

NSTX GMS Meeting 2-21-03 Minutes

J. E. Menard and S.A. Sabbagh

Attendees: J. Menard, S. Sabbagh, R. Kaita, D. Gates, M. Bell, W. Zhu, S. Kaye, A. Sontag, J. Bialek, T. Stevens, C. Neumeyer, H. Kugel, G. Navratil (remote), A. Garofalo (remote), H. Reimerdes (remote), M. Peng, M. Ono

Meeting Purpose:

The purpose of the meeting was to discuss as a group the initial engineering design activity for an active feedback stabilization system of global MHD modes in NSTX.

Meeting Agenda:

- 1) Presentation by J. Menard: "Status of NSTX internal RWM/EF sensor system and electronics"
- 2) Presentation by C. Neumeyer: "Scoping Study of RWM on NSTX"
- 3) Group discussion of active feedback system options, near-term schedule of system analysis and costing, and scheduling of system implementation and first operation on NSTX.

Summary of Action Items:

- 1) Provide full costing of feedback systems, first priority is a system with external control coils and high frequency response, second priority is a system with internal control coils and high frequency response (C. Neumeyer, D. Gates). Iterate with physics design support as required.
- 2) Determine the frequency response and phase lag of the active feedback system with the effect of the vacuum vessel and passive plates included, for both internal and external coils (logical next step of the initial VALEN physics design studies) (J. Bialek)
- 3) Compute impact of eddy currents on internal sensors with VALEN (J. Bialek)
- 4) Compute the impact of making an external coil that is vertically larger with VALEN (J. Bialek)
- 5) Model the impact of significant 3-D structure in NSTX with VALEN (NBI armor, RF antenna, ports), and assess if control coils can be easily matched to compensate (J. Bialek)
- 6) Determine if CDX-U style switching supply could meet specs and timeline for NSTX fast feedback applications.

Meeting Details:

Note: Copies of presentations and supporting memos by J. Menard and C. Neumeyer can be found at URL:

<http://nstx.pppl.gov/DragNDrop/NSTX%20GMS%20Meetings/February%2021,%202003/>

Presentation: J. Menard: “Status of NSTX internal RWM/EF sensor system and electronics”

Q: GAN: Regarding the eddy currents in the passive plates – what is the impact on the sensors of these currents?

A: ACTION ITEM (VALEN): check with VALEN

Q: MGB: Will it be possible to perform copper plasma tests of the internal sensor set before the next run?

A: No firm indication that this would not be possible, and should be considered as we approach the machine opening in the summer of CY03.

Q: JEM: what is the impact of making an external coil that is vertically larger?

A: ACTION ITEM (VALEN): check with VALEN

Q: SK: Do we need data from the new internal sensors as input to the design of the first active feedback coil system design?

A: SAS: This would be very useful data, but we will sacrifice time in bringing up the first active feedback system, which could be used as early as March 2004. Present theory and experimental results should provide enough guidance for the first active feedback system.

Q: MGB: what is the cost of a higher frequency system? GAN suggests that highest frequency response is best. SAS suggests that 200 Hz is minimum right now in all operating regimes, but we should use 1 kHz as a target (on the other extreme, 50 Hz is about the minimum imaginable in a high BetaN H-mode).

A: ACTION ITEM (CN): Full costing of the system by PPPL engineering, iterating with physics design support.

Q: JEM: is there preferred 3-D detail in the control coils that VALEN can model to best compensate error fields from 3-D structure in the machine (such as the NBI armor, RF antenna, ports, etc.)?

A: ACTION ITEM (VALEN): check with VALEN when internal system design starts.

Presentation: C. Neumeier: “Scoping Study of RWM on NSTX”

Charlie’s talk follows his memo closely. Rough estimate for internal system is \$1M, based on GA’s experience. External system is not yet costed, (30 Hz bandwidth without a SPA – add SPA later).

