**1. Purpose of Experiments**

Include immediate goal of the experiments, scientific importance and/or programmatic relevance. Refer to any relevant program milestones or ITER R&D commitments.

To establish whether boronization improves the H factors achievable during ICRF H modes.

**2. Background**

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

To date, the best quality (both in H factor and duration) ICRF H modes have been achieved at higher density (nₐ₀₄ > 1.2e20) and with continued strong gas puffing during the H mode, further increasing the density. These high density H modes are characterized by elm-free phases during which the density increases rapidly or very low level elms which allow us to maintain a steady-state and high density (nₐ₀₄ ≥ 1.8e20). The increased density prevents us from pushing significantly above the threshold power. Typically, high H factors are achieved when the input power is well above threshold. We have also observed significantly increased particle confinement during H modes, leading to moly accumulation in the core and higher radiated power fraction. It may be that the inability to get high quality H modes at lower density may be related to the already high moly levels in these plasmas. Routes to higher H factors may include achieving high quality H modes at lower density or avoiding the increased density that occurs during the ELM-free phases at higher density.

**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.

The main approach will be a density scan at as high ICRF power as possible, hopefully 2.5-3.5 MW, using position feedback to avoid rf trips. The goal will be to see how the
boronized walls affect H mode quality. We would hope that there will be reduced moly levels in the plasma at lower densities and this will lead to less elm activity, as we see at higher densities. Alternately, we will explore the higher density H modes to see if boronized walls will lead to better control of the density increase during elm-free phases. While H mode threshold studies with boronization are interesting, H factors are our biggest problem and should be explored while the walls are well-boronized.

4. Resources

4.1 Machine and Plasma Parameters

Give values or range for:

**Toroidal Field:** 5.3 T

**Plasma Current:** 800-1000 kA (higher if possible)

**Working gas species:** D

**Density:** $n_{e0} \sim 1 - 3 \times 10^{20} m^{-3}$

**Equilibrium configuration** (if possible, refer to database equilibria): $\kappa \sim 1.6$, outer gap = 1-1.5 cm (controlled by feedback on loading), lower strike point (strkpsi control)

**Pulse length, typical current & density waveforms, etc.** 1 sec

4.2 Auxiliary Systems

**RF Power, pulse length, phasing:** 2.5-3.5MW

**Pellet Injection (species):** none

**Impurity blow-off injection:** if possible for $\tau_{part}$

**Special gas puffing:** D/H

**Other:** spectroscopy for moly and boron levels

4.3 Diagnostics

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

All available diagnostics: Thomson, TCI, ECE, HIREX, bolometry, $Z_{eff}$, neutrons, laser blowoff, H-alpha, moly monitor, spectroscopy for boron, edge pressure gauges, FSP. Note that run is not contingent on availability of laser blowoff, but it is desirable to have it.

4.4 Neutron Budget

Estimate the neutron dose rate at the site boundary. Give basis for estimate. (Once some experience has been gained a standard formula will be provided for estimating dose rates.)

Typical for high power ICRF H modes.
5. Experimental Plan

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.

Start at nL04=0.8-1.e20, lower density than we have seen good H factors but not so low we may have trouble getting H mode at all. Get rf power up, vary puffing during H mode. Observe changes in H modes, particularly elm activity, moly levels, density and stored energy increases. If we see improvement, try scanning down in density and observe H mode quality. Finally scan up in density, puffing and not puffing during H mode, and observe changes in H mode quality with boronization in the regime where we have seen the best ICRF H modes without boronization.

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.

Establish H modes at nL04=0.8-1.e20 and and raise to high ICRF power (3-5 shots). Vary puffing during H mode, starting with no additional puffing (3 shots). If improved H modes observed, scan density down to 2-3 lower densities as long as H modes are still observed. Trying to get laser blowoff and allowing comparison of puffing and not puffing during H mode, we will need about three shots per density (10 shots). Scan up in density from initial case, establish best conditions (10 shots).

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.

Characterization of H mode quality with boronized walls. Hopefully we will achieve improved H factors by avoiding the moly buildup leading to high central radiated power.

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