

**TAMIL NADU ELECTRICITY REGULATORY COMMISSION**  
**(Constituted under section 82 (1) of the Electricity Act, 2003)**  
**(Central Act 36 of 2003)**

**PRESENT:-**

Thiru. M.Chandrasekar

.... Chairman

and

Thiru. K.Venkatasamy

.... Member (Legal)

**M.P.No. 25 of 2015**

Union of India  
Represented through  
Chief Electrical Distribution Engineer  
Southern Railways  
7<sup>th</sup> Floor, NGO Annex  
Park Town  
Chennai – 600 003.  
..

....Petitioner  
(Thiru Rahul Balaji  
Advocate for the Petitioner)

**Vs**

Tamil Nadu Generation and Distribution  
Corporation Limited  
Represented through  
The Chairman and Managing Director  
(TANGEDCO & TANTRANSCO)  
Tamil Nadu Electricity Board  
NPKRR Maaligai  
No.144, Anna salai,  
Chennai – 600 002.

....Respondent  
(Thiru. M. Gopinathan,  
Standing Counsel for TANGEDCO)

**Dates of hearing: 30-04-2015; 09-09-2016; 25-10-2017;  
15-03-2018; 14-08-2018; 01-10-2019;  
28-01-2020; 25-08-2020; 15-09-2020;  
29-09-2020; 03-11-2020; 15-12-2020;  
09-02-2021; 23-03-2021; 15-04-2021;  
03-08-2021; 24-08-2021; 21-09-2021;  
05-10-2021 and 12-10-2021**

**Date of order: 05-05-2022**

The M.P. 25 of 2015 came up for final hearing on 12-10-2021. The Commission upon perusing the affidavit filed by the petitioner, counter affidavit filed by the respondent and all other connected records and after hearing both the parties passes the following:-

**ORDER**

**1. Prayer of the Petitioner in M.P No. 25 of 2015:-**

The prayer of the petitioner in this petition is to direct TANGEDCO not to levy surcharge for harmonics, as far as Railway Traction is concerned, till such time a final decision is taken by CEA on the revision of the Technical Standards for Grid Connectivity Regulation and to direct TANGEDCO to refund the harmonic surcharges of Rs.73.98 lakhs already collected up to December 2014 from Railway Traction based on the Regulation under review.

**2. Contentions of the Petitioner:-**

2.1. Southern Railway is availing power supply at 110kV from TANGEDCO for Traction purposes through 26 supply points spread over the State of Tamil Nadu with a total Contracted Demand of 271.20 MVA. Southern Railway during the year 2013-14 has consumed 765.90 MU for Traction and paid about ₹503.19 Cr. as current consumption charges and that it is estimated to be 823.49 MU and ₹547.75 Cr. respectively for the year 2014-15.

2.2. Considering the unique characteristics of Railway Traction the Commission have adopted separate tariff category HT-1B for Railway Traction from 01.08.2010, tariff now being adopted for Railway Traction is as follows;

**Tariff for Railway Traction**

Tariff Order	Date with effect from	Category	Demand Charges ₹/kVA	Energy Charges ₹/ kWh
<b>T.O.1 of 2012</b>	<b>01.04.2012</b>	<b>HT-1B</b>	<b>250</b>	<b>5.50</b>
<b>T.O.9 of 2014</b>	<b>12.12.2014</b>	<b>HT-1B</b>	<b>300</b>	<b>6.35</b>

2.3. The Commission have stipulated in the Tamil Nadu Electricity Supply Code at Regulation 4 (1) (iv) as below;

*(iv) Additional charges for harmonics dumping*

*Where any equipment installed by a consumer generates harmonics, the consumer shall provide adequate harmonic suppression units to avoid dumping of harmonics into Licensee's distribution system and the Licensee is at liberty to provide suitable metering equipment to measure the harmonic level pursuant to such harmonic. Where the consumer fails to provide such units, he shall be liable to pay compensation at such rates as the Commission may declare from time to time.*

2.4. The Central Electricity Authority have set out certain limits for harmonics in their "CEA (Technical Standards for Connectivity to the Grid) Regulation 2007 at Part IV, Regulation (3) as below;

*3. Voltage and Current Harmonics*

- (1) The total harmonic distortion for voltage at the connection point shall not exceed 5% with no individual harmonic higher than 3%.*
- (2) The total harmonic distortion for current drawn from the transmission system at the connection point shall not exceed 8%.*
- (3) The limits prescribed in (1) and (2) shall be implemented in a phased manner so as to achieve complete compliance not later than five years from the date of publication of these regulations in the official Gazette.*

2.5. The Commission based on the above stipulations have introduced levy of surcharge for harmonics @ 15% of the respective tariff for HT-I & HT-III categories in their Tariff Order No.1 of 2012 dated 30.03.2012, which has been continued in their subsequent Tariff Orders dated 20.06.2013 and 11.12.2014.

2.6. In this regard, there are no clear guide lines in respect of type and accuracy of equipment to be used for measurement, method of measurement and duration of measurement etc., either in CEA Regulation or in the TNERC Supply Code.

2.7. There is intimate interplay between the harmonic voltage and the currents drawn by the load. Guidelines followed in the UK and also the IEC standards identify need of mitigation at the stage when the harmonic voltage limits gets violated. TANGEDCO has recorded harmonic distortion at two traction substations at Villupuram and Tirupattur. Even though no clear guidelines are available for the method of measurement in the TNERC regulation, in whatever way the measurement is done by TANGEDCO, the Harmonic distortion in voltage as recorded by TANGEDCO is 1.15% and 1.5%, which is well within the prescribed

limit of 5%. Hence there is no compelling need for imposing high level of surcharge for harmonics in current, causing serious financial implications. In the Villupuram substation the respondent have raised a demand for Rs.55.15 lakhs towards Harmonics surcharge in the current consumption bills of November 2014 with retrospective effect from September 2014 and Rs.18.83 lakhs in the bills of December 2014. Since the bills are to be paid within 7 days the Petitioners have paid the bills under protest, this has caused huge financial burden on Southern Railway.

2.8. Indian Railways have high stakes in the power quality and is committed to the same. Hence Indian Railways through The Ministry of Railways have represented before Central Electricity Authority for review of the Regulations regarding permissible levels of harmonics, method of measurement, etc.

2.9. Finding prima facie merit in the submissions of Railways that there is shortcomings in the very regulations regarding stipulation of harmonic levels, method of measurement etc., CEA vide their Office Order No.CEA/5-41(02)/Secy-2014/448 dated 28.01.2014 have constituted a Committee for reviewing the “Central Electricity Authority (Technical Standard for Connectivity to the Grid) regulations, 2007” under the Chairmanship of Chief Engineer (Distribution Planning & Development), CEA with Chief Engineer (Grid Management), CEA as Co-Chairman and representatives from various power sector entities, which includes STU of Tamil Nadu TANTRANSCO and Railways with the following Terms of Reference;

- i) To review and recommend the harmonic levels in CEA technical standards regulations.

- ii) To suggest the method of measurement of harmonics for the sake of uniformity across the utilities in the country,
- iii) To formulate the extent of the trespass of the harmonic limits inviting penal action,
- iv) To evolve mechanism for determining the contribution of various consumers to the harmonics levels at interconnection point in the grid,
- v) Any other issue related to harmonics.

2.10. The Committee is actively considering the above issues and the recommendations are yet to be submitted to CEA.

2.11. In the meantime, pursuant to the TNERC supply Code and Tariff Orders, TANGEDCO has now started levying 15% surcharge on the current consumption charges based on sample measurements made for short duration at Villupuram Traction Substation (HTSC No.04) where the voltage distortion is only 1.5% and issuing notices to other Traction Substations also.

2.12. When the very fundamental issues which form basis of this surcharge are under comprehensive review by the competent authority, and the voltage distortion which is the common good is well within the limits, levying of surcharge which will have serious financial implications, would be highly unjust.

2.13. The STU of Tamil Nadu TANTRANSOCO, which is a constituent entity of TNEB, is also a member in the Committee constituted by CEA for the review of "Central Electricity Authority (Technical Standard for Connectivity to the Grid) Regulations, 2007".

2.14. The very fundamental issues which forms basis of this surcharge are under comprehensive review, levying of surcharge when voltage distortion is well within

the limits would be unjust and not called for. As the CEA, which is the custodian of these Regulations is seized with the review of the issue of Harmonics, it is prayed that a conscious call be taken on the matter and stop imposition of surcharge on harmonics till revised regulations are issued by CEA.

2.15. Except the Respondent no other State is imposing surcharge for harmonics on Railways.

### **3. Counter affidavit filed by the Respondent:-**

3.1. The petition is neither maintainable in law nor on facts, among other things, on the grounds that the impugned demand was raised in terms of Regulation 4 (1) (iv) of the Tamil Nadu Electricity Supply Code, 2004 and the Tariff Order No. 1 of 2012 dt.30.03.2012 and Tariff Order vide T.P.No.1 of 2013 dated 20.06.2013 issued by the TNERC, the statutory authority under the Electricity Act, 2003. The petitioner has also failed to avail the alternate efficacious remedy of approaching the Consumer Grievances Redressal Forum and the TNE Ombudsman created under section 42 of the Electricity Act, 2003 and regulation 18 of the Tamil Nadu Electricity Supply Code instead of rushing to file petition; and that the petitioner has filed the above petition based on incorrect averments/ grounds, unmindful of the threat to the safety of the grid consequent to the pumping of Harmonics to the Grid by the petitioner and his refusal to put in place the safety measures has to be deprecated. Against the provisions of the Tariff Orders, the petitioner has the remedy before APTEL. Therefore, petition will not lie.

