Intertek

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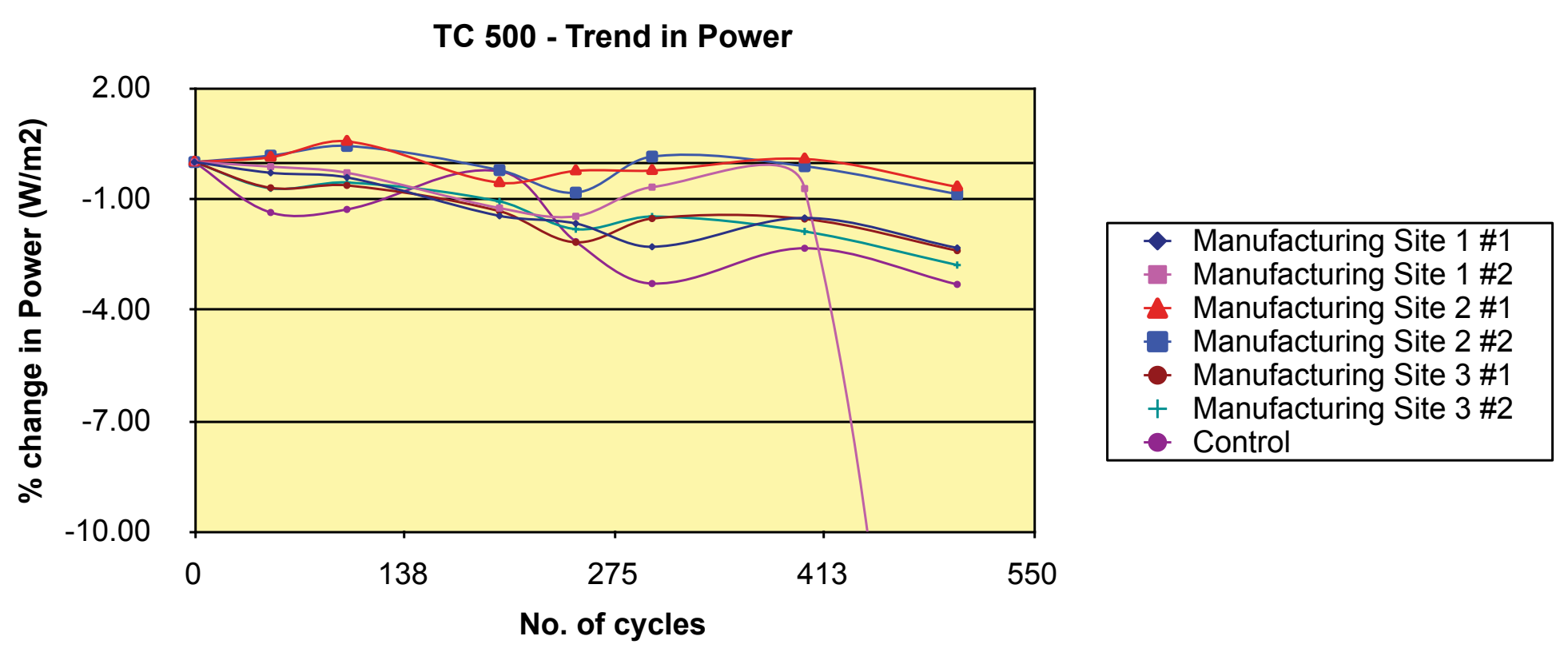
Performance & EL Studies on Single Crystalline Silicon Modules from Three Different Manufacturing Sites Exposed to TC 500 and Damp Heat 2500 Hrs

A study was initiated to determine if differences could be detected in modules constructed with the same materials and processes but assembled in different manufacturing locations. To detect changes performance measurements (Isc, Voc, Pmax, Imax, Vmax) were made along with visual and electroluminescent imaging as the modules were subjected to repetitive environmental conditions.

