

# **Status of China National SFR Program**

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**International Workshop on Prevention and Mitigation of Severe Accidents in  
Sodium-cooled fast Reactors  
12<sup>th</sup>-13<sup>th</sup> June, 2012 in Tsuruga, JAPAN**

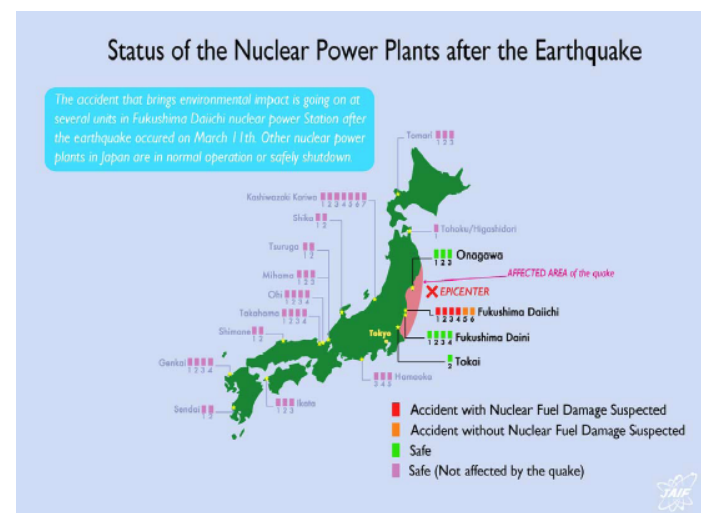
# Current Status of Nuclear Energy in China

## Influence of Fukushima Accident

March 11, the great east Japan earthquake attacked Fukushima NPP. Unite 1-4 had been severely damaged.

March 16, The China Government decided that:

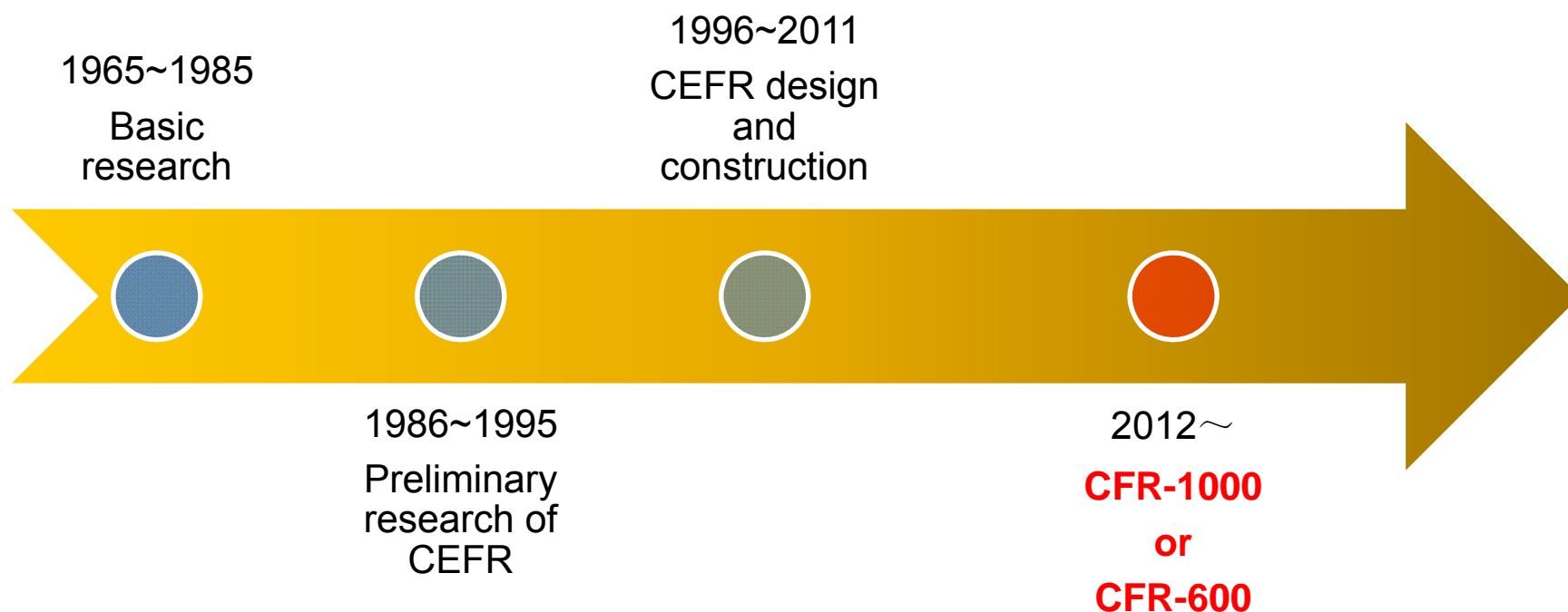
1. Organize a comprehensive safety inspection of nuclear facilities immediately;
2. Strengthen management of the security of existing nuclear facilities;
3. Conduct a thorough review of NPPs under construction with the most advanced standards;
4. Prepare the nuclear security plan immediately and suspend approvals of all of the new NPP projects.



