

- **Rue Phillips, CEO/Cofounder True South Renewables Inc.**
- **Pioneers in PV Operations and Maintenance protocols, procedures**
- **Maintaining and operating over \$1Billion of solar plants and rooftop systems (DG and Utility)**



- How O&M affects plant financial performance
- O&M cost modeling assumptions for levels of repairs and replacements
- Performance ratio modeling: when are O&M costs justified?



O&M Affects Financial Performance

“IF A PROVEN AND SUCCESSFUL O&M PROTOCOL IS IMPLEMENTED WITHIN THE SYSTEMS INITIAL DESIGN AND FINANCIAL MODELING, THEN PLANT PERFORMANCE IS IMMEDIATELY INCREASED AND LONG TERM O&M COSTS ARE REDUCED.”

OBJECTIVES OF A SECURE O&M PLAN

- **MAXIMIZE PERFORMANCE**
- **MINIMIZE RISK**
- **MAXIMIZE ROI**



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O&M Affects Financial Performance

Minimizing Risk:

- Will the EPC still be around to backup guarantees?
- Will the OEMs be around to back up warranties?

Solution -

O&M Affects Financial Performance

Maximizing ROI:

- Increasing the system availability will increase the performance
- Increasing the performance ratio will increase the revenue and ROI

Solution -

O & M Cost Modeling

CHECK LIST

- 1. Size and type of Plant (remote or fully manned)**
- 2. Mandatory manufactures PM warranty schedule (total man-hours)**
- 3. Annual Medium and High Voltage scheduled PM**
- 4/ Site maintenance (fencing, erosion, security, lighting, vegetation, pest control)**
- 5/ Monitoring, DAS, weather station calibration**
- 6/ Annual wash as per system design criteria (to wash or not to wash? That is the question!)**
- 7/ Unscheduled, unpredictable work-----Contingency O&M Budgets**
 - Yr-1**
 - Yr-2**
 - Yr-3**

Performance Ratio Modeling

- Performance ratio design and modeling
 - Considered the DNA of a Solar PV plant
 - Basis for ROI and IRR

- Often overlooked within Construction
 - Under long, tight budgetary constraints
 - Most certainly within the long term O & M protocol of the asset

Performance Ratio Modeling

We have become experts in the intrinsic analysis of performance ratio modeling and its effects on real world systems.



If the default overall DC to AC derate factor of 0.77 is not appropriate for your PV system, you may use this calculator to determine a new value by changing one or more of the component derate factors in the table and clicking the "Calculate Derate Factor" button. You may enter values within the ranges shown in the table. Values outside the ranges are reset to the default values by the derate calculator. The new overall DC to AC derate factor may be hand entered, or copied and pasted, into the "DC to AC Derate Factor" field on the PV Systems Specifications section of the PVWATTS input form. Click on **HELP** below the table for information about DC to AC derate factors.

Calculator for Overall DC to AC Derate Factor

Component Derate Factors	Component Derate Values	Range of Acceptable Values
PV module nameplate DC rating	<input type="text" value="0.95"/>	0.80 - 1.05
Inverter and Transformer	<input type="text" value="0.92"/>	0.88 - 0.98
Mismatch	<input type="text" value="0.98"/>	0.97 - 0.995
Diodes and connections	<input type="text" value="0.995"/>	0.99 - 0.997
DC wiring	<input type="text" value="0.98"/>	0.97 - 0.99
AC wiring	<input type="text" value="0.99"/>	0.98 - 0.993
Soiling	<input type="text" value="0.95"/>	0.30 - 0.995
System availability	<input type="text" value="0.98"/>	0.00 - 0.995
Shading	<input type="text" value="1.00"/>	0.00 - 1.00
Sun-tracking	<input type="text" value="1.00"/>	0.95 - 1.00
Age	<input type="text" value="1.00"/>	0.70 - 1.00
Overall DC to AC derate factor	0.77	<i>(PVWATTS Default)</i>

Calculate Derate Factor

Promising Greater Returns with Greater Performance

Performance Ratio Modeling

By identifying each impactful PR item we implement our protocol and raise the bar