3.2. The instructions were issued to the field officers in Memo.No.CE/Comrn/EE3/ AEE2/F.Harmonics/D.589/13,dated.19.08.2013 as per

the provisions contained in the TNERC Tariff Order issued vide T.P.No.1 of 2013 dt 20.6.2013. In the above tariff order under clause 6.1 (ii) of A6 Tariff Schedule prescribing the General Provisions applicable for High Tension Supply stipulates as below.

*" (ii) Harmonics: As specified in the Supply code, when the consumer fails to provide adequate Harmonic filtering equipment to avoid dumping of Harmonics into Licensee's network beyond the permissible limits as specified by CEA Regulations, the consumer is liable to pay compensation at 15% of the respective tariff. As and when the consumer brings down the Harmonics within the limit, compensation charges shall be withdrawn. The measurement of Harmonics shall be done by the Distribution Licensee using standard meters/equipment in the presence of consumer or their representatives. This compensation charges is applicable to HT-I & HT-III category of consumers. TANGEDCO shall give three months clear notice to all consumers under these categories stating that they shall pay 15% compensation charges if Harmonics introduced by their load is not within the limits set by CEA. The TANGEDCO shall implement the compensation provision after three months period from the date of measurement if the Harmonics measured is more than permissible limits".*

Accordingly, notices have been issued to all HT-I & III category of consumers in order to implement the Tariff order.

3.3. As per the CEA (Technical standards for connectivity to the Grid) Regulation, 2007, under part IV, Grid connectivity standards applicable to the Distribution systems and bulk consumers, the limits for current and voltage harmonics are stipulated as hereunder.

Para 3. Voltage and Current Harmonics

(1) The total harmonic distortion for voltage at the connection point shall not exceed 5% with no individual harmonic higher than 3%.

(2) The total harmonic distortion for current drawn from the transmission system at the connection point shall not exceed 8%.

3.4. The above regulation mandates that the harmonic distortion in the 'Distribution system and Bulk consumers' should be within the above limits. In order to maintain the harmonics within permissible limits in 'Distribution system and Bulk consumers' it is mandatory to insist the consumers to provide adequate harmonic suppression equipments. As per the TNERC Tariff Order No.1 of 2012, Tariff Order No.1 of 2013 dated 20.06.2013 and Order.No.9 of 2014 dated.11.12.2014, the compensation charges is applicable to HT- I & III category of consumers. As the petitioner is availing supply at 110 KV from TANGEDCO for Traction purposes through 26 supply points spread over the State with a total Contracted demand of 271.20 MVA, the petitioner is covered under the category of Bulk consumers and hence the petitioner has to provide adequate harmonic suppression equipments in order to avoid harmonics dumping in accordance with above regulations and orders.

3.5. Under Section 73(b) of the Electricity Act, 2003, the Central Electricity Authority (CEA) is empowered to specify technical standard, inter-alia, for connectivity to the grid. Regulatory provisions by CEA do specify limits for harmonic distortions but set out that the limits prescribed shall come into force not later than five years from the date of publication of these regulations in the official Gazette.

3.6. The Commission after taking into account of all the aspects of such provisions, issued the aforesaid Tariff Order No.1 of 2012 dt.30.03.2012 considering the norms stipulated by CEA. It may not be out of place to state that the Tariff Order was issued after considering the views of the State Advisory Committee and suggestions/ objections from public in the public hearings held on various dates

across Tamil Nadu. Likewise, T.P.No.1 of 2013 dt.20.06.2013 and SMT Order No.9 of 2014 dt.11.12.2014 were also issued.

3.7. In this regard, notices have been issued to all HT I & III category of consumers as per the provisions contained in the Tariff Order No. 1 of 2012 dated 30.3.2012 which was continued in the subsequent Tariff order issued vide T.P.No.1 of 2013 dated 20.6.2013 and SMT Order No.9 of 2014 dt.11.12.2014 (Clause 6.1 (ii)).

3.8. In view of the fact that the Regulations of the Commission (regulation 4 (1) (iv) of the Tamil Nadu Electricity Supply Code) have provision on the Harmonic Injection and levy of surcharge and CEA standards have come into force, such a levy of compensation charges for Harmonic injections is authorised by law and it is with authority. Hence it is the statutory provision having the source of law under the Electricity Act, 2003 and as such the same cannot be challenged.

3.9. The regulation 4 (1) (iv) of Tamil Nadu Electricity Supply Code on Additional charges for harmonics dumping states as follows:

*"Where any equipment installed by a consumer generates harmonics, the consumer shall provide adequate harmonic suppression units to avoid dumping of harmonics into Licensee's distribution system and the Licensee is at liberty to provide suitable metering equipment to measure the harmonic level pursuant to such harmonic. Where the consumer fails to provide such units, he shall be liable to pay compensation at such rates as the Commission may declare from time to time."*

The above regulation mandates installation of harmonic suppression equipment by the consumer irrespective of the consumers and payment of compensation charges as per the TNERC tariff order.

3.10. In this connection that the expression "Consumer" has been defined in the section 2 (15) in the Electricity Act, 2003 and regulation 2(20) of Tamil Nadu Electricity Grid Code, which is extracted below:-

"Consumer" means any person who is supplied with electricity for his own use by a licensee or the Government or by any other person engaged in the business of supplying electricity to the public under this Act or any other law for the time being in force and includes any person whose premises are for the time being connected for the purpose of receiving electricity with the works of a licensee, the Government or such other person, as the case may be;

3.11. The following technical details and facts are submitted as to how the harmonics are induced in the power system:-

- a. In an ideal condition, the voltage and current wave forms of the power system should be pure sine-wave with 50 cycles per second.
- b. Distortion in the above wave form occurs due to Harmonics.
- c. Harmonic distortion is caused due to non linear loads connected to the power system.
- d. Nonlinear Electrical Load is a load where wave shape of the current drawn does not follow the wave shape of the applied voltage.
- e. Characteristics of Non-Linear Loads

i. Non-linear loads change the shape of the current waveform from a sine wave to some other form.

ii. Non-linear loads create harmonic currents in addition to the original (fundamental frequency) AC current causing distortion of the current waveform which leads to distortion of the voltage waveform and also affects the Voltage wave form of the grid and other neighboring non-polluting consumers.

iii. Non-linear load's impedance changes with the applied voltage. The changing impedance means that the current drawn by the non-linear load will not be sinusoidal even when it is connected to a sinusoidal voltage. These non-sinusoidal currents contain harmonic currents that interact with the impedance of the power distribution system to create voltage distortion that can affect both the distribution system equipment and the loads connected to it.

f. Detrimental effects of harmonics:

The petitioner himself admits that harmonics has several undesirable effects and affects power quality. In his own words, one of the ways to improve the quality of power supply is to reduce the harmonic component that exists in a power system. Harmonics Voltage and currents in an electric power system are a result of non-linear electric loads. Again harmonics in power systems result in increased heating in the equipment and conductor, misfiring in variable speed drives and torque pulsations in motors. It is generally accepted that harmonic controls can lead to better quality of power supply.

Hence it is mandatory on part of the consumer to provide adequate harmonic suppression equipments so as to maintain the quality of supply by the Licensee (TANGEDCO) to all the consumers.

3.12. The provisions under Electricity Act 2003, TNE Supply code, TNERC (Grid connectivity and Intra-State Open Access) Regulations, 2014 as detailed below. The section 50 and subsection (1) of section 181 of the Electricity Act, 2003, provides as follows:-

Electricity Act,2003

"50.The Electricity Supply Code:

The State Commission shall specify an Electricity Supply Code to provide for recovery of electricity charges, intervals for billing of electricity charges disconnection of supply of electricity for non-payment thereof, restoration of supply of electricity, measures for preventing tampering, distress or damage to electrical plant or electric lines or meter, entry of distribution licensee or any person acting on his behalf for disconnecting supply and removing the meter; entry for replacing, altering or maintaining electric lines or electrical plant or meter and such other matters.

Powers of State Commissions to make regulations:

181. (l).The State Commissions may, by notification, make regulations consistent with this Act and the rules generally to carry out the provisions of this Act. In accordance with the section 50 of the Electricity Act,2003, the Tamil Nadu Electricity Regulatory Commission had issued the Tamil Nadu Electricity Supply Code, wherein the regulation 4 (1) (iv) of Tamil Nadu Electricity Supply Code on Additional charges for harmonics dumping states as follows:-

*“4. Charges recoverable by the Licensee- The charges, recoverable by the Licensee from the consumers are: -*

xxxxx

*(1). Tariff related charges, namely, -*

*(iv). Additional charges for harmonics dumping*

*Where any equipment installed by a consumer generates harmonics, the consumer shall provide adequate harmonic suppression units to avoid dumping of harmonics into Licensee's distribution system and the Licensee is at liberty to provide suitable metering equipment to measure the harmonic level pursuant to such harmonic. Where the consumer fails to provide such units, he shall be liable to pay compensation at such rates as the Commission may declare from time to time."*

3.13. In accordance with the said regulation, it is mandatory on part of the consumer to provide adequate harmonic suppression equipments so as to maintain the quality of supply by the Licensee (TANGEDCO) to all the consumers. Further, it is relevant to note that the State Commission had not discriminated the levy of compensation charges based on voltage.