## Latest attitude of China government

- Nuclear energy still be one of the most important selection.
- New technologies with more safety features are encouraged.
- The Atomic Energy Law is in draft.
- The nuclear security plan has been completed.
- The nuclear security inspection finished.

## History of SFR technology of China



R&D Program (1986)

1. CEFR (2010)

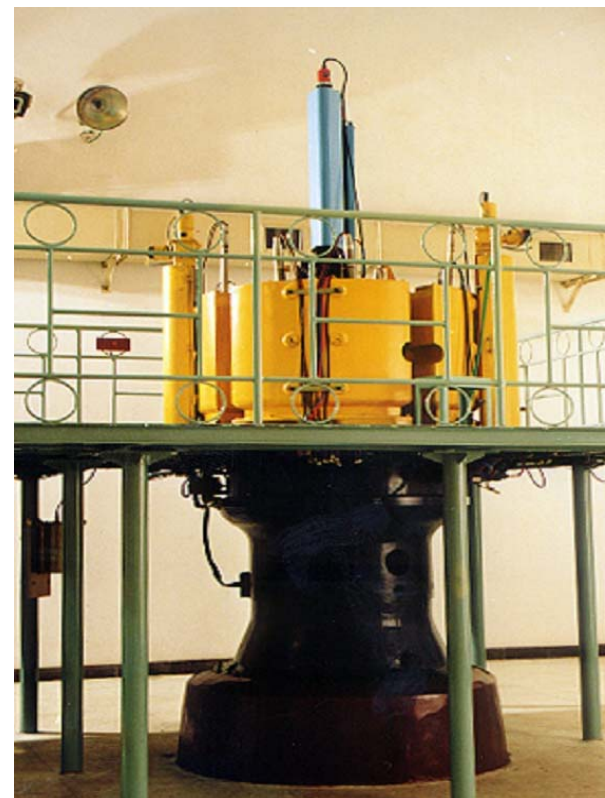
2. CDFR (~2020)

3. CCFR (~2030)

1. 1986, fast technology R&D Project was listed in national program on High-technology development (863 project) by Ministry of Science and Technology( MoST)
2. 1996, CEFR project was approved and in construction by Ministry of Science and Technology( MoST) and CAEA
3. 2006, fast reactor technology was listed in China National middle-long term science and technology development program(2006~2020) by Ministry of Science and Technology( MoST)

