

Phase I Run Coordination



NSTX

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NSTX Research Forum

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Role During Phase I



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- ◆ Developed overall schedule at start of run
 - advice from management, ET leaders, PAC on balance of experimental time: planned for
- ET1 (OH) : ET2 (HHFW) : ET3 (CHI) = 50 : 25 : 25**
- ◆ Oversaw Experimental Proposal (XP) system
 - preparation, review, revision, approval
 - ◆ Scheduled experiments on weekly/daily basis
 - adapting to availability of equipment (operations group) and evolution of experiments (physics)
 - publicized through NSTX website, meetings
 - ◆ Daily briefings / debriefings in Control Room
 - End-of-session (5pm) meetings broadcast

Experimental Proposals for Phase I



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- ◆ 10 Experimental Proposals (XPs) submitted
- ◆ 8 XPs reviewed, approved, scheduled
 - 2 deferred following PAC-7 advice (TF ramps)
 - many Machine Proposals (XMPs) also executed
- ◆ Most XPs prepared after discussion of physics objectives in Experimental Task (ET) groups
- ◆ Formal reviews of XPs conducted mainly at regularly scheduled NSTX Physics Meetings
 - a couple at special meetings
 - ShowStation broadcast for offsite team members
- ◆ XPs benefited from reviews: "chits" work
 - **requirement:** XP must show experiment is feasible, define requirements and present plan for tackling unresolved issues
 - quick turnaround: a day from review to approval

Experiments in Phase I (2)



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- ◆ Phase I also involved many Machine Proposals (XMPs, operations group) for commissioning
 - control, HHFW, CHI systems
 - ~ 30% of shots taken in XMPs and testing
- ◆ Tokamak and diagnostic capabilities a major issue for scheduling experiments in this phase
- ◆ No experiment got all it asked for *but ...*
 - substantial progress made on most
 - all XPs performed should be in position to write up some significant results
- ◆ Additional run time in January a substantial benefit to several experiments
 - research output non-linear function of time: improved machine capabilities, diagnostics, operational experience, *but ...*
 - physics operators were stretched by end of run

Run Schedule: Sep - Nov 1999



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<u>Week</u>	<u>Monday</u>	<u>Tuesday</u>	<u>Wednesday</u>	<u>Thursday</u>	<u>Friday</u>
Aug 30– Sep 3	Commissioning, Coil tests (ISTP001)				ISTP001 XMP002 Plasma
Sep 6 – 10	Holiday	XMP002 Plasma	BAKEOUT, Magnetics installation		
Sep 13 – 17	BAKEOUT, Installation	XMP003 Magnetics calibration	XMP002 → Plasma	XMP002 →	XMP002 →
Sep 20 – 24	XMP002 Plasma	XMP005 → Control system commissioning	XMP005	Installation	
Sep 27 - Oct 1	XMP002 Plasma	XMP003 Magnetics calibration	Installation, Maintenance		
Oct 4 – 8	Installation	XMP005 → Control system	XMP005 →	XMP005 →	XMP005 →
Oct 11 – 15	XMP005 → Control system	XMP005 →	XMP005	XP001 Flux Consumption	XP004 Equilibrium exploration
Oct 18 – 22	Installation, Maintenance				
Oct 25 – 29	Installation, Maintenance. SOFE				
Nov 1 – 6	BAKEOUT		ISTP - CHI (HHFW tests)	XP002 Wall conditioning	ISTP- CHI Sat. ISTP- CHI
Nov 8 – 13	XMP007 CHI startup	XP006 CHI startup	OPS-P HHFW commissioning	XP009 – HHFW coupling	XP009
Nov 15 - 19	APS-DPP meeting, Installation, Maintenance, BAKEOUT				
Nov 22 - 26	Installation, Maintenance, BAKEOUT			Thanksgiving holiday	

