Front. Energy 2021, 15(4): 832–841
https://doi.org/10.1007/s11708-021-0777-5

RESEARCH ARTICLE

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Preliminary design of an SCO_2 conversion system applied to the sodium cooled fast reactor

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Abstract The supercritical carbon dioxide (SCO_2) Brayton cycle has become an ideal power conversion system for sodium-cooled fast reactors (SFR) due to its high efficiency, compactness, and avoidance of sodium-water reaction. In this paper, the 1200 MW_e large pool SFR (CFR1200) is used as the heat source of the system, and the sodium circuit temperature and the heat load are the operating boundaries of the cycle system. The performance of different SCO_2 Brayton cycle systems and changes in key equipment performance are compared. The study indicates that the inter-stage cooling and recompression cycle has the best match with the heat source characteristics of the SFR, and the cycle efficiency is the highest (40.7%). Then, based on the developed system transient analysis program (FR-Sdaso), a pool-type SFR power plant system analysis model based on the inter-stage cooling and recompression cycle is established. In addition, the matching between the inter-stage cooling recompression cycle and the SFR during the load cycle of the power plant is studied. The analysis shows that when the nuclear island adopts the flow-advanced operation strategy and the carbon dioxide flowrate in the SCO_2 power conversion system is adjusted with the goal of maintaining the sodium-carbon dioxide heat exchanger sodium side outlet temperature unchanged, the inter-stage cooling recompression cycle can match the operation of the SFR very well.

Keywords sodium-cooled fast reactor (SFR), supercritical carbon dioxide (SCO_2), brayton cycle, load cycle

Received Dec. 1, 2020; accepted May 25, 2020; online Sept. 25, 2021

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Special Issue: Innovative Nuclear Energy Technology

1 Introduction

The sodium-cooled fast reactors (SFR) is one of the important reactor types in the fourth-generation nuclear energy system. The fast neutron spectrum of the SFR gives it a great advantage in the proliferation of nuclear fuel and the transmutation of long-lived radioactive waste. Therefore, SFR is an important part of the advanced nuclear fuel cycle, which can greatly improve the utilization of natural uranium resources and minimize radioactive waste. At present, the three-circuit power generation systems of SFR use the traditional steam Rankine cycle, which not only has a low efficiency, but also has adverse effects such as sodium-water reaction, which hinders the rapid development of SFR to some extent. Therefore, it is particularly impaortant to develop and study the power generation cycle system suitable for SFR.

In addition to water/steam power conversion in conventional energy power systems, there are also various power conversion methods such as helium, nitrogen, and supercritical carbon dioxide (SCO_2). The SCO_2 Brayton cycle has a high cycle thermal efficiency under moderate temperature conditions (450°C–700°C). The research on the Brayton cycle of SCO_2 began in the 1940s [1], and a series of studies were subsequently conducted [2–4]. Although the development was slow or even stagnant due to a number of factors in the process, the industry regained attention in the late 1990s.

Research on the SCO_2 Brayton cycle covers many aspects such as the application of the cycle, the efficiency of the cycle and its influencing factors, and the main equipment involved in the cycle. Dostal first proposed several cycle configurations for sodium-cooled reactors, and found that the recompression cycle has a high cycle efficiency [1]. Ahn et al. [5] compared 12 SCO_2 Brayton cycle configurations in a review and concluded that the SCO_2 recompression cycle has the best performance and is most suitable for next-generation nuclear power systems. Sarkar optimized the recompression SCO_2 Brayton cycle with single-stage reheat and pointed out that reheating can increase the cycle thermal efficiency by 3.5% by comparing with the configuration without reheat. At the same time, the exergy analysis of the recompression cycle was performed, and the influence of different design conditions on the optimal cycle pressure ratio, cycle thermal efficiency and exergy efficiency was studied [6,7]. Yari and Sirousazar [8] studied the performance improvement brought about by the cold-leg coupled transcritical CO_2 cycle of the recompression SCO_2 Brayton cycle, and pointed out that the thermal efficiency and exergy efficiency of the new coupled cycle can be increased by 5.5% and 26% compared with the ordinary recompression cycle. Akbari and Mahmoudi conducted a thermal economic analysis on the recompression SCO_2 Brayton cycle of the cold-leg coupled organic Rankine cycle, and pointed out that the new-coupled cycle configuration can bring about lower unit power generation costs and a higher cycle efficiency [9]. Moisseytsev and Sienicki compared the recompression cycle with the inter-stage cooling of the main compressor and pointed out that the inter-stage cooling of the main compressor did not bring about the improvement of the cycle performance [10]. Chinese scholars also conducted a lot of analysis and research on the cycle efficiency and parameter sensitivity of different cycle types [11–15].

A summarization of the current research status suggests that although many studies have been conducted on the configuration of the SCO_2 cycle system, there is a lack of matching studies between the SCO_2 cycle system and the sodium side cycle characteristics of the SFR. The difference from the traditional heat source only considering the maximum operating temperature is that the circulation system with SFR as the heat source not only needs to consider the maximum operating temperature of the circulation, but also to ensure that the minimum temperature of the sodium circulation system remains stable. Based on the heat source characteristics of large-scale SFR, this paper carried out the design of SCO_2 power conversion system and the matching study of SCO_2 power conversion system and SFR to provide support for subsequent large-scale SFR power plant system design.

