MR. CHANDRASEKHARA
Director ,Four-C-Tron

Practice of Standardization in BOMs for solar module

KEY FOR QUALITY AND COST REDUCTION

PV module is made of cells ,EVA,Backsheet,Interconnects, glass, junction box and Al frame. Let us see what standardization means for these materials from my experience in solar industry for more than 30 years in providing turnkey module production lines and materials.

WAFERS :

Semiconductor industry which uses mono wafers has long established SEMI standards which define every parameter of wafer right from 4" to 12" and this is Universal standard for semiconductor fabs. The entire fab equipment - from front end to backend are designed to handle SEMI standard wafers. Though the geometry of devices has shrunk the standards for wafer remain unique. For solar cells, mono or multiwafers is base material. Mono wafers were used in the beginning for solar PV modules with 4" dia and later 125 mm square, 156mm square and now 156.75 mm has been accepted as standard for both mono and multi-wafer.

CELLS :

In the beginning - it was mono round, mono square, pseudo square then multi square with dimension from 100/101mm, 125/126mm, and 156 mm/156.75 mm and recently one company is manufacturing black silicon cells of 160.5 mm. As automation was introduced to interconnect cells from 2BB,3 BB for certain period 4 BB, 5 BB and 6 BB cells emerged which changed the width of interconnecting ribbon and hence the Tabber /stringer manufacturers to incorporate these changes making earlier machines obsolete. By the time Indian companies settle with 5 BB or 6 BB stringers, multi-wire connection with 12 or 16 wires will head up! As cell dimension is standard now, why not bus bar width in the front and number of pads and its width in the back(still some cells at back has continuous bus bars) be standardized by cell manufacturers so that ribbon width gets more or less standard to avoid buildup of different width inventory due to different vendors of cells.

EVA :

Though the resin and EVA film has not changed much for last 25 years but there has been change in texture and thickness. Initially the thickness was 0.5 mm but now majority of module manufacturer use 0.45 mm thick EVA. Again some are trying to use Front and back EVA with different thickness. This will end up in extra inventory. However, the width of EVA keeps varying by 5 to 10mm than optimum width, which has implication on overall module price.

BACKSHEET :

The backbone of module is white backsheet to provide insulation, prevent moisture ingression. In early years Tedlar/Polyester/Tedlar (TPT) was the 3 layer backsheet material with 350 microns thick which has withstood the weather for more than 25 years proving TPT is best backsheet. As Tedlar was expensive and monopoly of Du Pont, Kynar was introduced by Arkema to replace Tedlar and M/s Krempel, leading backsheet manufacturer with 25 years' history in PV industry introduced KPK as alternative to TPT. But many new entrants are bringing in new materials with one or 2 layer instead of proven 3-layer laminate with different process viz., extrusionand coating to bring down the price to be competitive. But these new materials though certified under lab condition have to prove against natural harsh environment compared to proven TPT and KPK. Here again standard is missing about what exactly the composition should be and individual layer thickness and width. Not much data is generated to qualify the performance of new back sheets in the field.

RIBBON :

It is the critical material which connects each cell to make string and finally connect the junction box. The ribbon width keeps varying with increasing bus bars on the cells. This again increases the inventory depending on 4 BB or 5 BB cells. Again is it 60/40 Tin/Lead or 62/36/2 -Tin/Lead/Silver? Whynotone width commonto 4BB or 5BB and composition with 2% silver be set as standard? This will minimize inventory and adaptability to any supplier of cells and ribbon.

JUNCTION BOX :

As regard to connecting cable and diodes in Junction box there is a kind of acceptable standard as far as electrical parameters are concerned.

GLASS :

Transmittivity of AR coated glass is >93.5% and thickness of 3.2 mm and 4.0 mm is commonly used. But in case of 72 cell module, though 4 mm glass is recommended still many module manufacturers use 3.2 mm thick glass to cut cost. Each module manufacturer specifies width and length differently which again makes supplier of glass to customize the order and this will increase cost. When the cell size is almost standardized to 156.75 mm, why not glass dimension be standardized for 60 cells, 72 cells or 96 cells module? Standard size in glass helps in further saving of EVA, backsheet and Al frame as width and length of these 3 material is decided based on glass width and length. This is the hidden secret of cumulative saving upto 2 to 3%.