3.14. In exercise of the powers conferred by clauses (a),(c),(d) of sub-section (1) of section 62 and clause (a) of sub-section (1) of section 86 of the Electricity Act 2003, (Central Act 36 of 2003) and all other powers hereunto enabling in that behalf and after considering the views of the State Advisory Committee meeting the tariff order No.1 of 2012 was issued likewise, considering the views and State Advisory Committee meeting held on 26.4.2013 and after considering suggestions and objections received from the public during the Public hearings held on 03.05.2013, 08.05.2013, 10.05.2013, and 17.05.2013, as per sub-section (3) of section 64 of the said Act, the Tamil Nadu Electricity Regulatory Commission, passed the order for Generation and Distribution Tariff vide T.P.No.1 of 2013 dated 20.06.2013 and as

per the provision under A6, 6.1 (ii), the notices have been issued to all HT-I & III category of consumers.

3.15. If the regulation 4(1)(iv) of the Tamil Nadu Electricity Supply Code and Tariff schedule of the HT consumers in Tariff order No.1 of 2012 and Tariff Order 1 of 2013 dated 20.06.2013 are read in conjunction with each other it may be concluded that it shall be obligatory for all consumers to restrict the harmonics dumped by them to the limits stipulated by CEA. Hence, if the consumer has failed to provide adequate harmonic filtering equipment to avoid dumping of harmonics into Licensee's network beyond the permissible limits as specified by CEA regulations, the consumer is liable to pay compensation at 15% of the respective tariff. This compensation charges is applicable to HT-I & HT- III category of consumers.

3.16. The Central Electricity Authority (Technical standards for connectivity to the Grid) Regulation, 2007 defines the Bulk Consumers. Similarly, the Central Commission in exercise of powers under clause (h) of sub- section (1) of Section 79 read with clause (g) of sub-section (2) of Section 178 of the Act had issued the Indian Electricity Grid Code (IEGC), wherein "Bulk Consumer" had been defined as follows:

*2. Definition*

*XXXX*

*h.(i). Bulk Consumer means any consumer who avails supply at the voltage of 33 KV or above.*

From the above it could be clearly observed that if the above paragraphs are read in conjunction with each other, it can be concluded that installation/maintenance of harmonics suppression equipment is applicable to 11

KV, 22 KV and 33 KV and above in accordance with under Part -IV CEA [Technical Standard for connectivity to the Grid] Regulations, 2007.

3.17. Regulation 9 (1) of the TNE Distribution Code, inter-alia, specifies that no item of electrical equipment shall be allowed to remain connected to the distribution system unless it is covered by appropriate protection scheme. Regulation 13(4) of the TNE Distribution Code specifies the monitoring mechanism to be adhered to by the Licensee including by imposing Special condition as detailed below:

*"(4) Special conditions: Special conditions shall be incorporated in the connection agreement for loads with high harmonic content, lower power factor and unacceptable supply voltage and frequency fluctuations, so that the consumer shall be forced to install appropriate correction equipments to meet the requirements of this Code."*

3.18. The Commission has specified the Tamil Nadu Electricity Grid Code, 2005. Regulation 2 (70) of the said regulations defines the expression "User" as "A person including the STU, Generating Company, Licensee and Power Grid Corporation of India or any such entity that uses the Transmission System and who must comply with the provisions of the Grid Code. The petitioner being the user of the Grid is estopped to dispute the impugned demand. In this connection Regulation 3 (2) of the TNEGC, inter-alia, specified the objective of the TNEGC is to define the services rendered by each wing in the overall electric system and also for identifying the responsibility and performance factor and measurement points for each one of them; that the documentation of the principles and procedures, which define the relationship between various users of the Intra State Transmission System and State Load Despatch Centre as well; and to ensure economy and efficiency in the operation of the power system in the State. Regulation 4 of the TNEGC stipulates the General requirement as follows:-

*"(4) General Requirements: The Grid Code contains procedures to permit equitable management of day to day technical situations in the Electricity Supply System, taking into account a wide range of operational situations and requirements likely to be encountered under both normal and abnormal conditions.*

*It is nevertheless necessary to recognize that the Grid Code cannot predict and address all possible operational situations. Users must therefore understand and accept that, in such unforeseen circumstances, the State Transmission Utility (STU) who has to play a key role in the implementation of the Grid Code may be required to act decisively for maintaining the Grid regimes for discharging its obligations. Users shall provide such reasonable co-operation and assistance as the STU may request in such circumstances."*

3.19. Regulation 5 of the said Code, *inter-alia*, specifies that system planning include removing operating constraints and maintain standards of security. Regulation 6 (1) of the said Code, *inter-alia*, specifies the objectives of the grid connectivity conditions that are to be ensured include that connections shall neither suffer unacceptable effects due to its connection to the transmission system nor impose unacceptable effects on the system of any other connected agency and the user has to ensure the standard and parameters of the existing system with which his system has to be interfaced and the electrical environment in which his system has to operate. Regulation 6 (4) of the said Code, *inter-alia*, stipulates that the user's system to protect the Grid from the faults originating in the user's system and that no user of the Grid shall exceed the Harmonic Distortion Level specified in the CEA (Grid Connectivity) Regulations. In view of the aforesaid provisions, the HT consumers are liable to restrict the dumping of Harmonics and they cannot escape from the responsibility of restricting their dumping of Harmonics for the safety of the grid and in public interest as well. It is a settled position in law that the private interest should give way for public interest.

3.20. In the light of the aforesaid provisions stated above, that there is no infirmity or illegality in raising the impugned demand for the introduction of Harmonics into the Grid, in terms of the provisions of the Tamil Nadu Electricity Supply Code, Tamil Nadu Electricity Distribution Code and the Tariff Orders issued during the year 2012 and 2013. However, the petitioner has filed the petition in order to evade its responsibility of contributing to the safety of the Grid by restricting the introduction of Harmonics and also to evade the consequential penalty for such non-compliance / refusing the compliance.

3.21. As per the HT agreements being entered by the HT consumers with the Licensee, it had been declared and agreed under para 4 as follows;

*Para 4 : To comply' with requirements of Act and Terms and Conditions of Distribution Code and Supply Code:*

*" The consumer hereby undertakes to comply with all the requirements of the applicable Acts, Regulations etc, and Grid code, Distribution code and Supply Code and of any amendments, modifications or re enactment thereof or of any other enactment to be passed in relation to supply made under this agreement from time to time and the rules, regulations or orders etc. made there under from time to time, provisions of the Tariffs, Scale of Miscellaneous and other charges and the terms and conditions of supply prescribed from time to time, and the consumer hereby agrees not to dispute their applicability to this agreement."*

3.22. The petitioner has to adhere to the conditions of HT agreement which stipulates the applicability of provisions of the Tariffs, Scale of Miscellaneous and other charges and the consumer agrees not to dispute their applicability. Hence the petitioner has to comply the conditions of regulation 4 (1) (iv) of the TNE Distribution Code,2004 and the TNERC tariff order (T.O.No.1 of 2012 dt 30.3.2012 , T.P.No.1 of 2013 dt 20.6.2013 and SMT Order No:9 of 2014 dt.11.12.2014) which clearly specifies that the compensation provision for harmonics is applicable to HT-I&III

category of consumers. This has also been instructed vide Circular Memo. No.CFC/FC/R/AAO-WI-2/D.No.170/2012 dated 31.03.2012.

3.23. Both voltage and current harmonics are important. Current harmonics are generated by the consumer loads and in this case current harmonics have exceeded the prescribed limits. If many consumers are allowed to exceed the current harmonics even if the voltage harmonics are within the limits, it may lead to higher voltage harmonics thereby affecting the utility grid voltage quality and also other neighboring non polluting consumers connected to the grid. Hence the Petitioner's contention that "because voltage harmonics are within limits and only current harmonics is beyond limit, it should not be penalized" is erroneous, and need not be considered. In addition, CEA regulations, considering these aspects, have limits for both current and voltage harmonics which the Commission has stipulated in its order.

3.24. Regarding the petitioner's contention that a committee has been setup for review of the regulations by CEA, it is submitted that at present there is a CEA regulation duly prescribing the permissible harmonics limits. Hence the Commission has given orders to implement it in HT I and HT III category of consumers, which is followed by TANGEDCO. As the petitioner is a consumer of this category, the Commission's order is applicable to them. Further, the Commission has already rejected the Sothern Railway's contention vide its view in clause 2.422 of Tariff Order dated 20.06.2013 (T.P. No. 1 of 2013)

3.25. Railways have requested the Commission to defer charging of harmonics surcharge since there is no standard procedure available for measurement of harmonics. The harmonics limits have been fixed by the CEA in its Regulations notified on 21-02-2007. The Regulation specifies that the norms shall be implemented and complied with not later than 5 years from the date of publication of the regulation. Accordingly, the Commission has implemented the provision in its Order T.P.No.1 of 2012. The measurement of harmonics has already been done jointly by Salem Steel Plant and TANGEDCO and this has been recognized by the Commission in its order on MP No. 22 of 2011 dated 28- 9-2012.