2 Design of the SCO_2 power conversion system

2.1 Heat source characteristics of SFR

In this paper, a 1200 MW_e pool sodium-cooled fast reactor (CFR1200) is selected as the heat source matching the SCO_2 power conversion system for design analysis. The CFR1200 primary circuit adopts a pool structure, and the main heat transmission system adopts a sodium-sodium-power conversion three-circuit design. The rated thermal power is about 3000 MW and the rated electric power is about 1200 MW. The reactor is equipped with 4 loops, each of which carries a thermal power of 750 MW. The core inlet temperature is about 395°C. The outlet temperature is about 550°C. The hot end sodium temperature of the secondary circuit is about 520°C, and the cold end sodium temperature is about 350°C. Based on the above parameters and considering the design requirements of the SCO_2 thermal parameters and heat exchangers in the SCO_2 power conversion system, the basic design boundary parameters of the SCO_2 cyclic power conversion system of the SFR are determined in Table 1.

Table 1 Main design boundary parameters of SCO_2 power conversion system

Design parameters	Value
Rated thermal power/MW	750
Hot end temperature of sodium circuit/°C	520
Sodium circuit cold end temperature/°C	350
Na/SCO_2 heat exchanger hot end difference/°C	⩾25
Na/SCO_2 heat exchanger cold end difference/°C	⩾15
SCO_2 cycle design maximum temperature/°C	490
SCO_2 cycle design cold end temperature/°C	32
SCO_2 cycle design maximum pressure/MPa	20
SCO_2 cycle design cold end pressure/MPa	7.6
Heat recovery degree of regenerator	0.95
Regenerator pinch point temperature difference/°C	⩾5

2.2 Configuration design of the SCO_2 power conversion system

At present, there is a wide variety of system configurations for the SCO_2 cycle. However, the summary indicates that there are five basic cycle configurations as shown in Fig. 1: the simple regenerative cycle, the inter-stage cooling cycle, the recompression cycle, the inter-stage cooling recompression cycle, and the reheat inter-stage cooling recompression cycle. This paper calculates and analyzes the advantages and disadvantages of each system configuration, and finally obtains the SCO_2 cycle system configuration suitable for the SFR.

Based on the parameters in Table 1 and the different circulatory system configurations shown in Fig. 1, the calculation model of the SCO_2 Brayton circulatory system is built, including compressors, turbines, high-temperature sodium-heat exchangers, regenerative heat exchangers, pre-coolers, and inter-stage cooling heat exchangers. The circulatory system model can be obtained by modeling the key equipment and coupling each equipment model [16].

The compressor power consumption model is

$$w_c = \frac{m_c(h_{c,s,out} - h_{c,in})}{\eta_c}, \tag{1}$$

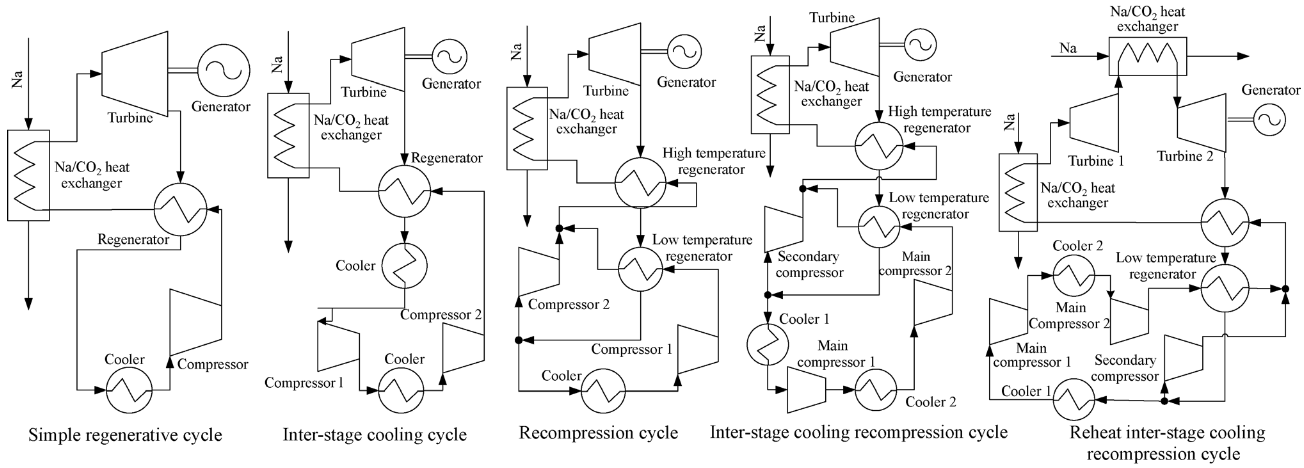

Fig. 1 Schematic diagram of different cycle configurations.

where w_c is the compressor power consumption, kW; m_c is the mass flow of the working substance through the compressor, kg/s; $h_{c,s,out}$ is the specific enthalpy of the outlet working substance of the compressor isentropic process, kJ/kg; $h_{c,in}$ is the specific enthalpy of the working substance at the compressor inlet, kJ/kg; and η_c is the compressor efficiency (isentropic efficiency). Since the power of the circulatory system studied in this paper is similar to the system power given by Dostal [1] and Wang et al. [17]. Based on similar analysis, the compressor design efficiency in this paper is 0.93.

