

Drone IR (DIR) Inspection Service

April, 2023

艾思特能源股份有限公司



EXTEL
ENERGY

OUR PRODUCT & SERVICES

EXTEL Energy is established in 2018 with a clear business vision, by utilizing the engineering skills and field experiences of team members, to provide innovative solutions to customers in the downstream PV Power Plant market. Our value-added solutions are grouped in 4 major technical segments – PV Analyzer (PVA), Dust Analysis System 2.0 (DAS 2.0), Warranty Inspection Service (WiS) and inspection service for PV power plants.

艾思特能源提供多項太陽能模組/電廠相關「現場檢測服務」，為您的太陽能資產進行多層次效能把關，確保收益。PV評價平台能協助客戶進行案場開發前期的資料收集-模組發電量、氣象日照資料等。新型落塵檢測系統可幫助業主隨時掌握案場落塵影響發電損失，以有效管理案場模組清洗的優先順序，提高整體發電量。



PV Power Plant
Inspection Service
太陽能电站檢測服務



Dust Analysis
System 2.0
新型落塵偵測系統



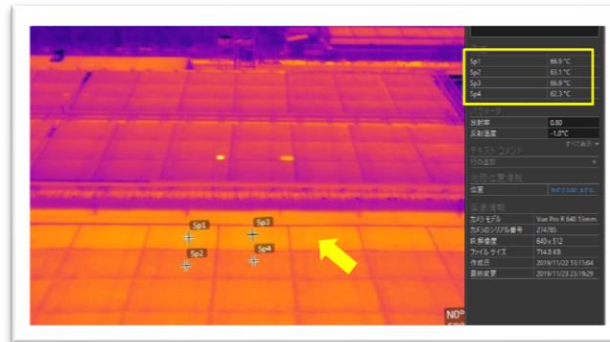
Warranty
Inspection Service
模組保固檢驗服務



PV Analyzer
Platform
PV 評價平台

ExTEL Drone Applications

- Drone Module Washer (DMW)
- Drone IR (DIR)
- Drone Albedo Measurement (DAM)



ExTEL Drone IR Inspection & Services

Drone IR

- Pre-inspection planning/Routing
- Drone IR
 - ✓ High resolution IR
 - ✓ RGB image
- IR inspection report



PV System Check

- System check by experienced team
- PV system performance check
 - ✓ PV module degradation
 - ✓ Inverter efficiency
 - ✓ I-V curve
- TDD



