NCSX CDR Preparation

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NCSX Project Meeting

Timeline

- Finalize coil design ~ 1 Sept. 2001 → engineering for CDR
  - Design new Modular coils, including using merged optimizer
  - Evaluate properties of new coil designs
  - Heal coils
  - Design PF coils
  - Final design of trim coils
  - VV clearance needed for edge design and upgrades

- Other near term physics issues for CDR
  - Edge design
  - Develop diagnostics plan

FY'02: rest of CDR issues (full validation of final design, PVR issues)

→ Publication of PVR Document ~ 1 Oct. 2001
Need to update some sections (esp. Chapter 4)

Physics Tasks for CDR v0.2 MCZ

Focus: Issues from PVR, needed developments for CDR.
Need to finalize physics design of coils by 1 October

1. Coil Design & Development
   - 1.1. Improve coil design tools
     - 1.1.1. Merge coilopt & stellopt
     - 1.1.2. Implement ability to model & optimize twist of coil-pack
     - 1.1.3. Better targetting of manufacturability characteristics (from Engineering)
     - 1.1.4. Ability to design PF, Saddle coils (?)
   - 1.2. Finalize Modular Coil Design (Highest priority). Need to obtain coils that have NBI losses more like LI383, allow NBI access, are manufacturable, compatible with startup variations, and healed to give good surfaces
     - 1.2.1. New designs using imporved tools, preserve physics properties & improve manufacturability
     - 1.2.2. Evaluate candidate designs, starting with existing new designs
       - 1.2.2.1.Physics properties of opt. reconstruction
       - 1.2.2.2.Flexibility (partial studies, including some of Ed's cases)
       - 1.2.2.3.Access and Engineering characteristics
     - 1.2.3. Further testing Promising candidates
       - 1.2.3.1.Heal for islands
       - 1.2.3.2.Flexibility range
   - 1.3. Final Design PF Coils
     - 1.3.1. Are the multipoles misleading? Test with existing coils (0907 or 1017)
     - 1.3.2. How many PF coils and locations needed to get good flexibility, physics properties
     - 1.3.3. Non-circular PF coils?
     - 1.3.4. Determine Volt-second requirements
   - 1.4. Final Design Trim Coils
     - 1.4.1. Compatibility with NBI and diagnostic access
     - 1.4.2. Is design effective across flex. range?
     - 1.4.3. How many sets required
     - 1.4.4. Evaluate using 0907h first,
   - 1.5. Explore configuration 2101
   - 1.6. Validation of Final Design
     - 1.6.1. Full flexibility study
     - 1.6.2. Startup simulations
     - 1.6.3. Flux surface quality across flex., including trim coils
2. Flux Surface Quality
   - 2.1. Finish development of routine healing algorithm (Highest priority)
     - 2.1.1. Target iota profile preservation in FreeHeal (~1 May)
     - 2.1.2. Free Boundary Healing paper (~15 May)
     - 2.1.3. Dynamical Healing Alg. Tested (~15 June)
     - 2.1.4. Parallelize Healing (~22 June)
     - 2.1.5. Add/merge with Stellopt Physics Measures (~1 July)

        2.1.6. Pies module for stellopt/coilopt ?
        2.1.7. Multiple-state targetting?
    2.2. PIES Development
        2.2.1. F90 / cvs conversion (~ 19 April)
        2.2.2. Mods for dynamical healing (~15 May)
        2.2.3. Benchmarking with Hint started (~15 May) (Finish ~April ’02)
        2.2.4. Port to Origin / Nersc (~30 May)
        2.2.5. Convergence tests
        2.2.6. Speed improvements (~1 August)
    2.3. Assessment of finite build coils
        2.3.1. Now, with healed 0907 coils
        2.3.2. Final coil design
    2.4. Sensitivity to construction erors; symmetry preserving and symmetry breaking, NB magnets; across flexibility range
        2.4.1. Start with 0907 coils
3. Flexibility and Startup
    3.1. Assess new coil designs to support 1.
    3.2. Final coil assessment
    3.3. Incorporate transport model into startup modeling
    3.4. Assess V-s requirement, for 1.2.4, including for low-beta no-bootstrap current cases
    3.5. Determine required range of coil currents, combinations
    3.6. Can NBI & OH alone make initial plasma evolution ??
    3.7. Compare 2D vs 3D flux evolution
4. Transport
    4.1. Flow damping assessment
        4.1.1. Analytic
        4.1.2. GTC (?)
    4.2. GTC – Analytic benchmarking
    4.3. Micro-stability; effect of ambipolar fields and driven rotation (GS2 or GTC)
        4.3.1. 2D equivalent
        4.3.2. full 3D (beyond CDR?)
    4.4. Transport and confinement assessment of final coils
5. Edge Design
    5.1. Requirements for PFC set-back to allow divertor, neutral recycling control
        5.1.1. Flexibility & startup configurations
        5.1.2. What will determine plasma edge?
        5.1.3. Where will power and fast ions go?
    5.2. VV setback requirements for divertor upgrades
    5.3. Design of initial PFCs and limiters
    5.4. Neutral penetration evaluation & comparison to existing database
    5.5. Is there an alternative to carbon, to reduce bake requirement?
6. Heating
    6.1. Beam aiming flexibility assessment
    6.2. Effect of stray fields from coils / flexibility & startup scenarios
    6.3. Effect of NB bending magnets on equilibrium

6.4. Costs of 500ms NBI upgrade
6.5. 3D NBI deposition and orbit loss assessment
6.6. ensure room for inside launch RF antenna

7. Diagnostics
   7.1. Need to link diagnostics to physics program & prioritize
   7.2. Conceptual design of magnetic diagnostics required for reconstruction and MHD analysis
   7.3. Pre-Conceptual design of adequate NB-based diagnostics
   7.4. Integrate diagnostic access requirements with VV and coil design
   7.5. Can diagnostic access to symmetry planes be obtained?
   7.6. E-beam mapping system design, plan for operation