Recommendations for ITER Operational Procedures and US ITER Team Formation and Management

BPO Subcommittee: 'Modes of Participation in ITER'

M. Greenwald, D. Hillis, A. Hubbard, J. Hughes, S. Kaye, R. Maingi (presenting), G. McKee, D. Thomas, M. Van Zeeland, M. Walker

BPO Webinar

Wednesday, Sept. 24 – 1 PM EDT

Purpose of Study

- Chapter 1: Advise ITER Organization on US Device experimental procedures
  - Make recommendations for ITER procedures directly to IO
  - *Timely because CODAC decisions being made now; IO requested input on what activities need to be supported*

- Chapter 2: Advise FES on US ITER team formation and management
  - Highlight issues for three classes of participants: universities, national labs, and industry
  - Consider scale of effort and possible role of various organizations (ITER Project Office, BPO, etc.)
  - Identify data access and storage issues

- *We did not intend to come up with a position on which technical areas the US should focus*

Committee members from **universities**, *lab*, and industry

- Martin Greenwald, **university** representative – MIT
- Don Hillis, *national lab* representative – Oak Ridge National Laboratory
- Amanda Hubbard, **university** representative – MIT
- Jerry Hughes, **university** representative – MIT
- Stan Kaye, *national lab* representative – Princeton Plasma Physics Laboratory
- George McKee, **university** representative – UW-Madison
- Rajesh Maingi, *national lab* representative – Princeton Plasma Physics Laboratory (Coordinator)
- Dan Thomas, industry representative – General Atomics
- Mike Van Zeeland, industry representative – General Atomics
- Mike Walker, industry representative – General Atomics

History and Timeline

- Group formed in early 2013
  - university, national lab, and industry participants
- Goals set in discussion with BPO leadership (Greenfield and Hubbard)
  - Also OFES and IO input
- First deliverable: recommendations for ITER operational procedure, based on US device practices
  - 9/2013: Delivered to IO in Sept. 2013
  - 12/2013: Chapter released to BPO, and revised to reflect comments from BPO members
- Second deliverable: US team formation and management, including data management
  - Draft chapter available now (see last page for web address)
  - 12/2014: Finish responding to BPO comments

Outline

- Chapter 1: Advise ITER Organization on US Device experimental procedures
  - Make recommendations for ITER procedures directly to IO, based on US practices
  - (EU devices similarly provided their recommendations)

- Chapter 2: Advise FES on US ITER team formation and management
  - Highlight issues for three classes of participants: universities, national labs, and industry
  - Consider scale of effort and possible role of various organizations (ITER Project Office, BPO, etc.)
  - Identify data access and storage issues

Chapter 1: Executive Summary for Recommendations for ITER experimental procedures, based on US practices

- Principles based on US device workflows:
  - Decision-making with broad participation, openness and traceability
  - Relatively open access to experimental data
  - Policies should ensure efforts by team members are rewarded with recognition, e.g. in priority for publication or conference presentation
  - Opportunity for full group participation in review of experimental proposals, presentations and publications
  - Opportunities for graduate student participation in diagnostic development, experiment development and execution, and analysis
  - Flexibility should be built into Program structure to adapt to changing priorities and to pursue new findings

Chapter 1: Outline

- Long and short term planning
- Experiment campaign planning
- Development and Review of Experimental Proposals
- Run scheduling
- Experiment preparation and execution
- Data analysis and results dissemination
- Program Review
  - Recommendations for decision points and responsible parties issued in tabular form in each of these areas

Chapter 1.1: Long and Short Term Planning

- Recommend separate activities for planning on two different timescales:
  - Long-term (on the order of 5 years),
  - Short-term (1 to 2 years)
- Long-term: developing the high-level focus and strategic goals for the ITER Physics and Technology Programs
- "ITER management": project level governance structures/leadership
- ITER Team includes researchers participating in the ITER project
- For long-term goals: Topical Group structure
  - General research areas (e.g., Transport, Edge Physics, etc.)
- Specific, short-term goals targeted by Task Forces
- Leaders of TF & TG chosen by ITER management with recommendations from and in consultation with the DAs

Chapter 1.2: Experiment Campaign Planning

- Development and execution of experiments should be accomplished within either the TGs or TFs
- Overall operations schedule made by ITER management
- Allocation of experimental run time:
  - ITER management makes an initial run time allocation to each TG and TF based on research priorities
  - TGs and TFs define experimental priorities and propose run time priorities to address research
  - Significant run time (~20%) in each experimental campaign be withheld for contingency

