# EPC Perspective

## McCarthy Building Co.

# Kyle Phelps

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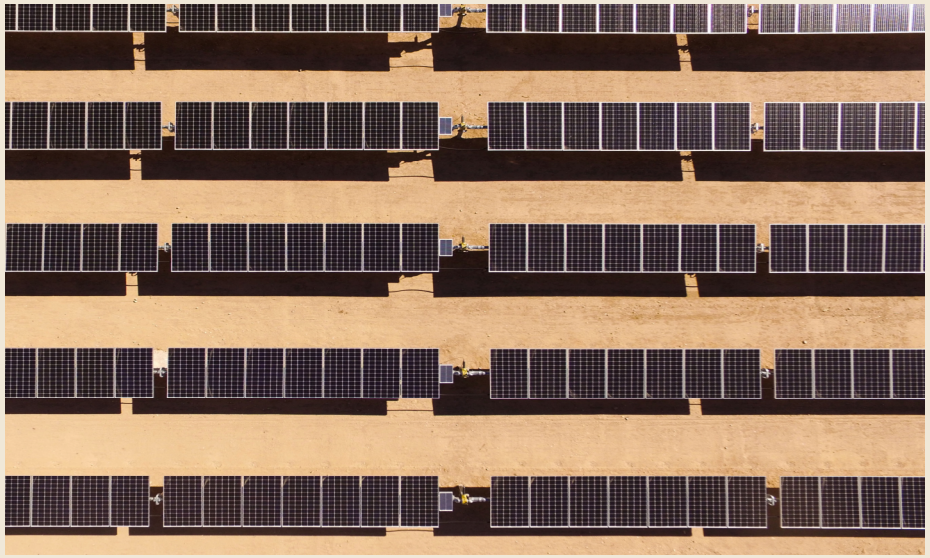
# Overview

- Field Findings
- EPC Enhancements
- Mitigation Efforts



Field Findings

# Top 5 Warranty and Quality Topics ’23

1. Medium Voltage Cable/Electrical Utilities
2. Electrical Harness/PV Connector Failures
3. Material Storage/Shakeout
4. Rodents
5. Civil Erosion

Improper tooling

*Evidence of improper tooling used for torquing*

Improper tooling

*Pliers/ Channel Locks marks*

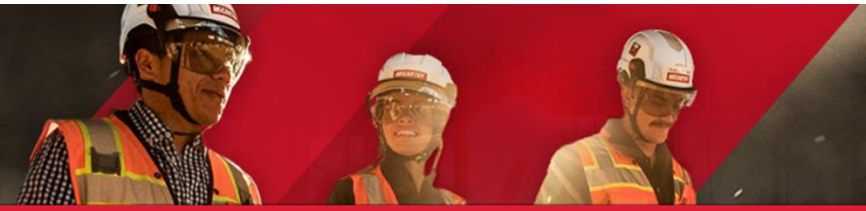
Opened connector

*Open connector, not fully engaged.*

Opened connector (particles inside)

*Visible debris or foreign particle inside connector body*

Field Findings



RENEWABLE ENERGY

# QUALITY FLASH

**Date:** Amended 8/16/23

**Project/ Department:** RE Electrical Department- Contact: Kyle Phelps PhelpsKDPhelps@mccarthy.com

**Product Information:** Mc4 and TE2 type connectors

## WHAT YOU NEED TO KNOW/ SUMMARY:

### PV Connector Quality Flash

Recently our projects have seen an uptick in PV connector failures. These failures are currently under investigation. Please review the recommendations below. There are five follow up action items below for all project teams to review to potentially mitigate.

## PROCESS INFORMATION:

**PV Wire Management**

## KEY FINDINGS:

Connector failures may be caused by inadequate air flow, overheating, UV degradation, or faulty connections. Please review the following action items.

## RECOMMENDATIONS/ FOLLOW UP:

- **Bundling connectors together may contribute to inadequate air flow and overheating. The recommendation is to avoid bundling more than 3 connectors together. (see figure 3)**
- **Locating connectors inside split-loom or any other conduit may contribute to inadequate air flow and overheating. The recommendation is to avoid locating connectors inside split-loom. (see figure 4)**
- **UV light can degrade the connector and increase the temperature. The recommendation is to locate all connectors behind the panel and out of direct UV exposure. See correct connector location circled in green in figure 1.**
- **Field made connections can expose the cabling to environmental conditions and affect the connections integrity. Please be advised that field made connections are the exception rather than the rule. Field made connectors are currently allowed only as a last resort. (see figure 2)**
- **Perform an assessment of these conditions in work completed and future work, including potential mitigation measures to review with project and quality leadership.**

## PHOTOS/ DRAWINGS:

Figure 1

Figure 2

Figure 3

Figure 4

# How Can An EPC Enhance Connector Reliability?

- Innovative Technology
- Early Identification

# McCarthy | OnSight

How is McCarthy using OnSight technology?

