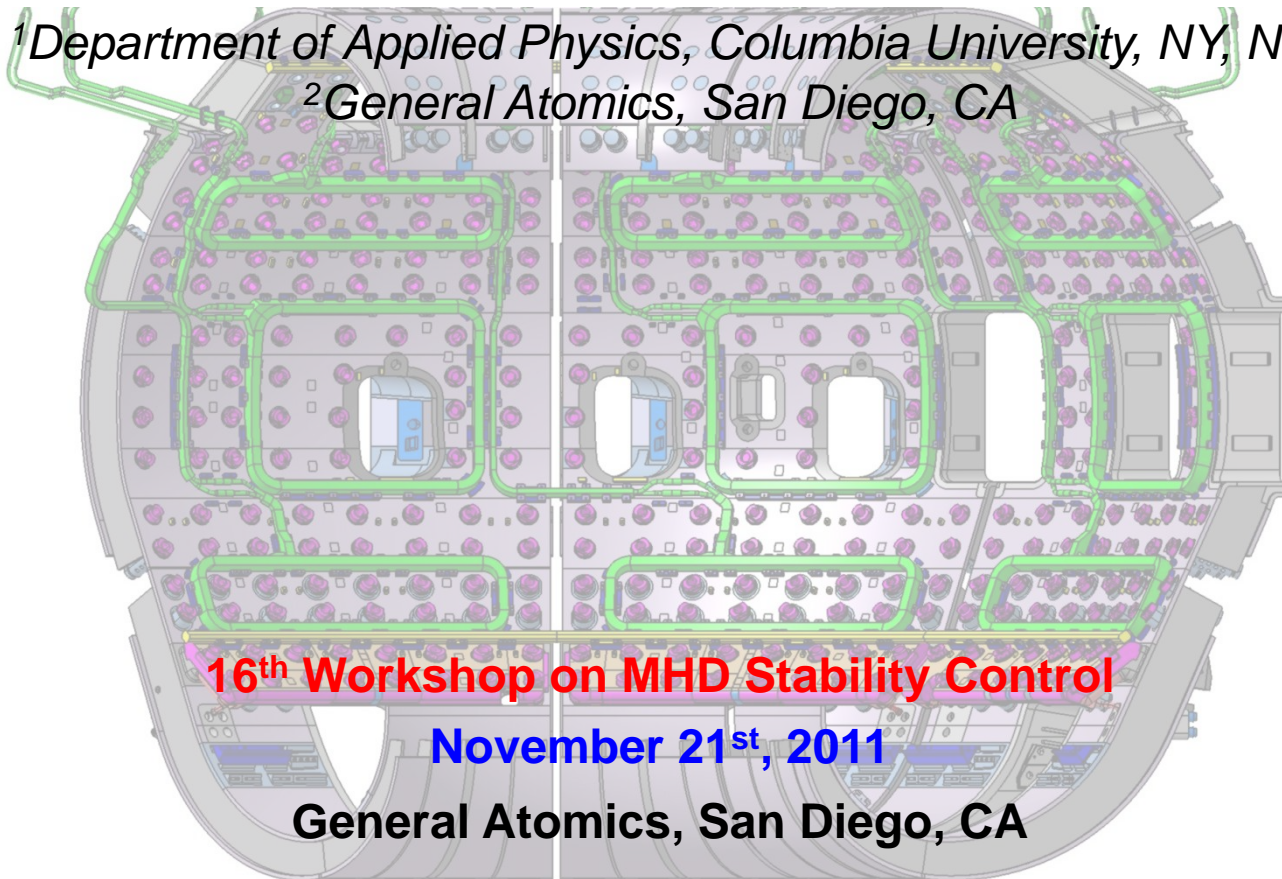


Importance of ITER In-vessel Control Coils in Meeting Device Goals

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16th Workshop on MHD Stability Control

