United States Nuclear Regulatory Commission

A SCALING METHOD FOR RIA DATA (Reactivity Initiated Accidents)

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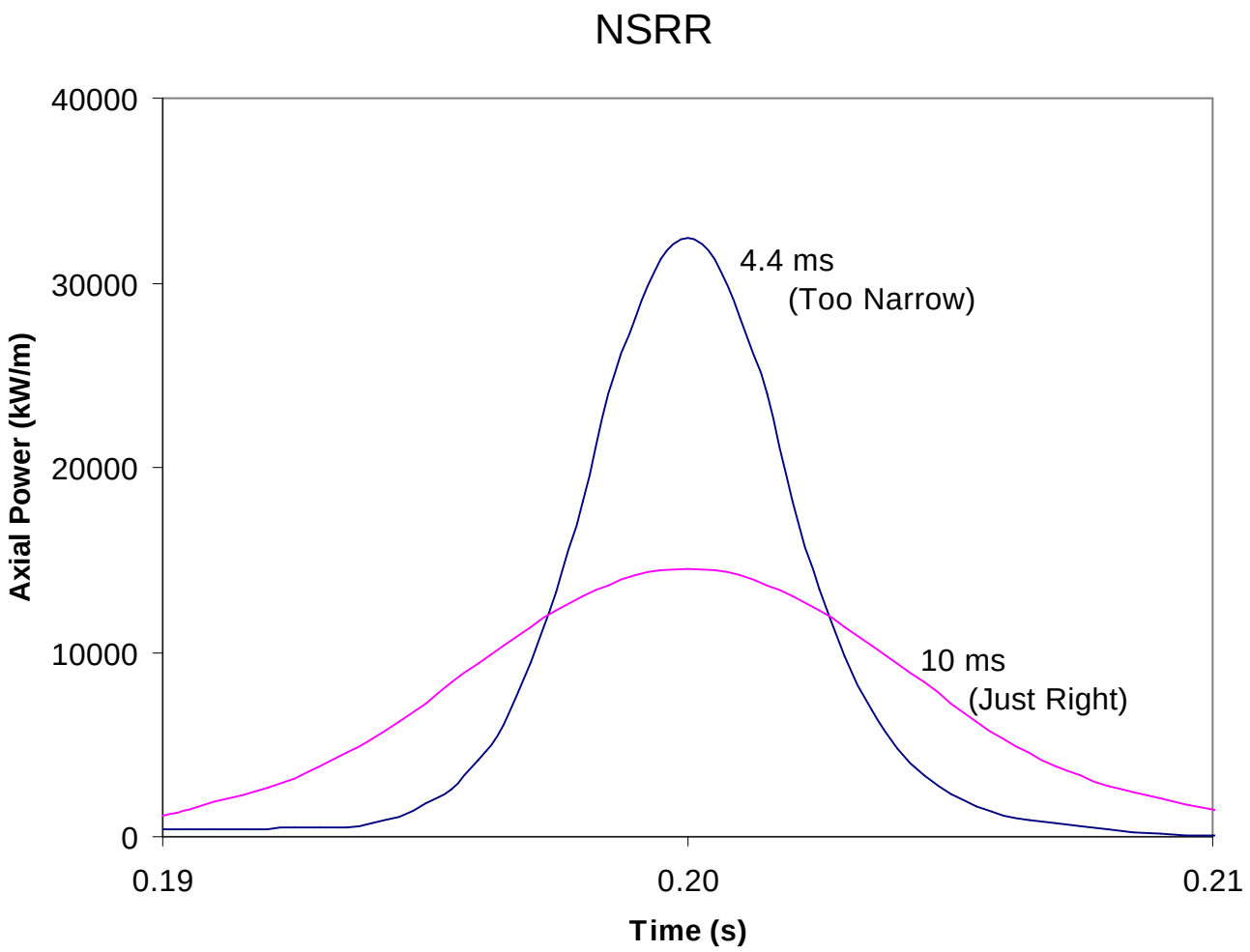
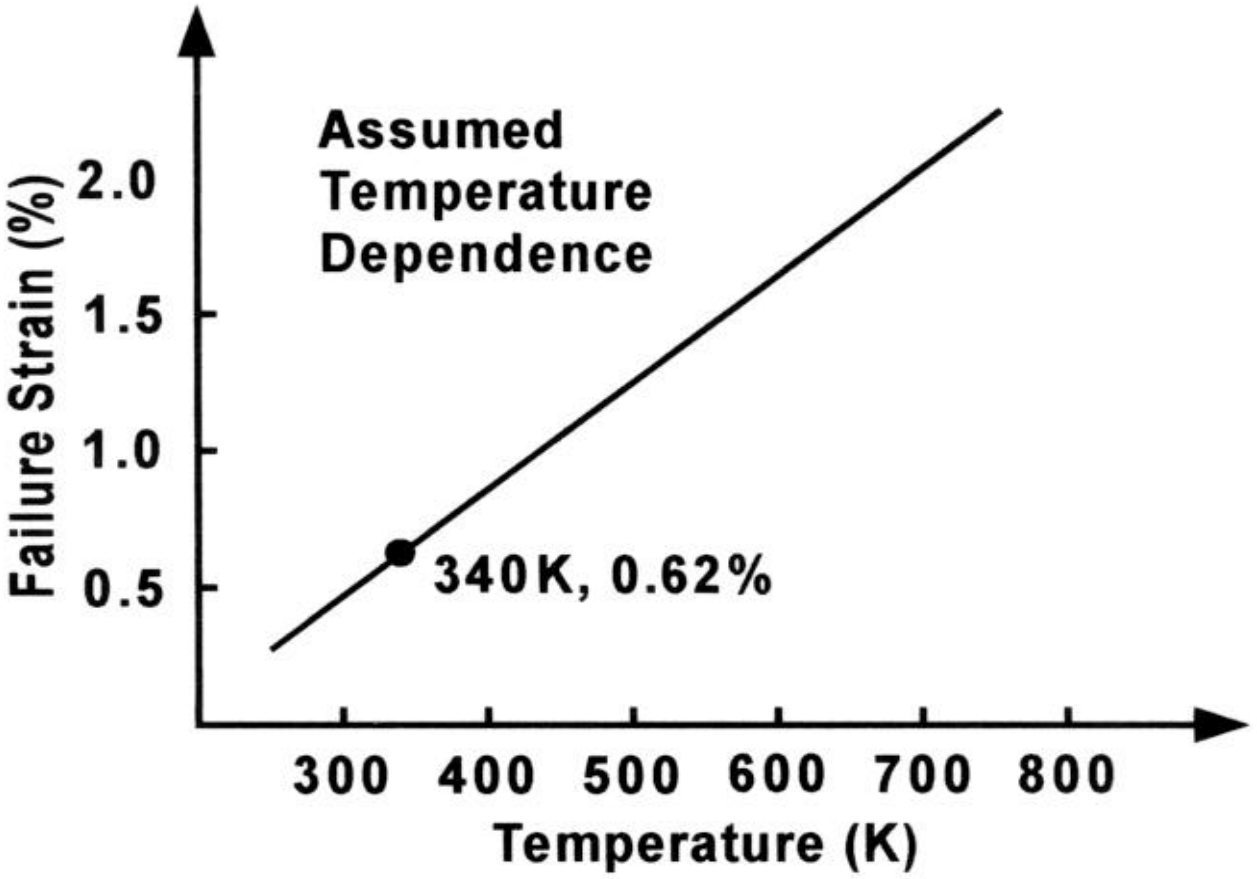
TEST REACTOR CONDITIONS DO NOT MATCH PWR

