

# Entire-process Risk Management Solution

—— *Independent engineer service*

Regions  
跨越地方区县 **156个**

Service Type  
服务类别 **24个**

Project Amounts  
项目总数 **266个**

Client Amounts  
客户数量 **149家**

Worldwide Performance  
全球评估量 **17.6GW**

Domestic Performance  
国内评估量 **13.6GW**



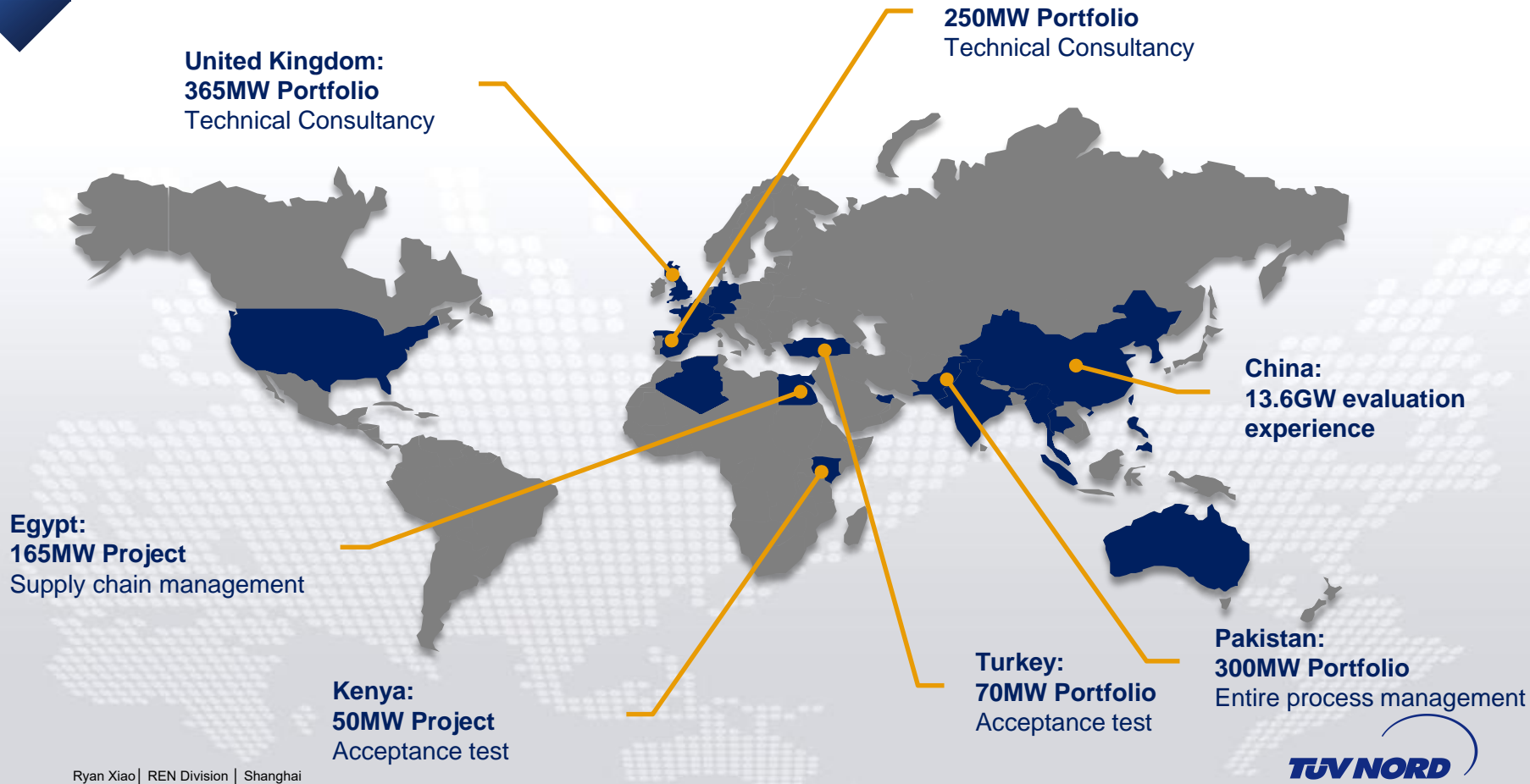
## COMPANY OVERVIEW



**TÜV NORD** is a leading global technical service provider who has a history over 150 years. Our head office is located in Hanover, with employee over 10000. We provide quality management, safety, reliability and performance solution. Our service scope covers consultancy, engineering, qualification, inspection and certification etc.



