PAC Recommendation/Response Number	PAC Report Section	Issue	PAC Recommendations	NSTX Response	Action for Speaker	Responsible person(s)
1	2.2	NSTX organization, high-priority research plans and upgrades, LLD, HHFW	The NSTX Team should consider organizational and planning decisions that strengthen the research associated with these priorities and that measure and highlight progress. For example, the NSTX Team should consider allocating “cross-cutting” and “reserve” run days in FY 2008 to experiments that enhance understanding of the effects of Li and that maximize the effectiveness of HHFW. The NSTX Team should formulate additional and explicit milestones that will measure your progress in the key research associated with the LLD and the HHFW. Program management should consider adding a FY 2008 milestone for demonstrating and understanding the effects of the second LITER, and consider adding FY 2009 milestones to measure progress with the LLD and the dual-feed HHFW antenna.	FY09 Joule milestone on retention will address pumping characteristics of Li surfaces using LITER. This work will continue in subsequent years. LLD will not be operational until FY10. FY10 research milestone will assess impact of LLD on edge plasma performance. Will use sample probe to assess surface chemistry of LITER and LLD and impact on edge/core plasma performance. FY11 BP milestone will utilized new surface analysis diagnostic (MAPP) to analyze surface chemistry in 'real-time'	Fold this response into boundary physics and/or Li program presentations.	Maingi, Skinner
2	2.2	NSTX organization, high-priority research plans and upgrades	The NSTX Team would benefit from identifying an organizational structure, with clearly defined leadership and responsibilities, for the 4 "cross-cutting" efforts associated with your key upgrade priorities (the LLD, the HHFW, and the BES), and key research priorities (NBICD, H-mode confinement, sustained high-?N operation and non-inductive current start-up and ramp-up.) Although the NSTX Team should not abandon those efforts that advance scientific investigations broadly and are well suited to the TSGs, the need to focus on priorities is urgent. As a consequence, the PAC urges the NSTX Team to identify one or more additional organizational structures to aid the implementation of priority upgrades and the coordination of high-priority research. The PAC acknowledges that this might be accomplished in several ways; the important point is that the chosen way should empower certain individuals with leadership and responsibility for each of your high-priority activities.	The NSTX research team agrees there is a need for a 'Lithium thrust', both to oversee the Li program on NSTX, and to aid the BP TSG in managing the broader range of BP issues. Particular attention must be paid to diagnostics and modelling for Li and LLD.	Form a 'Lithium research thrust' in parallel with the TSGs. This will be led by Charles Skinner (research plan and diagnostics) and Darren Stotler (modelling). Menard will discuss in program talk. Skinner+Stotler will give Li program/diagnostics/modelling presentation.	Menard, Skinner
3	3.1	NSTX organization, high-priority research plans and upgrades, LLD, HHFW	The PAC encourages the NSTX Team to further strengthen high priority activities in the FY 2008 run plan. The critical importance of the LLD for the achievement of FY 2010 goals suggests strengthening efforts to understand the underlying behavior of lithium in NSTX, in support of the role of lithium in the achievement of density reduction and other discharge performance goals. The PAC recommends that a FY 2008 milestone be defined to highlight new results from the dual LITER. Additionally, research that would directly benefit the utilization of future key upgrades and key research goals should have priority in the allocation of "cross-cutting" and "reserve" run days. Examples include experiments using the dual-LITER and experiments that yield new HHFW understanding.	Agree, and see responses #1 and #2 above, and corresponding actions.	Taylor to refer to success of LITER in improving HHFW performance in D H-mode. This shows we are already addressing some cross-cutting implications of Li.	Taylor
4	4.1	Transport	The observation that global confinement studies have given way to local transport studies is correct. Therefore, to have impact, NSTX global confinement studies must be clearly linked to local transport studies and conceptual understanding, for example, through coordinated modeling and theory efforts. The combination of low-k BES with high-k diagnostics to study phenomena across electron/ion scales should be matched with the development of modeling efforts that seek to address disparate scales and the significant physics likely occurring across those scales. Predictive capability and validation need to be backed up with specific plans like the joint design of experiments by experimenters, modelers, and theorists, and the development and implementation of validation metrics.	Agree	In transport presentation, discuss progress and plans to compare simulations of low-k and high-k turbulence to measurements, and the experiments to be performed and diagnostics that will be used to support this.	Tritz