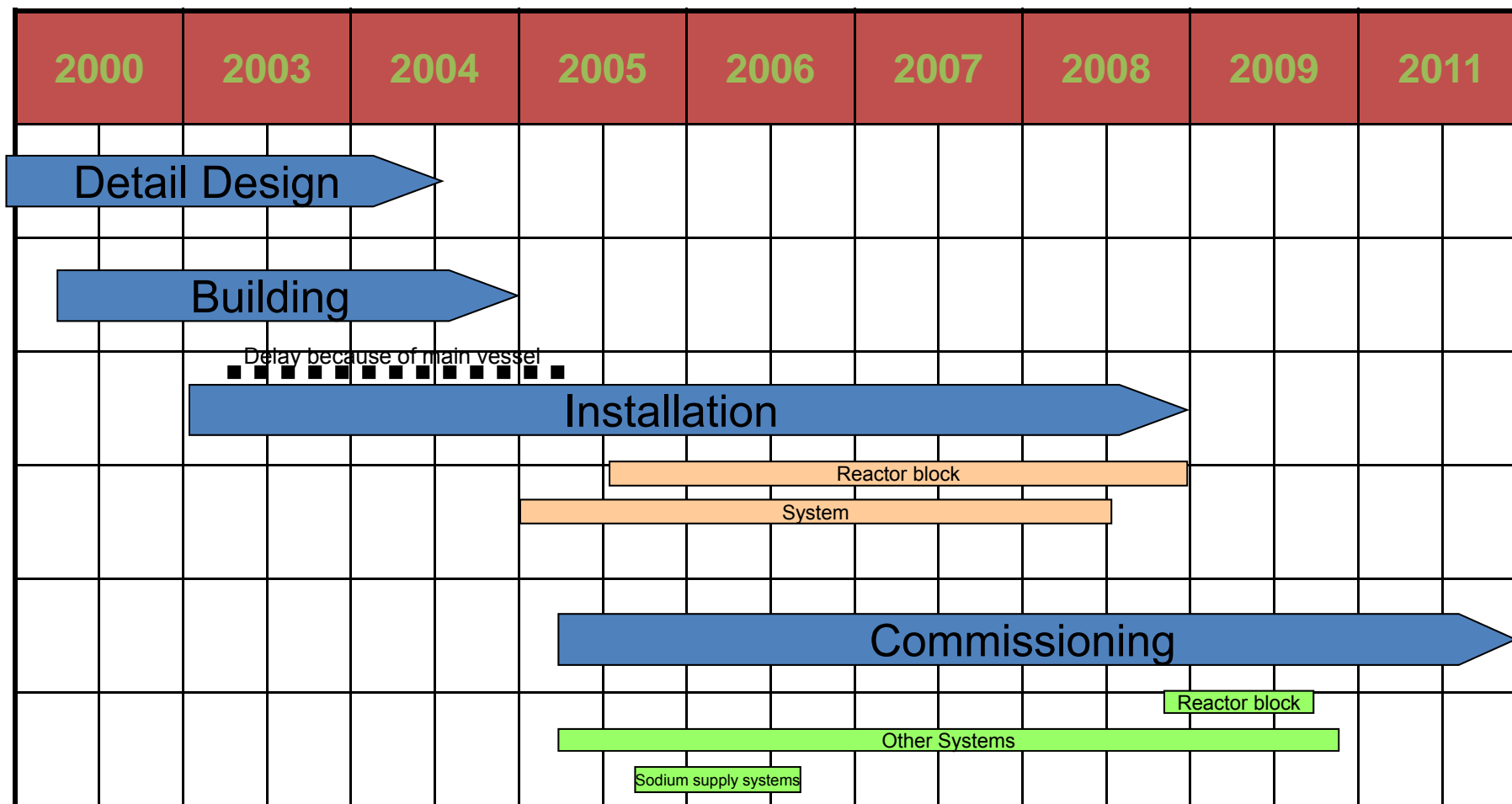
## Main works of basic research

- The research mainly focused on:
  - Reactor scheme selection
  - Neutron physics
  - Thermal Hydraulic and safety
  - Fuel
  - Sub-assembly related technical
  - Sodium technology
  - Structure and material
  - Sodium-water reaction and detection
  - Important safety related components