The turbine model is

$$w_t = m_t(h_{t,in} - h_{t,out})\eta_t, \tag{2}$$

where w_t is the work done by the turbine, kW; m_t is the mass flow of the working substance through the turbine, kg/s; $h_{t,in}$ is the specific enthalpy of the working substance at the inlet of the turbine, kJ/kg; $h_{t,out}$ is the specific enthalpy of the outlet working substance in the transparent entropy process, kJ/kg; and η_t is the internal efficiency of the turbine (isentropic efficiency). Similar to the compressor, referring to the turbine efficiency given by Dostal [1], the design of the turbine efficiency in this paper is 0.94.

For the heat exchanger, it is assumed that the working substance flows in a countercurrent arrangement, and the heat exchangers with the same function but different configurations have the same form, and the pressure loss on both sides of each heat exchanger are given and remain unchanged. Then, the heat balance method is used to calculate the inlet and outlet parameters of the heat exchanger.

$$Q = m_h(h_{h,in} - h_{h,out}) = m_l(h_{l,in} - h_{l,out}), \tag{3}$$

where Q is the heat exchange amount, kJ; m_h is the mass flow of the working substance at the high temperature side, kg/s; $h_{h,in}$ and $h_{h,out}$ are the specific enthalpy of the inlet and outlet of the working substance at the high temperature side, kJ/kg; m_l is the mass flow of the working substance at the low temperature side, kg/s; and $h_{l,in}$ and $h_{l,out}$ are the specific enthalpy of the inlet and outlet of the working substance at the low temperature side, kJ/kg.

In the regenerator calculation, the degree of the heat recovery of the regenerator is also considered. The degree χ of the heat recovery of the SCO_2 is defined as

$$\chi = \frac{h_{r,h,in} - h_{r,h,out}}{h_{r,h,in} - h(T_{r,l,in}, P_{r,h,out})} = \frac{h_{r,l,out} - h_{r,l,in}}{h_{r,h,in} - h(T_{r,l,in}, P_{r,h,out})}, \tag{4}$$

where $h_{r,h,in}$ and $h_{r,h,out}$ are the specific enthalpy of the inlet and outlet of the working substance at the high temperature side of the regenerator, kJ/kg; $h_{r,l,in}$ and $h_{r,l,out}$ are the specific enthalpy of the inlet and outlet of the working substance at the low temperature side of the regenerator, kJ/kg; and $h(T_{r,l,in}, P_{r,h,out})$ is the specific enthalpy when the temperature of the working substance is the inlet temperature at the low temperature side of the regenerator, and the pressure is the specific enthalpy of the outlet pressure of the high temperature side of the regenerator, kJ/kg.

The calculation model of the circulation system can be obtained by coupling the equipment models of the compressor, the turbine, the heat exchanger, etc. To determine the optimal cycle, this paper takes the optimal cycle efficiency as the goal. The analysis suggests that there are many main factors affecting the operation efficiency of the circulation system, including the compressor inlet temperature and pressure, the turbine inlet temperature and pressure, the main compressor and recompressor split ratio, the main compressor inter-stage cooling pressure ratio, etc. Intelligent algorithms such as the genetic algorithm are suitable for system multi-parameter optimization problems due to their simple modeling, fast calculation speed, wide applicability, and strong optimization ability. Therefore, the genetic algorithm is selected to optimize the multi-influencing factors globally. The objective function, design variables, and constraints in the optimization model are

$$\eta_{\max} = \max f(\varepsilon_{\mathrm{MC}}, P_{\mathrm{c,in}}, \varepsilon_{\mathrm{inter}}, T_{\mathrm{c,in}}, T_{\mathrm{t,in}}, F, P_{\mathrm{reheat}}), \quad (5)$$

optimization interval: $0 < \varepsilon_{\mathrm{MC}} \leqslant 3.0$, $0 < \varepsilon_{\mathrm{inter}} \leqslant \varepsilon_{\mathrm{MC}}$, $P_{\mathrm{c,in}} \geqslant 7.2$, $T_{\mathrm{c,in}} \geqslant 32$, $T_{\mathrm{t,in}} \leqslant 490$, $0 \leqslant F \leqslant 1$, $7.2 \leqslant P_{\mathrm{reheat}} \leqslant 20$, where $\eta_{\max}$ is the cycle efficiency; $\varepsilon_{\mathrm{MC}}$ is the main compression pressure ratio; $\varepsilon_{\mathrm{inter}}$ is the main pressure ratio of Compressor 1; $P_{\mathrm{c,in}}$ is the main inlet pressure of Compressor 1, MPa; $T_{\mathrm{c,in}}$ is the inlet temperature of the main Compressor 1, °C; $T_{\mathrm{t,in}}$ is the turbine inlet temperature, °C; F is the split ratio; and P_{reheat} is the reheat pressure, MPa. The calculation process of the genetic algorithm is depicted in Fig. 2.

Based on the main design boundary parameters in Table 1 and using the genetic algorithm, the cycle efficiency and equipment performance of each cycle system under the same thermal power and optimal operating parameters are obtained. The *T*-*S* diagram of each cycle is demonstrated in Fig. 3. It can be seen that the inter-stage cooling and recompression cycle (IC-RC) system has the highest efficiency, while the inter-stage cooling cycle (IC-SR) has the lowest efficiency. Although inter-stage cooling can reduce compressor power consumption and increase heat absorption, the cycle efficiency may not necessarily increase. For example, the efficiency of IC-SR is lower than that of the simple regenerative cycle (SR). Comparing the performance of these two circulation systems and equipment, it can be found that the compressor of IC-SR consumes less power and has a high heat exchange rate. However, the outlet temperature of the heat absorption side of the regenerator is lower than that of SR. Under the condition of constant heating power, the circulation flow will be lower, and the turbine work will be significantly reduced. Therefore, the circulation efficiency is lower.

