

# *Technical Risk Assessment during the Planning and Construction of PV plants/solar parks*



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## Agenda

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- **General introduction**
  - Rule-of-ten
- **Technical risks in Planning / Construction**
  - Component qualification
  - Risk analysis
  - Lessons learnt
  - Quality check lists
  - Internal site audits
- **Lessons learnt – some „highlights“**
- **Conclusion / Outlook**

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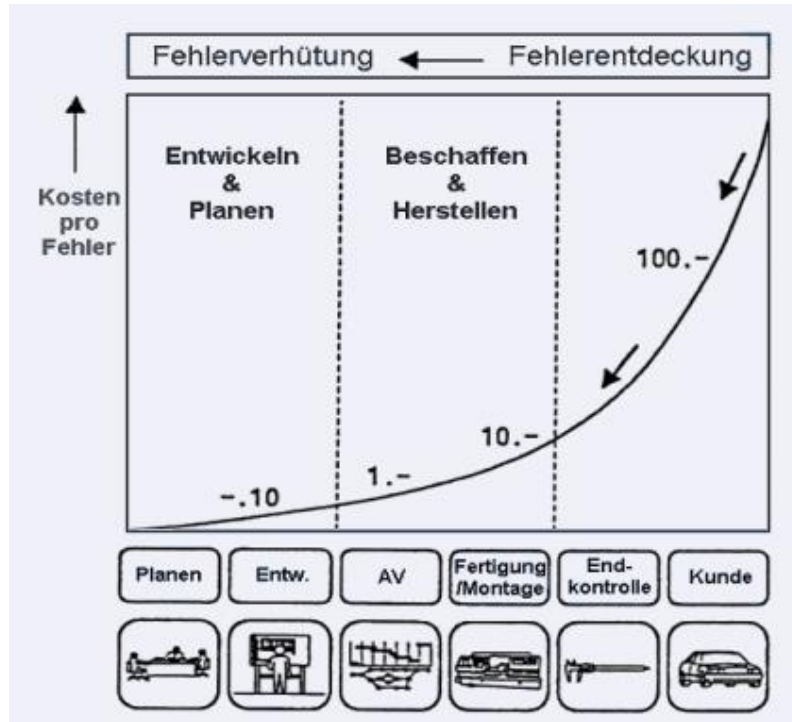
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# General introduction

## - Rule-of-ten -



## Rule-of-ten

- Costs for correction of defects increase from product idea to customer exponential
- Factor 10 in correction costs by each step
- ➔ Defect prevention instead of defect correction
- ➔ Risk management in System Design

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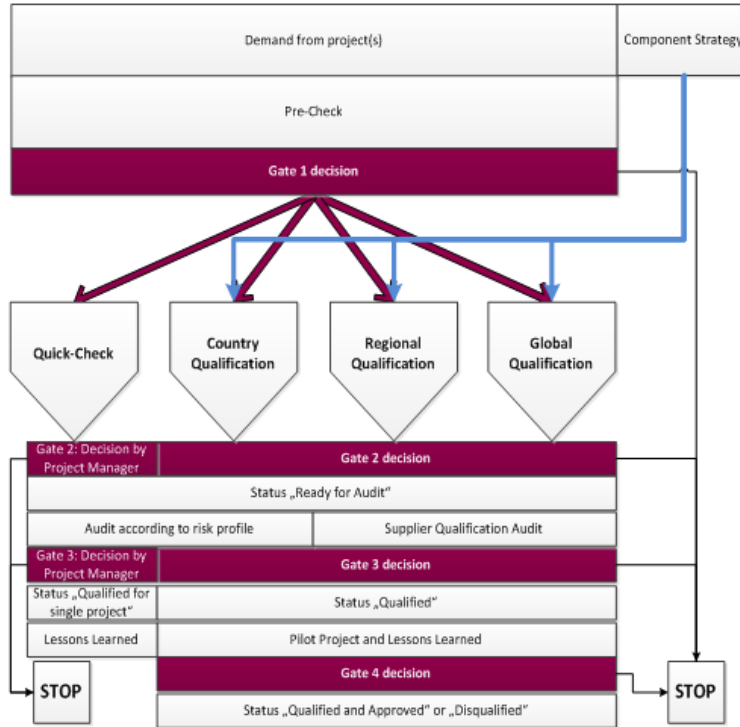
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# Technical risks in planning and construction

## - Component Qualification Process -



### Component Qualification Process

- Applicable for main components (module, inverter, rack)
- Contains compatibility check, risk analysis, supplier audit, lessons learnt
- Different complexity according to target classification (project, country, region, global)

# Technical risks in planning and construction

## - Risk analysis -



### Risk analysis

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- Risk evaluation for new component or systems
- Evaluation of risk probability and costs before and after mitigation
- Definition of possible mitigation measures

# Technical risks in planning and construction

## - Lessons Learnt -

### Lessons Learned

#### for Component Qualification Pilot Project

<b>Project Name and Project Number:</b>	Phillipines / ZA
<b>Project Start / Project End:</b>	2015
<b>Component Scope:</b>	Sunny Tripower STP 60
<b>Supplier:</b>	SMA Solar Technology
<b>Component Production Site:</b>	Niestetal
<b>Participants:</b>	Klaus Goll, Dung Vu Thi My
<b>Documentation of Lessons Learned done by:</b>	Ingo Klute
<b>Date of Lessons Learned:</b>	12.04.2016

#### How-to perform a Lessons Learned:

Please describe all experiences positive and negative you had during the project with this specific supplier and component. Did identified risks occur? If advisable, describe your recommendation so that the Lessons Learned in this project have an impact on future projects.

