MEMORANDUM

DATE: January 25, 2019

TO: DIII-D

FROM: David Hill, Wayne Solomon, Richard Buttery, Houyang Guo, Chuck Greenfield

SUBJECT: Run Time Guidance for FY 2019-20

Initial guidance for the combined FY19/20 experimental campaigns is provided in this memo. We hope that the guidance provided herein motivates submission of proposals at the Research Opportunities Forum (ROF) that align with the major areas of emphasis ("thrusts") described below. The guidance has been developed after consideration of input provided by the DIII-D Research Council and with consultation with the DIII-D Executive Committee.

The current plan for DIII-D calls for 12 weeks of operation in FY19 and a further 20 weeks of operation in FY20. Accordingly, the guidance numbers described below are based on a combined experimental campaign of 32 run weeks. The guidance numbers proposed in each area represent an upper limit to possible run time, and in aggregate exceed the total available run time by approximately 20%. As in previous years, group leaders will be responsible for prioritizing proposals from the ROF and assembling a compelling proposal for run time consistent with the guidance. These proposals will be presented at a future Research Council meeting anticipated in late March. In the final run-time allocation, a total of 18 days will be retained for Director's Reserve and a further 2 days held for the Torkil Jensen Award and 4 days for a possible Frontiers campaign in FY20.

This guidance identifies six high priority research thrusts (to be conducted and organized within the existing DIII-D research structure) as follows:

1. **Disruption Mitigation Thrust – D&C (up to 12 days)**
   Time is directed to address critical questions of shattered pellet injection for ITER, pursue the technology and physics of shell pellets, including the 'inside out' quench physics mechanisms as a potentially improved disruption mitigation process, and understand the physics of runaway electron growth and dissipation with a view to projecting how to avoid runaway electron damage to device structure.

2. **Core-Edge Scenario Optimization Thrust – CEITF (up to 10 days)**
   A heavy emphasis within the CEITF is given to achieving high fusion performance integrated core-edge scenarios, with attention given to understanding impurity dynamics, the control requirements, the principles behind pedestal optimization in these scenarios, including impact on the divertor.

3. **Pedestal Structure Thrust – PedELM (up to 10 days)**
   This thrust is to exploit new diagnostics and simulation capabilities to identify and assess the controlling physics mechanisms that limit the gradient and govern the pedestal structure. The

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research should focus on constraining physics model towards a validated predictive understanding of pedestal structure and density. This should include use of QH-mode and other regimes that can provide important tests of underlying physics.

4. **Isotope Mass Thrust – BPP (up to 10 days)**
   Run time is directed toward assessing isotope mass effects in order to (i) answer crucial questions regarding ITER's potential operational plans in hydrogen and helium, and (ii) gain critical insights into physics models governing projection of the physics. Potential scope includes H-mode access, ITER scenario development, transport, EP physics and ELM suppression, though work should be focused enough, with sufficient diagnosis, to ensure clear answers for ITER on the most urgent topics. Other groups within ES and BPMIC are expected to benefit from engaging in this thrust.

5. **High qmin Thrust – D&C (up to 12 days)**
   This thrust is expected to exploit new current drive capabilities available as a result of LTO3 activities to understand and optimize limits related to high β_N steady-state performance with broad current profiles, particularly those arising from MHD instabilities and energetic particle effects.

6. **Divertor Closure Thrust – BPMIC (up to 10 days)**
   This thrust should focus on the effect of closure/shaping on detachment using the realigned SAS and main upper divertor and compare with simulation codes. Research should also examine the effect of target and baffle geometry on particle transport by leveraging various different divertor configurations (from the most open to the most closed) to inform future divertor modifications such as SAS 2.

In addition to these research thrusts, a thrust-like effort of **up to 10 days** is proposed to **validate the current drive systems** being implemented following the LTO3 (off-axis beam, top-launch ECCD, helicon). This activity is to be organized through the BPP group.

Finally, **8 days** is included within the Director's Reserve allocation noted above to conduct a follow-on to the **metal rings campaign (e.g., SAS-1W)** to advance the physics understanding of divertor impurity sourcing and subsequent screening/transport in the SOL, to identify the controlling physics associated with divertor closure. A decision on allocating this potential thrust is pending the resolution of some operational considerations pertaining to FY20.

These thrusts are intended to provide areas of research emphasis to engage the entire DIII-D research program, and scientists are encouraged to conduct their work through engagement with and in support of these thrusts as far as is possible. The remaining run time will be divided between the physics groups and task forces as follows:

- **Burning Plasmas Physics Group (up to 9 days):**
  Guidance is given to emphasize research that projects plasma behavior and that clarifies the required approaches in ITER.

- **Pedestal/ELM group (up to 7 days):**
  Work should concentrate on foundational understanding to project and optimize ELM control (both RMP and pacing), noting the above thrust on pedestal structure and QH-mode.

- **Dynamics and Control (up to 10 days):**

Priority should be given to stability and control for development of robust disruption avoidance approaches for ITER, alongside other ITER and steady-state scenario studies.

- **Divertor Science (up to 6 days):**
  Research should focus on the understanding of divertor detachment structure and control, including flows, drifts, and impurity transport well as radial transport in more reactor-like conditions.
- **Divertor Development and Integration (up to 6 days)**
  Research will emphasize understanding the impact of impurities on divertor detachment in open and closed divertors and examining the interplay between divertor closure and magnetic configurations.
- **Advanced Materials Validation (up to 6 days):**
  Effort should be on evaluation of innovative reactor-relevant plasma-facing materials, validation of PMI models to further understand impurity sourcing and divertor screening, and to address high-priority ITER research needs. Preparation for the possible metal ring campaign should be given priority as needed.
- **The Joint DIII-D/EAST Task Force (up to 10 days):**
  This task force is expected to undertake a thrust level of effort with the goal of developing fully integrated high performance high β_p steady-state scenarios, including divertor dissipation and ELM mitigation, for CFETR specifically, and to advance the steady state AT concept physics basis more broadly.
- **Core-Edge Task Force (up to 6 days):**
  Time is anticipated for work beyond the above thrust to explore long range issues towards integrated core-edge scenarios, noting near-term objectives to understand transport for the 2020 JRT, and pursue real time wall conditioning.