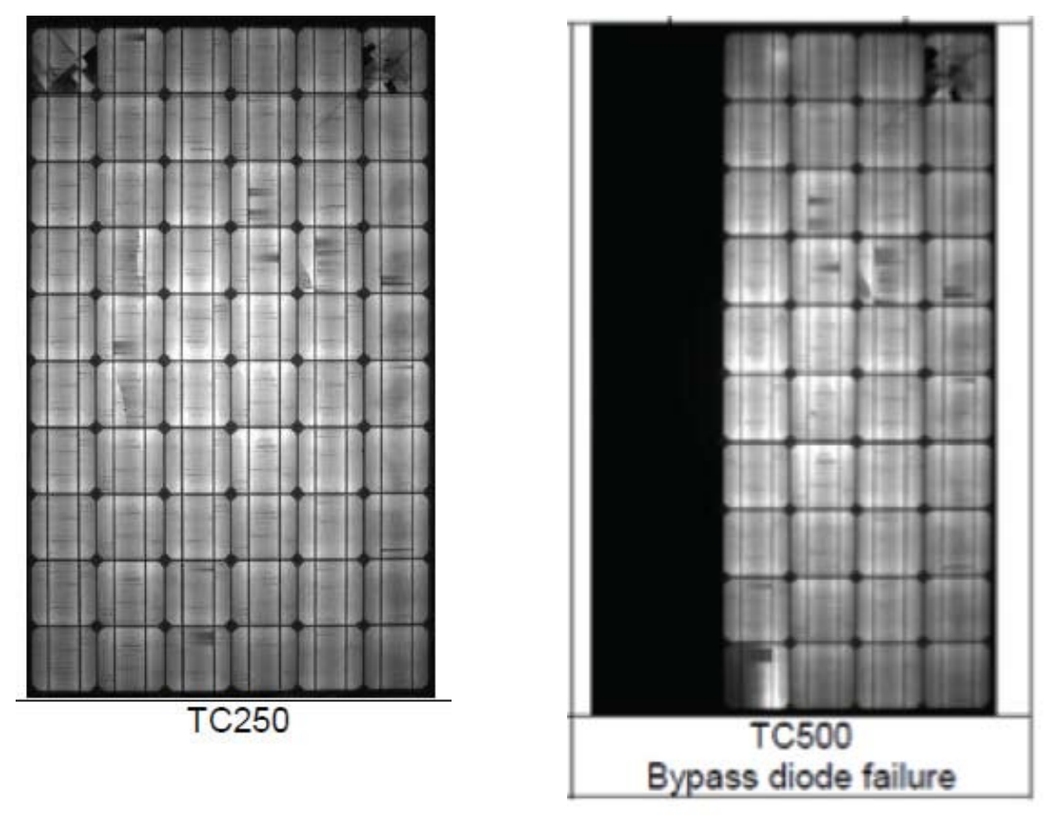
Thermal Cycling

Power Change for Thermal up to 500 Cycles

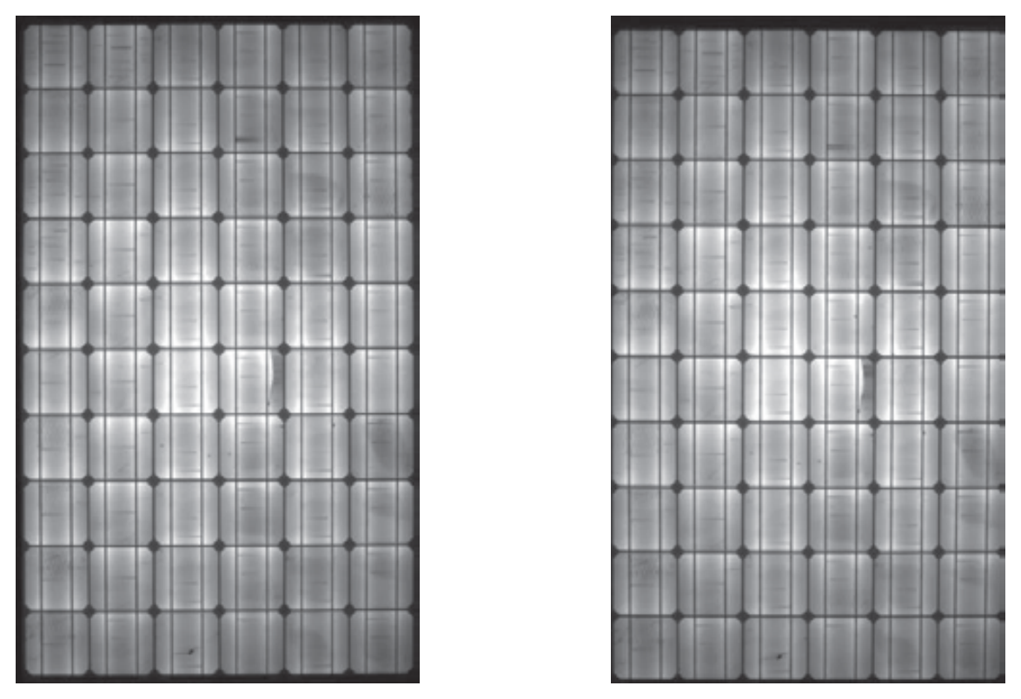


Pmax of Pink Sample decreased by 35% had a diode failure with diode removed the power drop was -2.73%

