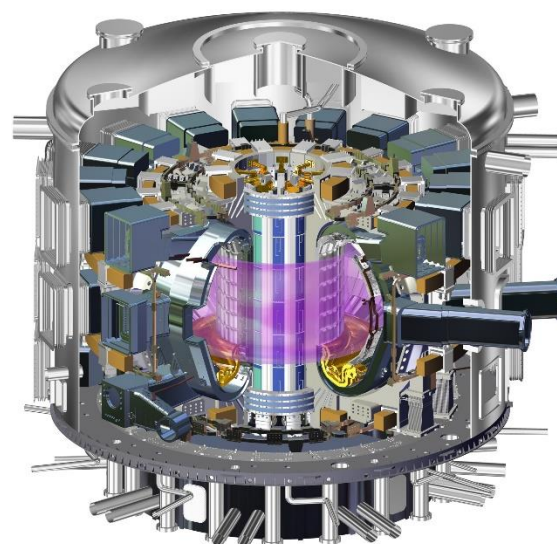


参考資料 4



Chinese National Fusion Program

Dr. LUO Delong

Director-General, ITER China, Ministry of Science & Technology

Presented at JWG-10

20 July, 2017

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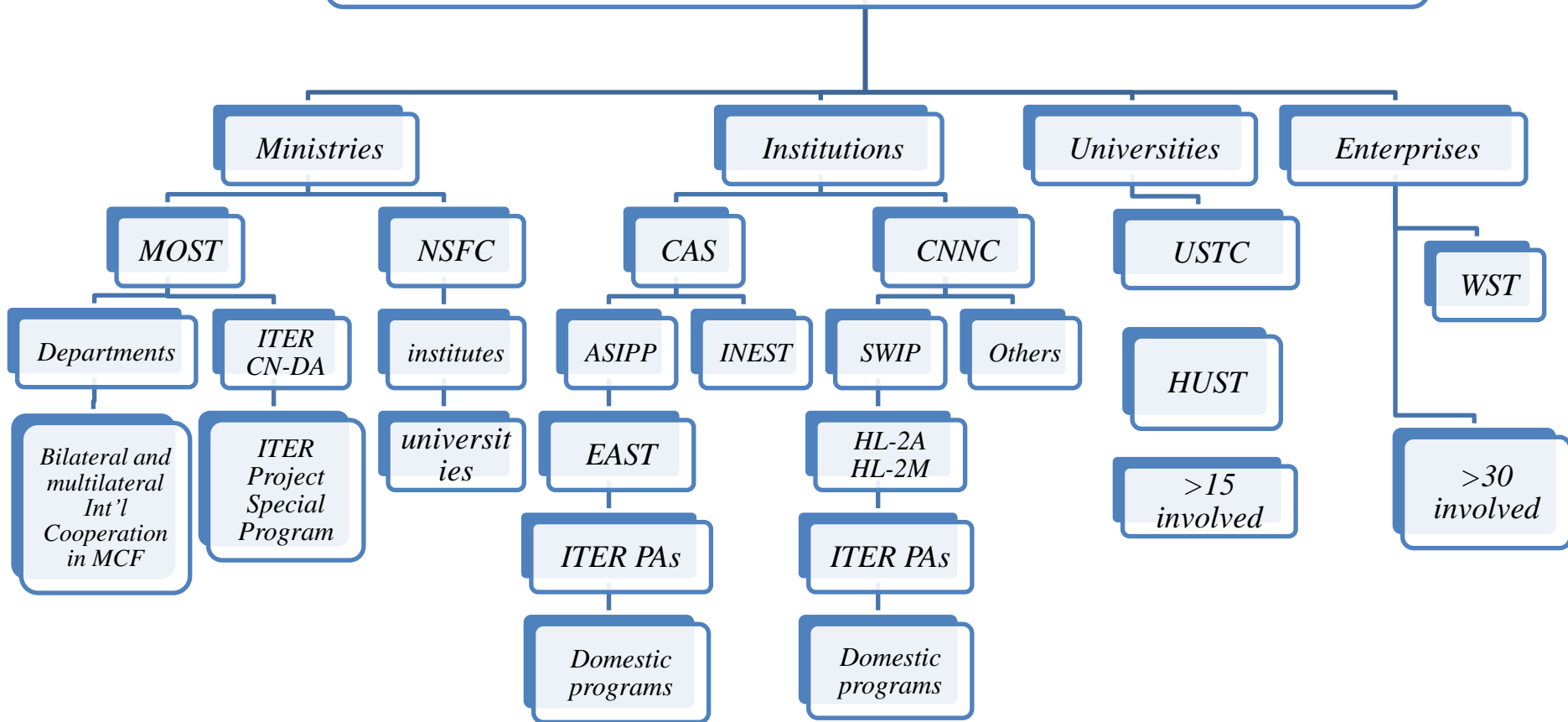
- 01 General management and support of Fusion and ITER in China
- 02 Fusion Energy R&D in China
- 03 International Cooperation of Fusion in China

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Global Pictures of Fusion and ITER in China

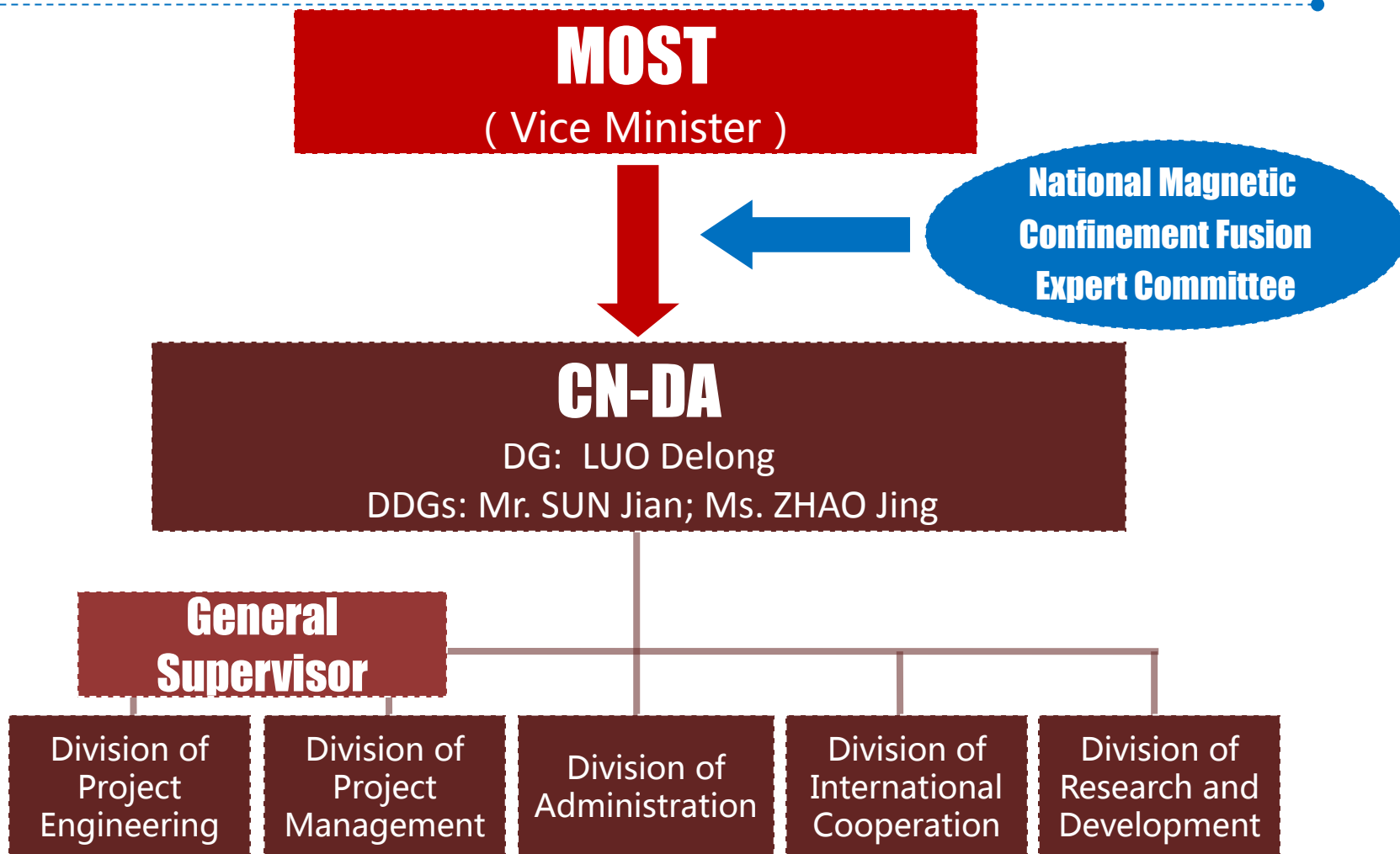
Global Pictures of Fusion and ITER in China



