

**Princeton Plasma Physics Laboratory
NSTX Machine Proposal**

Title: NSTX Start-up Commissioning and Evaluation Using Lithium Coating Only

OP-XMP-071	Revision: 0	Effective Date: May 23, 2010 <i>(Ref. OP-AD-97)</i> Expiration Date: May 23, 2012 <i>(2 yrs. unless otherwise stipulated)</i>
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Procedure Approvals

Responsible author: D. Mueller (Lead), H. Kugel (Deputy)	Date 5/2011
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ATI (NSTX Physics Ops): D. Mueller	Date 5/2011
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RLM (NSTX Experimental Research Ops): M.G. Bell	Date 5/2013
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Responsible Division: **Experimental Research Operations**

Procedure Requirements
designated by RLM

NSTX MACHINE PROPOSAL

TITLE: NSTX Start-up Commissioning and Evaluation Using Lithium Coating Only	No. OP-XMP-71
AUTHORS: : D. Mueller, H. Kugel	DATE: May 24, 2011

1. Overview:

This operation will establish initial high current, NBI heated plasmas with controlled equilibrium evolution following a major vacuum opening. It will be accomplished without employing boronization. Inner-wall limited (as part of the normal start-up), single null diverted, and double null diverted discharges will be produced. Plasmas for RF conditioning will be run, when appropriate. Plasmas for diagnostic checkout and for comparison with previous discharges will be produced, when appropriate.

This task involves three basic steps, 1) plasma breakdown and optimization to the extent possible without lithium coating, 2) deposition of a minimum amount of lithium needed to the achieve minimal research conditions needed for simultaneous start of XP1133 (R. Mangi) as defined below, which will be used to specify the amount of deposited lithium preceding each discharge thereafter, if machine conditions permit, and the 3) subsequent start of XP1134 (Kugel)

Tested FY2010 discharges will be adopted for this XMP. No new discharge development shall be performed. Steps 2 and 3 are crucial to the successful completion of XP 1133 and XP1134 and must not include any discharge development.

2. Justification:

This plasma scenario will meet the needs of several FY11 XPs discussed during Research Forum 2011 and which are under review for implementation during FY11 Experimental Operations.

3. Plan:

- I. After ISTP-001 and OP-NSTX-2 are completed, apply 2 hrs HeGDC in standard conditions. Record RGA spectra before, during, and after this HeGDC. Note: Experience indicates that the plasma will not reach a stable, MHD-free flattop without either boronization or Lithium. Expect that after a few failed attempts that Lithium will be evaporated at the rate of about 100 mg/shot in order to reduce impurities sufficiently to achieve ramp-up and at least 200 (300) ms of I_p flattop for the inductive only, steps II-IV (NBI heated, steps V-VIII) cases.
- II. Establish common startup phase using preprogrammed poloidal field coil current control with a preprogrammed prefill of deuterium from an outer midplane gas injector and helium puffing to maintain density. Verify that the plasma current, vessel current, and magnetic field and flux measurements used in the real time control system are being sampled and scaled appropriately in the real time the data acquisition system. Reference shot 123893; this is a 4.5 kG, 700 kA He RF (an alternate for 5.5 kG, 700 or 800 kA is 138394) conditioning target. Repeat as needed to establish reliable breakdown and initial current rise.

- III. Establish feedback control of the plasma using the discharge shape algorithm using the restored discharge as a starting point by setting all system waveforms to zero.

Shot numbers

- IV. Use rtEFIT-isoflux control to maintain control during flattop.

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- V. Establish a NBI heated, long pulse, high triangularity, **LSN** shot using PF1A using 1 NB source (B). Use as reference shot **125329**, a 900 kA, low- I_p , long-pulse shot using the SPAs with $n=3$ configuration and feedback to minimize error fields after 400 ms. If this does not work, try the 1 MA fiducial from the **2007 run 125320**. If that also does not work, try **122318**, an 800 kA **LSN** shot that worked at higher I_p .

Shot numbers

- VI. Increase NB power by adding sources A, then C as appropriate.

Shot numbers

- VII. Repeat steps VI-VII for lower single null configuration starting from reference shot **120640**, a long-pulse, NB-heated LSN shot using PF1B from XP614.

- VIII. Using 1 NB source, modify the outer gap request to move plasma to within 3 cm of the RF antennas for a couple shots for MPTS calibration if requested.
- IX. Produce reference discharges for LLD assessment based on shots 129061 (2008), 132582 (2009) with outer strike-points at $R_{OSP} = 0.35\text{m}, 0.5\text{m}$ respectively. The desired state at the conclusion of the XMP is obtaining conditions close to the fiducial shot from 2010 with a flattop extending beyond 0.8s (at least)

Shot numbers

If machine conditions permit, apply lithium as requested by XP1133 Session leader.