member
Representative from NTPC	Member
Representative from PGCIL	Member
Representative from ARAI	Member
Representative from BEE	Member
Representative from Department of Heavy Industries	Member
Representative from DST	Member
Representative from IIT Delhi	Member
Representative from MoUD	Member
Representative from DERC	Member
Representative from Tata Power	Member

Composition of the Committee : New Co-opted Members

- Other concerned divisions from CEA
- Representatives from :

i. Society of Indian Automobile Manufacturers (SIAM)
ii. NITI Aayog
iii. International Center for Automotive Technology(ICAT)
iv. Himachal Pradesh Transport Department

1st Meeting of the Committee:

- The first meeting of the committee was held on 12th February 2018 in Sewa Bhawan, New Delhi.
- Minutes of Meeting was circulated to the participants on 1st March, 2018.
- Draft Approach Paper with respect to the Terms of Reference of the Committee has been circulated on 9th March, 2018.

Terms of Reference

I. Regulations/Standards to be framed for charging infrastructure set up.

a. Regulations regarding connectivity with grid such as power factor, load factor, harmonics, voltage deviations etc.

b. Safety standards required for grid,

c. Standards/specification of equipment/ products to be used in charging infrastructure considering the interoperability of the device and the agency responsible for it. Specification for fast and slow chargers (level 1 to 5) and AC and DC chargers.

d. Testing and verifications of equipment's w.r.t standards.

e. Assessment and strengthening of capacity of sub transmission/distribution network to supply the load of electric vehicles.

f. Energy Performance Standards for Chargers.

Terms of Reference

II. Infrastructure

a. Identification of suitable location and density/penetration of charging infrastructure.

b. Concentration of Slow chargers and fast chargers based on suitability of location and utility.

c. Land requirement:

Capacity/number of charging stations being set up.

Availability of suitable land/location.

•Main Recommendations corresponding to the Terms of the Reference of the Committee

i. Regulations/Standards to be framed for charging infrastructure set up

- **a)Regulations regarding connectivity with grid such as power factor, load factor, harmonics, voltage deviations etc.**
- It is essential that power factor, load factor, harmonics, voltage deviations etc. are kept within the prescribed limit as defined by CEA regulations "Technical standards for connectivity of the Distributed Generation Resources".
- It is proposed to amend this regulation so as to include Charging stations since these would be connected below 33KV.
- The study of the stability and adequacy of the network with which the charging stations are to be connected to is to be ensured by the distribution licensee.

Vehicle to Grid (V2G) is also being included in the above regulations.

b) Safety standards required for grid

- CEA's safety standards for Safety of Supply i.e. CEA (Measures relating to safety and electric supply) Regulations, 2010 are being amended to incorporate safety w.r.t. Charging Stations.
- The charging stations need to comply with the safety requirements of the following IEC 61851 standards:

(i) IEC 61851-1: Part 1: General Requirements

(ii) IEC 61851-21: Part 21: Electric Vehicle Requirements for conductive connection to AC/DC supply

(iii) IEC 61851-22: Part 22: AC Electric Vehicle Charging Stations

(iv) IEC 61851-23: Part 23: DC Electric Vehicle Charging Stations

(v) IEC 61851-24: Part 24: Digital connection between a DC EV Charging Station and an Electric Vehicle for control of DC Charging.

c) Standards/specification of equipment/ products to be used in charging infrastructure considering the interoperability of the device and the agency responsible for it.

Specification for fast and slow chargers (level 1 to 5) and AC and DC chargers

Technical Standards for Electric Vehicles come under the purview of Ministry of Road Transport and Highways and are governed by AS Standards.

- **(1)Technical Standards for Charging Stations** are covered under IEC 61851 Standards, viz. IEC 61851-1, 61851-21,61851-22,61851-23, 61851-24.
- **(2)Technical Standards for Connectors** are covered in IEC 62196 Standards, viz. IEC 62196-1,62196-2, 62196-3.

**The ambient temperature conditions as mentioned in the IEC documents are: -25 C to + 40 C for outdoor as well as indoor units. For Indian conditions, they should be able to withstand temperature, at the higher end, upto +60 C.*

- **COMMUNICATION PROTOCOLS:**
- **1) Standard for Communication between EVSE and CMS:**
- Communication between Electrical Vehicle Supply Equipment(EVSE) and Central Monitoring System (CMS) located at power utility company is required to enable maximum charging rate to be controlled depending upon the rates of grid supply. This will also enable metering at different rates based on time-of-day.
- **The communication protocol used will be Open Charge Point Protocol (OCPP),** as is being used Internationally.
- OCPP is encrypted and therefore reasonably safe from hacking.