Chapter 1.3: Development and Review of Experimental Proposals

- Selection of experiments begins with an open Research Forum well in advance of the campaign
  - Challenges due to multiple time zones recognized
  - Pre-filtering of ideas will make process more manageable
- TG and TF leaders consolidate/combine ideas
  - Identify "Experiment Leader"
- Experimental proposal written by Experiment Leader
- Experiment Leader responsible for ensuring that necessary preliminary segment schedules are prepared, submitted, and reviewed
- Draft experiment proposal posted to web, reviewed, and stored on-line
- Operations Management group reviews proposals

Chapter 1.3: Development and Review of Experimental Proposals

- Allocation of run time guided by clear definitions of experimental priorities
  - Provided early in the planning process by ITER management with input from the TG and TF leaders
  - Relevance to research goals and program milestones
  - Scientific value and motivation
  - Technical feasibility and likelihood for success
    - *Facility safety is top priority*
  - Potential for developing new capabilities and/or operational regimes, i.e. scientific novelty, balanced against assessment of facility risk
  - Fair representation among partners

Chapter 1.4: Run Scheduling

- After proposals approved and prioritized, run time allocations made by the TG and TF leaders, in consultation with Experiment Leaders

- Assumptions:
  - Experiment will consist of an assigned number of time-limited segments within one or more ITER pulses
  - "Segment schedule" means the requested plasma and system behavior in one of those segments as specified by time-dependent reference signals and parameters
  - Before "segment schedules" for approved experiments are scheduled, they are combined with segments from other approved experiments, and resulting full pulse schedule run through ITER validation

Chapter 1.5: Experiment Preparation and Execution

- Pulse segment responsibilities assigned by the Experiment Leader
  - Facility specific roles assigned by Operations Managers
- Multiple Experiment Leaders for a single pulse:
  - "Session Leader" interfaces between Experiment Leaders and Engineering Operator (loads pulses into ITER PCS)
- Experiment Leader should have flexibility to modify segment schedules used during a particular pulse
  - Results from prior pulses used as decision basis
  - Type of modifications allowed to depend on level of risk
- Tools for timely access, analysis and display of selected diagnostics and derived physics quantities must be provided for between-pulse decision-making
- Online method for comments about results of segments: "Logbook"
- Presentations made shortly after day of experiment

Chapter 1.6: Data Analysis and Results Dissemination

- Under direction of the Experiment Leader, researchers will analyze different portions or characteristics of the experimental data, based on their area of expertise
- The data management system must support the multiple timescales by providing consistent, complete and up-to-date views of data at all stages of analysis
- Initial determination of analysis and publication "rights" made at time of experimental proposal
- Experiment Leader (or designee who is involved in experiment) has first priority on the major results of the experiment
  - Others who participate or support an experiment are expected to write papers describing certain details of the experiment and their analysis
- Publications and presentations subject to review before presentation
  - Data availability must be consistent with new US data access policies

Chapter 1.7: Program Review

- Mid-campaign Run Assessment:
  - Review results to-date, identify research gaps and opportunities for additional research

- High-level strategic goals and progress of ITER program periodically reviewed to evaluate appropriateness for, and progress towards, achieving defined mission
  - The review should assess whether the TG/TF structure are effective for addressing the research goals
  - This review should be coordinated by ITER management, with input from all ITER participating countries and outside review teams

Break for Discussion on Chapter 1

Outline

- Chapter 1: Advise ITER Organization on US Device experimental procedures
  - Make recommendations for ITER procedures directly to IO, based on US practices
  - (EU devices similarly provided their recommendations)

- Chapter 2: Advise FES on US ITER team formation and management
  - Highlight issues for three classes of participants: universities, national labs, and industry
  - Consider scale of effort and possible role of various organizations (ITER Project Office, BPO, etc.)
  - Identify data access and storage issues

Chapter 2 Outline: Advise FES on US ITER team formation and management

- Key questions identified through discussions with FES
  - What is the process by which the ITER Team should be formed?
    - Categories of US participants in ITER identified
    - Specific issues for university, national lab, and industry participants identified
  - How should the US ITER team be managed?
    - Staffing estimates, oversight, on-site management
  - How should research be accomplished?
    - Includes data management issues