EL Image of Diode Failure Manufacturing Site 1 #2

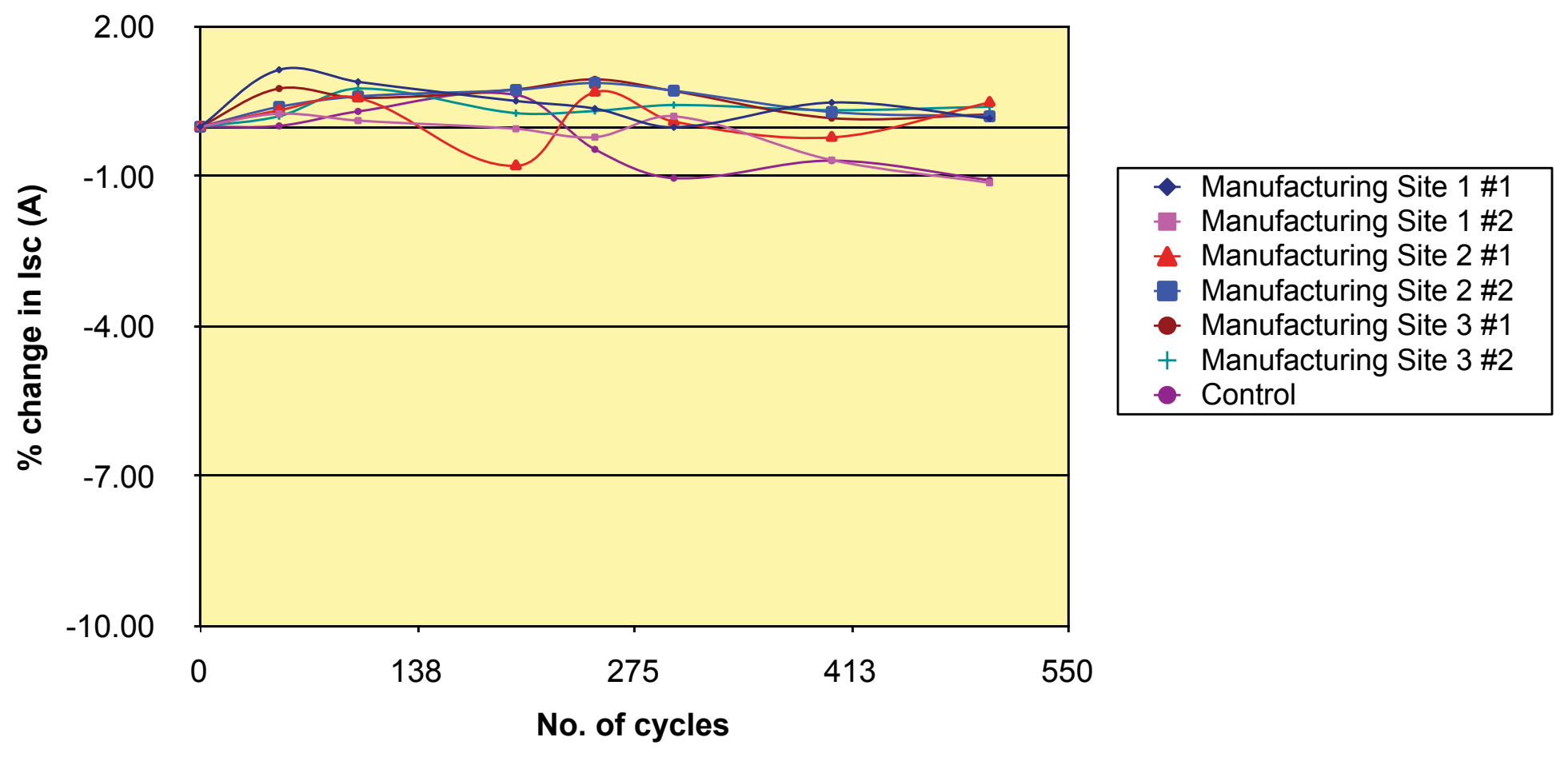


EL Images Manufacturing Site 1 #1

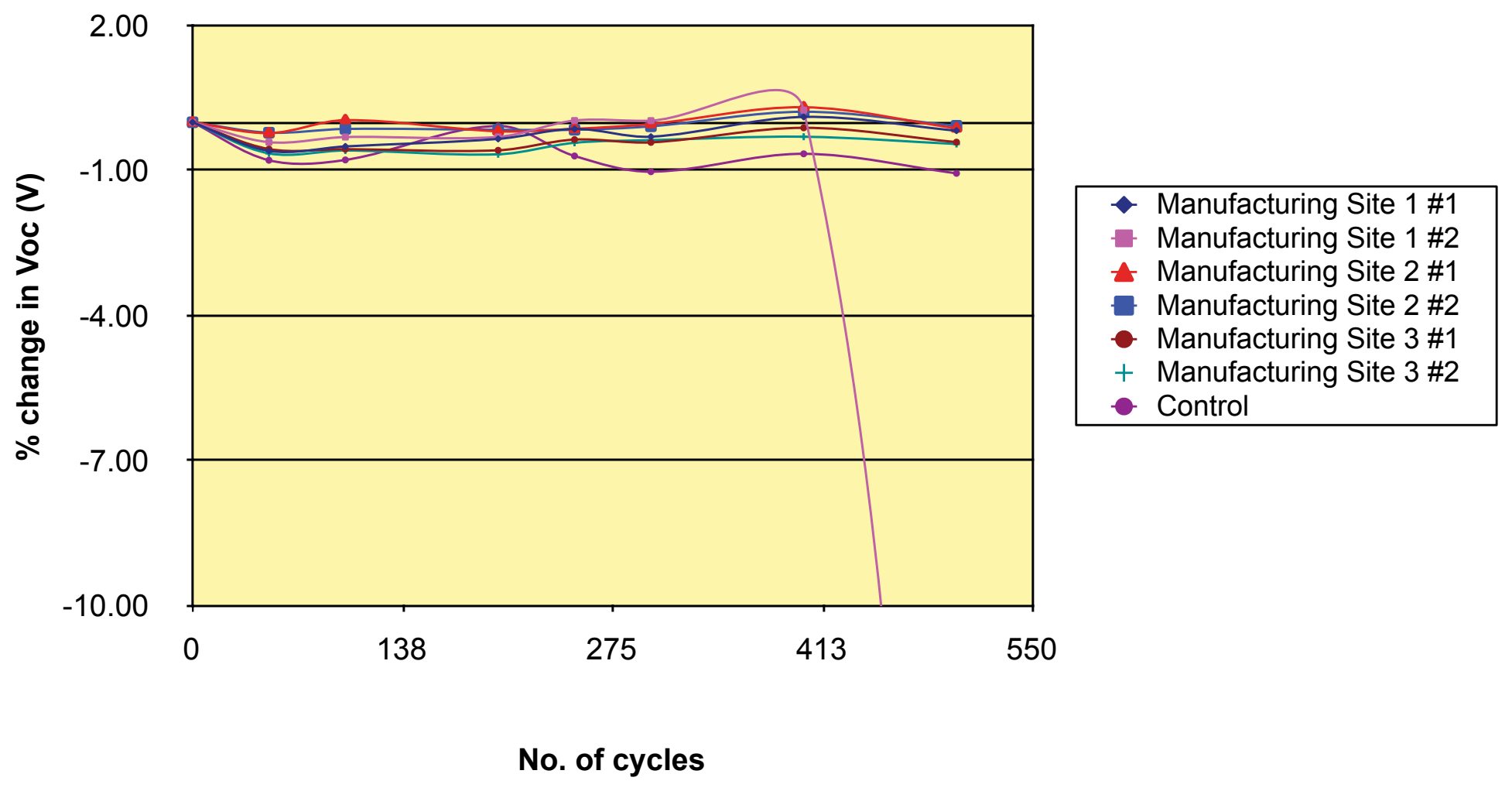


TC250 TC500

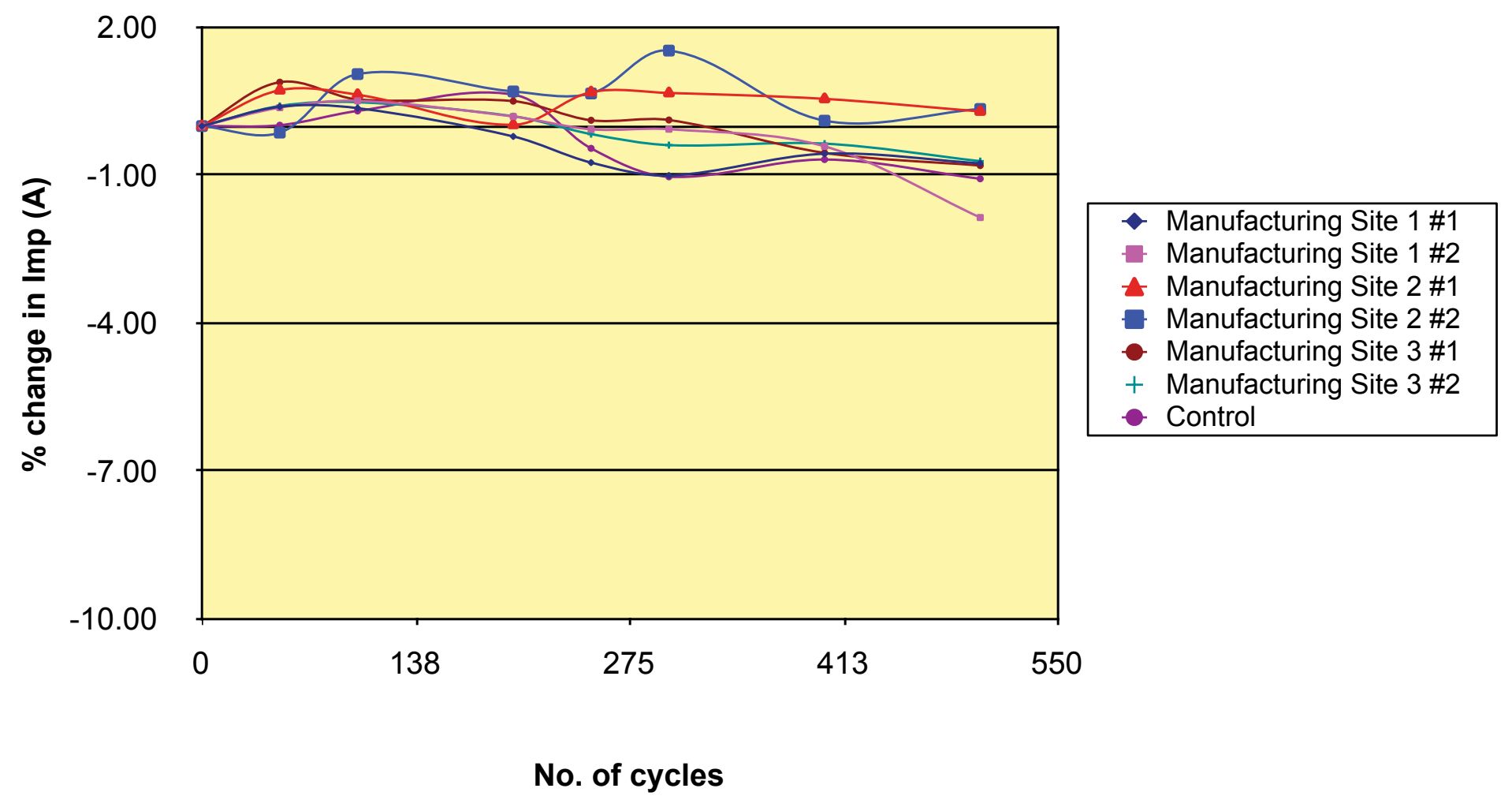
Isc Changes for TC 500