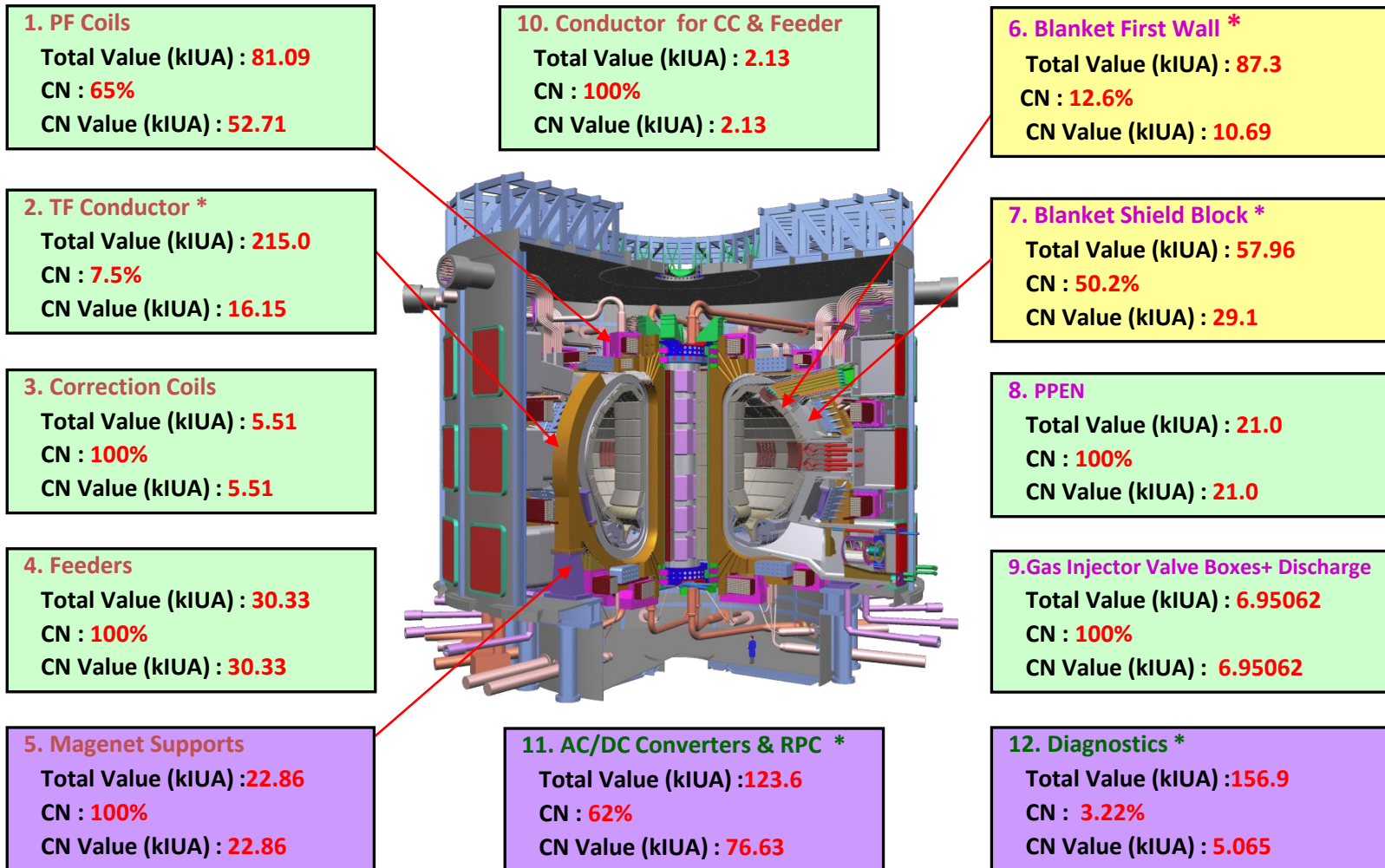
ITER China: Mission

- ✓ *Commitments to ITER Agreement*
- ✓ *Implementation of ITER Project*
- ✓ *Promotion of Fusion technological development*
- ✓ *Administration of R&D program in fusion energy*
- ✓ *International Cooperation in MCF*

Organizational Structure of CN DA



ITER-China Procurement Items



ITER PA Signature

PBS No.	Procurement Name	Signature Date
11. Magnet	TF conductor	Jun. 16, 2008
	PF conductor	Oct. 10 2010
	Correction Coils (CC)	May 11, 2010
	Feeders & Current Leads	Jan, 2011
	CC and Feeder Conductor	May 11, 2010
	Magnet Support	May 11, 2010
41. Coil Power Supply	AC/DC Convertors	Apr. 27, 2011
	Pulsed Power Electrical Network (PPEN)	Jun. 20, 2012
	Reactive Power Compensation (RPC)	Apr. 27, 2011

ITER PA Signature

PBS No.	Procurement Name	Signature Date
16. Blanket	Shield Block	Nov, 2013
	First Wall	Nov, 2016
18. Fueling & Wall Conditioning	Gas Injection System(GIS)	Feb 20, 2012
	Glow Discharge Cleaning(GDC)	Dec. 25, 2013
55. Diagnostics	Diag initial PA (Neutron Flux Monitor EQ#7)	Sep. 2, 2011
	Radial X Ray Camera(RXC)	May 23, 2013
	EQ#12 Port Integration	May 23, 2013
	Remaining Neutron Flux Monitor	Sep, 2013
	Divertor Langmuir Probe (DLP)	July, 2014