Chapter 2 Outline: Advise FES on US ITER team formation and management

- Key questions identified through discussions with FES
  - What is the process by which the ITER Team should be formed?
    - Categories of US participants in ITER identified
    - Specific issues for university, national lab, and industry participants identified
  - How should the US ITER team be managed?
    - Staffing estimates, oversight, on-site management
  - How should research be accomplished?
    - Includes data management issues

Chapter 2.1: Process of Team Selection

- A successful long-term scientific collaboration by the US on ITER will require a team of scientists with a range of skills from a variety of US institutions

- Team formation process should be based on
  - Transparency
  - Inclusiveness
  - Identification of best people for the team
  - Continuity
  - Timely and efficient means of joining a team for a short period

- Mostly selected by peer-reviewed (3-5 year renewable) proposals

Chapter 2.1: Classes of US participants

- Core scientific team: Scientific staff who are largely based on-site at ITER-Cadarache
  - Mostly or entirely on ITER (80-100% time per FTE)
- Cyclical scientific staff : Scientists who devote a significant fraction of their time to ITER research in a given task group; have other US responsibilities
- Short-term/task-specific participants: conduct specific experiments or analysis, etc.
- Graduate students and post-doctoral researchers
- Engineering Staff: located on-site for long term assignments
- US-based Support Staff

Chapter 2.1: Issues for Effective US participation

- U.S. research institutions have found it difficult or impossible to participate in ITER tasks because of terms and conditions imposed in ITER contracts – even for work that can be clearly categorized as R&D, rather than fabrication or construction
  - Most contentious issues concern intellectual property (IP) and publication rights

- IO views entities other than DSAs to be conducting "work-for-hire", insisted on ownership of IP and absolute control over publication or dissemination of research
  - Neither of these is consistent with current practice for research institutions funded by the U.S. government, nor are they consistent with policies at major universities
  - This "work-for-hire" paradigm also appears in contract conditions for payment – contingent upon acceptance of deliverables, which is inappropriate for collaborative research

Chapter 2.1: Overall Recommendations

- Develop an approach to IP rights, publication and other contracting issues that is consistent with current government regulations in the U.S. research community, and acceptable to both participating institutions and ITER, well before start of ITER research program
- All members of participants from the US should be considered as part of the ITER team and party/rights to the ITER agreement
  - Should not be classified as contractors
- Diagnosticians, machine operators, etc. can join Task Forces and be involved in proposal writing or analysis
- A strong cadre of postdocs will be essential to the continued health of the US participation in the ITER project
  - Establishing and maintaining requires close alignment of ITER research needs with the research goals pursued by postdocs
- Long-term participation of engineers enabled, as appropriate, to benefit from valuable engineering & technology experiences in ITER

Chapter 2.1: Special concerns for University Participants

- University participation is often diagnostic centric:
  - ITER party that designed diagnostic or other hardware is allowed and encouraged to play a significant role in the commissioning and operation of the instrument
- Both university faculty and student experimental proposals allowed through the ITER Research Forum
  - Proposals judged according to same criteria as those from any other member of the ITER Team
- Faculty and students should be considered as potential "Experimental Leaders"
- Optimally engaging the universities requires efficient communication of topics of greatest benefit to ITER that are appropriate for student/academia involvement
- IP issues mentioned previously

Chapter 2.1: Special concerns for National Lab Participants

- Benefit to having national lab participants as Visiting Scientists, so that they can return home after term of assignment and share knowledge with home team
  - Present NL participants have gone directly to work for ITER
- National labs are Federally Funded R&D Centers, and cannot compete directly for ITER contracts with universities, industries, or foreign entities
  - ITER can request direct involvement through ‘sole source’
- IP issues less problematic for National Labs:
  - Contractual agreements between the USDA and ITER written directly into NL contracts

Chapter 2.1: Special concerns for Industry Participants

- Labor rate disclosures needed for detailed breakdowns in proposals
  - More sensitive in industry than academia
- Assumption of 'shared liability' when teaming with international partners
  - Result: tasks laid out in extreme detail up front
  - Need for detailed organizational structure for simple, short duration tasks; tracking such structures onerous and increases effective costs
- IP issues described previously
- Advantage to industrial participation: people who are cognizant of the French nuclear regulatory agency rules and requirements

Chapter 2 Outline: Advise FES on US ITER team formation and management

- Key questions identified through discussions with FES
  - What is the process by which the ITER Team should be formed?
    - Categories of US participants in ITER identified
    - Specific issues for university, national lab, and industry participants identified
  - How should the US ITER team be managed?
    - Staffing estimates, oversight, on-site management
  - How should research be accomplished?
    - Includes data management issues

