§1. Operational Records of the LHD in FY1998

Nakamura, Y., Satow, T., Ohtake, I.
and Device Engineering Group

Device Engineering Group was organized with the purpose of progressing a research on engineering and technology in LHD (cryogenic system, superconducting coils, supporting structure, etc.) and operating the machine in safety. Our group consists of engineering researchers (14), technical staffs (38) in our institute and supporting staffs (42) from many companies. The main research subjects are to establish a method of stable and reliable operation of the cryogenic system and the superconducting magnet system, and to investigate the performances of the helical and poloidal superconducting coils (SC). Details of these studies are described in this book. Our main tasks during the operational campaign are to cool down the superconducting magnet system and to produce a steady-state magnetic field for plasma confinement. Moreover, in order to carry out plasma experiments successfully, it is very important to maintain a stable operation of each facility such as vacuum pumping system, cryogenic system, power supply system, plasma heating system and plasma diagnostic system. Our staffs are responsible for the stable operation and the maintenance of the Large Helical Device and the subsystems.

In this fiscal year, there were two operational campaigns as shown in Fig. 1. The first campaign has been carried out in succession after the completion of LHD until the middle of June. After the break of one and a half month, the second campaign with a long run of 5.5 months has been started from the beginning of August. The main activities in the operational phase are the evacuation of cryostat and plasma vacuum vessel, cooling down and excitation tests of SC, charging and discharging of SC during plasma experiments and warming up of cryogenic components. We can start plasma experiments in about 40 days from the initiation of pumping. In the initial operation of LHD, it was quite successful in general to run the machine though we experienced three times of fast down of SC charging current due to the defect of control system of power supply for SC. In the second cycle of operation, the charging of SC was attempted up to the full operating current which produces the magnetic field of 3T. Although we had an experience of protective action (quencch action) due to the generation of normal zone in one helical coil (LHD has a pair of helical coils), the whole system of superconducting magnet including the cryogenic system was successfully operated in accordance with the normal procedure and recovered to the original state. This was a large event in the second campaign. However, the plasma experiment with B = 2.7 T was carried out successfully and the magnetic field of 2.75 T was achieved just before the warmup of SC. The operation efficiency of LHD during plasma experiments, which was defined by the ratio of the actual operation time for experiment to the planned one, was around 75 % in both experimental campaigns. This efficiency depends on reliability of the magnet and cryogenic system and the efficiency reduction was caused by several times of fast down of the charging current including the quench action.

As a whole, in spite of the first year of LHD operation, each facility was successfully operated with no serious troubles and, in particular, a long-term stable (reliable) operation during the period of 152 days was demonstrated in the cryogenic system.

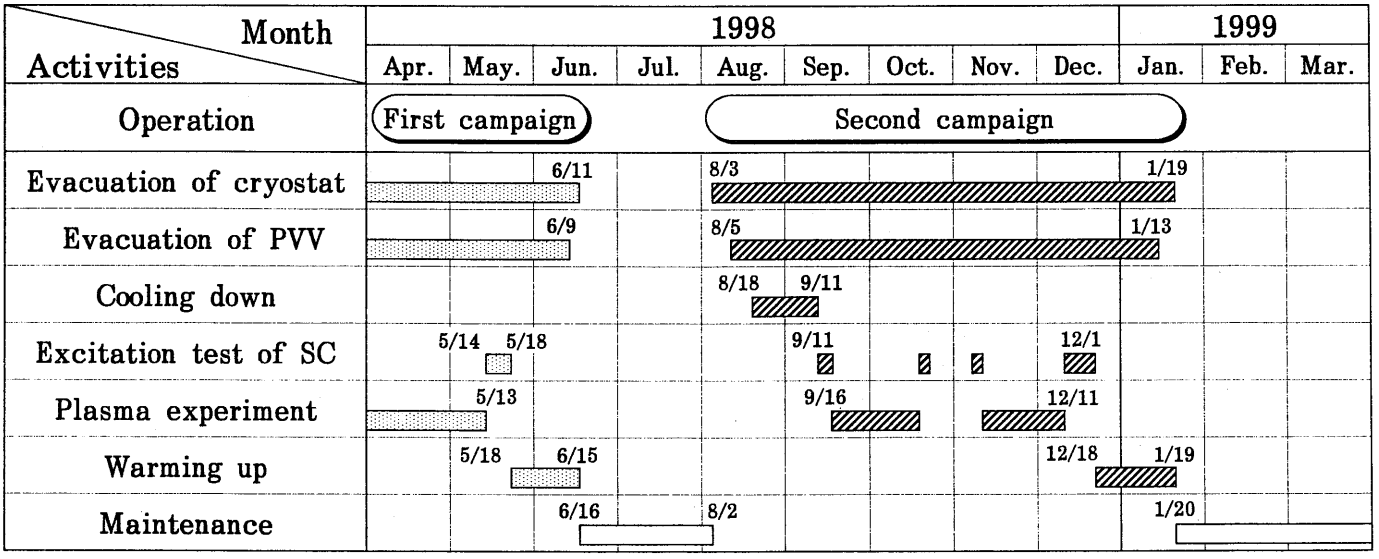

Fig.1. Operational records of the LHD