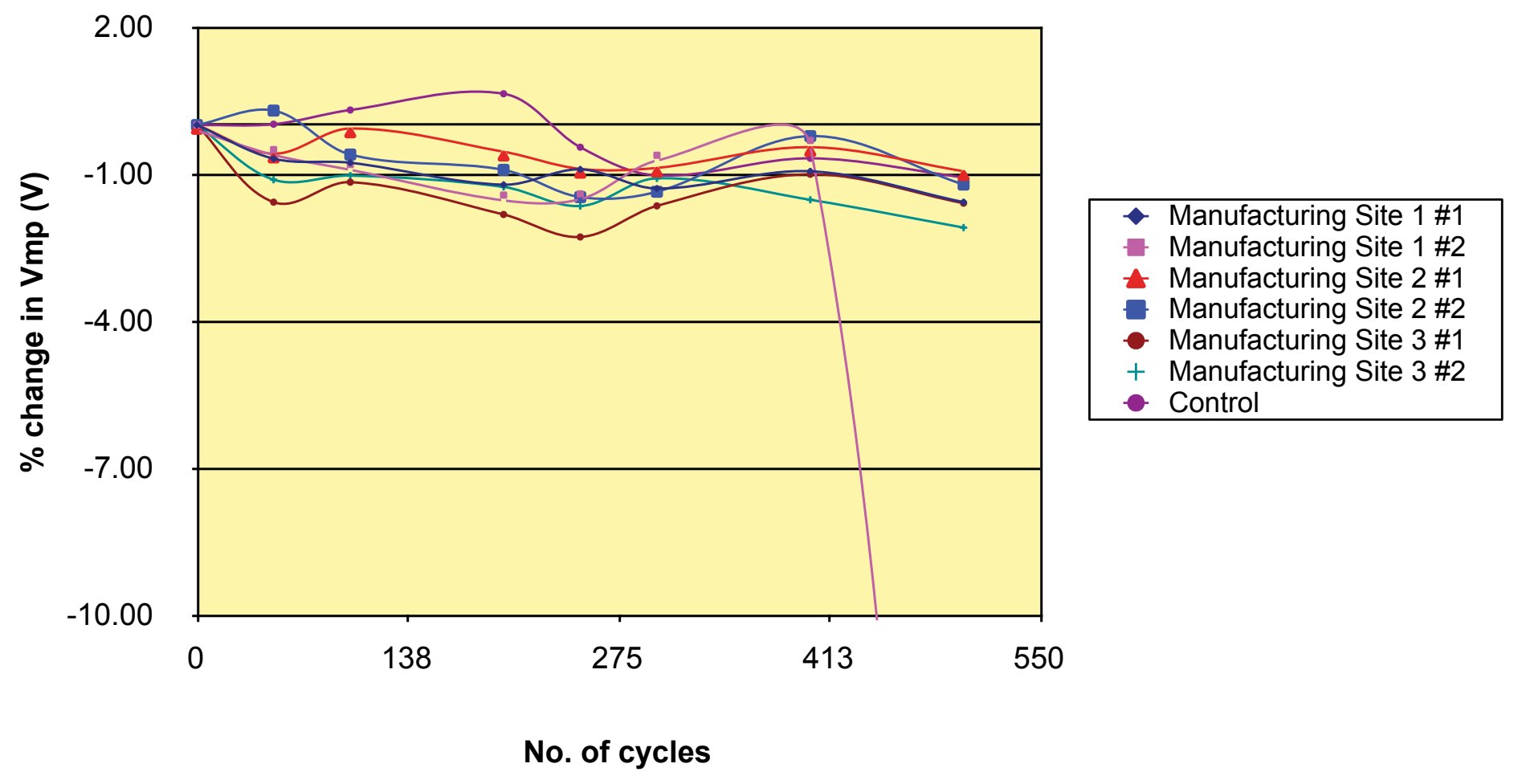
Voc Changes for TC 500 exposure



Imp Changes for TC 500



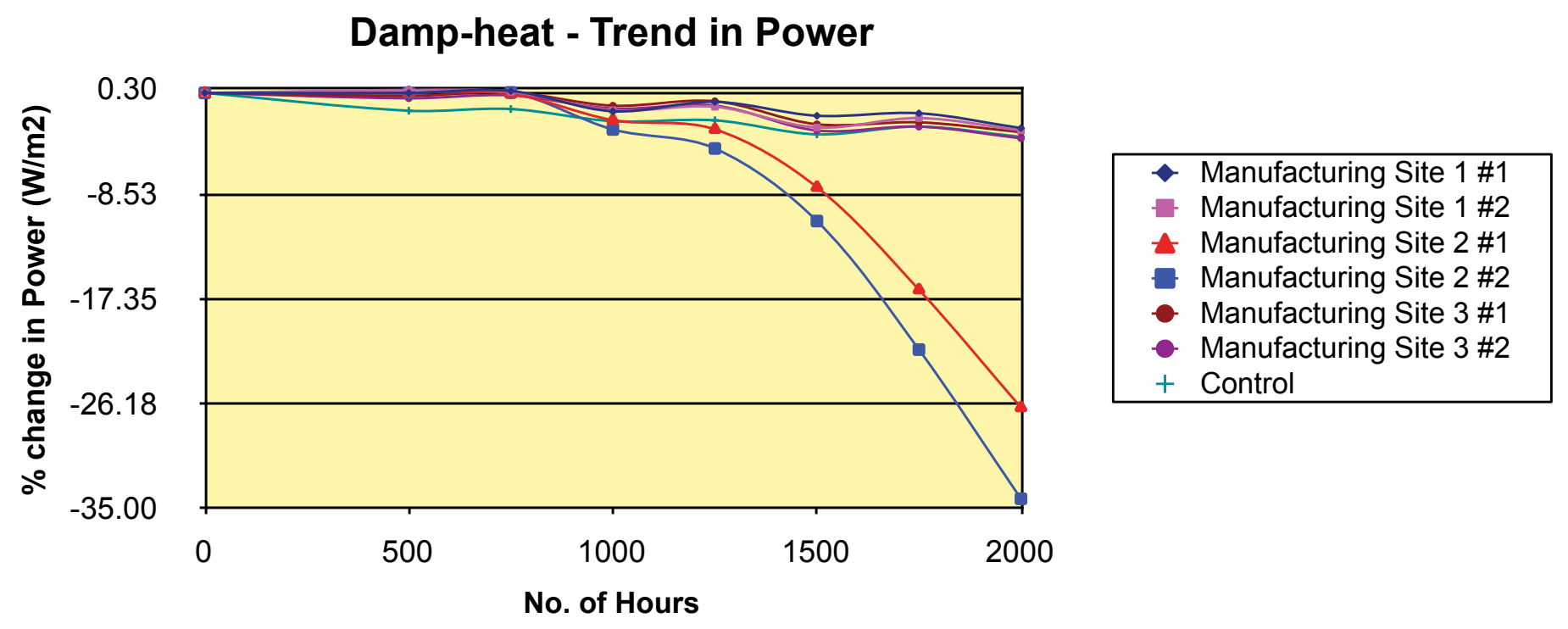
Vmp for TC 500



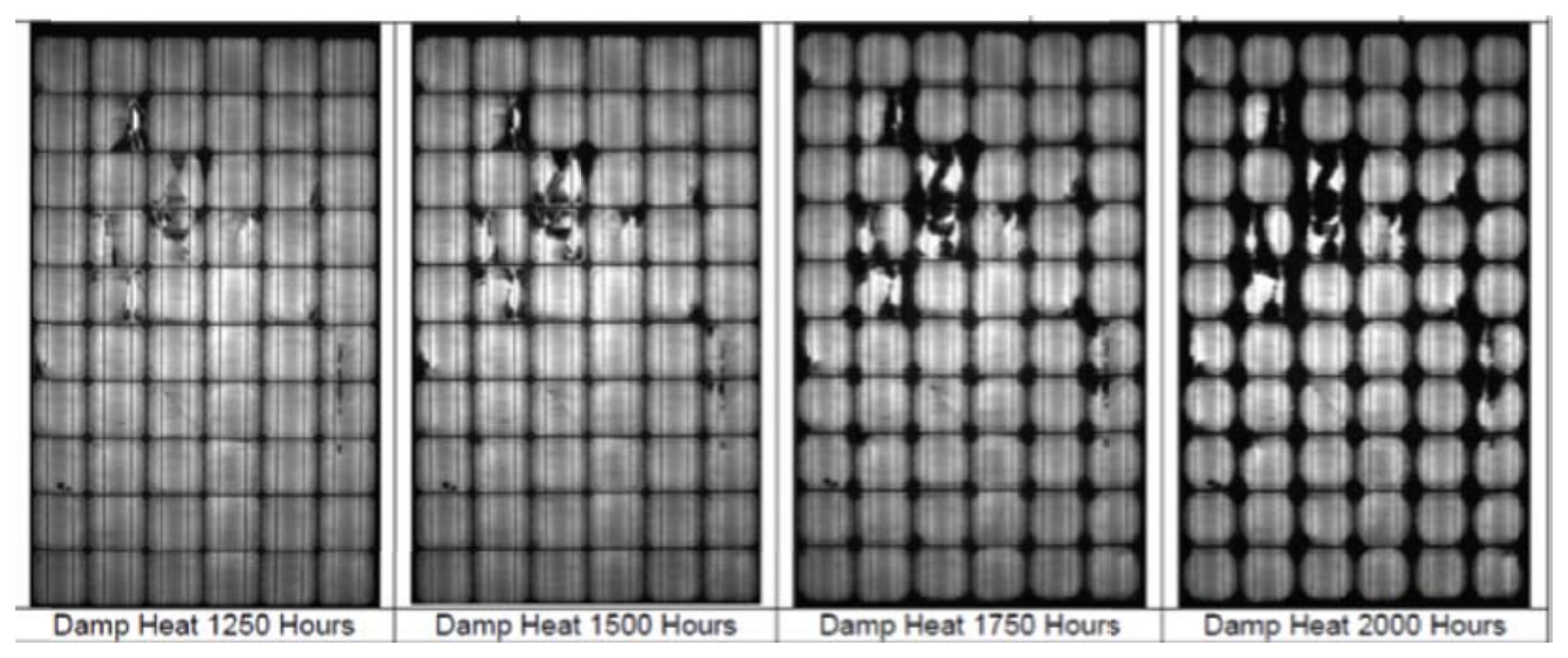
Pink sample dropped by 34%

Damp Heat

Power Change for Damp Heat to 2000 hours

