Design constraints – Maximum clad temperature, linear power rating

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1 Quiz

1.1 Questions

1. Most of the constraints in the design of nuclear reactor is connected with

(a) neutron induced changes in physical & chemical nature of fuel & structural materials
(b) temperature induced changes in physical & chemical nature of fuel & structural materials
(c) both (a) and (b)
(d) none of (a) and (b)

2. Higher linear rating of fuel for a fixed reactor power may be due to

(a) higher thermal conductivity of fuel (b) larger diameter of fuel pins
(c) more number of fuel pins (d) higher outer surface temperature of fuel

3. Which of the following is not a plausible reason for transients in clad temperature?

(a) change in reactor power (b) change in coolant flow
(c) change in neutron flux (d) changes in steam pressure

4. Arrange the following fuel types in the increasing order of linear rating under identical conditions:

(a) metals (b) metal oxides (c) metal nitrides

5. The average thermal conductivity of metal nitride may be taken as 15 W/mK. If the linear rating is 200 W/cm with the maximum temperature in the fuel as 900 °C, determine the minimum temperature in the fuel element.

1.2 Answers

1. (c) both (a) and (b)

2. (a) higher thermal conductivity of fuel

3. (d) changes in steam pressure

4. metal oxides<metal nitrides < metals

5. Linear rating =200 W/cm = 20000 W/m

Linear rating = $4\pi k(T_{fc}-T_s) = 20000$

Solving the above, with T_{fc}=900 °C we get the minimum temperature in the fuel element (T_s) as 793.9 °C