# CASE STUDY



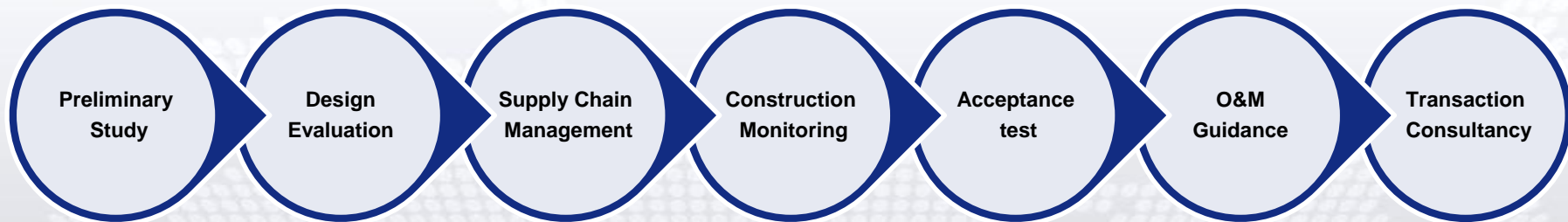


# RISK IDENTIFICATION OF PV PROJECT





# TIMELINE OF PV PROJECT





# SUPPLY CHAIN MANAGEMENT

## DUPRO

## Pre-shipment inspection

## Lab test

## Post-shipment inspection

- Check the internal QM of manufacture, which including BOM, technique, procedure and testing.
- Factory acceptance test.
- Ensure the performance and reliability of products by several type tests.
- Ensure the product quality during the transportation by the site inspection before installation.

### Provide full-scope of management in solar project:

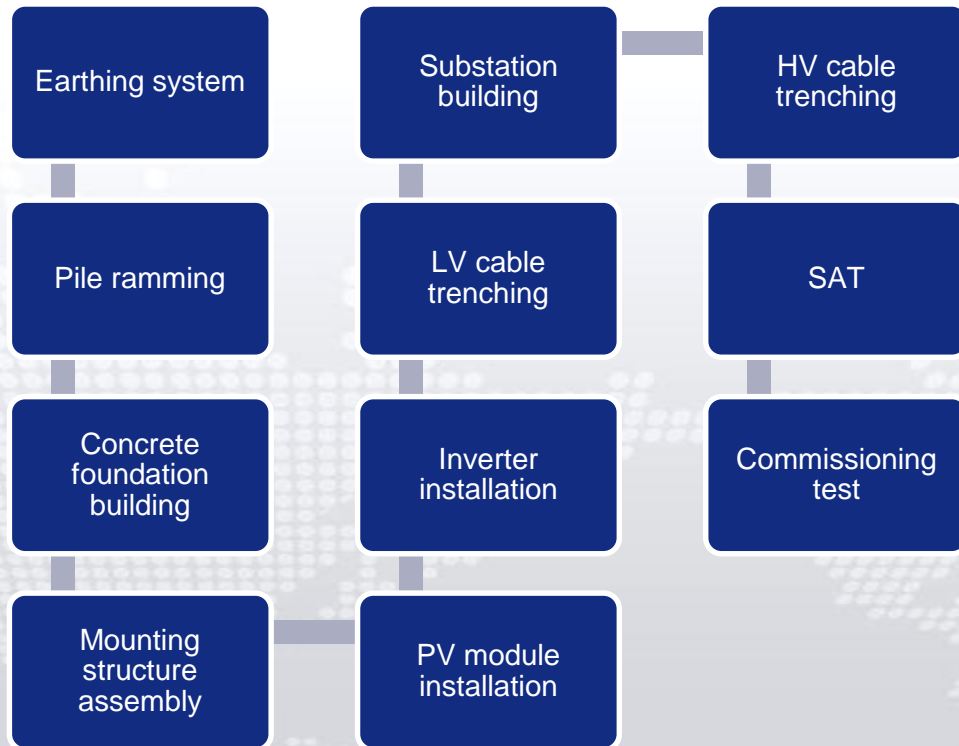
- ✓ PV module
- ✓ Mounting structure/Tracker
- ✓ DC cable
- ✓ DC combiner box
- ✓ Inverter
- ✓ Box transformer
- ✓ Power cable
- ✓ Switchgear
- ✓ GIS
- ✓ Main transformer
- ✓ SVC
- .....