ALUMINIUM FRAME :

Again what is the width and height of frame? Each manufacturer has his own design/drawing though Aluminium grade is same. If the height of frame is standardized with respect to 3.2 mm and 4 mm glass it will be more cost effective in packing and transportation.

SOLAR MODULES :

When you study various manufacturers' datasheet on modules, though the cells are of 156.75 mm with varying efficiency, the module dimension is different with each manufacturer. Four-C-Tron took up a study of about 30 leading Indian module manufacturers and 10 Chinese module manufacturers (who supply modules in India) with reference to module sizes of 60 cell and 72 cells. This study revealed large variation in dimension of Indian modules compared to uniform and minimum variation in Chinese modules which is surprising.

As 60 cell module production is slowly replaced by 72 cell module which is getting popular with EPC and roof top projects, 72 cell module was considered for deciding its optimum dimension.First, spacing between cells should be minimum 2 mm during tabbing and 2 mm spacing between the string during layup.

Thus the optimum cell matrix boundary will be 1903 mm in length and 950.5 mm in width with cell size of 156.75 mm. Taking this as reference, dimension of glass has to be fixed. A fixed dimension of glass will make big difference ie., each glass manufacturer produces same size, stock and sell to any module manufacturers at very competitive price as it is a standard size inventory and delivery will be fast. Setting standard size of glass alsohelps in optimizing the dimension of EVA, backsheet and Al frame in the chain. During the study, it is observed that there was variation in length and width amongst manufacturers. In case of Indian modules variation in length was upto 22mm vs 5 mm by Chinese modules and in width it was 12 mm vs 1 mm respectively. This reflects lack of standardization during design and engineering, which result in increased cost of production and wastage of material.Surprisingly all the 10 Chinese companies studied showed narrow band in dimension ie., 5 mm in length and 1 mm in width. It is also observed that Indian module channel height was either 35 /42/ 45 mm whereas Chinese company standard is 40 mm except one company which used 35 mm height channel for both 60 and 72 cell module. Many Indian module manufacturers use 3.2 mm glass for 72 cell module (same thickness for 60 cell modules) instead of 4 mm which is theoretically and from design perspective not advisable.

So who is responsible for module quality and standardization? - Design / standards engineers? Module manufacturers? Testing and certification agency?Neither MNRE nor BISlooked into the above aspectin setting the standards for module dimension. From our study of prevailing dimensional variations in module size and to bring in some standardization in manufacturing, it is suggested BIS to fix the overall dimension of modules for 72 mm as: length 1958 +/-2 mm, width 991+/- 1 mm and in case of 60 cell module 1642+/-2 mm and width 991+/-1 mm respectively. Now BIS insisting on BIS certification for Indian modules and standardizing the sizes for 60 and 72 cell modules will result in saving of module materials at GW level production besides at inspection, packing, logistics, transportation stages etc., leading to healthy competition amongst module manufacturers and trading at uniformpricing of module/watt.Further, Standardization in module size will benefit EPC contractors and roof top installers too in installation as their design can be streamlined, saving in real estate area, mounting structure, hardware and replacement of modules of any supplier during maintenance and life expectancy of module. This aspect has been overlooked.

Existing Test houses and certifying agencies like UL and TUV labs with long lead time for certification is depriving “in time” certification and recertification by nearly 170Indian module manufacturers. If solar mission is government vision with 100 GW target, then why not Government fund at least 5 centers of existing 14 centers of ERTLs/ETDCs which has ready infrastructure and manpower. These labs were earlier funded under GTZ, Germany program and all the labs are equipped with test chambers and qualified test engineers. Presently many of these test houses facility is underutilized and revamping them to test solar modules to BIS standards will be a wise and cost effective move and bring down the lead time and the certification charges. Further the staff of these labs can be deployed for periodic validation of module manufacturers and also power plant validation which in turn will generate income for these labs.The author has also written to The Director General of STQC and BIS to interact jointly with MNRE and National Solar Energy Centreon the above proposal.

(Note: The author with 13 years' experience inDefenceorganizations dealing with Standardization, Inspection and QC of equipment and components and 35 years in PV industry in wafer manufacturing and setting up Spire turnkey module lines and supplying modulematerials is ready of offer free service in upgrading the STQC labs and marketing their certification service to PV industry)