

Ideas for Projects

1. a) Develop event sequence diagrams for ACR-700 for the following initiating events: i) Loss of main feedwater flow; ii) small LOCA; iii) large LOCA; then b) Suppose an ACR-700 has a LOCA + LOECC + loss of moderator cooling. Calculate the demand availability of the Reserve Water makeup to the moderator. You will need the technical description of the ACR-700 (look on the USNRC Web site).
2. Assume a partial flow blockage in a CANDU fuel channel (your choice which CANDU and which channel). a) Calculate the pressure tube temperature near the channel exit for a range of *steady-state* flow reductions. c) What percentage reduction of the flow is required for the pressure tube to fail (assuming steady-state)? Justify this in terms of pressure-tube behaviour at high temperatures. d) Using the simple fuel model described in the lecture notes (or develop your own), and a reasonable value for the steam cooling sheath-to-coolant heat transfer coefficient, calculate the *steady-state* flow that will just lead to central melting of the fuel rod. (You will need to make simplifying assumptions on the channel and bundle power distributions). e) What conclusions can you draw from these answers re the likelihood of fuel melting before pressure-tube failure?
3. Consider an uncontrolled severe core damage accident in a CANDU (not ACR) resulting from loss of all heat sinks. Develop and describe the sequence of events up to failure of the shield tank or reactor vault and calculate (by hand, or write your own code) the (very) approximate timing of each major event. Include containment behaviour. *Hint: Use energy balances.*
4. Compare a large LOCA and a main steam line break inside containment. Use a CANDU safety report and develop a list of symptoms which the operator can see; use them to show how he can determine the accident that has occurred and what he should do. You will need to understand what signals are available and roughly how they would behave. Compare the symptoms and signals for a CANDU with a positive void coefficient with that for an ACR with a small negative void coefficient, and with that for a PWR.
5. From the report OH 84083 and other available reports, examine the accident that occurred in Pickering A Unit 2 in August 1983. Determine the immediate cause, evaluate the operating steps taken by staff, and derive the root causes of the event using formal methods. Considering the plant conditions as they unfolded during the event, determine the reasons and timing for each operating step. Evaluate the accident in terms of design and safety culture. (Note that a simple summary of existing reports is not acceptable).

6. Using the diagram of the SDS1 trip logic in the overheads in Chapter 4, Lecture 4 of your handouts, construct and evaluate the fault tree for initiation of a reactor trip on any one signal. Include all system components from the sensor signal to the clutch release. Estimate probabilities of each component and give the reasons for your estimates.
7. Calculate the design pressure of the ACR-700 containment building, from scratch. You will need to calculate the steam discharge rate and enthalpy after a main stream line break.
8. ...or any other project requiring similar levels of originality and of similar difficulty. You will need my prior agreement.