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An Adaptive Controller for Wolsong NGS Bulk Liquid Zone Control of RRS

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Abstract

The evaluation and inspection of linear stability of Liquid Zone Controller (LZC) has been being performed with design data and actual program parameters installed in plant Digital Control Computers (DCC) during licensing stage of Wolsong Units 2,3 and 4. The study was done to identify the candidates – the vulnerable devices or control parameters on stability when plant is undergone with improper tuning or control components' aging. The time constant of LZC valve was analyzed as the critical parameter among the candidates. However, the surveillance requirements could not be applied to the process control system such as control devices of RRS. The response time of RRS controllers have not been measured since commissioned. The fine tuning parameters and gains should have been justified with an analysis, but is tuned with experiences learned from previous CANDU plants. With limited simulation results, we have confirmed that no fundamental barriers of RRS bulk control for Wolsong 2/3/4 exist. The dynamic calibration in DCC program could correct continuously a wrong input-sensing signal of log neutron power such like an adaptive system. The first order lag term of the actuator, LZC valve, is the most critical among other sensing and actuating devices. It is, however, a quite large degradation from design value when it disturbs the plant. With a help of MRAS (model reference adaptive system) regulator in this study, the degraded controller with an aged actuator has a possibility to cope with the worst situation with which the DCC program could not deal. It will give a formal guidance for plant engineer when the tuning is necessary or preventive maintenance is planned against aging. If the fault tolerant control scheme is applied, the unstable operation of RRS will be relieved from such an unexpected malfunction. We recommend that the precautions and limitations for dynamic response of LZC be considered to apply the vulnerable parameters identified in this study. In this study we suggest an adaptive controller to follow the Reference Model to cope with an aged and degraded effect on the LZC controller.