3.26. The method of harmonics measurement as detailed below:

#### Methodology for measurement

The method of measurement used by TANGEDCO has been compiled from the relevant International Standard and nothing is arbitrary. Methodology used for measurement by TANGEDCO and recognised by the Commission in Tariff Order dated 20.06.2013 (T.P. No. of 2013)

Instrument used	:	Power Quality Analyzer of class A type (Based on IEC 61000-4-7 & IEC 61000-4-30). (Internationally accepted Standard Equipment)
Point of Evaluation	:	At PCC, based on IEC 61000-3-6.
Duration of Measurement	:	Based on IEC 61000 - 3 - 6 (the Period shall be sufficient to capture at least two operating cycle of the largest harmonics providing equipment).
Load at the time of measurement:		75% or more of the average maximum Demand of the past 12 months
	:	Aggregation and Algorithm - Based on Class - A as per IEC 61000-4-30;

: TDD will be considered based on the application example in IEEE 519, to avoid unnecessary penalization of consumer operating at lower loads when measurements are taken.

Limit values : As per TNERC directive based on CEA Regulation 2007

3.27. The impact of harmonics introduced by this type of consumers severely affects the TANGEDCO's grid power quality and it is the responsibility of the petitioner to reduce the harmful effects of harmonics and maintain within the CEA limits as per the regulations and TNERC tariff orders.

3.28. Even though IEC standard identify need of mitigation at the stage when the harmonic voltage limit gets Violated, IEEE-519 emphasis the need of Current harmonic measurement. The voltage harmonics present in the network, even though it is within the limit, is only due to the harmonic current drawn by the load. When too many customers are drawing the harmonic current from the same voltage source, the voltage harmonic level will tend to go high, and genuine consumers will be affected. Hence, CEA has recommended the limits for Current harmonics also apart from the Voltage harmonics. With the clear vision making the grid harmonic free, the Commission has imposed the penalty mechanism for violating consumers.

3.29. The method of measurement used by TANGEDCO has been compiled from the relevant International Standard and nothing is arbitrary. The Southern Railway is bound to adhere to the Tariff order by the Commission, as long as the existing CEA regulation is in vogue.

3.30. The voltage harmonics present in the network, even though it is within the limit, is only due to the harmonic current drawn by the load. When too many customers are drawing the harmonic current from the same voltage source, the voltage harmonic level will tend to go high, and genuine consumers, will be affected. Hence, CEA has recommended the limits for Current harmonics 'also apart from the Voltage harmonics. As per the Tariff Order, Harmonic Surcharge is applicable all consumers of HT-I & HT-III. Since, Southern Railway is coming under HT-IB category, they are bound to meet the requirements specified by the Commission and TANGEDCO issue notices to Traction Substations accordingly.

3.31. Southern Railway is bound to adhere to the Tariff order by the Commission, as long as the existing CEA regulation is in vogue. The voltage harmonics present in the network, even though it is within the limit, is only due to the harmonic current drawn by the load. When too many customers are drawing the harmonic current from the same voltage source, the voltage harmonic level will tend to go high, and genuine consumers will be affected. Hence, CEA has recommended the limits for Current harmonics also apart from the Voltage harmonics.

3.32. With the clear vision in making the grid harmonic free, Commission has imposed the penalty mechanism for violating consumers. The Southern Railway is bound to adhere "to the Tariff order by the Commission, as long as the existing CEA regulation is in vogue.

3.33. In view of the facts and circumstances of the case on hand and position of law as stated above, the petitioner have no prima facie case to further pursue the

above Petition. Therefore, the petitioner is not entitled to any relief as prayed for in the above petition. The balance of convenience is clearly in favour of the respondents herein. Hence, the above petition is liable to be dismissed. By dismissing the same, no prejudice will be caused to the petitioner as the compensation charges for Harmonics dumping is applicable to the HT-1 and HT-III category of consumers in accordance with law and in the manner known to law.

3.34. The petitioner has filed Writ Petition before Hon'ble High Court of Madras vide W.P.No.28977 of 2015 for the very similar issue and also obtained interim order. The Hon'ble High Court of Madras has passed an interim injunction on 15.09.2015 that the petitioner shall deposit 50% of the demand towards harmonic compensation being made to the other properties to the respondent without Prejudice to their rights and on such deposit, there shall be an order of interterm injunction.

#### **4. Rejoinder filed by the Petitioner:-**

4.1. The Petitioner is filing the instant Rejoinder as allowed by the Commission in view that Central Electricity Authority(CEA) has published the Technical standard for connectivity to the Grid (Amendment) Regulation, 2019. Save and except what is specifically admitted herein, all allegations contained in the reply filed are specifically denied. The Petitioner reiterates the averments made in the Petition.

4.2. The Petitioner have already prima-facie raised the issue of no clear guide lines in respect of type and accuracy of equipment to be used for measurement,

method of measurement and duration of measurement etc., in CEA Technical Standards for Connectivity to the Grid Regulation, 2007.

4.3. The Petitioner approached CEA and raised the Harmonics related issue. Finding merit in the submissions made by Railways, CEA formed a committee to review Technical standards for connectivity to the Grid Regulation – 2007.

4.4. That CEA has accordingly published Technical standards for connectivity to the Grid (Amendment) Regulation, 2019 in February 2019 with the following provisions with respect to Harmonics,

- i. Maintaining the Harmonics within the limit as prescribed in IEEE 519-2014
- ii. Point of harmonic measurement, i.e. point of common coupling, method of harmonic measurement and other related matters, shall be in accordance with the IEEE 519-2014 standards; and
- iii. Measuring and metering of harmonics shall be a continuous process with meters complying with provisions of IEC 61000-4-30 Class A

4.5. The CEA amendment to Regulation has addressed the issue raised by Railways with respect to type and accuracy of equipment to be used for measurement, method of measurement and duration of measurement etc, which is a clear indication that Railways contentions on the issues related to Harmonics measurement is endorsed in the CEA amended Regulation.

4.6. TANGEDCO proposes Harmonics measurement using Portable Power Quality Analyzer of Class A type (Based on IEC 61000 Part 4-7 & IEC 61000 Part 4-30) which has provision to read interharmonics but as per IEEE 519-2014 standard for measurement of Harmonics presented below interharmonics shall be excluded,

***“ Total demand distortion (TDD): The ratio of the root mean square of the harmonic content, considering harmonic components up to the 50th order and specifically excluding interharmonics, expressed as a percent of the***

*maximum demand current. Harmonic components of order greater than 50 may be included when necessary.”*

In this regard, the Respondent must submit before the Commission the specification of the Power Quality Analyser meter used for measurement so far and that The Respondent has never used Power quality Analyser meter which has the provision to measure interharmonics current in measurement of Harmonics currents.

4.7. That as per IEEE 519-2014 standards Maximum load current  $I_L$  (or demand current) must be used for calculation of short circuit ratio ( $I_{SC}/I_L$ ) and Total Current Demand Distortions (TDD). The recommendations of IEEE 519-2014 is submitted below,

*“ 5.3 Recommended current distortion limits for systems nominally rated above 69 kV through 161 kV*

*The limits in this subclause apply to users connected to systems where the rated voltage  $V$  at the PCC is  $69 \text{ kV} < V \leq 161 \text{ kV}$ . At the PCC, users should limit their harmonic currents as follows:*

- Daily 99th percentile very short time (3 s) harmonic currents should be less than 2.0 times the values given in Table 3.*
- Weekly 99th percentile short time (10 min) harmonic currents should be less than 1.5 times the values given in Table 3*
- Weekly 95th percentile short time (10 min) harmonic currents should be less than the values given in Table 3*

*All values should be in percent of the maximum demand current,  $I_L$ . This current value is established at the PCC and should be taken as the sum of the currents corresponding to the maximum demand during each of the twelve previous months divided by 12. Table 3 applies to harmonic currents whose frequencies are integer multiples of the power frequency.*

*Current distortion limits for systems rated above 69 kV through 161 kV*

<i>Maximum Harmonics Current distortion in percent of <math>I_L</math></i>						
<i>Individual Harmonics Order (odd harmonics) <sup>a,b</sup></i>						
<i><math>I_{sc}/I_L</math></i>	<i><math>3 \leq h \leq 11</math></i>	<i><math>11 &lt; h \leq 17</math></i>	<i><math>17 &lt; h \leq 23</math></i>	<i><math>23 &lt; h \leq 35</math></i>	<i><math>35 &lt; h \leq 50</math></i>	<i>TDD</i>
<i>&lt;20</i>	<i>2.0</i>	<i>1.0</i>	<i>0.75</i>	<i>0.3</i>	<i>0.15</i>	<i>2.5</i>
<i>20&lt;50</i>	<i>3.5</i>	<i>1.75</i>	<i>1.25</i>	<i>0.5</i>	<i>0.25</i>	<i>4.0</i>
<i>50&lt;100</i>	<i>5.0</i>	<i>2.25</i>	<i>2.0</i>	<i>0.75</i>	<i>0.35</i>	<i>6.0</i>
<i>100&lt;1000</i>	<i>6.0</i>	<i>2.75</i>	<i>2.5</i>	<i>1.0</i>	<i>0.5</i>	<i>7.5</i>
<i>&gt;1000</i>	<i>7.5</i>	<i>3.5</i>	<i>3.0</i>	<i>1.25</i>	<i>0.7</i>	<i>10.</i>

<sup>a</sup>*Even harmonics are limited to 25% of the odd harmonic limits above.*

<sup>b</sup>*Current distortions that result in a dc offset, e.g., half-wave converters, are not allowed.*

<sup>c</sup>*All power generation equipment is limited to these values of current distortion, regardless of actual  $I_{sc}/I_L$ .*

*where,*

*$I_{sc}$  = maximum short-circuit current at PCC*

*$I_L$  = maximum demand load current (fundamental frequency component) at the PCC under normal load operating conditions*

*.....”*

4.8. That Total demand distortion (TDD) limits is defined as reference for containing Harmonics distortion in IEEE 519-2014 and also this standard stipulates the measurement of TDD at Maximum demand load current only. The TDD measurement at Maximum load current will project the impact of harmonic distortion in the system. At low loads, there tends to be an increase in Harmonics current with respect to the fundamental current but the impact of such high Harmonics current to the system during low loads is minimal.

