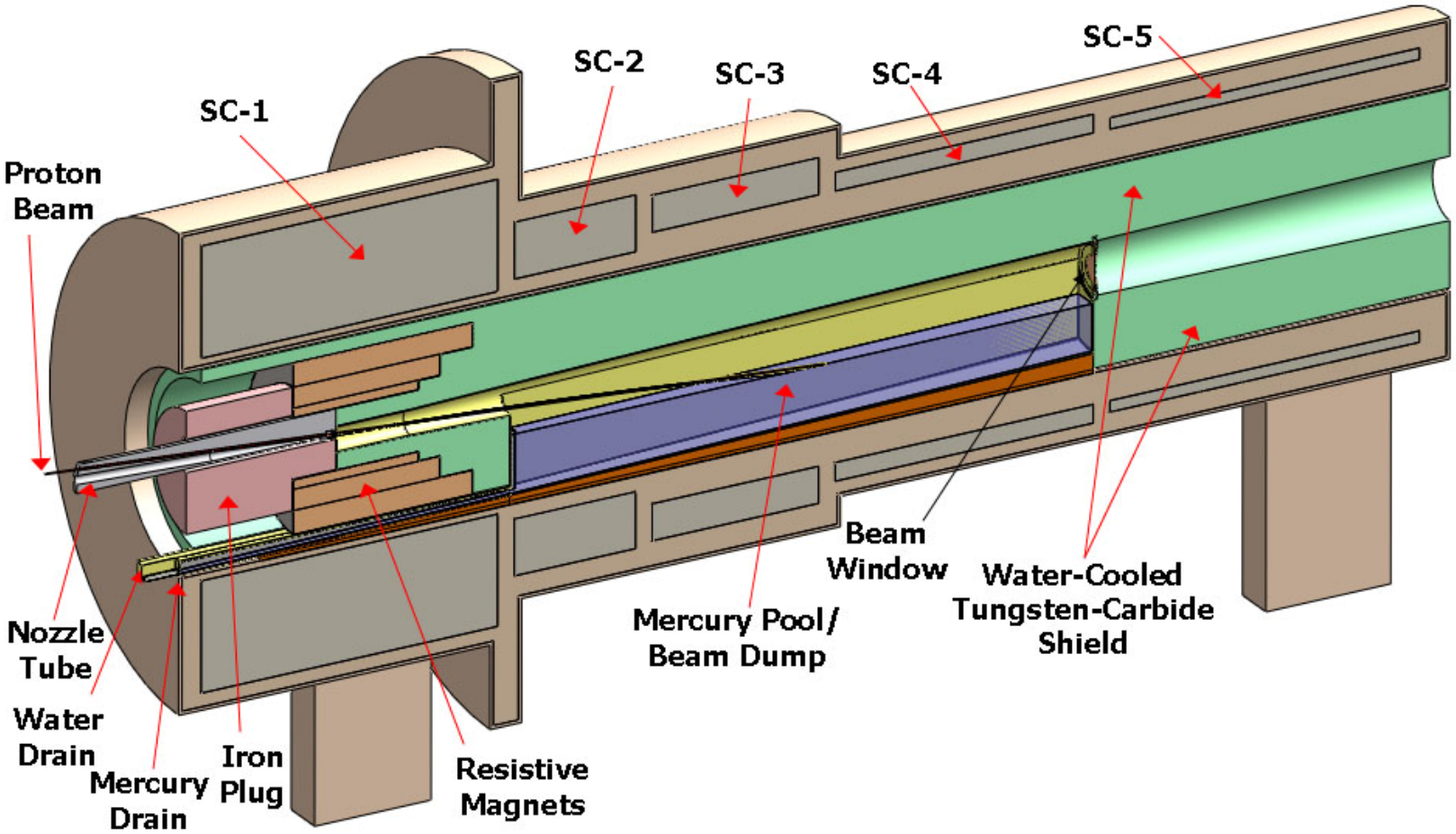
# Updating the Target-System Baseline

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# General Issues

The present baseline is more of a concept (Palmer, 1994) than an engineering design.

