“Tweaking The PV Business Model To Deliver PV as Energy Infrastructure”

A More Reliable & Profitable PV System Delivery Process Approach

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Why is PV System Delivery as Reliable Energy Infrastructure important to you?

Why it’s critical to have a PV Repowering Planning and Specification Processes in place prior to EPC bidding?

Why it’s critical to determine and agree on defining stakeholder Success and Failure, including an “All In” lifecycle cost and benefits analysis?

The historic challenges in building PV Energy Infrastructure, what holds us back?

Two Industry Solutions to Consider
PV System Capacity from 2000 to 2050
(End – of – Life - Management, Solar Photovoltaic Panels, IRENA and IEA-PVPS)
Dramatic Improvement of PV Reliability & Profitability Requires Substantively Different Thinking, Choices & Change

Issues to be Resolve in Delivering PV as Infrastructure

- All Lifecycle Stakeholders wants, needs, expectations and profitability must be addressed in a PV Lifecycle System Deliver Process including O&M

- The primary System Specification must be completed prior to EPC bidding to reduce Lifecycle costs

- The EPC bidding Process must refine the “System Specification & Design prior to signing contracts.”
What will be operable in 2050?
End – of – Life - Management, Solar Photovoltaic Panels, IRENA and IEA-PVPS

![Graph showing the forecasted US PV panel waste from 2020 to 2050. The graph includes cumulative PV panel waste in million US tons and cumulative PV capacity in GW. The years 2020, 2030, 2040, and 2050 are marked on the x-axis, while the cumulative PV panel waste is shown on the y-axis. The graph shows three lines: PV Capacity (dashed green), Regular-Loss (solid blue), and Early-Loss (solid red). The data is sourced from the IRENA Report.]

(End – of – Life - Management, Solar Photovoltaic Panels, IRENA and IEA-PVPS)
Sources of Module Defects in Manufacturing

Sources of PV module defects in the manufacturing process (2016-2020)
Credit: PI Photovoltaik-Institut Berlin AG (PI Berlin)

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The Distribution of Defects in faulty modules

[Diagram showing distribution of defects]

Distribution of defects in faulty PV modules (2016-2020)
Credit: PI Photovoltaik-Institut Berlin AG (PI Berlin)
Today's PV Project repowering model Versus a PV System Planning Repowering™ Process Model

- Today's PV project repowering has no defined standards, requirements, industry wide planning processes, procedures or practices
- It is whatever major maintenance must be done to keep the plant viable
- Everyone's version of repowering is different with little to no attention to downstream stakeholders.

A PV Repowering™ System Delivery Process with a capital “R” includes:
- Clearly defines language, standards, requirements processes, procedures, commonly used Metrics, shared data and useable documentation
- Addresses long term needs for lifecycle planning, increased energy production, revenue and delivery, plus the costs of site restoration.
- It is a Systems Engineering (SE) and a Reliability, Availability and Maintainability (including Testability) and Safety (RAMS) Process
The (PAM) Model Infrastructure Model

- Preemptive Analytical Maintenance
- PAM PV As Energy Infrastructure Model
- Details O&M Contract Requirements
- Commission With Robust Benchmarking & Certification
- Installation with Effective QA/QC
- Detailed Training & Education Certification Requirements
- EPC Bid Documents, Process, Feedback & Selection
- Preliminary Site Specific Specification / Engineering
- Funding, Insuring, Entitlements & Regulatory
- Detailed Plant Specification, O&M Integration
- Repowering Planning: SE, RAMS, O&M ETC.
- Decommission & Site Restoration
- Concept Feasibility Assessments
- Feedback to Future Concept & Projects
- Details O&M Contract Requirements

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Two Functional Solutions Including Incentives for Success

- **Solution 1**
  - Determine and agree on defining stakeholder requirements for Success and Failure, including an “All In” lifecycle cost and benefits analysis at concept
  - Include stakeholder participation
  - Agree to address stakeholder concerns at concept and specification prior to EPC Bidding

- **Solution 2**
  - Lobby Congress for a 10 year PV “Plant Infrastructure & Resiliency” (PIR) Tax Credit with Requirements at 5%
  - Include requirements that increase for the first five years and reduce the PIR Credit over the last five years
Flow of PV Plant Infrastructure & Resiliency (PIR)
US 5% Tax Credit with PAM Requirements

Primary Requirements to be continually updated 2023 - 2032 and beyond:

- PV Repowering Process:
- Specification
- SE - RAMS
- Component Reliability, Reparability & Recyclability
- Clearly Defined Data Requirements and Sharing
- Education and Training
- Plant Evaluation Criteria

Initial Requirements 2023
Transition
Foundation: Set for Continual Improvement of Requirements
Tax Credit Reduction:

- Beginning In 2029, the PIR will be reduced by 1% annually until it is eliminated following December 31, 2032
- All Requirements will be updated annual beginning in 202.
Conclusion: A Change for the Better:

With the More Resilient PAM System Delivery Model:

- The Existing Project Delivery module is a short term - high risk Financial Model
- We can build and operate longer lived, more productive and profitable PV Infrastructure.
- Reliability and Repowering Planning are a critical foundation to building better more robust, durable and profitable plants.
- Success requires addressing the performance and reliability issues at specification, including both RAMS and SE-SMART Engineering Practices that define the system prior to EPC bidding and contracting.
Thank you for your participation

Please reach out if you would like to discuss the issues and Learn more!
High Performance PV Measurements of Success and Failure

Success:

➢ If you don’t ask for it, you will not get it! It’s all about the Details!!!
➢ Never Assume Anything!
➢ There is a Great Need for Improved Training and Education Industry Wide
➢ Requires addressing real technical and financial challenges to improve the industry

Failure:

➢ Not being able to dismiss industry Myths and Assumptions
➢ Not Meeting All Stakeholder Requirements, Want, Needs and Expectations.