

8.2 Consulting AG

Solarpraxis / 23.04.2010 / Christian Schram/

8.2 Ingenieurbüro Schram, München

in Vertretung für

8.2 Ingenieurpartnerschaft Obst & Ziehmann

8.2 Group

- Founded by Manfred Lührs in 1995
- Changing into 8.2 AG in 2006
- 14 stockholder in 8 independent offices founding the 8.2 AG
- 46 Experts plus 12 commercial employees
- Establishments in France, Austria, Taiwan, (Poland, Turkey)

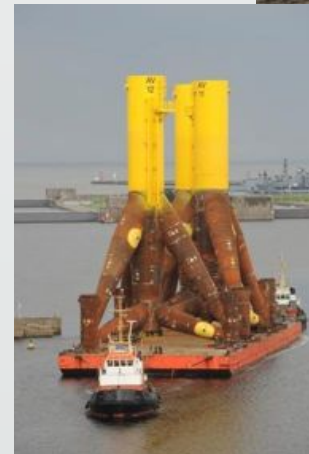


8.2 Business Segment

- Concentration on Technical Expertise
- Independency

8.2 Areas of Operations

- Wind Energy
- **Photovoltaics**
- Biomass



Photovoltaics

QA through final system
commissioning:

- Experiences
- Lessons learned from final acceptance testing
- Typical problems



Photovoltaic Power Plants are

- a combination of many single, mostly proven serial products (modules, power inverter, wiring etc.)
- are (nearly) always individual

Consequence

- There is not one power plant certified and ready for use in different sites like for example in the wind industry
- The general contractor is required and responsible to do the system integration of the components and to do it properly

Assignments through

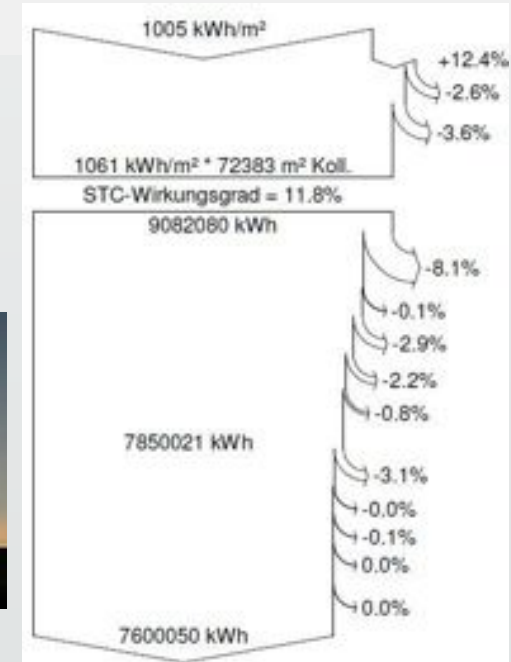
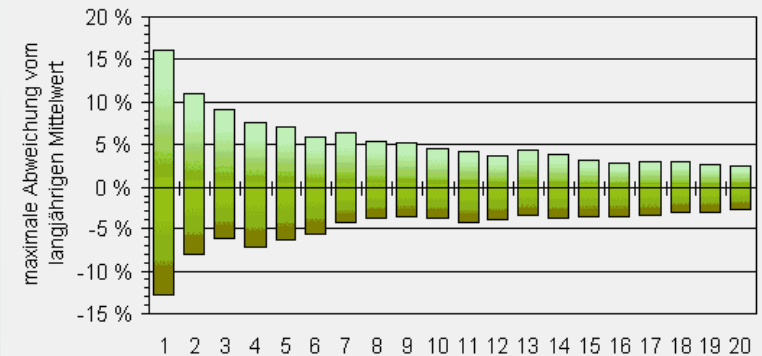
- Investment / Revenue
- Loan security

Aim is the limitation of risks through

- Energy prediction
- Enforceable contracts
- Quality of products, manufacturer, references
- Technical inspection after commissioning
- Operating control / Monitoring
- Inspection before end of warranty
- Independent damage analysis

