A.4: Development of magnet cycling verification system for Indus-2

Repeatable and history-free magnetic field profile is a prerequisite for proper and repeatable operation of Indus-2 machine. This is achieved by cycling the output current of Magnet Power Supplies (MPS) in every beam injection cycle.

Verification of the correctness of cycling is an important aspect of day-to-day machine operation. Earlier, such verification had to be carried out by the tedious manual process by analyzing the data corresponding to 138 MPS pertaining to the cycling duration.

A system providing automatic verification of the process and reporting the results is developed and put in regular use.

The overall verification system consists of sequential execution of various tasks by interconnected software modules developed in WinCCOA SCADA and Matlab which is depicted in Fig. A.4.1.

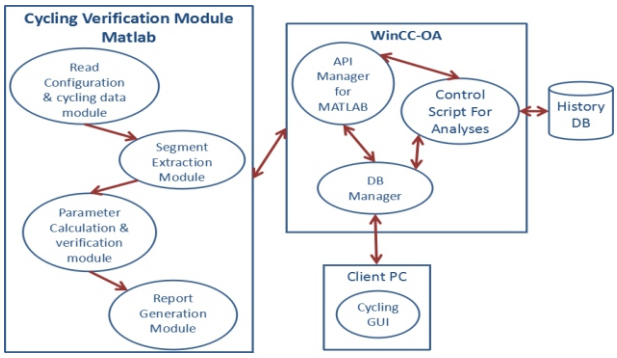

Fig. A.4.1: Overall cycling verification process

The cycling of MPS has some key parameters viz. number of cycles, initial value, maximum flat top value, rise and fall slope etc. Verification process involves checking the deviation beyond tolerance limits for the key parameters and also to detect presence of any spikes and glitches in the signals. An algorithm is designed and developed in the form of various MATLAB modules to achieve the same. The tolerance limits were finalised by carrying out cycling experiments on the Indus-2 machine by varying various key cycling parameters and subsequently analyzing their effects on the beam. The developed algorithm was tested with archived, online and simulated cycling data.

The system is modular, has configurable tolerance limits and option for enabling/disabling of individual MPS for verification. The system provides verification status in the form of a report depicting the pass/fail status of individual MPS for all three signals viz. power supply current read-back, reference read-back and digital set as shown in Fig. A.4.2. A detailed report indicating the faulty key parameter(s) is also available, in case of any problem, which helps in quick identification of the faulty system.

Fig. A.4.2: Cycling analysis results

The report also provides plots of above signals (Fig. A.4.3) for all power supplies. The various verification parameters are stored in a csv file and their history is also maintained.

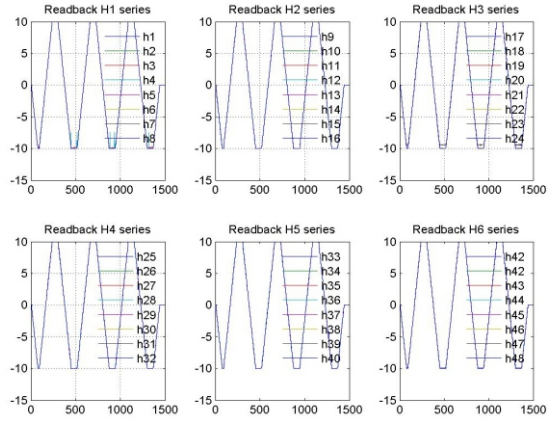

Fig. A.4.3: Signal plot for horizontal steering coils

The overall integrated system is deployed for regular operation. This has resulted in identification of cycling related faults at the early stage of beam injection cycle.

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