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## Leak detection design for ITER gas injection system

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The main functions of ITER Gas injection system (GIS) are providing gas fueling ( $H_2$ ,  $D_2$ ,  $T_2$ ,  $4He/3He$ ,  $N_2/Ne$ ,  $Ar$ ) for plasma, wall conditioning operation and neutral beam injectors. If there is a leak on the gas supply lines during ITER plasma operation state, abnormal gas composition will affect or have the potential to affect operation. Furthermore, out-leak of Hydrogen or Tritium from gas supply lines will lead to safety issues, therefore a leak of gas supply lines especially  $H_2(D_2)/T_2$  lines shall be detected as soon as possible during the operation. Leak detection design for GIS  $H_2(D_2)/T_2$  gas supply lines during ITER operation state is introduced in this paper. Pressure monitoring of manifold is an effective way to check a problem of a line. Considering the handling of tritium, all the gas supply lines are enclosed in a secondary containment pipe (guard pipe), the pressure of which shall be lower than the environment pressure. Since the nominal pressure of the gas supply pipe is also lower than the pressure in the interspace, by monitoring and comparing the pressure in the gas supply pipe and guard pipe a leak of gas supply line could be identified with reasonable control logic.

Besides, hydrogen isotope may leak out to the interspace by diffusion. In this case Hydrogen detector and Tritium detector are employed to the interspace. The manifold interspace is continuously vented to the Detritiation System with  $N_2$ , therefore  $H_2(D_2)/T_2$  detectors are connected to monitor their concentration in the flow. Requirements that the interspace pressure is maintained to be lower than the environment pressure, at the same time the hydrogen isotope gas in the flow could be transferred to the detector as fast as possible are taken into consideration for the design of purge configuration and parameters (pipe diameter, flow rate, etc.).

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