

## Renewable Energy Industry Documents

I find the lack of documents and appropriate application data deplorable for the renewable energy industry; which is one of the reasons usage is not more widespread. I worked in the Solid State Integrated Circuit (IC) industry (note photovoltaic cells are extremely simple integrated circuits), where the growth of the industry was greatly assisted by the generation, then use of documents covering every aspect of the high volume production and distribution of IC's. Although some IC standards were generated through the IEEE and ASTM, virtually all that are in worldwide every day use were prepared and are updated through JEDEC (see [www.jedec.org](http://www.jedec.org)). JEDEC standards and publications are free to download, which greatly improves acceptability. Note, initially the prime customer for the IC industry was the US government, both DOD and NASA; but to achieve the ubiquitous use of IC's now in consumer and other commercial markets, a significant documentation effort was required.

In my opinion, JEDEC is the best organization to use to generate working documentation, for additional information contact Ken McGee at [kenm@jedec.org](mailto:kenm@jedec.org) . One would form a committee, e.g., Renewable Energy Equipment, and then the participating companies (after paying the applicable annual fee to JEDEC) select the individual members. Members would also come from other sources, e.g., ASES, DOE/NREL, Home Power, distributors, installers, etc. as appropriate; fees may or may not be applicable. The committee would then be organized, e.g., with point committees and task groups, to write the appropriate standards, publications, and specifications. Eventually these could go to ISO for full international applicability. Note, JEDEC is open to all companies worldwide, so initial applicability and acceptance is not restricted.

There are varieties of types of documentation, including:

- Standards: Documents that are intended to represent a sound approach to product specification and application.
- Publications: Documents containing general engineering information on products, procedures, or services, which are not necessarily appropriate for standardization.
- Specifications: Documents prepared specifically to facilitate procurement, which clearly and accurately describe the essential technical requirements for purchased material or services.
- Regulations: Documents that codify special requirements, e.g., safety, and are generally mandated by the government. This is the only active area of standardization, e.g., updating the NEC, Solar ABC, access regulations, and other installation codes.

Appropriate standards from the solid state industry (IC's and passives) as well as the electronic industries (e.g., EIA) can be used as models, not just for document format and style, but the nature of the contents to generate documents in at least the following areas. The NEC and other regulations (IEEE, UL) exist and codify many of the electrical safety aspects of renewable energy systems for installation; however, to not adequately address the following areas for design, installation, operation, or maintenance:

1. Performance:
  - To what defined limits a piece of equipment should comply.
  - To what defined limits a system should comply.
  - Performance standards should be independent of manufacturing technology.
2. Measurement and Test:
  - How to measure performance for pieces of equipment and systems.
  - The measurement methodology is independent of the results, e.g., acceptance limits are not included in the method.
  - How to report and advertise theoretical vs. “real-world” results.
3. Quality and Reliability:
  - What are the measures of variance control and longevity in manufacturing, assembly, test, packing, and shipping?
  - What are the expected nonconformance and MTTF or MTBF rates?
  - What methods of SPC and SQC are used?
4. Educational standards:
  - What is the theory and practice of how each piece of equipment and system is supposed to function?
  - What tools, methods, knowledge, training is required to design, assemble, install functional systems.
  - How to operate and maintain systems.
5. Interface:
  - What are the electrical, mechanical, environmental interface specifications and values?
  - How pieces of equipment work together and what connection methods should be used, including hardware, firmware, and software.
  - Terminology so that the same words used by different manufacturers have the same meaning, both denotation and connotation.
6. Form, fit, function:
  - What each piece of equipment and system should "look" like, i.e., how do the various pieces of equipment fit together to form a functional system.
  - How will each piece of equipment and system operate to provide the desired results?
  - What considerations are required to interface with the grid, e.g., compatibility with transformers?
7. Shipping and labeling:
  - How is equipment packed to prevent breakage and damage?
  - How is packaging labeled to comply with RoHS, Country of Origin, recycling, etc. requirements?

In general, standardization should be independent of technology (something that JEDEC has learned to handle very well, e.g., each meeting has a notice of the patent policy) and what design and manufacturing technologies that are used should not be an impediment to the standardization process. For example, standards on how the performance on any given piece of equipment is achieved, e.g., for a PV panel, the intrinsic crystalline technology (single, poly, amorphous) is not mandated or restricted; however, interface, and measurement of performance could be. Unfortunately, a significant fraction of management is poorly educated regarding both standards and the standardization process; therefore, some "selling" of the benefits (and costs) of standardization may be required to get participation.

Note, I did not include safety regulations, which are already pretty much covered by the NEC; however, some of the "educational standards" could ease implementation and understanding of NEC requirements (note in the integrated circuit world, there are educational standards from IEEE and ASTM that complement the working standards provided by JEDEC).