1. Purpose of Experiments
Include immediate goal of the experiments, scientific importance and/or programmatic relevance. Refer to any relevant program milestones.

The purpose of this experiment is to minimize reflection coefficients for the LHCD system. Minimum power reflection coefficients ($\Gamma^2$) during the 2006 run campaign were ~20%, whereas modeling predicts a minimum ~5%. Experiments indicate $\Gamma^2$ increases with $n$, suggesting a region of evanescence at grill---under what plasma conditions can this be minimized?

2. Background
Discuss Physics Basis of the proposed research. Prior results at Alcator or elsewhere, and any related work being carried out separately.

Current profile control by LHCD is needed to produce and sustain AT regimes in steady state. In the 2006 run campaign, ~40% of the klystron power was coupled to the plasma (3dB loss from klystron to antenna, and an additional ~20% power reflection at antenna). Optimizing the antenna coupling has the potential to give us substantially more net power without increasing source power or changing waveguide hardware. Results from JET [1,2], Tore Supra [3], and ASDEX [4] show reflections of 5-10% are achievable.

3. Approach
Describe the methodology to be employed; explain the rationale for the choice of parameters, etc. Describe the analysis techniques to be employed in interpreting the data, if applicable. If the approach is standard or otherwise self-evident, this section may be absorbed into the Experimental Plan.

Plasma shape, density, and plasma position will be varied to find optimal conditions for coupling. Radial position of the LH antenna and power will also be scanned. Use of Cryopump and GPI for density control will be explored.
4. Resources

4.1 Machine and Plasma Parameters

Give values or range for:

- Toroidal Field: 5.4T
- Plasma Current: 500kA-1MA
- Working Gas Species: D
- Density: 0.1-1e20
- Equilibrium configuration (if possible, refer to database equilibria):

4.2 Auxiliary Systems

- RF Power, pulse length, phasing: LH system, 60, 90, 120 deg phasing
- Pellet Injection (species):
- Impurity blow-off injection:
- Diagnostic Neutral Beam:
- Special gas puffing: GPI
- Non-axisymmetric Coils (Connections, Current):
- Other: Cryopump

4.3 Diagnostics

List required diagnostics, and any special setup or configuration, e.g. non-standard digitization rate.

- Core and edge density (TCI, reciprocating probes)
- LH Langmuir probes
- Neutral pressure gauges

5. Experimental Plan

Both sections must be filled in.

5.1 Run sequence Plan

Specify total number of runs required, and any special requirements, such as consecutive days, no Monday runs, extended run period – 10 hours maximum – etc.

3 run days, 1-2 of which could be done during LH conditioning and machine conditioning. Low hydrogen level not required.

5.2 Shot sequence plan

For each run day, give detailed specification for proposed shot sequence: number of shots at each condition, specific parameters and auxiliary systems requirements, etc. Include contingency plans, if appropriate.

**Day 1:** Low power (100-200kW).
Short pulses (10ms) with low duty cycle (25%) and scan phase through 60, 90, 120 twice during each shot (6 segments). Start with equilibrium from 1060728014 and launcher 3mm behind LH limiter.
1) Position scan moving plasma down 5mm, then 10mm. Best result will minimize top/bottom asymmetry in reflection coefficient, not necessarily total reflection coefficient. (3 shots)

2.) Shape scan varying upper x-point radial position by +/- 5mm. Best result will minimize top/bottom coupling asymmetry. (2 shots)

3.) Density scan from 1e19 (or as low as possible)-1e20 m$^{-2}$ on nl_04 using best result from position/shape scans. (5 shots)

Repeat steps 1-3 with antenna 2mm behind LH limiter (and 1mm if time allows).

**Day 2:** Medium Power (~500kW)

1.) Start with best conditions (position, shape, and density) from Day 1. Extend pulse length from 10 to 50 and 100 ms at 50% DC, scan phase 60, 90, 120, once during shot (3 shots).

2.) Increase pulse length to 500ms at 60 degrees and 100% DC. Fire GPI at 200ms starting with 10psi fill, increasing or decreasing fill depending on density at LH grill. Repeat for 90 and 120 degrees (10 shots).

3.) Turn on cryopump and pulse for 500ms at 60 degrees. Repeat for 90 and 120 degrees (3 shots).

4.) Repeat step 2 at best phasing with cryopump on. (5 shots)

**Day 3:** High Power (~1MW)

Extend pulse length to 500ms and increase power to source maximum. This will require several shots to reach full power without tripping. Explore use of GPI and cryopump to control grill density during long, high power pulses given results of Day 2.

### 6. Anticipated Results

Discuss possible experimental outcomes and implications. Indicate if the program may be expected to lead to publications, milestone completions, improved operating techniques, etc. Indicate if the experiments are intended to contribute to a joint research effort, or an external database.

Lower power reflection coefficient to perhaps 5%, corresponding to a 20% increase in net LH power without increasing source power. Detailed comparison with coupling code will show if evanescent region is required for agreement.

### 7. References

Include references both to external and internal literature or communications which bear on this proposal. See Section 2.