Contracts Between CN DA and Suppliers

- ✓ *The total contribution from China are totally **281.3 kIUA**. Up to now, **65.43kIUA** has been earned.*
- ✓ *Totally **77** contracts have been awarded since Oct, 2009. Five of them have been completed (relevant to conductors and Magnet Support qualification).*
- ✓ ***26** main suppliers, and more subcontractors and Chinese industries are involved in the ITER project.*

CN Enterprise Involved in ITER and MCF

2008 CNDA Found

2008 TF& PF Conductors

2010 Support & CC & Feeder
Conductor & CC Coil

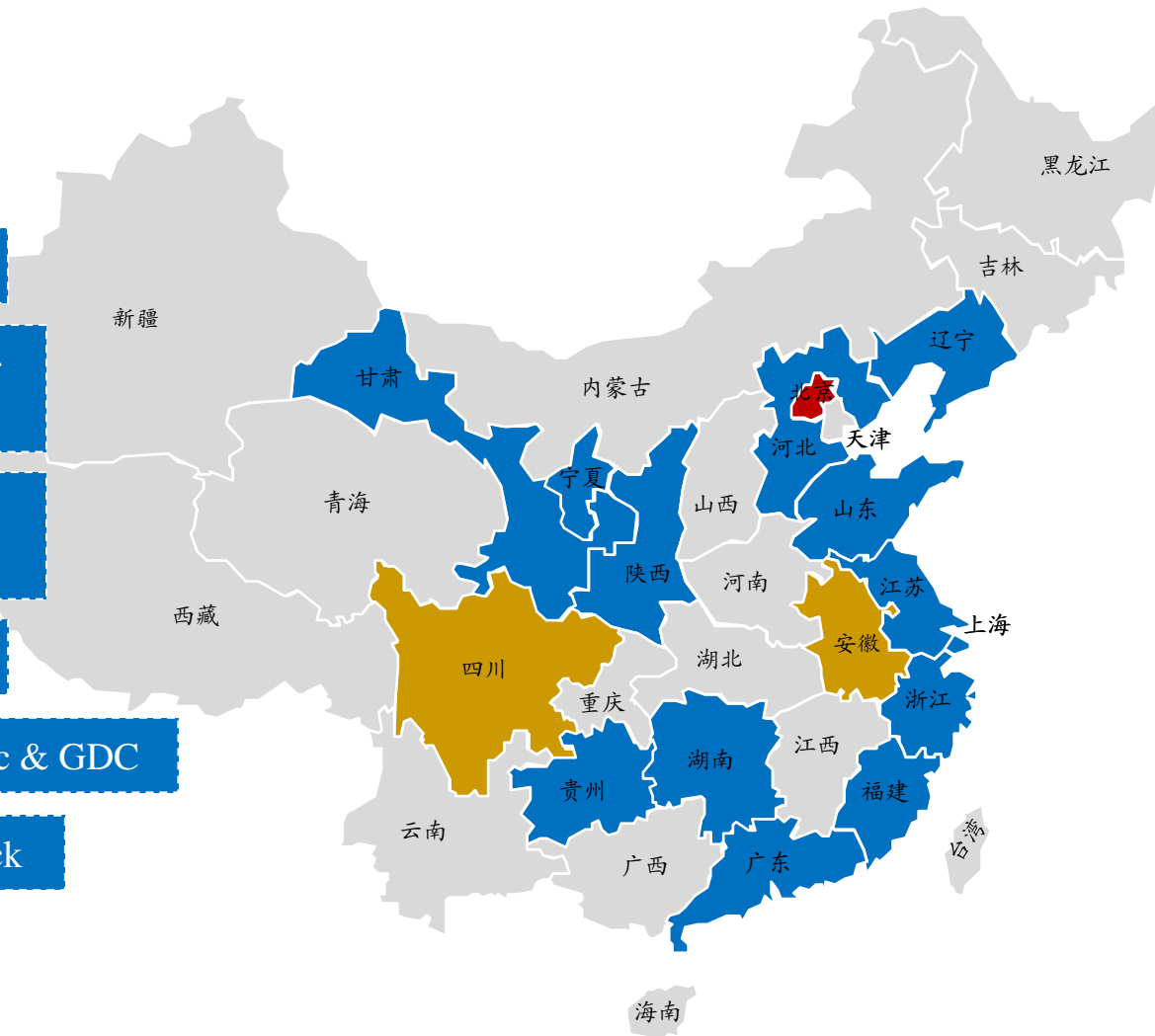
2011 Feeder & AC/DC &
RPC&HF & NFM#7

2012 PPEN & GIS & PPEN

2013 EQ#12 PI & DLP & Rxc & GDC

2014 First Wall & Shield Block

Service Supplier



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China Attaches Great Importance to MCF R&D



President Xi and Prime Minister Li Visited Chinese Main Fusion Energy Research Institutes respectively.



China Attaches Great Importance to MCF R&D

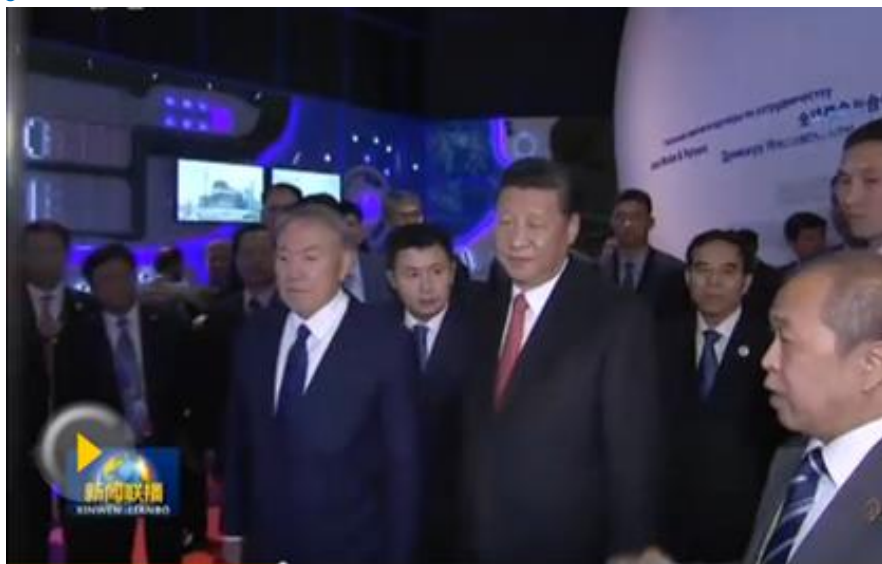


President Xi visiting ITER stand during the China National S&T Outcome Exhibition of Twelfth Five-year Plan in June 2016.