5	4.1	Transport	Planned work with lithium provides unique opportunities for particle transport studies that should not be missed. Where possible these should be combined with other resources known to affect particle transport, like RMPs. NSTX's combination of neoclassical ions and anomalous electrons also offers unique opportunities for transport studies. Comparisons with MAST, where chi-phi appears to be more closely correlated with chi-i, would be instructive for characterizing transport across STs, as well as helping to advance understanding of momentum transport. Related questions should be pursued like understanding the role of pinch anomalies in momentum transport when chi-phi remains smaller than a neoclassical chi-i.	Agree	In transport presentation, discuss impact of RMP field on ELM triggering and impurity accumulation (i.e. particle transport). Also discuss momentum pinch results, and if available, compare NSTX results to MAST results	Tritz
6	4.2	Boundary Physics	As discussed last year and also during this year's meeting, it is very important to determine the physics behind the changes in plasma performance correlated with the use of Li. Are the positive effects on plasma performance and plasma profiles the result of changes in recycling (pumping)? If the Li pumping is the dominant effect, is the important pumping occurring at the divertor or around the first-wall generally? Is it possible that lithium coatings primarily bind deuterium loaded into the carbon wall, making it unavailable for recycling? Could it be that the positive effects correlating with Li usage are due to suppression of some impurities (e.g. C, O) and/or their replacement with Li in the plasma? Closer collaborations with FTU, which is the largest metal-walled tokamak performing extensive lithium PFC work, may also provide information on the role of carbon-lithium interactions.	Agree these are critical issues and questions for the Lithium program. See response #1 above. The FY09 milestone on retention will give us significant insight into retention and pumping. This research will continue in subsequent year.	Incorporate responses to these questions, or the plan the respond to these questions, in a presentation from the "Lithium Research Thrust".	Skinner
7	4.2	Boundary Physics	Returning to the issue of pumping, such experiments should include particle accounting (i.e., how much gas is injected versus how much is left in the vessel after a shot, as well as postmortem analysis of the tiles). Experiments should be done with bare walls after a vacuum break (no Li on surfaces) and then, after lithium is introduced, for each shot (which was a direct recommendation from PAC-21).	Agree. These experiments were performed in 08, more to come in 09 and beyond.	Incorporate response in a presentation from the "Lithium Research Thrust".	Skinner

8	4.2	Boundary Physics	Based on the importance of this issue for NSTX, STs in general, and all fusion devices, we urge the NSTX staff to devote more resources to understanding the physics that lead to changes in plasma behavior with Li along the lines of the questions above. By more resources is meant more personnel, more diagnostics, an increased integrated modeling effort, and more experiments. The latter should come from allocation of the 'cross-cutting' and 'reserve' days, as well as from allocation of the additional 6 run weeks if those become available.	See responses 1, 2, 3 6, 7 above	Incorporate response in a presentation from the "Lithium Research Thrust".	Skinner
9	4.2	Boundary Physics	We also recommend studies, if possible, of the efficacy of impurity puffing (e.g., N2, Ne) for achieving detachment. Comparison of the effectiveness of impurity puffing to enhance divertor radiation with and without a fresh Li surface may lead to some useful information about the effect of Li on core impurities as well.	Will consider. But are there risks to trapping impurity ions in Lithium coatings?	Discuss issues associated with impurity puffing for detachment in boundary physics talk	Maingi
10	4.3	HHFW and EBW	An upgrade to the HHFW system is planned, to increase the voltage handling capability of the antenna. This upgrade should result in higher power coupling during both startup and full current operation. The NSTX team should accordingly ensure that sufficient resources are allocated to prepare for and take advantage of this upgrade. In FY08, it is planned to extend the L-mode helium plasma studies to L- and H-mode NBI-heated D plasmas, with a phase scan and MSE measurements to determine the non-inductive current profile. Sufficient run time should be allocated for a thorough study, and the work should be extended to higher neutral beam power	Agreed.	In HHFW talk, describe FY09-11 plans to utilize higher power and ELM resilience capabilities. Also describe FY08 results of HHFW heating of D H-mode heated with NBI, and role of lithium coatings.	Taylor
11	4.3	HHFW and EBW	Results with - 90 degree (co-) phasing are clearly relevant to startup and provide benchmarking of 3D RF codes. However, the peaking of the current profile produced by on-axis current drive at 90 degree phasing and the resultant drop in q(0) is undesirable. Consideration should be given to additional work with symmetric or counter (+ 90 degree) phasing to heat without additional current peaking, or even broaden the current profile. If absorption at - 150 degree is very strong and significantly off-axis, it may also be useful for broadening the current profile.	Agreed.	In HHFW talk, decribe FY08 HHFW-CD results, and describe FY09-11 plans to utilize higher power and ELM resilience capabilities + alternative phasing options to optimize HHFW-CD.	Taylor
