Princeton Plasma Physics Laboratory

NSTX Experimental Proposal

Title: Plasma Fuelling With TMB

XP-	**Revision: 0**	Effective Date: 1/29/02 *(Ref. OP-AD-97)* Expiration Date: 1/29/04 *(2 yrs. unless otherwise stipulated)*

PROPOSAL APPROVALS

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ATI - Task Force Leader: H. Kugel	Date
RLM - Run Coordinator: R. Maingi	Date

Responsible Division: Experimental Research Operations

Chit Review Board (designated by Run Coordinator)

MINOR MODIFICATIONS (Approved by Experimental Research Operations)

1. Intoduction

Boroinzation by injecting a mixture of 90% He and 10 % trimethylboron (TMB) into a HeGDC is used during maintenance periods to deposit boron film over the vessel interior to thicknesses of about 100 nm. The subsequent erosion of this deposited film occurs preferentially on plasma wetted surfaces, e.g., Center Column and Divertor strike points. The TEXTOR (Esser et al.) and TdeV (Boucher, et al.) tokamaks tested plasma fuelling with boron gases, and obtained interesting results and improved performance. On the PISCES linear machine, the injection of carborane into the plasma resulted in very high boron film deposition rates on the target samples (~1000 nm/min). This was attributed to good transport of the injected carborane to the plasma wetted surface.

On 7/20/0, NSTX-OP-XMP-12 tested the feasibility of plasma boronization using a mixture of 90% He and 10 % TMB. Fig.1.1 shows sequence of plasma fuelling used for XMP-12.

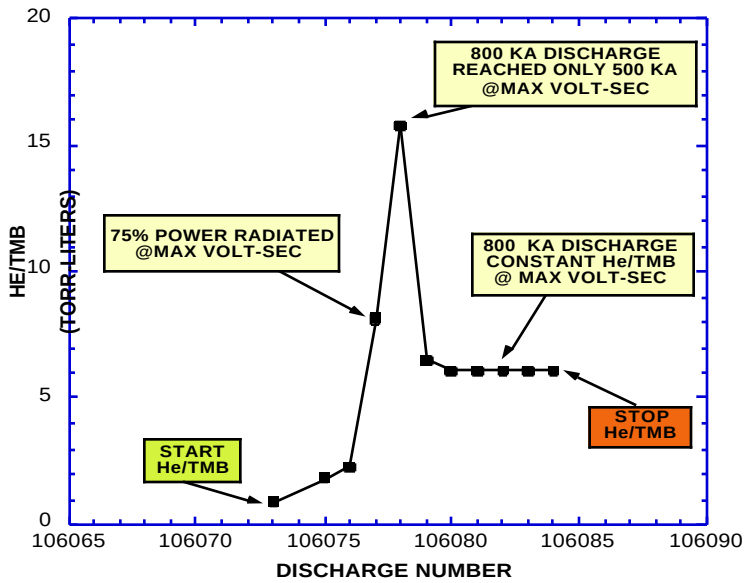

Fig.1.1 Fuelling sequence used for XMP-12.

XMP-12 found that TMB fueling to 15.8 Torr-liters reached operational limits. A 800 KA discharge reached only 500 kA due to high radiative power losses and He recycling. TMB fueling was then reduced to 6 Torr-liters for next 6 TMB fueled discharges (12 discharges total) and yielded a x2 decrease in central radiation after TMB. The subsequent post-TMB, LSN, 900 kA, 1.5 MW, NBI fiducial discharge exhibited a transition into the H-mode. The edge O and C luminosities were comparable within the limited statistics due to initially clean conditions. Edge fueling with TMB did not increase B V and C VI. The density profile for the post-TMB CSL discharge exhibited an outboard shoulder.

2. Issues to Be Addressed By This Experimental Proposal

This XP will fuel D_2 discharges with pure TMB. The goal of this XP is to obtain results that can be used to initiate or complete investigations of the following questions:

2.1What is the minimal fuelling rate producing an observable performance enhancement?
2.2 How does the absence of Helium effect this limit and overall performance?
2.3 What is the erosion rate per discharge and how does this depend on fuelling rate?
2.4 What is the maximum fuelling rate before the available volt-sec are consumed?
2.5 What is the edge distribution of B and C as observed by a Filtered Fast Camera?
2.6 How is core performance, transport, energy balance effected by fuelling rate?
2.7 At what fuelling rate can the Shutters be safely opened.
2.8 What is the ratio Plasma Wetted Surface to Outer Wall deposition vs fuelling rate?
2.9 What is the optimum redeposition rate, amount, and frequency.
2.10 What are the effects of cladding the plasma edge in a low-Z mantle.
2.11How can the results be used to enhance performance.