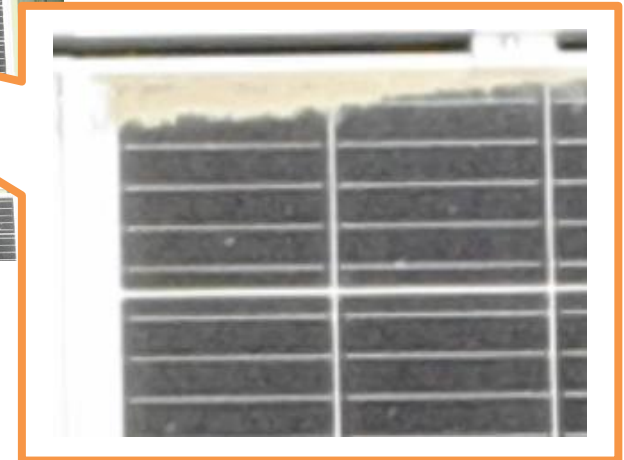
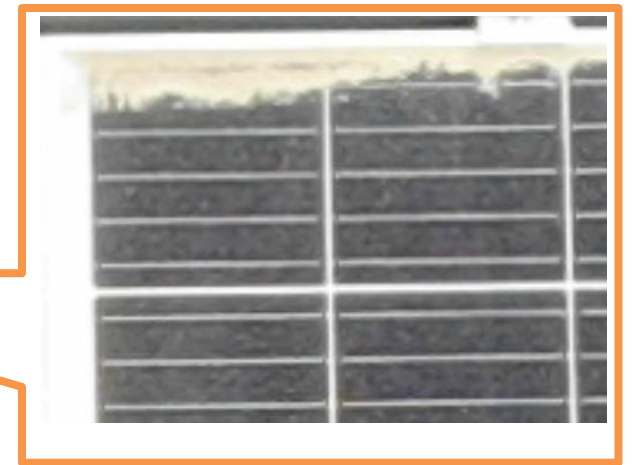
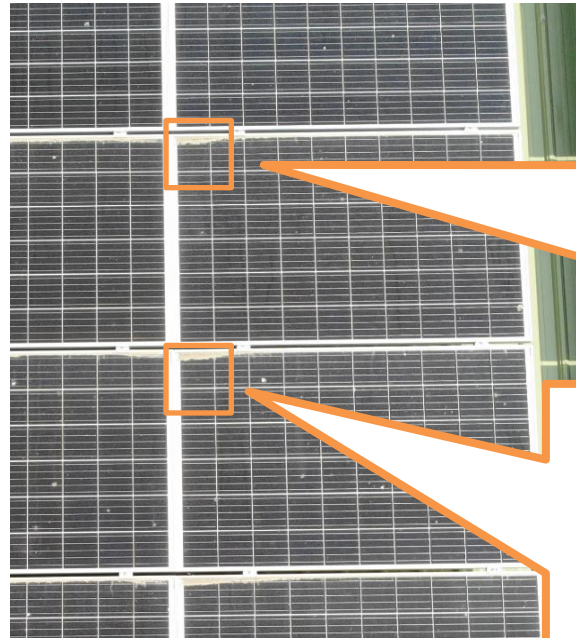
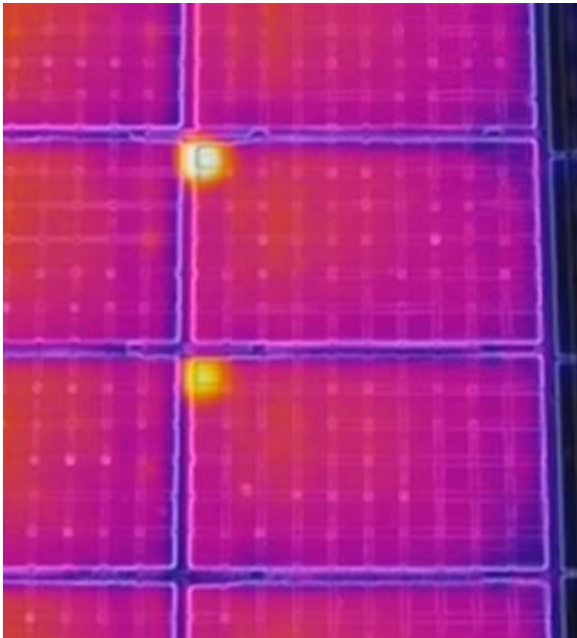
Repair/Improve Service

- PV System improvement list-up
- System improvement /overhaul work
- IR image re-inspection



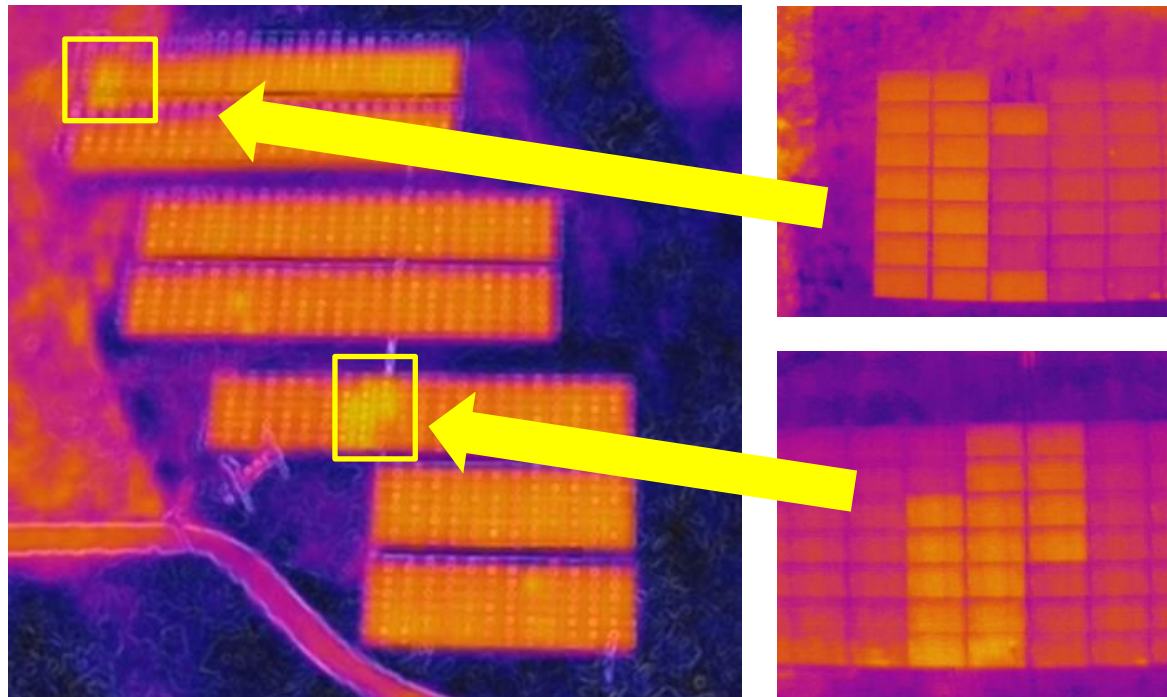
DIR Inspection Case Study. 1 (Soiling hot spot)

