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

   Our goal is demonstration the expected advantages of gas mixtures versus single species noble gas injection for disruption mitigation.

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

   Previous disruption mitigation experiments in Alcator C-Mod showed that pure low-Z gases (e.g. Helium) are fast in delivering gas inventory to the plasma volume, resulting in a rapid electron density increment in the core plasma, and as a consequence, runaway electron avoidance during the current quench. However due to its low number of charge state, the radiated energy is usually not maximized. Conversely, high-Z gases are slow in gas delivery due to their larger mass, thus delivering particle to the plasma at a much slower rate and make weak density increment, but with high radiation fraction. The slow gas delivery rate for high-Z gases is made worse by frictional dissipation of the gas shock front propagating down the delivery tube. Gas delivery and radiation modeling indicates that a mixture of mostly Helium gas, with seeded Argon or Krypton (~4%) will optimize the tradeoff between rapid particle delivery and radiation efficiency.

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.
A non-disruptive 1.0 MA, 5.4 T plasma, both Ohmic and RF-heated is the target. In order to make comparison three different plasma terminations will be examined; a mixture injection, pure Helium injection, and pure Argon injection. We wish to study how the thermal and current quench times, vertical and horizontal plasma motion, halo currents, and radiated energy efficiency (Wrad/Wth) are affected by the gas jet species. We would like to practice mixtures with 4% Argon concentration. The PSI fast framing camera, viewing the plasma cross-section in the gas nozzle region, will provide images to study the 2-D target plasma. Thomson measurements of temperature profiles and soft X-ray arrays will be used to observe the particle and cold front penetration.

4. Resources

4.1 Machine and Plasma Parameters

Give values or range for:

- Toroidal Field: 5.4 T
- Plasma Current: 1.0 MA
- Working Gas Species: D2
- Density: \( n_e \approx 1.0 \times 10^{20} \text{m}^{-3} \)
- Equilibrium configuration (if possible, refer to database equilibria):

4.2 Auxiliary Systems

- RF Power, pulse length, phasing: 0.0, 1.5, 3.0 MW
- Pellet Injection (species):
- Impurity blow-off injection:
- Diagnostic Neutral Beam: No
- Special gas puffing: gas jet with Helium, Argon (Krypton) and a mixture of them
- Non-axisymmetric Coils (Connections, Current); standard
- Other:

4.3 Diagnostics

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

- Bolometry, TS (in burst mode), Soft X-ray arrays, PSI camera (300-frame unit), halo Rogowskis, IR imaging of divertor if available.
- Other diagnostics might want to shut their respective gate valves and/or shutters.

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.

One day.
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.

Changing noble gas species will require a cell access. We will probably want to do this at least 3 times during the run day. Helium and Argon are the nominal gas jet species for this initial MP.
Run the same shot all day, with the first part of the day using Mixture in the gas jet plenum, then Helium and Argon. TS timing and PSI camera timing will be adjusted as necessary.

Shot accounting:
3 gas jet species x 3 ICRH heating powers x 3 repetition to show the reproducibility = 27 shots. We may also need a number of additional shots to adjust the timing of diagnostics. We will probably also want at least one non-gas-jet disruption (by turning off the vertical feedback) for comparison.

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.

Disruption mitigation is a high priority for ITER as ITER has high plasma current and stored energy. The data obtained from these experiments will be used for NIMROD calculation, which is, now, available with a gas flow code+KPRAD coupled to.

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