For the recompression cycle (RC) system, although the recompression leads to a significant increase in the total power consumption of the compressor, the heat absorption of RC is significantly increased, and the heat release at the cold end is significantly reduced, thus increasing the cycle efficiency. It can be observed that the total power consumption of the compressor is about 1/10 of the total regenerative heat exchange of the regenerator, and the cold end discharge heat is only about 1/3 of the regenerative heat exchange, thus the most important factor affecting the cycle efficiency of the system is the heat recovery capacity.

For the reheat inter-stage cooling and recompression cycle (RH-IC-RC) system, due to the high operating temperature gradient of the high-temperature heat exchanger, there is a large difference between heat exchange temperatures, and the temperature matching between the

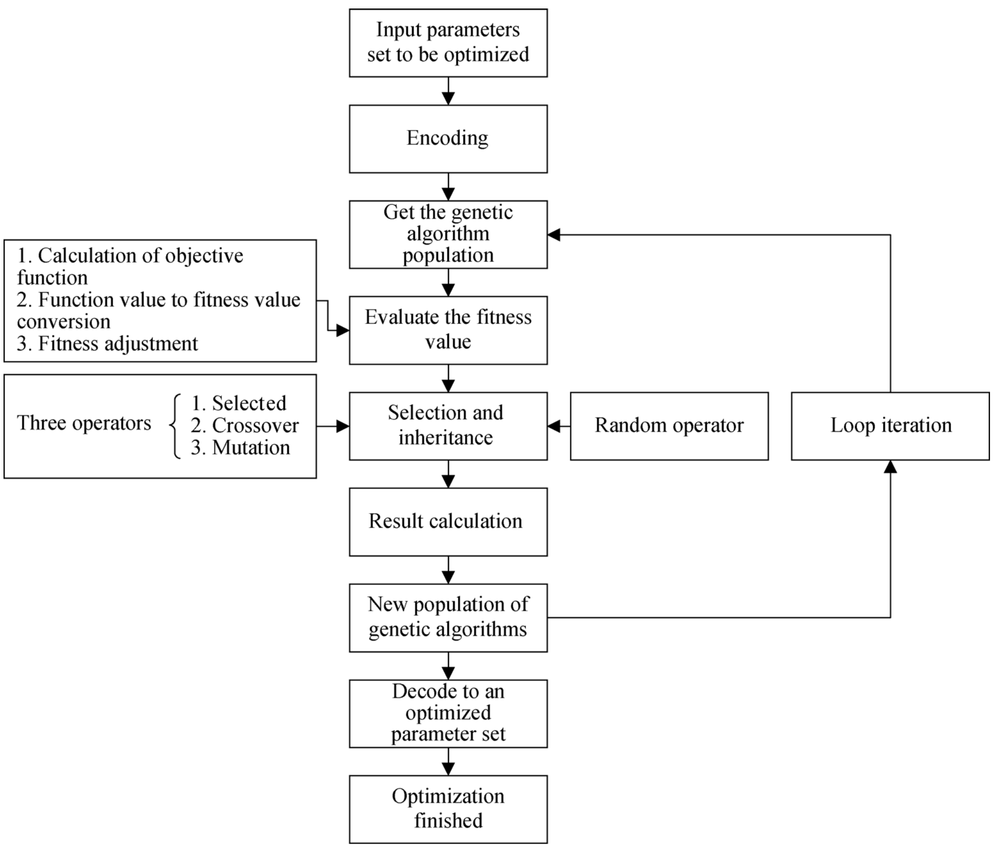

Fig. 2 Calculation process of genetic algorithm.

