PRESENTATION SUMMARY

• Black & Veatch’s PV Qualifications
• Module Failure and Damage Case Studies
• Q&A
B&V PV SOLAR SERVICES

- Independent Engineering (IE) for investors and lenders
- Owner’s Engineering (OE) for power producers & utilities
- More than 4,000 MW of on-site construction monitoring experience worldwide
- 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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