Dongfeng-VI, Jul.1970

# Project Plan





# Main milestones of CEFR

Preparation of Site



1998.10

FCD



2000.5

Main building finished



2002.8

Reactor block  
installation finished



2008.12

Commissioning of  
Phase A ended



2009.8

First Physical critical



2010.7.21

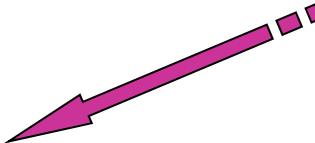
Connect to Grid



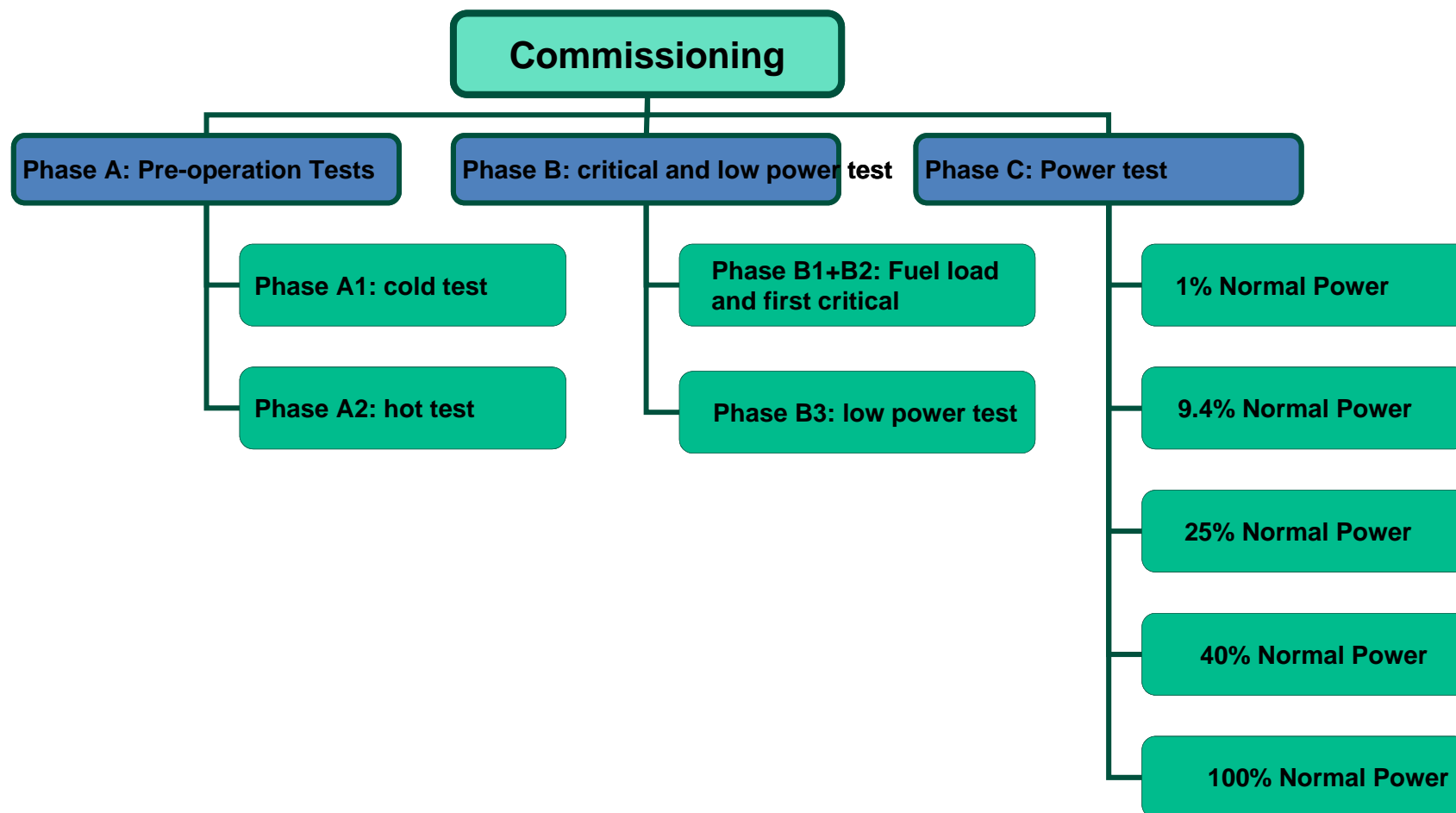
2011.7.21



## China National medium- and long-term program for science and technology development (2006~2020)

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- The program emphasized that the features of future energy should be cheap, efficiently and clean.
  - The Gen-IV nuclear power system, advanced fuel cycle system and fusion technology should be paid more attention.
  - The aim of fast reactor technology is to complete the project of CEFR and master the design, fuel and material technologies.

