	<b>SOLAR BUSINESS DIVISION</b>	<b>NOTICE INVITING TENDER (NIT)</b>	<b>MATERIAL: Mono Perc Cell 157mm 5.38Wp &amp; Multi Cell 157mm 4.67Wp</b>
<b>TENDER REFERENCE: 12302328MUMPC</b>			

Dear Sir,

**Subject: Tender for "Mono Perc Cell 157mm 5.38Wp & Multi Cell 157mm 4.67Wp".**

BHEL invites offers from reputed Vendors {Refer Pre-qualifying (PQR) requirements and other requirements given in tender enquiry letter uploaded on our websites) for supply including packing & transportation to as per incoterms, satisfactory completion of supply of " Mono Perc Cell 157mm 5.38Wp & Multi Cell 157mm 4.67Wp as per Tender Ref: SOLAR CELLS 12302328MUMPC".

Your offer shall be submitted in two parts strictly as per "Instructions to Bidders" of GCC, Rev R0 in sealed covers.

Your best quotation / offer for the above requirement, in line with our terms and conditions, should either be delivered in person or sent by COURIER/REGISTERED POST, to the following address only:

**BHEL- EPD Tender box (Reception of SBD)**

C/o. **AGM/MM**

M/s BHARAT HEAVY ELECTRICALS LTD. (SOLAR BUSINESS DIVISION (SBD),  
Prof CNR Rao Circle, IISc Post, Malleswaram, Bangalore- 560 012  
Ph. No. +91-080-22182219, 080-22182261, +91-080-22182286.

**Offer can also be submitted thru email to email ids specified below only:-**

PART-A (I) BID i.e. TECHNICAL BID on [technicalbid-epd@bhel.in](mailto:technicalbid-epd@bhel.in)

PART-B (II) BID i.e. PRICE BID on [pricebid-epd@bhel.in](mailto:pricebid-epd@bhel.in)

**NOTE:-**

1. Tender reference & due date to be mentioned in subject of mail.
2. Bidders may adopt this mode at their own risk. The Purchaser does not own any responsibility /liability for delays in receipt / loss of secrecy of such offers.

It shall be the responsibility of the bidder to ensure that the tender is delivered on or before the due date by **02:00 P.M. The offer has to be deposited in tender box only.** Part-I bids shall be opened at **02:30 P.M.** on the due date in the presence of authorized representatives of the bidders, who may like to be present.


The bidder is required to clearly mention

1. Tender Ref., RFQ/Tender Due Date & Name of the item in BOLD LETTERS on the top of each envelope submitted.
2. Name and contact details (including mobile no. and email address) of minimum one contact person along with date of submission of offer in a cover letter.

**ENQUIRY TERMS AND CONDITIONS**

The prices offered shall be firm till the completion of project.

1. Tender Ref No., due date etc. must be legibly super scribed on the sealed envelopes as per clause no. 2.0 of "Instructions to Bidders of GCC, Rev. R0".
2. Offers should be submitted in two parts in two separate sealed covers as follows:  
Part-I: **TECHNO-COMMERCIAL BID** Part-II: **PRICE BID.**  
**For detailed instructions. Please see "Instructions to Bidders of GCC Rev. R0".**
3. Bidders shall submit their offers meeting the requirements of the following tender documents (enclosed) included in this Enquiry Letter :

	<b>SOLAR BUSINESS DIVISION</b>	<b>NOTICE INVITING TENDER (NIT)</b>	<b>MATERIAL: Mono Perc Cell 157mm 5.38Wp &amp; Multi Cell 157mm 4.67Wp</b>
<b>TENDER REFERENCE: 12302328MUMPC</b>			

General Conditions of Contract (GCC) Rev R0 comprising of: Instructions to Bidders and General Commercial Terms & Conditions. Technical Specification, Price format & Special Conditions of Contract (SCC).


4. Tenders shall be submitted strictly in accordance with the requirements of the above tender documents. In case of deviations (Technical/ Commercial), the same shall be highlighted separately giving clause references along with the **Cost of withdrawal of Deviations as per Annexure-II to GCC Rev. R0 of "DEVIATION SHEET (COST OF WITHDRAWAL)"** along with reasons for taking such deviations.

Cost of withdrawal for the deviations, for which, the "Cost of withdrawal" is not specified, shall be taken as NIL. **Bidder to note all the points mentioned in "Notes" of Annexure-II to GCC Rev.R0.**

5. All the above Tender Documents shall automatically become a part of the Order / Contract after its finalisation.
6. Bidder has to submit "NO DEVIATION CERTIFICATE FOR COMMERCIAL TERMS AND CONDITIONS as per General Conditions of Contracts (GCC, Rev.R0), Special Conditions of Contracts and Notice Inviting Tender (NIT)" **in case of no deviations.**
7. Purchaser shall be under no obligation to accept the lowest or any other tender and shall be entitled to accept or reject any/all tender(s) in part or full without assigning any reason whatsoever.
8. Late tenders are liable to be rejected.
9. All correspondence thereof, shall be addressed to the undersigned by name & designation and sent at the following address:

