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P4.087 High voltage direct current power supplies for electron cyclotron resonance heating at ASDEX Upgrade

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The electron cyclotron resonance heating group installs four new gyrotrons to enlarge the heating power at ASDEX Upgrade (Axially Symmetric Divertor Experiment). Gyrotrons are microwave oscillators for additional plasma heating. Therefore two new direct current power supplies are needed. One power supply is able to feed two gyrotrons.

The engineering data for both power supplies are:

- dc voltage control up to 60 kV
- dc current load capacity of 100 A
- dc power of 5 MW
- smoothed dc voltage by 12 pulse rectifier and capacitors
- impact load strength while 10 s

Usually two gyrotrons in maximum continuous wave mode operation need a power supply with 55 kV and 84 A load capacity. That means a dc power of 4.62 MW. The constructed power supplies are conventional thyristor based types and the main parts obtained by the Deutsches Elektronen Synchrotron (DESY) in Hamburg. The operating principle is the following. A step-down transformer is connected to the 10 kV grid and provides 890 V at the low voltage side. The 890 V part is connected to a star point controller. This controlled three phase bridge rectifier adjusts the root mean square voltage of the following high voltage transformer. An uncontrolled three phase bridge rectifier converts the AC voltage to DC. The DC voltage is smoothed by high voltage capacitors. To get a 12 pulse system with lower ripple voltage, two 6 pulse systems have to be connected. The two 6 pulse systems are connected in series in this case. That requires two AC systems with a phase difference of 30° to each other. To reach this, two different vector groups are used.

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