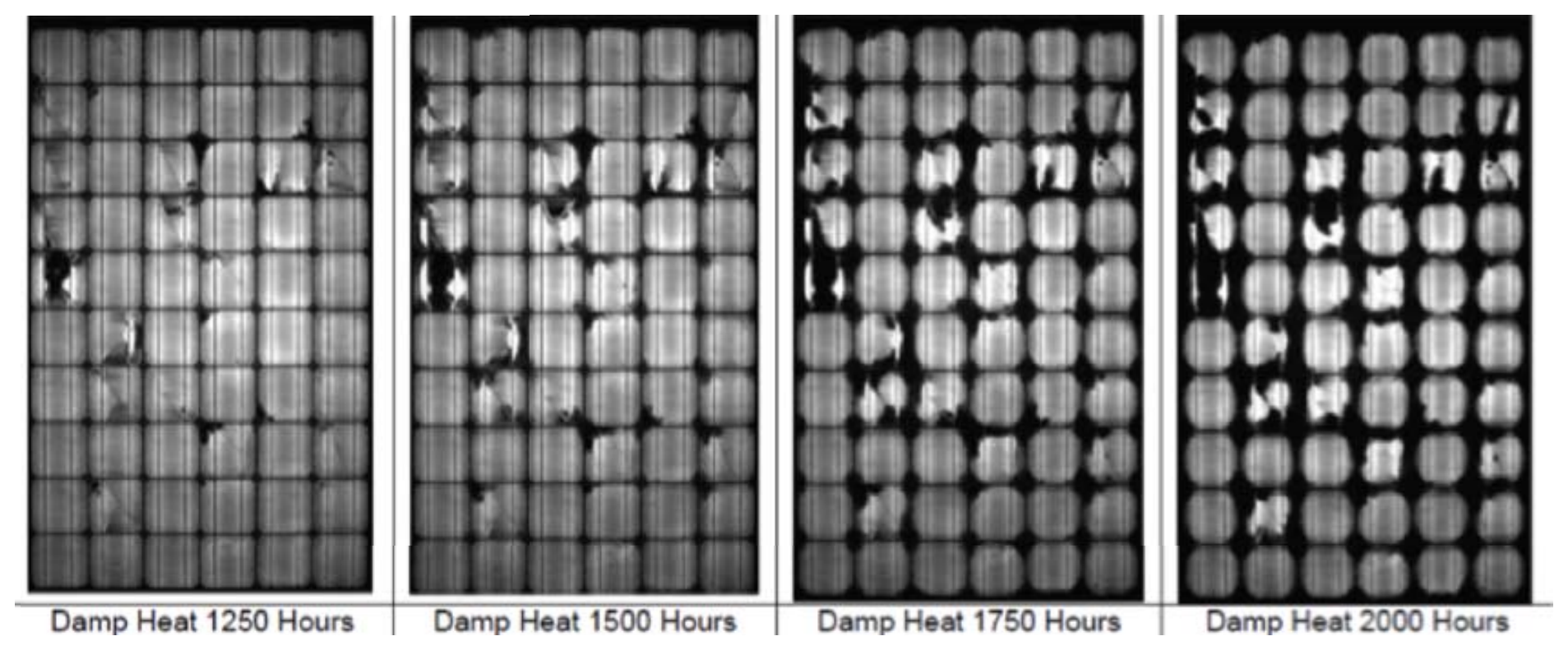


EL Images Damp Heat 2000 hrs Manufacturing Site 2 #1



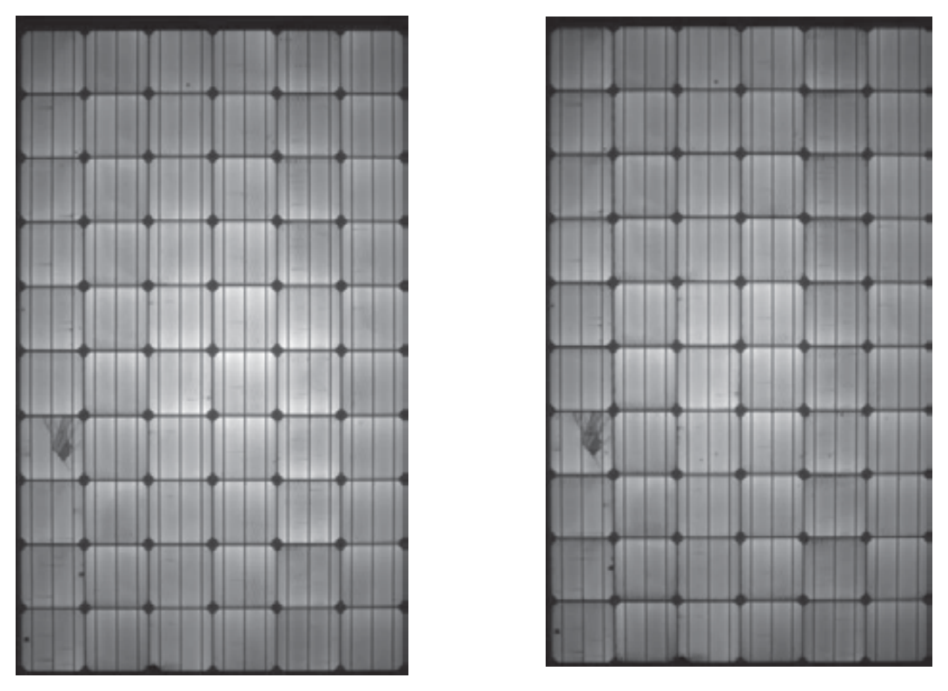
Increased Cell Damage

EL Images Damp Heat 2000 hrs Manufacturing Site 2 #2



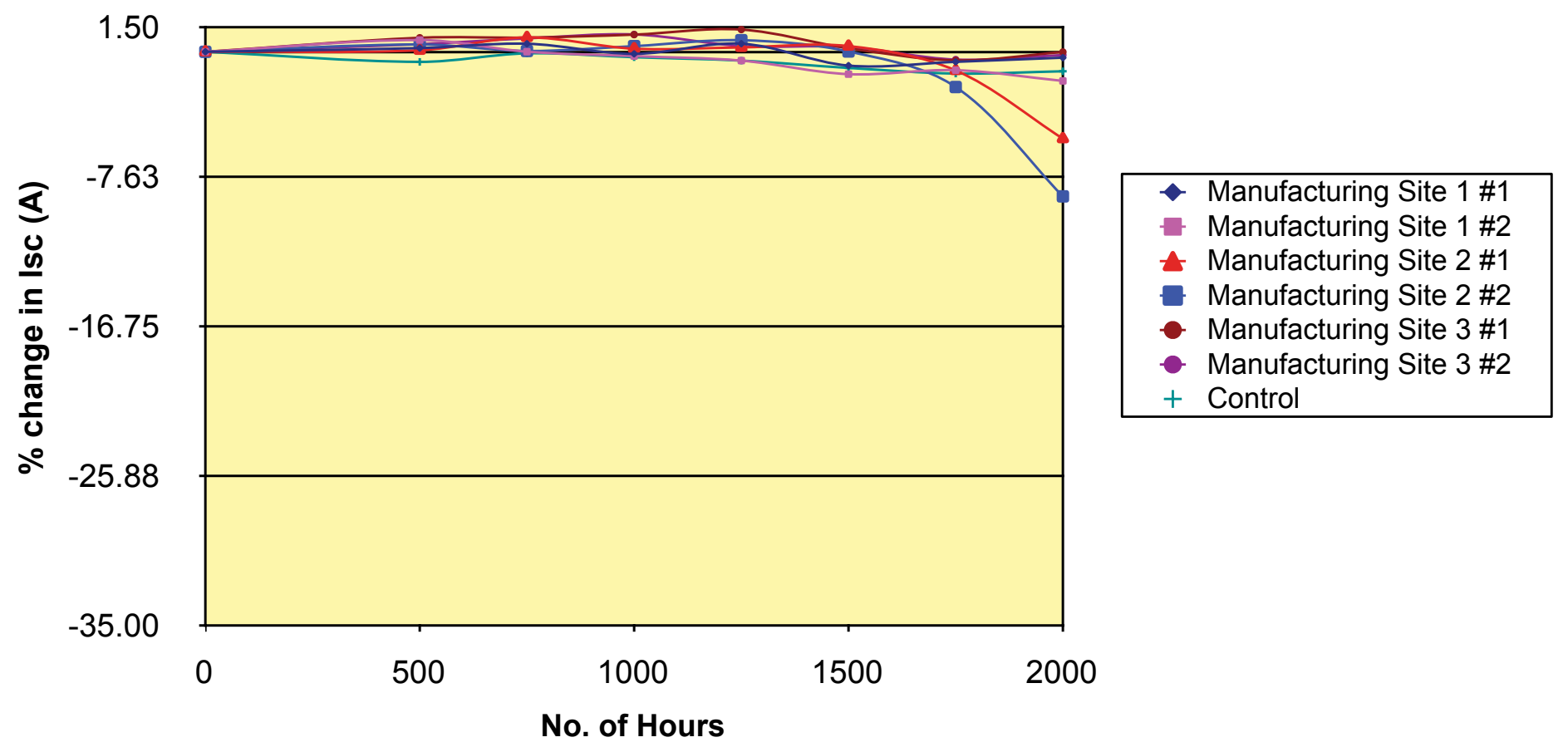
