Review of the Project Group:
Group Code: 41 EPR
Full title: General Features and Principles of EPR Nuclear Reactor Operation: A Design and Calculation Study

It was sometimes unclear which section corresponded to which Task, so for the final report it could be helpful to structure it more aligned to the prompted tasks. For all tasks, I included more detailed comments in the pdf directly.

Intended learning outcome (ILO)	Grade (0-3)	Explanation for the grading of the evidences of achieving respective ILO. Suggestions for improvements and other comments
1. *Collect information on* General design specification of the nuclear power plant with selected reactor type (Task 1, ILO1, ILO2)	2	The description of the reactor core is very detailed. The section about the reactor coolant system and its components is supported by helpful figures. Only at some points more information could be included, such as the dimensions, the operating and design conditions of the vessel or the pressurizer volume (commented in the text). The plant layout, which is not necessarily required in the task (unless it is presented as being unique for the EPR design) and thus additional information. The secondary loop and the balance of plant is not described as an independent section. Some relevant information is in section 2.1 Plant Layout. However, it only mentions the location of different balance of plant components. More technical information on the turbine, condenser, feedwater-cycle could be included. Task 1 should include a literature study, yet no reference was provided during the text. When facts and technical details are defined, the corresponding sources would be important for verification. For figures, unless they were really created by the authors themselves, the source must be specified.
2. *Describe* Operational principles of the power plant. (Task 2, ILO1, ILO2)	2	The report discusses reactor shutdown, draining and opening of the primary system, core un- and reloading, closing and filling of the primary system, as well as heating of the primary coolant. Then it continues discussing which operations are necessary to achieve power operation after a cold shutdown, and describing normal operation and load-following. It includes additional information on extended cycle operation as well as preventive maintenance. Methods for reactivity control are described as well. Thus, the description covers all required topics and even includes additional information. Unfortunately, as before, the references are again missing in this section. Possibly, the same reference was used for the complete report – if so, that should be indicated somewhere.

3. *Explain* Safety features of the power plant. (Task 3, ILO1, ILO2)	2	The safety systems are discussed starting in section 3. Various safety systems of the EPR are described there. Further discussion of Nuclear Safety is provided in section 6 on Nuclear Safety. In this section, the principles of reactor safety are discussed. Unfortunately, the results of reactor safety analysis and some key safety parameters, such as, e.g., core damage frequency are missing. As in the above tasks, references were missing for figures and statements. Including sources at the end of each paragraph and for each figure would allow the reader to find more information and check the validity of the statements made.
4. *Calculate* Selected core parameters (Task 4, ILO3)	1	Input data has been collected. The presentation of the collected data could be improved by noting, where each value comes from. This could be done by either citing the relevant source or mentioning that a parameter is an engineering estimate. The description of the applied equations could be improved by extending it for the calculation of the inlet orifices pressure drop, pressure drop calculations in two phase flow, void fraction model, etc. Also, it should be clarified in more detail, how the system was discretized axially, particularly by including how many cells were employed and how the equations such as for pressure drop were discretized. The results are provided as figures only. Readability could be improved if the figures were a bit larger. The plotted power distribution differs from the expected cosine shape, which also alters the shapes of the enthalpy and temperature distributions. If a power distribution different from a cosine-shape was employed, it should be mentioned in the methodology. The flow characteristics indicate errors in the calculation, as the pressure drop found for nominal conditions ~0.3 MPa differs significantly from the pressure drop at 100% power and 100% flow ~0.1 MPa in the flow characteristics plot. The plots are neither described nor discussed. Possible ideas for discussion are: - Which pressure drop mechanisms have the largest impact on the pressure drop distribution in (a)? The friction, local, gravity pressure drops could be plotted individually to support possible comments. - Does the obtained temperature distribution agree with literature values for in- and outlet temperature? - What is the reason that the flow characteristics differ so much for high and low flow rates? Why is the pressure drop in the heated cases smaller than in the non-heated case when approaching zero flow rate? Which pressure drop mechanisms are most relevant at different flow rates?
5. *Calculate* CHF margins in a hot channel (Task 5, ILO4a)	1	The peaking factor is discussed in detail in section 8.3 for critical heat flux. It could be improved by defining how the hot channel parameters depend on the peaking factor. The Bowring

		correlation and the Reddy-Fighetti correlations are introduced. It is unclear, which of them was applied to obtain Figure 16 (e) and (f). Further comments on the applicability ranges of each correlation and how your actual values compare to them should be made. Again, the resulting plots are not described. The plots would be better visible if they were a little larger. Legends for plots including more than one curve (average and hot channel) should be included. In Figure 16 (c) it seems like two-phase-flow is reached in the hot channel, which should not happen in a PWR design. Therefore, comments on this should be included. Particularly the maximal power possible without reaching two phase flow should be reported as discussed in the lecture. Further discussion could cover what a DNBR of 1.71 at a location of 350 cm would mean.
6. *Calculate* Maximum cladding and fuel pellet temperature (Task 6, ILO4b)	1	Heat conduction calculations in the fuel, gap and cladding are described. It is not mentioned how the thermal conductivities and the heat transfer coefficients were obtained. The task stated that temperature dependent thermal conductivities of clad and fuel materials should be assumed. Further, since two phase flow was reached in the hot channel, different correlations to obtain the heat transfer coefficient are necessary. Finally, the report could be extended by explaining how these equations were implemented in the code, i.e., was the system discretized radially, or were there iterations to find the cladding average temperature for the cladding thermal conductivity? The axial temperature profiles for outer fuel and fuel center, as well as for outer and inner cladding are provided as plots. In addition, the maximal temperatures, and locations in each of these profiles are noted. The report could be improved by discussing how the found maximal temperatures correspond to the melting temperature of the fuel material and the maximum allowed value for the clad material.