<p><b>Commercial</b> Himanshu Kumar Naik- Dy Manager-MM Manjunath Rao- Engineer-MM. BHEL-SBD, Prof CNR Rao Circle, IISc Post, Malleswaram, Bangalore- 560 012 E-MAIL: <a href="mailto:manjunath.rao@bhel.in">manjunath.rao@bhel.in</a>; <a href="mailto:himanshun@bhel.in">himanshun@bhel.in</a>; Ph. No. +91-080-22182286/2161, 9449115728/8755642264</p>	<p><b>Technical</b> Subir Roy-Sr. Engineer Indrajit Kumar.- Sr. Manager BHEL-SBD, Prof CNR Rao Circle, IISc Post, Malleswaram, Bangalore- 560 012 E-MAIL: <a href="mailto:subirroy@bhel.in">subirroy@bhel.in</a>; <a href="mailto:indrajit.kumar@bhel.in">indrajit.kumar@bhel.in</a>; Ph. No. +91-080-22182495, +91 9486847302/+91 9818088393</p>
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10. Bidders, who are not registered with BHEL-SBD, are requested to get registered through online supplier registration portal available on <https://supplier.bhel.in/>
11. BHEL shall be resorting to Reverse Auction (RA) (Guidelines as available on ([www.bhel.com](http://www.bhel.com))) for this tender. RA shall be conducted among the techno commercially qualified bidders. Price bids of all techno-commercially qualified bidders shall be opened and same shall be considered for RA. In case any bidder(s) do(es) not participate in online Reverse Auction, their sealed envelope price bid along with applicable loading, if any, shall be considered for ranking."
- Bidders are required to submit their acceptance to the terms/ conditions/ modalities before participating in the Reverse Auction in the process compliance form as enclosed. Without this, the bidder will not be eligible to participate in the event.
12. The evaluation of the offer shall be done on the basis of delivered cost (i.e. Total F.O.R. BHEL EPD stores, Bangalore price for supply with necessary loadings as applicable) as per GCC Rev. R0.
13. Please note that detailed offers are to be submitted including the following documents duly stamped & signed on each page:
14. Acceptance of GCC, Rev.R0.

	<b>SOLAR BUSINESS DIVISION</b>	<b>NOTICE INVITING TENDER (NIT)</b>	<b>MATERIAL: Mono Perc Cell 157mm 5.38Wp &amp; Multi Cell 157mm 4.67Wp</b>
<b>TENDER REFERENCE: 12302328MUMPC</b>			

15. Acceptance of Special Conditions of Contract (SCC).
  16. Pre-qualifying Requirements (PQRs) documents including Technical Bid Format with supporting documents.
  17. Technical Deviations and commercial deviations, if any as per format enclosed at Annexure-II of GCC, Rev.R0.
  18. Annexure – I, III, VII, XIII, XIV, XVIII & XIX of GCC Rev R0.
  19. Along with your offer, please submit a copy of this letter duly signed & stamped on each page as token of acceptance of all terms & instructions conveyed.
  20. Un-Priced price schedules (format) duly filled in 'Quoted' or 'Q' in each column/row.
  21. Separate sealed price-bid envelope mentioning Tender/Enquiry No., RFQ due date & Name of the item in BOLD LETTERS on the top of envelope.
- Note: Bidder must submit UN-PRICED Price format duly filled mentioning the word "QUOTED" in place of actual price. The actual price is to be filled in separately and submitted in sealed price bid.**
22. Bidders to keep visiting BHEL website i.e [www.bhel.com](http://www.bhel.com) for any Amendments/Clarifications/Corrigenda/Errata etc issued in respect of the tender documents by BHEL. Same shall be uploaded on above BHEL website.
  23. Order of Precedence.

In the event of any ambiguity or conflict between the Tender Documents, the order of precedence shall be in the order below:

1. Amendments/Clarifications/Corrigenda/Errata etc. issued in respect of the tender documents by BHEL.
2. Notice Inviting Tender (NIT)
3. Price Schedule
4. Special Conditions of Contract (SCC)
5. Technical specification & scope of work
6. General Conditions of Contract (GCC)

Thanking You.  
Yours faithfully,

For and on behalf of BHEL

(Manjunath Rao)  
**Engineer-MM**

**Enclosures:**

1. Enquiry Letter with Terms & Conditions (This letter)
2. RFQ, PQR, QAP's & Technical Specifications No. PS-901-05-0018 Rev 4 & PS-901-05-0022 Rev 0
3. Special Conditions of Contracts (SCC)
4. Price formats/schedules (Prices should be quoted strictly in this format only)
5. General Conditions of Contracts (GCC Rev R0)
6. Conciliation Scheme
7. Integrity Pact

Qty: 3,117,000 No's-MONO PERC and 16,555,000 Nos.- Poly Crystalline Solar PV Cells.