4.9. As defined in CEA regulation to follow IEEE 519-2014 standard, The Harmonics measurement must be done at Maximum demand load current only and not at low load conditions due to the presence of higher Harmonics current with respect to fundamental current. TANGEDCO’s methodology of measurement of

Harmonics at minimum 75% the Maximum demand load current or above is against the standard specified by IEEE 519-2014.

4.10. TANGEDCO have measured Harmonics current and computed TDD at load current even as less as 50% of Maximum demand load current and imposed Harmonics penalty which is against the standards specified in IEEE 519-2014 and gross violation of the CEA regulations. The Respondent may submit before the commission the details of the load during which measurements were taken and the parameters taken for Harmonics current component calculation in all the Railway Traction sub-station to clarify the commission on Harmonics measurement methodology adopted with respect to Railway Traction sub-station.

4.11. That in a bunch of Appeal Petition filed in 2017 by Southern Railway before Tamil Nadu Electricity Ombudsman, Chennai; EE/MRT/Erode informed that load survey data of Ingur Railway Traction sub-station was analysed for 12 months period. Out of total number of 20995 blocks ( 13410 blocks in 30 minutes demand and 7585 blocks in 15 minutes demand) the above EHT consumer has utilized more than 7576 kVA (ie) 75% of 10101.83 kVA only in 429 blocks (110 blocks in 30 minutes demand and 319 blocks in 15 minutes demand) and it is about 2.04% of the total blocks over the 12 months period

4.12. It is evident from the above submission of EE/MRT/Erode that the demand load current is minimal or less than 75% of Maximum demand load current for 97.96 % of the block duration in a year and hence, it will be difficult to satisfy the standard stipulated in IEEE 519-2014 to measure TDD at Maximum Demand Load current in as far as measurement of Harmonics current in Railway Traction sub-station are concerned due to its dynamic load pattern.

4.13. The basic understanding of the requirement to measure harmonics current component at Maximum demand load current is given below,

- i. At low load, there is increase in Harmonics current component with respect to fundamental current but the impact of such high Harmonic current to the system is low.
- ii. At maximum demand load current, Harmonics current component decreases with respect to fundamental current but the impact of such less harmonic current to the system is high.

It is because of this consideration, IEEE 519-2014 standard specifies to measure Harmonics current component at Maximum demand load current only to assess the impact to the system. Since, Railway Traction sub-station load is less than 75% of Maximum demand load during major part of the year i.e, 97.96% of block period in a year, it is submitted without accepting the presence of Harmonics current component above limits at Maximum demand load taking all the recommendation in to consideration as per IEEE 519-2014 that the impact of high harmonics current component measured at low demand to the system will be less, so measurements taken at low demand current should not be interpolated to Maximum demand load current condition for the purpose of imposing harmonics surcharges.

4.14. The duration of measurement mentioned in IEEE 519-2014 is submitted below,

- “ .....
- Daily 99th percentile very short time (3 s) harmonic currents should be less than 2.0 times the values given in Table 3.
  - Weekly 99th percentile short time (10 min) harmonic currents should be less than 1.5 times the values given in Table 3
  - Weekly 95th percentile short time (10 min) harmonic currents should be less than the values given

in Table 3.....”

From the above duration of measurement it can be seen that the Harmonics currents limit should be less than 2 times of the specified limit when considering daily 99<sup>th</sup> percentile very short time(3s) Harmonics current. Similarly, Harmonics currents limit should be less than 1.5 times of the specified limit when considering weekly 99<sup>th</sup> percentile short time (10min) Harmonics current and Harmonics currents limit should be less than the specified limit when considering weekly 95<sup>th</sup> percentile short time (10min) Harmonics current.

Hence, Very short time and short time Harmonics current reading must be measured daily and weekly respectively to compare the Harmonics current component with respect to the limit specified in IEEE 519-2014 but in contrast TANGEDCO have measured readings for 24 hours (daily) only and compared the reading with the limit specified without applying the multiplier factor of 2 as per the standard. The weekly readings as specified in the standard are not measured at all. This shows that TANGEDCO has measured Harmonics current as per their convenience and didn't follow the standard of IEEE 519-2014 as mentioned in CEA Regulation. The Respondent may be requested to submit the details of duration of Harmonics measurement taken at all the Railway Traction sub-stations.

4.15. Further, as per IEEE 519-2014 standard it is recommended to increase the Harmonics current limits when action is taken by user to reduce lower order Harmonics.

“

#### 5.5 Recommendations for increasing harmonic current limits

It is recommended that the values given in Table 2, Table 3, and Table 4 be increased by a multiplying factor when actions are taken by a user to reduce lower-

order harmonics. The multipliers given in the second column of Table 5 are applicable when steps are taken to reduce the harmonic orders given in the first column.

Recommended multipliers for increases in harmonic current limits

<b>Harmonics orders limited to 25% of values given in Table 2, Table 3, and Table 4</b>	<b>Multiplier</b>
5,7	1.4
5,7,11,13	1.7
5,7,11,13,17,19	2.0
5,7,11,13,17,19,23,25	2.2

From the recommendations it can be seen that whenever a user takes action to reduce the lower order Harmonics current then the Harmonics current Limits specified must be increased with the respective multiplier. Accordingly, it is submitted that Railways have introduced 3-phase locos which have reduced the Harmonics current injected into the system. Hence, the Harmonics Limits specified is applicable after duly computing with the multiplier only with respect to Railway Traction sub-stations.

4.16. In a case between M/s S.Palaniyandi Mudaliar Memorial Hospital vs TANGEDCO in High Court of Madras, the order dated 05.06.2017 has mentioned TANGEDCO submission that, “no technology exists in the world to design and filter out the huge quantum of harmonics at the distribution grid location”. This being the scenario for state discom, it cannot be different for a consumer who is having a dynamic load pattern. CEA gave five years of time to comply with the Harmonics limits specified in the Technical Standard for Connectivity to the Grid Regulation, 2007 but due to lack of methodology of measurement in the said regulation and as such Railways couldn’t finalise the specification for Harmonics suppression and now CEA having published the Technical standard for Connectivity to the Grid

(amendment) Regulation, 2019 specifying the standards for measurement, in the principals of natural justice, five years time may be given for complying to the regulation from the date of publishing the amended Regulation in February'2019. Railway have now commissioned a power quality restorter equipment at Thiruvalam Traction sub-station on a trial basis and based on its performance, the specification will be finalised to implement in other Traction sub-stations. Hence, reasonable time may be given for Railways for implementing Harmonics suppression in its system and until such time, no Harmonics penalty should be levied on Railways and the penalty amount already recovered should be refunded or adjusted in the ensuing energy Bill.

4.17. That none of the provisions in the methodology of measurement adopted by TANGEDCO is as per IEEE 519-2014 standard stipulated by CEA regulation, Hence the earlier measurements taken by TANGEDCO must not be considered as valid for imposing Harmonics Surcharges. If TANGEDCO is unable to meet the methodology of measurement as per the standards specified in IEEE then TANGEDCO shall not impose harmonics surcharges. It is worth to mention that due to the lack of clarity in the methodology of measurement in CEA regulation, 2007 and the complexity involved in strictly following the standards of measurement, no other state discom has imposed Harmonics penalty except TANGEDCO. CEA Regulations is a secondary law from a statute body and any regulation to be implemented it must be done without any deviation otherwise it must not be entrusted as per the convenience of the implementing authority, which will be a violation of the Regulation by the implementing authority themselves.

## **5. Written Submission filed by the Petitioner:-**

5.1. The Petitioner is filing the written submission as allowed by the Commission during the hearing held on 12.10.2021. Save and except what is specifically admitted herein, all submissions by the Respondent is not maintainable and the Petitioner reiterates the averments made in the Petition and Re-joinder.

5.2. The Respondent argument that harmonics compensation charge was imposed as per the Commission's Tariff Order T.P. no.1 of 2013 dated: 20-06-2013 and hence, refund of Harmonics charges collected till date as sought by Railways cannot be made. Further, the Respondent also opined that Railway should have filed Appeal against the Tariff order, if aggrieved by the order.