Increased Cell Damage

EL Images Damp Heat 2000 hrs Manufacturing Site 3 #1

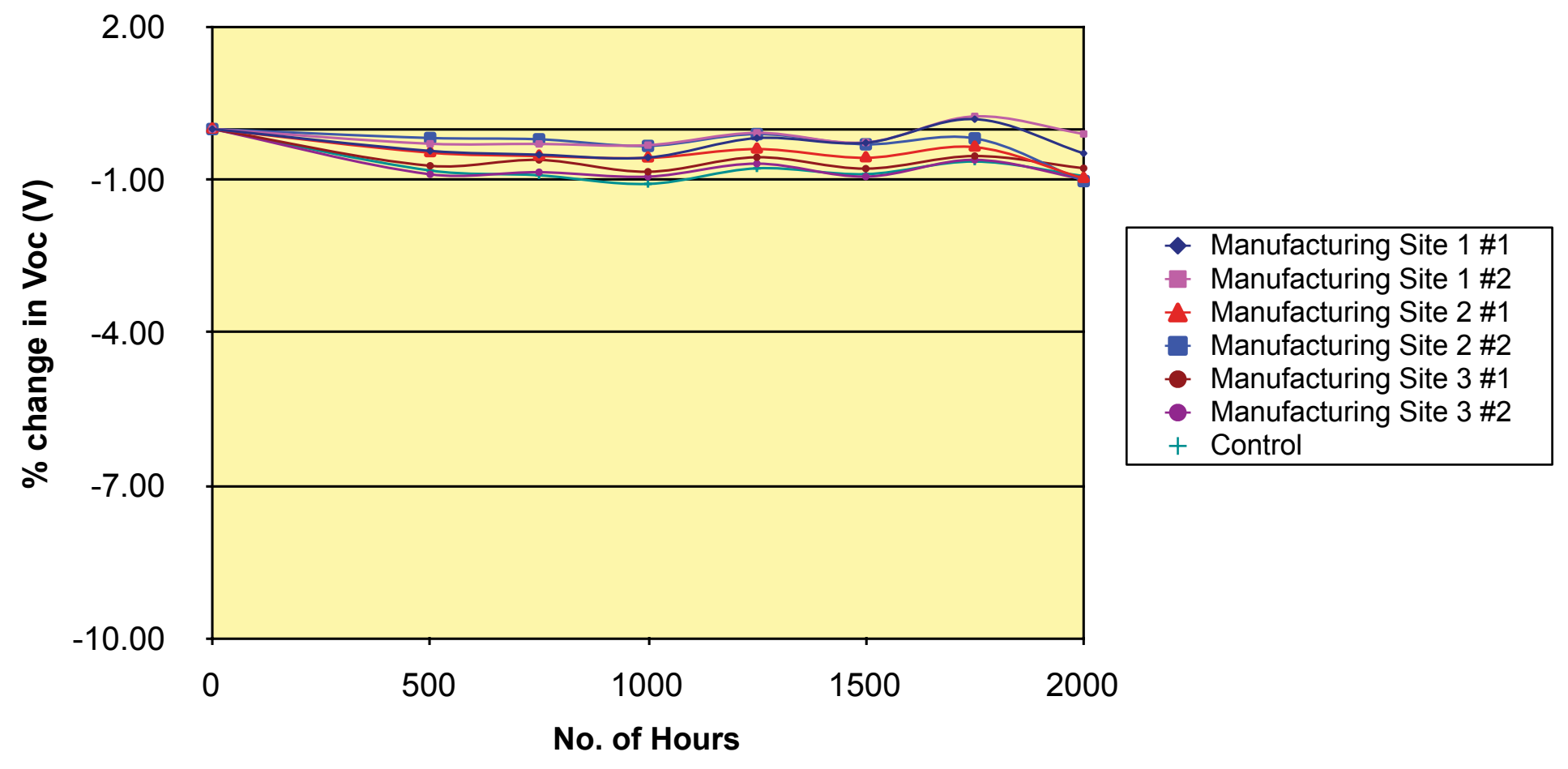


1250 Hours 2000 Hours

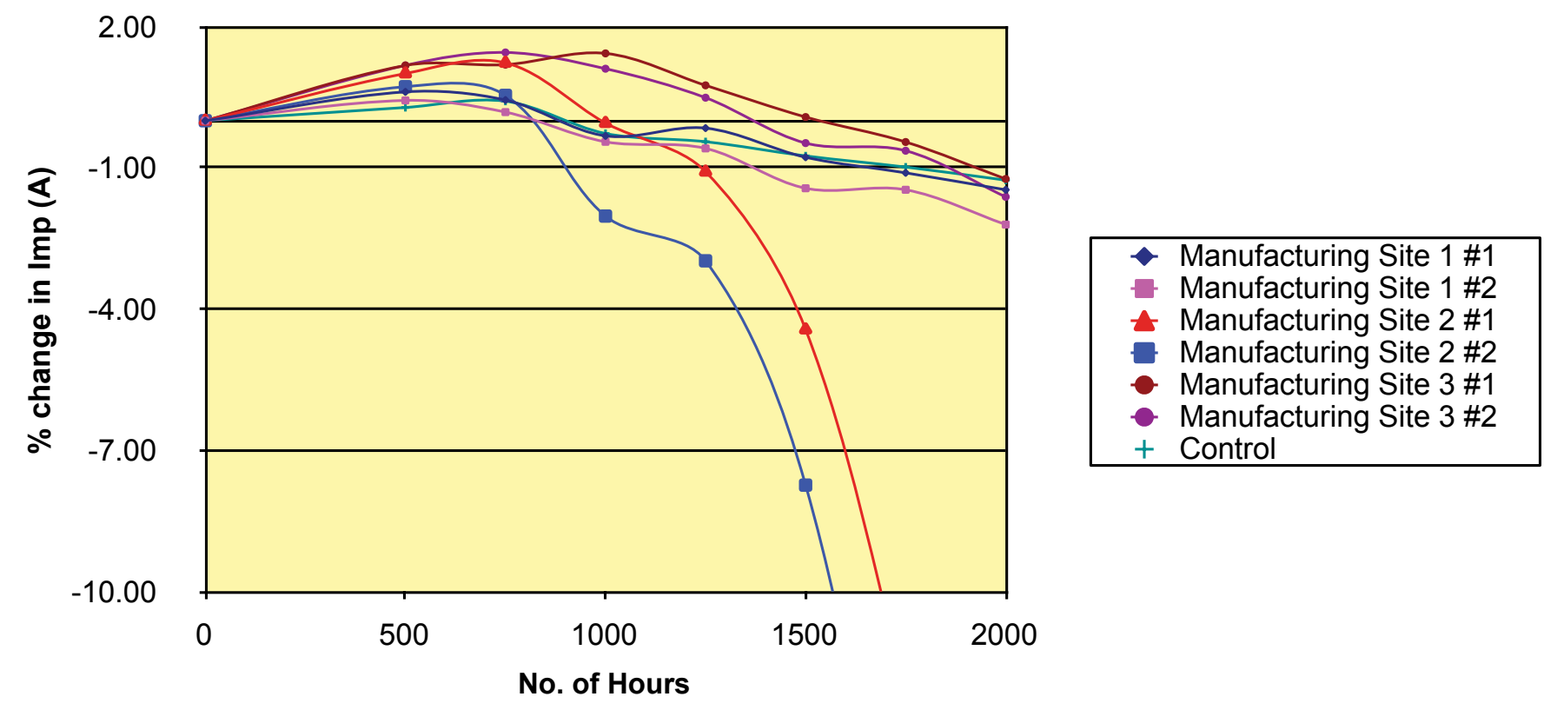
Isc for Damp Heat 2000 hrs



Voc for Damp Heat 2000 hrs

