Comments from mid-term reviewers

Mostly Positive:

- The project has made extremely good progress in addressing the issues in the original proposal.

- The groups have published their results in the leading journals, and the publication record is excellent.

- The groups have done an excellent job in advancing their algorithms to take full advantage of the computing power available to them.

- They have also addressed the issues of efficient mathematical formulation of boundary condition and wall issues.

- The need for further improvement in NIMROD is recognized and is being addressed.

- The center appears to be bondedvery well in terms of the amount of trust developed over the years between different code teams

- There is excellent cooperation between physicists, applied mathematicians, and computer scientists in these groups.

Reviewer #5 suggestions:

- There are a number of publications, but among them, *there is only one PRL* with an experimental lead author. This lack of high visibility publication compares poorly with other SciDAC centers.

- For the primary application problems such as the RMP and soft-beta limit, it should be emphasized that a *joint effort between NIMROD and M3D-C1 would be highly desirable*, considering the discrepancy between the M3D-C1 results and experimental data.

Reviewer #6 Suggestions:

- The ELM results are more complete, but the question here is *whether fluid models are adequate, even with kinetic modifications superimposed on two fluid models.* Other groups have asserted that the outer regions of a tokamak are far from local thermodynamic equilibrium. If this is the case, the possibility of fluid representation is uncertain. *Validation studies would be very useful here to resolve the matter.*

- An issue that runs through the entire review is the question of whether the codes are able to predict *quantitatively* the plasma dynamics, *qualitatively* the dynamics, or act primarily as an *interpretive tool*, quantitative or quantitative, for plasma dynamics. It is useful to make these distinctions, and it does no disservice to the substantial value of the work to offer less that complete predictive capability.

Reviewer #6 Suggestions: (Cont.)

- Finally, the groups should ask themselves: What is the limit possibility for multifluid modeling? It is obvious that if the correct energy and momentum exchange vectors and heat flux tensors were given for some problem then one could easily solve a multifluid problem for the plasma dynamics. However it does not follow that it is possible, or possibly efficient, to give such information. *The proposers should keep in mind the potential limitations of the basic assumptions inherent in their work. When true turbulence is added to the system these questions become even more relevant.*

Reviewer #9 Suggestions

- This is a very mature project that has reached a level of world leadership in simulating MHD behavior. It deserves to be funded. *However, as the era of burning plasmas approaches, it is not clear that the contemplated improvements in the MHD description will be sufficient.*