Run Schedule: Dec 1999 - Jan 2000



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<u>Week</u>	<u>Monday</u>	<u>Tuesday</u>	<u>Wednesday</u>	<u>Thursday</u>	<u>Friday</u>
Nov 29- Dec 3	Cooldown, Scrub	Commissioning (OH 24kA)	Commissioning XP002 Wall Conditions	XP001 Flux Consumption	XP004 Equilibrium exploration
Dec 6 - 10	XP002 Wall Conditions XP005 → Operational limits	XP005 Operational limits	XP003 Feedback response	XP009 → HHFW heating	XP009
Dec 13 - 17	Commissioning (OH 6kV) XP001 Flux Consumption	XP009 → HHFW heating	XP009 XP001 → Flux Consumption	XP001 Flux Consumption XP006 → CHI startup	XP006 CHI startup
Dec 20 - 24	XP006 → CHI startup	XP006	Shutdown	Holiday	
Dec 27 - 31	Holiday				
Jan 3 - 7	Restart	Scrub XMP003 Magnetics calib'n	XP002 Wall Conditions	XP002 XMP Boronization	XP005 Operational limits
Jan 10 - 14	XP009 → HHFW heating (XMP Boronization)	XP009 XMP003 Magnetics calib'n	XP010 Edge turbulence (XMP Ar puff) XP004 Equilibrium expl'n	XMP003 Magnetics calib'n XP006 → CHI startup	XP006
Jan 17 - 31	Shutdown				

Distribution of Experimental Run Time



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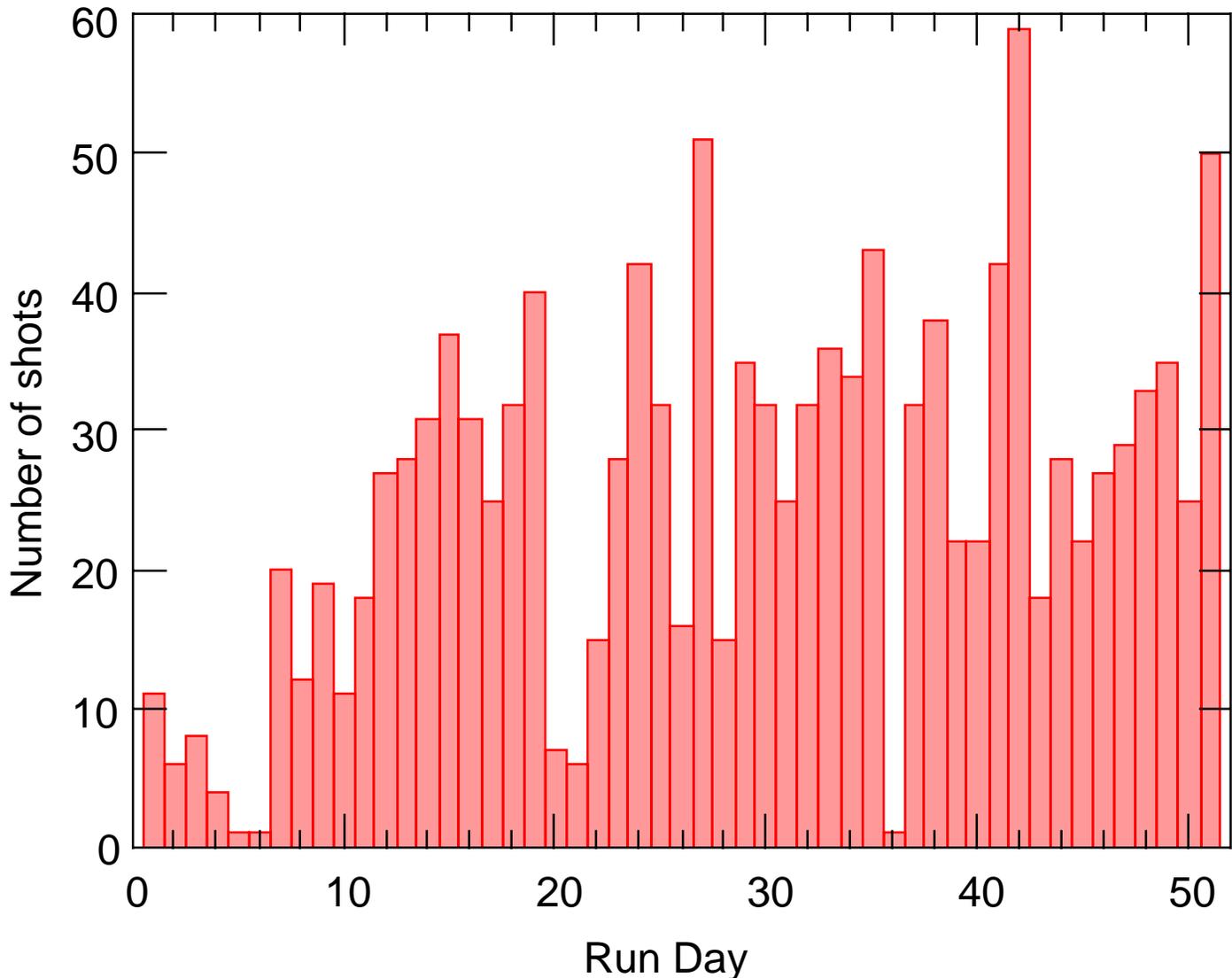
XP (ET)	Title	Lead author	Approved	Days needed	Run dates	Shots run
001 (1)	Optimization of Volt-Second Consumption in Day 1 Plasmas	J. Menard	10/6/99	2	Oct 13,14, Dec 2,14,15,16	128
002 (1)	Establishing Reproducible Wall Conditions	H. Kugel	10/7/99	4 * 0.5 +cleanup as needed	Nov 4,10, Dec 1,6, Jan 5,6	118
003 (1)	Control System Response	D. Gates	10/5/99	1	Dec 8	36
004 (1)	Investigation of Equilibrium domain in Ohmic Plasmas	S. Sabbagh	10/15/99	2	Oct 15, Dec 3, Jan 12	92
005 (1)	Exploring Operational Limits	S. Kaye	11/3/99	2	Dec 6,7, Jan 7	71
006 (3)	Generation of CHI Plasma	R. Raman	11/5/99	4	Nov 8,9, Dec 16,17,20,21, Jan 13,14	234
007 (1)	Ohmic High Beta Exploration	D. Gates	Draft 10/25/99			
008 (1)	Using TF Rampup for Current Drive	D. Gates	Draft 10/25/99			
009 (2)	HHFW Coupling Study	R. Wilson	11/9/99	4	Nov 11,12, Dec 9,10,14,15, Jan 10,11	240
010 (1)	Edge Turbulence Measurements	R. Maqueda	1/11/00	1	Jan 12	15