5.3. The Petitioner in the public comments invited had requested the Commission to defer charging of harmonics compensating charge since there is no standard procedure available for measurement of harmonics. Hence, the argument of the Respondent that the petitioner should have appealed in the Tariff order T.P.no.1 of 2013 order dated 20.06.2013 is factually not correct.

5.4. The Petitioner is gravely aggrieved due to the non-compliance of TANGEDCO in following the Commission's approved standard of methodology of Harmonics measurement.

5.5. The Commission have approved the methodology of measurement as given below:-

a). Instrument used	: Power Quality Analyser of class A type (based on IEC 61000-4-7 & IEC 61000-4-30)
b). Point of Evaluation	: At PCC based on IEC 61000-3-6
c). Duration of measurement	: Based on IEC 61000-3-6 ( the period shall be sufficient to capture at least two operating cycle of the largest harmonics providing equipment)

d). Load at the time of measurement	: 75% or more of the average maximum demand of the past 12 months : Aggregation and Algorithm – based on class-A as per IEC 61000-4-30 : TDD will be considered based on the application example in IEEE 519, to avoid unnecessary penalization of consumers operating at lower loads when measurements are taken
e). Limit values	: As per TNERC directive based on CEA Regulation - 2007

5.6. TANGEDCO has to measure the harmonics when the load is at 75% or above as per the Methodology approved by the Commission.

5.7. The petitioner have already submitted the fact in Rejoinder stating that in a bunch of Appeal Petition filed in 2017 by Southern Railway before Tamil Nadu Electricity Ombudsman, Chennai; EE/MRT/Erode informed that load survey data of Ingur Railway Traction sub-station was analysed for 12 months period. Out of total number of 20995 blocks (13410 blocks in 30 minutes demand and 7585 blocks in 15 minutes demand) the above EHT consumer has utilized more than 7576 kVA (ie) 75% of 10101.83 kVA only in 429 blocks (110 blocks in 30 minutes demand and 319 blocks in 15 minutes demand) and it is about 2.04% of the total blocks over the 12 months period.

5.8. It is evident from the above submission of EE/MRT/Erode that the demand load current is minimal or less than 75% of Maximum demand load current for 97.96 % of the block duration in a year and hence, it will be difficult to measure Harmonics at Maximum Demand Load current in as far as Railway Traction load is concerned due to its highly dynamic load pattern.

5.9. The Commission in the Order pertaining to petition R.A.No.5 of 2020, have stated the following with regard to Railway Traction load,

*(i). (Page no.94, para – 6.21) “.....since the Railways with a peculiar nature of operation unlike other conventional operations.....”*

*(ii). (Page no.99, para – 6.29) “.....with varying loads of unbalanced nature.....”*

5.10. The Commission have clearly indicated that the Railways with a peculiar nature of operation unlike other conventional operations and varying loads of unbalanced nature and it is because of this peculiar nature of load TANGEDCO deviated from the standard of measurement of harmonics approved by Hon'ble commission thereby arbitrarily measured the harmonics without compliance and imposed penalty which is challenged by the petitioner in this case.

5.11. It is submitted that the Harmonics measurements done by TANGEDCO doesn't comply with the methodology of measurements approved by the Commission and finding merit in the case, the Commission have admitted this petition, hence the Respondent argument that appeal should have been filed in T.P No.1 of 2013 dated 20.06.2013 is factually incorrect in regard to this petition and misleading the Commission.

5.12. Even though some of the Regulatory Commission in certain States have framed Regulations for limiting Harmonics in Power supply based on the CEA Grid Regulation-2007, but none of the respective State Discoms have imposed penalty because of the lack of clarity in Methodology of measurement in CEA Regulation-

2007 and difficulty in complying with the standard of measurement if any framed by the State Commissions as far as Railway Traction supply is concerned owing to its dynamic load pattern.

5.13. Without admitting that Traction load cause disturbances in Power supply Grid, that as a responsible organization, Railway have already introduced Harmonics filters in 3-phase locomotives to ensure that Harmonics level even within the permissible limit is mitigated and the Traction supply strives for a healthy grid system.

**6. Additional Written Submission filed by the Petitioner:**

Accuracy of harmonics measurement:-

6.1. It evident from the above submission of EE/MRT/Erode that the demand load current is minimal or less than 75% of Maximum demand load current for 97.96 % of the block duration in a year and hence It is submitted that there will be error in accuracy of harmonics measured making it practically impossible to measure the correct Harmonics level, if the methodology of measurement like duration of measurement and Maximum demand load conditions are followed as per approved standard. However as a responsible organization, Railway is gradually phasing out old technology locomotives and have already introduced new technology locomotives equipped with Harmonics filters in 3-phase locomotives and also commissioned power quality equipments at Traction sub-stations on trial basis to eliminate/mitigate the ill-effects of Harmonics. Thus Railway is perpetually striving to improve the Traction supply for a healthy grid system.

### **Continuous measurement of harmonics:-**

6.2. When Railways were gradually phasing out old technology locomotives and introducing new technology locomotives with Harmonics filters and adopting latest technologies in commissioning of Rolling stock and Power supply equipments, only the continuous measurement of Harmonics by TANGEDCO at Traction sub-stations as per approved standard would have resulted in eliminating the harmonics charges levied to Railways, whereas TANGEDCO has not adopted continuous and approved methodology of Harmonics measurement.

6.3. In latest developments related to Harmonics, CEA published amendment to Technical standards for connectivity to the Grid Regulations-2007 and in this regard, TANGEDCO filed petition M.P. no.22 of 2020 before the Commission, "In the matter of methodology for measurement of Harmonics in respect of HT/EHT services based on the Central Electricity Authority (1) Technical standards for connectivity to the Grid (Amendment) Regulations, 2019". It is submitted that in connection with the above said petition, Commission appointed consultant team to submit recommendations for formulating the directions to be issued by the Commission to the licensee to the methodology as per the latest Regulation.

6.4. The consultant team have stated as follows:-

*"It is therefore submitted that, unless measurements are taken under normal load conditions which will establish maximum demand load current at PCC, correct value of current distortion cannot be arrived and compared with the measured value"*

6.5. The above statement of the expert consultant team appointed by Commission is a testimony of Railways contention that in Railways dynamic

Traction load, Harmonics measurement at normal load conditions of at least 75% of Maximum demand load current is practically not possible (as submitted in para.8) and hence, TANGEDCO imposing penalty by adopting its own Harmonics measuring methodology which is having an overriding effect on the Regulations and Orders is not acceptable.

6.6. Further in the summary submitted by the Consultant team before the Commission, it has been said that,

*“Ill-effects of Harmonic currents cannot be adequately estimated and compensated in terms of money, Remedy is either to altogether eliminate the harmonic if possible or minimize them within limits stated in standards,*

*As far as voltage harmonics distortion, it is a shared responsibility of the supplier (licensee) and the consumers (users). Current harmonic distortion of the non-linear loads of consumers distorts the supply and the supplier network impedance characteristic also distorts the voltage. Licensee and the consumers should strive to mitigate the ill-effects of Harmonics, rather than seeking / paying compensation. Further such compensation charges cannot be perennial revenue to the licensee (supplier)”.*

6.7. From the summary of the consultant team appointed by Commission, it is clear that the Licensee and the consumers should strive to mitigate the ill-effects of Harmonics and seeking / paying compensation as it is not a perennial revenue for the Licensee whereas it is a huge revenue loss for Railways organization perpetually taking steps to eliminate/mitigate Harmonics.

6.8. Harmonics measurement and imposing compensation charges for Traction supply system by strictly following the standard regulation is not possible due to its dynamic load pattern and hence imposing compensation charges is not applicable as far as Railway Traction load is concerned but Railway is taking sincere efforts in eliminating/mitigating harmonics. The expert committee had also stated that,

“Harmonics is a subtle subject and industries will avail the advantages of the electronic based technology as and when it grows. It requires some time for the consumer to adapt the new technology(involving of measurement, design, manufacturer, installation of harmonics filters and conformity tests)”. Hence, it will be just to give Railways having dynamic load pattern with sufficient time for eliminating/mitigating the Harmonics and refund the Harmonics compensation charges would enable Railways with necessary funds to expedite the steps to eliminate/mitigate Harmonics, which will truly fulfill the objective of CEA regulation on Harmonics.

6.9. The consultant team recommended a maximum of 10% penalty in steps of 1% increase and the consultant have further informed that it is not commensurable to levy flat charge for a wide slab.

6.10. The flat 15% Harmonics compensation charges levied is not commensurable and should not be treated as a perennial revenue for the Respondent but the Harmonics compensation charges has cast a huge revenue deficit which would have otherwise been constructively used for eliminating/mitigating Harmonics in Railway Traction.

## **7. Written Submission filed by the Respondent:-**

The Respondent has made the same averments as was made in the counter affidavit for the present Written Submission also and hence it is not necessary to reproduce it.

## **8. Findings of the Commission:-**

8.1 We have heard both sides and perused the materials submitted by the respective parties.

The prayer of the petitioner is

- (i) To direct the TANGEDCO not to levy surcharge for harmonics till such time a final decision is taken by CEA on the revised technical standards for grid connectivity Regulation.
- (ii) To refund the harmonic surcharges already collected up to December 2014 from Railways.

