



# KSTAR EXPERIMENTAL PROPOSAL PROCESS

*April 2009*

*Presented by Y. K. Oh*

**National Fusion Research Institute**



- 2009 Operational schedule
- Plan of proposal submission
- Proposal on-line submission guideline

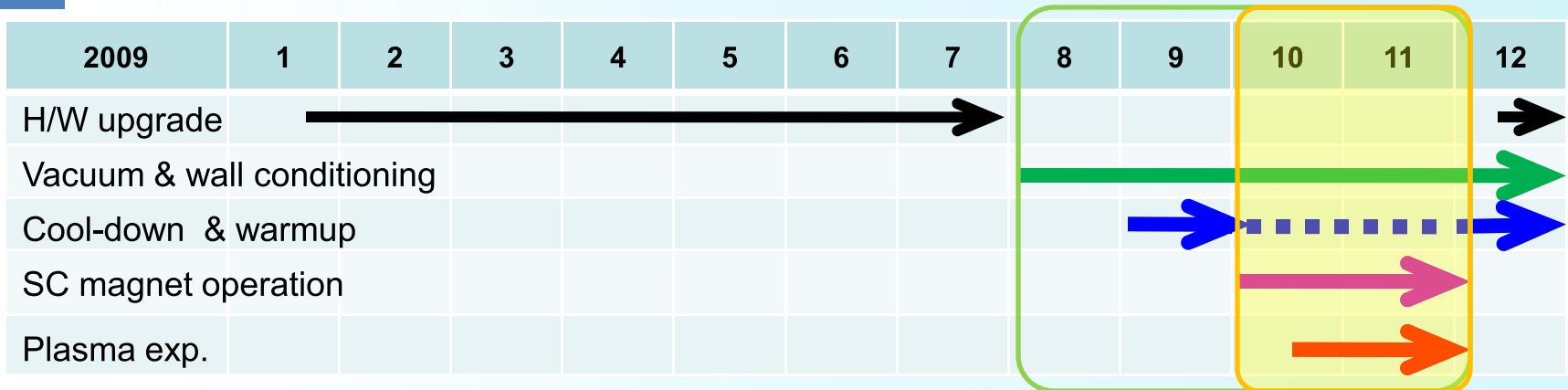


# KSTAR Operation & Upgrade Plan

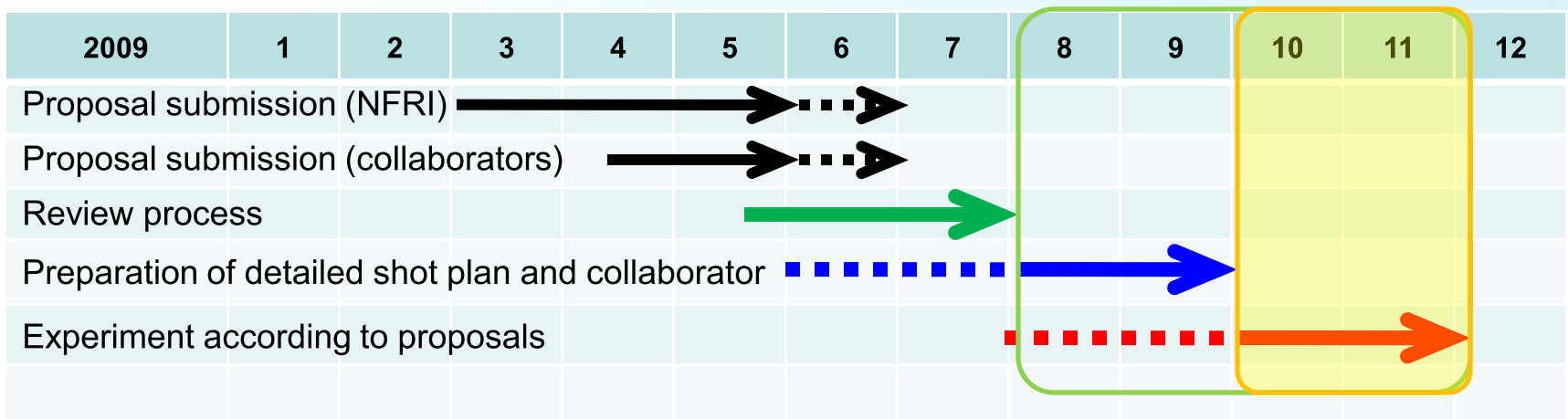


	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012
<b>Operation</b> (Vac,CD & WU)	'08. 3 ~ '08. 8 (6 mon.)	'09. 8 ~ '09.12 (5 mon.)	'10.6 ~ '10. 11 (6 mon.)	'11. 4~ '11. 9 (6 mon.)	'12. 2 ~ '12. 7 (6 mon.)
<b>Experimental Goals</b>	<ul style="list-style-type: none"> <li>• First plasma startup</li> <li>• 2<sup>nd</sup> Harmonic ECH pre-ionization</li> </ul>	<ul style="list-style-type: none"> <li>• 1<sup>st</sup> Harmonic ECH Pre-ionization</li> <li>• Startup stabilization</li> </ul>	<ul style="list-style-type: none"> <li>• Shaping control &amp; vertical stabilization</li> <li>• Heating</li> </ul>	<ul style="list-style-type: none"> <li>• Confinement (L-H)</li> <li>• Stabilization</li> <li>• Heating</li> </ul>	<ul style="list-style-type: none"> <li>• Plasma-Wall Interaction</li> <li>• Profile control</li> <li>• RWM, ELM control</li> <li>• Off-axis current drive</li> </ul>
<b>Target Operation Parameters</b>	<ul style="list-style-type: none"> <li>• <math>B_T \sim 1.5</math> T</li> <li>• <math>I_p &gt; 0.1</math> MA</li> <li>• <math>t_p &gt; 0.1</math> s</li> <li>• <math>T_e &gt; 0.3</math> keV</li> <li>• <math>T_i \sim 0</math> keV</li> <li>• Flux <math>\sim 1</math> Wb</li> <li>• Shape <math>\sim</math> Circular</li> <li>• Gas : <math>H_2</math></li> </ul>	<ul style="list-style-type: none"> <li>• <math>B_T \sim 3</math> T</li> <li>• <math>I_p &gt; 0.3</math> MA</li> <li>• <math>t_p &gt; 2</math> s</li> <li>• <math>T_e &gt; 0.3</math> keV</li> <li>• <math>T_i \sim 0.3</math> keV</li> <li>• Flux <math>\sim 2</math> Wb</li> <li>• Shape <math>\sim</math> Circular</li> <li>• Gas : <math>H_2, D_2</math></li> </ul>	<ul style="list-style-type: none"> <li>• <math>B_T \sim 3</math> T</li> <li>• <math>I_p &lt; 1</math> MA</li> <li>• <math>t_p \sim 10</math> s</li> <li>• <math>T_e \sim 1</math> keV</li> <li>• <math>T_i \sim 1</math> keV</li> <li>• Flux <math>\sim 4</math> Wb</li> <li>• Shape <math>\sim</math> DN(double null)</li> <li>• Gas : <math>H_2, D_2</math></li> </ul>	<ul style="list-style-type: none"> <li>• <math>B_T \sim 3</math> T</li> <li>• <math>I_p &lt; 1.5</math> MA</li> <li>• <math>t_p \sim 10</math> s</li> <li>• <math>T_e \sim 1</math> keV</li> <li>• <math>T_i \sim 3</math> keV</li> <li>• Flux <math>\sim 6</math> Wb</li> <li>• Shape <math>\sim</math> DN &amp; SN</li> <li>• Gas : <math>D_2</math></li> </ul>	<ul style="list-style-type: none"> <li>• <math>B_T \sim 3</math> T</li> <li>• <math>I_p &lt; 2</math> MA</li> <li>• <math>t_p &gt; 100</math> s (0.5 MA)</li> <li>• <math>T_e \sim 1</math> keV</li> <li>• <math>T_i \sim 5</math> keV</li> <li>• Flux <math>\sim 8</math> Wb</li> <li>• Shape <math>\sim</math> DN &amp; SN</li> <li>• Gas : <math>D_2</math></li> </ul>
<b>PFC &amp; Wall conditioning</b>	<ul style="list-style-type: none"> <li>• Inboard limiter (belt)</li> <li>• Gas puff</li> </ul>	<ul style="list-style-type: none"> <li>• Inboard limiter (w/o cooling)</li> <li>• Boronization</li> </ul>	<ul style="list-style-type: none"> <li>• Divertor / Passive plate</li> <li>• PFC baking</li> <li>• In-vessel coil</li> </ul>	<ul style="list-style-type: none"> <li>• Cryopump operation</li> <li>• PFC cooling</li> </ul>	<ul style="list-style-type: none"> <li>• PFC cooling</li> <li>• Pellet</li> </ul>
<b>Magnetic control</b>	<ul style="list-style-type: none"> <li>• TF : 1.5 T</li> <li>• PF : 4 kA unipolar</li> </ul>	<ul style="list-style-type: none"> <li>• TF : up to 3.5 T</li> <li>• PF : +/-4 kA</li> </ul>	<ul style="list-style-type: none"> <li>• TF : up to 3.5 T</li> <li>• PF : +/-10 kA</li> <li>• IVCC : VS, RS</li> </ul>	<ul style="list-style-type: none"> <li>• TF : up to 3.5 T</li> <li>• PF : +/-15 kA</li> <li>• IVCC : FEC, RMP</li> </ul>	<ul style="list-style-type: none"> <li>• TF : up to 3.5 T</li> <li>• PF : +/-20 kA</li> <li>• IVCC : RMP, RWM</li> </ul>