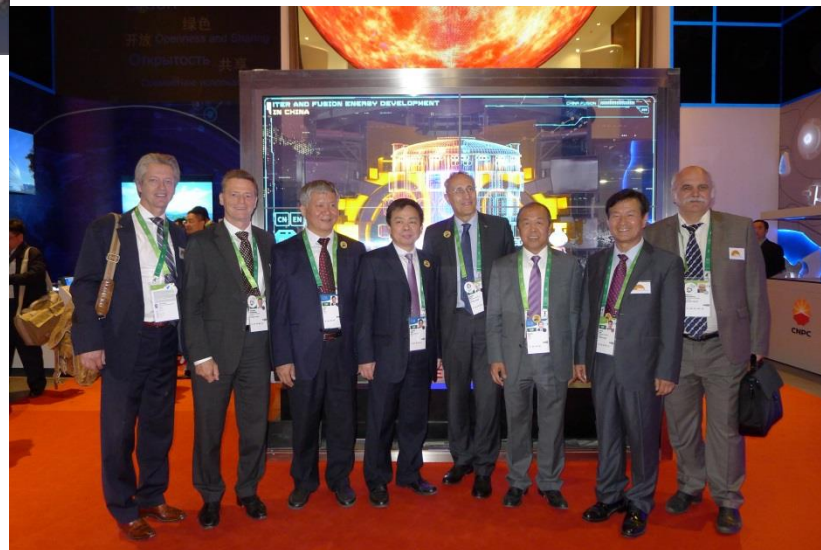
Exhibition in HongKong and Macau

ITER China in Astana Expo 2017



President Xi visiting ITER China in Astana Expo in June 2017.

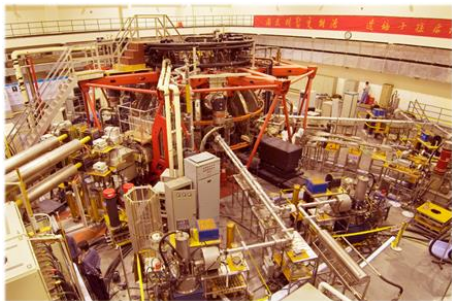
DG of ITER Organization and guests from ITER DA visit ITER China in Astana Expo 2017.



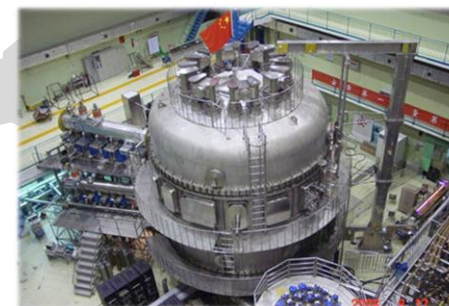
Institutes & Universities

- *Southwestern Institute of Physics (SWIP)*
- *Institute of Plasma Physics, CAS (ASIPP)*
- *Institute of Nuclear Energy Safety Technology, CAS*
- *University of Science and Technology of China*
- *Huazhong University of Science and Technology*
- *Tsinghua University*
- *Beijing University*
- *Zhejiang University*
- *Sichuan University*
- *University of Science and Technology Beijing*
- *Shanghai Jiaotong , CAS*
- *Beihang Universtiy*
- *Dalian Universtiy of Technology*
- *Harbin Institute of Technology*
- *More and more institutes and universtiiies involved*

