**PROJECT DESIGN DOCUMENT FORM
FOR SMALL-SCALE CDM PROJECT ACTIVITIES (F-CDM-SSC-PDD)
Version 04.1**

# PROJECT DESIGN DOCUMENT (PDD)

| | |
|---|---|
| **Title of the project activity** | Installation of Low Green House Gases (GHG) emitting rolling stock cars in metro system |
| **Version number of the PDD** | Version: 05 |
| **Completion date of the PDD** | 2013-10-20 |
| **Project participant(s)** | The project participants are:<br>• Delhi Metro Rail Corporation (DMRC) (Private Entity) ; and<br>• Japan Carbon Finance, Ltd. (Private Entity) |
| **Host Party(ies)** | India |
| **Sectoral scope(s) and selected methodology(ies)** | Scope 7.1, AMS III.C. "Emission reduction by low greenhouse gas emitting vehicles"<br>Version: 10 |
| **Estimated amount of annual average GHG emission reductions** | 47,053 $tCO_2$/year |

## SECTION A. Description of project activity

### A.1. Purpose and general description of project activity

>>

**Purpose of the project activity and the measures taken to reduce greenhouse gas emissions.**

The project activity operates low GHG emitting rolling stocks having regenerative braking system in Delhi Metro Rail Corporation (DMRC). The project activity replaces the conventional electro-dynamic rheostatic braking technology, with regenerative braking technology fitted rolling stocks. The regenerated electrical energy reduces the consumption of equivalent grid electrical energy required by the powering trains, thereby conserving electrical energy and subsequently leading to GHG emission reduction.

**Brief description of the installed technology and equipments.**

Delhi Metro Rail Corporation (DMRC) has electrical driven Mass Rapid Transport System which uses 4 car rolling stocks on different service lines. A typical rolling stock used by DMRC consists of two units, each comprising of two cars, a Driving Trailer car (DT) and a Motor Car (M). The Delhi Metro System is designed for rolling stock where coaches are equipped with 3 phase AC traction motors with regenerative braking system. The regenerative braking technology employed in DMRC is different from the prevalent system adopted by metro system in the country which uses conventional electro-dynamic rheostatic braking system. The electro-dynamic rheostatic braking system converts the kinetic energy of decelerating Rolling stock into the thermal energy of rheostats which is dissipated as heat without regenerating electrical energy while decelerating. Hence, the choice made by DMRC for using regenerative braking technology displays the environmental consciousness of the management.
The technology for regenerative braking system in the rolling stock is provided by Mitsubishi Electric Corporation, Japan without any technology transfer. The regenerative braking system works on the principle of converting kinetic energy of the rolling stock while decelerating, into electrical energy using 3 phase Induction motor and Variable Voltage Variable Frequency Control (VVVF) Technology. In the regenerative mode, the traction motors work as generators and the Converter- Inverter (CI) converts the electrical energy regenerated to Direct Current (DC). The DC is subsequently converted to single-phase line frequency AC voltage, which is stepped up by transformer to the level of 25 kV. The single phase line frequency AC voltage is then fed back to the Over Head Equipment (OHE). The regenerated electrical energy supplied back to the OHE is used by other accelerating Rolling stock in the same service line. The regenerated electrical energy reduces the consumption of equivalent amount of grid electrical energy which would otherwise have been consumed by the accelerating trains, thereby conserving electrical energy and reducing GHG emissions.

**Relevant dates for the project activity (e.g. construction, commissioning, continued operation periods, etc.).**

**Table 1:**

| Service line | Year of commissioning | Corridor | No. of rolling stocks |
|---|---|---|---|
| 1 | March 04 | Dilshad Garden- Rithala – Red Line | 25 |
| 2 | July 05 | Badli -Jahangirpuri - Huda City Centre – Yellow Line | 14 |
| 3 & 4 | November 06 | Noida City Centre - Dwarka Sec 21,- Najafgarh and Vaishali – Yamuna Bank – Blue Line | 31 |
| **Total** | | | **70** |

*Line 4 is also a part of Blue line which has same Origination from Dwarka Sec 21,- Najafgarh to Yamuna Bank and from Yamuna Bank its further goes to Noida City centre ( as a Line 3 of Blue Line) and another line goes to Vaishali (as a Line 4 of Blue line for 7 stations)

The detail implementation of the project is as below:-

**Phase I of Delhi Metro Rail project consists of the following three lines:**
*Line No.1*- Shandara-Tri Nagar-Rithala
*Line No.2*- VishwaAdyalaya-Central Secretariat
*Line No.3*- Indraprastha-Barakhamba Road-Dwarka Sub City

**Phase II of Delhi Metro Rail project consists of the following lines:**
*Line No.1*- Shandara — Dilshad **Garden**
*Line No.2* -
Vishwavidyalaya — Jahangir Pur
Central Secretariat — HUDA City Centre

*Line No.3&4* -
lndraprastha — Noida Sector 32 City Centre
Yam una Bank —Anand Vihar
Dwarka Sector 9 to Dwarka Sector 21
Anand Mhar— KB Vaishali

**Phase III of Delhi Metro Rail project consists of the following lines:**
Jahangirpuri – Badli
Dwarka – Najafgarh
* expected to opening in year 2016

*The total no. of rolling stocks will be fixed to 70, but they can be shifted to the respective any three service lines
** Phase III, Further the Service line 2 will be extended to Jahangirpuri Badli and for service line 3 will be extended to Dwarka to Najafgarh

*** Project is restricted to only to Red,Yellow & Blue service lines ( Line 1(Red Line),Line 2(Yellow Line) and Line 3 & 4 ( Blue Line)

**PROJECT UPDATE**

**Present Status**

Line 1 (Dilshad Garden - Rithala) - Red Line

Line - 1 (Dilshad Garden - Rithala) was made operational for commercial services in four stages:
(1) Shahdara - Tis Hazari : with effect from 25th December, 2002 (Phase - I).
(2) Tis Hazari - Inderlok : with effect from 4th October, 2003 (Phase - I).
(3) Inderlok - Rithala : with effect from 1st April, 2004 (Phase - I).
(4) Dilshad Garden - Shahdara : with effect from 3rd June 2008 (Phase - II).

Line 2 ( HUDA City Centre - Jahangirpuri) - Yellow Line

Line - 2 (HUDA City Centre - Jahangirpuri) was made operational for commercial services in five stages:
(1) Vishwavidyalaya - Kashmere Gate : with effect from 20th December, 2004 (Phase - I).
(2) Kashmere Gate - Central Secretariat : with effect from 3rd July, 2005 (Phase - I).
(3) Vishwavidyalaya - Jahangirpuri : with effect from 3rd February 2009 (Phase - II).
(4) HUDA City Centre - Qutab Minar : with effect from 21st June 2010 (Phase - II).
(5) Central Secretariat - Qutab Minar : with effect from 3rd September 2010 (Phase - II).

Line 3 (Dwarka Sector 21 - Noida City Centre) - Blue Line

Line - 3 (Dwarka Sector 21 - Noida City Centre) was made operational for commercial services in six stages:
(1) Barakhamba - Dwarka : with effect from 31st December 2005 (Phase - I)
(2) Dwarka - Dwarka Sector 9 : with effect from 1st April 2006 (Phase - I).
(3) Barakhamba - Indraprastha : with effect from 11th November 2006 (Phase - I).
(4) Indraprastha - Yamuna Bank : with effect from 10th May 2009 (Phase - II).
(5) Yamuna Bank - Noida City Centre : with effect from 13th November 2009 (Phase - II).
(6) Dwarka sector 9 - Dwarka Sector 21 : with effect from 30th October 2010 (Phase - II).

Line 4 (Yamuna Bank - Vaishali) - Blue Line

Anand Vihar ISBT - Vaishali : with effect from 27th January 2010 (Phase - II).