- ❑ Residual soiling on the module surface can cause hot spots, reduce PV efficiency and bring safety risk



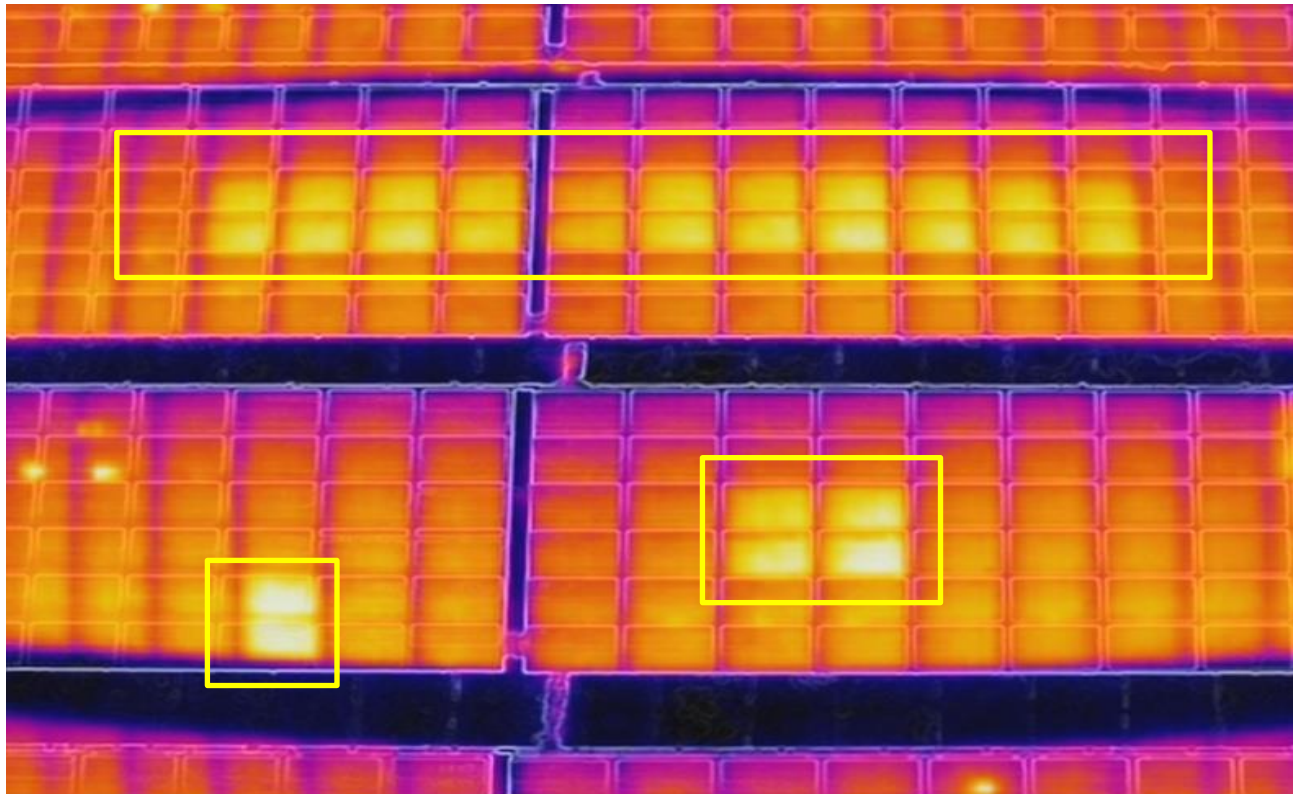
DIR Inspection Case Study. 3 (String not on-grid)