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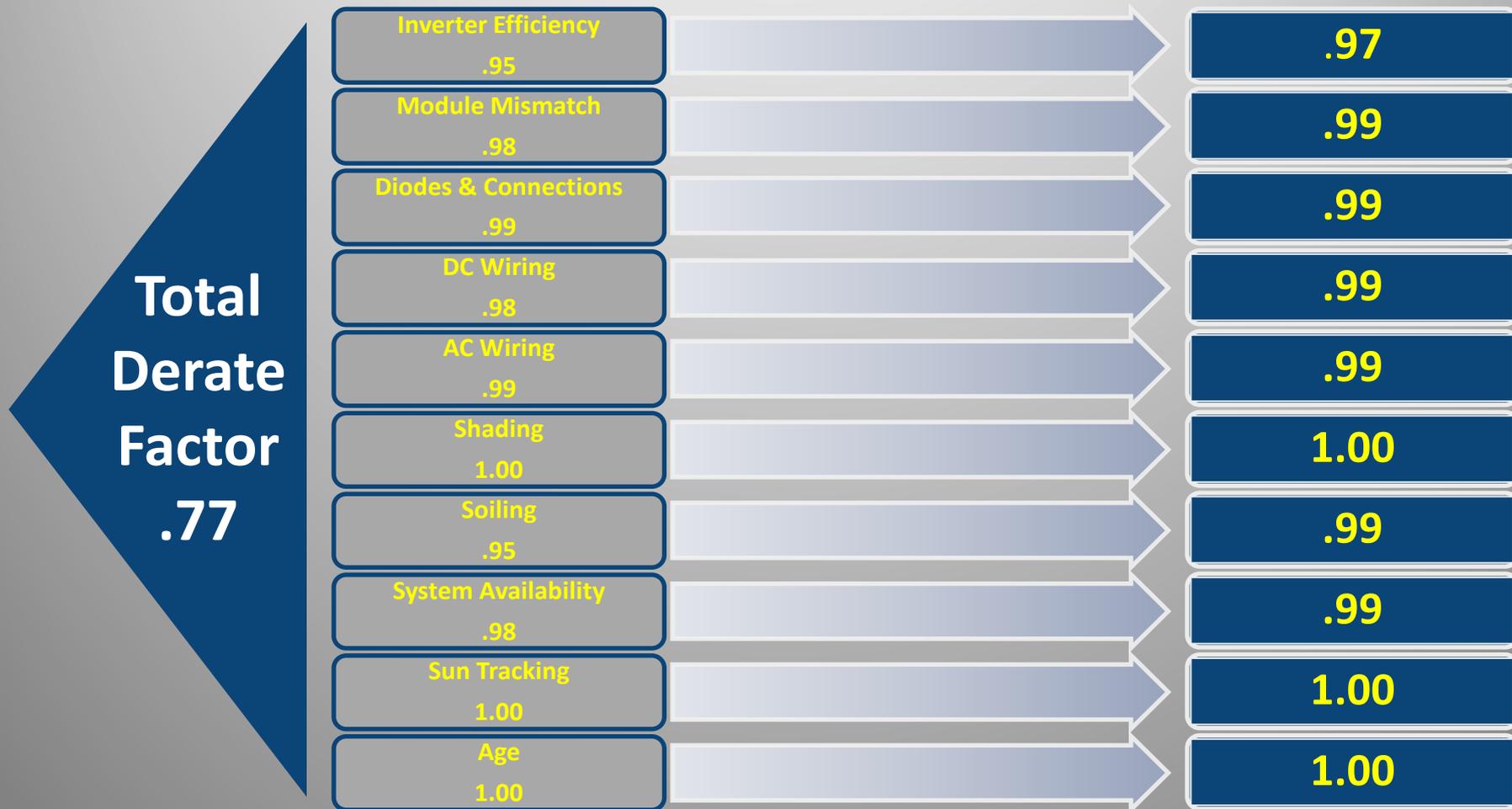
Calculator for Overall DC to AC Derate Factor