### Pre-Qualification Criteria

S No.	Description	Bidder's Confirmation (Yes / No)
1	The offer shall be submitted only by the original poly crystalline solar cell manufacturers. However OEMs can also quote through their authorized channel partners/ dealers/ representatives with a valid authorization certificate.	Manufacturing Plant location: (Name of original Solar Cell manufacturer, complete address & contact details)
2	Vendor should have a minimum of 100 MW/annum in-house Poly Crystalline silicon solar cell and MONO PERC cell each manufacturing capacity.	Crystalline silicon solar cell manufacturing capacity in MW/annum: _____
3	Vendor should have supplied PV cells to reputed PV module manufacturers whose modules with the prospective vendor cells are certified for 2016 version of IEC: 61215, 61730.	Documentary evidence to be provided (Purchase order copy, supply certificate or acceptance certificate from customer)
4	Vendor should have supplied at least 1,000,000 (One million) pieces of 156 to 158.75mm poly crystalline silicon solar cells and MONO PERC cells each, to PV modules manufacturers in last 3 years.	Documentary evidence to be provided (PO copy or Client certificate)
5	Vendor should have an established quality assurance system and should have valid ISO 9001:2008/2015 certification for QMS.	Confirm and furnish copy of ISO 9001 certificate
6	Technical deviation sheet	Provided/ Not provided
7	Endorsed BHEL Technical specification sheet	Provided/ Not provided
8	Endorsed BHEL PQR sheet	Provided/ Not provided

**BHEL RESERVES THE RIGHT FOR INDEPENDENT VERIFICATION OF THE CLAIMS MADE FOR CONFORMANCE TO THE PRE-QUALIFICATION CRITERION. BIDDERS TO ENSURE PROVIDING AUTHENTIC CERTIFICATES / DOCUMENTATION AND CREDENTIALS IN ORDER TO QUALIFY FOR BHEL TENDER PROCESS.**



**SOLAR BUSINESS DIVISION**  
**BENGALURU – 560012, INDIA**  
**Purchase Specification**  
**Group : Photovoltaic Module**

DOC. NO: PS-901-05-0018

REV. 04 JOB NO.- STD.

PAGE 01 OF 03 DT 02.03.21

**SILICON SOLAR CELL – MULTI CRYSTALLINE 5 BUS BAR**

**1.0 PHYSICAL CHARACTERISTICS**

Sl No.	Description	Parameter
1.01	Cell Model Number	(vendor to indicate model no. of Solar cell being offered)
1.02	Material	Multi (Poly) Crystalline Silicon
1.03	Busbar	Five (5) Bus bar
1.04	Dimensions (mm)	157 ± 0.5 x 157 ± 0.5 mm
1.05	Thickness (microns)	200 ± 20
1.06	Diagonal	Diagonal variation shall not be more than 0.5 mm
1.07	Cell Power Wattage (Wp)	≥ BHEL required wattage (Negative tolerance not allowed)
1.08	Soldering peel strength (N/mm)	≥ 1.0 Front (Across each Busbar) ≥ 1.5 Back (Across each Busbar)
1.09	Cell bow (mm)	< 1.0
1.10	Shape	Square
1.11	Metallization	▪ Front - Silver ▪ Back - Silver Bus bar with Aluminum BSF
1.12	PID Resistant	Cell shall be 100% PID Resistant.
1.13	Anti-Reflection coating	PECVD - Silicon Nitride (Blue Color)

**2.0 TYPICAL I-V CHARACTERISTICS**

Sl No.	Pmax (Wp)	Vmp (V)	Imp (A)	Voc (V)	Isc (A)	Fill Factor (%)
1	4.82	0.595	9.782	0.698	9.998	83.40
2	4.80	0.594	9.764	0.697	9.997	83.24
3	4.78	0.594	9.731	0.697	9.991	83.34
4	4.76	0.594	9.685	0.696	9.991	82.55
5	4.74	0.593	9.680	0.696	9.990	82.55
6	4.72	0.593	9.646	0.695	9.985	82.43
7	4.70	0.593	9.628	0.693	9.983	82.39
8	4.68	0.592	9.595	0.692	9.982	82.27
9	4.67	0.592	9.595	0.685	9.980	82.25
10	4.65	0.591	9.544	0.680	9.978	82.12
11	4.63	0.591	9.526	0.689	9.975	81.92

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**SOLAR BUSINESS DIVISION**  
**BENGALURU – 560012, INDIA**  
**Purchase Specification**  
**Group : Photovoltaic Module**

DOC. NO: PS-901-05-0018

REV. 04 | JOB NO.- STD.

PAGE 02 OF 03 | DT 02.03.21

SI No.	Pmax (Wp)	Vmp (V)	Imp (A)	Voc (V)	Isc (A)	Fill Factor (%)
12	4.62	0.539	8.571	0.635	9.076	80.16
13	4.61	0.539	8.553	0.635	9.059	80.14
14	4.60	0.538	8.550	0.635	9.040	80.13
15	4.59	0.538	8.532	0.635	9.023	80.11
16	4.58	0.538	8.513	0.635	9.004	80.10
17	4.57	0.537	8.510	0.635	8.986	80.09
18	4.56	0.537	8.492	0.635	8.967	80.08
19	4.55	0.537	8.473	0.635	8.949	80.07
20	4.54	0.537	8.454	0.635	8.930	80.06
21	4.53	0.537	8.436	0.635	8.913	80.04
22	4.52	0.536	8.433	0.634	8.911	80.01

Note : Above I-V datas are typical values at irradiance 1000 W/m<sup>2</sup> with AM 1.5 spectrum, Cell temperature 25<sup>o</sup> C, Test method according to IEC 60904-1.