- ❑ Stings not on-grid will show higher working temperature compare to the normal strings



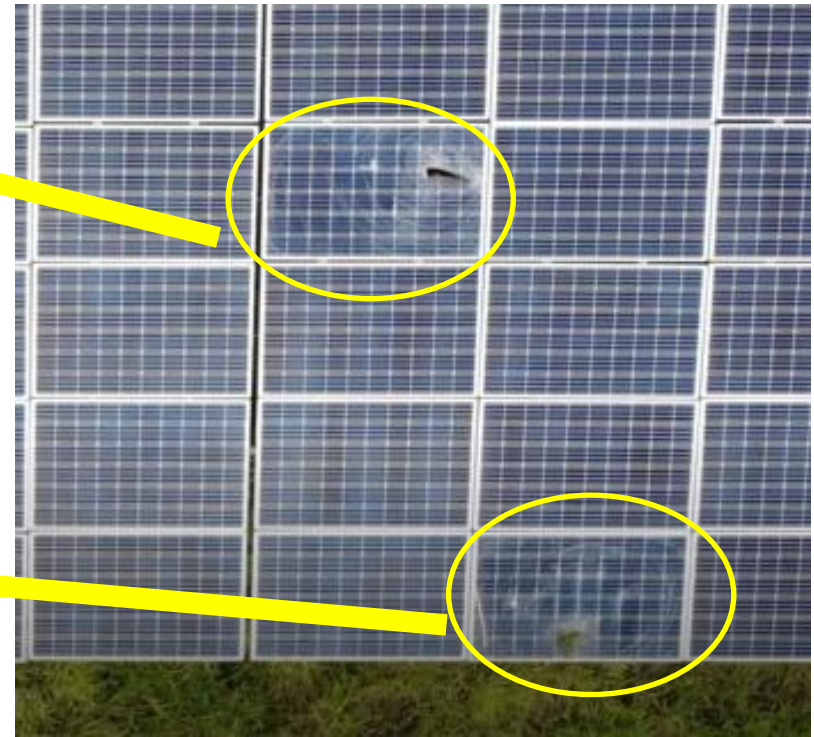
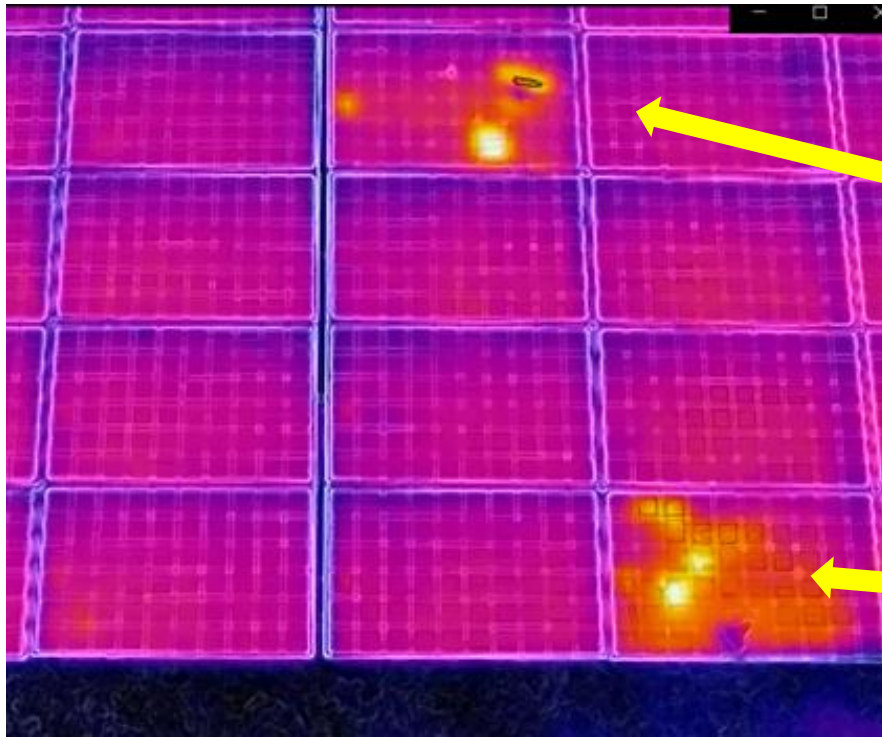
DIR Inspection Case Study. 4 (Optimizer abnormal)