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Diodes and connections	<input type="text" value="0.995"/>	0.99 - 0.997	INSTALLATION
DC wiring	<input type="text" value="0.98"/>	0.97 - 0.99	
AC wiring	<input type="text" value="0.99"/>	0.98 - 0.993	
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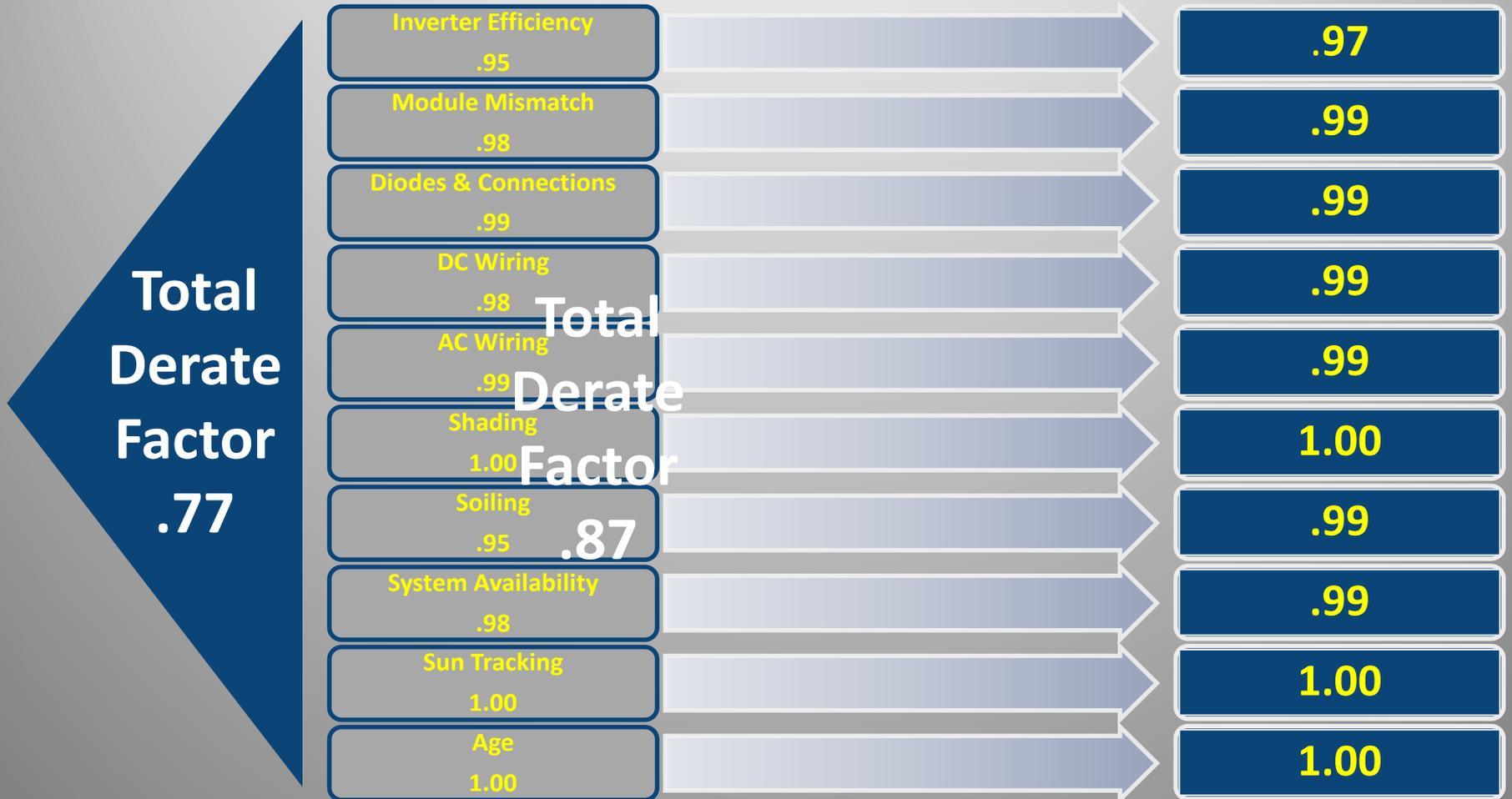
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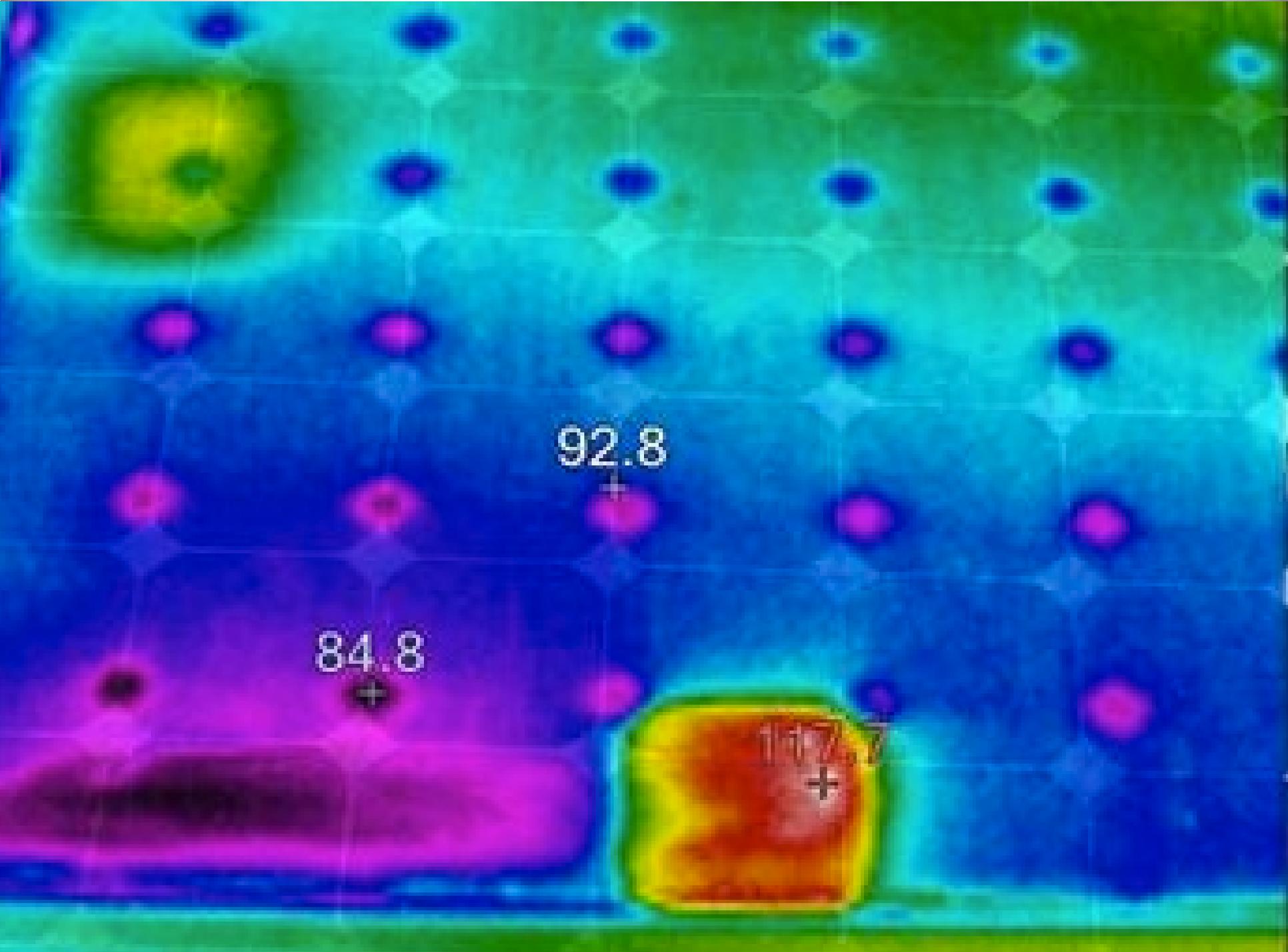