# CONSTRUCTION MONITORING

## KEY MILESTONES





# ACCEPTANCE TEST

## Site Test (PV Zone)

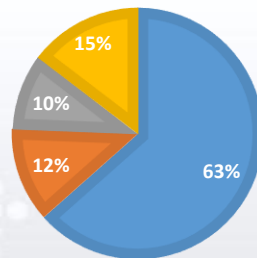


- ☐ Design Consistency
- ☐ PV String/Module IV Test
- ☐ IR Test
- ☐ EL Evaluation
- ☐ Mounting structure check
- ☐ Inverter Efficiency
- ☐ Power Quality
- ☐ Insulation Test
- ☐ Earthing Resistance test



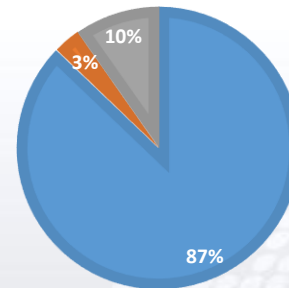
DISTRIBUTION OF EL FAILURE RATIO

0~25% 25~50% 50~75% 75%+



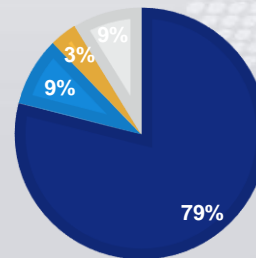
DISTRIBUTION OF HOT SPOT

Pollution Shield Quality



DISTRIBUTION OF STRINGS' IV DEVIATION

0~5% 5~10% 10~15% 20%+







# ACCEPTANCE TEST

## Site Test (HV/MV Side)



- ☐ Design Consistency
- ☐ Equipment FAT/SAT Report
- ☐ Label and Indication
- ☐ Protection and Intertrip Logic
- ☐ Control and Interlocking Logic
- ☐ Data Acquisition and Archive
- ☐ Insulation Test
- ☐ Functional Test



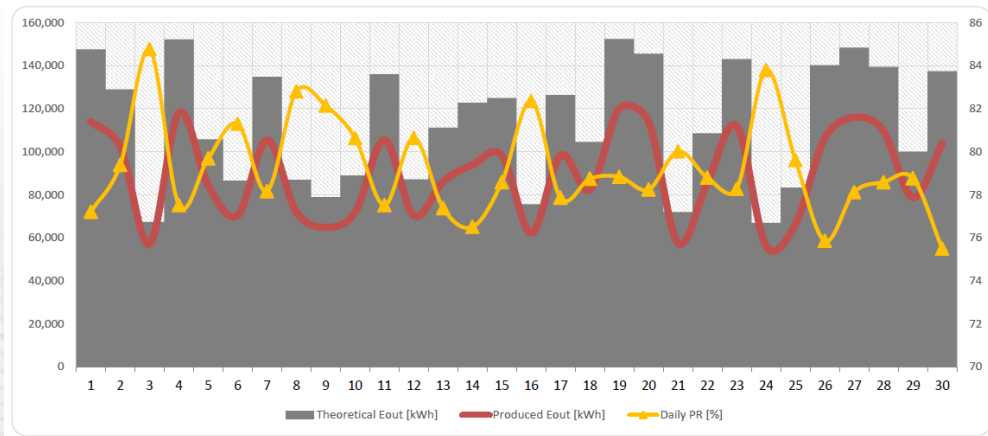
- ✓ Full technical abilities in HV/MV side, covered all electrical equipment from primary to secondary side.
- ✓ Rich experienced in both solar project, CSP project and PTD project, reference cases:
  - 50MW CSP project in Middle East.
  - 300MW Solar project in South Asia.
  - 330kV substation project in Africa.