**3.0 MECHANICAL, VISUAL & ELECTROLUMINESCENCE (EL) CHARACTERISTICS:**

- 3.1 The cells shall be of 'A' category without any Visual defects.
- 3.2 Cell should not have any edge chips or any visible crack or deep scratches.
- 3.3 Cell should not have any printing defects. Cells shall not have any misalignment (of bus-bars) on the either surface. Cells must have precise printing & superior silver contacts for ease of automatic soldering.
- 3.4 Cell should not have print shift, finger knots other printing defects of more than 0.5 mm on width and 3.0 mm on length.
- 3.5 Cell shall not have bus bar or grid line interruptions, finger print interruptions, finger breaks, stains or paste smudges on either surface etc.
- 3.6 Cells shall have homogenous Silicon Nitride coating. There shall not be any colour variations.
- 3.7 Bus line Silver shall not be tarnished or oxidized.

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**SOLAR BUSINESS DIVISION**  
**BENGALURU – 560012, INDIA**  
**Purchase Specification**  
**Group : Photovoltaic Module**

DOC. NO: PS-901-05-0018  
REV. 04 | JOB NO.- STD.  
PAGE 03 OF 03 | DT 02.03.21

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- 3.8 Cell shall not have Micro Crack, Dark Area, Dark Spot & Dead cell.
- 4.0 PACKING CONDITIONS:**
  - 4.1 Cell shall be vacuum / air tight packed with heat shrinkable sleeve or polythene / polypropylene sachets of not more than 125 cells per sachet.
  - 4.2 Sachets shall be packed in foam / thermocol boxes with soft pads on both ends or in polyethylene foam packing to absorb transit handling shocks.
  - 4.3 Packing of sachets shall be in carton boxes with soft spacers & bubble wrap.
  - 4.4 The final packing shall be with suitable pallet for mechanised handling.
  - 4.5 Manufacturer name, Cell type, Lot number, Wattage/ efficiency, Quantity, date of manufacture to be identified on each sachet. Total quantity of cells in each carton to be displayed.
  - 4.6 Each pallets shall have marking of BHEL PO No. and item description etc. for traceability.
- 5.0 TEST CERTIFICATE / REPORTS / COC:**
  - 5.1 Each lot must be accompanied with routine Test Certificate, for the parameters described in clause from 1.04 to 1.08 of section 1.0.
  - 5.2 Certificate Of Compliance (COC) for each point mentioned under section 1.0, clause no. 1.02 to 1.03, 1.09 to 1.13, section 3.0 & section 4.0 shall be provided along with each lot.
- 6.0 INSPECTION CRITERIA :**
  - 6.1 Visual inspection, Dimensional & Electrical characteristics : Single Sampling Plan as per ISO: 2859-1 / IS: 10673-1983, General Inspection Level - 2, AQL 0.65
  - 6.2 Solder peel strength : Single Sampling Plan as per ISO: 2859-1 / IS: 10673-1983, Special Inspection Level - 1, AQL 1.5

	<b>BHARAT HEAVY ELECTRICALS LIMITED</b> <b>SOLAR BUSINESS DIVISION</b> <b>BANGALORE -560012</b> <b>QUALITY (SPV)</b>	<b>QP NO.: EPD/QP/SPV/2020-21/0015</b> <b>REV. NO.: 00</b> <b>DATE: 12.03.2021</b>
<b>BHEL-SBD</b>	<b>STANDARD QUALITY ASSURANCE PLAN</b>	

For the items listed below, the Supplier shall raise the inspection call along with Internal Test Report, Manufacture Test Certificates/Type Test Reports (wherever applicable) for BHEL/BHEL TPIA /**Customer Inspection**.

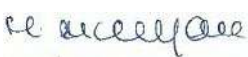

SI no	Item/BHEL SPEC.
01	<b>ITEM : SILICON SOLAR CELL – MULTI CRYSTALLINE 5 BUS BAR</b> <b>BHEL SPECIFICATION: PS-901-05-0018 REV.04</b>

**Note:**

1. The SQAP shall be read in conjunction with BHEL Specification mentioned in Purchase Order and shall deem to include any additional tests as per the specification/Standard.
2. Material supplied shall be in line with BHEL Purchase Order, Technical Specification, Data Sheet, BOM, Approved Drawings, applicable Standard References, or any other document/references.
3. In case of any contradiction between this SQAP, BHEL Specifications the following precedence shall be followed:  
1<sup>st</sup>: BHEL Purchase Order Specification;  
2<sup>nd</sup>: This STANDARD QUALITY ASSURANCE PLAN & Applicable standard;  
3<sup>rd</sup>: Manufacturers plant standards
4. **Packing** shall be as per BHEL purchase order packing specification/ or as per Manufacturer standard or approved Drgs from BHEL Engineering.
5. All **packing** cases should be **marked** with BHEL Purchase Order no, Item description and **CQIR NO** (by which material has been cleared for dispatch).
6. BHEL reserves the right for pre-dispatch inspection at vendor works by BHEL or BHEL nominated agency.
7. BHEL at its discretion may waive the pre-dispatch inspection at vendors work based on review of submitted vendor inspection reports. However, the vendor responsibility is not absolved till the material is finally inspected and accepted at BHEL. In case of any rejection at BHEL, vendor is liable to replace with good quality materials at vendor cost confirming with this purchase specification.
8. Vendor to submit Manufacturing Quality Plan – MQP in BHEL prescribed format in BHEL prescribed format for review & approval on receipt of purchase order.

