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Project: Solar Variability  
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# Operation's Effect on Solar Receiver Lifetimes

- Considering Solar Power Tower Receivers that use molten salt ( $\text{NaNO}_3 - \text{KNO}_3$ )
- Solar flux is only incident on one side of tubes, which causes significant temperature gradients, thermal stresses, and thermal strains
- Using solar receiver tool (*SRLIFE*) to compare fatigue and creep damage mechanisms to determine primary cause of receiver lifetime failures



Heliostat field and tower receiver at Crescent Dunes CSP plant [1]

example of solar receiver cylindrical configuration [1]

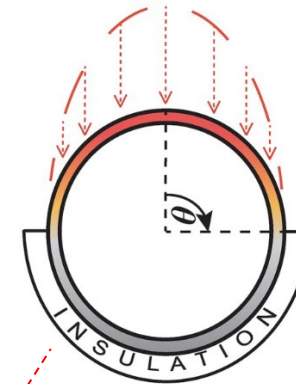
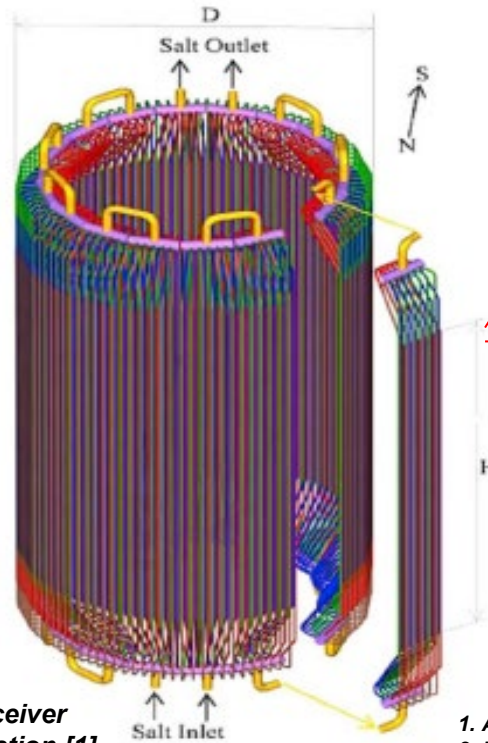
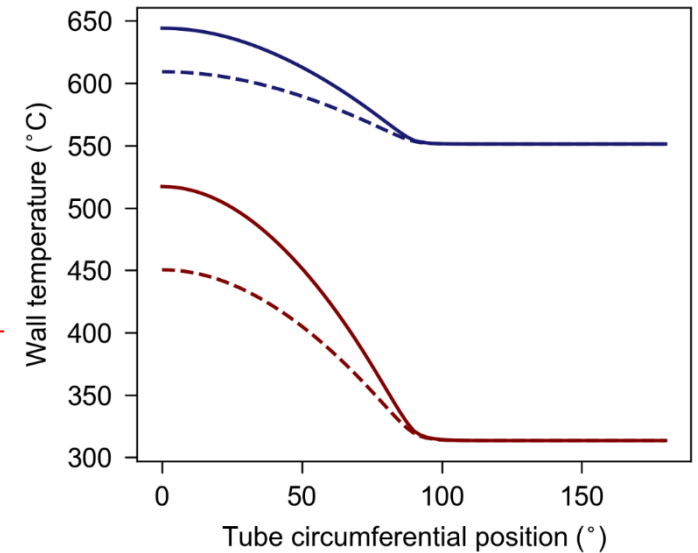


Illustration showing typical tube flux as a function of position. [1]

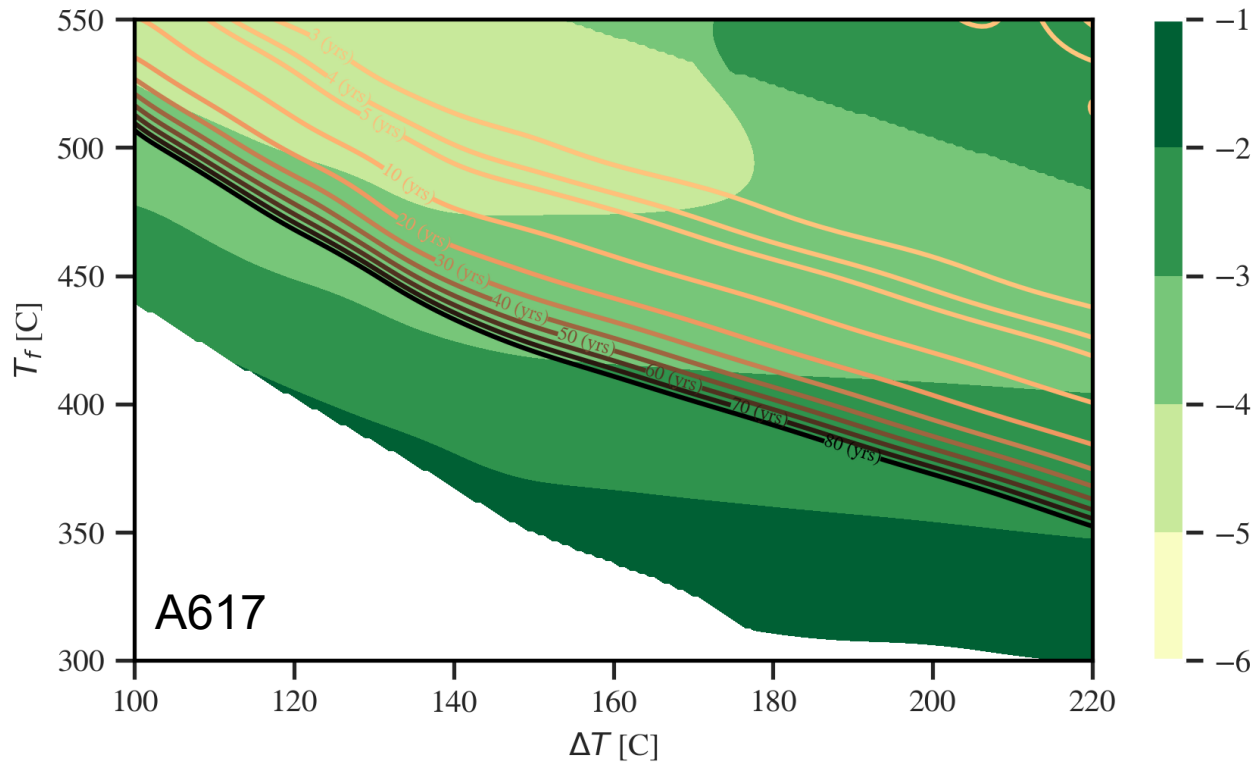


simulated temperature position at  $z=0.5$ , for representative tubes in panel 0 and panel 6 [2]

1. A Review of Steady-State Thermal and Mechanical Modelling on Tubular Solar Receivers by Conroy et al.  
2. Model developed by J. Martinek (NREL)



# Preliminary Results



- (above) lifetime contours and cumulative ratios of fatigue to creep damage for A617 material
- For A617 tubes at high  $T_f$  and low  $\Delta T$ , failure occurs due to creep, so cycling is not a concern
- For A617 tubes at medium  $T_f$  and high  $\Delta T$ , fatigue damage could be a risk, so cycling should be avoided

Results are based on FEA thermomechanical simulations in *SRLIFE*

- (below) lifetime contours and cumulative ratios of fatigue to creep damage for A282 material
- All operation regions for A282 clearly predict creep damage to be the dominant cause of failure