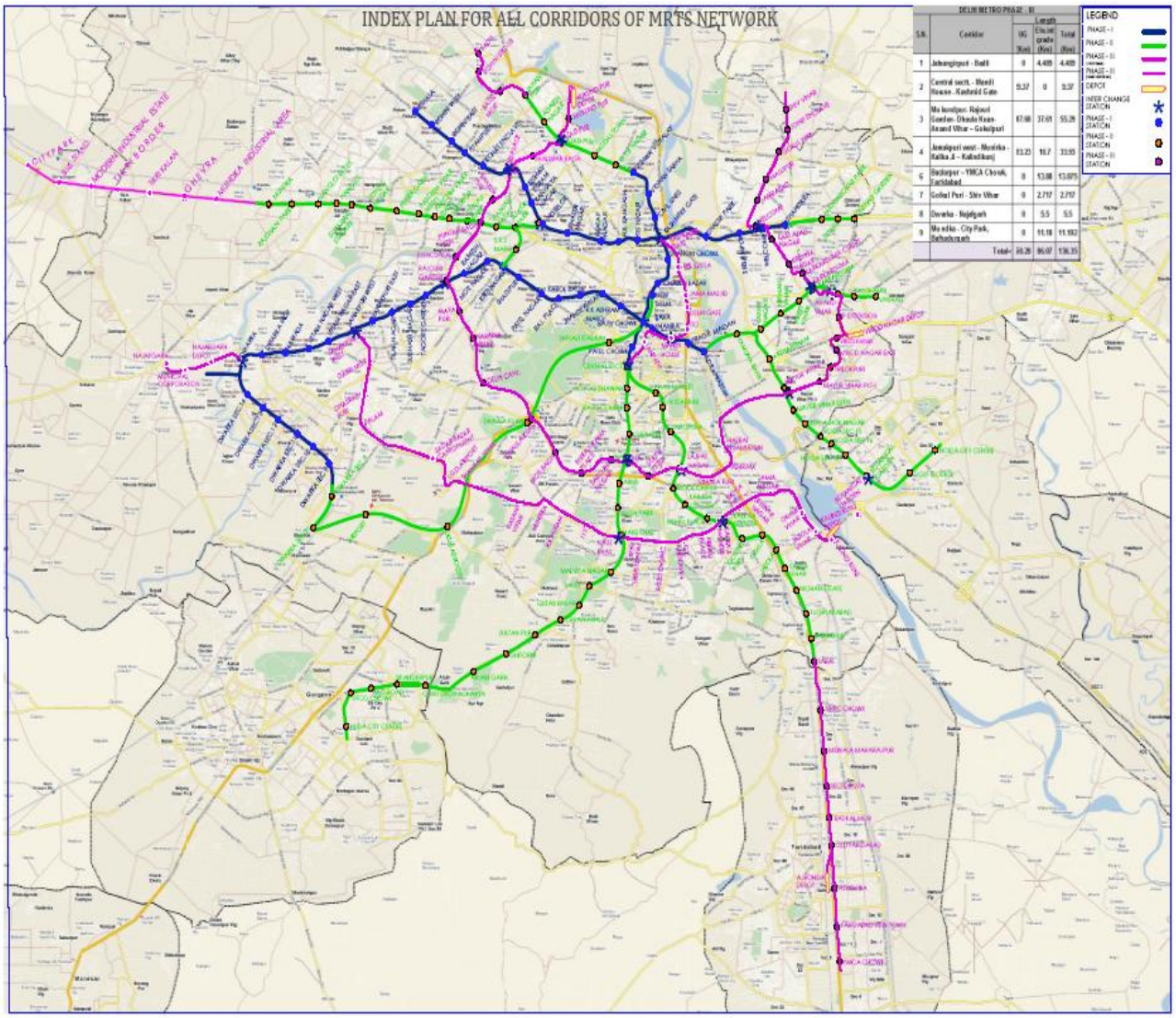
The project has been completed as described in the Project Design Document (PDD). The trains in the 3 service lines (Red, Yellow & Blue) of the project activity are in operation continuously (with outages – forced & planned) since the respective commissioning dates.

**A.2. Location of project activity**
**A.2.1. Host Party(ies)**
>>
The project activity has been implemented in Delhi, India.

The project activity has been implemented in Delhi on the following metro corridors:

- Dilshad Garden- Rithala
- Jahangirpuri -Huda City Centre
- Noida City Centre- Dwarka Sector 9
- Vaishali-Yamuna Bank

The map of these metro corridors(Phase I, Phase II and Phase III) is as follows:




**A.2.2. Region/State/Province etc.**

>>

Delhi

**A.2.3. City/Town/Community etc.**

>>

Delhi

**A.2.4. Physical/ Geographical location**

>>

The geographical details of the project site are given below:

| | |
|---|---|
| Longitude | $77.23^0$E |
| Latitude | $28.61^0$ N |

**A.3. Technologies and/or measures**

>>

The project is defined as **Type III: Other project Activities** and **Category III.C. Emission reductions by low-greenhouse gas emitting vehicles**, of the indicative simplified baseline and monitoring methodologies for selected small scale project activities categories.

*Type: III – Other project activities*

**Category: III.C. – Emission reductions by low-greenhouse gas emitting vehicles**

**Technology**[1]

Delhi Metro Rail Corporation (DMRC) has electrical driven Mass Rapid Transport System which uses state-of-the-art Rolling Stocks on different service lines. A typical Rolling stock used by DMRC consists of 2 units, each comprising of a Driving Trailer car (DT) and a Motor Car (M). Thus, each train consists of a 4 car arrangement aligned as DT-M-M-DT. The Delhi Metro System's rolling stock cars are equipped with 3 phase AC motors with regenerative braking system. The regenerative braking technology employed in DMRC is different from the prevalent conventional electro-dynamic rheostatic braking system adopted by the other metro system in the country i.e Kolkata Metro.

The technology for regenerative braking system in the rolling stock is provided by Mitsubishi Electric Corporation, Japan without any technology transfer. The overall rolling stock technology transfer to India subsequently, would be as per MOU between M/s Rotem and Bharat Earth Movers Limited[2]. The regenerative braking system works on the principle of converting kinetic energy of the rolling stock while decelerating, into electrical energy using 3 phase Induction motor and Variable Voltage Variable Frequency Control (VVVF) Technology. In the regenerative mode, the traction motors work as generators and the Converter- Inverter (CI) converts the electrical energy regenerated to Direct Current (DC). The DC is subsequently converted to single-phase line frequency AC voltage, which is stepped up by transformer to the level of 25 kV. The single phase line frequency AC voltage is then fed back to the Over Head Equipment (OHE). The regenerated electrical energy supplied back to the OHE is used by other accelerating Rolling stock in the same service line. The regenerated electrical energy reduces the consumption of equivalent amount of grid electrical energy which would otherwise have been consumed by the accelerating trains, thereby conserving electrical energy and reducing GHG emissions. In the project activity, the electrical energy regenerated is consumed by other powering rolling stocks of same service lines.

The regenerated electrical energy reduces the consumption of equivalent grid electrical energy required by the powering rolling stocks, thereby conserving electrical energy and subsequently leading to GHG emission reduction.

The regenerative braking system used in the Delhi Metro regenerates electricity and reduces GHG emissions. The project activity does not have any significant adverse environmental impacts and is thus environmentally safe and sound technology.

## A.4. Parties and project participants

| Party involved (host) indicates a host Party | Private and/or public entity(ies) project participants (as applicable) | Indicate if the Party involved wishes to be considered as project participant (Yes/No) |
|---|---|---|
| India (Host) | Delhi Metro Rail Corporation (DMRC) (Private Entity) | No |
| Japan | Japan Carbon Finance, Ltd. (Private Entity) | No |

[1] Kindly refer Appendix 3 for detailed diagram of the various components of the system

2 http://www.thehindubusinessline.com/2006/10/19/stories/2006101901340700.htm

**A.5. Public funding of project activity**

>>

The Project activity is partly financed by the Government of Japan through JBIC. The funding however is separate from and is not counted towards the financial obligations of the aforesaid party. The relevant documents have been submitted to the validator.