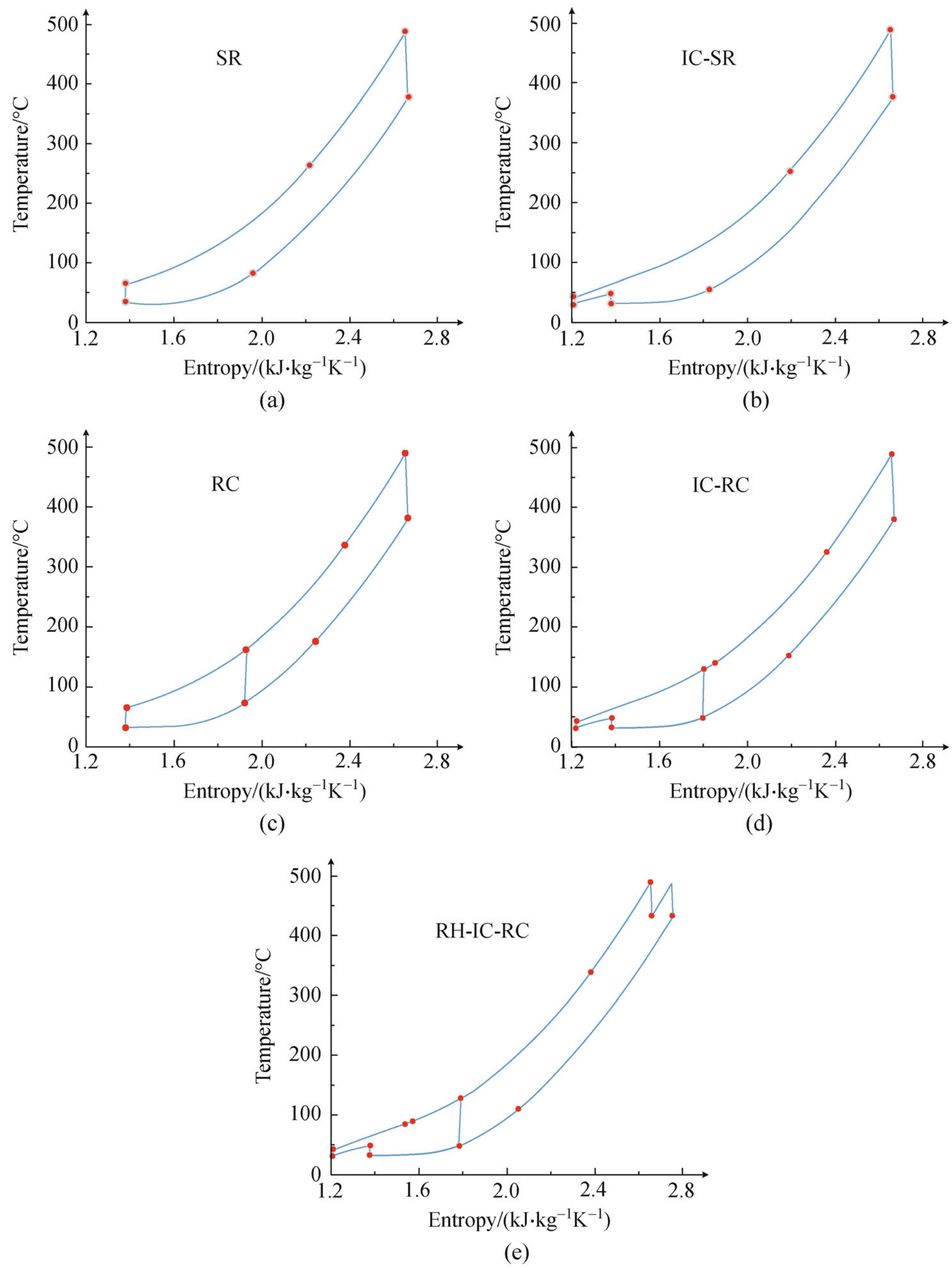

Fig. 3 *T-S* diagram of each cycle.
(a) SR; (b) IC-SR; (c) RC; (d) IC-RC; (e) RH-IC-RC.

heat absorption side and the heat release side of the regenerator is poor. Besides, there is a large irreversible loss in the heat exchange process and a small total heat exchange heat, which, in turn, leads to a significant decrease in the cycle efficiency of the system. In addition, in the RH-IC-RC system, in order to prevent the inlet temperature of the high-temperature heat exchanger from getting too high, the recompression split ratio of the system is kept only about 13.5%, which is much lower than that of the IC-RC system (about 36.8%). Therefore, the probability of the temperature pinch point of the low-temperature regenerator is significantly increased, which is not conducive to the safe and stable operation of the system. Finally, the inlet temperature of the heat absorption side of the reheat exchanger exceeds the design temperature of the cold end of the sodium side (350°C). To further reduce the temperature of the sodium side of the cycle, other auxiliary heat exchange equipment must be added, which will make the cycle system too complicated.

In summary, this paper selects the IC-RC system with the highest cycle efficiency as the final matching cycle configuration of the SFR. The configuration and key node parameters of the cycle are displayed in Fig. 4. The cycle split ratio is 0.368 and the cycle efficiency is about 0.407.

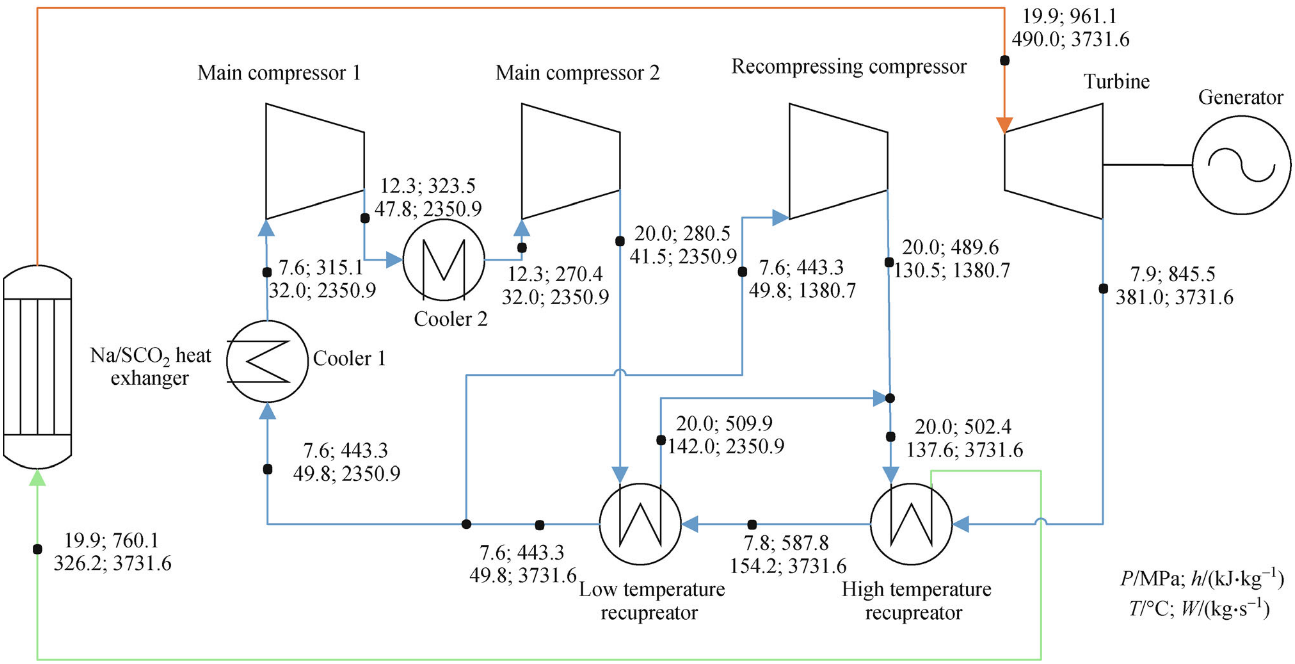

Fig. 4 Parameter of inter-stage cooling and recompression cycle system.

