

Summary of Chapter 17: Power conversion

The parameters range and efficiency of different power conversion system have been review for the APEX applications. The power conversion systems review are steam cycle, the close cycle gas turbine, and the binary cycle.

Here are some of the summaries from this review:

1. For steam cycle, advanced cycle efficiency can reach 50%, based on super critical steam cycle. Multiple reheat will be required to increase the thermal efficiency. A more realist, and maybe more reliable system will be based on double reheat, with steam and reheat temperature near 600C. A thermal efficiency of 47% can be achieved.
2. For more conventional design, a close cycle gas turbine has to have an operating temperature of ~ 850C, to reach high cycl efficiency. However, recent proposal suggested that 46% thermal efficiency can be achieved with gas temperature as low as 650C. To achieve this high efficiency at a modest temperature, the efficiencies of the compressor, turbine, and especially the recuperator have to be between 92 to 96%. Also, the coolant pressure has to be high, to reduce the circulation power. The efficiency of the recuperator, assumed to be 96%, is particularly important. While there is no issue that a recuperator heat exchanger can be designed to 96%, the reliability of this heat exchanger has to be demonstrated due to the very large number of coolant channels.
3. Binary cycle: While binary cycle is attractive for open cycle design to convert the thermal energy in the low temperature regime, there si no reason to adopt a binary cycle for a closed cycle design, as the ones will be used by fusion. It is always more efficient to design a regenerator heat exchanger to recovery the thermal energy, and concert thie thermal energy to electricity at a higher temperature.