**A.6. Debundling for project activity**

>>

Appendix C of the simplified modalities and procedures for small-scale CDM project activities corresponds to the procedures for determining the occurrence of debundling. According to Appendix C 'debundling' is defined as the fragmentation of a large project activity into smaller parts. A small-scale project activity that is part of a large project activity is not eligible to use the simplified modalities and procedures for small-scale CDM project activities. A proposed small-scale project activity shall be deemed to be a debundled component of a large project activity if there is a registered small-scale CDM project activity or an application to register another small-scale CDM project activity:

- With the same project participants;
- In the same project category and technology/measure;
- Registered within the previous 2 years; and
- Whose project boundary is within 1 km of the project boundary of the proposed small- scale activity at the closest point.

According to above-mentioned points of de-bundling, DMRC project activity is not a part of any of the above and therefore considered as small scale CDM project activity.

**SECTION B. Application of selected approved baseline and monitoring methodology**

**B.1. Reference of methodology**

>>

**Title:** Emission reduction by low green-house gas emitting vehicles (Type III – Other project activities, Category III.C.: Emission reduction by low greenhouse gas emitting vehicles (version 10, 23 December 2006)

**Reference**: "Appendix B- Indicative Simplified Baseline and monitoring Methodologies for Selected Small Scale CDM Project Activities"

**B.2. Project activity eligibility**

>>

*As per the provisions of appendix B of simplified modalities and procedures for small scale CDM project activities (version 10 dated 23 Dec 2006), Type III C category:*

1. *"Comprises low-greenhouse gas emitting vehicles".*
2. "*Measures are limited to those that result in emission reductions of less than or equal to 60 kt CO2 equivalent annually*".

- The project boundary covers the low-greenhouse gas emitting rolling stock in all the 3 service lines that are part of the project activity.
- The emission reductions from the project activity are 41,160 $tCO_2e$ annually which is below the specified limit of 60,000 $tCO_2e$ per year through-out the crediting period.

Hence, the project activity meets both the applicability criterion of the AMS III.C. (version 10, 23 December 2006) methodology.

The baseline and emission reduction calculations for the project would be based on paragraph 4, 5, 6 under Type III.C. of Appendix B of the simplified modalities and procedures for small-scale CDM project activities.

The monitoring methodology of the project activity would be based on guidance provided in the paragraph 8 and 9 under Type III.C. of Appendix B of the simplified modalities and procedures for small-scale CDM project activities.

**B.3. Project boundary**

>>

*The project boundary is the physical, geographical site of the facility / equipment affected by the project activity.*

**Project Boundary**

As per the guidelines mentioned in Type III.C of Appendix-B of the simplified modalities and procedures for small-scale CDM project activities, the project boundary includes low-greenhouse gas emitting vehicles that are a part of the project activity.

The rolling stocks in all the 3 lines of Phase–I, Phase –II and Phase –III are included in project boundary of the project activity. The project boundary therefore, consists of 70 rolling stocks. Each of the rolling stock has a unique identification number that has been presented in Appendix -1. Currently 60 rolling stocks are in operation and from September 2007 onwards 70 will be operational.

**B.4. Establishment and description of baseline scenario**

>>

The baseline for the proposed project activity has been arrived at using the methodology specified in the applicable project category for small-scale CDM projects. Indicative simplified baseline and monitoring methodologies for selected small-scale CDM project activity categories for Type-III C defines the baseline as:

"The baseline is the energy use per unit of service for the vehicle that would otherwise have been used times the average annual units of service per vehicle times the number of vehicles affected times the emission coefficient for the fuel used by vehicle that would otherwise have been used. If electricity is used by the vehicles, the associated emissions shall be estimated in accordance with paragraphs of category I.D".

Non regenerative braking (rheostatic braking) in Kolkata metro is selected as the baseline scenario as this is the only metro system existing in the country prior to Delhi Metro and in the absence of the project activity the same would have been adopted since non regenerative braking system (rheostatic braking) does not face barriers (explained in section B.5) compared to the project activity.

Thus in the baseline scenario for the project activity, rolling stocks without regenerative braking system would have been used and total electricity consumption of rolling stocks would have been met from northern regional grid.

For the project activity, the baseline and project emissions are from the total electrical energy (kWh) consumed in running the rolling stock during the project activity. The associated emissions are estimated in accordance with paragraphs 9 for category I.D projects[3], as per which, the emission coefficient (measured in $kgCO_2/kWh$) is calculated in a transparent and conservative manner.

(a) A combined margin (CM), consisting of the combination of operating margin (OM) and build margin (BM) according to the procedures prescribed in the approved methodology ACM0002. Any of the four procedures to calculate the operating margin can be chosen, but the restrictions to use the Simple OM and the Average OM calculations must be considered

OR

(b) The weighted average emissions (in kg CO2e/kWh) of the current generation mix. The data of the year in which project generation occurs must be used.

For the project activity option (a) has been used to determine the ex ante emission factor. Also, as the average percentage contribution of low cost /must run resources for last five years, 28.1 %[4] is less than

[3] As per AMS III.C, AMS ID (ver 10, 23 December 2006) has been used for calculation of emission factor. Refer approved small scale methodologies at http://cdm.unfccc.int/methodologies/SSCmethodologies/approved.html

4 Carbon Dioxide Emission Factor database, version 2.0,
http://www.cea.nic.in/planning/c%20and%20e/Government%20of%20India%20website.htm

50% of the total generation, hence Operating margin has been calculated as Simple Operating Margin. The values of OM and BM are mentioned in Annex 3

**B.5. Demonstration of additionality**

>>

In accordance with paragraph 28 of the simplified modalities and procedures for small-scale CDM project activities, a simplified baseline and monitoring methodology listed in Appendix B may be used for a small-scale CDM project activity if project participants are able to demonstrate to a designated operational entity that the project activity would otherwise not be implemented due to the existence of one or more barrier(s) listed in Attachment A of Appendix. B.

**Barriers and Additionality**

Appendix B "Indicative Simplified baseline and monitoring methodologies for selected small scale CDM project activity categories" of the simplified modalities and procedures for small-scale CDM project activities attachment A of appendix B states that project participants shall provide an explanation to show that the project activity would not have occurred anyway due to at least one of the following barriers:

- Barrier due to prevailing Practice
- Investment barrier
- Technological Barriers
- Other Barriers

The barriers due to prevailing practices and institutional aspects have been integrated to justify barriers faced by DMRC project activity reducing GHG emissions.

**Barrier due to prevailing practice:**

The regenerative braking technology being used by DMRC is being used for the first time in India in the metro railway systems. The other metro railway system in India i.e. Kolkata metro uses rheostatic braking technology in its rolling stocks. It is not the common practice in the metro systems in India and DMRC is pioneer in the Indian metro systems to regenerate electrical energy through regenerative braking. DMRC therefore, lacked the familiarity about the technology and faces unforeseen risks and barriers due to unfamiliarity of the project.

Thus the common practice in Indian Metro Transport System to use rheostatic braking would have led to higher emissions on account of higher electricity drawn by the rolling stocks from the regional grid as compared to the regenerative braking equipped rolling stocks.

**Investment Barrier:**

The use of energy efficient regenerative braking technology in rolling stocks increased the investments required by DMRC for the Delhi Metro Rail project.

The use of regenerative braking in the Delhi Metro System required installing a Converter Inverter (CI) unit which is the main propulsion equipment controlling the regenerative braking. The cost of a CI system is approximately Rs. 159 Lakhs. On the other hand, use of rheostatic braking requires installing a Dynamic Braking Resistors (DBR) for dissipating the decelerating energy in form of heat in atmosphere. The unit cost of a DBR is approximately Rs. 7 lakhs. Hence, the total additional investment by DMRC for installing regenerative braking system over rheostatic braking system for 70 rolling stock of Phase-I is Rs.212.8 Crores for the project activity (each rolling stock consists of DT-M-M-DT arrangement of cars and contains two CI units)

The use of rheostatic braking would not have required the additional investment of Rs 212.8 crores as mentioned above. However, it would have resulted in higher GHG emissions due to higher electricity demand, from the fossil fuel based regional grid, for the rolling stocks. Thus, the rheostatic braking system being financially more viable (as it would have required lesser investment) would have led to higher GHG emissions.