3 Matching analysis of the SCO_2 power conversion system and SFR

To conduct the whole plant system analysis, the system code FR-Sdaso (Fast Reactor State Design and Analysis Software) is used [18–22]. The SCO_2 version of FR-Sdaso is based on the vPower simulation support system, using a full graphical modeling interface.

The point reactor dynamic model is used to simulate the change of power in the core, whose equations are

$$\frac{\mathrm{d}N(t)}{\mathrm{d}t} = \frac{\rho(t)-\beta}{\Lambda}N(t) + \sum_{i=1}^{M}\lambda_i C_i(t), \tag{6}$$

$$\frac{\mathrm{d}C_i(t)}{\mathrm{d}t} = \frac{\beta_i}{\Lambda}N(t) - \lambda_i C_i(t) \qquad i = 1,2,\cdots,M, \tag{7}$$

where $N(t)$ represents the neutron number density, m^{-3}; $\rho(t)$ represents the reactivity, pcm; Λ represents the neutron generation time, s; β represents the effective delayed neutron fraction, dimensionless number; M represents the number of delayed neutron groups; λ_i represents the decay constant of the ith group of delayed neutron precursor nuclei, s^{-1}; $C_i(t)$ represents the number density of the ith group of the delayed neutron precursor nuclei, m^{-3}, and β_i represents the effective delayed neutron fraction of the ith delayed neutron precursor nucleus, dimensionless number.

The primary and secondary circuit of the power plant and the SCO_2 power conversion system circuit adopt the modeling method based on fluid network. By abstracting the main heat transfer system of the whole plant into a thermal fluid network, the graphical modeling method is used to establish the main heat transfer system model of the whole plant. The pressure and flowrate of the fluid network are solved by solving momentum and energy conservation equations. The temperature of each fluid node is solved by solving the energy conservation equation, and finally the main node parameters of the main heat transfer system of the whole plant are given. In addition, through the basic control and regulation algorithms assembly, such as addition, subtraction, multiplication, division, differential and integral, etc., the main control regulation and protection logic of the power plant are realized, such as power control, sodium outlet temperature of sodium SCO_2 heat exchanger control and core outlet sodium temperature, nuclear power, power flow ratio, and other emergency shutdown protection logic.

The basic conservation equations are as follows:

Energy conservation equation:

$$\rho c_{\mathrm{p}} V\frac{\mathrm{d}T}{\mathrm{d}\tau} = q_{\mathrm{in}} + q_{\mathrm{gen}} - q_{\mathrm{out}}, \tag{8}$$

where ρ means density, kg/m^3; c_{p} means specific heat capacity, J/(kg·°C); V means volume, m^3; T means temperature, °C; τ means time, s; q_{in} represents the energy entered per unit time, W; q_{gen} represents the energy generated per unit time, W; and q_{out} represents the energy released per unit time, W.

Mass conservation equation:

$$V\frac{\mathrm{d}\rho}{\mathrm{d}\tau} = D_{\mathrm{in}} + D_{\mathrm{gen}} - D_{\mathrm{out}}, \tag{9}$$

where D_{in} represents the mass entering the node per unit time, kg/s; D_{gen} represents the mass produced per unit time, kg/s; and D_{out} represents the mass lost per unit time, kg/s.

Momentum conservation equation:

$$\frac{1}{\rho C_v^2}|w|w = p_{in} - p_{out} + f(w) + \rho g \Delta z, \tag{10}$$

where C_v represents the branch flow capacity, m^2; w represents the branch mass flow, kg/s; p_{in} and p_{out} represent the branch inlet and outlet pressures, Pa; $f(w)$ represents the driving force on the branch, Pa; g represents the acceleration of gravity, m/s^2; and Δz represents the height difference between the entrance and exit of the branch, m.

The modeling of the carbon dioxide heat exchanger is most important in modeling the whole SCO_2 power conversion system. The modeling of the carbon dioxide heat exchanger adopts the method of coupling fluid network calculation and heat transfer calculation. The fluid network models of the cold side and the hot side are built respectively, and the corresponding hot and cold side fluid network nodes are connected through the heat transfer module to realize the heat transfer calculation. The configuration diagram of the heat exchanger model is exhibited in Fig. 5, where the circle indicates that the cold fluid and hot fluid at both sides of the heat exchanger are divided into several fluid nodes along the flow direction. The square indicates the tube wall of the heat exchange tube, and the arrows indicate the heat transfer of the hot and cold fluid nodes at both sides through the tube wall. Due to the characteristics of SCO_2, the state parameters vary greatly near the critical point. For example, if the length of the heat exchanger corresponding to the node is too long, it will cause considerable error and cause the "inverse temperature" phenomenon that the temperature of the cold side node is higher than that of the hot side node. To avoid this problem, the heat exchanger needs to be divided into several sections for calculation, and the number of segments is related to the linear power density, calculation step length, and the SCO_2 velocity of the heat exchanger. In this paper, for different heat exchangers, through theoretical calculation and practical test, different segments are selected to ensure that accurate results can be obtained under various working conditions.

