

No.	WMS-EHS-01-TMLL
Rev. No.	00
Date	15.12.2023

Work Method Statement of TATA MOTORS LIMITED, Lucknow Rooftop & Ground Mount Solar Power Plant

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Site Safety Officer	Safety Manager	

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1. Project introduction

Project Capacity	2.6 MWP Rooftop & Ground Mount Solar Power Plant
Site	Tata Motors Limited Lucknow
Roof Type	GI roof & Ground Mount (Standing Seam)
Scope	Installation and Construction of Rooftop & Ground Mount solar power plant
Client	Tata Motors Limited Lucknow Utter Pradesh

1 Material movement

Installer shall be responsible for shifting all the material to the roof. Installer may do so by employing manpower whenever need. Installer will adhere to these guidelines.

1. Modules – There are 3,704 solar modules, each weighing between 24 and 25 kilograms. These modules will be moved to the roof in stacks of 10 to 12, properly secured from the ground in the plant premises using a high-capacity Farana crane. After shifting the modules, they will be distributed over the roof in stacks of 5 modules, secured with module mounting clamps and rope. For ground mounting, stacks of 10 to 12 modules will be moved to the installation area of the module mounting structure using a Hydra, Farana, or forklift.
2. During material movement the area will be soft barricaded at ground level.

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3. LT panel – The LT panel weighs between 1 and 2 tons. It needs to be shifted by Farana or forklift to the electrical room or the location specified in the drawings, ensuring that no damage occurs to the LT panel.
4. Structure members, earth strips, and cable trays should be shifted to the roof or the ground mount area manually using rope or any suitable shifting equipment, as their weight is very light.
5. AC cable – AC cable drum should be put on rolling wheels/Jack for Cable Laying.
6. Remaining material – All material shall be shifted to the roof manually using rope.
7. Movement on roof when shifting the material on roof premises, storing the same on roof and during installation care should be taken that GI sheet does not get any damages which subject to leakage.

2. Installation method and work instructions

The scope of the work includes –

Sr.No.	Work Group	Installation Method and Work Instructions
1	Activities Overview	<ol style="list-style-type: none"> 1) Complete area marking of roof to be done before start of installation 2) Safety Net & Lifeline installation should be the first activity to reduce the maximum risk. 3) Walkway installation will start after installation of MMS, in parallel to module installation. 4) Structure installation to be done as per structure layout drawing. 5) For ground-mounted installations, the initial step involves marking the designated area for the Mounting Module System (MMS). Following this, ground piling activities should be conducted. Once the piling is complete, the MMS can be installed in the piling area. To ensure stability, the structure should then be secured with concrete.
2	Safety Net & Lifeline	<p>Safety net & Lifeline installation will be the first activity for safety purpose to reduce the maximum safety and risk mitigation, particularly for preventing falls from height.</p> <ol style="list-style-type: none"> 1) The installation of a safety net, specifically HDG Mesh, will encompass the entire area of the skylight screen, adhering to the specifications outlined in the safety net installation drawing.

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		2) lifeline system that meets the EN 795 standard will be strategically placed following the detailed guidelines provided in the Lifeline Installation drawing.
3	Mechanical – Solar module mounting structure (MMS) & Walkway	<p>1) 1) Segregate all fasteners and clamps into batches or sets, and store them in separate boxes to prevent misplacement.</p> <p>2) 2) The vendor and their workers should receive training on structure assembly. A BECIS project engineer will demonstrate the assembly of a single table on-site before the commencement of the full structure assembly and mounting process.</p> <p>3) 3) Conduct a visual inspection of the structure for any deformities, damage, or surface scratches.</p> <p>Walkway: -</p> <p>1) Walkway installation will start after installation of MMS , in parallel to module installation</p> <p>2) the support to be installed on roof as per the layout.</p>
4	Mechanical – Module installation	<p>1) Care should be taken during module shifting from stored location on roof to working area,</p> <p>2) Will follow the solar modules Installation manual as per make.</p> <p>3) Torque to be applied for the Clamps (Mid & End clamp nut) during erection with the help of battery-operated tools.</p>
5	Mechanical – Earthing flat laying and DC and AC earthing	<p>1) Earthing flats of 25x3 mm and 50x6 mm will be laid on the roof for structure earthing.</p> <p>2) These earthing flats will be placed on insulators and connected with bolted joints between the two strips.</p> <p>3) The "L" bend of the earth strip should be made correctly using proper tools.</p> <p>4) A cross joint should be provided for the earth strip at the main junction. The downcomer strip should be fixed to the vertical wall by installing insulators and supports.</p>
6	Mechanical – Erection and mounting of inverter, AC isolator and LT panel	<p>1) Erection and mounting of inverter, isolator & LT panel as per drawing.</p> <p>2) The inverters and isolators will be mounted on the hot-dip galvanized (HDG) structure according to the installation drawing and the finalized location.</p> <p>3) LT panel will be installed at sub-station/ Finalized location.</p>
7	DC cable Management	<p>1) The DC cables must be routed through DWC conduits on the roof as per the DC cable layout. Ensure that the positive (+) and negative (-) cables are laid separately in individual conduits.</p>