So, the decision to adopt regenerative braking with high investment is led by mainly environmental consciousness of management of DMRC and considering CDM revenues would off set the investment required for regenerative braking system.

**Technological Barrier**

The Converter Inverter (CI) is critical component that controls the operations of regenerative braking system. CI is a static device with a number of electronic components and operates non linearly. Hence, CI generates odd harmonics of third and fifth order (current/voltage) due to non linear current / voltage functions which can cause operational problems in the nearby electronic equipments. The harmonics generated by CI can cause malfunctioning of the following critical equipments due to extra heating caused by harmonics:

a. Signalling and Communication systems,
b. The AC traction motors,
c. Transformers, etc.

To overcome the harmonics disturbances, DMRC had to install harmonic filters. The harmonics filter essentially consists of an inductance – capacitance circuit to reduce the harmonic disturbances. The proper functioning of filters is essential to shield other critical equipments from electrical damages.
If harmonic filter fails, the harmonics generated would affect or damage the Signalling and Communication systems, AC traction motors, Transformers etc. The harmonics disturbances can hinder or lead to malfunctioning of the signalling and communication systems, which may affect train operations and might disrupt the timely running of the trains. If there is any delay or disruption in train operations, DMRC would incur huge financial losses on account of non operation of trains.
*The filters require regular inspection and maintenance for their proper functioning.* Also, it is envisaged that the some filters might need to be replaced over a period of time. The CDM revenue would provide for the replacement costs of the filters and revenue losses due to rolling stock delay/disruption caused by harmonic disturbances.
No such harmonic filters would have been required in case a DC third rail system with rheostatic braking system would have been used as no harmonic disturbances would have generated due to non existence of CI. Thus a less advanced rheostatic braking technology would have involved lower operational risks on account of harmonic disturbances as no CI or harmonic filters would have been required. However, that would have caused higher GHG emissions due to equivalent amount of electricity drawn from the regional grid.
The revenues against the sale of carbon credits would help in meeting the expenditure on regular and much required maintenance of harmonic filters etc.

**Other barriers – Requirement of training programs**

During a typical run of Delhi Metro Rolling stock with regenerative braking system, the rolling stock first accelerates, then turns to stable speed and finally decelerates by turning to regenerative mode of braking. The driver has to optimise the accelerating speed and braking distance to optimise the regenerative electrical energy production. To optimise the regenerative electrical energy production, optimum travel time between the starting and stopping point has to be maintained. For optimum regeneration, all the train operators have been provided with extensive training on regular basis. The training involves both financial and human resources to impart adequate knowledge and expertise to the train operators.
Improper driving of the train w.r.t regenerative braking would result in lesser regeneration of electricity thereby causing higher GHG emissions.
DMRC has also initiated a reward for train operator who maximises the regenerative electrical energy.
Thus, the CDM revenues from the project would be helpful in meeting the training expenses incurred due to implementation of the project activity.

Following impacts of CDM fund are identified from the point of view of removal of barriers:

a) The CDM fund will be used to cover the operational risks faced by the project
b) The CDM fund would be used to offset the additional investment and operating costs incurred due to implementation of the project activity.

c) The fund will stimulate R&D efforts of DMRC to find methods of mitigating risks and enhance replication of such projects in other Mass Rapid Transport System in India, to promote GHG abatement.

**B.6. Emission reductions**

**B.6.1. Explanation of methodological choices**

>>

**Calculation / Choice of emission factor:**

For determining the grid emission factor, as per guidance in AMS IIIC for the project activity option (a) of paragraph 9 of category I.D. (version 10, 23 December 2006) has been used to determine the emission factor. Also, as the average percentage contribution of low cost /must run resources for last five years, 28.1 %[5] is less than 50% of the total generation, hence Operating margin has been calculated as Simple Operating Margin.

**Baseline emission calculations:**

The baseline is the use of electro dynamic rheostatic braking system with no electrical energy regeneration in the rolling stock. Thus in the baseline scenario, the total electrical energy consumed by rolling stock is consumed from the grid only. Therefore, the baseline emissions are equal to the total electrical energy which is consumed by rolling stock in all the service lines during the project activity without the regenerative braking

**Step 1: Total Electrical energy consumed by the rolling stocks[6] without regenerative braking:**

$$EG_{Wr} = [\sum_{i=1}^{N} (EG_{i,,Wr} / S_i) * S_i]$$

(for $i$ =1to N, $i$ is the number of the rolling stock)

Where,

$EG_{Wr}$ total electrical energy consumed by rolling stocks without regenerative braking (GWh / year)

$EG_{i, Wr}$ total energy consumed by the rolling stock '$i$' without regenerative braking (GWh / year)

$S_i$ total distance covered by the rolling stock '$i$' (Km /year)

N total number of operational rolling stocks

**Step 2: Baseline emission calculation:**

The baseline emissions (in $tCO_2$/ year) from rolling stock cars regenerating electrical energy during a year, is calculated as:

$BE_y = EG_{Wr} * EF_y$

Where,

$EF_y$ $CO_2$ emission factor of the northern grid (t $CO_2$ e / GWh)

**Project emissions calculation:**

In the project activity, while decelerating, the rolling stocks regenerate electrical energy that is fed to supply line which is consumed by other accelerating rolling stock in the same service line. The equivalent electrical energy regenerated by rolling stock in the project activity would have otherwise been consumed from the grid in the baseline scenario with no regeneration by rolling stock. Therefore, the project

[5] Carbon Dioxide Emission Factor database, version 2.0, http://www.cea.nic.in/planning/c%20and%20e/Government%20of%20India%20website.htm

6 The Total electrical energy consumed by the rolling stock includes the electrical energy consumed by the rolling stock for motoring and meeting the Auxiliary electricity requirements.

emissions are the emissions equivalent to actual energy consumed by rolling stock which is the difference between total electrical energy which is consumed and the electrical energy regenerated by rolling stock in all the 3 service lines.

**Step 1**: **Total electrical Energy regenerated by rolling stock:**

$$EG_R = [\sum_{i=1}^{N} (EG_{i,,R} / S_i) * S_i]$$

(for $i$ =1to N, $i$ is the number of the rolling stock)

Where,

$EG_R$ total electrical energy regenerated with regenerative braking (GWh / year)

$EG_{i,R}$ total energy regenerated by the rolling stock '$i$' with regenerative braking (GWh/ year)

**Step 2: Project emission calculation:**

The project emissions (in $tCO_2$/ year) from rolling stock cars regenerating electrical energy during a year, is calculated as:

$$PE_y = [\{\sum_{i=1}^{N} \{(EG_{i,,Wr} / S_i) - (EG_{i,,R} / S_i)\} * S_i\}] * EF_y$$

Where,

$EF_y$ $CO_2$ emission factor of the northern grid (t $CO_2$ e / GWh)

**Leakage:**

According to the methodology, the baseline emissions as mentioned in paragraph 7 are, "No leakage calculation is required".

**B.6.2. Data and parameters fixed ex ante**

*(Copy this table for each piece of data and parameter.)*

| | |
|---|---|
| **Data / Parameter** | $EF_y$ |
| **Unit** | t $CO_2$/ GWh |
| **Description** | Emission factor for northern grid |
| **Source of data** | $CO_2$ Emission Factor database, version 2.0 as given by Central Electricity Authority a statutory body under Ministry of Power, Government of India. |
| **Value(s) applied** | 800 |
| **Choice of data or Measurement methods and procedures** | Emission Factor from Carbon Emission Database Latest Version 2.0 of Central Electricity Authority, Ministry of Power, Government of India. |
| **Purpose of data** | To calculate baseline emission |
| **Additional comment** | None |

**B.6.3. Ex-ante calculation of emission reductions**

>>

**Baseline emission calculations:**

| **$BE_y$** | **=** | **$EG_{Wr}$** | ***** | **$EF_y$** |
|---|---|---|---|---|
| $tCO_2$/yr | | GWh/yr | | $tCO_2$/GWh |
| **129,648** | **=** | **162.06** | ***** | **800** |