The present parameters were set during the 2001 Feasibility Study II, and are largely reasonable guesses.

The most speculative aspect of the target-system concept (use of a free mercury jet target inside a 20-T solenoid) has been validated by the CERN MERIT experiment.

As we look more into the technical details of the target system, we find that it needs a major "makeover", although we believe the over concept is sound.

The biggest issue is management of the heat load and radiation damage from the 4 MW of beam power, of which about 80% is dissipated in the target system (with ~ 20% going into the "front end"). [Only 10% of the power is dissipated in the target itself.]

- The concept is to line the superconducting magnet string with a shield of water-cooled tungsten-carbide spheres. [10% of the beam power is dissipated in the inner SS jacket of the shield.]
- The baseline shield is almost certainly inadequate.
- A thicker shield implies a larger bore for the 20-T magnet, larger stored energy, and larger risk for this critical component.
- The viability of the cooling of the shield is unknown.
- The shield must be extended well into the "front end" (50-100 m more?) with significant (but presently unknown) cost consequences.

Compared to the issue of the shield, the issue of the viability of the mercury pool as a beam dump is minor, but little understood.

Other significant issues include the iron plug (can we get rid of it), the downstream beam window, and the target itself (including the mercury circulation system).



# Near-Term Activities

The IDSNF desires a better baseline (by end October) for the Interim Design Report (to be completed in 2010).

The issues are too complex to make changes now to the target-system such that we are confident that a revised baseline is both viable and affordable.

- Still 20-T magnet, with a mercury jet target.
- Inner radius of magnets should be increased to accommodate more shielding, but we are not yet prepared to make a "baseline" recommendation on this.
- Change length of the taper down to 1.5 T to be 15 m.
- Revisions to beam and jet size and angles appropriate for 8 GeV protons have been studied and can be recommended.

There is a similar pressure within MAP to (re) define the target-system baseline "soon", and to introduce "change control procedures" to manage subsequent changes.

The target-system baseline is expected to undergo an external review "soon", with a (tentative) charge to the committee to comment on:

1. What has the experimental program (including MERIT) established / not established?
2. Is the proposed initial configuration likely to meet its requirements?
3. Is the documentation describing the initial configuration adequate? How can it be improved?
4. What are the main risks and uncertainties associated with the proposed initial configuration, and what actions should be taken to mitigate the risks and reduce the uncertainties?
5. Are the proposed fall-back options appropriate?

# My View of Answers to the Review Questions

1. What has the experimental program (including MERIT) established / not established?

   The viability of the concept of a free mercury jet target in a strong solenoid has been established, but the viability of the system as a whole has scarcely been considered.

2. Is the proposed initial configuration likely to meet its requirements?

   Unknown in detail, but very unlikely that the present baseline is adequate.

3. Is the documentation describing the initial configuration adequate? How can it be improved?

   There is little/no documentation of the system as a whole, because little/no effort has been made to understand the rather formidable technical issues in any detail.

4. What are the main risks and uncertainties associated with the proposed initial configuration, and what actions should be taken to mitigate the risks and reduce the uncertainties?

   The main risks are failure of magnets, and of the shield itself, due to inadequate cooling and radiation damage. Extensive engineering studies need to be performed to assess and mitigate these risks – which are not so much insurmountable as uninvestigated.

5. Are the proposed fall-back options appropriate?

   We believe the baseline concept of a liquid metal jet target in a solenoid magnet can be made viable, and we are not presently considering "fall-back" options such as a toroidal horn system.

My question: Do we need an external review to tell us that we need to develop a plan that will result in an engineered baseline design that permits assessment of risks, costs, and meaningful alternatives?

For a sketch of that plan, see http://www.hep.princeton.edu/~mcdonald/mumu/target/Target_R&D_Plan_v2.pdf