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		<ol style="list-style-type: none"> 2) The cables then be directed to the inverters using a cable tray that descends from the roof. 3) Install the cable tray on the roof with clamps and secure the drop-down run to the wall using clamp fixtures. 4) Ferrules should be applied to both ends of all DC cables for proper identification and connection.
8	AC cable Management over Roof and Ground	<ol style="list-style-type: none"> 1) AC cables should be routed through a cable tray. 2) The cable tray should be installed on the roof , and the roof's elevation should be considered to carry the AC cable from the inverter to the Solar LT Panel across various roofs. For Ground Mount AC Cable Tray is been routed through the cable Tray with Structural support beneath the AC Cable Tray. 3) The cable tray will be mounted on stands and fixed to the wall wherever necessary. 4) A sufficient gap should be maintained in the cable tray to lay cables in the future, and the cables should be neatly dressed using UV-protected cable ties. 5) The cable tray support should be installed according to the drawing, and the welding joints of the tray should be painted with primer and paint.
9	Electrical – Erection and mounting of SCADA and sensors	<ol style="list-style-type: none"> 1) Erection and mounting of SCADA box and sensors as per drawings 2) RS485 cable can be laid with minimum 100mm spacing from power cable 3) Communication cable to be put through 15mm UPVC pipe, as per the layout.
10	Electrical – Stringing and DC cable laying	<ol style="list-style-type: none"> 1) Stringing will be done as per the layout using proper crimping tool suitable for solar DC cable connector crimping. 2) DC cables will be laid through DWC conduit and cable tray as per layout. 3) DC conduit clamps shall be fixed with rivet joint or SDS in support which is fixed to roof by utility clamps.
11	Electrical – AC cable laying	<ol style="list-style-type: none"> 1) AC Cables to be routed through cable tray 2) Cable tray support to be installed as per the drawing, the welding joint of tray to be painted by primer and paint
12	Electrical – Earthing on DC and AC side	<p>Earthing on DC and AC side includes</p> <ol style="list-style-type: none"> 1) DC side earthing of modules as per the instruction given by the manufactures. 2) Module-Module earthing to be done by 4sq mm cables. 3) AC side earthing of inverter, LT panel(dual) and SCADA box should be done by earth strip and Cu. Wire. 4) DC & AC side earthing shall be connected as per layout.

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13	Electrical – Cable termination	<ol style="list-style-type: none"> 1) Termination of cable include at location of inverter, isolator, LT panel, final injection point, SCADA box, sensors, and ref meters. 2) For DC cable terminations, crimping tool for MC4 connector shall be used 3) For AC cable terminations, hydraulic crimping tool for AC cable size shall be used 4) For CAT 6 cable terminations, RJ45 lug crimping tool shall be used. 5) All joints should be firm with no air gap between joining members such as lug and bus bar etc. 6) All lugs shall be covered using heat sleeve or insulation tape of appropriate color.
14	Electrical – SCADA power supply and terminations	<ol style="list-style-type: none"> 1) SCADA system installation will be done as per approved layout. 2) For RS 485 cable termination, crimping tool shall be used.
15	Civil Work – Earth pit	<ol style="list-style-type: none"> 1. Earth pits to be constructed as per drawing including earth pit for LA at various location. Approved depth to be maintained for electrode. Drilling depth shall be as per drawing from ground level to make space for pit depth. 2. PVC / RCC earth chamber shall be installed for every earth pit. 3. The filling should be done with mix of soil and compound in ratio of 1:1. 4. Earthing electrode is fixed in the pit in the center and mixture of soil and compound shall be filled uniformly. Earthing flat shall be connected using right size SS 304 nut bolt with electrode and tightened firmly. There shall be no gap between earthing flat and surface of earthing electrode. No welding will be done to fix flat with electrode. The connection in earth pit to be made like, which can disconnect and connect for testing purpose in future. 5. Earthing flats shall be laid under the ground at minimum of 200 mm depth. 6. Earth resistivity shall be checked. Combined value should be less than 3 Ohm.
16	Information management – Ferrules, stickers, cable markers, information board installation	<p>Various information management related aspects shall be done as per instruction from BECIS engineers. They include Ferrules, stickers, cable markers, information board installation.</p> <p>BECIS safety procedure poster to be put on prominent places on site</p>

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