Chapter 2.2: US ITER Team Management: Staffing (1)

- Difficult to estimate staffing by US personnel – what level of effort foreseen?
- Examined total FTEs for US devices from self-reported workforce survey (Source: Estimates provided upon request by the Department of Energy, Office of Science, Fusion Energy Sciences); JET #s from L.D. Horton

	C-Mod	NSTX	DIII-D	JET
Total FTEs	94	226	169	700

- Scaling from JET by R_{ITER}/R_{JET} gives ~ 1470 FTE; the US portion of this is 13% or 190 FTE
- Data from C-Mod/DIII-D to JET show faster than linear R dependence; scaling with R^2 gives 400 FTE for U.S.

Chapter 2.2: US ITER Team Management: Staffing (2)

- Resource needs for ITER might be estimable by comparison with other large-scale international physics collaborations
  - CERN employs ~ 2400 full-time employees and 1500 part-time employees, and hosts some 10,000 visiting scientists and engineers, representing 608 universities and research facilities
  - Fermilab had approximately 2000 employees when Tevatron was operating
- The scale of ITER is larger than either of these facilities, hence 2000 FTEs overall may represent a minimum; the US share of such a venture would be ~ 250 FTEs
- Range of US participation ~ 200-400 FTE

Chapter 2.2: US ITER Team Management: Oversight

Oversight agency needed (some combination of IPO & BPO); tasks:

- Coordinate planning activities with ITER IO and on-site Team managers, including timely development of likely subtopics within each TF with lead time for proposal writing and review cycle
- Interface with ITER Task Forces to help develop research goals and specific research thrusts, and disseminate to U.S. fusion community
- Facilitate discussions among groups to develop strong US-wide research teams to participate in ITER TF
- Mediate disputes within the US team and ensure that the interests of smaller groups are represented
- Review progress and level of participation, success in achieving deliverable goals, etc.
- Make recommendations to FES for continuation of funding year-to-year (i.e., assess progress annually of every funded group/ individual), or for personnel changes

Chapter 2.2: US ITER Team Management: Onsite management

- On-site managerial coordination of US-ITER participation to ensure that US-based interests (DOE-FES, xPO, institutes) are adequately represented and managed is needed
- Manager should reside on-site, and is primary contact of the BPO and FES for assessment of US research goals and personnel on the ITER Team
  - This includes both physics and technical participation
- This manager, as US Team leader, should be on "ITER Physics Program Committee" that develops high-level and more focused research goals for experimental campaigns

Chapter 2 Outline: Advise FES on US ITER team formation and management

- Key questions identified through discussions with FES
  - What is the process by which the ITER Team should be formed?
    - Categories of US participants in ITER identified
    - Specific issues for university, national lab, and industry participants identified
  - How should the US ITER team be managed?
    - Staffing estimates, oversight, on-site management
  - How should research be accomplished?
    - Includes data management issues

Chapter 2.3: Execution of research program, data access/storage

- *Effective mechanisms for remote participation and timely access to data will be critical for the success of U.S. research on ITER*
- In accordance with the ITER implementing agreement, IP Annex, all raw and processed data should be made available to all members of the ITER team
- ITER team members need to work effectively wherever they are physically located
- Researchers working at the same physical location - whether at the Cadarache site or at designated remote control/participation sites, have a natural benefit
- The computer and communications architecture should support all modes of participation to extent possible

Chapter 2.3: Summary of recommendations

- US (FES and community) develop and articulate a consistent position supporting remote data access and data sharing principles on ITER
- Develop an architecture for distributed data caching, consistent with the principles outlined above
- Develop and articulate a position supporting remote control of some ITER functions, particularly diagnostics
  - At an appropriate time, the US should develop the technical requirements and architecture for remote participation sites
- The US IPO should ensure that there is provision at the Cadarache site for locating adequate computing resources for analysis of ITER data by US researchers
- The US should ensure consistency between emerging US regulations for data/code management and ITER practice and policy

Thank you for your attention!

The draft report is available at:
https://www.burningplasma.org/resources/PDFS/taskgroups/BPO_ITER_Participation_FullReport_DRAFT%2022Sep2014.pdf

Your input and feedback is sought! Please send these to iteropstask@burningplasma.org (goes to entire committee) or to rmaingi@pppl.gov

Goal is to consider your comments and issue a final report by Dec. 2014.