A Hydraulic Transfer System for Producing Radioisotopes

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1. Introduction

Research reactors are constructed mainly for producing radioisotopes, neutron beams and neutron irradiation research and so on. The research reactors generally have two separate area; one is the reactor area and the other is the radioisotopes (RI) production area. After various irradiation objects are irradiated in the reactor located in the reactor area, they are transferred to the RI production building for post-processing. The Hydraulic Transfer System (HTS) is one of RI production and utilization facilities of a research reactor. The HTS is for irradiating targets in the reactor core, and targets are transferred through pipes by hydraulic force. A similar system can be seen in other research reactor such as FRM II [1], JMTR [2], HFIR, *etc*.

There are two parallel open-loops used to irradiate targets, and the HTS will circulate pool water to load/unload targets into/from the irradiation tubes and cool targets during irradiation. This paper contains the introduction and operation of the HTS.

2. Hydraulic Transfer System

2.1 System Description

The HTS is composed of three parallel 50 % capacity pumps, a target transfer station (TTS), target transfer pipes (TTPs), an irradiation tube assembly (ITA), a 100 % capacity decay tank, target handling tools, related piping, valves, and instruments. The general layout of the HTS is shown in Fig. 1.

The TTS is submerged in the service pool and it is supported at the pool wall. Targets stay on the TTS before and after irradiation. The in-pool pipes are designated as TTPs, and they are connected to the ITA. There are branch lines on the TTPs to reduce the moving speed of targets. The ITA is installed in the reflector for HTS, and includes IT-001/002 and a tube joined from two ITs.

If three targets are inserted into the TTS by using the target handling tool, pumps located in the HTS room are operated. Water sucked from the service pool flows into the TTS, and three fresh targets are transferred into the ITs through TTPs. The moving speed of the targets is first reduced by bypassing the flow control when loading targets. The targets arrive stably at the ITs having the function to decelerate the moving speed of the targets .

If the irradiation of the targets is finished, the water flow is reversed by control valves as compared to the targets' loading and cooling operation modes. In the same manner as the targets' loading operation, the bypassing flow control slows down the moving speed of targets initially. The impact due to the targets is cushioned in the TTS when targets return. The irradiated targets are cooled on the TTS, and are put into the cask by using the target handling tool. Finally, the cask is transferred to the FM area through the transfer elevator.

When it is necessary to unload some of the three irradiated targets, all three irradiated targets are transferred from the IT to the TTS. Then, the dummy targets are replaced by some targets by using the target handling tool, and three targets including dummy targets are re-loaded into the IT.

Because the targets generate heat during irradiation, the cooling water flows in the HTS. The cooling water is always circulated on the loops to reduce heat although the targets are loaded/unloaded into/from IT in the one targets transfer loop. Finally, the PWMS removes the irradiation heat and maintain the pool water quality through a heat exchanger.

All the circulating water in the HTS passes through the decay tank to reduce the N-16 activity before it is discharged into the service pool.

All the valves for the flow control are located in the HTS room, and are controlled by a local control panel (LCP) which is located near the pool top. Various instruments are installed in the HTS, and the operation status of the HTS is also displayed on the LCP.

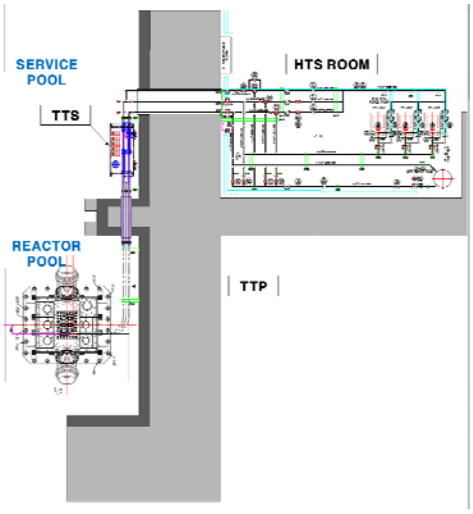

Fig. 1. The layout of the Hydraulic Transfer System

2.2 System Operation

Various instruments and control equipment such as meters, indicators, alarms, lamps and a hand switch is installed to operate the HTS. If the targets are inserted into the TTS, the 'LOADING' on the operating mode selection switch of the LCP is selected. By the interlock signals, two pumps are operated and the pressurized water flows in the HTS as shown in Fig. 2.