- Tests are performed to determine energy required to cause cladding failure or determine margin (needed for safety analysis)
- Pulse width and initial test conditions produce atypical cladding temperatures at the time of cladding failure
- If cladding temperature is too high, the tendency for cladding failure is reduced (tougher, more ductile)
- If cladding temperature is too low, the tendency for cladding failure is increased (more brittle)



Power Pulse for NSRR and PWR



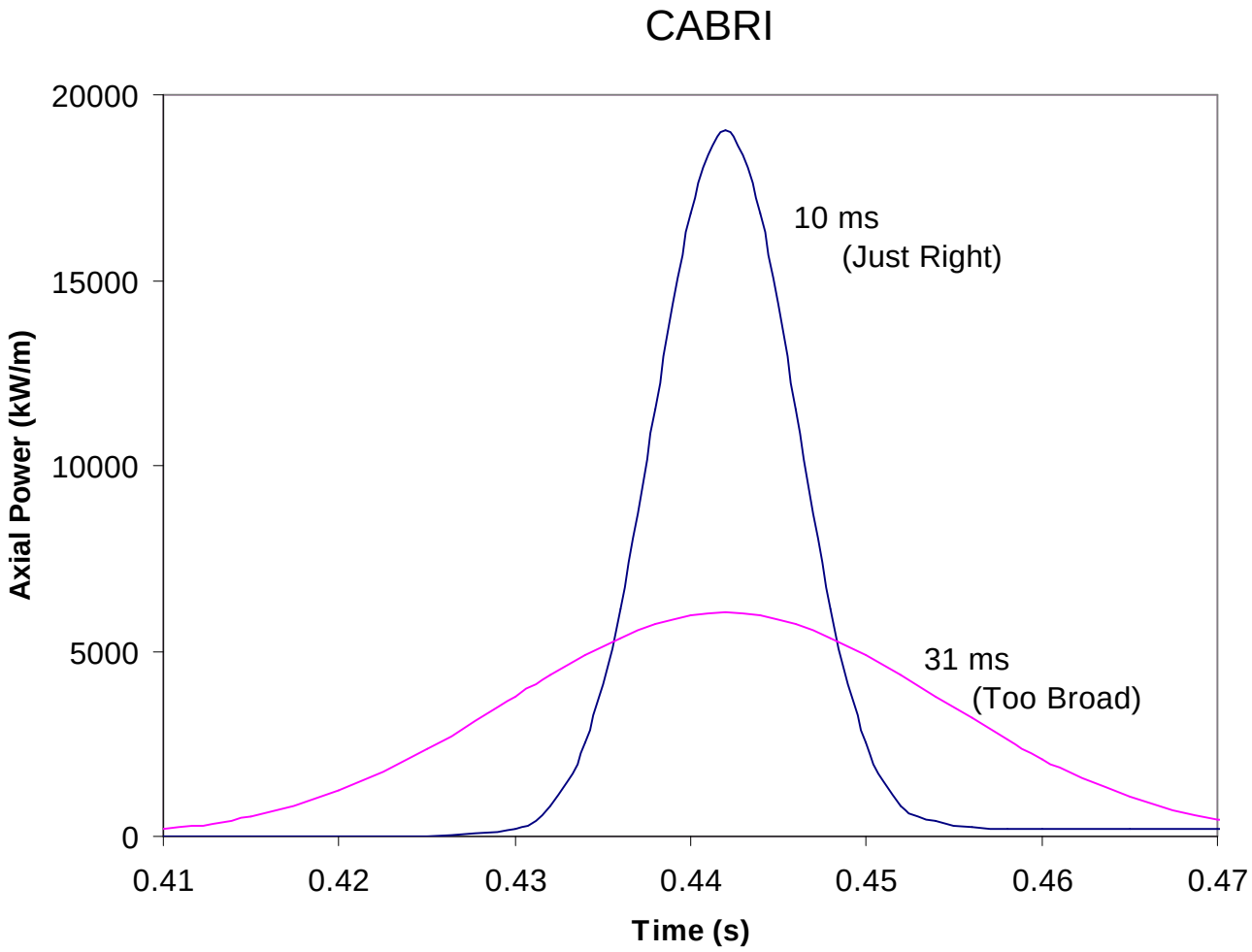
Strain is most important parameter for ductile failure

Measured Parameters for HBO-1	
Total Energy Input	93 cal/g
Time at Failure (arbitary zero)	0.2045 s
Pulse Width (Full Width at Half Maximum)	4.4 ms
Initial Coolant Temperature	291^{o}K

