

§2. Interlock Signal Control between the LHD and the Access Control Systems

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Concurrent with the construction of the large helical device (LHD), an access-control system for the LHD experimental hall was developed to incorporate interlock signals, which are used to exchange information with the LHD-control system. The interlock-signal system is characterized by the following two points. One is a function provided for the LHD-operation control, and the other, for the personnel-access control that corresponds to the LHD-operation mode. In this report, the former interlock signal system will be described in detail.

For the safe operation of the LHD and the entrance gates, an interlock-signal system is integrated and the signals are used to exchange information between the access-control system and the LHD-control system. That is, both systems provide a safe operating environment based on the use of the interlock signals.

As shown previous reports, the total number of signals is fifteen, and seven of those are used for the LHD-operation control. The seven interlock signals are shown in Fig. 1 and numbered from ① to ⑦. Some are automatically sent based on the judgment of the access-control system, and others need an operator's decision before being sent. Furthermore, the access-control system has a manual-operation box beside the main computer. Using the box, all the interlock signals can be manually sent independently to the main computer. The box is provided in case of accident with or serious trouble of the main computer. According to the interlock signals sent from the access-control system, the operation of the LHD is timely and reasonably restricted. As a typical case, we will show the function of "Major Fault" of all seven interlock signals.

In Fig. 1, the interlock signal "Major Fault" will be sent from the access-control system to the LHD control system only when something serious actually happens. Once this signal is sent, the following two actions will be induced. In one action, shown in Fig. 1, the second signal (A) is dispatched and, in the another action, an alarm lamp indicating a "Major

Fault" lights up on "Large Central-Alarm Panel", which has a height of 1.8 meters and a width of 2.3 meters (lower right corner in Fig. 1). The panel is an important component of the LHD-control system and more than 300 various alarm lamps can be indicated on it. An LHD-control system operator verifies safe operation by checking the alarm lamps during an LHD operation. Seven of those alarm lamps, "Major Fault", "Minor Fault", "Personnel Access to Controlled Area", "Shielding Door Closed", "No Entrance", "Operation", and "Stop", all concern the access-control system, in which "Operation" and "Stop" are shown together in the same square in Fig. 1. In Fig. 1, once the interlock signal (A) is dispatched due to "Major Fault", a series of emergency actions is taken, that is, a "Gus Puff" and a "Compulsory Stop" of the plasma heating devices. The plasma heating devices are the Electron Cyclotron Resonance Heating (ECH) Device, the Neural Beam Injection (NBI) Device, and the Ion Cyclotron Range of Frequency (ICRF) Device. In the "Gus Puff" action, high-pressure argon gas is blown into plasma created in the plasma vessel of the LHD, and the argon gas spreads in the vessel controlling the high-energy running away electrons that occur due to drastic change of the magnetic field. "Gus Puff" will be practiced only when a signal (A) is sent under the LHD operational state of "Coil Exciting" in which an electric current is sent to the super-conducting coil to make the magnetic field. And, due to the interlock signal (A), the plasma heating devices are immediately stopped their operation by having the electric power to them cut. The interlock signal of (A) will be also dispatched by one of the several other interlock signals, "Personnel Access to Controlled Area (LHD Basement)", "Personnel Access to Controlled Area (LHD Main Hall)", and others like "Earthquake (over 120 gal)" as shown in the upper left corner of Fig. 1. The interlock signal "Major Fault" is a typical one.

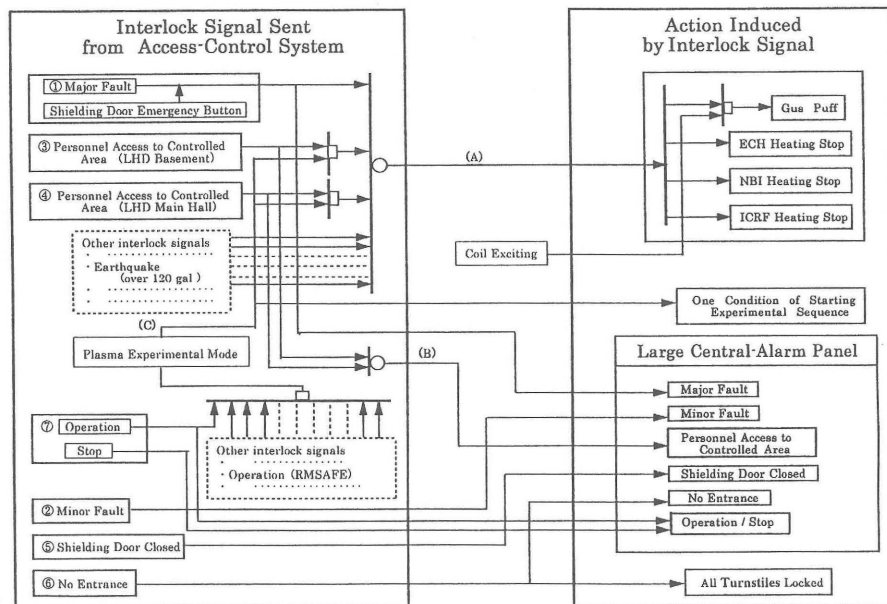


Fig. 1 Action induced by interlock signal sent from the access-control system to the LHD-control system (○ and □ stand for "or" and "and" in logical representation, respectively).