**Documentation Part:**

1. **Supplier shall raise the inspection call in the CQIR with inspection agency as BHEL SBD. URL: [www.cqir.bhel.in](http://www.cqir.bhel.in). and shall upload documents mention under Note 2 in CQIR Portal.**
2. Supplier to furnish Test Certificates, Internal Tests Report and Type Test Reports (wherever applicable) as per this SQAP along with inspection call.
3. The items will be **inspected at BHEL approved manufacturer work.**



PREPARED BY:		APPROVED BY:	
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 BHBL-SBD	BHARAT HEAVY ELECTRICALS LIMITED SOLAR BUSINESS DIVISION PROF.C.N.R RAO CIRCLE, IISc POST MALLESHWARAM, BENGALURU-560012	<b>STANDARD QUALITY ASSURANCE PLAN</b>					QP NO.: EPD/QP/SPV/2020-21/0015 REV. NO.: 00 DATE: 12.03.2021 PAGE 1 OF 5				
		ITEM : SILICON SOLAR CELL – MULTI CRYSTALLINE 5 BUS BAR BHEL SPECIFICATION: PS-901-05-0018 REV.04									

SL. NO	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY		REMARKS
					M	B				D*	M	B	
1.	2.	3.	4.	5.	6.		7.	8.	9.	D*	** 10.	11.	


1.0 IN-PROCESS INSPECTION													
A	DIMENSIONS	Length	Critical	Dimensional	Hourly	-	BHEL Spec.	157± 0.5 mm	Inspection Report	√	P	V	
B		Width	Critical	Dimensional	Hourly	-	BHEL Spec.	157± 0.5 mm	Inspection Report	√	P	V	
C		Thickness (Microns)	Critical	Dimensional	Hourly	-	BHEL Spec.	200 ± 20	Inspection Report	√	P	V	
D		Diagonal Difference	Critical	Dimensional	Hourly	-	BHEL Spec.	≤ 0.5 mm	Inspection Report	√	P	V	
E		Cell bow (mm)	Major	Dimensional	Hourly	-	BHEL Spec.	< 1.0	Inspection Report	√	P	V	
F	VISUAL CHECK	No. of Busbars	Major	Visual	100% Online	-	BHEL Spec.	Five	Inspection Report	√	P	V	
G		Shape	Major	Visual	100% Online	-	BHEL Spec.	Square	Inspection Report	√	P	V	
H		Anti-Reflection coating	Major	Visual	100% Online	-	BHEL Spec.	PECVD - Silicon Nitride (Blue Color)	Inspection Report	√	P	V	
I		Visual defects	Major	Visual	100% Online	-	BHEL Spec.	As per BHEL Spec.	Inspection Report	√	P	V	
J		Metallization	Major	Visual	100% Online	-	BHEL Spec.	Front-Silver Back-Silver Bus bar with Aluminum BSF	Inspection Report	√	P	V	
2.0 FINISHED PRODUCT INSPECTION													
A	ROUTINE TESTS	Cell Power Wattage (Wp)	Critical	Electrical	100%	AQL*	BHEL Spec.	As per Section 2.0 of BHEL Spec.	Inspection Report	√	P	W	

<b>LEGEND:</b> *D: RECORDS, IDENTIFIED WITH "TICK" (√) SHALL BE ESSENTIALLY INCLUDED BY VENDOR IN QA DOCUMENTATION. ** M: MANUFACTURER/SUB-VENDOR, B: BHEL/BHEL NOMINATED INSPECTION AGENCY P: PERFORM W: WITNESS AND V: VERIFICATION. AS APPROPRIATE CHP: CUSTOMER HOLD POINT BY BHEL/BHEL NOMINATED INSPECTION AGENCY SHALL IDENTIFIED IN COLUMN "B" AS 'W' AQL*: SINGLE SAMPLING PLAN AS PER ISO: 2859-1 / IS: 10673-1983, GENERAL INSPECTION LEVEL - 2, AQL 0.65	<b>FOR BHEL USE</b>		
	DOC. NO.:	REV.....	CAT.....
	 REVIEWED BY: MM	 APPROVED BY: MK	QUALITY ASSURANCE


 BHBL-SBD	BHARAT HEAVY ELECTRICALS LIMITED SOLAR BUSINESS DIVISION PROF.C.N.R RAO CIRCLE, IISc POST MALLESHWARAM, BENGALURU-560012	<b>STANDARD QUALITY ASSURANCE PLAN</b> ITEM : SILICON SOLAR CELL – MULTI CRYSTALLINE 5 BUS BAR BHEL SPECIFICATION: PS-901-05-0018 REV.04	QP NO.: EPD/QP/SPV/2020-21/0015 REV. NO.: 00 DATE: 12.03.2021 PAGE 2 OF 5
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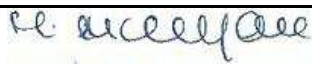