12	4.3	HHFW and EBW	Since fast wave heating or current drive in either NHTX or CTF would very possibly operate at lower normalized harmonic, we once again recommend that consideration be given to operation at 5.5 kG in hydrogen, perhaps at the end of the FY08 run to minimize impact on machine operations. Note also that the onset density for surface wave excitation should decrease as the normalized frequency decreases, for fixed wavenumber, which should further illuminate the role of surface waves in NSTX.	We did not do this in FY08. We are considering H and He experiments for L-H threshold physics studies. If we use H for those experiments, we can also test HHFW coupling and heating.	Discuss this in HHFW talk	Taylor
13	4.3	Fast particle physics	The synthetic diagnostic in the NOVA code was used to reproduce the radial mode structure seen with reflectometers. However, it was not clear whether these modes were the energetic particle multi modes or the TAE avalanche-or something else. It was stated that the computed mode structure, as verified against the experimental measurements, could then be put into the ORBIT code to simulate fast ion redistribution. However, no results were presented to allow comparison with DIII-D experiments (in which PPPL scientists are heavily involved) where a large discrepancy between the ORBIT prediction for redistribution and the measured result was found.	Agree this is an important issue.	In EP physics talk, describe which modes we are talking about, describe NOVA-K/ORBIT modeling effort and initial results (i.e. discrepancies), and linkage to DIII-D results and experiments.	Fredrickson
14	4.3	Fast particle physics	Another important result in FY07 was the finding that HHFW suppresses CAE/GAE modes that exhibit hole-clump frequency chirping. It would be interesting to check if this result is consistent with the Berk-Breizman nonlinear theory, which predicts that high "collisionality" (which can be supplied by an RF wave) tends to eliminate the instability.	Agree it would be interesting.	In EP physics talk, describe status and/or plans to assess impact of HHFW on CAE/GAE stability - is this a good project for HYM?	Fredrickson
15	4.4	Macro-stability	Given that the ITER design is expected to be finalized in FY 2008, there are several near-term, high-priority experiments in macro-stability that have been identified by the NSTX Team and the broader community that are included in the FY 2008 program. These are tests of resonant magnetic perturbations for ELM control, experiments to increase the understanding of the neoclassical toroidal viscosity, and tests of an ITER-like RWM coil configuration. Completing these experiments as early as possible in FY 2008 will represent a significant and timely contribution from NSTX to the ITER design decisions.	Agree.	In MHD talk, describe Joule milestone results on NTV, ITER-like RWM coil configuration, and RMP ELM mitigation experiments (pacing will be covered in BP talk)	Sabbagh
16	4.4	Macro-stability	The PAC notes that the NSTX team has clearly identified important and high-priority research in macro-stability, both in support of next-step ST options as well as in contribution to the science of toroidal confinement more generally. This area of research enjoyed a large amount of run time in FY 2007. Since the PAC is recommending more emphasis in other topical areas for FY 2008, we feel that the clear identification of high priorities in macro-stability research will be beneficial to ensure a productive year in this area of research in FY 2008.	Agree	In MHD talk, state what the highest priority experiments were for FY2008, and that they were completed.	Sabbagh
17	4.4	Macro-stability	The experiments in FY 2007 on the aspect-ratio comparison of neoclassical tearing mode stability were very efficient and effective, producing interesting comparisons of the marginal island width for stabilization and tearing onset conditions as a function of plasma rotation at different aspect ratios (in particular, comparing NSTX and DIII-D). The PAC recommends that a similar level of run time be devoted to tearing studies in FY 2008, and that the research focus might best be aimed at plasma rotation effects, since rotation is more generally a Joule milestone. Experiments probing dependencies on normalized gyroradius and collisionallity might need to be deferred.	Agree	In MHD talk, describe successful correlation of NTM onset threshold with flow-shear. Describe plans to extend NTM research in FY09 and beyond	Sabbagh/Gerhardt

18	4.4	Macro-stability	The new set of 12 internal coils (the non-axisymmetric control coils NCC) proposed in the five year plan appears to be well motivated and will add significant new capability for a wide range of research. The PAC agrees that this upgrade will not be possible if NSTX does not operate past FY 2010. However, if it becomes clear that post-FY 2010 operation is possible, then we recommend pursuing a more detailed design so that the option to install NCC would be available.	Agree - but need to point out that NCC coils are now incremental in 5yr plan, and new CS and 2nd NBI are higher priority.	In MHD talk, describe NCC coil analysis done by CU group, and status/plans of GA collaboration on coil design for NSTX.	Sabbagh