<b>Heating operation</b>	<ul style="list-style-type: none"> <li>• ECH(84G): 0.5MW, 0.4s</li> </ul>	<ul style="list-style-type: none"> <li>• ECH(84GHz): 0.5MW, 2s</li> <li>• ICRH(45MHz): 0.3MW, 10 s</li> </ul>	<ul style="list-style-type: none"> <li>• ECH(84/110GHz): 0.5MW</li> <li>• ICRH(45MHz): 1MW, 10 s</li> <li>• NBI: 1.0MW, 10s</li> <li>• LHCD: 0.5MW, 2s</li> </ul>	<ul style="list-style-type: none"> <li>• ECH(84/110GHz): 0.5MW</li> <li>• ICRH(45MHz): 2MW, 10 s</li> <li>• NBI: 2.5MW, 10s</li> <li>• LHCD: 0.5MW, 2s</li> <li>• ECCD(170GHz): 1MW, 10s</li> </ul>	<ul style="list-style-type: none"> <li>• ECH(84/110GHz): 0.5MW</li> <li>• ICRH(45MHz): 2MW, 300 s</li> <li>• NBI :5MW, 300s</li> <li>• LHCD : 1MW, 2s</li> <li>• ECCD(170GHz): 1MW, 300s</li> </ul>
<b>Diagnostics</b>	<ul style="list-style-type: none"> <li>• MD (77 Ch)/ MMWI / ECE / <math>H_\alpha</math> / filterscope / VS / TV</li> </ul>	<ul style="list-style-type: none"> <li>• MD/ MMWI / ECE / <math>H_\alpha</math> / filterscope / VS / TV</li> <li>• PD / XCS (1 set) / Bolometer (resistive) / Reflect. / Soft X-ray</li> </ul>	<ul style="list-style-type: none"> <li>• MD / MMWI / ECE / <math>H_\alpha</math> / filterscope / VS / TV</li> <li>• PD / XCS / Bolometer / Reflect. / Soft X-ray</li> <li>• Thomson Scattering / Hard X-ray / Fast neutral / IR TV / ECEI</li> </ul>	<ul style="list-style-type: none"> <li>• MD / MMWI / ECE / <math>H_\alpha</math> / filterscope / VS / TV</li> <li>• PD / XCS / Bolometer / Reflect. / Soft X-ray</li> <li>• TS / Hard X-ray / Fast neutral / IR TV / ECEI</li> <li>• MSE / FIR / CES / neutron</li> </ul>	<ul style="list-style-type: none"> <li>• MD / MMWI / ECE / <math>H_\alpha</math> / filterscope / VS / TV</li> <li>• PD / XCS / Bolometer / Reflect. / Soft X-ray</li> <li>• TS / Hard X-ray / Fast neutral / IR TV / ECEI</li> <li>• MSE / FIR / CES / neutron / VUV</li> <li>• MIR / BES / CI /</li> </ul>