SL. NO	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY		REMARKS	
					M	B				M	B		
1.	2.	3.	4.	5.	6.		7.	8.	9.	D*	** 10.	11.	
B		Typical I-V Characteristics	Critical	Electrical	100%	AQL*	BHEL Spec.	As per Section 2.0 of BHEL Spec.	Inspection Report	√	P	W	
C		Soldering Peel strength	Critical	Mechanical	Hourly	Single Sampling Plan as per ISO: 2859-1 / IS: 10673-1983, Special Inspection Level - I, AQL 1.5	BHEL Spec.	≥1.0 N/mm Front (Across each bus bar) ≥1.5 N/mm Back (Across each bus bar)	Inspection Report	√	P	W	
D	DIMENSIONS	Length	Critical	Dimensional	Hourly	AQL*	BHEL Spec.	157± 0.5 mm	Inspection Report	√	P	W	
E		Width	Critical	Dimensional	Hourly	AQL*	BHEL Spec.	157± 0.5 mm	Inspection Report	√	P	W	
F		Thickness (Microns)	Critical	Dimensional	Hourly	AQL*	BHEL Spec.	200 ± 20	Inspection Report	√	P	W	
G		Diagonal Difference	Critical	Dimensional	Hourly	AQL*	BHEL Spec.	≤ 0.5 mm	Inspection Report	√	P	W	
H		Cell bow (mm)	Major	Dimensional	Hourly	AQL*	BHEL Spec.	1.0	Inspection Report	√	P	W	
I	VISUAL CHECK	No. of Busbars	Major	Visual	100% Online	AQL*	BHEL Spec.	Five	Inspection Report	√	P	W	Certificate Of Compliance (COC) for each point to be given
J		Cell Material & Cell Type	Major	Functional	100% Online	AQL*	BHEL Spec.	Multi (Poly) Crystalline Silicon	Inspection Report	√	P	V	
K		Shape	Major	Visual	100% Online	AQL*	BHEL Spec.	Square	Inspection Report	√	P	W	


<b>LEGEND:</b> *D: RECORDS, IDENTIFIED WITH "TICK" (√) SHALL BE ESSENTIALLY INCLUDED BY VENDOR IN QA DOCUMENTATION. ** M: MANUFACTURER/SUB-VENDOR, B: BHEL/BHEL NOMINATED INSPECTION AGENCY P: PERFORM W: WITNESS AND V: VERIFICATION. AS APPROPRIATE CHP: CUSTOMER HOLD POINT BY BHEL/BHEL NOMINATED INSPECTION AGENCY SHALL IDENTIFIED IN COLUMN "B" AS 'W' AQL*: SINGLE SAMPLING PLAN AS PER ISO: 2859-1 / IS: 10673-1983, GENERAL INSPECTION LEVEL - 2, AQL 0.65	FOR BHEL USE		
	DOC. NO.:	REV.....	CAT.....
	REVIEWED BY: MM	APPROVED BY: MK	QUALITY ASSURANCE



 BHARAT HEAVY ELECTRICALS LIMITED SOLAR BUSINESS DIVISION PROF.C.N.R RAO CIRCLE, IISc POST MALLESHWARAM, BENGALURU-560012 BHEL-SBD		<b>STANDARD QUALITY ASSURANCE PLAN</b>					QP NO.: EPD/QP/SPV/2020-21/0015 REV. NO.: 00 DATE: 12.03.2021 PAGE 3 OF 5					
		ITEM : SILICON SOLAR CELL – MULTI CRYSTALLINE 5 BUS BAR BHEL SPECIFICATION: PS-901-05-0018 REV.04										
SL. NO	COMPONENT & OPERATIONS	CHARACTERISTIC S	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY		REMARKS
					M	B				M	B	
1.	2.	3.	4.	5.	6.		7.	8.	9.	D*	** 10.	11.
L		Anti-Reflection coating	Critical	Functional	100% Online	AQL*	BHEL Spec.	PECVD - Silicon Nitride (Blue Color)	Inspection Report	√	P	V
M		Visual defects	Critical	Visual	100% Online	AQL*	BHEL Spec.	<p>The cells shall be of 'A' category without any Visual defects.            No edge chips or any visible crack or deep scratches.</p> <p>No printing defects, No misalignment (of bus-bars) on the either surface. Cells must have precise printing &amp; superior silver contacts for ease of automatic soldering.</p> <p>No print shift, finger knots other printing defects of more than 0.5 mm on width and 3.0 mm on length.            No bus bar or grid line interruptions, finger print interruptions, finger breaks, stains or paste smudges on either surface etc.</p>	Inspection Report	√	P	W