- **2) Standard for Communication between Electric Vehicle and EVSE**
- There are three categories:

i. Low Voltage<120V

ii. Medium Voltage >120V but <500V

iii. High Voltage>500V

- **For Low Voltage Category: Bharat EV Charger AC-001 and Bharat EV Charger DC-001 Specifications** are already in place. These specifications are intended to cater to the immediate need of existing and announced electric 2 wheelers, electric 3 wheelers and passenger cars/vehicles having battery voltage less than 100 V.

- **For Medium and Heavy Voltage Category:** Three standards mainly used worldwide:
- i. **CHAdeMO** – Japanese
- ii. **GB/T-27930** – Chinese
- iii. **Combined Charging System(CCS)** – European

- **The general consensus is being built around CCS because of the following reasons:**

1. CCS has a single connector inlet for both the AC and DC charging types at the vehicle end unlike GB/T and CHAdeMO.
2. DC charging power in CCS is up to 350 kW with one charging gun, while other standards require dual guns for this amount of power. Charging voltage is up to 1000V and current up to 350 A, using liquid cooled cables and connectors. For DC Fast charge, CHAdeMO provides for voltage up to 500 V DC and current upto 125 A. GBT has defined a connector which can be used for up to 200A of DC current.
3. For communication, CCS uses Control Area Network(CAN) physical network within the vehicle, but, unlike ChadeMO and GBT, it uses Power Line Carrier Communications (PLCC) for communication between vehicle and charging station. PLC allows secure communication using encrypted messages and the link can support higher data-rate as compared to that by CAN.
4. Majority brands follow CCS standards. Out of top 20 brands in 2016 by volume, 12- follow CCS protocol, 3- follow CCS+ChadeMO, 3-follow ChadeMO and rest two are still open. This will help India in future exports and imports of e-vehicles.

- **Recommendation :** CCS could be made mandatory at each charging stations however charging stations can also install other charging standards.
- It is similar to the instruction of the European Parliament on 22nd October 2014, which issued the directive that DC High Power Charging shall be equipped, for interoperability purposes, at least with connectors of the CCS type.

d) Testing and verifications of equipment's w.r.t standards.

- Testing and verifications of equipment's w.r.t standards shall be done by ARAI using their testing and verification facilities available in their premises.
- It is proposed to have other centers which are geographically distributed all over India.
- The testing and verification facilities should be ready to accommodate the latest technological development and others advancements.

e)Assessment and strengthening of capacity of sub transmission/distribution network to supply the load of electric vehicles.

- It is proposed to select the public charging stations by state DISCOM in coordination with state transport department/urban development department.
- Study of the stability and adequacy of the network with which the charging stations are to be connected is to be ensured by the licensee while granting connectivity. This is being included in the grid connectivity regulations.

f)Energy performance standards for chargers

- Energy performance standards for chargers shall be assessed by BEE.
- However, at present there are no IEC standards of chargers for reference.

ii. Infrastructure

a) **Identification of suitable location and density/penetration of charging infrastructure**

- There could be a phase wise approach to charging station allocations. Initially Govt Buildings, Malls, Parking places could be used where land is already available. Later on, bidding process could be used.
- The charging stations points could be identified by the DISCOMs, State Road Transport Department and Ministry of Urban Development of the State.
- For charging infrastructure for slow charging at residences, the setting up of charging points should be mandated in the building code as per the requirement. This could be ensured by Ministry Of Housing & Urban Affairs.
- For public places identified for setting up charging stations, land could be given on lease, as is done for petrol stations so as to reduce the service charge.