Q: DG: What is the latency in the system? Transrex system has 3 – 5 ms latency. We need to make sure that the latency is included in the full calculations of system response.

A: Latency not included at the moment, but will be in the full study.

Q: SAS: Can an external active control coil system *with* a SPA unit meet a cost target of \$350K?

A: Unknown – ACTION ITEM: (Charlie to evaluate this). Presently, coil estimate without labor is \$150K, SPA is another \$150K, if labor is \leq \$50K, then we make the target.

A: MO: Cost can be “phased” over two fiscal years. There’s approximately \$300K available for FY03, and \$250K - \$300K available for FY04. Therefore, a system installed over the FY03-FY04 period could tap both budgets.

Q: SAS: Effect of the vessel not modeled when comparing in and ex-vessel control coils, but is critical to assessing system effectiveness.

A: ACTION ITEM (VALEN): determine the frequency response of the system with the effect of the vacuum vessel and passive plates included, for both internal and external coils (logical next step of the initial VALEN physics design studies).

NOTES: 10G is about best you can do at 1 kHz. 50G is possible DC. Ripple requirement is the largest constraint (however, the vessel has not been included in the present model – might not need an additional choke).

Comment: GAN: 10G is overkill – 3 - 4 times the RWM detection threshold should be adequate. SAS: Agreed, this number was chosen to be conservative, which is still a good idea. The cost per Gauss should be evaluated for all systems.

Q: DG: It is a major concern to rely on the vessel as a filter. High ripple on the system can yield a lot of noise on external magnetic diagnostics. We know this is a major concern from PF1A ripple experience.

A: JM: not clear if this is such a large concern since only ex-vessel sensors are flux loops and Rogowski loops, and active coils should not generate $n=0$ field which would impact flux loops. However, JM already expects to have to compensate most sensor signals for active coil pickup.

Questions to address:

1) Timing of system installation (relates to external vs. internal system)?

GAN: What is the present outage schedule based on the present TF situation on NSTX.

MO: Most optimistic schedule has NSTX up in September – October 2003. Masa says that external system is the only one feasible in the short term.

GAN: Do you want to develop a system that is 2 years older in capability than existing systems?

MO: Taking the step to immediately go for the internal system is very risky.

JM: is \$0.5M worth going internal system first?

SAS: (to JM) do you favor external system first?

JM: Favors higher frequency system as top priority.

SAS: Agrees – internal vs. external per se is not important – what matters is system performance.

ACTION ITEM: (VALEN): what is the highest possible frequency response for an external control coil set given the vacuum vessel and passive plates?

NOTE: Several concerns from T. Stevens, D. Mueller, M. Ono etc. regarding installing internal coils first. In general, all believe that it's a risky approach.

A: External system, do full analysis to find out the frequency response of an external system. JM: build a system in which you could simply plug in a SPA quickly after you try the ~ DC system.

CONCLUSION:

- MO: External, high frequency, full system design should proceed immediately, with the goal of having the system operating on NSTX by March 2003. Internal system study should be delayed until this summer, when the vacuum vessel is opened.

2) Is it worth deploying a system with low frequency response at all? (What if no improvement is found?)

A: The case of no improvement does give us new knowledge, but is a fairly weak result that may not significantly add to global mode stabilization physics research. If an internal coil set would not be the first option, the best middle ground solution is to determine the frequency response of an external coil set, driven by a SPA or other high frequency power supply.

3) Cost of system installation? How much effort to include internal system costing in parallel with external?

JM: Really need tight cost estimates for internal vs. external systems to move forward. (ACTION ITEM: Charlie). NOTE from MO: Internal coil system design will be delayed until the summer, when the vessel is vented.

- MB: Can we get SPA system in 1 kV rating?

A: Is this desired? If so, is this possible, and at what cost? (ACTION ITEM: Charlie)

- DG: Design includes control hardware – needs to be included in the costing, and needs to be bought now. Software also needs to be considered now.

A: Include control hardware and software costs and scheduling in the full system design – with begins now.