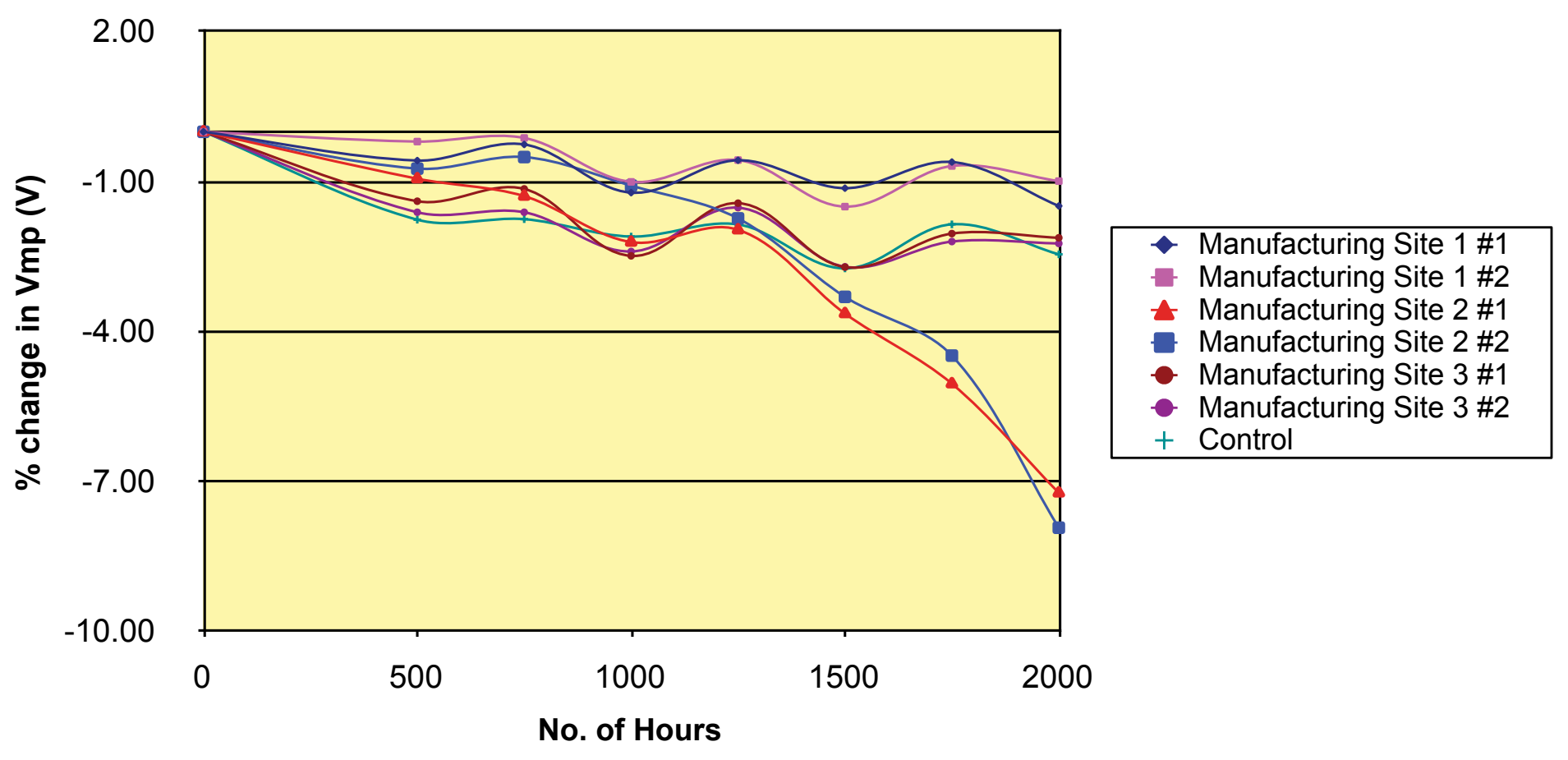


Imp for Damp Heat 2000 hrs



Modules from Manufacturing Site 2 had outdoor exposure for a few months. Visual Inspection showed signs for localized discoloration

Vmp for Damp Heat 2000 hrs



Summary: Three different manufacturing sites have shown different initial failures

- Diode from one site
- Discoloration proved to have shorter life time from a different site
- Implies Process/Materials not the same at each manufacturing site

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