Princeton Plasma Physics Laboratory

NSTX Machine Proposal

Title: **Re-commissioning of the Supersonic Gas Injector for FY05 operations**

OP-XMP-36	Revision**: 0**	Effective Date: **March 15, 2005** *(Ref. OP-AD-97)* Expiration Date: *(2 yrs. unless otherwise stipulated)*

Procedure Approvals

Responsible authors: V. A. Soukhanovskii	Date
ATI (NSTX Physics Ops):	Date
RLM (NSTX Experimental Research Ops):	Date

Responsible Division: **Experimental Research Operations**

Procedure Requirements
designated by RLM

	NSTX Work Permit (TBD)		Lockout/Tagout (OP-AD-61)
	TFTR Work Permit (OP-AD-09)		Door Permit (OP-G-93)
	Tritium Work Permit (OP-AD-49)		T-MOD (OP-AD-03)
	RWP (HP-OP-20)		Lift Procedure (ENG-021)
	Confined Space Permit		DCA/DCN (OP-AD-104)
	Pre-job brief (OP-AD-79)		ATI Walkdown
	USQD (OP-AD-63)		Independent Review
	Master Equip. List Mod (OP-AD-112)		ES&H Review (NEPA, IH, etc)

MINOR MODIFICATIONS

REVIEWERS (designated by RLM)		**Reviewer name**	**Reviewer Initials**
ATI	✓	D, Mueller	
Test Director			
Independent Reviewer			
D-Site Shift Supervisor			
NSTX			
TFTR Caretaking			
Vacuum			
Computer			
Tritium			
QA/QC			
AC Power			
FED			
ECS/MG			
FED			
ERWM			
Water			
NB			
RF			
Diagnostics			
Head, Boundary Physics	✓	H. Kugel	

TRAINING (designated by RLM)

Training required: No ■ Yes ☐ Instructor _____

Personnel (group, job title or individual name)	Read Only	Instruction	Hands-On

Training Rep. _____

RLM _____

NSTX MACHINE PROPOSAL

TITLE: **Re-commissioning of Supersonic Gas Injector** No. **OP-XMP-36**

AUTHORS: **V. A. Soukhanovskii** DATE: **March 15, 2005**

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1. Overview of experiment:

The purpose of this XMP is to re-commission the supersonic gas injector (SGI), Langmuir probe and thermocouple mounted on the SGI head and to calibrate the pressure and timing of the SGI system for experiments in FY05.

2. Justification:

The SGI was commissioned in August 2004, in the very end of FY04 experimental campaign. During the maintenance period, the SGI probe was removed from its Bay I port location for various upgrades. The purpose of this XMP is to perform a gas injection rate calibration, and to confirm operational conditions and consistency of all computer software and electronic components. The new computer software for the SGI gas feed and linear feedthrough drive will be tested. The Langmuir probe and thermocouple mounted on the SGI head will be commissioned.

3. Plan:

1. Motion feedthrough software test.

Park SGI at R = 1.60 m. Assign a travel distance of 1, 3, 5, 10 cm and exercise the control software observing the actual probe motion with camera or by an observer in NTC.

Operation verified: _____

Test Director

2. Gas injections without plasma to calibrate injection characteristics.

Park SGI at about R = 1.60 m. Inject D_2 as specified in Table 1. Record pressure rise in vacuum vessel using microion and ionization gauges. For comparison, inject D_2 from the conventional gas injector # 2 as specified in Table 1.

Table 1. Gas injection parameters for calibration

Pulse #	Injector	Pulse duration (ms)	Plenum pressure (Torr)	Flow rate (Torr l / s)	Number of particles in gas pulse	Comment
	SGI	50	500	13	5e19	
	SGI	50	1000	25	8.75e19	
	SGI	50	2000	51	1.8e20	

Table 1. (cont.)

