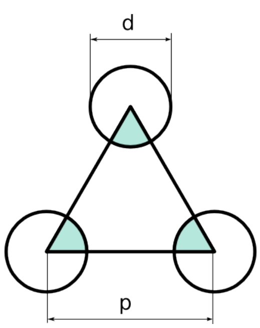
NE-620 Nuclear Thermal-hydraulics Final Exam

Due Date: 05/11/2017 by 11:59 PM

1. In the figure shown below is a section of Mark-II TRIGA reactor (Total power rating 1.25 MWth with 85 fuel rods of length $l = 0.381m$) where fuel rods are placed in a triangular lattice. Fuel rod outer diameter, $d = 3.7\ cm$, triangular pitch, $p = 4\ cm$, cladding thickness $= 0.05\ cm$. Using these dimensions, you can compute flow area, hydraulic and heated diameters, for a single representative channel heated by 1 fuel rod. Note that flow area for the RELAP input corresponds to 1 fuel rod. Solve the following problem by modifying the example RELAP5 input deck for Mark-II TRIGA reactor (two channel model- hot and cold) provided here (Exam_Triga.i) and the RELAP executable.



Fuel rods shown in the figure are subjected to radial power peaking factor of 1.2 and axial power profile is a sine function with maximum peak in the center and zero power at the ends. Obtain and plot the hot channel steady state axial temperature distribution of the coolant and cladding (clad - outer node of the heat structure). Obtain the axial velocity distribution from the output and evaluate average velocity. Assuming the average velocity to be constant everywhere and inlet temperature as specified in the RELAP file, find the analytical solution i.e. coolant and cladding temperature distribution in axial direction of the hot channel. Compare analytical temperature profiles and RELAP simulation results. Use Dittus Boelter correlation for evaluating heat transfer coefficient between coolant and cladding.

Provide complete report of your work with details on - derivation of the geometric or operating parameters you intend to change in the input file, what other specific changes you made in the input deck, clear presentation of results with plots, analytical solution to the problem, and discussion of results/comparisons or any unexpected behavior. (65 points)

2. Consider a tank which stores a single phase gas at pressure P_0 and temperature T_0 develops a break in one of the connecting pipes resulting into isentropic discharge of this gas into atmosphere at pressure P_b. Derive the maximum flow rate condition and maximum flow rate of the gas exiting out of this tank in terms of $\gamma(=\frac{C_p}{C_v})$. Show that the maximum speed of gas discharge is also equivalent to speed of sound at pressure P_b. (30 points)

5 Bonus points for uploading your presentation on Reactor Systems (If you have not, upload the pdf of your file on Canvas for my records)