8.2 The respondent Licensee has contended that

- (i) Till enactment of Revised Regulations by the CEA and TNERC the Licensee are bound to follow the existing Regulations and the provisions of the existing Tariff orders which have statutory powers.
- (ii) As the measurements and collection of penalties towards exceeding the specified harmonics limits were in accordance with the above statutory provisions in vogue, the petitioner is not entitled to the relief prayed for.

8.3 We deal with the above two issues one by one.

As far as the first issue of adhering to the revised standards and amended regulations in terms of meter standards, methodology of measurements and evolution of Harmonic levels are concerned, there is no ideological dispute between the parties in regard to their statutory obligation in principle, to adopt the new standards and undergo the revised methodologies in accordance with the amended regulation. The dispute exists only in the practical methodology and duration of measurement, which needs technical analysis as follows.

8.4 The case has chequered stages of history since 2015. The Railway had maintained in the original petition at the initial stage of the case in 2015 that the methodology to measure harmonics adopted by the Respondent Licensee was arbitrary without adhering to standards and hence not acceptable. Further the petitioner had submitted that they had represented before Central Electricity Authority through Ministry of Railways for review of the existing in Central Electricity Authority- Grid connectivity regulations 2007 which has inadequate provision of standards and specific methodologies of measurement and accordingly the Central Electricity Authority constituted a Committee in 2014 with representation from various power sector entities to review and revise the Standards and methodologies.

It has also been submitted by the Railways that the Committee chaired by the CEA authorities and constituted with various power sector entities set out Specific Terms and Reference to formulate the limits, methodologies, penal action for non-adherence etc relating to harmonics measurement and determination of values. Accordingly after five years of formation of said committee with terms of reference, the CEA has finally come out framing amended Regulations in 2019 with revised standards and specific methodologies of measurement.

8.5 Now after five years of formation of said Committee as above and finally CEA having framed Amended Regulations in 2019 with revised Standard and specific methodologies to measure the Harmonics as sought by the original prayer of the Railways, the petitioner have now chosen to change their stand by submitting in their written submission that *“Harmonics measurement and imposing*

*compensation charges for traction supply system by strictly following the standard regulation is not possible due to its dynamic load pattern and hence imposing compensation change is not applicable as far as Railway Traction load is concerned but Railway is taking sincere efforts in eliminating / mitigating harmonics”.*

Initiating the litigation with a prayer to stop TANGEDCO from penalizing till a final decision was taken by the CEA and taking a 'U' turn as above at the end of five year episode after the final decision was taken by the CEA as prayed by the petitioners themselves, cannot be appreciated by this Commission. Neither the reasons stated by the petitioner for such an inconsistent stand by the Railways is convincing and acceptable in view of the technical reasons as summarized below.

8.6 The petitioner has submitted in their rejoinder that IEEE 519-2014 Standard specifies to measure Harmonic current component at maximum demand load current only to assess the impact to the system. The petitioner relies on this requirement as mentioned by them in the rejoinder as one of the reasons as to why the measurement could not be done for Railway traction as per the Standards.

In this regard, we would like to refer the relevant portion of the IEEE 519-2019 Standard under the topic 'Harmonic measurement' which is extracted below:

***“4. Harmonic measurements:***

*For the purposes of assessing harmonic levels for comparison with the recommended limits in this document, any instrument used should comply with the specifications of IEC 61000-4-7 and IEC 61000-4-30. The most relevant portions of the IEC specifications are summarized in 4.1 through 4.4.*

#### **4.1 Measurement window width:**

*The width of the measurement window used by digital instruments employing Discrete Fourier Transform techniques should be 12 cycles (approximately 200 ms) for 60 Hz power systems (10 cycles for 50 Hz power systems). With this window width, spectral components will be available every 5 Hz (e.g., 0, 5, 10...50, 55, 60, 65, 70,... Hz). For the purposes of this document, a harmonic component magnitude is considered to be the value at a center frequency (60, 120, 180, etc. and 50, 100, 150, etc. Hz for 60 Hz and 50 Hz power systems, respectively) combined with the two adjacent 5 Hz bin values. The three values are combined into a single rms value that defines the harmonic magnitude for the particular center frequency component.*

#### **4.2 Very short time harmonic measurements:**

*Very short time harmonic values are assessed over a 3-second interval based on an aggregation of 15 consecutive 12 (10) cycle windows for 60 (50) Hz power systems. Individual frequency components are aggregated based on an rms calculation as shown in Equation (1) where  $F$  represents voltage (V) or current (I),  $n$  represents the harmonic order, and  $i$  is a simple counter. The subscript  $vs$  is used to denote “very short.” In all cases,  $F$  represents an rms value.*

$$F_{n,vs} = \sqrt{\frac{1}{15} \sum_{i=1}^{15} F_{n,i}^2}$$

#### **4.3 Short time harmonic measurements:**

*Short time harmonic values are assessed over a 10-minute interval based on an aggregation of 200 consecutive very short time values for a specific frequency component. The 200 values are aggregated based on an rms calculation as shown in Equation (2) where  $F$  represents voltage (V) or current (I),  $n$  represents the harmonic order, and  $i$  is a simple counter. The subscript  $sh$  is used to denote “short.” In all cases,  $F$  represents an rms value.*

$$F_{n,sh} = \sqrt{\frac{1}{200} \sum_{i=1}^{200} F_{(n,vs),i}^2}$$

#### **4.4 Statistical evaluation:**

*Very short and short time harmonic values should be accumulated over periods of one day and one week, respectively. For very short time harmonic measurements, the 99th percentile value (i.e., the value that is exceeded for 1% of the measurement period) should be calculated for each 24-hour period for comparison with the recommend limits in Clause 5. For short time harmonic measurements, the 95th and 99th percentile values (i.e., those values that are exceeded for 5% and 1% of the measurement period) should be calculated for each 7-day period for comparison with the recommended limits in Clause 5. These statistics should be used for both voltage and current harmonics with the exception that the 99th percentile short time value is not recommended for use with voltage harmonics.”*

It can be seen and studied from the above that there is no specific requirement in the standards to measure the Harmonic current component only at maximum demand load current as misinterpreted by the Petitioner Railways. A careful reading of the above portion of the IEEE standards would imply that the Standards specify the duration of short time and very short time for accumulation of harmonic values over the period of the duration in relevance to the point being discussed.

Understandably, such duration must have been devised in the international standards with due analysis by the wide range of technical experts in order to accommodate broad range of categories of loads like continuous, non-continuous, intermittent, dynamic nature etc., Therefore, the railways cannot be placed outside the purview of the set of standards and selectively made immune to the applicability of the standards in the name of dynamic nature.

Pertinently the crucial factor to be noted in the discussion of measurement is that the resultant harmonic value is evolved in terms of TDD (Total Demand

Distortion) which takes in to account of the total accumulated values covering the entire load pattern of multiple pieces of operating conditions over the entire duration of measurement.

More importantly the TDD is determined in percentage of not the instantaneous current values but in percentage of Average demand load current, ( $I_L$ ) which is the sum of the currents corresponding to the maximum demand during each of the twelve previous months divided by 12. This means, the basic parameter upon which the percentage of TDD is determined is a large bracketed capsule containing the average value of multi pattern of low and high loads over a broad period of twelve months. It is not a percentage of instantaneous current corresponding to an instantaneous duration. This is evidently to safeguard the user from being unfairly penalized for the harmonic values corresponding to low load of particular duration. In sum, the apprehension of the petitioner citing the dynamic nature of the Railway load is taken care in the Standards both in the form of duration of measurement and evaluation of measurement in terms of TDD as explained above.

8.7 The petitioner has also extracted in their additional written submission some portions of the report of the consultants appointed by the Commission in connection with the M.P.22 of 2020 filed by the TANGEDCO before the Commission relating to enforcement of Harmonic control in accordance with amendment to CEA-Technical Standards for connectivity to Grid regulation 2007.

The Consultants have also given their conclusive comment to the contention of the Railways as follows:

*“Current harmonics are the steady state power quality parameter. As the railway traction load will be varying from time to time, the quantum of current harmonics injected into the licensee’s network will only vary accordingly. In the case of welding, arc furnaces etc., load current drawn by them is also varying in an erratic manner. The traction load variation is not erratic but like variation of loads of many industries.*

*Since current harmonic is a pollutant to the electricity, the current harmonics injected to the grid by the railways will bring many ill effects especially on the resources supply voltage distortion.*

*Non-linear loads, supplied either with single phase supply, or two-phase supply or three phase supply, will inject current harmonics to the power system. Further Railway traction brings the other power quality issue of unbalancing the load currents on the power system.*

*The IEEE STD has not mentioned any exemption. If there is no means to mitigate Current Harmonic distortion, then there is reason for seeking exemption. It is not so.*

*Thus the reasons put forth for exempting the railway traction are baseless.”*

Also the Consultants have remarked,

*“The comment is made without referring to the full text (vide the recommendations) of Consultancy Report but adopted a selective approach and reading in between the Consultancy Report in favour to them”*

8.8 The international standards having been revised, and Regulations have been amended with high concern to improve the Grid and quality of the supply to the consumers, the magnitude of ill effect of the Harmonic dumping in to the grid besides spoiling the quality of supply to other consumers and general public need not be emphasized again. Every user of electricity is committed to contribute to the quality of supply. No standards or Regulation exempts any category of user of electricity from polluting the grid. The petitioner being one of the largest Government organizations operating entire width and breath of the country could set an example in faithfully complying with the statutory Regulations and be in

forefront taking priority measures to suppress harmonics aiding to power quality of the nation.

