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Disruptions, eddy currents, tile damage, Hiro currents, and grounding of LLD

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NSTX Research Forum

PPPL, Princeton NJ, March 16, 2011

[1]This work is supported by US DoE contract No. DE-AC02-09-CH11466.

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1 M.Ono: LLD is reinstalled on NSTX

Liquid lithium divertor target system commissioned

Utilized in four LLD experimental proposals in three campaigns

LLD plate covered with lithium
Significant over-flow evident consistent with evaporating 2 x fill capacity

- **Plasma surface heating raised the LLD surface temperature to ~ 200 - 250 °C.**
- **No significant moly surface damage or moly influx observed.**
- **Damage discovered after operations. Plasma disruptions caused mechanical support and arcing damages. Explains why electrical heaters failed. Air heater has worked well but the heating tubes were arc damaged.**
- **LLD plates being reinstalled with improvements in the mechanical support structure and grounding. No active heaters but will utilize plasma heating.**

2 Tiles, LLD and Hiro currents

For protection of the PFC against plasma disruptions the conventional wisdom can be summarized as:

1. ***Eddy currents should be broken.***
2. ***Plasma Facing Conducting Surfaces (PFCS) should have a tile based design.***
3. ***The grounding should be point-wise (in the middle of the tile).***
4. ***The same is applicable for LLD sectors (considered as "tiles").***

New understanding of disruptions suggests that:

1. ***Eddy currents are a relatively minor effect in disruyptions.***
2. ***Instead, the Hiro currents represent the dominant effct.***
3. ***Hiro currents cannot be eliminated by tiling PFCS.***
4. ***In order to mitigate (eliminate) the effect of arcing it is necessary to facilitate the flow of the Hiro currents by an appropriate grounding.***