Pulse #	Injector	Pulse duration (ms)	Plenum pressure (Torr)	Flow rate (Torr l / s)	Number of particles in gas pulse	Comment
	SGI	5	2000	51	1.8e19	
	SGI	25	2000	51	9e19	
	SGI	100	2000	51	3.6e20	
	# 2	50	n/a	25	8.75e19	
	# 2	50	n/a	50	1.75e20	

3. Gas injections into ohmically heated plasma.

1. Run a shot and verify that the SGI probe will remain at least 2 cm outside LCFS during the entire discharge before inserting the SGI probe beyond R = 1.60 m. Typical uncertainty in R_{LCFS} from EFIT is 1-2 cm. For the plasma with $R_{LCFS}(t) <$ (1.53+/-0.02) m, the SGI insertion radius should be R_{SGI} = 1.58 m.

Shot: _____

2. Perform D_2 injections into two plasma shots with the following SGI parameters: start time 0.25-0.4 s (towards the end of discharge), gas pulse duration 50 ms, SGI plenum pressure of P_0 = 2000 Torr. For P_0 = 2000 Torr, the number of particles injected from the SGI in a 50 ms pulse is 50 Torr l / s x 50e-3 s = 2.5 Torr l = 1.75 x 10^{20} (compare to the typical NSTX inventory of about 7 x 10^{20}).

Shots: _____

3. Verify the Langmuir probe (LP) and thermocouple operation. The SGI LP will be operated at U = 50 V as other NSTX flush-mounted LPs to verify that a reliable I-V characteristic can be obtained at this voltage. The steady-state thermocouple readings should not exceed 80 ^{0}C.

Operation verified: _____

Test Director

4. Required machine, beam, ICRF and diagnostic capabilities:

SGI operational for plenum pressures up to 2000 Torr. NBI and HHFW are not requested.

5. Sign-off and Documentation

5.1 Permission to Proceed:

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Head, Experimental Research

Operations Division

5.2 Documentation of results:

Documentation of the results completed, attached to proposal and sent to Ops. Center with copies to Cognizant Physicist and Head of Boundary Physics.

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Test Director

PHYSICS OPERATIONS REQUEST

Title: **Re-commissioning of Supersonic Gas Injector** **OP-XMP-36**

Machine conditions

I_{TF} (kA): -35 Flattop start/stop (s): -0.02 / 0.7 s

I_P (MA): 0.4-0.8 Flattop start/stop (s): 0.1 / 0.6

Configuration: LSN Z (m): 0

Gas Species: D_2

NBI: none

ICRF: none

CHI: none

Previous shot numbers for setup: **113729**

Note: Part 3.3 can be done in a piggy-back mode by injecting D_2 from SGI into any LSN ohmic discharge with the following characteristics: I_p = 0.6 – 0.8 MA, flat-top of 100 ms or greater, $R_{LCFS}(t) <$ (1.53+/-0.02) m.

DIAGNOSTIC CHECKLIST

Title: **Re-commissioning of Supersonic Gas Injector** **OP-XMP-36**

Diagnostic	Need	Desire	Instructions
Bolometer – tangential array		✓	
Bolometer array - divertor		✓	
CHERS			
Divertor fast camera		✓	
Dust detector			
EBW radiometers			
Edge pressure gauges	✓		
Edge rotation spectroscopy		✓	
Fast lost ion probes - IFLIP			
Fast lost ion probes - SFLIP			
Filterscopes	✓		
FIReTIP	✓		
Gas puff imaging			
$H_{\square}$ camera - 1D	✓		
Infrared cameras		✓	
Interferometer - 1 mm			
Langmuir probe array		✓	
Magnetics – Diamagnetism			
Magnetics - Flux loops	✓		
Magnetics - Locked modes			
Magnetics - Pickup coils	✓		
Magnetics - Rogowski coils	✓		
Magnetics - RWM sensors			
Mirnov coils – high frequency	✓		
Mirnov coils – poloidal array			
Mirnov coils – toroidal array			
MSE			
Neutral particle analyzer			
Neutron measurements			
Plasma TV	✓		
Reciprocating probe			
Reflectometer – core			
Reflectometer - SOL		✓	
RF antenna camera			
RF antenna probe			
SPRED		✓	
Thomson scattering		✓	
Ultrasoft X-ray arrays		✓	
Ultrasoft X-ray arrays – bicolor			
Visible bremsstrahlung det.		✓	
Visible spectrometer (VIPS)		✓	