## 2009 Operation



## Proposal and planning of 2009 experiments



## Online proposals for 2009 experiments

- On-line submission on kstar website
  - [http://kstar\\_exp.nfri.re.kr](http://kstar_exp.nfri.re.kr)
  - Currently korean language, English version will be prepared soon.
  - If not available, e-mail submission will be possible too.
  - Submission by the end of May 2009.
  - Mainly two areas (system commissioning or Plasma experiments)
- Review and arrangement of the proposals
  - KSTAR executive committee
  - Selection of proposal by July 2009
- Contacts:
  - Experiment issues  
Woong Chae Kim ([woong@nfri.re.kr](mailto:woong@nfri.re.kr))
  - Website issues  
Sulhee Baek ([shbaek@nfri.re.kr](mailto:shbaek@nfri.re.kr))

## Website for KSTAR proposal submission

• [http://kstar\\_exp.nfri.re.kr](http://kstar_exp.nfri.re.kr)

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차세대 초전도

MEMBERSHIP

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PASSWORD: [ ]  
Member Login

KSTAR News

[세미나] SOL width scale lengths in NSTX 세미나	2008-01-23
[공지]연료주입계 피에조밸브 시험	2008-01-23
[공지]주장치실 지하 방사선 테스트	2008-01-23
[공지]국가핵융합연구소 단수(급수중지)관련	2008-01-23
[공지]한일 공동 ICF Heating physics 워크숍 개최	2008-01-23

Shot IMG

Operation Report

[공지 사항] 실험 데이터 변경 신청서 양식	2009-02-03
[공지 사항]전산인프라 Upgrade 일정 및 데이터 접근 제한	2008-08-25
실험관련 공지 사항	2008-06-10
KSTAR Commissioning Report (08.5.12)	2008-05-19
KSTAR Commissioning Report (08.5.11)	2008-05-19

2009. 4

Sun Mon Tue Wed Thu Fri Sat

1 2 3 4

5 6 7 8 9 10 11

12 13 14 15 16 17 18

19 20 21 22 23 24 25

26 27 28 29 30

PROPOSAL for 2009 campaign

TMS VMS

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• Currently main page is in Korean & English version will be prepared.

• Click to submit proposal

## KSTAR status and availability

[http://203.230.119.122/kstarweb/intranet/proposal2009\\_mstatus.jsp](http://203.230.119.122/kstarweb/intranet/proposal2009_mstatus.jsp)

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PROPOSAL2009

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**KSTAR status**

Proposal

Guide-line

### KSTAR Status

#### Machine Status

TF field	1.5~3.5 T
Plasma current	0.1~0.5 MA
Minor radius	0.3~0.5 m
Major radius	1.8 m
Line density	Upto $10^{20} \text{ m}^{-3}$
Max PF flux	1~3 Vs
Average Te	0.5~2 keV
Average Ti	0.1~0.5 keV
Pulse length	0.2~4 s
Gas type	H, D
Base pressure	10~5 Pa
Plasma shape	Circular limited