## Commissioning phases



## Commissioning schedule

**Phase A (cold and hot status tests):**

**2005-2009.9.30**



**Phase B (physical startup):**

**2010.6.5-2010.12.31**



**Phase C (power startup):**

**2011.1.1-2011.7.21**

# Fuel loading



# Radiation detection system test



# Control room test





# Sodium system test





# Physical startup preparation



## Hot cell test



## Main test programs in the CEFR Physical start-up(Phase B)

### 1. Fuel Loading and Criticality

1.1 Fuel Loading and Minimum Mass Criticality

1.2 250°C critical test in the operational loading

1.3 300°C critical test in the operational loading

1.4 Doppler point measurement

### 2. Control Rod Worth Measurement

2.1 Control rod worth preliminary measurement(minimum loading)

2.2 250°C control rod worth measurement in the operational loading

2.3 300°C Control Rod Worth Measurement in the operational loading

### 3. Reactivity Measurement

3.1 Coolant Flow reactivity

3.2 Reactor Pressure reactivity

3.3 Sodium void reactivity Worth

3.4 Displace fuel subassembly reactivity

3.5 temperature Reactivity Effect

### 4. Foil Irradiation

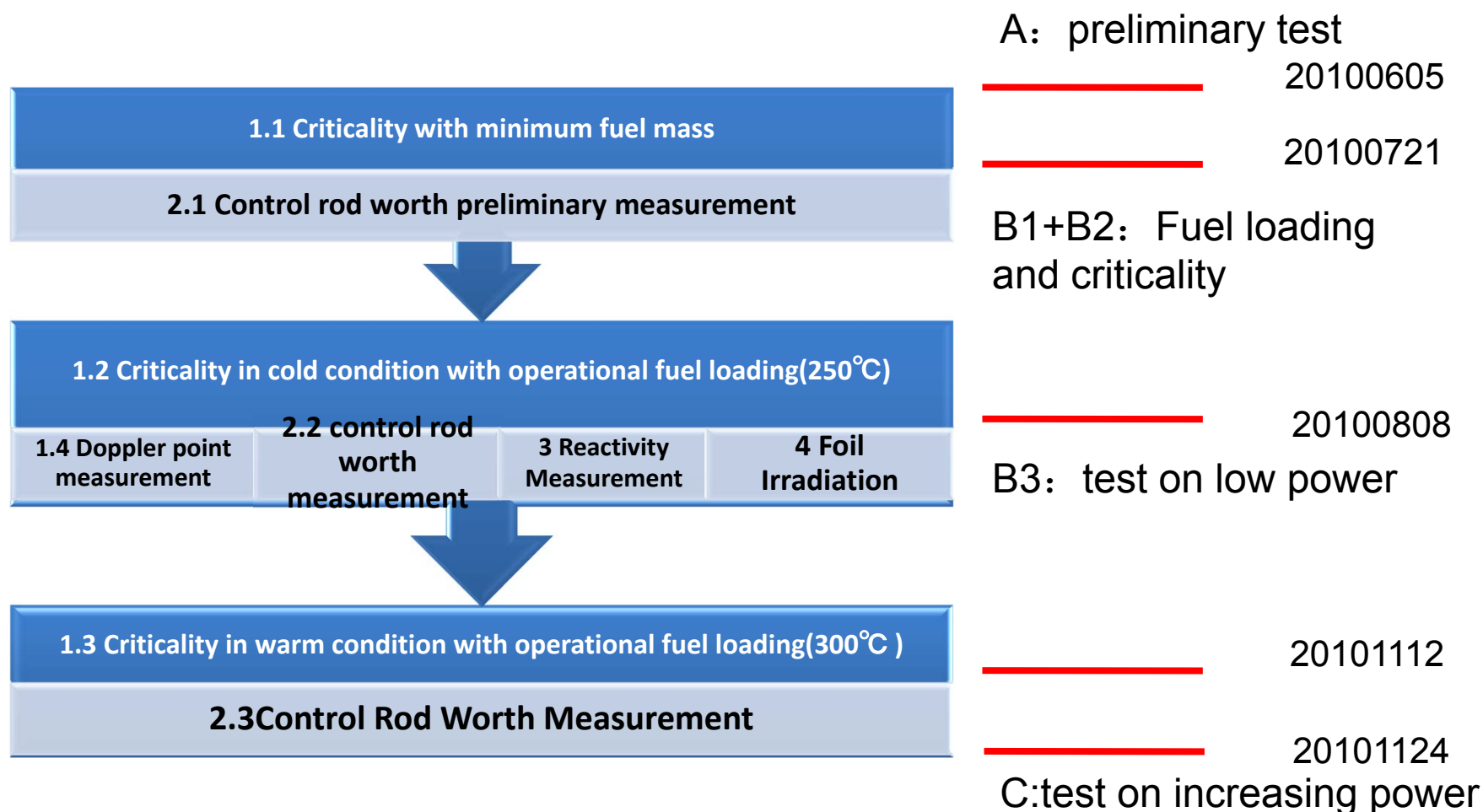
4.1 Nuclear reaction rate distribution measurement