<b>LEGEND:</b> *D: RECORDS, IDENTIFIED WITH "TICK" (√) SHALL BE ESSENTIALLY INCLUDED BY VENDOR IN QA DOCUMENTATION. ** M: MANUFACTURER/SUB-VENDOR, B: BHEL/BHEL NOMINATED INSPECTION AGENCY P: PERFORM W: WITNESS AND V: VERIFICATION. AS APPROPRIATE CHP: CUSTOMER HOLD POINT BY BHEL/BHEL NOMINATED INSPECTION AGENCY SHALL IDENTIFIED IN COLUMN "B" AS 'W' AQL*: SINGLE SAMPLING PLAN AS PER ISO: 2859-1 / IS: 10673-1983, GENERAL INSPECTION LEVEL - 2, AQL 0.65	<b>FOR BHEL USE</b>		
	DOC. NO.:	REV.....	CAT.....
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 BHARAT HEAVY ELECTRICALS LIMITED SOLAR BUSINESS DIVISION PROF.C.N.R RAO CIRCLE, IISc POST MALLESHWARAM, BENGALURU-560012 BHEL-SBD		<b>STANDARD QUALITY ASSURANCE PLAN</b>					QP NO.: EPD/QP/SPV/2020-21/0015 REV. NO.: 00 DATE: 12.03.2021 PAGE 4 OF 5						
		ITEM : SILICON SOLAR CELL – MULTI CRYSTALLINE 5 BUS BAR BHEL SPECIFICATION: PS-901-05-0018 REV.04											
SL. NO	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY		REMARKS	
					M	B				M	B		
1.	2.	3.	4.	5.	6.		7.	8.	9.	D*	** 10.	11.	
N		Metallization	Major	Visual	100% Online	-	BHEL Spec.	Front-Silver Back-Silver Bus bar with Aluminum BSF	Inspection Report	√	P	V	
O	SPECIAL TESTS	PID Resistance	Critical	Functional	AQL*	AQL*	BHEL Spec.	Cell shall be 100% PID Resistant.	Inspection Report	√	P	V	Certificate Of Compliance (COC)
P		Electroluminescence Test	Critical	Functional	AQL*	AQL*	BHEL Spec.	Cell shall not have Micro Crack, Dark Area, Dark Spot & Dead cell	Inspection Report	√	P	W	
3.0	PACKING												
A	PACKING	Packing	Major	Visual	100%	AQL*	BHEL Spec.	Cell shall be vacuum / air tight packed with heat shrinkable sleeve or polythene / polypropylene sachets of not more than 125 cells per sachet.	COC	√	P	W	Certificate Of Compliance (COC) for each point to be given
B		Packing	Major	Visual	100%	AQL*	BHEL Spec.	Sachets shall be packed in foam / thermocol boxes with soft pads on both ends or in polyethylene foam packing to absorb transit handling shocks.	COC	√	P	W	

<b>LEGEND:</b> *D: RECORDS, IDENTIFIED WITH "TICK" (√) SHALL BE ESSENTIALLY INCLUDED BY VENDOR IN QA DOCUMENTATION. ** M: MANUFACTURER/SUB-VENDOR, B: BHEL/BHEL NOMINATED INSPECTION AGENCY P: PERFORM W: WITNESS AND V: VERIFICATION. AS APPROPRIATE CHP: CUSTOMER HOLD POINT BY BHEL/BHEL NOMINATED INSPECTION AGENCY SHALL IDENTIFIED IN COLUMN "B" AS 'W' AQL*: SINGLE SAMPLING PLAN AS PER ISO: 2859-1 / IS: 10673-1983, GENERAL INSPECTION LEVEL - 2, AQL 0.65	<b>FOR BHEL USE</b>		
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 BHARAT HEAVY ELECTRICALS LIMITED SOLAR BUSINESS DIVISION PROF.C.N.R RAO CIRCLE, IISc POST MALLESHWARAM, BENGALURU-560012 BHEL-SBD		<b>STANDARD QUALITY ASSURANCE PLAN</b>					QP NO.: EPD/QP/SPV/2020-21/0015 REV. NO.: 00 DATE: 12.03.2021 PAGE 5 OF 5						
		ITEM : SILICON SOLAR CELL – MULTI CRYSTALLINE 5 BUS BAR BHEL SPECIFICATION: PS-901-05-0018 REV.04											
SL. NO	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY		REMARKS
					M	B				D*	M	B	
1.	2.	3.	4.	5.	6.		7.	8.	9.		**	10.	11.
C		Packing	Major	Visual	100%	AQL*	BHEL Spec.	Packing of sachets shall be in carton boxes with soft spacers & bubble wrap. Final packing shall be with suitable pallet for mechanised handling.	COC	v	P	W	
D		Packing	Major	Visual	100%	AQL*	BHEL Spec.	The final packing shall be with suitable pallet for mechanized handling. Manufacturer name, Cell type, Lot number, Wattage/ efficiency, Quantity, date of manufacture to be identified on each sachet. Total quantity of cells in each carton to be displayed. Each pallets shall have marking of BHEL PO No. and item description etc. for traceability.	COC	v	P	W	

<b>LEGEND:</b> *D: RECORDS, IDENTIFIED WITH "TICK" (√) SHALL BE ESSENTIALLY INCLUDED BY VENDOR IN QA DOCUMENTATION. ** M: MANUFACTURER/SUB-VENDOR, B: BHEL/BHEL NOMINATED INSPECTION AGENCY P: PERFORM W: WITNESS AND V: VERIFICATION. AS APPROPRIATE CHP: CUSTOMER HOLD POINT BY BHEL/BHEL NOMINATED INSPECTION AGENCY SHALL IDENTIFIED IN COLUMN "B" AS 'W' AQL*: SINGLE SAMPLING PLAN AS PER ISO: 2859-1 / IS: 10673-1983, GENERAL INSPECTION LEVEL - 2, AQL 0.65	<b>FOR BHEL USE</b>		
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**SOLAR BUSINESS DIVISION**  
**BENGALURU – 560012, INDIA**  
**Purchase Specification**  
**Group : Photovoltaic Module**

