Maintain symmetry as much as possible.

Consider using a non-magnetic base plate or no base plate at all.

Avoid Saturation

Geometric asymmetries, variations in steel magnetic properties and top to bottom yoke packing factor differences are amplified with the onset of magnetic saturation.

Magnetic flux density in the bulk of the yoke and poles should be kept less than 1.4T when using silicon electrical steel. Using percent saturation based on modelled integrated field strength may be misleading as the allowed level of saturation is arbitrary and local saturation (in say the back leg of a quadrupole yoke) can be overlooked.

The flux density can only be decreased so much by increasing cross sectional area. Flux density must be managed by increasing magnetic length and decreasing magnetic gradient. This needs to be done very early on in the design process.

Increase space/size (Think +20% when asked for the minimum required).
Increase aperture to decrease mechanical tolerances required to achieve a tight harmonic specification. (This may also allow more space for the vacuum chamber)

Increase free space around coils (4-5mm minimum). Don’t make coils and coil mounts precision parts. This also allows for small changes in conductor geometry (possibly to meet voltage, temperature or flow rate specs) and variations in insulation geometry/spec.

Increase space to allow for easy assembly / disassembly of parts.
Increase the cross sectional area of the yoke to reduce magnetic flux below saturation and to increase the rigidity of the magnet structure
Increasing the cross sectional area of the magnet does not necessarily increase the cost of the magnet. If the same numbers of parts nest on a sheet of lamination steel (standard ThyssenKrupp steel is 1250mm wide) then the cost is the same.

Don’t over constrain (or over complicate) the coupling of the yoke halves as this may induce stresses in the magnet yoke and/or decrease assembly repeatability.
There should be minimal (or no) horizontal clamping. Possibly on one side only and only enough to remove any play in the dowels.

Do not dowel pole braces. (Clamping with tie rods provides adequate support, does not induce stresses in the poles of the magnet and can be easily adjusted if shimming is required)

Simplify interfaces. Interfaces between yoke halves should be as large as possible, horizontal, ground flat and be made with the minimum number of parts and materials

Design for adjustability not a “perfect” magnet when specifying low order harmonics less than 3 parts/10000 of the fundamental. Variations in the magnetic properties of the steel and packing factor variations can lead to a magnet that that requires asymmetric shimming to bring harmonic errors into spec.

Try to minimise design changes

There is no such thing as a perfect magnet. If a design is adequate/fit for purpose leave it alone

Make it as clear as possible from the beginning what can and cannot be changed and what the physical design envelope for each magnet is (no go areas). Also standardise interfaces (power, water, instrumentation etc) across magnets and manufactures.

Magnetic Testing

Don’t underestimate the importance of magnetic testing and the time and resource required early on in a project to set up a successful system. Planning (by manufactures) needs to start in the prototype magnet design stage to be ready to test the prototype magnets.

It would be highly useful to have some sort of reference magnets made available for manufactures to validate their magnetic measurement systems with, both at the prototype stage and for later system checks. Early on perhaps these reference magnets could be borrowed from other labs and later on the prototype magnets might be returned and used to check the systems

performance. Whenever a magnet is out of spec doubt can be cast on the measurement system. Having a reference magnet removes this doubt.

Customer Observers

Having a full time customer presence at a manufactures facility is highly beneficial. It improves communication, reduces misunderstanding and improves trust.

A customer representative may be able to directly help solve technical issues as they arise

A customer representative also helps to push the production of their product which no doubt has a large positive impact on the overall project schedule.