Technical design (issues, potential improvements, feature wish list)	
Topic	Experience
without communication inverter stops operation	if in the beginning of a communication string a cable failure occur or one inverter has the be exchanged, the rest of the inverter will stop working
without inverter manager all connected inverters stop operation	if the inverter manufacturer shuts down, all connected inverter shuts down
Recommendation (Action)	Responsible
communication between inverter and inverter manager in ring configuration	system design
inverter manager as spare part at site	O&M

### Lessons Learnt

- Applicable for pilot project
- Contains different „views“ from purchase, logistic, design, construction, project management,
- Aim:
  - „learning from failures“
  - What can we improve in the next project?
  - Define responsibilities for implementation



# Technical risks in planning and construction

## - quality check lists -



### Quality Checklist

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- Applicable for every subsection like ramming, rack installation, DC-cabeling, module mounting, DC-B mounting, inverter mounting,...
- Contains supplier recommendation according to installation manual and outcome of lessons learnt
- Performed by „special“ QM people at site
- Aim:
  - Ensure a constant high quality of the work at site

# Technical risks in planning and construction

## - internal site audits -



### Internal site audits

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- Approve quality processes at site
- Control of quality checklists
- Performed by system designer at site
- Aim:
  - Ensure constant high quality of the PV-plant
  - Lessons learnt for system design and construction

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# SMA Optiprotect

Description	Optiprotect switches fail due to higher currents and temperatures than expected
Risk	Switching of Optiprotect cause bad plant availability and performance
Probability	high
Impact	high
Priority	high
Mitigation	Redesign and reconstruction with less strings per optiprotect channel
Cost:	
- 25 MWp	
- 700.000 €	






# Rack with dynamic wind forces

Description	Dynamic wind loads leads to swinging of the rack, which cause module lost
Risk	Defect modules
Probability	medium 
Impact	high 
Priority	high 
Mitigation	Strengthening of rack in the outer space
Cost:	
- 35 MWp	
- 800.000 €	






# Water in inverter station cable cellar

Description	Water ingress in cable cellar of inverter station due to surface water
Risk	Corrosion of metallic components in cellar
Probability	medium 
Impact	high 
Priority	high 
Mitigation	Jack the inverter station higher
Cost:	
- 11 stations	
- 180.000 €	







# Corrosion on rack screws

Description	Corrosion on different rack screws due to salty air in case of installation near to the coast
Risk	Corrosion and defect of screw connection
Probability	medium 
Impact	high 
Priority	high 
Mitigation	Exchange screws
Cost:	
- 1,1 MWp	
- 20.000 €	







# Bending radius module cable

Description	Kind of installation result in cable bending radius below the limit (DIN: 3xD; BYD: 5xD; CSI: 32mm)
Risk	Defect in cable or module junction box
Probability	low 
Impact	high 
Priority	medium 
Mitigation	Change kind of module cable installation
Cost:	
- 20 MWp	
- 60.000 €	






# MC connector fitting

Description	According to the MC manual the fitting of the MC connector has to be closed with up to 3 Nm
Risk	Water ingress in connection
Probability	low 
Impact	high 
Priority	low 
Mitigation	Close connector fitting with special tool and check torque 




# V-clamps with Aluminium cable

Description	Aluminium cable requires special treatment for installation (rubbing, greasing); in combination with V-clamps critical
Risk	Failing of connection (heat and fire)
Probability	medium to high <span style="color: red;">●</span>
Impact	high <span style="color: red;">●</span>
Priority	high <span style="color: red;">●</span>
Mitigation	Change the high current connections to cable glants
Cost:	
- 20 MWp	
- 50.000 €	







# Unsymmetric cable laying in one phase

Description	Unsymmetric cable laying in one phase AC-side between inverter and transformer can lead to overload of cable and connectors
Risk	Failing of connection (heat and fire)
Probability	medium to high <span style="color: red;">●</span>
Impact	high <span style="color: red;">●</span>
Priority	high <span style="color: red;">●</span>
Mitigation	Measure the current distribution on the AC-cables inbetween one phase 






# Overvoltage event on communication cable

Description	Indirect lightning can lead to overvoltages on the RS485 or auxiliary power line
Risk	Failing of DC-B's (function and fire)
Probability	medium 
Impact	high 
Priority	high 
Mitigation	Install in RS485 line and auxiliary power SPDs 















# Broken earthing jumpers due to mechanical tension

Description	overvoltage damages on DC-string cable due to broken earthing jumpers
Risk	Overvoltage damages on DC-cables
Probability	medium 
Impact	high 
Priority	high 
Mitigation	Different geometric of the earthing jumpers



# others

Description	Risk	Probability	Impact	Priority	Mitigation	Mitigation cost
Crane intake on station roof not sealed	Water ingress	High 	High 	Medium 	Seal the intake correctly	5.000 €/station
Cable tie not UV resistant	Cable tie break	Medium 	High 	Medium 	Use UV resistant or metallic cable tie	high
Overtemperature in Com-Boxes	Outage of com.	High 	Medium 	Medium 	Install additional cooling openings	2.000 €/station
Warning plates not UV resistant	Plates break	Medium 	Low 	Low 	Use aluminium plates	1.500 €/project
...						

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## Conclusions / Outlook

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- Factor 10 in correction costs by each step leads to high mitigation costs for small design failures
- Still high potential for damage in existing plants
- Energy losses often more cost intensive than mitigation costs
- Business model possibility:
  - Proactive quality checks of existing parks in order to secure the functionality and economy of the plant



**Vielen Dank für Ihre  
Aufmerksamkeit /  
Thank You for Your Attention**

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