Main facilities in China



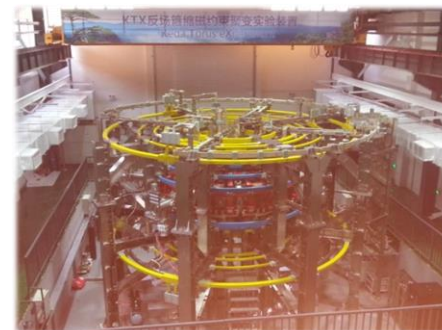
Chengdu, SWIP, HL-2A



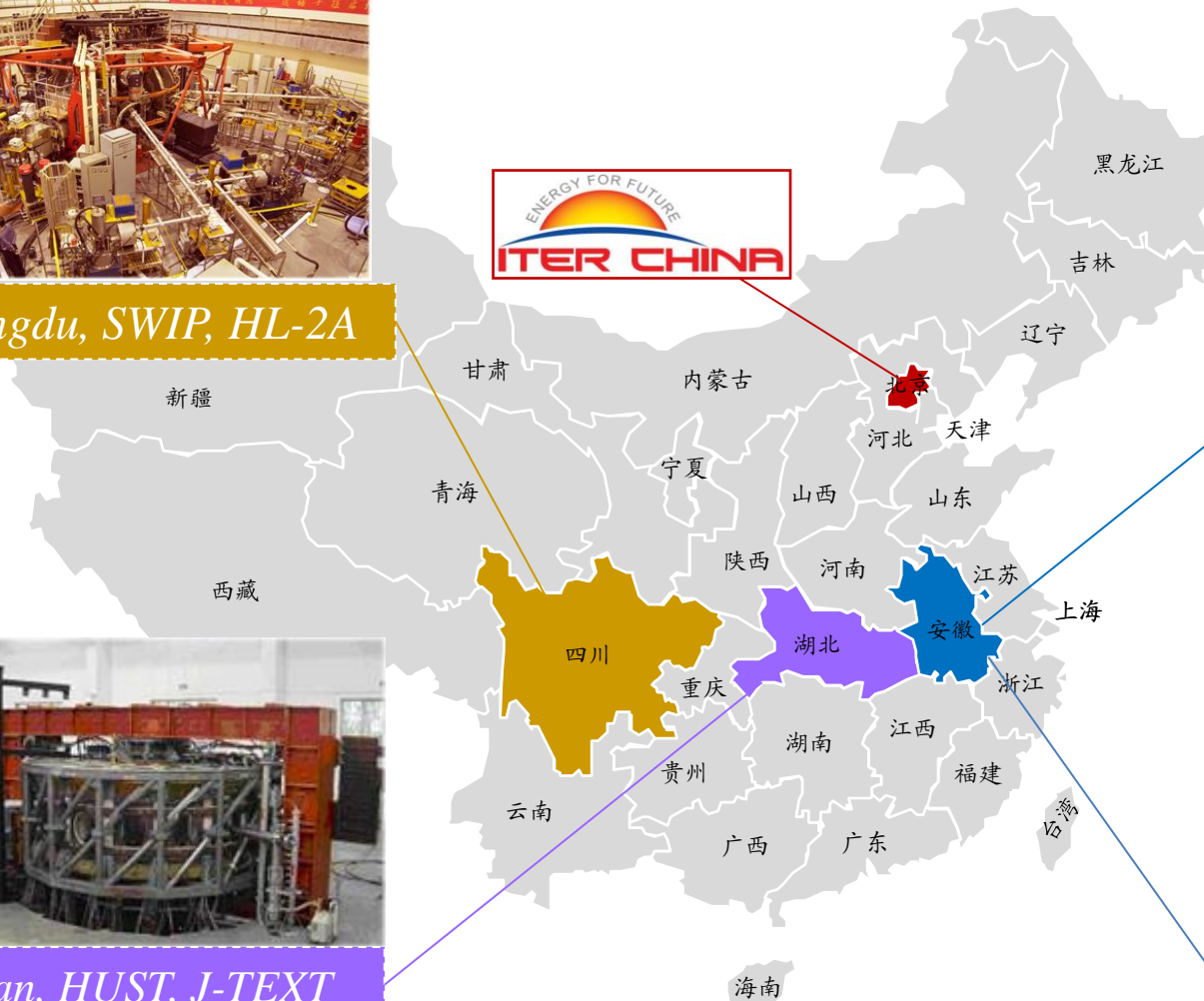
Hefei, ASIPP, EAST



Wuhan, HUST, J-TEXT



Hefei, USTC, KTX



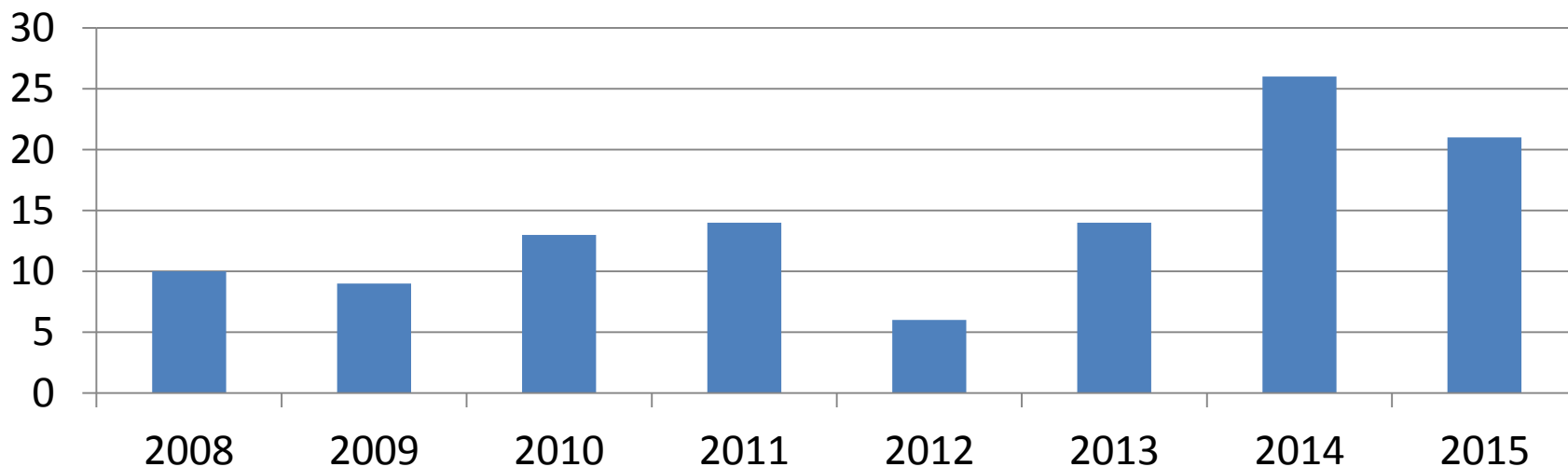
Domestic R&D Programs for MCF

- *Programs Supporting ITER CN PAs*
- *Programs for Domestic Fusion R&D, including:*
 - *Fusion reactor design*
 - *Upgrade of EAST and HL-2A*
 - *Plasma and Diagnostics*
 - *Fusion material*
 - *Fusion Engineering and Technology*
 - *TBM and related technology*
 - *Demo reactor*

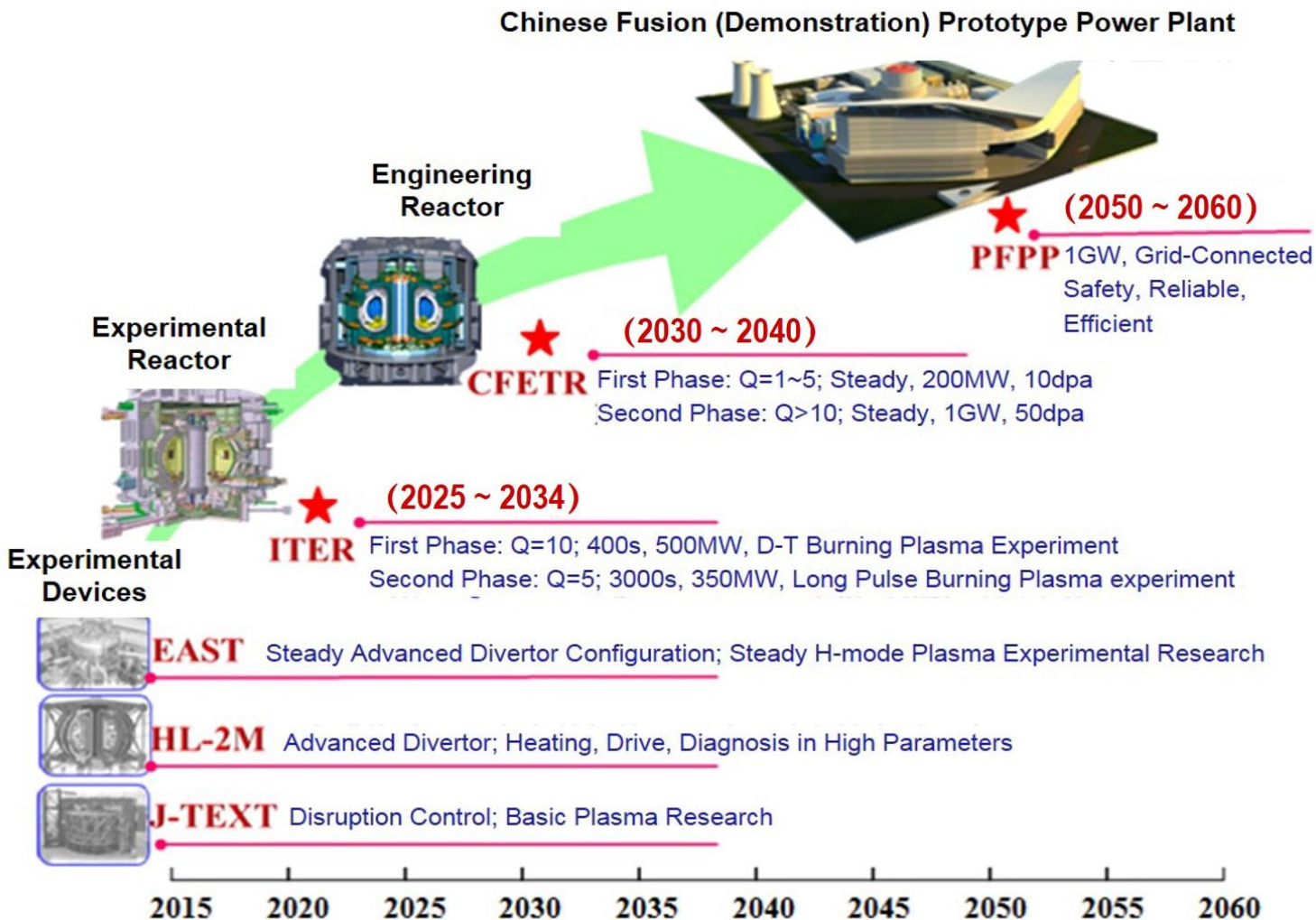
Domestic R&D Projects for MCF

Since 2008, more than one hundred projects were accumulated to support R&D in MCF domestically. some for pre-ITER and some beyond ITER Project.