## Pre-energization inspections

- Module cracking inspections
- Wire management inspections
- Module bar code scanning.
- SWPP Inspections

## Post-energization inspections

- Connector health monitoring
- Module performance and temperature reading
- O&M remediation
- Vegetation monitoring
- SWPP Inspections
- Gauge readings
- Substation thermal monitoring
- Wildfire monitoring

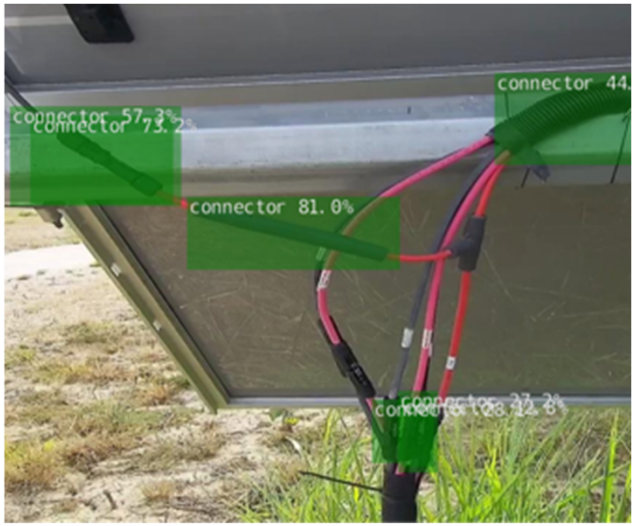
## Current status of development

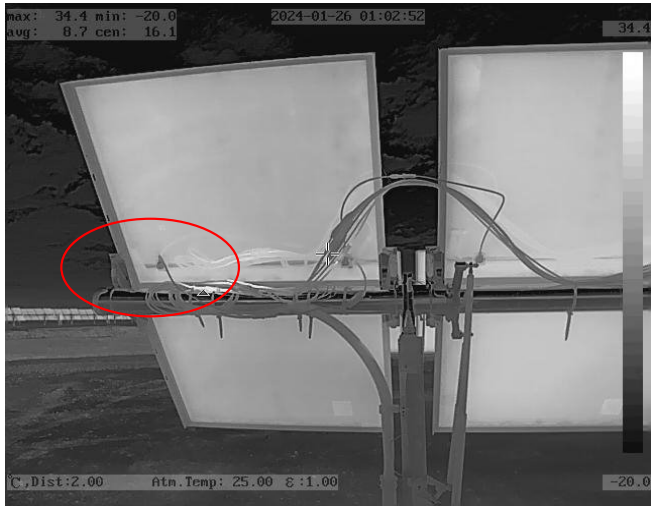
- GIS
- Reporting – Data workflow, PROCORE & GIS Data Integration

# OnSight Findings

McCarthy's RE Quality Group is leveraging OnSight Technology's robots and machine learning to Identify leading indicators of connector health and quality.

- Preventive plant maintenance
- OnSight works within McCarthy's existing quality processes, providing a differentiated quality product.



# Mitigation Efforts

- Craft Training
- Design
- Best Practices

# Mitigation Efforts

- Craft-focused manufacturer training. McCarthy's craft workforce is engaging with connector manufacturers to ensure qualified personnel are accomplishing connector repairs.
  - McCarthy has had approximately 90+ personnel trained and certified by Staubli.
- Design-focused – Efforts are made through procurement to ensure no intermating of connectors.
- Verification of ULs on integrated wire harness solutions through 3rd party testing proves to be a "worthwhile" cost to EPCs.

**NEC COMPLIANCE RISK**

- Article 690.33(C) of the 2020 NEC states "*Where mating connectors are not of identical type and brand, they shall be listed and identified for intermatability, as described in the manufacturer's instructions*"
- Product listing as identified in this NEC article is difficult to obtain as it requires long-term cooperation and sharing of intellectual property between competing product manufactures. Because of this, no PV connectors of different brands are currently listed to be used together and it is likely they never will be.
- In other words, **it is impossible to comply to the letter of NEC 690.33(C) when using connectors from different manufacturers**.

## THE PATH FORWARD

**IF POSSIBLE, ENSURE ALL PROJECT PV CONNECTORS ARE OF SAME MAKE AND MODEL**

- Make best efforts during design and procurement phase to ensure that all PV connectors which will mated together are of the same make and model.
  - This resolves all issues related to PV connector intermatability
  - Particular attention should be paid to interface of PV strings with wiring harnesses

# Mitigating Risk

- Concerted efforts to cap all end-of-row connectors.



As Received

- Module manufacturer education.
  - Module manufacturers are providing modules with no connector caps. This further increases connector challenges in the field.

# Summary

- The renewable energy industry lacks guidance around PV connectors.
  - UV exposure, connector temperatures, and UL Standards.
  - Design Build Contractors will continue to struggle to achieve plant life expectancy of 25+ years.
- McCarthy and other EPCs should continually be focused on identifying leading indicators of poor quality and early diagnosis of faulty connectors to prevent plant degradation.
- Risk Mitigation is possible and effective. EPCs need to have plans in place to ensure connector reliability.


THANK YOU