The SCO_2 power conversion system and the reactor are coupled through the sodium-SCO_2 heat exchanger. During the operation of the reactor, the flowrate of SCO_2 is adjusted with the goal of maintaining the sodium-side outlet temperature of the sodium-SCO_2 heat exchanger within a certain range, so as to maintain a stable temperature at the cold leg of the reactor, thereby achieving a stable operation of the reactor. In the simulation, a proportional integral derivative (PID) adjustment model is used to simulate the flow adjustment process. The model calculates the SCO_2 flow adjustment valve opening based on the deviation between the current temperature of the sodium side outlet of the sodium-SCO_2 heat exchanger and the target temperature, and realizes the adjustment of the flow.

To analyze the transient matching of the SCO_2 power conversion system and the sodium cooled fast reactor, a pool sodium cooled fast reactor power plant system analysis model based on inter-stage cooling recompression cycle is established using FR-Sdaso. The load cycle process of the power plant is simulated. In the simulation, it is assumed that within 1 h, the nuclear power of the power plant decreases from the rated power to 50%, and then increases again to 100% after stabilization for a period of time. According to the flow-advanced operation principle, the power flow ratio is always less than 1 in the whole transient process, and the flowrate of the core and the secondary circuit changes synchronously in the transient process. The carbon dioxide flowrate is adjusted by keeping the sodium side outlet temperature of the

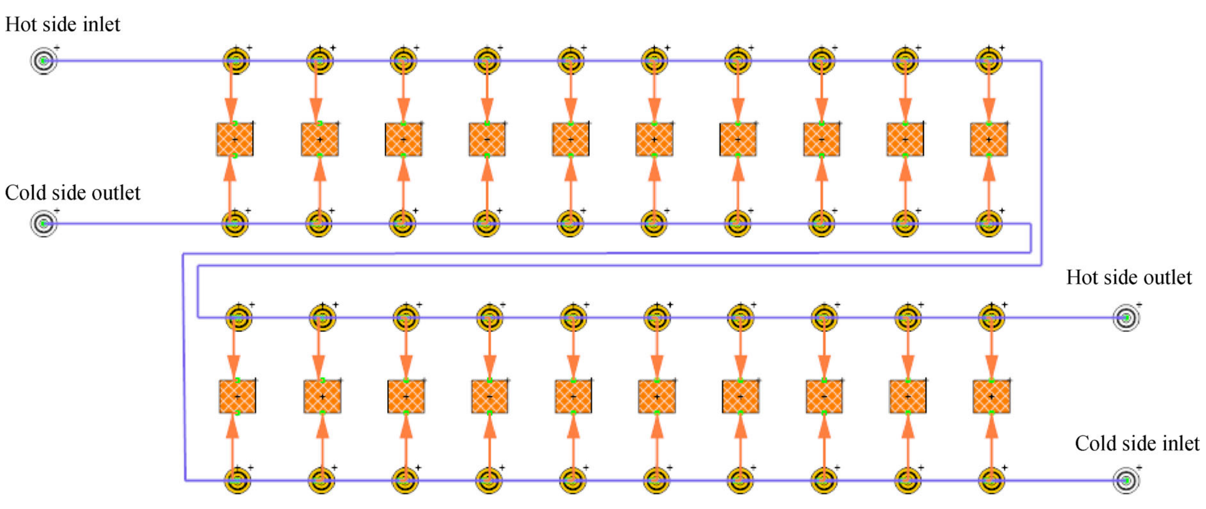

Fig. 5 Heat exchanger internal configuration.

sodium-carbon dioxide heat exchanger unchanged, and the speed of the compressor and turbine remains constant in the whole transient process. Figure 6 presents the relative change curve of the power and flow of the power plant during the load cycle simulation of the CFR1200 power plant. Figure 7 illustrates the temperature variation of the main nodes of the power plant during the transient process. It can be observed from the Fig. 7 that with the decrease or increase of nuclear power during the whole transient process, the temperature of the hot end of the power plant also drops or raises, while the outlet temperature of the sodium side of the sodium-carbon dioxide heat exchanger is kept constant by adjusting the carbon dioxide flow. On the one hand, the heat generated by the core can be brought out by the SCO_2 power conversion system. On the other hand, by stabilizing the sodium side outlet temperature of the sodium-SCO_2 heat exchanger, the cold end temperature of the whole power plant is stabilized and the stable and safe operation of the power plant is ensured. The calculation results suggest that the designed SCO_2 power conversion system can match the operation of the CFR1200 in a large power transient range. In the future, this paper will continue to analyze and study the operation, control strategy, and accident conditions of the SCO_2 power conversion system with the SFR.