Amount of Projects



Road Map in China



First Design version of CFETR (2011.11-2015.8)

Phase I

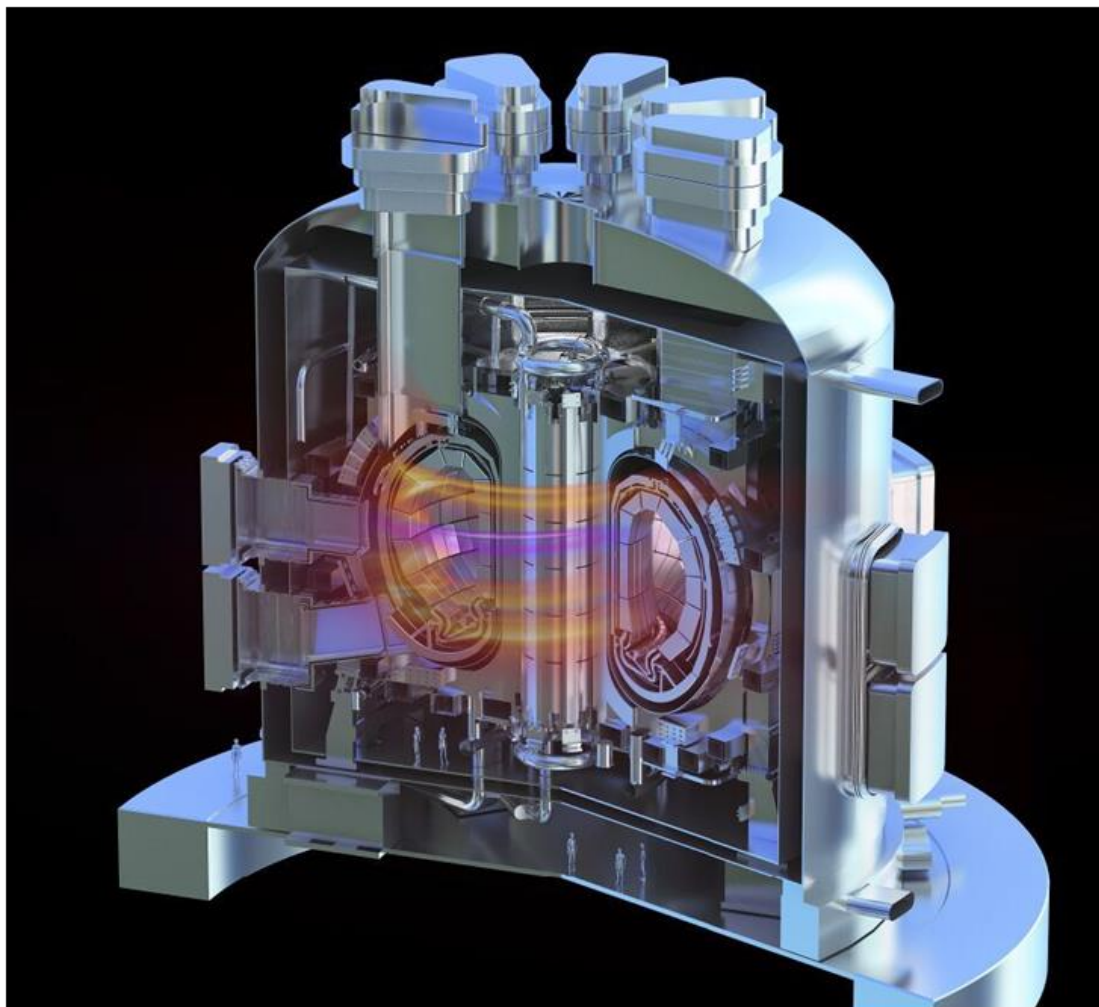
- $I_p = 7-10$ MA
- $B_{t0} = 4.5-5.0$ T
- $R_0 = 5.7$ m ;
- $a = 1.6$ m;
- $k = 1.8 \sim 2.0$
- $q_{95} \geq 3$;
- $\beta_N \sim 2-3$

$P_{\text{fusion}} : 200$ MW

Phase II

**Possible upgrade
to $R \sim 5.9$ m, $a \sim 2.0$
m, $B_t = 4.8$ T,
 $I_p \sim 15$ MA**

$P_{\text{fusion}} : 1000$ MW

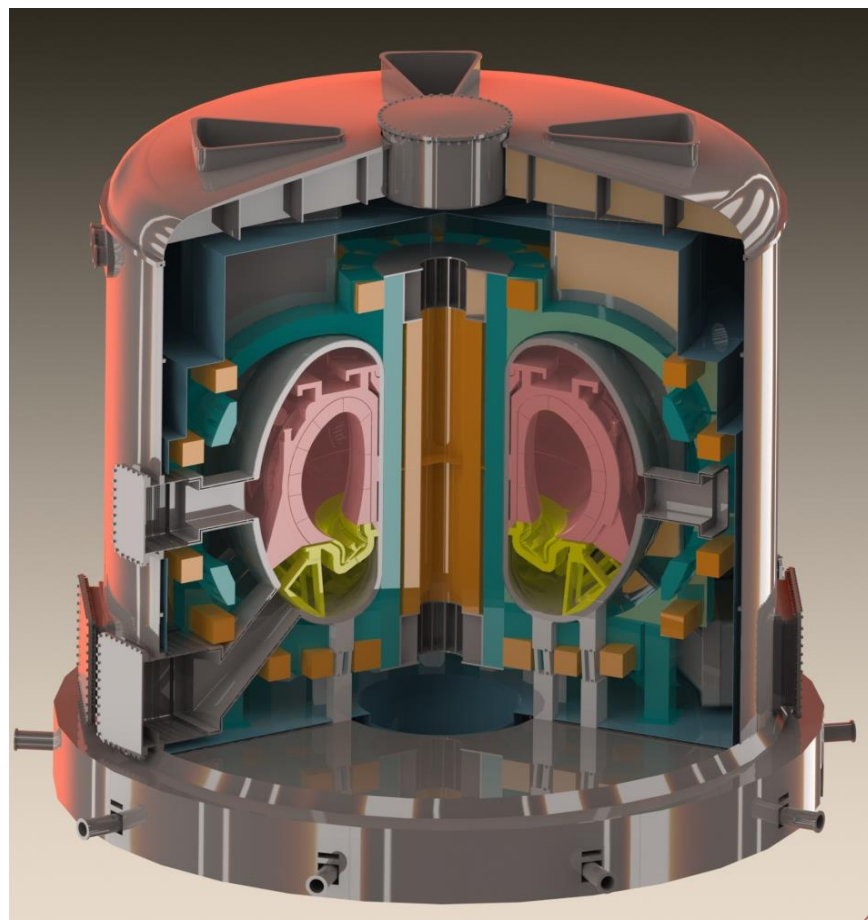


Second Design Version (2015.8-2016.8)