- ❑ Optimizer malfunction, such panels/strings will show higher working temperature compared to the normal panels/strings



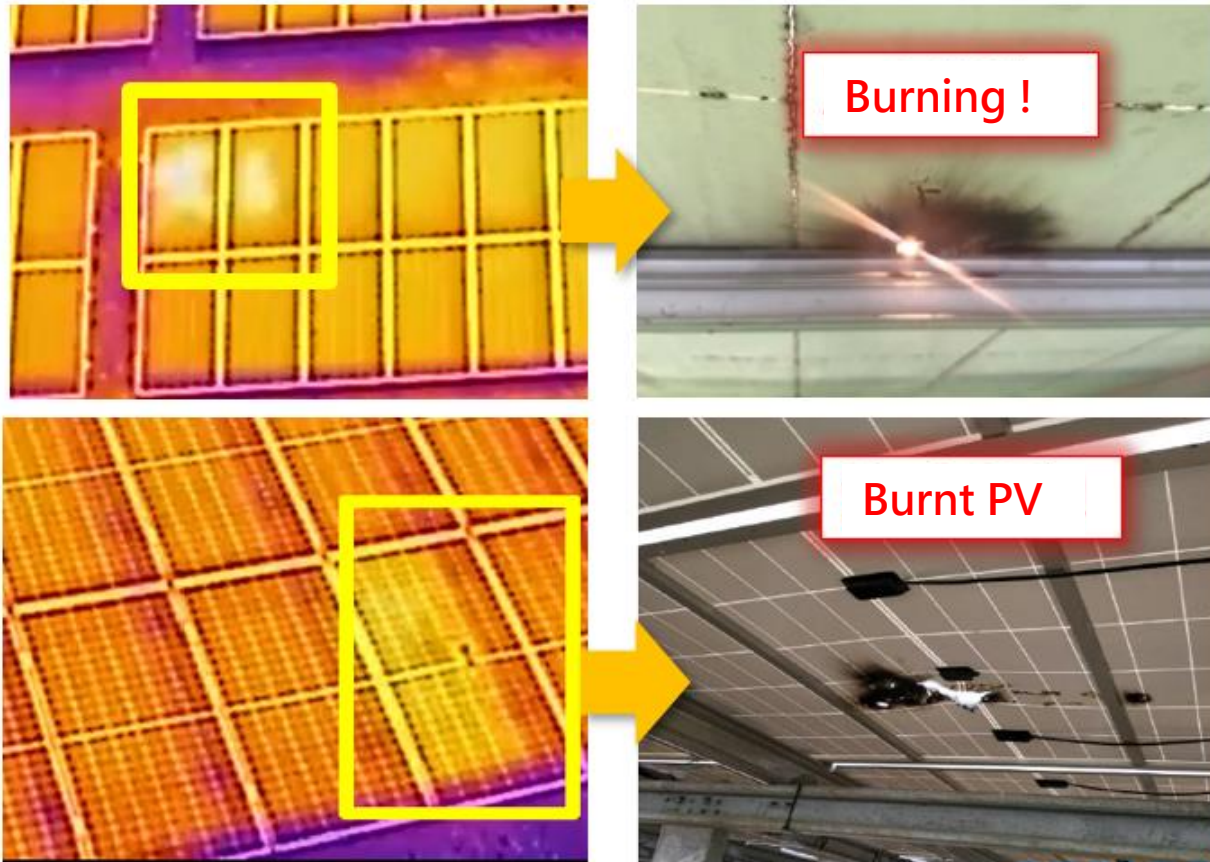
DIR Inspection Case Study. 5 (PV panel broken)