Energy Prediction Analysis

- System configuration
- Solar irradiation
- Surroundings / external effects
- Loss factors
- Uncertainties
- Reduced output



Purchase Contract Risks

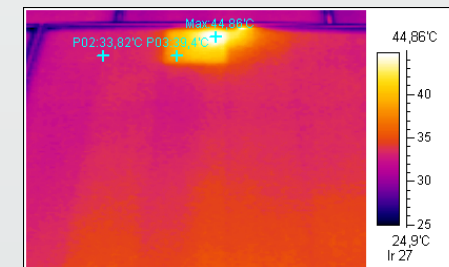
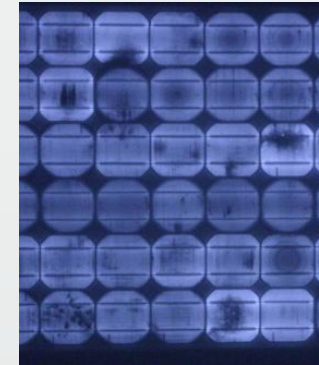
- There are even megawatt installations with non professional purchase contracts in Germany (Europe)
- Legal basis (e.g. Germany BGB / VOB)
- Manufacturer warranties negotiable
- Manufacturer xy „or similar“
- Big differences in monitoring concepts
- Cost-performance ratio

Operations and Maintenance Contract Risks

- Scope of services / spare parts
- Monitoring Concept
- Fault repair (Spare parts in stock)
- Performance warranties
- Prices
- Liabilities
- Site preservation

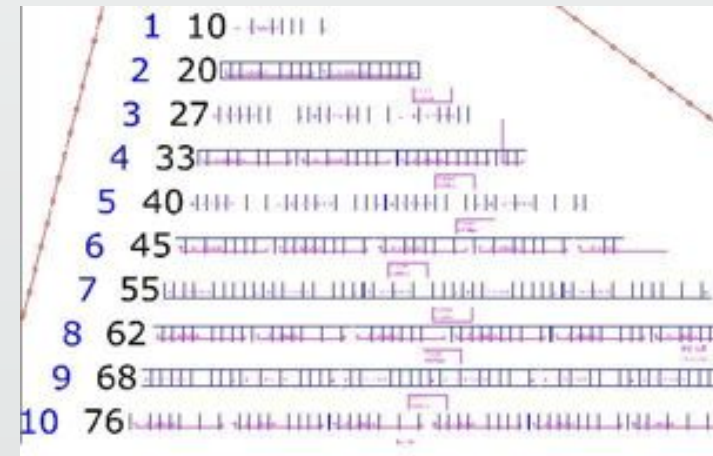
Product Confidence risks (Module Man.)

- Quality assurance
 - Factory inspections
 - Good criteria for delivered modules
 - Production accompanying module inspections
 - Impact on purchase contract
- Reclamations
 - Warranties (product guaranty, enforceable performance warranty)
 - OEM-product (creditworthiness)
 - Serial product with widespread failures



Scope of Inspections (e.g. Commissioning Examination)

- Examination of the documentation
- Comparison of the contractual agreements with the built installation
- Evaluation of the compliance with the building regulations from the building permission
- Functional testing of the plant
- Examination of compliance with relevant norms
- Examination whether the plant is compliant with the insurance requirements



End of Warranty Inspections

- Checking of operating data
- Visual inspection
- Functional testing of the plant (current-, IV-curve-, thermographic measurements)
- Module tests (power measurements, widespread failures)

Independent Damage Analysis

- Root Cause Analysis
- Corrective Action recommendations

Possible Deficiencies I (Extract)

- Design, construction
- Cable routing (wrong dimension, insufficient laying, missing UV protection)
- Lightning protection (missing or insufficient installation)
- Earthing (insufficient installation)
- wrong distance between rows (shade)