4.2 Cross section ratio measurement

4.3 Neutron spectrum measurement

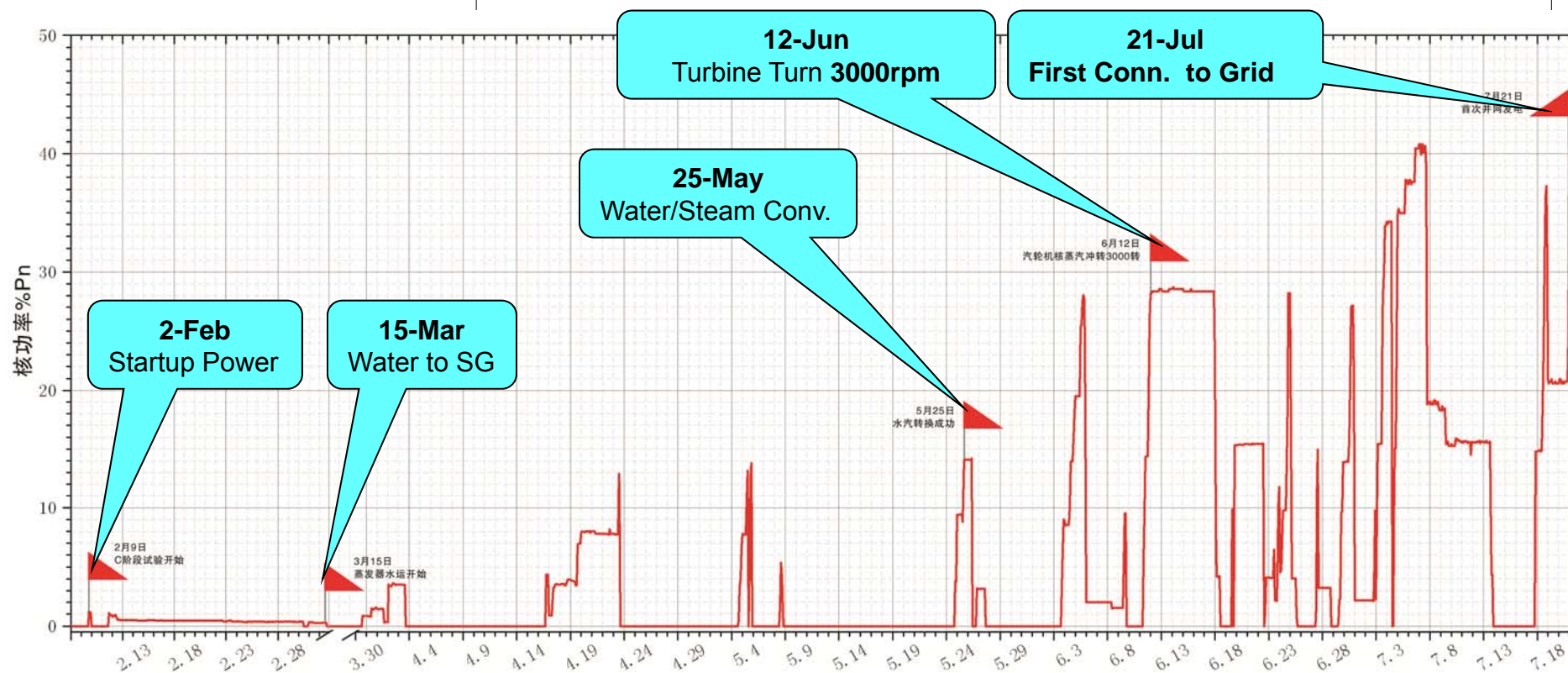
4.4 Absolutely nuclear power measurement