8.9 Coming to the deliberation of the Respondent during hearing that the Licensee is awaiting the re-enactment of CEA amended Regulation in the Supply Code of TNERC to start adapting to the revised standards and amended regulations of the CEA, the following sections of the Electricity Act are to be referred:

Section 42. of the Electricity Act cast duties on distribution licensee as

*“to develop and maintain an efficient, co-ordinated and economical distribution system in his area of supply and to supply electricity in accordance with the provisions contained in this Act”.*

The provisions contained in the Act to be complied with in accordance with the above section includes:

(a) Section 73(b) of the Electricity Act, that earmarks the Central Electricity Authority to

*“Specify the technical standards for construction of electrical plants, electric lines and connectivity to the grid;”*

(b) Section 177 (1) of the Electricity Act, that empowers the Central Electricity Authority to make regulations as

*“The Authority may, by notification, make regulations consistent with this Act and the rules generally to carry out the provisions of this Act.”*

A conjoint reading of the above provisions of the Electricity Act 2003 make it clear that the Regulations / Amendments to the Regulations made by the Central Electricity Authority which is an apex body recognized by the Act to frame

Technical Standards assumes the status of the subordinate legislation and is required to be followed by the Distribution Licensee statutorily, as the same is the duty of the Distribution Licensee.

The above provisions further make it clear that the Distribution Licensees, after revised CEA notified amendments are not supposed to continue to follow the erstwhile obsolete provisions of the Regulation or Codes that are inconsistent to the amended regulations. The provision in the regulations of Supply and Distribution Codes of the State Commission is only to formulate the enforcing framework in furtherance to the CEA regulations.

Given the above legal framework, it is directed that the Respondent shall strictly follow the meter standards, measuring methodology in all aspects, point of measurement, duration of measurement, limits etc., CEA (Technical standards for connectivity to the Grid) (Amendment) Regulations 2019, and CEA (Technical Standards for Connectivity of the Distributed Generation Resources) Regulations, 2019, without waiting for the adoption of the same in the Supply Code of the Commission. Accordingly the Respondent Licensee shall start procuring the new meters of revised standards to comply with the statutory requirement.

8.10 Considering the request of the Petitioner to grant reasonable time to make arrangements to suppress harmonics which is acceptable, the following direction is issued:

(i) The Respondent Licensee shall procure / arrange new meters of revised standards as per IEEE519-2014 and CEA (Technical standards for connectivity to the Grid) (Amendment) Regulations 2019, and CEA (Technical Standards for Connectivity of the Distributed Generation Resources) Regulations, 2019 and carry

out measurements in accordance with revised standards and methodology specified therein in presence of the respondent in a transparent manner . The respondent shall cooperate with the Licensee for the safety of the meter and allied properties during entire duration of measurement. At the end of measurement and determination of values, if the values are found exceeding the limits, six months time shall be given from the date of receipt of intimation from the Licensee to the Petitioner with measurement values and test results, to facilitate remedial measures to suppress harmonics within limits. If not complied till the expiry of the given six months, the penalty shall be levied in accordance with the orders/ regulations of this Commission notified from time to time. The Commission is in the process of finalizing and notifying the necessary incorporations in the Supply Code.

8.11. Now we proceed to deal with the second prayer of the issue of refunding the harmonic surcharges already collected by the TANGEDCO up to December 2014 from Railways as follows:

8.12. The Petitioner relies on the ground for their claim of refund that the respondent had not adopted the meter standard and methodology as specified in the IEEE 519-2014 standards and as specified in the CEA amendment Regulations 2019, but adopted its own method arbitrarily and hence the earlier measurements taken by TANGEDCO must not be considered as valid for imposing harmonic surcharges.

8.13. The respondent Licensee, while questioning the maintainability of the above claim of the Petitioner and responding to the contention of not following the Standards, have contended that the instrument used for measurement and

methodology of measurements were in compliance with IEC 61000-4-7 & IEC 61000-4-30 and IEC-61000-3-6 respectively.

The limits adopted were in accordance with the limits for current and voltage harmonics CEA (Technical standards for connectivity to the Grid) Regulation, 2007, under part IV, Grid connectivity standards applicable to the Distribution systems and bulk consumers as follows:

*Para 3. Voltage and Current Harmonics*

*(1) The total harmonic distortion for voltage at the connection point shall not exceed 5% with no individual harmonic higher than 3%.*

*(2) The total harmonic distortion for current drawn from the transmission system at the connection point shall not exceed 8%.*

Further the respondent Licensee has submitted that the charges for exceeding the limit was levied in accordance with the statutory provisions contained in the TNERC Tariff Order T.P.No.1 of 2013 dt 20.6.2013 clause 6.1 (ii) of A6 Tariff Schedule as below:

*" (ii) Harmonics: As specified in the Supply code, when the consumer fails to provide adequate Harmonic filtering equipment to avoid dumping of Harmonics into Licensee's network beyond the permissible limits as specified by CEA Regulations, the consumer is liable to pay compensation at 15% of the respective tariff. As and when the consumer brings down the Harmonics within the limit, compensation charges shall be withdrawn. The measurement of Harmonics shall be done by the Distribution Licensee using standard meters/equipment in the presence of consumer or their representatives. This compensation charges is applicable to HT-I & HT-III category of consumers. TANGEDCO shall give three months clear notice to all consumers under these categories stating that they shall pay 15% compensation charges if Harmonics introduced by their load is not within the limits set by CEA. The TANGEDCO shall implement the compensation provision after three months period from the date of measurement if the Harmonics measured is more than permissible limits".*

8.14. Though the provisions under which the respondent has collected the charges are not challenged, the crux of dispute between the parties revolve around a focal point as to whether the measurement made by the Licensee is technically valid and tenable in the eye of law.

We have to consider two things to decide the validity of the measurement by the respondent and maintainability of the refund claim of the petitioner.

The first thing to be decided is the validity of measurement / authenticity of results. Such question of validity stems from adoption of set standards. When the technical standards set by an Indian institution recognized by law for such activity exists, the same is bound to be followed by default. In the absence of such Indian standards, other International standards such as IEEE/IEC/BS/ANSI etc., are to be followed.

In the case on hand, the petitioner relies on the point that TANGEDCO had not adopted any standard or methodology specified in IEEE519-2014 and CEA Amendment Regulation 2019, but followed their own standards.

Before going to deal with what standard the TANGEDCO followed or otherwise, we need to decide the validity of the contention as to whether the Amendment made in Regulation in 2019 could have been followed in 2014 by the Respondent as insisted by the Petitioner?

Any regulation unless specifically provided for, takes effect only prospectively. The amendments to regulations made in 2019 or the IEEE standards published in 2014 could no way be made applicable retrospectively to declare that the TANGEDCO must have made their measurements in the past periods of 2019 retrospectively, in accordance with the amended regulations 2019. In the absence

of meter standards and methodology specified either in the earlier version of IEEE519-1992 prior to IEEE519-2014 or in any Indian Standards, TANGEDCO chose to adopt the IEC 61000-4-7 & IEC 61000-4-30 standard power quality analyzer and IEC 61000-3-6 standard measurement methodology which cannot be deserved to be termed as non-standard and declared invalid in view of IEC being an International Standard. Further TANGEDCO adopted the limit prescribed by the CEA regulation 2007 and determined the TDD in percentile of the average maximum demand load current to be fair to avoid undue penalty corresponding to lower loads as apprehended by the petitioner. The charges collected are also in accordance with the relevant provisions of the Tariff order. Considering the IEC standards and methodology upon which the respondent carried out the measurement in the absence of Indian standard, we are unable to accept the contention of the petitioner that the standards and methodology followed by the TANGEDCO is arbitrary.

8.15 We are further unable to accept the contention of the petitioner that the breaching the current harmonic limits could be compromised in view of the voltage harmonic limits being within limits. Though a long technical deliberation is required to explain as to why both parameters are distinct and detrimental to the Grid and power quality, we restrict our observations to the extent that no Standards or Regulation provides option for such compromise in a crucial subject like power quality. Law cannot operate selectively to one's convenience.

Having concluded as above, we are not in a position to order the claim of the petitioner for refund and accordingly reject it.

**In effect we order as follows:**

1. Respondent TANGEDCO is directed to procure/arrange new meters of revised standard IEEE 519-2014 and amended CEA Regulations 2019 as given in Para 8.9
2. Respondent TANGEDCO to make measurements and determine the TDD values adopting the methodology and duration strictly in accordance with the provisions in the IEEE 519-2014 standard and CEA amended Regulations 2019 without any deviation.
3. To grant time of six months from the date of receipt of intimation from Respondent to the Petitioner with measurement values and test results to facilitate to suppress harmonics in case of measured values exceeding the limits, as given in Para 8.10.
4. The petitioner's prayer to refund the harmonic surcharge already collected is rejected.

(Sd.....)  
(K.Venkatasamy)  
Member (Legal)

(Sd.....)  
(M.Chandrasekar)  
Chairman

/True Copy /

**Secretary  
Tamil Nadu Electricity  
Regulatory Commission**