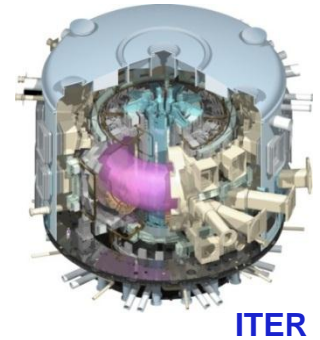
November 21st, 2011

General Atomics, San Diego, CA

US effort to elucidate the importance of the ITER in-vessel 3D control coils (IVCC) in reaching device goals

□ Document

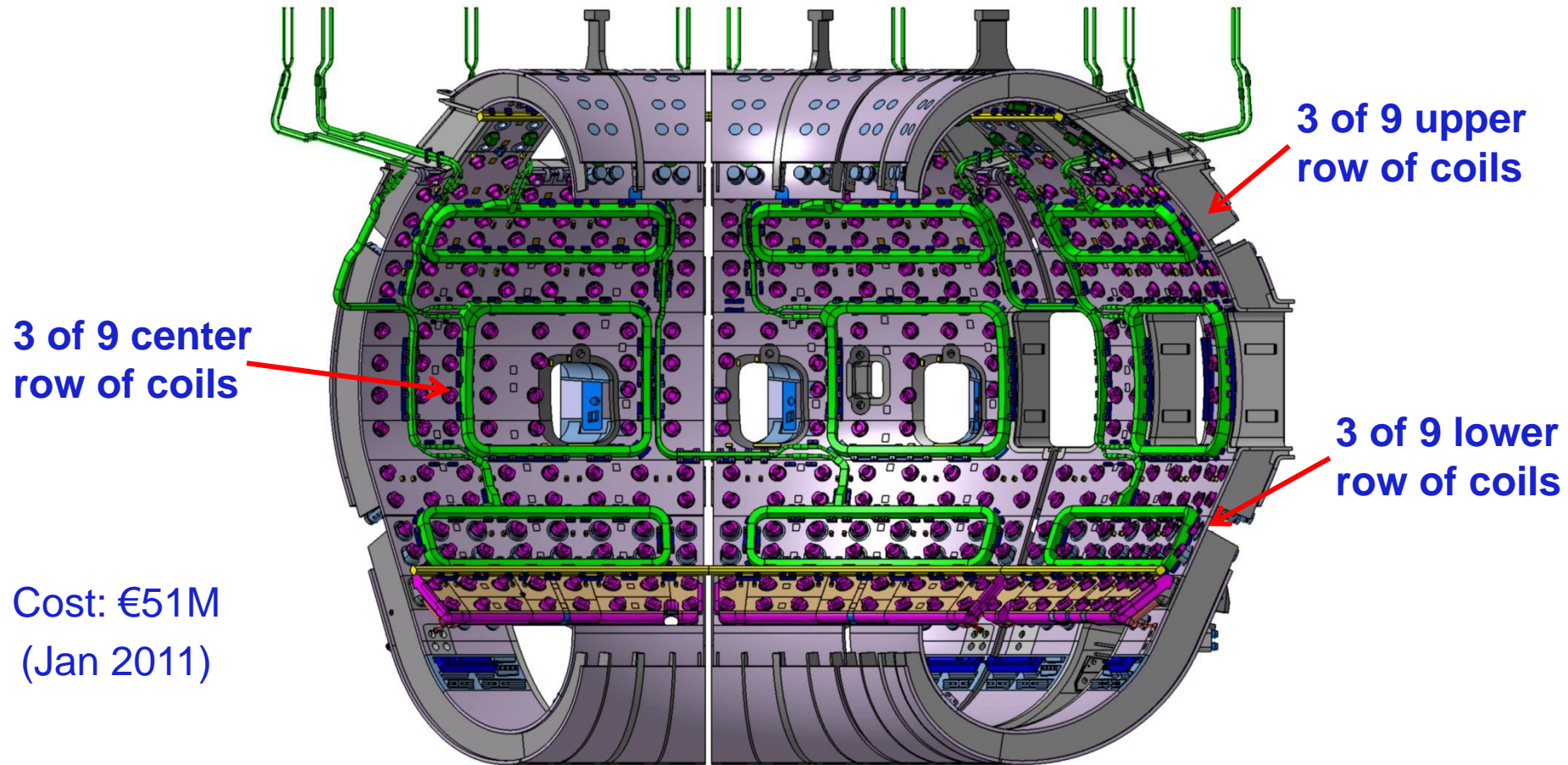
- Simple, short white paper defining key reasons to maintain the IVCC in the ITER design
- Physics reasons go beyond ELM mitigation