## Test programs Schedule in the CEFR Physical start-up

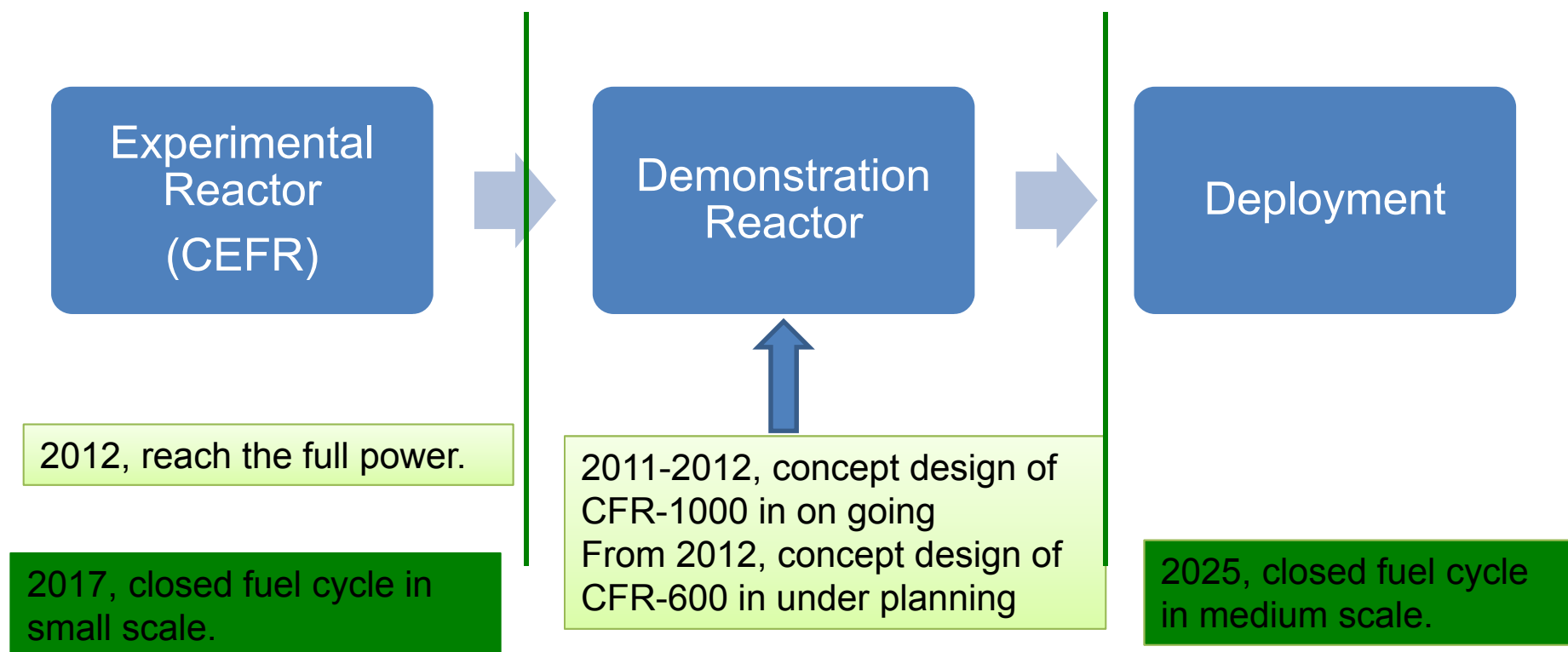




# Nuclear power graph

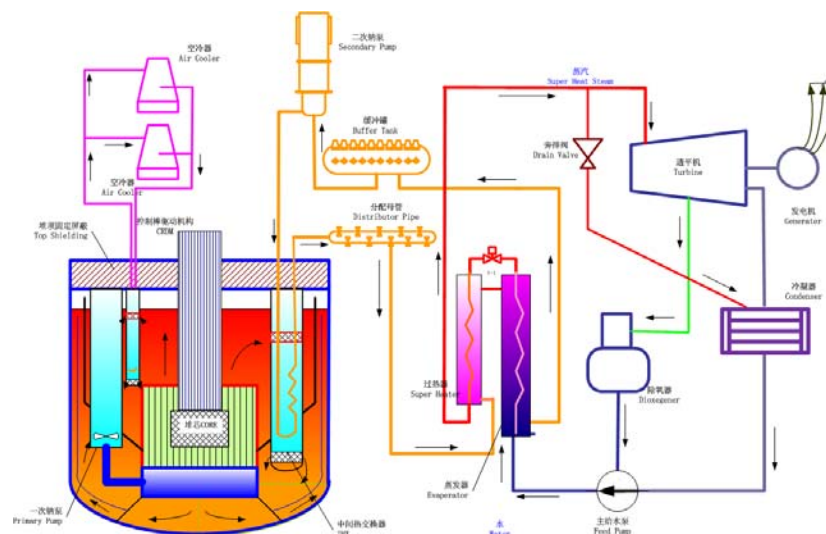


## SFR Program on going and next proposal



# CFR-1000

- 2500MWth, ~1000MWe
- MOX fuel
- $BR \geq 1.2$
- Sodium as coolant
- Na-Na-H<sub>2</sub>O loops with 3 circuits of primary and secondary loop
- One turbine
- Negative feedback
- Confinement
- $CDF < 10^{-6}$
- Life > 40y



