

6 Conclusions

In order to examine the influence of the current redistribution on the quench propagation velocity, we performed the Rutherford cable tests and numerical simulations. In addition, in order to discuss the influence of the polyimide tape wrapped on the cable for electrical insulation, the single strand test was also performed.

In the Rutherford cable used in the tests, strands were electrically connected each other. We measured the quench propagation velocity and the current redistribution during quench processes, simultaneously. In the measurement of the current redistribution, sets of pickup coils were used. The heater quench tests were performed under four cable conditions, i.e.,

- original cable : a cable with no treatment,
- cable without polyimide : a cable stripped of polyimide tape for cable insulation,
- low contact cable : a cable with lower electrical contact conductance and contact thermal conductivity between strands, and
- high contact cable : a cable with higher electrical contact conductance and contact thermal conductivity between strands.

From the tests, we found that the polyimide tape influenced largely the quench propagation velocity at the high cable current. In terms of the electrical contact conductance, we obtained the results that the quench propagation velocities in the cable with higher contact conductance between strands were higher than those with lower contact conductance. About the current redistribution around the quench front, we found that it depended on the contact condition between strands. In original cable, the current redistribution occurred twice, and it was explained by the magnetic field gradient across

the cable cross section. In low contact cable, the current changed periodically when the quench front passed through, and the time span of the current change was slightly longer than that in original cable and high contact cable. In high contact cable, the current redistribution occurs only once from the higher field to lower field region.

In order to examine whether the influence of the polyimide tape appeared only in the Rutherford cable, the quench propagation velocity of the strand was measured. The quench propagation in the strand wrapped with the polyimide tape was different from that in the adiabatic strand and the strand cooled with pool boiling helium. This result was almost the same as the result of the cable tests. We made the assumption that the helium gas higher than 4.22 K in the cooling channel caused the increase of the quench propagation velocity, namely, the thermal hydraulic quenchback phenomenon occurred in the limited space around the cable surrounded by the polyimide tape.

We developed a simulation code to discuss the relation between the current redistribution and the quench propagation velocity in more detail. To simplify the calculation, a two-parallel strand model with a magnetic field distribution was considered. From the comparison between the simulation results and the results in the Rutherford cable tests, we could explain the current redistribution for any electrical contact conductance between strands. And we proved that the current redistribution around the quench front due to the magnetic field gradient caused the increase of the quench propagation velocity.

More detailed measurements are required to study the influence of polyimide tape on the quench propagation velocity. In order to examine the assumption for the influence of the polyimide tape in the present study, it is necessary to perform measurements quantitatively by changing the transport current, the magnetic field, the cooling channel, and so on.