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Estimates of Radiation Levels in the Main Linac Tunnel and Beam Dump Caverns for the CLIC Design Study

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The Compact Linear Collider (CLIC) study investigates the feasibility of a high-energy electron-positron linear collider optimized for a centre of mass energy of 3 TeV. The total tunnel length will be about 48 km, requiring the main linacs to operate at very high electric accelerating gradients of 100 MV/m. The RF power will be produced by a 'two-beam acceleration method' in which a high intensity drive beam supplies energy to the main accelerating beam. The main beam will be accelerated from 9 GeV to 1.5 TeV and the drive beam decelerated from 2.37 to 0.237 GeV. Current designs include 24 beam dump caverns for each linac, positioned at the end of every drive beam decelerator sector.

Ionizing radiation in the tunnel and caverns can cause damage to materials, lead to errors in semiconductor devices and have long-term health effects on exposed humans. Calculating the potential radiation levels in all parts of the CLIC facility is therefore an important part of the CLIC design study.

The Monte-Carlo particle transport code FLUKA is used to simulate main and drive beam losses in the CLIC tunnel at several different energies. An irradiation pattern with cycles of 180 days continuous running followed by 185 days of shutdown is used. Estimates of residual dose rates inside the tunnel at several waiting times ranging from 4 hours to 4 months within several different shutdown periods between 1 to 11 years of operation are presented. With the exception of areas very close to the beamline, the residual dose rates in the tunnel are found to be less than 100 µSvh-1 at waiting times of 4 hours. According to CERN limits, most interventions in the tunnel during offline periods would therefore be achievable without necessitating detailed optimizations of interventions and strict control times.

In addition, FLUKA is used to simulate an electron beam impinging on a graphite and iron composite dump inside a drive beam dump cavern. The resulting residual dose rates are presented.

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