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LLRF Controller for High Current Cyclotron Based BNCT System

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The 30 MeV high current proton cyclotron had been demonstrated successfully for BNCT System in Japan. From the M-C simulation at China Institute of Atomic Energy (CIAE), the lower energy, e.g. 14 MeV proton beam will be benefit obviously for the neutron modulator and may not affect the neutron flux very much. A project of high current cyclotron based BNCT system was approved to start the design and construction in 2016. For such a 14 MeV compact high current cyclotron, the load of RF cavities is small, while its beam loading is quite high for the mA level machine. Thus, during the beam commissioning and machine operation, the RF system requires a more powerful, flexible, and reliable real time LLRF system. Although the 100 MeV compact cyclotron had produced up to 52 kW of proton beam at CIAE, the ability of its analog-digital hybrid LLRF system cannot satisfy the requirements of the high beam loading situation of the 14 MeV cyclotron. At TRIUMF, a digital LLRF system was developed for the pre-buncher of ARIEL project. The state-of-art design is extended and utilized for the BNCT LLRF system. In which, the amplitude and phase of the two separate Dees as well as the buncher for beam injection will be regulated by a single FPGA. For such a demanding control task, the design shows a promising future, both from real-time response and flexibility point of view. The design ideas, technique feature, system structure, hardware manufacture and software development will be presented.

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