

Current status of fuel R&D

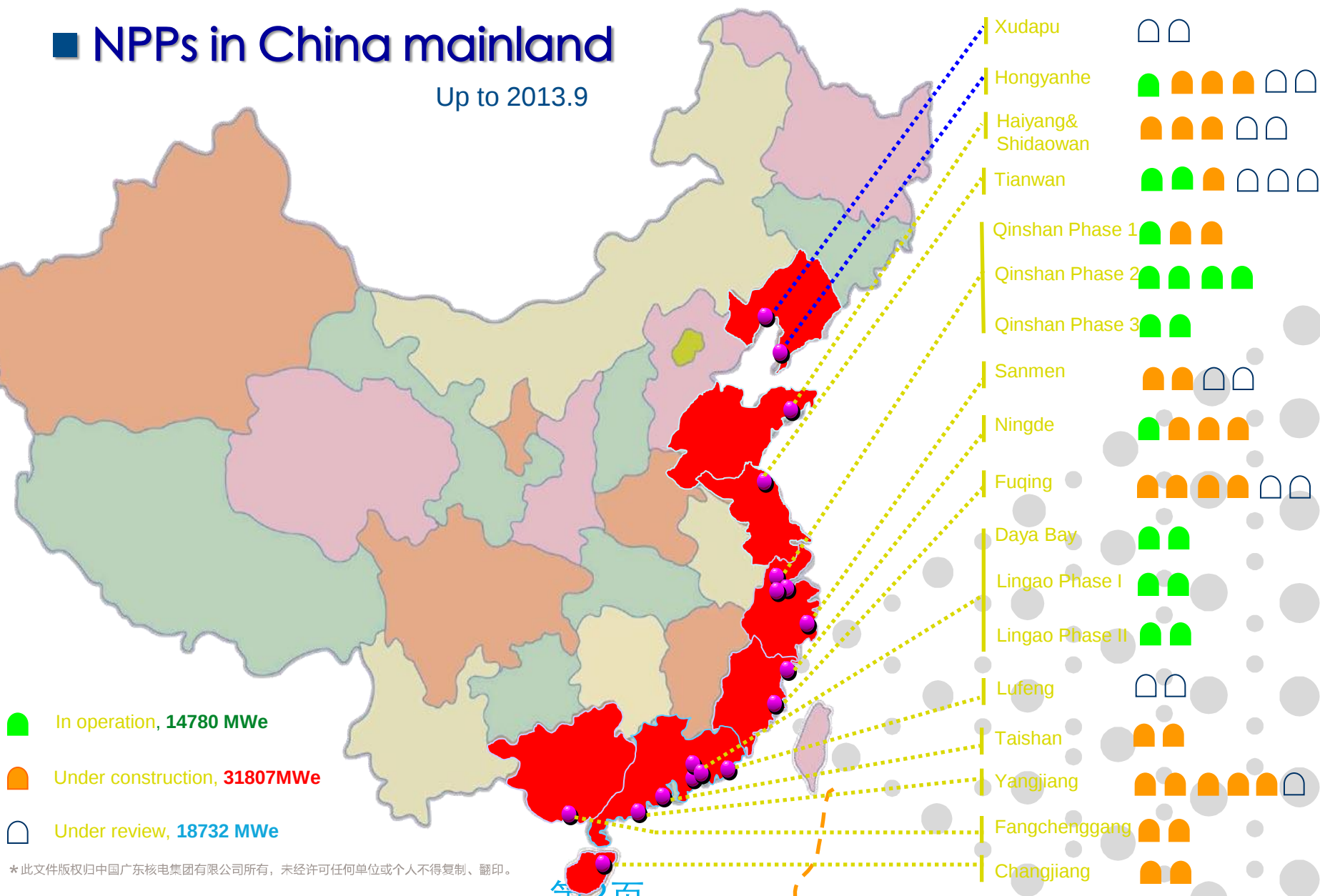
Nuclear Fuel R&D Center
China General Nuclear Power Corporation

OECD-NEA Meeting on Increased Accident Tolerance
of Fuels for LWRs, Paris, France
28-29 October 2013

NPPs in China mainland

Up to 2013.9

- In operation, 14780 MWe
- Under construction, 31807 MWe
- Under review, 18732 MWe



About China General Nuclear — we are a supplier and service deliverer in the clean energy sector

- GNPS
- start from a high level
- construction with loans, repayment by electricity sales, operation through joint venture



first large commercial nuclear power station in mainland China

- LNPS Phase II, HNPS, NNPS, YNPS, FNPS, CPR1000
- TNPS (3G technology — EPR)
- developing renewable energies such as wind power, hydropower and solar energy etc.



