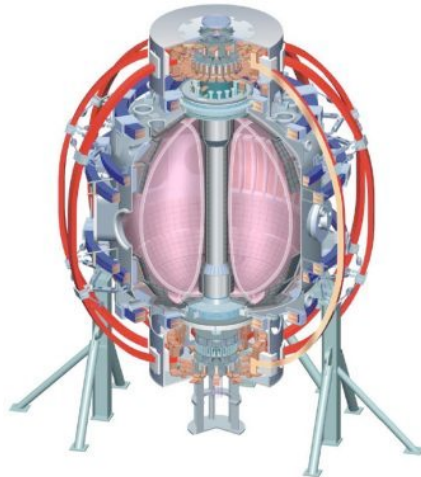


## Qualification of LLD Over the Full NSTX Operating Range of Current and Power

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Anybody Else?

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LR TSG Breakout Session  
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# Overview

- Background
  - LLD commissioning XP (Kugel, et al.) will do explicit scans of triangularity (I think).
    - Follow-up XP by Maingi et al. addressing  $\delta_L$  dependence.
  - First fuelling optimization with SGI by Soukhanovskii.
  - XP proposals by Soukhanovskii, Kallman, Jaworski, will address important issues in SOL and boundary physics.
  - Proposal to assess  $T_{LLD}$  effects by Soukhanovskii....erosion, evaporation,...
  - There is utility in further developing the reduced-density H-mode operating space with a warm LLD.
- Goals
  - Qualify a range of  $I_p$  and  $P_{NB}$  scenarios in a fixed shape (shape TBD).
    - Understand operational issues over this range of parameters.
    - Develop a first understanding of transport, stability,  $f_{BS}$ ,  $f_{NBI}$  scalings with  $I_p$  with Lithium
    - Develop operational scenarios for other other TSGs and XPs...
      - Recipes for shots at various  $I_p$  and power levels.
  - Compare at least some cases to “comparable” cold LLD configurations.
  - Lots of piggy-back opportunities (craft XP to make it most useful to the most people):
    - Pedestal height studies (Diallo, Maingi).
    - Further SOL characterization (Soukhanovskii, Kallman, Jaworski, McLean, many others).
    - Core turbulence (Ren)
- Contributes to
  - Efficient NSTX operation with LLD

# Issues To Be Addressed

- Operations Issues
  - Develop intuition about the fuelling needs vs.  $I_p$  and  $P_{inj}$ .
  - Measure heating of the LLD surface over a range of parameters.
  - Get first hint if the  $\beta$ -limit is lower when the collisionality is reduced.
  - Develop broader set of early EFC techniques.
  - Verify that H-mode access is not a problem.
  - Field line angle effects.
  - Disruption consequences at various levels of  $I_p$  and  $P_{inj}$ ?
  - See how impurity accumulation changes with  $I_p$ .
    - Develop targets for later impurity reduction XPs.
- Physics Issues (A few examples)
  - $I_p$  and  $P_{inj}$  scaling of global confinement & non-inductive current fractions: R(11-3)
    - Slowed evolution of the current profile at higher  $T_e$ , larger NBCD?
    - Current profile evolution.
  - First look at SOL widths scaling with  $I_p$  at reduced collisionality.
  - First look at pedestal height and ELMs vs.  $I_p$ .
  - Impurity sources.

***We don't even know all the issues that will come up → key to be flexible in this XP.  
SPG not interested in "owning" all this → make it a team effort to maximize science output.***

# First-Cut XP Plan

- Finish commissioning and pumping/fuelling XPs will
  - Learn the effects of triangularity.
  - Get a good look at pumping/fuelling balance.
  - First look at early EFC techniques.
  - Pick a reference case from these scans.
- Conduct  $I_p$  scans around the reference. (15 shots?)
  - For instance, 700, 850, 1000, 1150 kA?
  - This should be “easy”...if it isn't, then we need to understand why.
  - Try this at constant density?...traditionally  $n_e \propto I_p$  in  $D_2$  H-mode.
- For one of these cases, make a systematic injected power scan. (15 shots?)
  - For instance, 2,3,4,5 MW, up to the beta limit (use fast feedback and DEFC).
- Repeat some/all of these cases with a cold LLD. (15 shots)
  - Get good baselines comparisons with liquid lithium at matched power levels.
    - Same power or same  $W_{MHD}$ ?

## Analogy: Commercial Airliner (Thanks to H. Kugel)

- Design and build an airplane
  - Much previous work by ORNL, PPPL and SNL...almost done!
- First test flight
  - Commissioning XP.
- Qualify it for flight in a range of conditions.
  - Pumping studies and first fuelling XPs.
  - Early EFC.
  - Jon's MHD submission about stability aspects vs. collisionality.
  - This XP.
- Sell it to customers.
  - The many XPs in other TSGs.