Promising Greater Returns with Greater Performance

Proactive Maintenance

➤ Visual Inspection of
Arrays





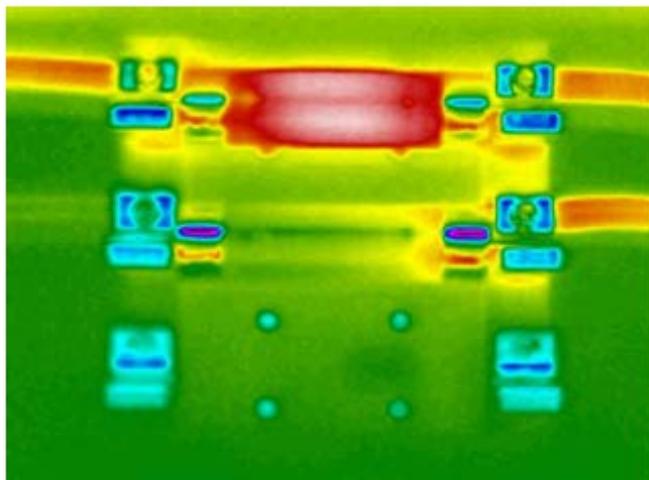
Site Location:

Safeway - Vons
369 Magnolia Ave.
Corona, CA 92879

THERMAL IMAGE REPORT

Date: 07/29/09

Description of Image:
Sub-combiner # 3



Sub-combiner #3 073009.is2
7/29/2009 10:56:17 AM



Visible Light Image

NOTES:

See non-conforming report # 0709-08 for more information on improper bussing. Thermal image shows large temperature variations between the two parallel fuses. See non-conforming report # 0709-02.

ALIGRO

ORDEN DE DESCARGA

DE LA COMISION O

ALCA FOR ANGELO

DE LA CIUDAD DE

BUENOS AIRES

REPUBLICA ARGENTINA

EN VIRTUD DE LA

LEY 13.012 DEL 27 DE

NOVIEMBRE DE 1966

Y SU MODIFICACION

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DE LA COMISION

WIRE SHIELD (TW) E51583 (UL) 400 VOLT (600 V) 73

GND

Spot
TRS 100R
100A
600V AC
600V DC
Shawmut

INV







FINAL THOUGHTS

1. Identify and analyze what are the performance guarantees and obligations
2. What RELIABLE level of O&M (skilled manpower) is required to fulfill the guarantees and obligations
3. Has a long term O&M solution been considered within the plant design and financial model AND CONSTRUCTION
4. What are the risks, liabilities and damages for under performance and not hitting the benchmark?
5. What are the most important Components of the long term O&M Process and Protocol?



Promising Greater Returns with Greater Performance

QUESTIONS?

Rue Phillips

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