- realizing “four self-reliance” capabilities

Pioneering period
1979-1994

Development period
1995-2004

Second pioneering period
2005-2011

Post-Fukushima period
2012 —

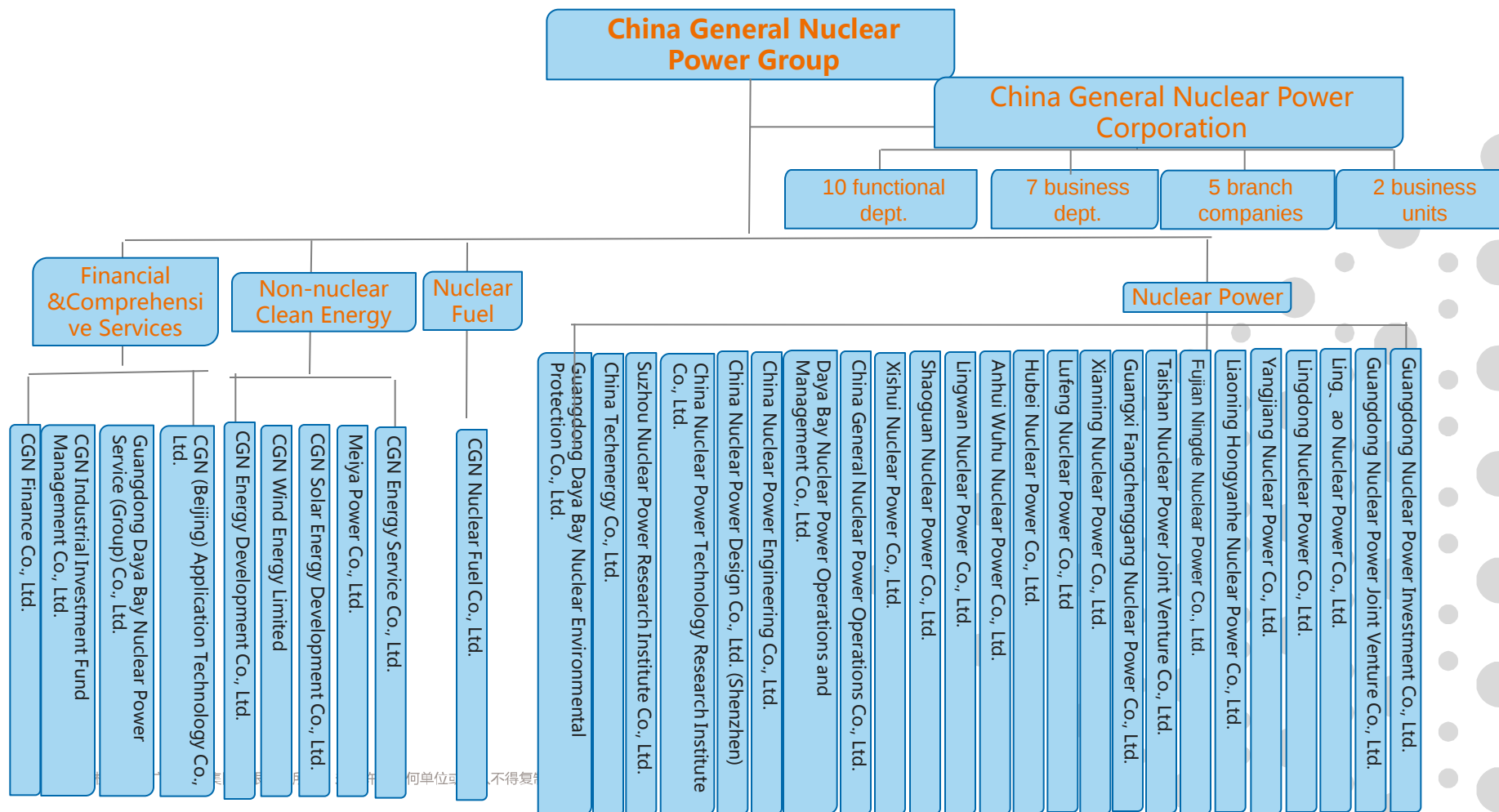
- LNPS Phase I
- self-reliant development of nuclear power per international standards