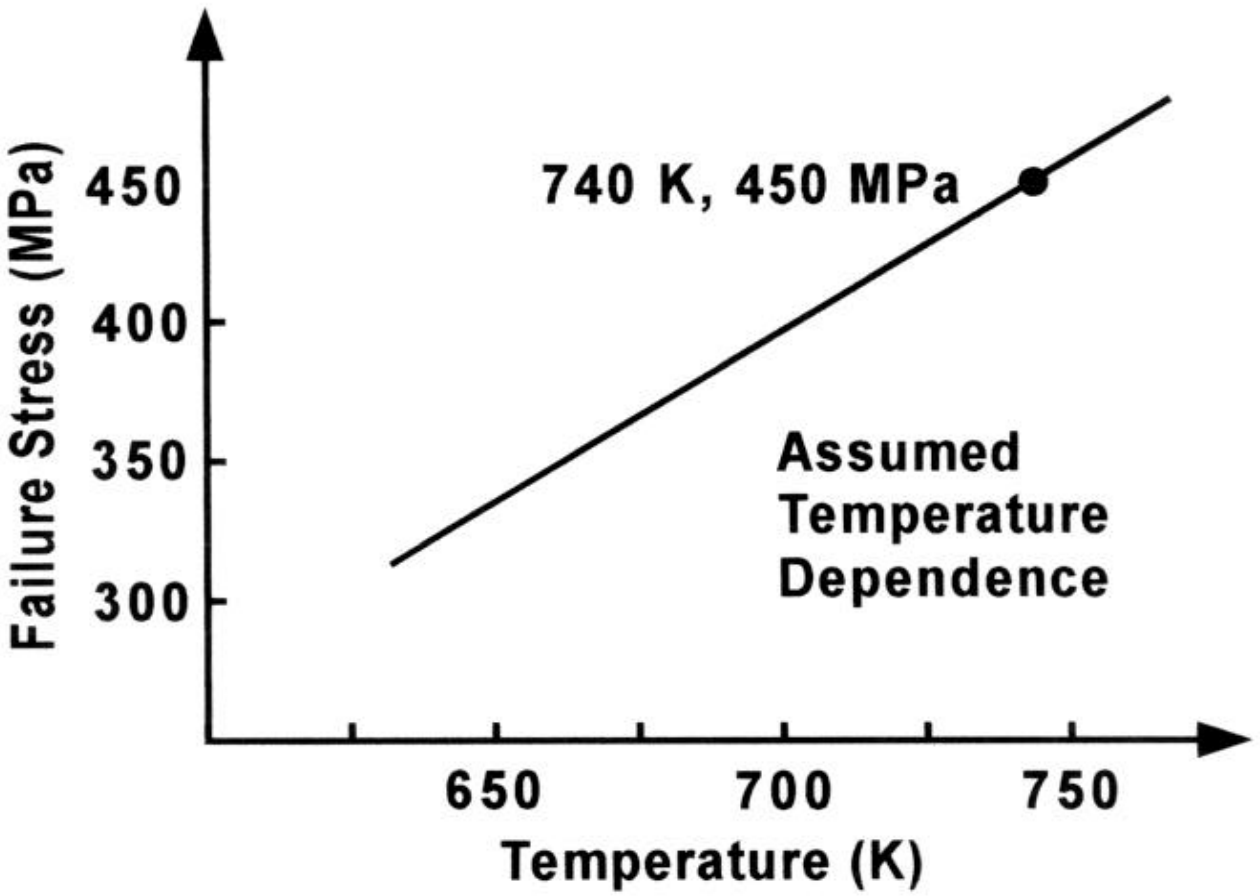
Calculated Parameters for HBO-1	
Fuel Enthalpy Increase at Failure	60 cal/g
Cladding Plastic Hoop Strain (Failure Strain)	0.62%
Cladding Average Temperature	340^{o}K

Calculated Parameters for HBO-1 (with a 10ms pulse and 553^{o}K test temperature)	
Fuel Enthalpy Increase at Failure	100 cal/g
Cladding Plastic Hoop Strain (Failure Strain)	1.7%
Cladding Average Temperature	710^{o}K