**Project emissions calculation:**

| $PE_y$ | = | $\{(EG_{i,,Wr} / S_i) - (EG_{i,,R} / S_i)\} * S_i\}]$ | * | $EF_y$ |
|---|---|---|---|---|
| $tCO_2/yr$ | | GWh/yr | | $tCO_2/GWh$ |
| **81,758** | = | **102.1975** | * | **800** |

**Leakage Emissions**

The methodology does not require leakage calculations

**Emission reductions**

| $ER_y$ | = | $BE_y$ | - | $PE_y$ | - | Leakage |
|---|---|---|---|---|---|---|
| $tCO_2/yr$ | | $tCO_2/yr$ | | $tCO_2/yr$ | | $tCO_2/yr$ |
| **47,890** | = | **129,648** | - | **81,758** | - | **0** |

**B.6.4. Summary of ex-ante estimates of emission reductions**

| Year | Baseline emissions ($tCO_2$ e) | Project emissions ($tCO_2$ e) | Leakage ($tCO_2$ e) | Emission reductions ($tCO_2$ e) |
|---|---|---|---|---|
| **2007-2008** | 112,460 | 71,300 | 0 | 41,160 |
| **2008-2009** | 123,362 | 79,609 | 0 | 43,753 |
| **2009-2010** | 129,020 | 81,731 | 0 | 47,289 |
| **2010-2011** | 132,021 | 84,425 | 0 | 47,597 |
| **2011-2012** | 132,021 | 84,425 | 0 | 47,597 |
| **2012-2013** | 129,648 | 81,758 | 0 | 47,890 |
| **2013-2014** | 129,648 | 81,758 | 0 | 47,890 |
| **2014-2015** | 129,648 | 81,758 | 0 | 47,890 |
| **2015-2016** | 129,648 | 81,758 | 0 | 47,890 |
| **2016-2017** | 139,630 | 88,053 | 0 | 51,577 |
| **Total** | 1,287,106 | 816,575 | 0 | 470,533 |
| **Total number of crediting years** | 10 years | | | |
| **Annual average over the crediting period** | 128,710.6 | 81,657.5 | 0 | 47,053.3 |

**B.7. Monitoring plan**

**B.7.1. Data and parameters to be monitored**

*(Copy this table for each data and parameter.)*

| **Data / Parameter** | **N** |
|---|---|
| **Unit** | -- |
| **Description** | Total number of operational Rolling stocks in the three service lines in each year y. |
| **Source of data** | Rolling Stock Department Log Book |
| **Value(s) applied** | 70 |
| **Measurement methods and procedures** | Unique Identification number of each Rolling stock is identified and verified at the regular monitoring interval. Appendix – 1 details the unique identification number of each train. |
| **Monitoring frequency** | Not applicable |
| **QA/QC procedures** | The data is monitored by the operation and maintenance department of DMRC ISO 9001 or similar system is in place. |
| **Purpose of data** | The data are used for Baseline emission calculation |
| **Additional comment** | The data monitored would be kept for two years after the end of the crediting period or the last issuance of CERs for the project activity whichever occurs later |

| **Data / Parameter** | **$EG_{i, wr}$** |
|---|---|
| **Unit** | GWh/year |
| **Description** | Electrical energy consumed by the operational rolling stock '*i*' |
| **Source of data** | Train Integration and Management System (TIMS) reading |
| **Value(s) applied** | The data will be monitored ex-post. |
| **Measurement methods and procedures** | Electrical energy consumed by each rolling stock is the sum of the electrical energy consumed by the rolling stock 'i' for motoring (M) and the Auxiliary electricity consumption (SIV), both of which are monitored by TIMS. The energy data for monitoring will be downloaded from TIMS of Rolling Stock using a maintenance terminal. Since TIMS is software based electronic equipment it has a high degree of accuracy ($\pm$ 0.01%) and as per manufacturer specifications requires no calibration from time to time. |
| **Monitoring frequency** | The readings are cumulative. These readings are noted daily and downloaded monthly using a maintenance terminal. |
| **QA/QC procedures** | The TIMS data is recorded by CDM team member (From each service line depot) of the Rolling Stock Department and is forwarded to the CDM Coordinator of the project. A data review meeting is conducted once in 6 months which is chaired by CDM Chairman. In this meeting, data compiled by CDM coordinator is cross checked with service line data of all the rolling stock. Subsequently to check further the data authenticity and accuracy, data is verified, audited and signed by senior officials from DMRC. |
| **Purpose of data** | The data are used for Baseline emission calculation |
| **Additional comment** | The data monitored would be kept for two years after the end of the crediting period or the last issuance of CERs for the project activity whichever occurs later. |

| Data / Parameter | $EG_{i, R}$ |
|---|---|
| Unit | GWh/year |
| Description | Electrical energy regenerated by the operational rolling stock 'i' |
| Source of data | TIMS reading |
| Value(s) applied | The data will be monitored ex-post |
| Measurement methods and procedures | Electrical energy regenerated by each rolling stock is monitored by TIMS. The energy data for monitoring will be downloaded from TIMS of Rolling Stock using a maintenance terminal. Since TIMS is software based electronic equipment it has a high degree of accuracy (± 0.01%) and as per manufacturer specifications requires no calibration from time to time. |
| Monitoring frequency | The readings are cumulative. These readings are noted daily and downloaded monthly using a maintenance terminal. |
| QA/QC procedures | The TIMS data is recorded by CDM team member (From each service line depot) of the Rolling Stock Department and is forwarded to the CDM Coordinator of the project. A data review meeting is conducted once in 6 months which is chaired by CDM Chairman (Head of Maintenances department). In this meeting, data compiled by CDM coordinator is cross checked with service line data of all the rolling stock. Subsequently to check further the data authenticity and accuracy, data is verified, audited and signed by senior officials from DMRC. |
| Purpose of data | The data are used for Baseline emission calculation. |
| Additional comment | The data monitored would be kept for two years after the end of the crediting period or the last issuance of CERs for the project activity whichever occurs later. |

| Data / Parameter | $S_i$ |
|---|---|
| Unit | Km |
| Description | Total distance covered by the rolling stock '*i*' |
| Source of data | Train Integration and Management System (TIMS) reading |
| Value(s) applied | The data will be monitored ex-post |
| Measurement methods and procedures | The distance travelled by each rolling stock is monitored by TIMS.. The energy data for monitoring will be downloaded from TIMS of Rolling Stock using a maintenance terminal. Since TIMS is software based electronic equipment it has a high degree of accuracy (± 0.01%) and as per manufacturer specifications requires no calibration from time to time. |
| Monitoring frequency | The readings are cumulative. These readings are noted daily and downloaded monthly using a maintenance terminal. |
| QA/QC procedures | The data is monitored by the operation and maintenance department of DMRC ISO 9001 or similar system is in place. |
| Purpose of data | The data are used for Baseline emission calculation. |
| Additional comment | The data monitored would be kept for two years after the end of the crediting period or the last issuance of CERs for the project activity whichever occurs later |

**B.7.2. Sampling plan**

>>

N/A

**B.7.3. Other elements of monitoring plan**

>>

As per Type III C, monitoring shall track the number of low emission vehicles operated under the small-scale CDM project activity and the annual units of service for a sample of the vehicles. Emissions from electricity shall be taken into account for electric vehicles.

As per the provisions of paragraph 14 of Draft simplified modalities and procedures for small scale CDM project activities [UNFCCC/CP/2002/7/Add.3, English, Page 21] the "Project participants may use the simplified baseline and monitoring methodologies specified in appendix B for their project category" if they meet the applicability criteria of small scale CDM project activity. Since the project activity is a small-scale CDM project of Type III.C category, the monitoring methodology and plan has been developed in line with the guidance provided in paragraph 8 under Type III.C of Appendix B.

The project activity is to install low GHG emitting rolling stock having regenerative braking technology instead of conventional electro-dynamic rheostatic braking system. The emission reduction quantity depends on the number of rolling stock and annual units of service provided by rolling stock units in all the 3 service lines of DMRC project activity. The monitoring of the all electrical energy data required for estimation of baseline and project emissions for the project activity is through state of the art electronic equipments like Train Integration Management system (TIMS). .This is an electronic device very high accuracy for measurement and recording. The projects activity represents all the rolling stock trains of all the service lines for which electrical energy data is monitored through TIMS during the project activity.