- ❑ PV panel broken, such panel should be replaced ASAP to avoid safety hazard



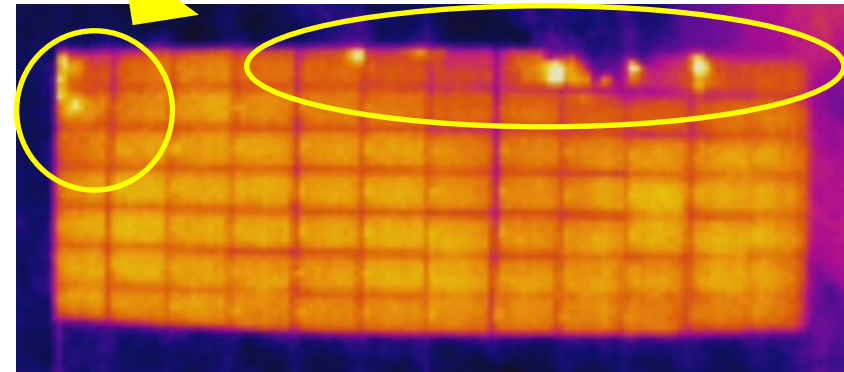
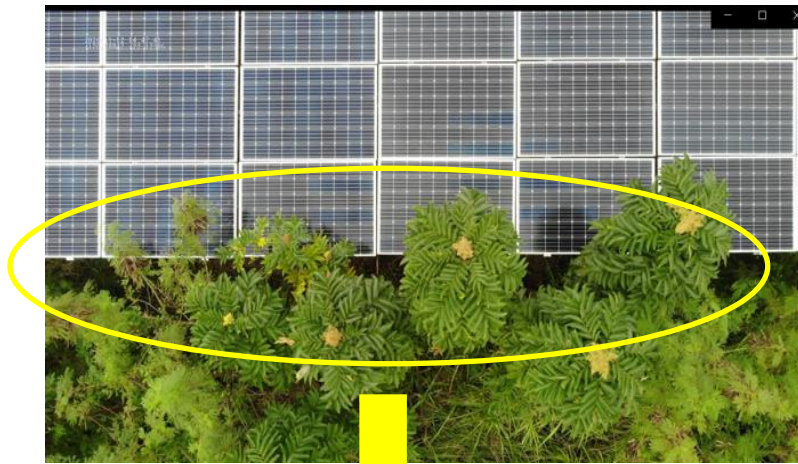
DIR Inspection Case Study. 6 (PV broken & burning)

- ❑ PV panel broken, such panel should be replaced ASAP to avoid safety hazard



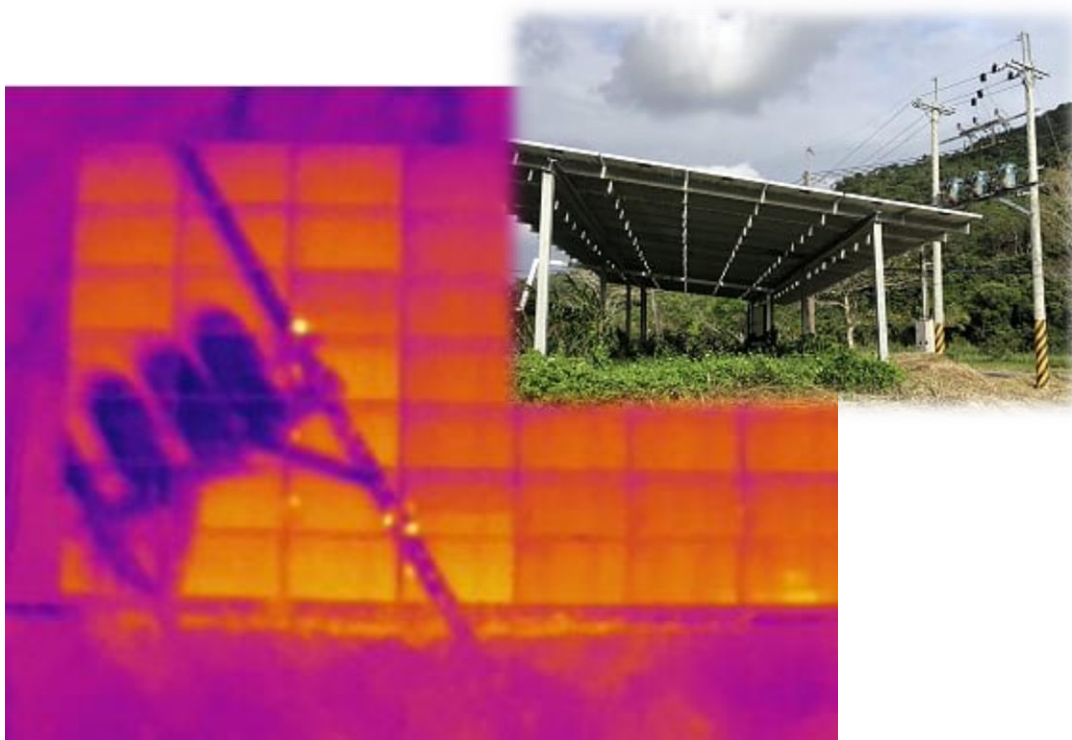
DIR Inspection Case Study. 7 (Shading by trees)