□ History

- Triggered by APS DPP 2010 ITER Town Meeting (Nov 2010)
 - G.S. Lee calls to exclude the IVCC from the baseline design
 - Request to G.S. to provide venue for further discussion not sufficiently addressed
- DG Motojima states IVCC will remain in design (Jan 2011)
- White paper written, put through GA review, vetted to USBPO
 - Suggestion to not state that ITER could not fulfill mission without the IVCC
 - Authors do not fully agree - plan to revise language carefully
 - Document under 2nd revision, to be delivered to USBPO after 2nd GA review

ITER 3D IVCC is a significant tool for control, and other key physics research



- ❑ The cost and design impact of such a significant tool requires that it be continually defended
 - ❑ N. Uckan reminds us that IVCC is in design, but not baseline budget

ITER IVCC white paper aims to illustrate the larger picture of IVCC importance

□ Document introductory sentence

- *The ITER non-axisymmetric in-vessel control coil (IVCC) is a multi-functional coil that provides a variety of opportunities for enabling new physics discoveries and helps ensure the success of reaching ITER mission targets. (...)*

□ Introductory summary of key points: *not* having the IVCC...

- 1) may jeopardize the ITER mission of reaching $Q = 10$
- 2) increases the risk of damage to the device, potentially impacting the operating schedule and long-term cost of ITER for repairs
- 3) reduces ITER's potential to reach key physics goals in support of DEMO, including the practical elimination of 3D physics studies on the device

White paper: summary of physics points outlined to illustrate need to reach ITER goals, study required physics (I)

❑ Power handling

- ❑ ELM suppression and mitigation
- ❑ ELM pacing

❑ Disruption prevention / avoidance

- ❑ Reduction of $n > 1$ error fields - locked modes and NTV
- ❑ Reduction of resonant field amplification
- ❑ Resistive Wall Mode control and stabilization
- ❑ Rotation of islands after locking to enable ECCD suppression
- ❑ Control of transport transients
 - Transport barrier transients, gradient changes due to ELMs, etc.
 - Instability due to alteration of stabilizing fast particle population
- ❑ Control of burn instability
- ❑ Test of advanced control techniques for future devices
 - E.g. demonstrate dynamic control effectiveness of shielded IVCC

White paper: summary of physics points outlined to illustrate need to reach ITER goals, study required physics (II)

❑ Disruption mitigation

- ❑ Reduction of wall forces during disruptions
- ❑ Suppression of runaway electrons during disruptions
- ❑ Nonaxisymmetric field control of runaway electron deconfinement following disruptions

❑ Transport

- ❑ H-mode power threshold minimization ($n > 1$ fields)
 - Correction of $n > 1$ fields can greatly reduce H-mode power threshold

Contributions from the entire community to future define the importance and need of the ITER IVCC are encouraged (email: sabbagh@pppl.gov)

ITER IVCC white paper: course of action and evolution

- ❑ Complete 2nd draft and send to USBPO
 - ❑ Update based on results from APS DPP 2011
 - ❑ 2nd draft for GA review – Nov 2011
 - ❑ Presentation to USBPO to directly follow GA review completion
- ❑ Once approved by USBPO, send to ITER STAC
- ❑ Continue evolution of document
 - ❑ To include contributions from the community
 - ❑ To remain current, based on advances in present devices / theory
- ❑ Use document as a centerpiece for discussion if ITER IVCC construction and installation runs into budget issues

ITER IVCC white paper: some points for discussion

- ❑ What further functions and physics should the IVCC be used to address in ITER?
- ❑ Should the approach to the ITER Organization be more proactive?
- ❑ To be effective at all, must the IVCC justification include a strong statement tying the IVCC to ITER reaching its goals?
- ❑ Should the role of physics studies enabled by the IVCC to answers issues for DEMO be further emphasized?