Possible Deficiencies II

- Shading within rows



Possible Deficiencies III

- Strong dirt on modules



Possible Deficiencies IV

- Nearby Shading of surrounding area



Possible Deficiencies V

- Nearby Shading of surrounding area



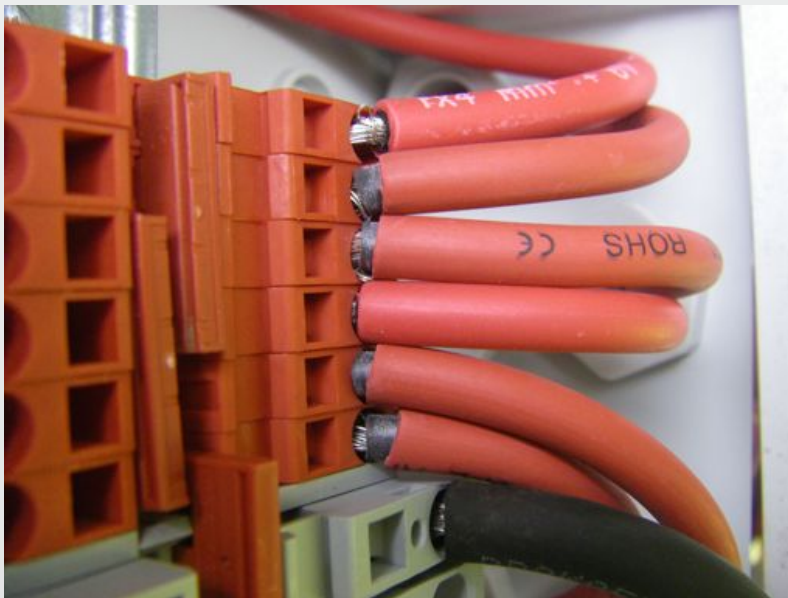
Possible Deficiencies VI

- Strings (low power, insufficient cable installation)



Possible Deficiencies VII

- Field assembling



Possible Deficiencies VIII

- Junction boxes (humidity, thermal problems, improper components)



Possible Deficiencies IX

- Inverters (break down, defects, thermal problems, MPP-tracking)



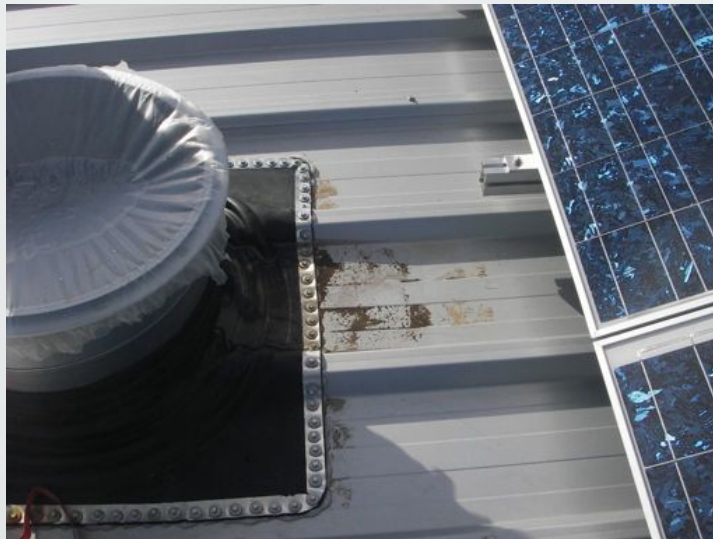
Possible Deficiencies X

- Substructure (stability, connection to roof, bad roof quality)



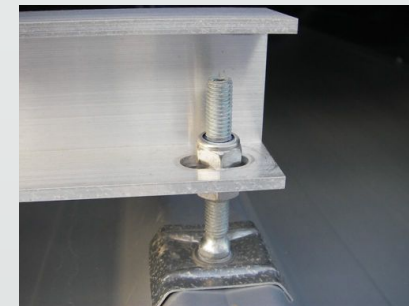
Possible Deficiencies XI

- Subsequent damage on roofs caused by unqualified installation



Possible Deficiencies XII

- Substructure (stability, connection to the ground, corrosion)