CFR-1000 diagram

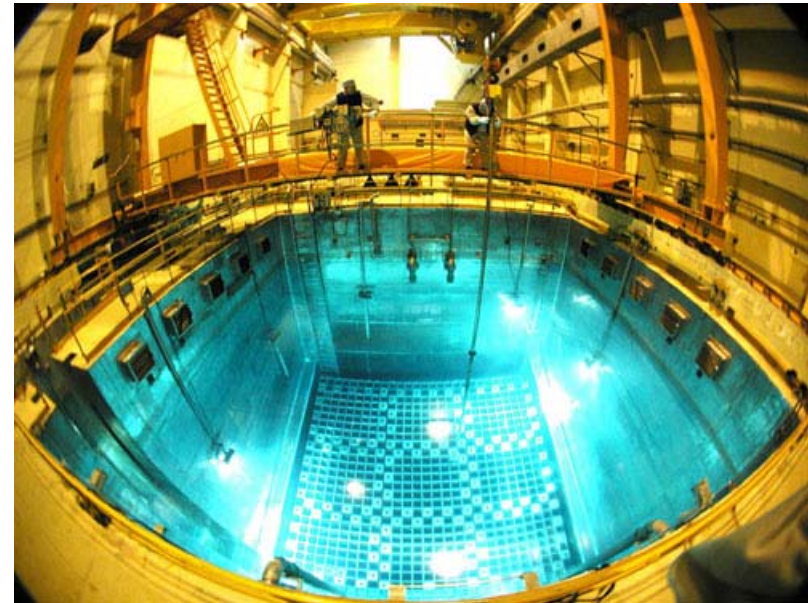


## Site of CFR-1000 (Fujian province of China)



## Spent fuel Reprocessing

- The pilot reprocessing plant with a capacity of 50tHM/a completed successfully the hot test in December 2010.
- An industry scale reprocessing plant with a capacity of about 200tHM/a will be built before 2020.



## Repossessing experimental facility project

- The facility is under testing now.
- It will be put into operation this year.





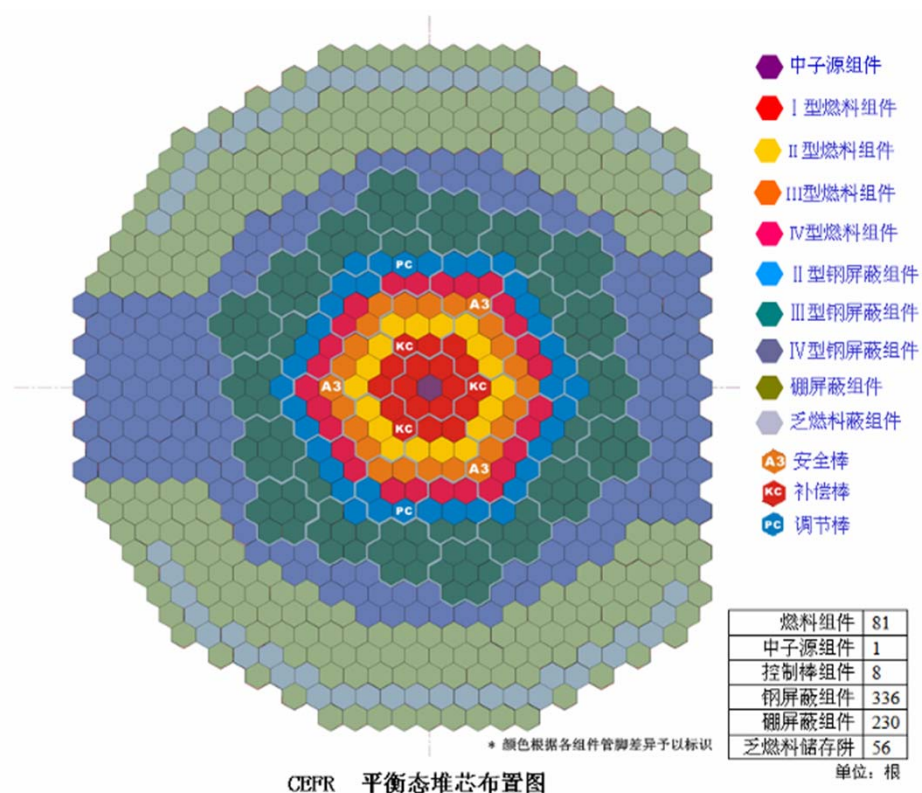
## MOX fuel

- A pilot MOX fuel fabrication line (with a capacity of 500kg/a) is under construction.
- Several research projects about pellet, clad, rod and subassembly were approved.
- The testing rods will be put into CEFR for irradiation before 2017.



## Irradiation facility - CEFR

- Samples can be put into container
- Test fuel pin could be loaded into test subassembly
- There are two testing holes in the rotating plug.



## Irradiation facility - CARR

Power: 60MW

Max. neutron flux:  $10^{14}$





***CEFR**, the coming platform for R&D international cooperation.*

中国实验快堆，建设中的快堆技术研发平台





The achievement, is the beginning.



Thanks for your attention!