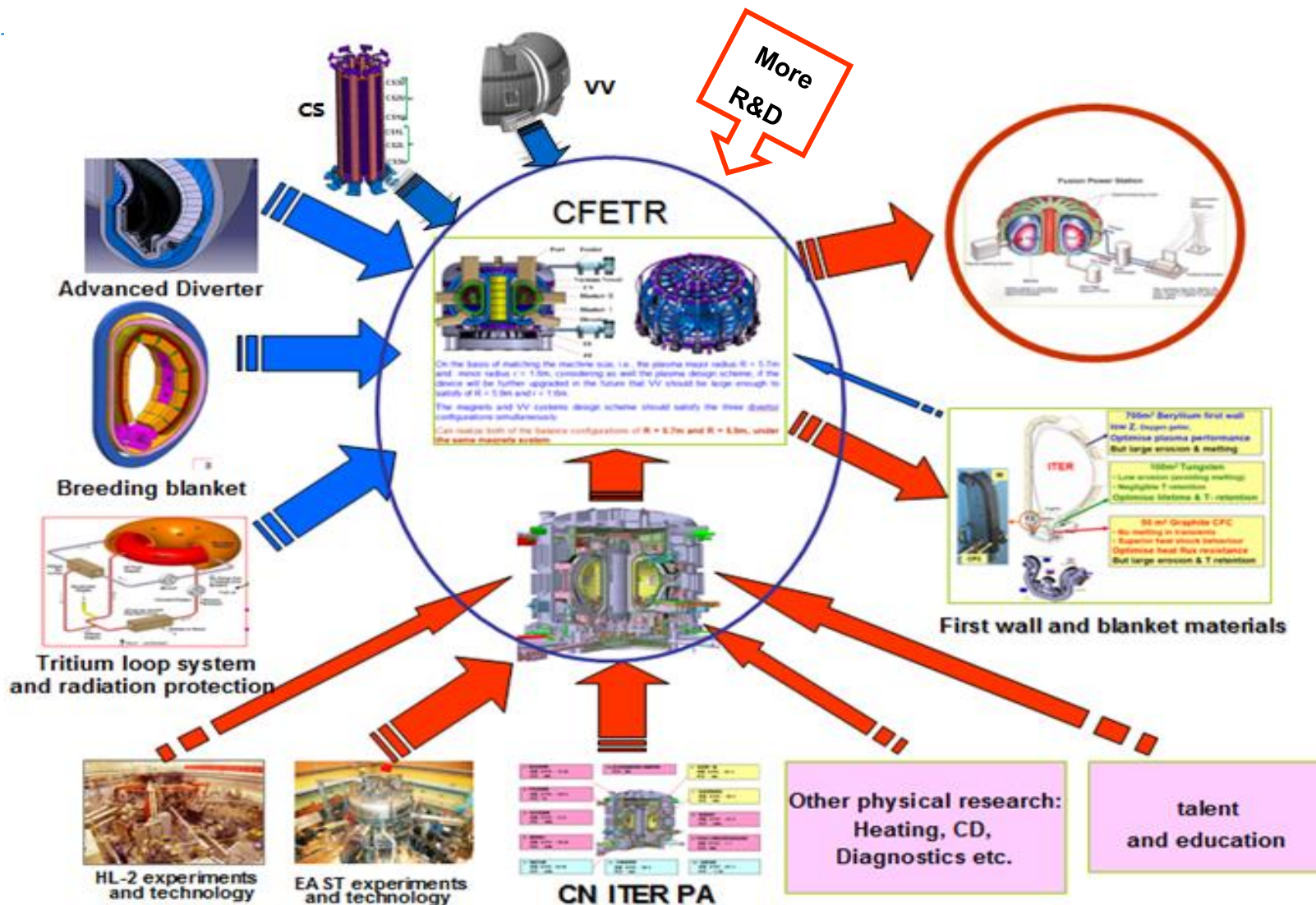
Easy transfer from Phase I to Phase II

The key points changed:

- Larger size:
R= 6.7m, a=1.95m
- Higher B_T : 5.0-7.0 T
- Advanced CS magnet: ≥ 480 VS
- Lower I_p : 6-12MA
- 12 TF coils for easy RH, H&CD
- More reliable Plasma targets
- Higher confidence for STE goals



