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OBSERVATIONS ON PV MODULE QUALITY MANAGEMENT

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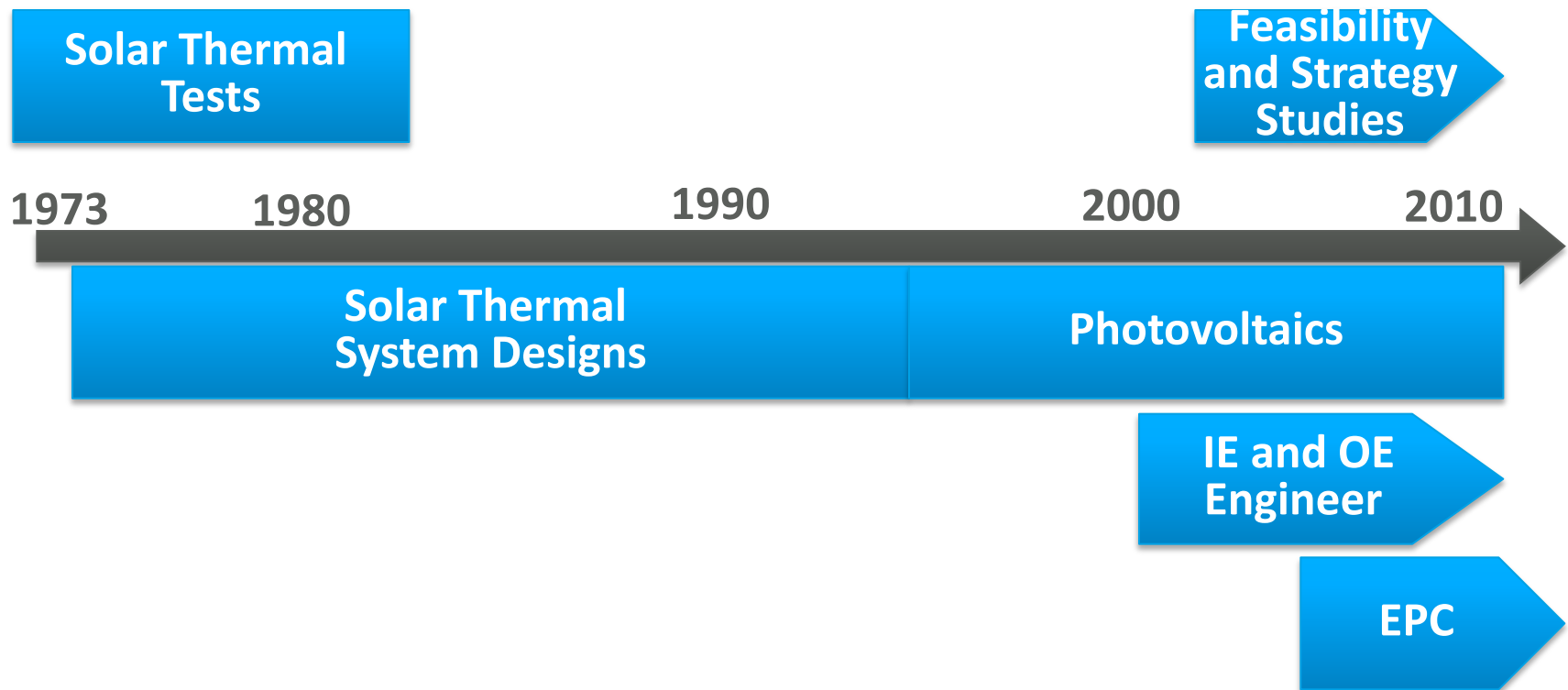


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PRESENTATION SUMMARY

- **Comment on:**
 - **Key requirements in proposed guide for Quality Management Systems (QMS) for PV manufacturing and,**
 - **QMS in manufacturing today**
- **Discuss possible actions to narrow the gaps**
- **Conclusions**

BLACK & VEATCH HAS BEEN ACTIVELY ENGAGED IN THE SOLAR INDUSTRY FOR DECADES



Black & Veatch has been actively engaged in the solar industry for decades.



