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Smarter Solar™

Modules: Remaining Reliability Challenges

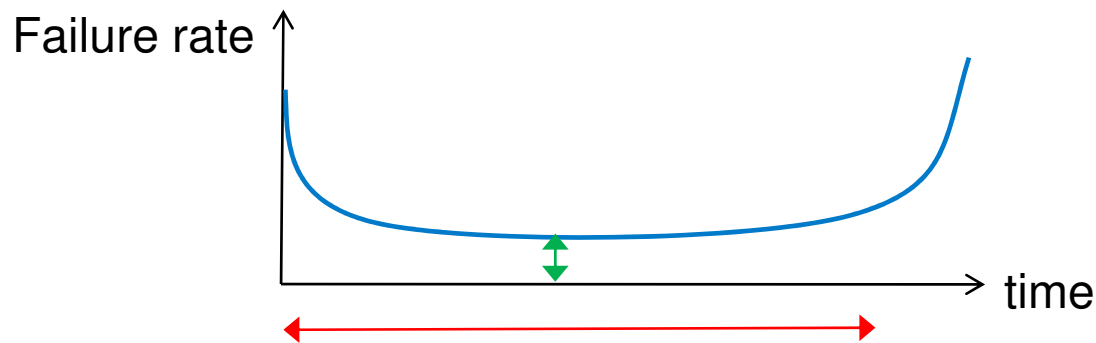
Akira Terao, Principal Reliability Engineer

“Remaining” Challenges

- 25 year warranty
- □ Ill-defined field conditions
- Harsh and varied outdoor conditions
- □ Materials used near their limits
- □ Limited acceleration factor → □ Long tests
- □ Large samples, small sample size
- □ Subtle polymer chemistry
- Cumulative effects, positive feedback loops
- □ New materials, new structures

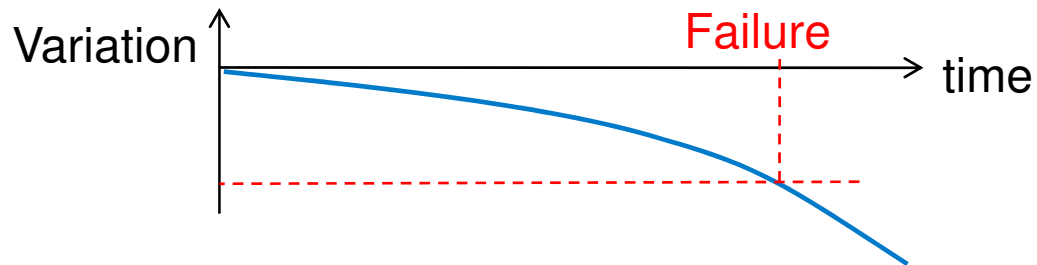
Best approaches

- **Reliability** is easy, **lifetime** is not

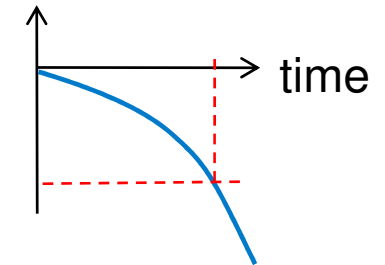


- **Physics of failure**

– Degradation rate:



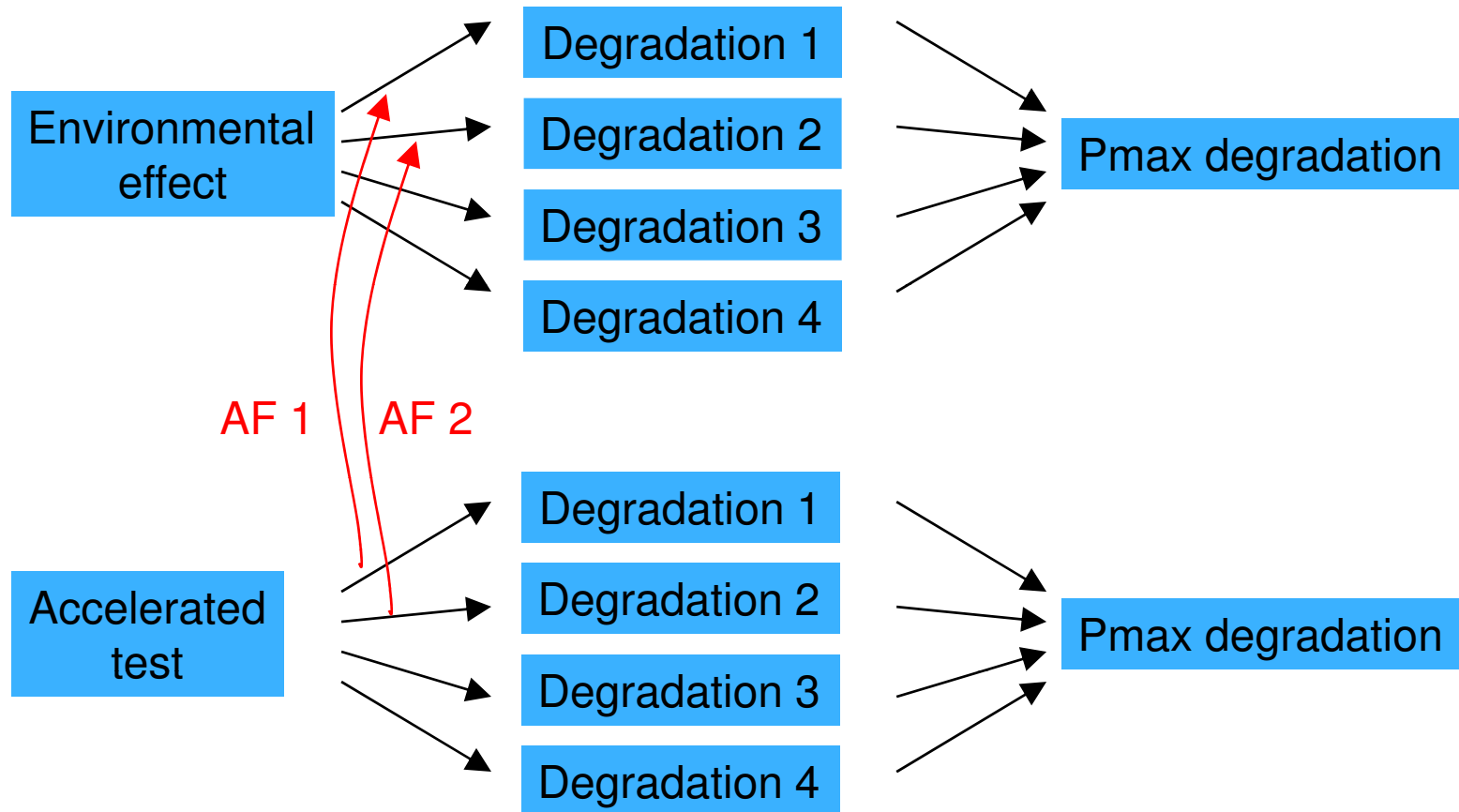
and acceleration factor:



...for **each** failure mode

Physics of failure (cont'd)

– Decomposition:



Physics of failure (cont'd)

- Advantages:
 - Each failure mode can be studied separately
 - Smaller samples can be used
 - Each failure mode can be fully accelerated
 - Different field conditions can be simulated
 - Degradations can be measured even before they affect performance

Advancements needed

- Acceleration factors
 - Standardized definition of field conditions?
- Certification tests
 - Increasing number of designs and materials
 - Increasing range of applications
 - Increasing harshness of environmental conditions (pollution, global warming)
 - Parametric tests?
 - E.g.: TC based on maximum temperature measured