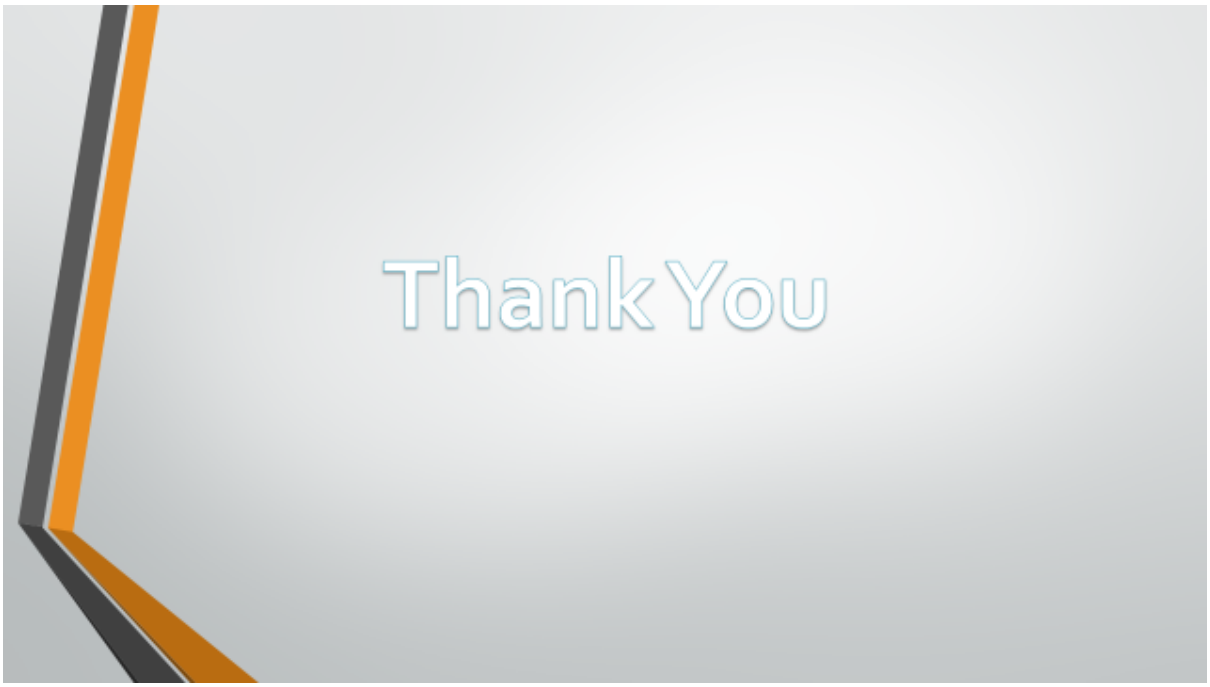
b) Concentration of slow chargers and fast chargers based on suitability of location and utility.

- It is proposed that 80-90% of charging should be through slow chargers at residential/office/malls' parking lots just as is done Internationally.
- **Slow Chargers-** Mainly in residential areas, municipal or community parking spaces. The ground floor of every upcoming multi-storey building should provide for charging points of e-vehicles.
- **Fast Chargers-** Mainly on highways, malls parking spots, petrol pumps, etc. Land resources of Petrol pumps could be shared for a fast top-up of electric recharge which could be in the range of 5-10 minutes. However, these could only be viewed as a limited charging facility.
- **Combined-** Office spaces should provide for a combination of slow and fast chargers, where the number of slow chargers should be more than that of fast ones.

c) Land requirement:

(i)**Capacity/number of charging stations being set up.**
(ii)**Availability of suitable land/location.**

- The capacity/number of charging stations may be decided as per the population density of the city/area.
- There could be a phase wise approach to charging station allocations.
- The charging stations points could be identified by the DISCOMs, State Road Transport Department and Ministry of Urban Development of the State.


Thank You

Annex-III

AIS STANDARDS ON ELECTRIC/HYBRID VEHICLES

Electric/ Hybrid Vehicle Regulation in India

Electric Vehicles

Indian Standard	International reference
AIS 038 Rev 1 :Requirements for Construction and Functional Safety	ECE R 100
AIS 039 Rev 1: Measurement of Electrical Energy Consumption (Wh/km)	ECE R 101
AIS 040 Rev 1: Method of Measuring the Range (km)	ECE R 101
AIS 041 Rev 1: Measurement of Net Power & Maximum 30 minute power	ECE R 85
AIS 049 Rev 1: CMVR Type Approval for EV	-
AIS 048: Safety Requirements for Traction Batteries	USABC, ISO/IEC Standards

Hybrid Vehicles

Indian Standard	International reference
AIS 102 (Part 1) : CMVR Type Approval for Hybrid Electric Vehicles with GVW < 3500 kg	ECE R100 ECE R 101 ECE R 83 ECE R 85
AIS 102 (Part 2) : CMVR Type Approval for Hybrid Electric Vehicles of M and N Category with GVW > 3500 kg	