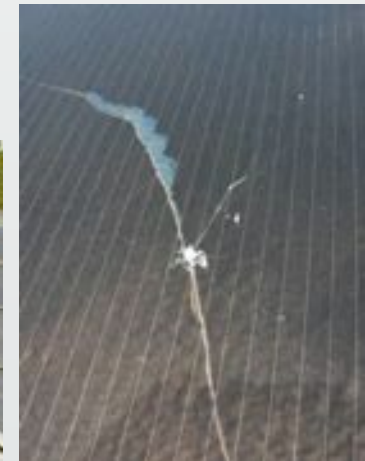
Possible Deficiencies XIII

- modules mounting under mechanical stress, insufficient or lose module fixation



Possible Deficiencies XIV

- Module breakage



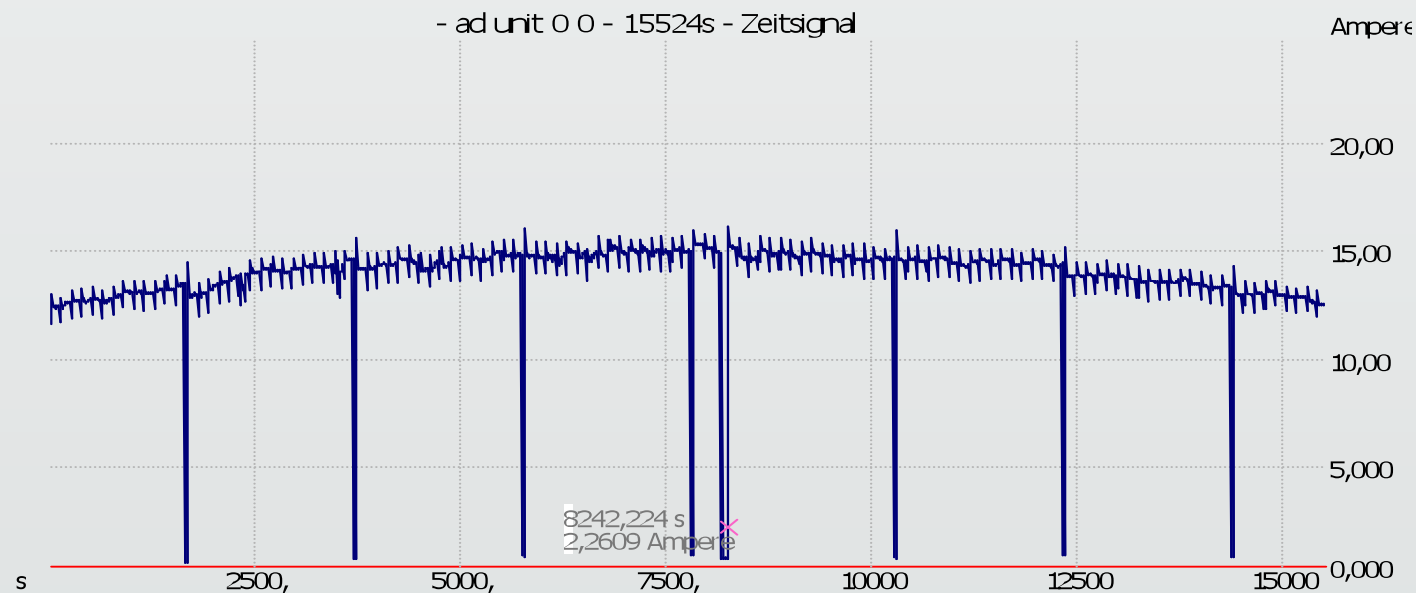
Possible Deficiencies XV

- Tracker (insufficient mechanical components, bad maintenance, inadequate controller, missing protection of moving components against dust and dirt)



Possible Deficiencies XVI

- Insufficient monitoring
(missing remote control, no string monitoring, low depth of data => in case of damages: complex fault analysis necessary)



Summary

- Photovoltaic power plants = individual plants
- Deficiencies are common and diverse
- Possibility to repair defects
- Very high availability
- Relatively safe investment if the plant is planned and installed properly
- But surveillance necessary
- Operation time up to 30 years possible

Thanks for your Attention

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