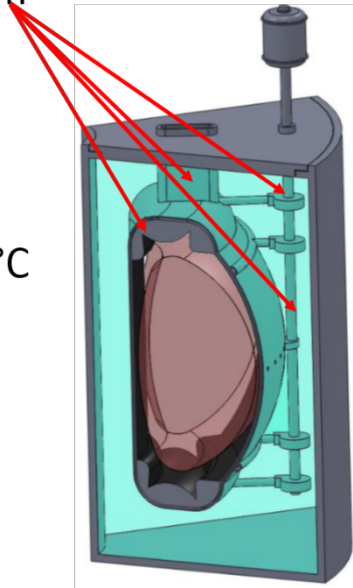


2019 NSE Materials Qualifying Exam – Unprepared Question

The ARC fusion reactor is a molten salt-cooled and liquid breeder blanket reactor. Its main vacuum vessel and molten FLiBe salt blanket is shown below. Considering this diagram and the desire to run the ARC reactor at 700°C for five years at once, answer the following questions:

- ARC structural material for vacuum vessel, salt piping, and other components immersed in FLiBe molten salt at 700°C



- Design a program of experiments to rapidly (within 7 years) down-select a suitable alloy to serve as the ARC vacuum vessel and structural materials. Consider aspects of molten salt corrosion, exposure to neutrons, stresses expected during operation & shutdown, and any other parameters you think should be considered. Think also about what information the Nuclear Regulatory Commission (NRC) would want to know to qualify these materials for service in ARC.

- Suggest and compare three potential materials which could serve as the ARC structural backbone, and compare them in terms of corrosion resistance, radiation resistance, mechanical properties, and anything else you feel should be considered.