- ❑ Shading near the PV array causing hot spots, which reduce PV efficiency and bring safety risks



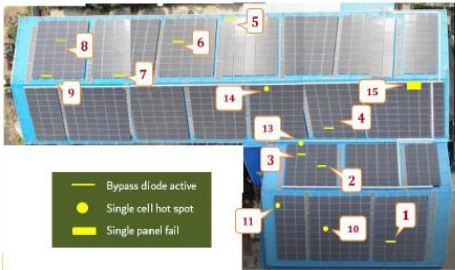
DIR Inspection Case Study. 8 (Shading by pole)

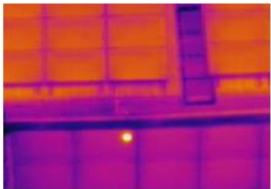
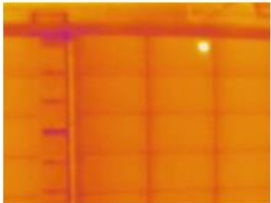
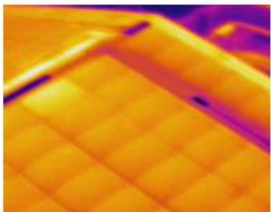
- ❑ Objects(Poles) near the PV array causing hot spots, which reduce PV efficiency and bring safety risk



Drone IR Inspection Report

- IR report will be provided to customer 3 days after the inspection; and report will cover the abnormality, CoA, locations of the defects and suggested actions

Table 4.1.3.2 ③ DIR: PV module Thermal Image inspection result																
Item	Contents			Remark												
Abnormality Summary	<table><thead><tr><th>Abnormality</th><th>Count</th><th>CoA(*)</th></tr></thead><tbody><tr><td>Bypass Diode active</td><td>9</td><td>2</td></tr><tr><td>Cell hot spot</td><td>3</td><td>2</td></tr><tr><td>PV panel fail</td><td>1</td><td>2</td></tr></tbody></table>			Abnormality	Count	CoA(*)	Bypass Diode active	9	2	Cell hot spot	3	2	PV panel fail	1	2	Failure ratio: 1.3%
	Abnormality	Count	CoA(*)													
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	Cell hot spot	3	2													
PV panel fail	1	2														
Abnormality Location																
	<table><tr><td>Class of Abnormality (CoA)</td><td>1 (no abnormalities – OK)</td><td>2 (thermal abnormality – 1A)</td><td>3 (safety relevant thermal abnormality – 2B)</td></tr><tr><td>Recommendation for actions</td><td>No imminent action</td><td>Checking the cause and, if necessary, rectification in a reasonable period.</td><td>Prompt interruption of operations, checking the cause and rectification in a reasonable period.</td></tr></table>			Class of Abnormality (CoA)	1 (no abnormalities – OK)	2 (thermal abnormality – 1A)	3 (safety relevant thermal abnormality – 2B)	Recommendation for actions	No imminent action	Checking the cause and, if necessary, rectification in a reasonable period.	Prompt interruption of operations, checking the cause and rectification in a reasonable period.					
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12		Hot spot (cell)	2	Replacement when next maintenance
13		Hot spot (cell)	2	Replacement when next maintenance
14		Hot spot of entire PV	2	Replacement when next maintenance



ExTEL's Engineering Services

❑ ExTEL “after-inspection engineering service”

- On-site PV performance check
 - *IV-curve measurement*
 - *Inverter efficiency*
 - *PV Module degradation*
 - *Site PR measurement*
 - *EL measurement*
- PV System improvement
 - System improvement list-up /overhaul work
 - DIR image re-inspection
- Third party Technical Due Diligence (TDD)



Summary

Advantages of ExTEL's Drone IR

- ✓ IR inspection comply with IEC standard
- ✓ Inspection report provided with improvement suggestion
- ✓ Specialized in PV inspection with years of international experience
- ✓ Provide PV plant performance check, improvement and 3rd party Technical

Due Diligence (TDD)





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