EX 5.2.b)

Maximum energy :

$\rho = 3$ Km
$B = 16$ T $\longrightarrow \frac{P}{e} = B\rho \rightarrow p = 3\times10^3 m \times 16T \times e \times 3\times10^8 \frac{m}{s} = 14{,}4 \frac{TeV}{c}$

and so the energy is $\boxed{E = 14{,}4 \text{ TeV}}$

Synchrotron radiation :

$\gamma(14{,}4\,\text{TeV}) = 15{,}3\times10^3$

now the magority of the photons is emitted at the criticae energy

$$\boxed{\epsilon_c = \hbar\omega_c = \hbar \frac{2}{3}\frac{c}{\rho}\gamma^3 = 158{,}5 \text{ eV}}$$

So in the UV.

The energy lost per turn by one proton is :

$$\boxed{U_0(\text{KeV}) = 6{,}03 \frac{E^4(\text{TeV})}{\rho(m)} = 86{,}4 \text{ KeV}}$$

this means that for an 1 A beam the power irradiated is

$$\boxed{P(\text{KW}) = U_0^{(\text{KeV})} \cdot I(A) = 86{,}4 \text{ KW}}$$

So this means :

- the vacuum is stressed a lot by the synchrotron emission, the beam pipe will probbly need proper conditioning. Also the working of getters and ion pump. has to be verified carefully because ad- and ab-sorbtion of gases is reduced by radiation. (smaller capture time on the surfaces of the residual gas)

- the RF system has to be designed to transfer to the beam at least 86,4 kW of power. And ~~at top~~ ~~and~~ this just to maintain the energy at flattop.

  Compared to the LHC at 7 TeV, where just 3.7 kW are irradiated per beam [1], this means to require a much higher performance of the RF system.

  [1] LHC project report 316, 1.12.1999

- In general such high radiation level is stressing for all the instrumentation, in particular the electronics.