19	4.5	Start-up and ramp-up	Currently, PF start-up is scheduled to begin in FY 2009. The PAC believes that outer-PF start-up could possibly begin in FY 2008, since pre-ionization is probably already good enough from CHI to initiate the outer-PF ramp-up. The PAC suggests investigating an earlier start for outer-PF start-up, as it appears to be a promising technique. The Plasma Gun also looks promising, and the PAC endorses the continuation of this work. With the Plasma Gun coming online in FY2010, it is uncomfortably close to the end of the three-year time period.	CHI work will focus on using absorber field-nulling coils and CHI-startup with non-zero OH. There are no proposals for PF-only startup. We do not have scenarios modelled which indicate coupling CHI to PF-only induction is possible/probable. The HHFW power will likely not be available in FY09 to re-visit PF-only startup. Pegasus group is developing capability and understanding of plasma guns and will bring to NSTX when technically ready - perhaps in FY11 or later. SFSU TSG will work jointly with HHFW TSG to assess BS-current overdrive.	In SFSU presentation, provide these responses.	Mueller/Taylor
20	4.5	Start-up and ramp-up	In a three-year program horizon, the current focus on CHI is appropriate. The PF Startup and Plasma Gun will be more difficult to master in a 3-year time frame, and it may be difficult to make progress on all three approaches with the limited run time available. We recommend that the NSTX team weigh carefully the benefits of CHI, PF, and plasma gun startup techniques, taking into account the availability of run time and resources. All of the techniques would benefit from an extended operational period lasting until FY 2013.	Agree, and this is true even in context of 5 year plan. The NSTX team has effectively down-selected to 1) CHI for start up and 2) HHFW for BS-overdrive ramp-up. We may not be able to couple these (CHI and HHFW) without ECH heating of CHI for HHFW absoprtion. NBI ramp-up from 0.4 to 0.8 MA is predicted to be possible with 2nd NBI and higher TF.	In SFSU presentation, provide these responses.	Mueller
21	4.6	Integrated Scenarios	An important by-product of the very-high-kappa capability is the ability to provide key information on vertical stability issues for ITER. This is a key issue for ITER, in which NSTX can play an important role in the scaling of the maximum controllable displacement from present-day devices to ITER. While there appears to be experimental time provided for this research in the FY 2008 plan, a description of the exact research to be done was not provided to the PAC, giving the impression that this is lower-priority research. The PAC encourages the NSTX team to place relatively high priority on providing this critical information to ITER.	Agree this is important, and experiments were performed in FY2008	In ASC presentation, describe vertical displacement experimental results for ITER.	Gates
22	4.6	Integrated Scenarios	The NSTX approach to push further towards the required operating space (for 100% non-inductive current drive) involves the use of liquid lithium for enhanced density control and improved confinement and HHFW for electron heating. The PAC is concerned that each of these enabling elements are presently at a limited level of maturity. In this regard, the PAC recommends that the NSTX team develop a multi-year plan that both develops these individual elements to the necessary level and combines these elements systematically into a self-consistent integrated scenario. The PAC realizes that each of these activities is a first-of-a-kind activity, so the development of such systems may require increased resources (manpower and experimental time) and an extended research program to develop the necessary knowledge base. While the PAC believes some level of integration may be possible in FY 2010, NSTX operation beyond FY 2010 will likely be required (rather than simply desired) in order to demonstrate this important capability.	Agree this is a good idea.	In ASC presentation, describe (transient) density reduction achieved in FY08, and elimination of He glow, and operational benefits. Describe confinement improvement (M. Bell scatter plot) with LITER/Li. Describe e-heating from HHFW in D H-mode with NBI, and plans for increased HHFW power and ELM resilience. Describe 3 year research program to integrate these. Also describe plans for beta-control.	Gates
23	4.6	Integrated Scenarios	The PAC is concerned that there appears to have been limited progress on refining the modeling of scenarios that were presented at PAC-21 since the scenarios presented this year are the same as those presented at PAC-21. The development of self-consistent scenarios will require several iterations between experiments and scenario simulation/modeling in order to identify the most favorable development path. In particular, it is important to establish the credibility of the models through comparison with experimental data. NSTX is now equipped with sufficient profile diagnostics that modeling of the obtained data can and should be an integral part of scenario development.	Agree this is an important issue.	In ASC presentation, describe how most recent scenario modelling focused on assessing higher TF (new CS) and 2nd NBI. Also mention ramp-up to 0.8MA modelling by Kessel using HHFW --> 2nd NBI. Mention that Kessel is now unavailable to NSTX (C-MOD, ITPA, ITER work). Emphasize new work on strikepoint control and rotation control.	Gates