DOC. NO: PS-901-05-0022

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**MONO CRYSTALLINE PERC SILICON SOLAR CELL 5 BUS BAR**

**1.0 PHYSICAL CHARACTERISTICS**

Sl No.	Description	Parameter
1.01	Cell Model Number	_____ (vendor to indicate model no. of Solar cell being offered)
1.02	Cell Material & Cell Type	Mono Crystalline Silicon & Mono PERC
1.03	Busbar	Five (5) Bus bar
1.04	Dimensions (mm)	156.75 ± 0.5 x 156.75 ± 0.5 mm
1.05	Thickness (microns)	220 ± 20
1.06	Diagonal	Diagonal variation shall not be more than 0.5 mm
1.07	Cell Power Wattage (Wp)	≥ BHEL required wattage (Negative tolerance not allowed)
1.08	Soldering peel strength (N/mm)	≥ 1.0 Front (Across each Busbar) ≥ 1.5 Back (Across each Busbar)
1.09	Cell bow (mm)	< 0.2
1.10	Shape	Square
1.11	Metallization	▪ Front - Silver oxide ▪ Back – Passivated emitter
1.12	PID Resistant	Cell shall be 100% PID Resistant.
1.13	Anti-Reflection coating	PECVD - Silicon Nitride (Blue Colour)

**2.0 TYPICAL I-V CHARACTERISTICS**

Sl No.	Pmax (Wp)	Vmp (V)	Imp (A)	Voc (V)	Isc (A)	Fill Factor (%)
1	5.44	0.573	9.579	0.668	10.234	80.3
2	5.42	0.571	9.558	0.666	10.224	80.2
3	5.40	0.570	9.536	0.665	10.203	80.1
4	5.39	0.570	9.515	0.664	10.197	80.1
5	5.38	0.568	9.511	0.663	10.192	79.9
6	5.37	0.568	9.502	0.662	10.186	80.0
7	5.35	0.567	9.495	0.661	10.164	80.1
8	5.34	0.567	9.489	0.660	10.158	80.3
9	5.32	0.565	9.477	0.659	10.115	80.3
10	5.29	0.562	9.463	0.658	10.089	80.1
11	5.28	0.561	9.454	0.658	10.075	80.0

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SI No.	Pmax (Wp)	Vmp (V)	Imp (A)	Voc (V)	Isc (A)	Fill Factor (%)
12	5.27	0.559	9.445	0.657	10.063	79.9
13	5.26	0.558	9.436	0.657	10.054	79.7
14	5.25	0.557	9.435	0.657	10.043	79.6
15	5.24	0.556	9.433	0.656	10.038	79.6
16	5.23	0.551	9.432	0.656	10.021	79.1
17	5.22	0.548	9.431	0.656	10.012	78.7
18	5.20	0.547	9.429	0.703	9.998	73.4
19	5.16	0.546	9.428	0.703	9.998	73.2
20	5.08	0.545	9.422	0.703	9.998	73.1
21	5.03	0.545	9.418	0.703	9.998	73.0

Note : Above I-V datas are typical values at irradiance 1000 W/m<sup>2</sup> with AM 1.5 spectrum, Cell temperature 25<sup>0</sup> C, Test method according to IEC 60904-1.

### 3.0 MECHANICAL, VISUAL & ELECTROLUMINESCENCE (EL) CHARACTERISTICS:

- 3.1 The cells shall be of 'A' category without any Visual defects.
- 3.2 Cell should not have any edge chips or any visible crack or deep scratches.
- 3.3 Cell should not have any printing defects. Cells shall not have any misalignment (of bus-bars) on the either surface. Cells must have precise printing & superior silver contacts for ease of automatic soldering.
- 3.4 Cell should not have print shift, finger knots other printing defects of more than 0.5 mm on width and 3.0 mm on length.
- 3.5 Cell shall not have bus bar or grid line interruptions, finger print interruptions, finger breaks, stains or paste smudges on either surface etc.

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3.6 Cells shall have homogenous Silicon Nitride coating. There shall not be any colour variations.

3.7 Bus line Silver shall not be tarnished or oxidized.

3.8 Cell shall not have Micro Crack, Dark Area, Dark Spot & Dead cell.

**4.0 PACKING CONDITIONS:**

4.1 Cell shall be vacuum / air tight packed with heat shrinkable sleeve or polythene / polypropylene sachets of not more than 125 cells per sachet.

4.2 Sachets shall be packed in foam / thermocol boxes with soft pads on both ends or in polyethylene foam packing to absorb transit handling shocks.

4.3 Packing of sachets shall be in carton boxes with soft spacers & bubble wrap.

4.4 The final packing shall be with suitable pallet for mechanised handling.

4.5 Manufacturer name, Cell type, Lot number, Wattage/ efficiency, Quantity, date of manufacture to be identified on each sachet. Total quantity of cells in each carton to be displayed.

4.6 Each pallets shall have marking of BHEL PO No. and item description etc. for traceability.

**5.0 TEST CERTIFICATE / REPORTS / COC:**

5.1 Each lot must be accompanied with routine Test Certificate, for the parameters described in clause from 1.04 to 1.08 of section 1.0.

5.2 Certificate Of Compliance (COC) for each point mentioned under section 1.0, clause no. 1.02 to 1.03, 1.09 to 1.13, section 3.0 & section 4.0 shall be provided along with each lot.

**6.0 INSPECTION CRITERIA :**

6.1 Visual inspection, Dimensional & Electrical characteristics : Single Sampling Plan as per ISO: 2859-1 / IS: 10673-1983, General Inspection Level - 2, AQL 0.65

6.2 Solder peel strength : Single Sampling Plan as per ISO: 2859-1 / IS: 10673-1983, Special Inspection Level - I, AQL 1.5