- developing proprietary advanced PWR technology — ACPR1000⁺
- building world's first-class clean energy corporation

CGN Organization

- CGN's business covers the development of nuclear power, wind power, hydropower, solar energy, energy conservation and nuclear technology and so forth.
- CGN has 34 main subsidiaries and affiliates



Nuclear Fuel Center

National Energy Administration

National Energy R&D Center of Advanced Nuclear Fuel

Nuclear Fuel R&D Center of CGN

Academic Committee

Dep of SD

Dep of SM

Dep of PA
and SD

Dep of EV

Dep of PT

Dep of I&T

Dep of GT

SD: Structure design

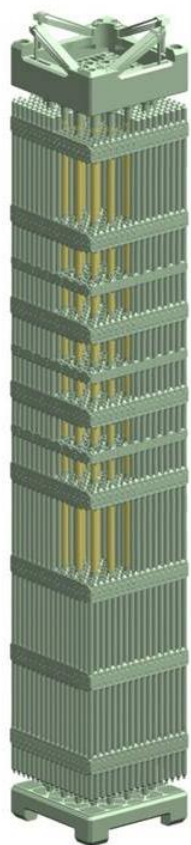
SM: Structure Material Research

PA and SD: Performance analysis and software development

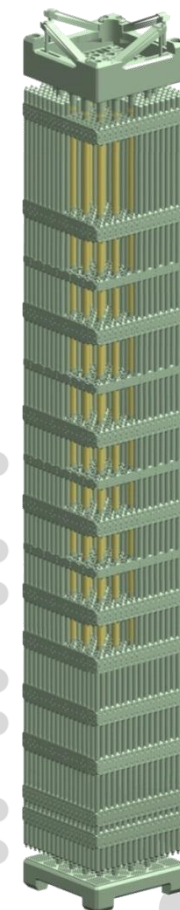
EV: Experiment Verification **PT: Physics & Thermal**

