

BUILDING A WORLD OF DIFFERENCE

FIELD OBSERVATIONS OF MODULE FAILURE AND DAMAGE

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PRESENTATION SUMMARY

- **Black & Veatch's PV Qualifications**
- **Module Failure and Damage Case Studies**
- **Q&A**

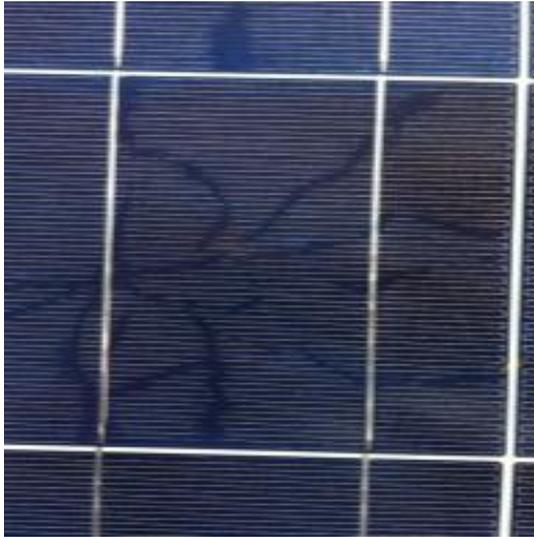


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- **Projects in United States, Canada, Mexico, South Africa, Puerto Rico, Thailand and India**

MODULE FAILURE AND DAMAGE CASE STUDIES

CASE STUDY #1: SNAIL TRAILS



Snail trails and microcracks observed on installed modules.

Lesson Learned: The causes of snail trails should be investigated, monitored, and mitigated by the manufacturer.

CASE STUDY #2: MODULE GLASS CRACKING

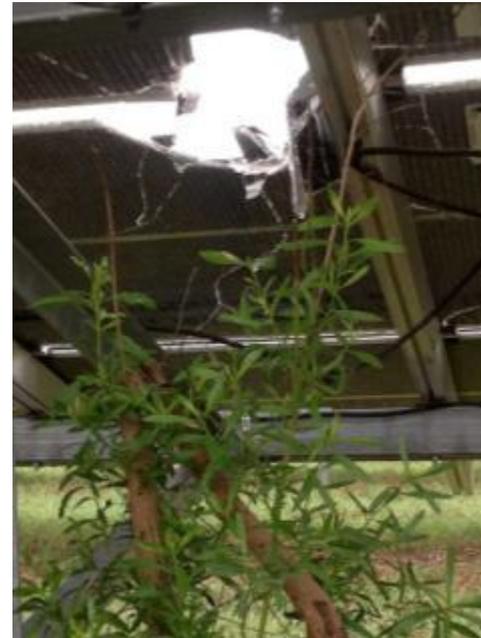
- **Cracks in thin film module glass were observed in one project in a desert climate.**
- **Possible cause: Excessive module deflection at high temperatures.**
- **No thermal breakage seen in crystalline Si modules.**

Lesson Learned: The effects of thermal expansion on racking and modules should be carefully considered in the system design.

CASE STUDY #3: MODULE DAMAGE DURING SYSTEM OPERATION



Module back glass cracked due to rock from mowing equipment.



Broken modules due to growth of tree under modules.

Lesson Learned: Diligent O&M oversight and security is critical in preventing module damage.

CASE STUDY #4: IMPROPER MODULE STORAGE DURING CONSTRUCTION

Water accumulation in modules caused corrosion in junction boxes and connectors.



Lesson Learned: Consider storage environments when designing packaging.

FINAL OBSERVATIONS

- **The vast majority of the modules that we have observed operate properly and do not show damage.**
- **We speculate that less than 0.5 % of modules require replacement before system commissioning.**

THANK YOU & QUESTIONS

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