Issues and Near-Term Plans

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Progress in coil topology study

- Interesting alternatives have been identified
- Coil designs have been developed
  - Limited coil optimization performed
  - Plasma properties (esp. surface quality) not assessed
    - Quantification of Berror v. Xerror
- Substantial progress in developing machine configurations
  - Key issues for each configuration identified
  - Some issues sensitive to plasma configuration
- Cost algorithm development largely complete
  - Differential costs have not yet been determined, key questions unanswered

Progress elsewhere

- PIES is operational in fixed and free boundary modes with finite beta and finite current (ref. Monticello)
  - Ready to be used to assess surface quality
  - C82 appears to be a non-starter - bad surfaces at 3% beta even in fixed boundary with bootstrap effect on – cause and fix unknown
  - Additional benchmarking will be performed to test implementation of bootstrap effect – not an issue at low beta
- Free boundary optimizer is operational
  - Ready to be used to both assess and improve plasma properties
  - Quantification of achievable improvements would be useful
- Better plasma configurations than c82 now exist (ref. Ku and Kessel)
  - Need to verify adequate surface quality in fixed boundary before accepting

What next?

- Revisit plans
- Bring work on c82 options to ‘natural’ conclusion
  - Complete work with results that are transferrable to new plasma configurations
  - Curtail work with results relevant only to c82 (e.g. making incremental improvements in conformal or modular coil designs)
- Begin work on new plasma configurations to understand impacts on machine design

Coil design

- Assess surface quality in fixed boundary over the operating space
  - What is our operating space in beta, Ip, and li?
  - Do we have sufficiently clean (toroidal flux lost << 10%) surfaces in fixed boundary to warrant doing coil design in the c82 plasma configuration? High iota? High elongation?
- Develop realizable, apples-to-apples coil designs for a candidate topology based on Xerr and Berr, assess surface quality over operating space
  - Is there a consistent advantage in Xerr? Should we switch?
- Assess surface quality in free boundary at one operating point (zero beta, full current?) for all candidate coil topologies
  - What additional toroidal flux is lost in free boundary with real coils?
  - Is there a significant difference between candidate topologies?

Coil design (continued)

- Modify free boundary optimizer to improve utility
  - Complete implementation of limiter points
  - Add measure of surface quality into objective function
- Apply free boundary optimizer for a candidate coil topology to improve plasma properties, demonstrate that it works
  - What is the magnitude of the improvements seen?
- Develop coil designs for new plasma configurations (high iota and high elongation) based on promising coil topologies
  - Provide comparative assessment with c82-based options
- Generate plasma configurations starting with a flexible coil set and large plasma chamber using free boundary optimizer
  - Use Geogiyevskiy's high shear, clean vacuum configuration as starting point

New background coil options

- Complete assessment of constructability and access for L=3 and tilted TF options
- Assess differential costs between PBX and new background coil options
- Assess cost sensitivity to major radius for new background coil options
- Assess impact of stray field on PBX NB performance
- Assess flexibility, especially with tight fitting vacuum vessel

Modular coil option

- Many technical issues strongly coupled to plasma configuration (coil geometry, current density)
  - Switch focus of coil design effort (Strickler/Berry) from c82 to high iota (or high elongation) plasma configuration
- Address flexibility and mechanical design/cost of modular coils around c82 until new coil design is available

NCC option

- Assess whether adequate plasma properties can be recovered through use of the free boundary optimizer
- Assess whether high iota and high elongations are more amenable to NCC solutions