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Analysis of redundancy design and reliability estimation of 60 kW CW RF HPA for ALS-U project at LBNL

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The 60 kW CW AR RF HPA is critical major equipment in new RF system for ALS-U project at LBNL and so it has been designed & built with a modular redundant topology having large array of 96 RF final PA modules (each delivering ˜ 700 W RF output) that are combined in parallel, and large 30 DC PS modules (each ˜ 5 kW DC power) operating in parallel for achieving very high reliability (MTBF ˜ 135,000 hours) & availability (˜ 99.997 %) of RF HPA which is essential for continuous 24/7 beam operations. The redundancy design to modules failures is such that in the event upto 10% failures of RF PA modules and simultaneously upto 15 % failures of DC PS modules the HPA still can generate minimum 48 kW CW RF output that is needed for full beam power and so RF power headroom of 12 kW is built in. The operating power levels & temperatures of all components in HPA are well below to their maximum ratings for high reliability. The MBTF values of subsystems in HPA has been estimated based on components with high failures rates. The reliability probabilities having exponential distribution parameterized on failure rate were determined and the binomial distribution used for modules having redundancy. This paper presents such redundancy design analysis of HPA to such modules failures to achieve such minimum output power. Also the Availability (˜99.997%) and the Reliability (MTBF ˜ 135,000 hours) Estimation analysis of the overall HPA with such redundancy to modules failures is presented.

Footnotes

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