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P2.191 Optimal operation and pump regeneration plan of fusion fuel cycle based on the state-task network representation

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The fuel cycle of the tritium plant has to safely handle the fuel gases including tritium and provide those gases to the fusion reactor. Given a required amount of tritium for fuelling scenarios considering ramp-up, flat-top, and ramp-down, a scheduling model is developed base on the state-task-network representation to provide the optimal operation plan for DT plasma operation including information on fueling rate, duration, and timing between each unit. The model aims to minimize tritium inventory including base inventory and working inventory inside the fuel cycle. The system scope of fuel cycle consists of Vacuum Roughing System, Tokamak Exhaust Process, Isotope Separation System, Storage Delivery System, and Fueling System. The model considers specific operation condition and tritium inventory limitation of each unit. The problem is formulated as a mixed integer nonlinear program (MINLP) model based on the state-task network representation with non-linear constraints. A case study of inductive operation mode is presented to illustrate the applicability of the proposed modeling and solution method. Presented case study is expected to provide many useful insights to determine the regeneration schedule of Vacuum Roughing System.

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