#### Heating/Fueling Status

ECH	84GHz, 500kW, 2 500kW, 1-s long
ICRH	30~60MHz, 2MW 500kW, 100-s lon

#### Diagnostics Status

Visible camera	1,2,3 Available 48 frame, 210(420) frame, 1K frame
mm-Wave interferometer	Available Density Range: $5 \times 10^{17} - 5 \times 10^{19} \text{ m}^{-2}$
ECE radiometer	Available 100eV~5keV
Visible survey spectrometer	Available 200~800nm
H-alpha monitor	Available Pol, 10ch, Tor, 20ch
Reflectometer	Available $0.2 \times 10^{13} \text{ cm}^{-3}$
Resistive bolometer	Available $10^6 \text{ W/cm}^2$
Reciprocating probe	Available
Soft x-ray	Available
Rogowski coil	Available 10~130kA
Flux loop	Available 1~10V
Magnetic field probe	Available
Diamagnetic loop	Available
Mirnov coil	Available
XCS	Available 500eV~2keV
Filterscope	Available 100kHz sampling



## Guideline for proposal submission

[http://203.230.119.122/kstarweb/intranet/proposal2009\\_guideline.jsp](http://203.230.119.122/kstarweb/intranet/proposal2009_guideline.jsp)

### PROPOSAL2009

▶ KSTAR status

▶ Proposal

▶ Guide-line

## Proposal Guide-line

### How to register KSTAR experiment proposal?

1. Login kstar\_exp site([http://kstar\\_exp.nfri.re.kr](http://kstar_exp.nfri.re.kr)). If you don't have ID, you have to register first.
2. Move to the proposal2009 list page and click WRITE icon.
3. Insert data into proposal write form. Title and Background fields are mandatory. Use the **proposal template** to write proposal document file.
4. Make sure that your proposal is registered on list page. Click MP No. or Title to see registered contents. If you are the primary author of the proposal, you can modify the contents.
5. Wait for the approved results from the committee.

**Contacts:** KSTAR experiment issues- **Woong Chae Kim**  
KSTAR\_EXP web issues - **Sulhee Baek**

## Status of mini-proposal submission

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- KSTAR status
- Proposal
- Guide-line**

No.	MP No.	Title	Area	Primary Author	Scheduled Date	Related shots	Status	Proposal	Result
12	2009-04-01-001	Calibration of Resistive bolom	Plasma experiment	서동철	null	--	Registered	--	--
11	2009-03-05-003	Calibration of Line-integrated	Plasma experiment	남용운	null	--	Registered	--	--
10	2009-03-05-001	Direct observation of poloidal	Plasma experiment	정진일	null	--	Registered	--	--
9	2009-03-04-001	Thomson mirror operation test	System commissioning	이종하	null	--	Registered	--	--
8	2009-03-03-001	Final integration tests on the	System commissioning	한상희	null	--	Registered	Proposal file	--
7	2009-02-28-003	Plasma startup	Plasma experiment	한상희	null	--	Registered	Proposal file	--
6	2009-02-28-002	Superconducting PF magnet inte	System commissioning	한상희	null	--	Registered	Proposal file	--
5	2009-02-27-005	Individual Superconducting PF	System commissioning	한상희	null	--	Registered	Proposal file	--
4	2009-02-27-004	Engineering test of KSTAR supe	System commissioning	박수환	null	--	Registered	--	--
3	2009-02-27-003	Stabilization and destabilizat	Plasma experiment	윤시우	null	--	Registered	--	--

LIST  WRITE

- Progress or status of acceptance
- Click for new proposal submission

## Example of proposal

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- KSTAR status
- Proposal
- Guide-line

### Stabilization and destabilization of the sawteeth

윤시우(swoon)

<b>Area</b>	Plasma experiment
<b>Co-authors</b>	J. G. Kwak
<b>Registered date</b>	2009-02-27
<b>Scheduled date</b>	null
<b>Mini-Proposal number</b>	2009-02-27-003
<b>Proposal file</b>	--
<b>Result file</b>	--

#### Machine Requirements

<b>Ip(kA)</b>	max:
<b>Bt(T)</b>	1.5~3.5
<b>Gas type</b>	H

#### Heating Requirements

<b>ECH (kW)</b>	max:
<b>ECH Pulse Length (s)</b>	
<b>ICRH (kW)</b>	max:
<b>ICRH Pulse Length (s)</b>	