4 Conclusions

This paper studies the SCO_2 cycle system for the SFR. After obtaining the inter-stage cooling and recompression cycle as the system configuration, the compatibility between the inter-stage cooling and recompression cycle and the SFR is further studied. The main conclusions are as follows:

Among the simple regenerative cycle, the recompression cycle, the inter-stage cooling cycle, the inter-stage cooling recompression cycle, and the reheat inter-stage cooling recompression cycle studied in this paper, the inter-stage cooling cycle can effectively reduce compressor power consumption and increase the heat absorption of heat recovery. Although the recompression cycle leads to the increase of compressor power consumption, it is beneficial to avoid the temperature pinch point of the cold end heat exchanger and increase the regenerative heat absorption. The reheat cycle will cause a large irreversible loss in the heat exchange process of the high temperature heat exchanger, and the reheater will be over-temperature. Therefore, it is not suitable for the sodium-cooled fast reactor. The inter-stage cooling recompression cycle configuration has the highest efficiency (about 40.7%), and the temperature matching with the sodium side of the sodium-cooled reactor is also the best. Therefore, it is suitable for the SFR system.

During the load cycle of the power plant, the flow-advanced operation principle is followed, the core and the secondary circuit flow are changed simultaneously, and the carbon dioxide flow is adjusted with the goal of keeping the sodium side outlet temperature of the sodium-carbon dioxide heat exchanger unchanged. Based on the above operation strategy, the inter-stage cooling and recompression cycle can match the operation of the SFR very well.

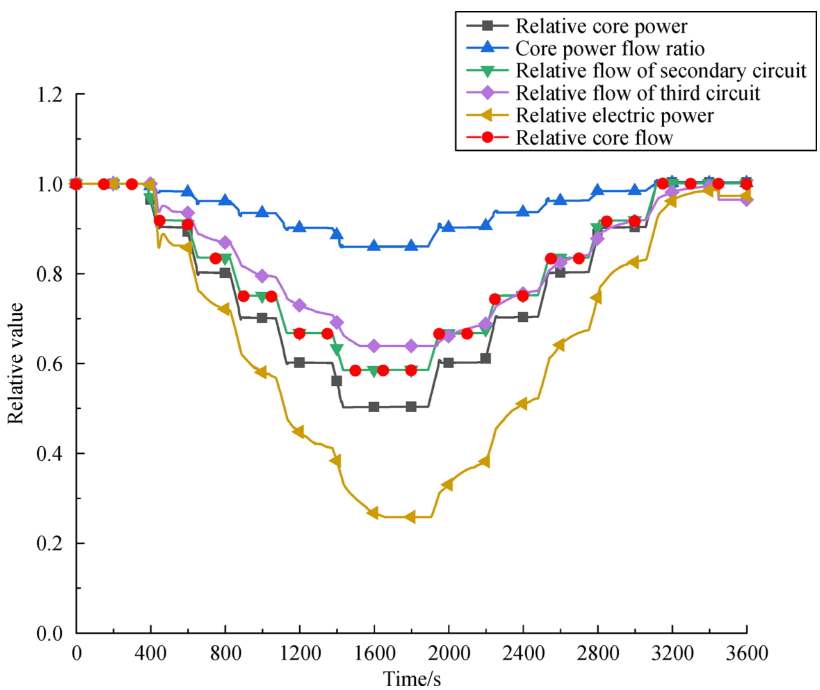

Fig. 6 Relative power and flow during load cycle of the CFR1200 power plant.

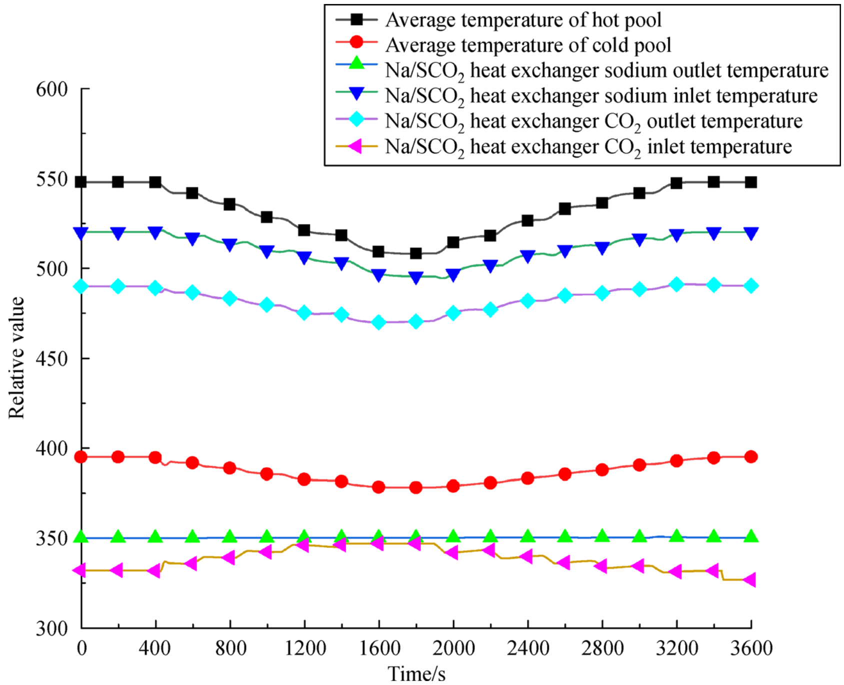

Fig. 7 Main node temperature of the hot and cold leg of the power plant during the load cycle of the CFR1200 power plant.

This paper proposes using the inter stage cooling recompression cycle as the SCO_2 power conversion system of large pool type sodium cooled fast reactor. In the future, the scheme will be further studied to provide technical support for the development of large pool type sodium cooled fast reactor in China.

Acknowledgements This work was supported by the International Cooperative Research and Development Project on Key Technologies of the Fourth Generation Nuclear Energy System Sodium-cooled Fast Reactor (2016YFE0100800).

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