A variety of load cases, ranging from nominal to degraded or abnormal operating conditions, were studied both numerically and analytically.
The reviewers recommend that this set of load cases be thoroughly verified, specifically ascertaining the consistency with the Functional Specification and that out of these a dimensioning design case be defined.
It is also advised that the design choices be documented and substantiated in an official Technical Specification.

- verify load cases → EN-STI
- write technical specification → EN-STI

The alternative design options of active cooling and passive (radiative) cooling were studied extensively.

- no action

The relevance of inductive heating and grazing beam load should be assessed.

- action for EN-STI

Best practices suggest to avoid combining multiple functions in one component whenever possible. In particular, it would be advisable to keep the dump design separated from that of the beam monitor.

- EN-STI to possibly revise the design (with BI), but may be difficult or impossible

The beam monitor and the dump are integral parts of a PSB kicker magnet. The engineering design of this assembly should be integrated:

a. Thermal and structural response of this assembly should be assessed as a whole.

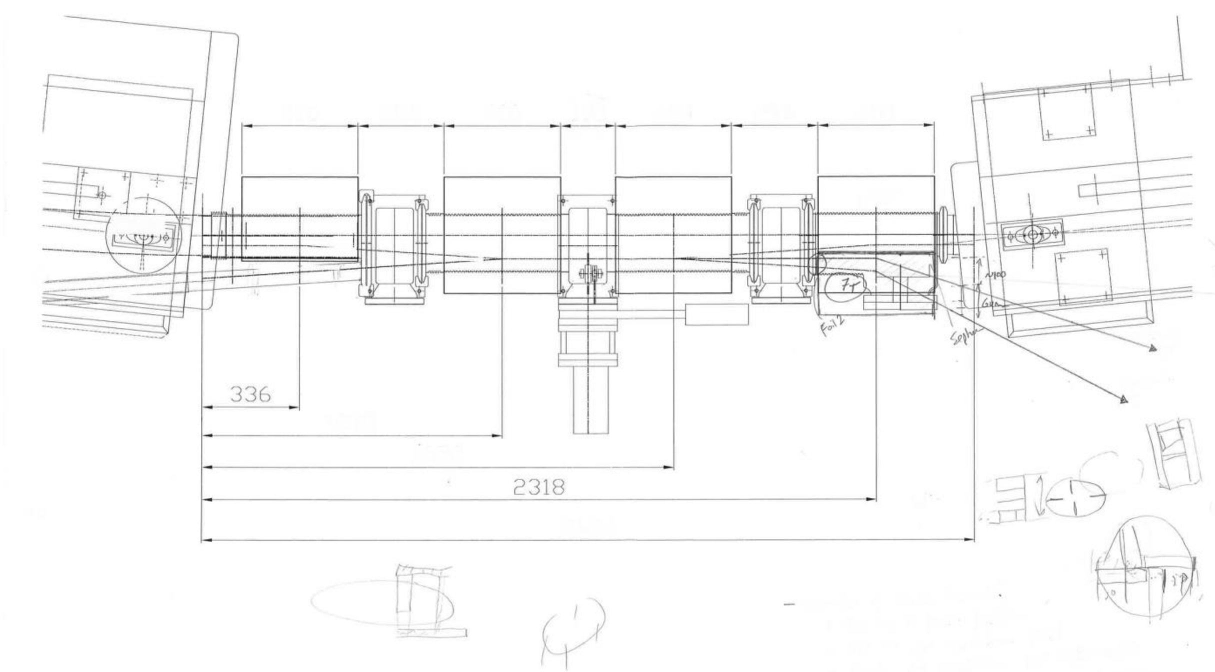
b. Design choices should be consistent (e.g. presence of metallic parts in the beam monitor vs. absence in the dump)

c. Synergies between components could open new design possibilities (e.g. indirect cooling of the dump/vacuum chamber by the magnet cooling system).

- integrated design magnet-monitor-dump (EN-STI, ABT, BI, EN-MME)

The possibility to use high-Z materials (e.g. Molybdenum) as an alternative to low-Z SiC or Graphite should be considered in view of removing (the largest part of) the dump from the PSB kicker magnet.

- do we have time to study alternatives?
- look into possibilities to move the dumps outside of the magnet; if there is the smallest chance to do so, we must do it



A risk of swelling for SiC was mentioned during the review, but little information was initially provided concerning the expected effect on mechanical behavior in function of the expected radiation damage over the cumulative life of the dump. Reference papers were provided after the review, confirming the increased interest for SiC in nuclear industry and providing data on swelling and thermal conductivity of high-purity CVD SiC over an irradiation temperature range of 200–1600°C, on swelling of beta silicon carbide in the lower irradiation T range 333 K – 873 K, on thermal conductivity degradation for CVD SiC between 200 °C and 1000 °C irradiation, etc.

- are we sufficiently confident that SiC will not cause any problems?

A more targeted synthesis of the available information on radiation damage in view of the operating conditions of the dump should nevertheless be provided. We suggest that the project summarizes in one slide the effects of the expected radiation damage and irradiation-induced swelling on the mechanical and thermal properties of the material (estimated with the best reasonable and conservative assumptions) and on dimensional stability, in order to assess on this basis the viability of the dump over its lifetime.

- EN-STI, produce a very short document on the expected behavior of SiC

P. Sievers separate mail

- Si-C is certainly a good material. Temperatures and thermal stresses at normal operation look ok? Si-C is a Ceramic, rather brittle (low resistance to traction). Therefore a failure may occur with the “worst case”-incident? Are the instantaneous temperatures and stresses known for this case? Thermal shock and vibrations at 100 micro-s rise times may be small. Since this is a rare event, thermal fatigue should not occur?

- Other low electrical conductivity metals, like Ti-alloy Ti-Al-6-V are still too conductive? It has, of course, also a bad thermal conductivity. Si-C, if I remember well, is a kind of semi-conductor, with thermal and electrical conductivity, depending on temperature. To be checked?

- Molybdenum is selected as the mating material, because of the thermal expansion coefficient. Others, like Zircalloy, used in reactor technology , and Tantalum (somewhat higher th. Expansion) may also be candidates?

P. Sievers separate mail

- Bake out (if required) could be arranged by brazing metallic, mineral insulated, radiation hard coax-heating cables into grooves machined into the Si-C? How to protect the environment around the 200 oC-dump???

- With no active cooling and 2% beam, the surface temperature is nearly 160 oC? The Si-C might stand it, but again, its environment, who has to be kept cool and has to absorb the radiated power? Some, even “slobby” active cooling should be accepted.

- The “worst case” is very rare. However, some thermal transients, involving transient thermal stresses are provoked by beam trips, beam starts and beam stops, where the dump rises from room temperature to steady state or from there back to room temperature. These may occur more often. Can this lead to fatigue?

P. Sievers separate mail

- There was the question, why not send the dumped beam through a window onto an external dump. The window would add a risk factor and the vacuum chamber between the circulating beam and the edge of the outside dump may also be hit by the beam. Not a good idea!

- I believe that, with some R+D, the brazing of Si-C can be managed (Many ceramic-vacuum feedthroughs are available, and work even after bake out).

- DPA's and radiation swelling. How long will it take to accumulate 0.5 DPA? Radiation damaged metals can sometimes be healed by annealing to higher temperatures. For Si-C it may be difficult.