The operation and maintenance staff downloads the TIMS recorded data from the rolling stock on a regular basis and stores this data on a Computer for further records. The parameters concerned are well documented and numbered. The documented parameters are duly signed by respective Rolling Stock Depot in-charges and forwarded to CDM co-coordinator on a monthly basis. The parameters are documented according to the standard procedures quite similar to the ISO requirements. The report received from O&M department is compiled and maintained by CDM coordinator. The reports would be retained till 2 years after the end of crediting period or the last issuance of CERs for the project activity whichever occurs later.

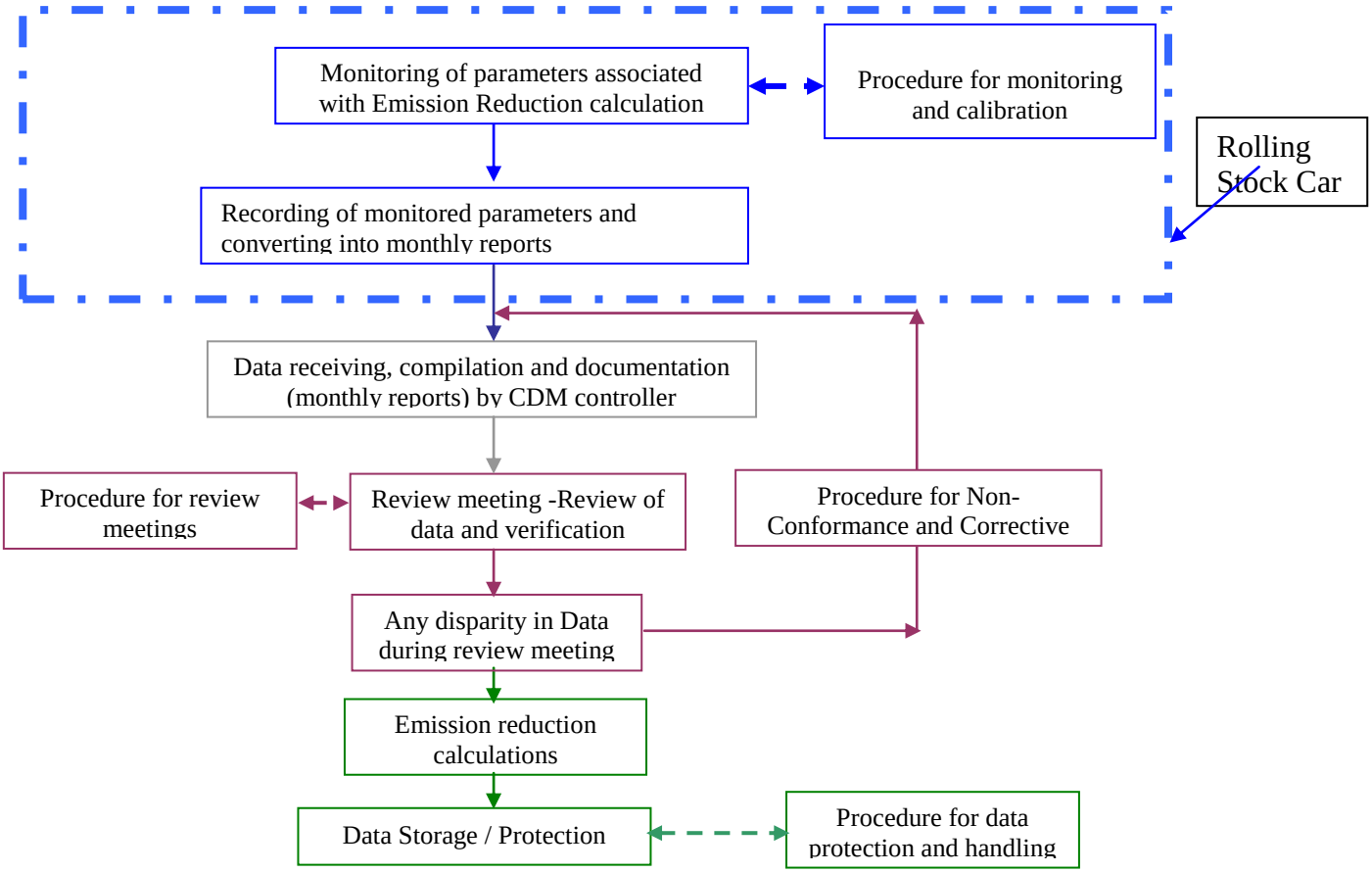
The Delhi Metro is the first metro train system in the world to receive ISO 14001 EMS certification during the construction phase, for environmental consideration during project planning and execution of Phase-I. The Delhi metro has also been awarded OHSAS 18001 (Occupational Health and Safety Assessment series) for sections of its operational corridor on phase-1 by Registro Italiano Navale India Pvt. Ltd. (RINA), Genova. Plans are afoot to extend this certification to construction activities on all operational lines of Phase-1.

To ascertain the Quality Control and Quality Assurance of the monitored parameters, following procedure is adopted:

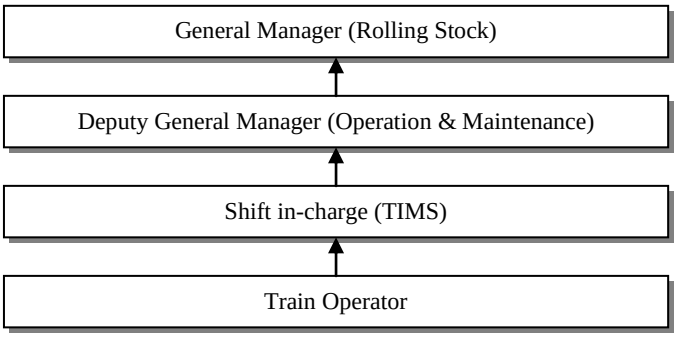
- The monitored data is reviewed by conducting an inter-department review meeting once in six months. The Coordinator CDM will discuss the data (received from O&M department) with CDM Team member of concerned departments. Once the data is compiled and checked, it will be handed over to Verifier (DMRC official) for Verification. After data verification, Auditor (DMRC official) will be invited to carry out the Audit for concerned data.
- TIMS is an electronic device which monitors performance of variation subassemblies of the train through a sophisticated software. Hence no calibration is required on this item.

The flow chart for CDM data monitoring, recording and storage and various procedures adopted for Quality Control and Quality Assurance of monitored parameters is given below:

**Flow Chart for CDM Data Monitoring, Recording and Storage**




A comprehensive CDM manual is prepared to illustrate the roles and responsibility of each and every person involved in project activity. The CDM manual also consist of procedure for monitoring of various associated parameters, frequency of monitoring, procedure for data storage and protection procedure for review meetings and procedure for non conformance of data etc. CDM manual also comprises specimen copy of data formats of technical department.




**Note: - To capture the data without monitoring system is not possible, Development of emergency procedure for monitoring of data is also not possible, and hence DMRC will not claim the CERs for the duration of failure**

**SECTION C. Duration and crediting period**
**C.1. Duration of project activity**
**C.1.1. Start date of project activity**
>>
02/05/2001

**C.1.2. Expected operational lifetime of project activity**
>>
30 Years

**C.2. Crediting period of project activity**
**C.2.1. Type of crediting period**
>>

A Fixed crediting period of 10 years has been selected for the project activity

**C.2.2. Start date of crediting period**
>>
Not Applicable

**C.2.3. Length of crediting period**
>>

10y – 0m

**SECTION D. Environmental impacts**
**D.1. Analysis of environmental impacts**
>>
The Ministry of Environment and Forests (MoEF), Government of India, under the Environment Impact Assessment Notification vide S.O. 60 (E) dated 27/01/94 and S.O. 1533 dated 14/09/06 has listed a set of industrial activities in Schedule of the notification which for setting up new projects or modernization / expansion will require environmental clearance and will have to conduct an Environment Impact Assessment (EIA) study. DMRC project activity of installing regenerative braking technology does not require EIA to be conducted as the activity is not included in schedule of MoEF for mandatory EIA requirements.
Article 12 of the Kyoto Protocol requires that a CDM project activity contributes to the sustainable development of the host country. Assessing the project activity's positive and negative impacts on the local environment and on society is thus key element for each CDM project. The project activity leads to fossil fuel conservation by reducing the consumption of electricity, hence leading to GHG emission reduction. The project activity has positive impacts on environment- air, land, water.