~ 40 cal/g increase due to pulse width and test temperature



REPNa-10 and corresponding PWR pulse shape



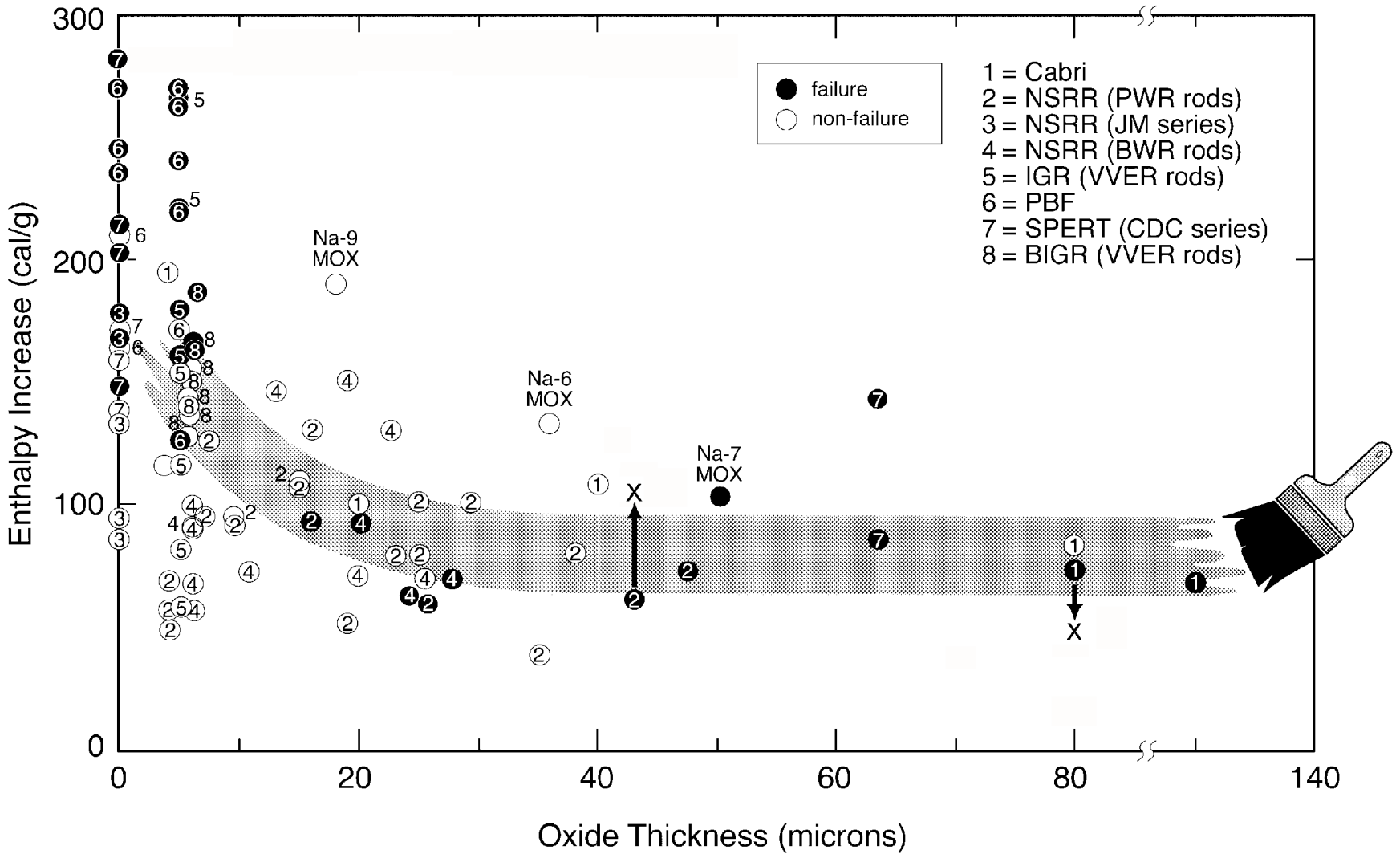
Stress is most important parameter for brittle failure

Measured Parameters for REP-Na10	
Total Energy Input	107 cal/g
Time at Failure (arbitary zero)	0.456 s
Pulse Width (Full Width at Half Maximum)	31 ms
Initial Coolant Temperature	553^{o}K

Calculated Parameters for REP-Na10	
Fuel Enthalpy Increase at Failure	59 cal/g
Cladding Hoop Stress (Failure Stress)	450 MPa
Cladding Average Temperature	740^{o}K

Calculated Parameters for REP-Na10 (with a 10ms rather than a 31ms pulse)	
Fuel Enthalpy Increase at Failure	40 cal/g
Cladding Hoop Stress (Failure Stress)	350 MPa
Cladding Average Temperature	660^{o}K

~ 20 cal/g decrease due to pulse width



Scaling may have significant effect on failure boundary