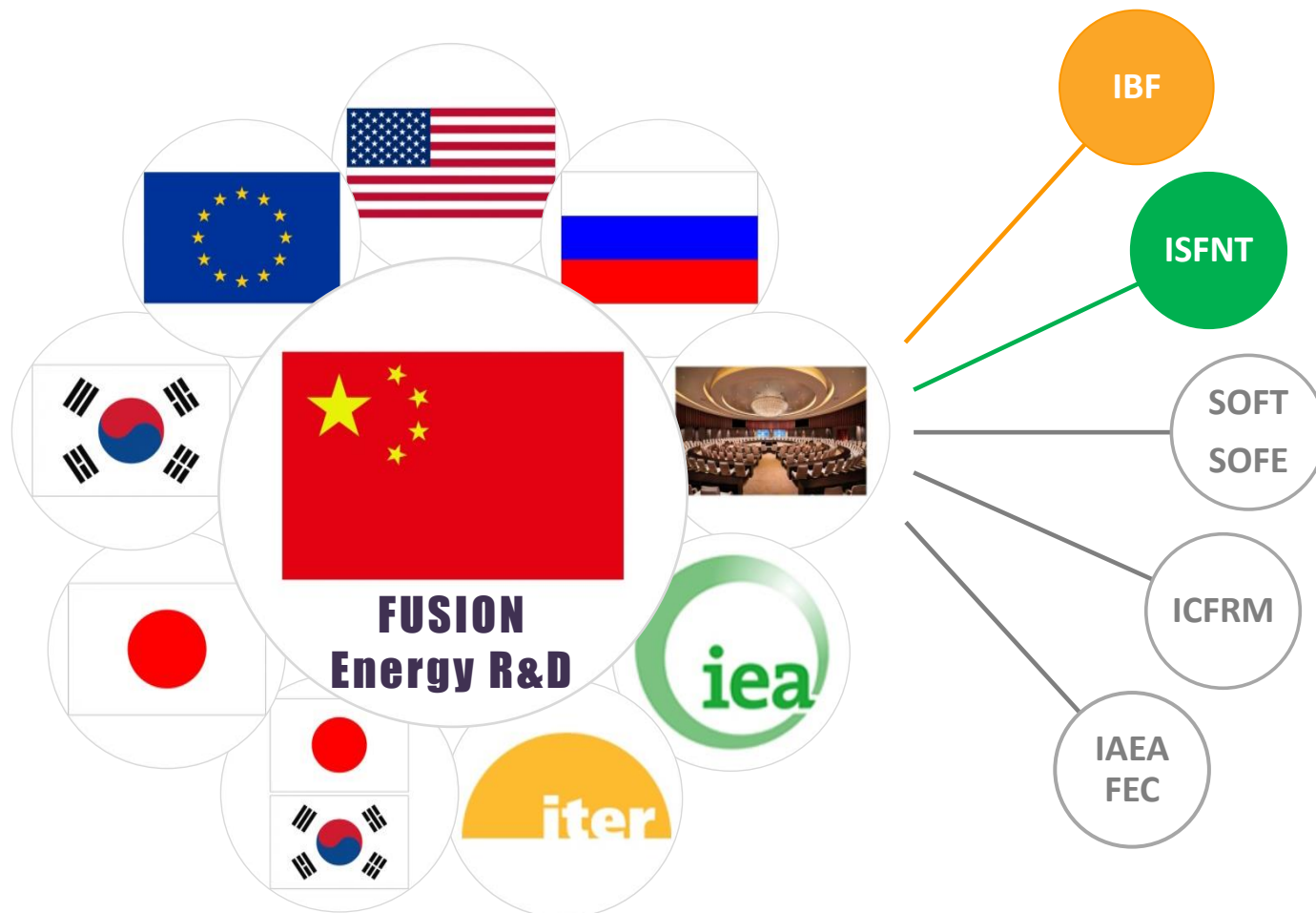
R&D strategy of CFETR



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Bilateral and Multilateral International Cooperation on MCF



China -Japan

- JWG between China and Japan has been held every year since 2007.
- JWG-9 held in July in Lanzhou, China.
- Report on the progress of joint research program in the last fiscal year and proposal of the coming fiscal year.



China-Japan-Korea

- CJK Trilateral ITER workshop has been held since 2014.
- Progress Report of ITER Procurement Activities in Each DA , General Issues and Joint proposal.
- CJK-3 Trilateral meeting was held in June 2016 in Busan, Korea.
- CJK-4 Trilateral meeting to be held on 2 Aug to 4 Aug. 2017 in Yunnan, China.



China - Korea

- JCM between China and Korea has been held every year since 2013.
- Collaborations mainly on six fields. Report on the progress of collaboration activities and proposal for the next year.
- JCM-4 between China and Korea was held in June 2016 in Busan, Korea.
- JCM-5 to be held on 31 July to 1 Aug. 2017 in Yunnan, China.



China - EU

- Under the China-EU Joint Steering Committee on S&T Cooperation and R&D Cooperation in the Peaceful Uses of Nuclear Energy(PUNE).
- Subcommittee on Fusion Energy Research (FU-6) was held in Oct 2016 in Kyoto.
- FU-7 to be held in November in Beijing, China.



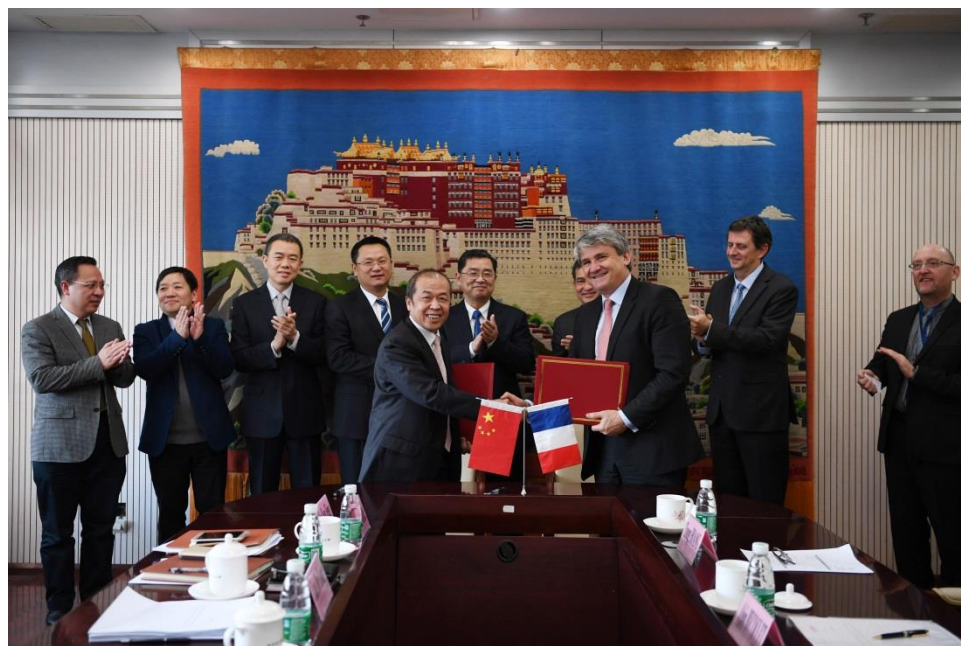
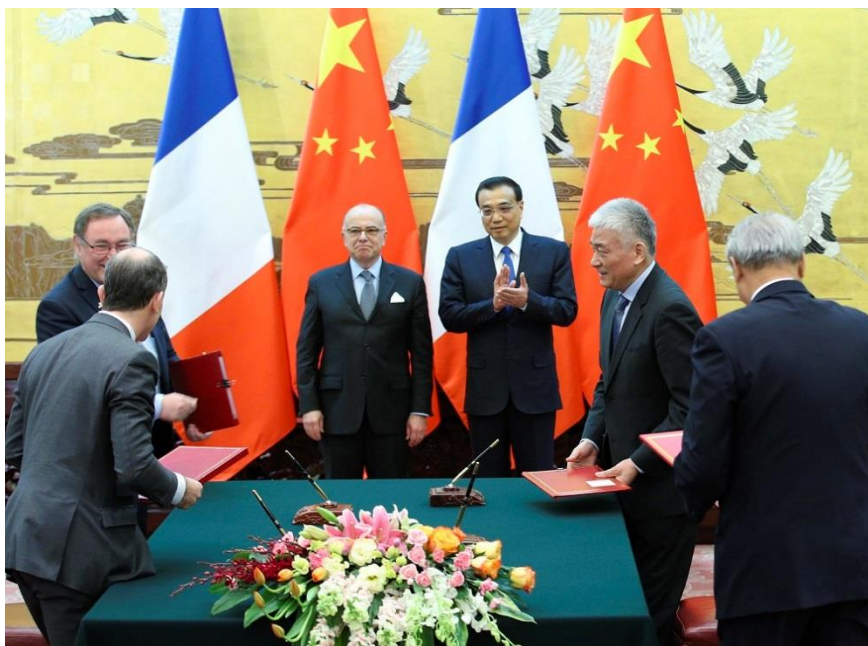
China-US

- Annual bilateral meetings.
- China- US meeting held in July 2016 in DOE, USA.

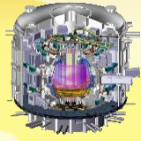


China - France

- Letter of Intent between MOST and CEA was signed in Feb 2017.
- Memorandum of understanding for mutual collaboration for the creation of a joint research center on fusion energy between ITER China and CEA was signed in Feb 2017.



ITER China will have the 10-year Anniversary in November 2017 in Beijing, meanwhile will launch a serial of international meetings on Fusion and ITER.



Thank you!