# ACCEPTANCE TEST

## Calculation in Three Stages

Stage	Test Period
Provisional Acceptance Test (PAC)	15 days
Intermediate Acceptance Test (IAC)	1 year
Final Acceptance Test (FAC)	2 years



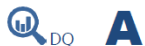
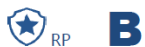
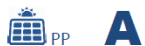


# TRANSACTION CONSULTANCY

Index	Service Category	Content
1	Documents review	Grid connection agreement
		PPA
		Land lease
		Environment assessment report
		EPC contract
2	Equipment review	Technical specification
		Certification
		Warranty letter
3	O&M evaluation	O&M contract review
		Malfunction rate/Fault record
		Availability
4	Energy yield review	Historical energy yield and PR
		Feasibility report
		Weather database
5	PV module degradation	STC power determination
		Existed 3rd party report
6	Other information	Subsidy condition
		Solar resource
		Curtailement

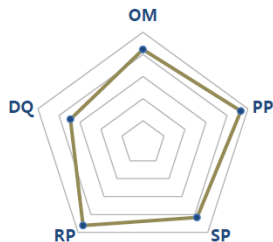


# PV PLANT RATING



## General

To judge the whole property of a PV plant, TÜV Nord PVS has designed a series of metrics, in order to quantize the PV plant by its running status.



## Detail

Month	OM	PP	SP	RP	DQ	Final
01	A+	A	A	A	A	A
02	A+	A+	A	A	A+	A+
03	B	B	A	B	C	B

OM: Operation & Maintenance  
PP: Plant Performance  
SP: Safety Performance  
RP: Reliability Performance  
DQ: Data Quality

- Operation & Maintenance
- Safety Performance
- Plant Performance
- Reliability Performance
- Data Quality



# CERTIFICATION

## **Certification of Grid Connected PV Power Plant**

- Minimum requirement of documents, commissioning tests and inspections of PV project.

## **Certification of PV Power Plant Performance**

- Classification of monitoring system in PV plant.

## **Certification of O&M**

- Management system of company and O&M effect assessment.

## **Certification of EPC**

- Competence and qualification of EPC company.



# Accreditation

**Accreditation** is the process in which certification of competency, authority, or credibility is presented.

- ✓ Quality Management System
- ✓ Equipment Control
- ✓ Inspector Qualification



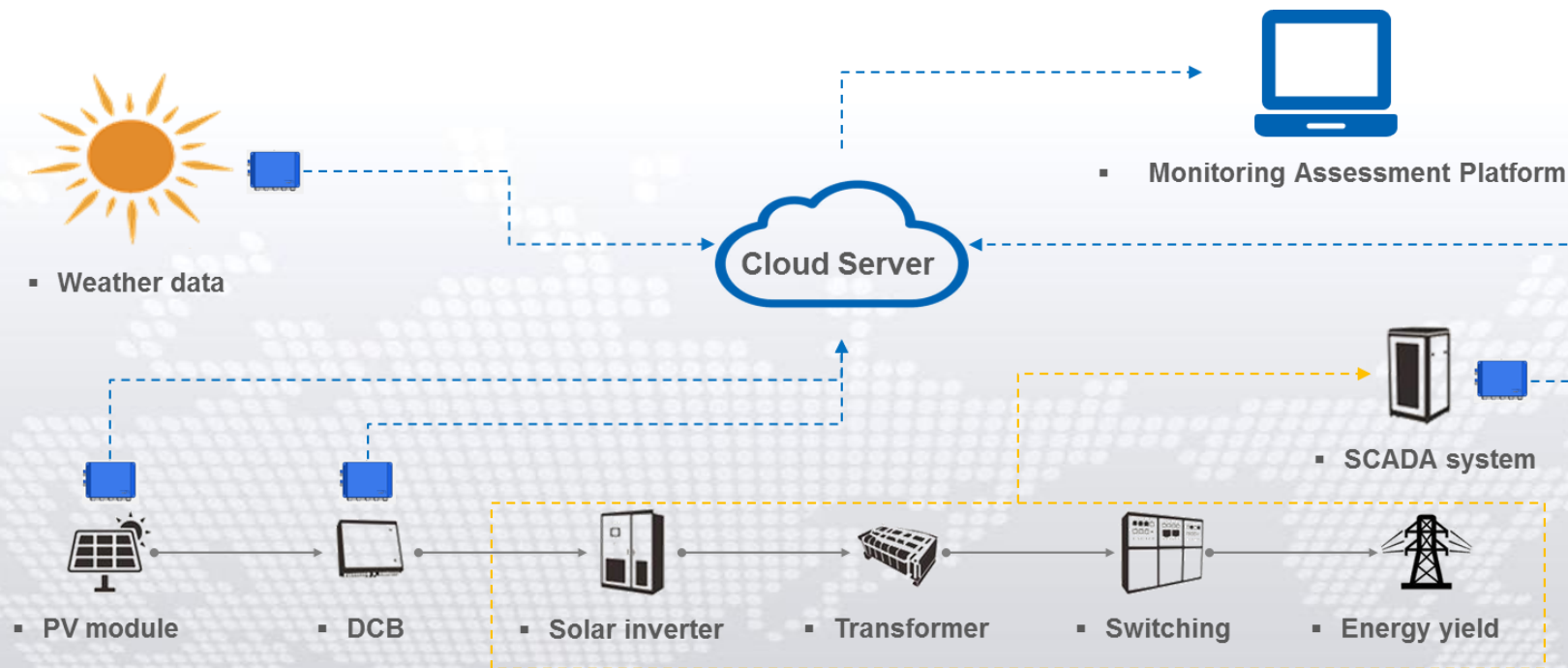
TÜV NORD has been accredited by the following standards:

- ✓ Grid connected PV power plant, IEC 62446-1, IEC 62446-3
- ✓ Operation and Maintenance, IEC 63049, Q/TN 20001, Q/TN 20002
- ✓ Monitoring System, IEC 61724-1,-2,-3
- ✓ Design, IEC 62548
- ✓ EPC Requirement, IEC 63049, OD 410-2-1





# INTELLIGENT INSPECTION SOLUTION





# INTELLIGENT INSPECTION SOLUTION



## Digital monitoring devices

- Weather monitoring
- PV Modules monitoring
- PV Strings monitoring
- Inverters monitoring
- Energy yield monitoring





# INTELLIGENT INSPECTION SOLUTION

## Long-term system assessment

- Performance ratio monitoring
- System availability
- Fault alarm
- Energy yield prediction and accomplishment
- O&M guidance
- System rating
- Financial analysis

Date	Total Production [kWh]	Radiation [Wh/m <sup>2</sup> ]	Daily PR [%]	Daily Availability Kd
01	35,929.00	2,253.26	88.32	100.00
02	29,677.00	1,825.38	90.05	100.00
03	28,359.00	1,791.02	87.70	100.00
04	22,243.00	1,394.46	88.35	100.00
05	41,333.00	2,524.74	90.68	100.00
06	21,864.00	1,344.74	90.06	100.00
07	80,397.00	5,222.18	85.27	-
08	30,337.00	1,803.05	93.19	100.00
09	16,092.00	942.35	94.59	100.00
10	16,942.00	1,053.46	89.08	100.00
11	49,744.00	3,105.31	88.73	100.00
12	51,614.00	3,207.02	89.14	100.00
13	74,034.00	4,666.80	87.87	100.00
14	75,539.00	4,662.26	89.74	100.00
15	19,163.00	1,227.76	86.45	100.00
16	71,281.00	4,397.35	89.79	100.00
17	58,515.00	3,664.65	88.44	100.00
18	10,346.00	655.27	87.45	100.00
19	14,530.00	893.56	90.07	100.00
20	60,467.00	3,701.67	86.07	100.00
21	60,467.00	3,701.67	86.07	100.00
22	60,467.00	3,701.67	86.07	100.00
23	60,467.00	3,701.67	86.07	100.00
24	60,467.00	3,701.67	86.07	100.00
25	60,467.00	3,701.67	86.07	100.00
26	60,467.00	3,701.67	86.07	100.00
27	60,467.00	3,701.67	86.07	100.00
28	60,467.00	3,701.67	86.07	100.00
29	60,467.00	3,701.67	86.07	100.00
30	60,467.00	3,701.67	86.07	100.00



# TÜV NORD – Contact

**Thanks for Attention!**

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