The Delhi Metro is the first metro in the world to receive ISO 14001 EMS certification during the construction phase reflecting the environmental considerations during project planning. The Delhi metro has also been awarded OHSAS 18001 (Occupational Health and Safety Assessment series) for sections of its operational corridor on phase-1 by Registro Italiano Navale India Pvt. Ltd. (RINA), Genova. Plans are afoot to extend this certification to construction activities on Phase-II as well as all operational lines of phase-1.

**SECTION E. Local stakeholder consultation**
**E.1. Solicitation of comments from local stakeholders**
>>

**Stakeholder Identification:**
Stakeholders have been identified on the basis of their involvement at various stages of project activity. The list of relevant stakeholders includes all the organizations, which were communicated / applied to get necessary clearances. The stakeholders identified for the project are as under:

- Employees of DMRC
- Ministry of Environment & Forest (MoEF), Government of India
- Equipment Suppliers

DMRC invited employees from various departments like Over Head Equipments (OHE), Depot, Maintenance etc for a meeting through an invitation letter to discuss on various initiatives taken by DMRC in the field of energy efficiency and environment. During the meeting various activities carried out by DMRC in field of energy efficiency and environment were explained to the employees. DMRC informed about techno-economical benefits and the associated environmental benefits of the project.

**E.2. Summary of comments received**
>>
The employees appreciated the efforts taken by DMRC and expressed satisfaction over implementation of the project. The employees also suggested that DMRC should explore more opportunities in the field of energy efficiency in the future.
Equipment suppliers have supplied the equipments with designed specifications for the project activity and helped in erection and commissioning.
Ministry of Environment & Forests (MoEF) would be providing the host country approval for the project activity.

**E.3. Report on consideration of comments received**
>>
No significant adverse comments were in the stakeholders meeting and the initiative of DMRC towards reducing GHG emissions was appreciated by the stakeholders present.

**SECTION F. Approval and authorization**
>>

- - - - -

## Appendix 1: Contact information of project participants

| | |
|---|---|
| **Organization** | Delhi Metro Rail Corporation |
| **Street/P.O. Box** | Bhishma Pitamah Marg Pragati Vihar |
| **Building** | IIIrd NBCC Place |
| **City** | New Delhi |
| **State/Region** | Delhi |
| **Postcode** | 110003 |
| **Country** | India |
| **Telephone** | 91-11-24366238 |
| **Fax** | 91-11-24366238 |
| **E-mail** | Ed_cp@dmrc.org |
| **Website** | www.delhimetrorail.com |
| **Contact person** | |
| **Title** | Executive Director |
| **Salutation** | Mr. |
| **Last name** | Singh |
| **Middle name** | |
| **First name** | Mangu |
| **Department** | |
| **Mobile** | |
| **Direct fax** | |
| **Direct tel.** | |
| **Personal e-mail** | arunkr_2k@rediffmail.com |

| | |
|---|---|
| **Organization** | Japan Carbon Finance, Ltd. |
| **Street/P.O. Box** | - |
| **Building** | 6th Floor, 1-3, Kudankita 4-Chome, |
| **City** | Chiyoda-ku |
| **State/Region** | Tokyo |
| **Postcode** | 102-0073 |
| **Country** | Japan |
| **Telephone** | +81-3-5212-8870 |
| **Fax** | +81-3-5212-8886 |
| **E-mail** | jcf@jcarbon.co.jp |
| **Website** | http://www.jcarbon.co.jp |
| **Contact person** | |
| **Title** | Director General |
| **Salutation** | Mr. |
| **Last name** | Ari |
| **Middle name** | |
| **First name** | Masato |
| **Department** | Carbon Finance Department |
| **Mobile** | - |
| **Direct fax** | +81-3-5212-8886 |
| **Direct tel.** | +81-3-5212-8878 |
| **Personal e-mail** | m-ari@jcarbon.co.jp |

## Appendix 2: Affirmation regarding public funding

The Project activity is partly financed by the Government of Japan through JBIC. The funding however is separate from and is not counted towards the financial obligations of the aforesaid party. The relevant documents have been submitted to the validator.

## Appendix 3: Applicability of selected methodology

Please refer to section B. 2.

## Appendix 4: Further background information on ex ante calculation of emission reductions

In absence of project activity (installation of regenerative braking), equivalent amount of electricity would have been consumed by rolling stocks, from the grid. Thus, project activity displaces equivalent amount of electricity that would have been generated in the fossil fuel based power plant connected to the regional grid.

**Choice of the grid that will be affected by the project activity**

The electricity system in India is divided into five regions – Northern, Eastern, Western, Southern and North-Eastern Electricity Boards. Northern Region grid is chosen as the grid system for the project activity, since the project activity is in Delhi which falls in the Northern Region grid.

**The Emission Factor for the Grid**

As per the **Carbon Dioxide Emission Factor database, version 2.0**, given by **CEA**[7]**,** a statutory body under the Ministry of Power, the ex-ante emission factor for the Grid is the following:

| | | |
|---|---|---|
| *Simple Operating Margin* | = | *0.99 kg CO2 /KWh* |
| *Build Margin* | = | *0.60 kg CO2 /KWh* |
| ***Combined Margin*** | **=** | ***0.80 kg CO2 /KWh*** |

*Thus the emission factor for the northern region grid is **0.80 kg CO2/KWh***

**Appendix 1:**

**Unique ID of the rolling stocks i.e. trains in three services line for the project activity.**

7 http://www.cea.nic.in/planning/c%20and%20e/Government%20of%20India%20website.htm

| Service line 1 |
|---|
| Train No. 101 (TS# 1) |
| Train No. 102 (TS# 2) |
| Train No. 103 (TS# 3) |
| Train No. 104 (TS# 4) |
| Train No. 105 (TS# 5) |
| Train No. 106 (TS# 6) |
| Train No. 107 (TS# 7) |
| Train No. 108 (TS# 8) |
| Train No. 109 (TS# 9) |
| Train No. 110 (TS# 10) |
| Train No. 111 (TS# 11) |
| Train No. 112 (TS# 12) |
| Train No. 113 (TS# 13) |
| Train No. 114 (TS# 14) |
| Train No. 115 (TS# 15) |
| Train No. 116 (TS# 16) |
| Train No. 117 (TS# 17) |
| Train No. 118 (TS# 18) |
| Train No. 119 (TS# 19) |
| Train No. 120 (TS# 20) |
| Train No. 121 (TS# 21) |
| Train No. 122 (TS# 22) |
| Train No. 123 (TS# 23) |
| Train No. 124 (TS# 24) |
| Train No. 125 (TS# 25) |
| Train No. 126 (TS#26) |
| Train No. 127 (TS#27) |

| Service line 2 |
|---|
| Train No. 201 (MC # 1) |
| Train No. 202 (MC # 2) |
| Train No. 203 (MC # 3) |
| Train No. 204 (MC # 4) |
| Train No. 205 (MC# 5) |
| Train No. 206 (MC # 6) |
| Train No. 207 (MC # 7) |
| Train No. 208 (MC # 8) |
| Train No. 209 (MC # 9) |
| Train No. 210 (MC # 10) |
| Train No. 211 (MC # 11) |
| Train No. 212 (MC # 12) |
| |
| |