INDEPENDENT ASSESSMENTS PERFORMED

- **Modules**
 - Crystalline silicon - 31
 - Thin film - 10
- **Trackers - 22**
- **Inverters -7**
- **Concentrator PV- 4**

QMS GUIDE KEY REQUIREMENT

“Focus on the organization’s control of the PV module’s design to align the expected lifetime with its relationship to the organization’s warranty...”



OBSERVATIONS

- **Proliferation of PV component manufacturers**

| Chinese suppliers | More than |
|--------------------------|------------------|
| Wafers | 50 |
| Glass | 25 |
| Encapsulant | 15 |
| Backsheet | 15 |
| Junction box | 25 |
| Connectors | 25 |



- **Module manufacturers rely heavily on successful IEC 61215 and UL 1703 test results to include a specific component in a bill of materials.**

Suggestions:

- **Implement tests, such as the Qualification Plus protocol, that reveal failures modes seen in the field, e.g.**
 - Corrosion
 - Delamination
 - Encapsulant discoloration
 - Junction box failures
 - Power degradation
- **Further develop component technical specifications.**

KEY REQUIREMENT IN QMS GUIDE FOR PV MANUFACTURING

“Design of a manufacturing process that will ensure conformance to the design intent for power, lifetime, and warranty.”



OBSERVATIONS

- The module manufacturing process contains steps that are common to all manufacturers.

SOME DIFFERENCES:

- Personal safety (personal protective equipment, electrical safety)
- Incoming inspection (equipment, sampling plans)
- Degree of automation (soldering, module assembly)
- Quality control (peel test, electroluminescence, flash test, hipot test)
- Personnel retention and training



SUGGESTIONS:

Implement industry accepted best practices in:

- Personal safety
- Incoming inspection
- Soldering and assembly
- Quality control
- Staffing and training

QMS GUIDE KEY REQUIREMENT

“A product realization that includes appropriate certification (e.g. IEC qualification, including both type approval and safety testing), a design lifetime that enables compliance with warranty, and recycling provisions”



OBSERVATIONS

- **Modules that are sold in North America have BOMs that successfully passed IEC 61215 and UL 1703.**
- **High number of module bills of materials.**
- **Strict control required of certified BOMs following IEC 61215 and UL1703 retesting guidelines.**
- **Implement Qualification Plus testing.**

KEY REQUIREMENT IN QMS GUIDE FOR PV MANUFACTURING

**“Improve product traceability
through the entire supply chain
to enact positive control of the
product for recalls and warranty
claims.”**





OBSERVATIONS

- Most module manufacturers have a means to correlate direct material, component and manufacturing information to module serial numbers.
- Less than half of the manufacturers have this information in electronic databases.
- Upstream product traceability requirements are not widespread.

Suggestions:

- Expand electronic storage of module traceability data.
- Increase upstream supplier traceability.

KEY REQUIREMENT IN QMS GUIDE FOR PV MANUFACTURING

“An ongoing, periodic monitoring program to ensure consistency of aspects of manufacturing that may affect safety, performance, and reliability.”





OBSERVATIONS

- **Manufacturers have ongoing production monitoring programs.**
- **Manufacturers receive and react to customer claims.**
- **Most manufacturers have had modules in the field for less than ten years.**

Suggestion:

- **Focus production monitoring programs on revealing known failure modes.**

KEY REQUIREMENT IN QMS GUIDE FOR PV MANUFACTURING

“Routine tests on 100% of product to ensure consistency of initial quality”.





OBSERVATIONS

- Most manufacturers utilize electroluminescence (EL) testing before and after lamination.
- Over thirty percent of the manufacturers use EL systems where the operator is not able to clearly identify cell defects.

Suggestion:

- Utilize EL systems that provide clear images of cell defects.

CONCLUSIONS

- **Quality should be the leading module differentiator.**
- **Continued increase in stakeholder demands will lead to further quality improvements.**
- **The PV QMS guide can assist in improving module quality.**



THANK YOU!

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