EV / HEV Retro-fitment Regulations

Indian Standard	International reference
AIS 123 (Part 1) : CMVR Type Approval of Hybrid Electric System Intended for Retro-fitment on Vehicles of M & N Category having GVW <= 3500kg	Nil
AIS 123 (Part 2): CMVR Type Approval of Hybrid Electric System Intended for Retro-fitment on Vehicles of M & N Category having GVW > 3500kg	
AIS 123 (Part 3): CMVR Type Approval of Electric Propulsion kit Intended for Conversion of Vehicles for Pure Electric Operation	

ANNEXURE III

AIS STANDARDS ON ELECTRIC/HYBRID VEHICLES

ANNEXURE III

AIS STANDARDS ON ELECTRIC/HYBRID VEHICLES

Electric/ Hybrid Vehicle Regulation in India

Electric Vehicles

Indian Standard	International reference
AIS 038 Rev 1 :Requirements for Construction and Functional Safety	ECE R 100
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AIS 048: Safety Requirements for Traction Batteries	USABC, ISO/IEC Standards

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Indian Standard	International reference
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AIS 123 (Part 3): CMVR Type Approval of Electric Propulsion kit Intended for Conversion of Vehicles for Pure Electric Operation	

ANNEXURE IV -

OFFICE MEMORANDUM FOR CONSTITUTION OF COMMITTEE

ANNEXURE - IV

No.12/20/2017-UMPP
Government of India
Ministry of Power
Shram Shakti Bhawan, Rafi Marg,

New Delhi, the 31st January, 2018

Office Memorandum

Sub: Committee on Technical Aspects of Charging Infrastructure for Electric Vehicles-reg.

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The undersigned is directed to inform that a Committee on Technical Aspects of Charging Stations for Electric Vehicles has been setup in Ministry of Power (MoP) to address the technical aspects and draw a roadmap for setting up charging infrastructure. The composition of the Committee is as follows:

a.	Member(Planning), CEA	Chairperson
b.	Joint Secretary(Distribution)	Member
c.	Director(Distribution)	Member
d.	Representative from EESL	Member
e.	Representative from POSOCO	Member
f.	Representative from State of Karnataka	Member
g.	Representative from BSES	Member
h.	Representative from NTPC	Member
i.	Representative from PGCIL	Member
j.	Representative from ARAI	Member
k.	Representative from BEE	Member
l.	Representative from DHI	Member
m.	Representative from DST	Member
n.	Representative from IIT Delhi	Member
o.	Representative from MoUD	Member
p.	Representative from DERC	Member
q.	Representative from Tata Power	Member

2. The Terms of Reference for the committee are enclosed.
3. The Committee may give its report in 30 days.
4. This issues with the approval of Hon'ble Minister of State for Power & NRE(I/C).

Encl: as above

(Anoop Singh Bisht)
Under Secretary to the Govt. of India
Ph. 23766236
Email: anoopsingh.bisht@nic.in

PPS

To,

1. Secretary, MoUD
2. Secretary, DHI
3. Secretary, DST
4. Chief Secretary, Karnataka
5. DG, BEE

With request to nominate a suitable representative for the Committee on urgent basis.

6. Member(Planning), CEA
7. Joint Secretary(Distribution), MoP
8. Director(Distribution), MoP
9. Secretary, DERC
10. CMD, NTPC
11. CMD, PGCIL
12. MD, EESL
13. MD, POSOCO
14. Director, ARAI
15. Dean, IIT Delhi
16. MD, Tata Power
17. Chairperson, BSES

With request to nominate a suitable representative for the Committee on urgent basis.

(Anoop Singh Bisht)
Under Secretary to the Govt. of India
Ph. 23766236
Email: anoopsingh.bisht@nic.in

TERMS OF REFERENCE

Technical and Infrastructure related Issues:

i. **Regulations/Standards to be framed for Charging Infrastructure set up.**

a. Regulations regarding connectivity with the grid such as power factor, load factor, harmonics, voltage deviations etc.
b. Safety standards required for connection to the Grid.
c. Standards/specifications of equipment / products to be used in charging infrastructure considering the interoperability of the devices and the agency responsible for it.

- Specifications for Fast and slow chargers (Level 1 to Level 5) and AC/DC Chargers.

d. Testing and Verification of equipment w.r.t Standards.
e. Assessment and strengthening of capacity of sub-transmission/ Distribution network to supply the load of Electric Vehicles.
f. Energy Performance Standards for Chargers.

ii. **Infrastructure**

a. Identification of Suitable Location and Density/Penetration of charging infrastructure.
b. Concentration of Slow chargers and fast chargers based on suitability of location and utility.
c. Land requirement:

- Capacity/number of charging stations being set up.
- Availability of suitable land/location.