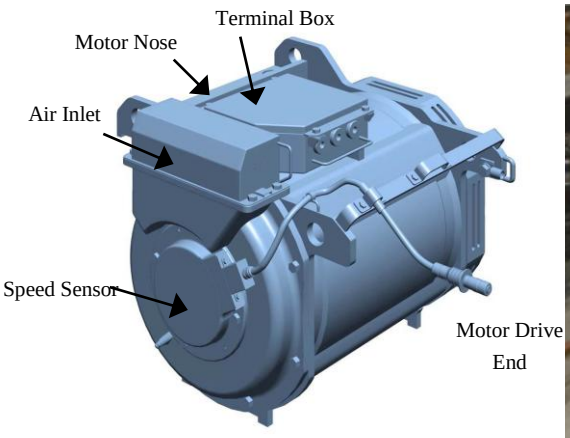
| Service line 3 |
|---|
| Train No. 301 (TS # 1) |
| Train No. 302 (TS # 2) |
| Train No. 303 (TS # 3) |
| Train No. 304 (TS # 4) |
| Train No. 305 (TS # 5) |
| Train No. 306 (TS # 6) |
| Train No. 307 (TS # 7) |
| Train No. 308 (TS # 8) |
| Train No. 309 (TS # 9) |
| Train No. 310 (TS # 10) |
| Train No. 311 (TS # 11) |
| Train No. 312 (TS # 12) |
| Train No. 313 (TS # 13) |
| Train No. 314 (TS # 14) |
| Train No. 315 (TS # 15) |
| Train No. 316 (TS # 16) |
| Train No. 317 (TS # 17) |
| Train No. 318 (TS # 18) |
| Train No. 319 (TS # 19) |
| Train No. 320 (TS # 20) |
| Train No. 321 (TS # 21) |
| Train No. 322 (TS # 22) |
| Train No. 323 (TS # 23) |
| Train No. 324 (TS # 24) |
| Train No. 325 (TS # 25) |
| Train No. 326 (TS # 26) |
| Train No. 327 (TS # 27) |
| Train No. 328 (TS # 28) |
| Train No. 329 (TS # 29) |
| Train No. 330 (TS # 30) |
| Train No. 331 (TS # 31) |

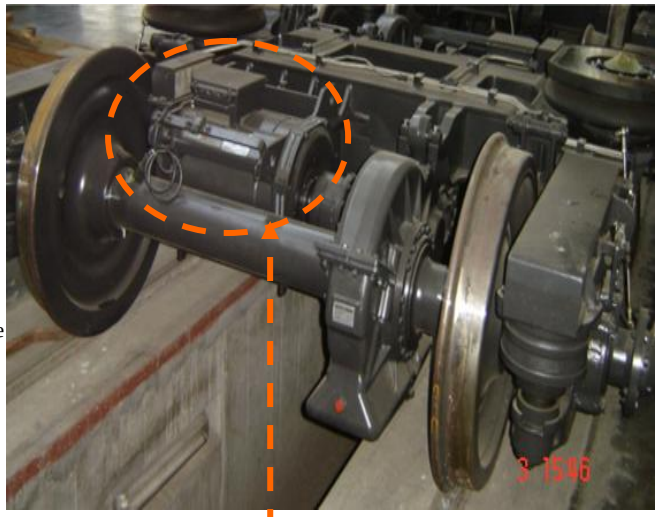
## Appendix 5: Further background information on monitoring plan

The monitoring plant is as described in Section B.7.3.

### Equipment Details

- **Traction motor** : The AC traction motor used in the project activity is shown below



Traction motor as mounted on Bogie and Axle

- **Pentograph** : the pentograph under various stages of operation is shown below:

Pentograph – No operation state


Pentograph – under operation state

- **Convertor Invertor (CI)** : The converter inverter (CI) is shown below:

## Appendix 6: Summary of post registration changes

**1. Details of the Corridor length extended:-**

**Service line 1(Red Line)** has been extended from Shahdara to Dilshad Garden (instead of Shahdara), earlier the end point was Shahdara and there is an extension of 3 more stations and at present the end point is Dilshad Garden.
**Service line 2 (Yellow Line)**, the last two pints was Vishvavidyalaya - Central Sectt and now the same has been extended one side from Vishvavidyalaya to Jahangirpuri and other side from Central Sectt to Huda City Centre.
*Further it will be extended to Badli

**Service line 3 & 4 (Blue Line)** the last two points was Indraprastha that has been extended to Noida city Centre and Vaishali – Yamuna Bank and from Dwarka- Sub City to Dwarka Sec 21.

* Further it will be extended to Najafgarh

The present extended map of Delhi Metro Rail is also attached , also the details of commissioning date for the extension in respective lines are below:-(The below details can also be verified on the below website of DMRC)

The detail implementation of the project is as below:-

**Phase I of Delhi Metro Rail project consists of the following three lines:**

*Line No.1*- Shandara-Tri Nagar-Rithala
*Line No.2*- VishwaAdyalaya-Central Secretariat
*Line No.3*- Indraprastha-Barakhamba Road-Dwarka Sub City

**Phase II of Delhi Metro Rail project consists of the following lines:**

*Line No.1(Red Line)*- Shandara — Dilshad **Garden**

*Line No.2 (Yellow Line)* –
Vishwavidyalaya — Jahangir Puri
Central Secretariat — HUDA City Centre

*Line No.3 & 4(Blue Line)*-
lndraprastha — Noida Sector 32 City Centre
Yam una Bank —Anand Vihar
Dwarka Sector 9 to Dwarka Sector 21
Anand Mhar— KB Vaishali

**Phase III of Delhi Metro Rail project consists of the following lines:**

Jahangirpuri – Badli
Dwarka – Najafgarh

* expected to opening in year 2016

| S. No. | Line Corridor | Km | |
|---|---|---|---|
| | Line 1(Red Line) | | |
| | Shahdara to Dilshad Garden | 3.09 | |
| | Line 2 (Yellow Line) | | |
| | Vishvavidyalaya to Jahangirpuri | 6.36 | |
| | Central Secretariat – Huda City Centre | 27.45 | |
| | | | |
| | Line-3& 4 (Blue Line) | | |
| | Indraprastha – Noida Sector 32 City Centre | 15.07 | |
| | | | |
| | Yamuna Bank –Anand Vihar | 6.17 | |
| | Dwarka Sector 9 - Dwarka Sec 21 | 2.76 | |
| | Anand Vihar- Vaishali | 2.57 | |

| | **Total distance** | **Total no. of Stations** |
|---|---|---|
| **Line 1 ( Red Line) (After completion of Phase l & phase ll)** | 25.15 | 21 |
| | | |
| **Line 2 ( Yellow Line) (After completion of Phase l & phase ll)** | 44.65 | 34 |
| Planned in Phase III further extended | 4.489 | 3 |
| Total | 49.139 | 37 |
| | | |
| **Line 3(Blue Line) (After completion of Phase l & phase ll)** | 58.67 | 50 |
| Planned in Phase III further extended | 5.5 | 3 |
| Total | 64.17 | 53 |

All these details are available at the website of DMRC.

http://www.delhimetrorail.com/zoom-route-map.aspx

**2.**

**3. To capture the data without monitoring system is not possible, Development of emergency procedure for monitoring of data is also not possible, and hence DMRC will not claim the CERs for the duration of failure.**

**History of the document**

| Version | Date | Nature of revision |
|---|---|---|
| 04.1 | 11 April 2012 | Editorial revision to change history box by adding EB meeting and annex numbers in the Date column. |
| 04.0 | EB 66<br>13 March 2012 | Revision required to ensure consistency with the "Guidelines for completing the project design document form for small-scale CDM project activities" (EB 66, Annex 9). |
| 03 | EB 28, Annex 34<br>15 December 2006 | • The Board agreed to revise the CDM project design document for small-scale activities (CDM-SSC-PDD), taking into account CDM-PDD and CDM-NM. |
| 02 | EB 20, Annex 14<br>08 July 2005 | • The Board agreed to revise the CDM SSC PDD to reflect guidance and clarifications provided by the Board since version 01 of this document.<br>• As a consequence, the guidelines for completing CDM SSC PDD have been revised accordingly to version 2. The latest version can be found at <http://cdm.unfccc.int/Reference/Documents>. |
| 01 | EB 07, Annex 05<br>21 January 2003 | Initial adoption. |
| **Decision Class:** Regulatory<br>**Document Type:** Form<br>**Business Function:** Registration | | |