3. Discharge Scenario for addressing the Above XP issues

3.1 A schematic of the fuelling sequence for this XP is shown in Fig.3.1.

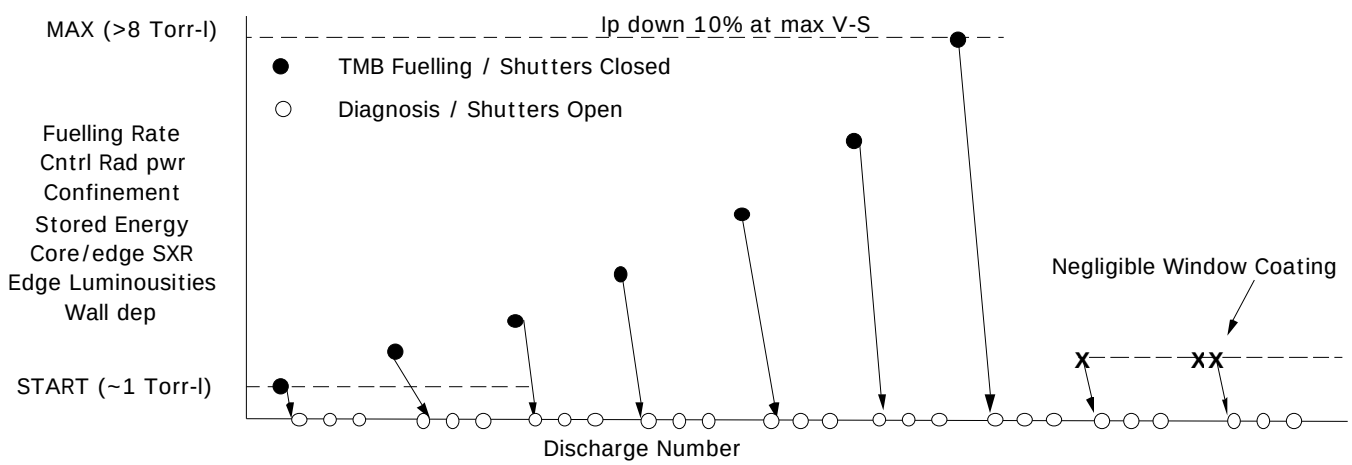

Fig.2. Schematic of the fuelling sequence for this XP.

3.2 The fiducial discharges selected for this XP may depend on preceding machine discharge development but these fiducials should be similar to the fudicals used for XMP-12.

XMP-12 Fiducial Discharges
Ohmic LSN: #106068
NBI/CCL: #106070
NBI/LSN: #106072

SUMMARY OF DISCHARGES

Discharge No.	Discharge Type	Example Fiducial	TMB Fuelling (Torr-liters)	Comments
1	Ohmic/ LSN	106068	0	
2	NBI/ CSL	106070	0	
3	NBI/ LSN	106072	0	
4	**Ohmic/ LSN**	**106068**	**1**	
5	Ohmic/ LSN	106068	0	
6	NBI/ CSL	106070	0	
7	NBI/ LSN	106072	0	
8	**Ohmic/ LSN**	**106068**	**2**	
9	Ohmic/ LSN	106068	0	
10	NBI/ CSL	106070	0	
11	NBI/ LSN	106072	0	
12	**Ohmic/ LSN**	**106068**	**4**	
13	Ohmic/ LSN	106068	0	
14	NBI/ CSL	106070	0	
15	NBI/ LSN	106072	0	
16	**Ohmic/ LSN**	**106068**	**8**	
17	Ohmic/ LSN	106068	0	
18	NBI/ CSL	106070	0	
19	NBI/ LSN	106072	0	
20	**Ohmic/ LSN**	**106068**	**16**	
21	Ohmic/ LSN	106068	0	
22	NBI/ CSL	106070	0	
23	NBI/ LSN	106072	0	
24	**Ohmic/ LSN**	**106068**	LOW (TBD)	Shutters Open
25	Ohmic/ LSN	106068	0	
26	NBI/ CSL	106070	0	
27	NBI/ LSN	106072	0	
28	**Ohmic/ LSN**	**106068**	LOW (TBD)	Shutters Open and Inner Wall Gas Fuelling With D2
29	Ohmic/ LSN	106068	0	
30	NBI/ CSL	106070	0	
31	NBI/ LSN	106072	0	