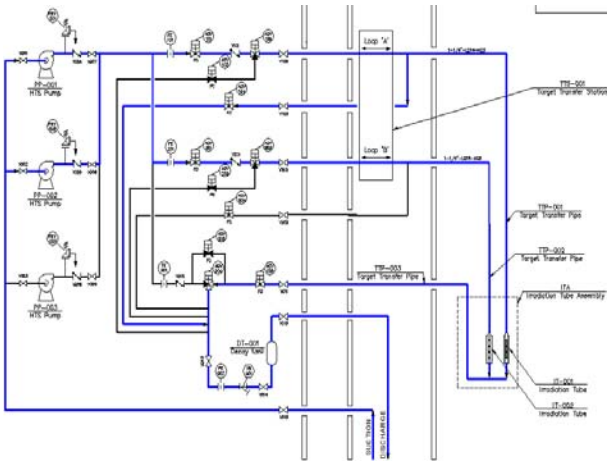

Fig. 2. Flow diagram for HTS under the targets loading condition.

Because the targets generated heat during irradiation, cooling water must always be circulated in the HTS. The operating mode selection switch is selected as the 'COOLING', and one pump is operated and maintain the water circulation in the HTS. The flow in the cooling operating mode is shown in Fig. 3.

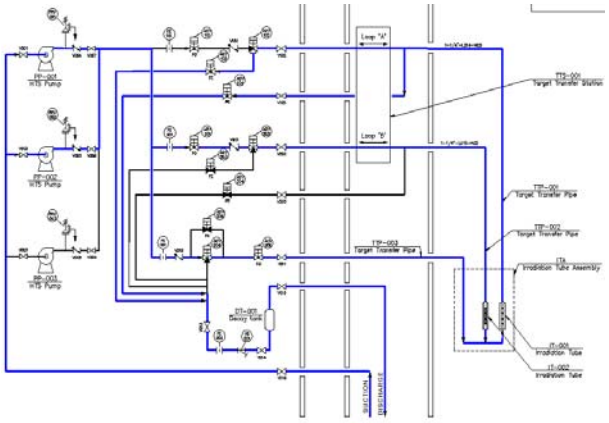

Fig.3. Flow diagram for HTS under the targets cooling condition.

If the irradiation of the targets is finished, the 'operating mode on the LCP is changed into the 'UNLOADING' mode. By the interlocking signal, the two pumps and valves are actuated, and the targets are transferred into the TTS. The flow in the unloading operating mode is shown in Fig. 4.

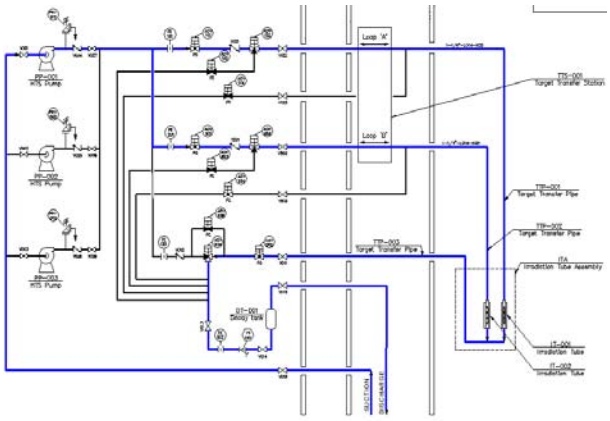

Fig.4. Flow diagram for HTS under the targets unloading condition.

3. Conclusions

The HTS permits instantaneous irradiation activity during the reactor operation. It contributes to the RI production and utilization for public welfare, industrial applications and research areas.

ACKNOWLEDGMENTS

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