Studies of Alternative Lower Cost Options for NCSX

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Our Situation

- The reference stellarator configuration had to be changed to meet physics requirements.
- **The new configuration does not fit in PBX-M.**
- Two new concepts were developed:
  - *A modular coil option which DOES meet plasma reconstruction requirements.*
  - *A saddle coil option which, although simpler, has not yet met reconstruction requirements.*

The Modular NCSX

- *Much different than the original!*
- All new core. Major core components:
  - **Highly shaped modular coils**
  - **A relatively simple background TF coil system.**
  - **A strong PF coil system**
  - **Trim coils**
  - **A shaped vacuum vessel.**
  - **Advanced molded CFC plasma facing components.**

The Good and the Bad…

- The Good ….
  - The modular NCSX meets performance requirements.-
  - It is a larger device – 1.7 vs. 1.4 m. (better access)
  - The "core systems" will be all new.
  - It will be provided with 6 MW of NB heating from PBX-M.
  - The new device will be located in a roomy, PBX-M / PLT Test Cell
  - Its power needs will be fulfilled by the TFTR power supplies "bussed" to C-site, supplemented by a few existing C-site supplies.
- And the Bad….. Costs will be higher!

Still substantial site credits!!!

What are we doing about costs?

- Holding cost and schedule peer reviews to verify the costing basis and look for opportunities for cost reductions.
- Working with Physics to consider mission modifications that might facilitate cost reductions.. (ie, changes in B and R)
- Seeking industrial involvement in the design and costing process.
  - To understand how the design can be changed to reduce costs;
  - To assure that our costing is reflective of current manufacturing practices.
- Looking at incremental design improvements, especially in the magnet and vacuum vessel areas.
- Considering alternatives to the current baseline design.

Alternatives Are Being Considered

- **Goal: identify options that could result in a savings of ~20%.**
  - **Consider both smaller and larger machines.**
    - **Hoping to identify "break points" that would permit substantial savings in a few major systems. Examples:**
      - **A larger machine with reduced field, and lower J. Could we go to water cooling (ie, no cryo system, no cryostat), no coil cases, and re-use TFTR's long pulse capable NBs in the TFTR Test Cell? Considering the machine's larger size, and higher power, will there be a substantial savings?**
      - **A smaller machine which would use HHFW heating with NBs as a possible upgrade.**
    - **A smaller machine which would use the PBX-M neutral beams.**
      - **Rather than achieving cost savings by crossing a break point, this would achieve cost savings fairly uniformly through all systems.**

Recommendations

- We feel that the 20% reduction goal can be achieved through a combination of:
  - Peer reviews to sharpen the costing basis;
  - Close coordination of physics and engineering requirements to identify the “best value” point and consider staged implementation.
  - Incremental improvements to the stellarator core details;
  - Working with industry on engineering and costing;
  - Looking rather closely at a machine with :
    - R=1.5m, Bo~1.5T; 18 (vs. 21) coils; 4 NBs.

Our Vision for the Future

- Plan is to continue to develop the cost of the current baseline modular machine.
  - Will be available at the PVR
  - Will serve as a basis to compare possible cost saving alternatives.
- We hope to identify ways of reducing the baseline costs by ~20%.
- This should provide the information needed to make a choice by the PVR.

Summary

- The modular machine is considerably more complex and more capable than the one envisioned at the start.
- We are extremely sensitive to the costing issues and have plans in place to identify opportunities for cost savings and to identify the “best value” point.