Shots: ET1 : ET2 : ET3 = 49 : 25 : 26

Facility Achieved Good Productivity



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- ◆ Average 30 shots per day during XP sessions
- ◆ Shot rate could be increased with improved monitoring of OH coil temperature
- ◆ Recovery from CHI an issue for scheduling

Summaries of First Experiments



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- ◆ Initial XPs aimed to develop capabilities and explore operating space
 - diagnostics could not support confinement and transport studies

XP-1 measured Ejima coefficient for an ST and demonstrated 1MA capability

XP-2 determined conditioning requirements after, *e.g.*, vacuum opening, bakeout, CHI

XP-3 measured growth rates of vertical instability

XP-4 demonstrated wide range of equilibrium configurations at current 0.4 - 0.8 MA

XP-5 showed operational density limit with gas puffing follows Hugill-Murakami scaling

Summaries of Experiments (2)



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- XP-6 explored requirements for CHI initiation and demonstrated 130kA toroidal current
- XP-9 coupled 2MW HHFW and showed effects on plasma core
- XP-10 obtained high speed images of fluctuating structures in edge ionization light
- ◆ More detailed results will be given by ET leaders
- ◆ XPs underestimated overall number of shots and time required
 - need to factor into scheduling future runs
 - session productivity should improve as basic operation develops and diagnostic coverage improves

Reporting Status of Experiments



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- ◆ Physics Operator's and Session Leader's Logs (electronic)
 - comments are usually perfunctory but can be searched for information on experiments
 - there are some errors in XP numbers in log
 - need better summaries of sessions and experiments
 - link to commentary logger
- ◆ Experimenters need to prepare annotated lists of shots from experiment for detailed analysis
 - we should plan a central repository of shot lists
 - include records of status of analysis
- ◆ Plan for presentations at NSTX Physics Meetings, Task Force Meetings as results are analyzed

Phase I Run Coordination - Summary



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- ◆ First extended NSTX run was a success
 - met two major milestones: 1MA, 2MW
 - greatly increased operational capability
 - averaged 30 and ran up to ~60 shots per day
 - developed recovery strategies for normal operational situations
 - 8 experiments (XPs) performed plus 7 Machine Proposals (XMPs)
- ◆ Most experiments will need additional run time to improve diagnostic coverage
 - particularly an issue for XP-2 (wall conditioning)
- ◆ XP model should continue into future runs
 - To be approved, XPs must demonstrate awareness of machine capabilities, limitations and present plan for resolving unknowns
 - need to be realistic about demands for run time