#### Diagnostics Requirements

<b>Visual Camera 1, 2, 3</b>	Essential
<b>mm-Wave interferometer</b>	Essential
<b>ECE radiometer</b>	Essential
<b>Visible survey</b>	Essential

#### Purpose

**Purpose** The purpose of this experiments is to identify the mechanism of the effect of fast particles and external power deposition on sawteeth activity. By comparison of the ECH and ICRH heating, the relative contribution of fast particles and heating will be evaluated. This experiments will include the identification of electron fishbone discovered at HT-7, and the determination of the critical power level for sawteeth stailization. By shifting the current center using feedback-control, the heating layer will be varied inside and outside of the inversion radius and correlation of the sawteeth characteristics with deposition layer will be analyzed for ECH and ICRH heating independently. The main diagnostics involved are 64 channel ECE and soft X-ray

#### Background

The sawteeth is one of the potential concern for ITER and a future reactor because it is reported that a giant sawtooth induces the neoclassical tearing mode and degrades confinement. On the other hand, sawteething is a good tool for efficient particle pump-out including control of impurity accumulation in the core. There has been significant advance for understanding basic mechanism of interaction of sawteeth and external heating and current drives and it has been identified that the major players are delay of current penetration, effect of the fast ions and position of heat deposition layer. However, estimation of the critical power for stabilization and relative importance of the each players are still in the primitive stage. IN KSTAR, by a dedicated long-pulse experiments with combined heating of ECH and ICRH with real-time feedback control of plasma position, extensive control capability of sawteeth activity will be tested focusing on the relative importance of the each physics players and critical power required.

#### Experimental plan Expected output

1. clarify mechanism of interaction between sawteeth and external heating
2. relative importance of delay of current penetration, effect of the fast ions and position of heat deposition layer
3. testing of real-time control of sawtooth activity and estimation of the critical power for ECH and ICRH

#### Review Comments

**Reviewer**  
**Enter scheduled date**  
**Enter comments**

Enter scheduled date:

Enter comments:

**Approval status** Registered



## E-mail proposal submission could be in tentatively.

- E-mail to with miniproposal file :  
Woong Chae Kim ([woong@nfri.re.kr](mailto:woong@nfri.re.kr))  
Leader of joint experiments team

### KSTAR Mini-Proposal

MP No. \_\_\_\_\_

Subject: Plasma startup

From: Sang-hee Hahn, Jayhyun Kim, Y.M. Jeon, S.W. Yoon, S.H. Hong and J.M. Kwon

Group: Joint Experiment Team, NFRI

Date: April 16, 2009

Approved by:

Date Approved:

#### 1. Purpose of Experiments

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

The target plasma of the 2009 campaign is very similar to the one in 2008, but changes of the in-vessel component and the wall condition methods will give the breakdown condition different. The purpose of this experiment is on finding an acceptable startup scenario for creation and robust ramp-up toward the target plasma (300 kA circular, for present) which will be repeatedly used for the upcoming physics experiments including plasma controls and seeking operational boundary.

#### 2. Background

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

There are several items which will give differences to the characteristics of the plasma startup conditions from the one in 2008 – The EC resonance characteristics will change if the toroidal field strength increases from 2<sup>nd</sup> harmonic to fundamental. Full plate of inner limiter and the poor wall conditions in first attempt will make more eddies which would increase the required minimum loop voltage. Still, the electricity upgrades for the higher loop voltage will not be available in the 2009 campaign.

Hence there will be different optimization of IM state, field null conditions, different base hydrogen pressure and EC resonance condition. Even the radial force balance could be different from the one in 2008. The optimization needs empirical tuning before the burnthrough, as we experienced in the last campaign. However this approach will only cover until the plasma current reaches 110 kA, and the real-time plasma feedback control will follow the maintenance of plasma force balance afterwards.

#### 3. Approach

April 16, 2009

1