I&T: Irradiation and test **GT: General Technology Research**

CGN strategy project- STEP fuel R&D

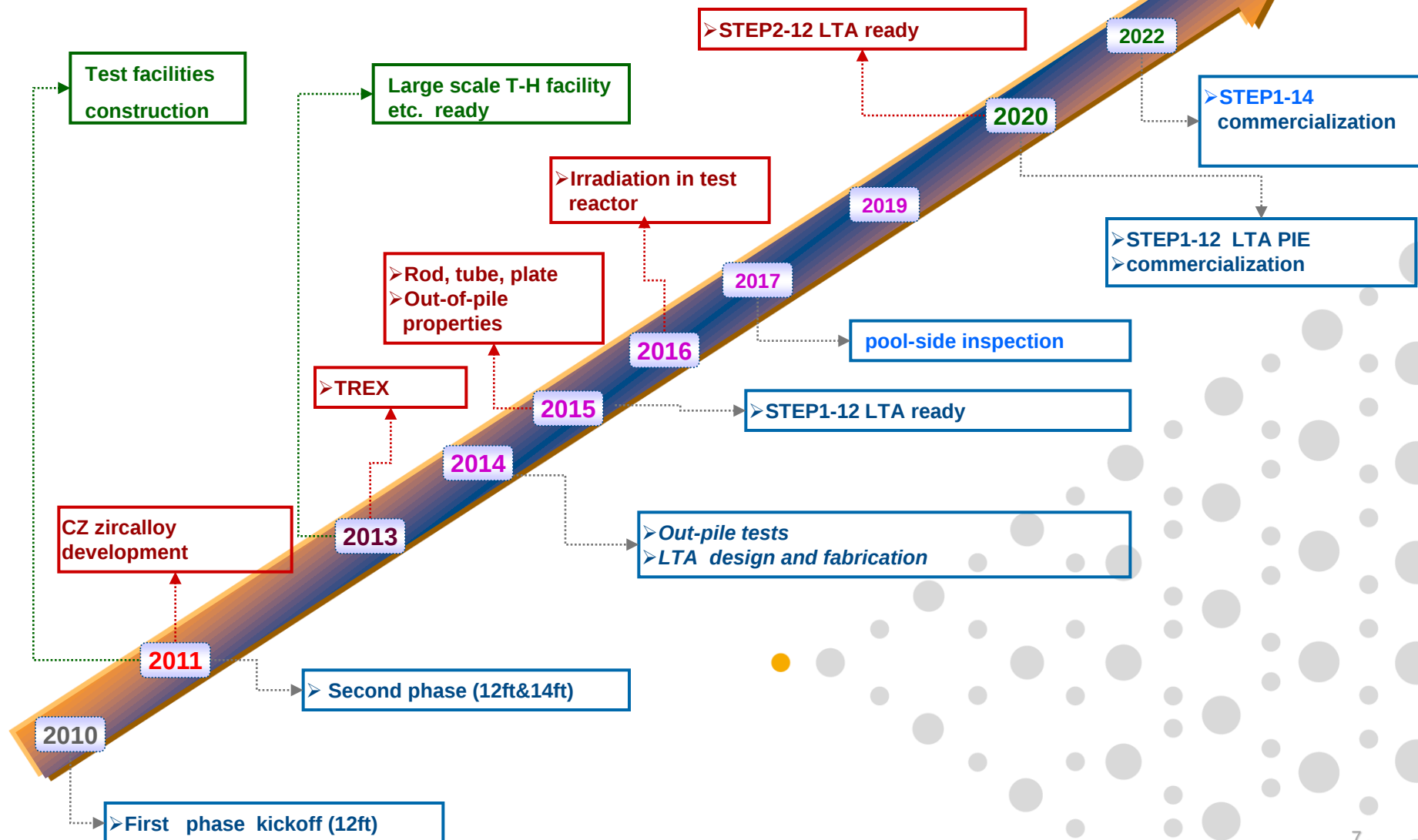


STEP -12



STEP-14

CGN strategy project- STEP fuel R&D



CGN strategy project- STEP fuel R&D

■ Modelling and software development

- Fuel rod performance codes
- Fuel assembly codes
- Associated assemblies codes



**LINUX 5.6 REDHAT
(64位服务器版)**

曙光服务器

- C, C++语言
- 图形界面
- 网络终端计算作业



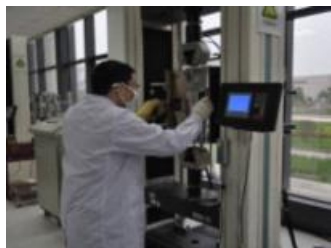
CGN strategy project- STEP fuel R&D

■ New zircaloy CZ development

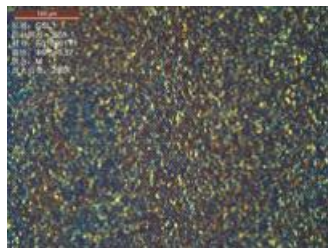
- Alloy Design and screen tests
- Manufacture process development, test tubes\
- Out-of-pile tests (undergoing)
- Research reactor irradiation (planning)



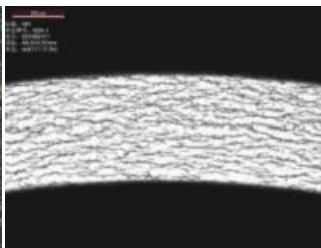
4.5m ϕ 9.5 $\times$ 0.57mm



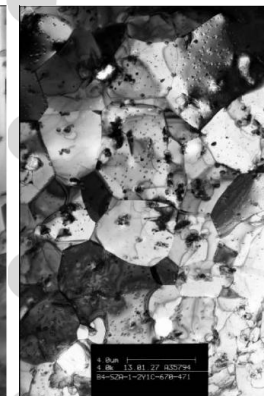
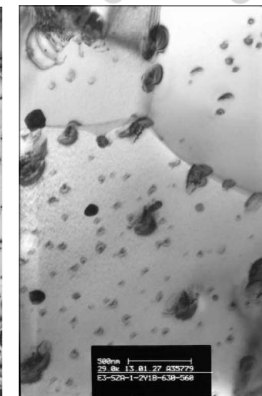
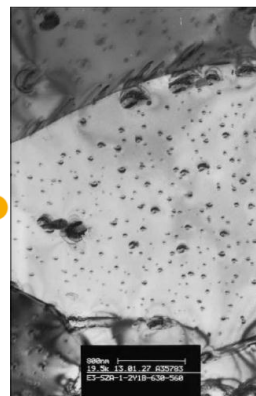
常规力学性能测试



晶粒度评级

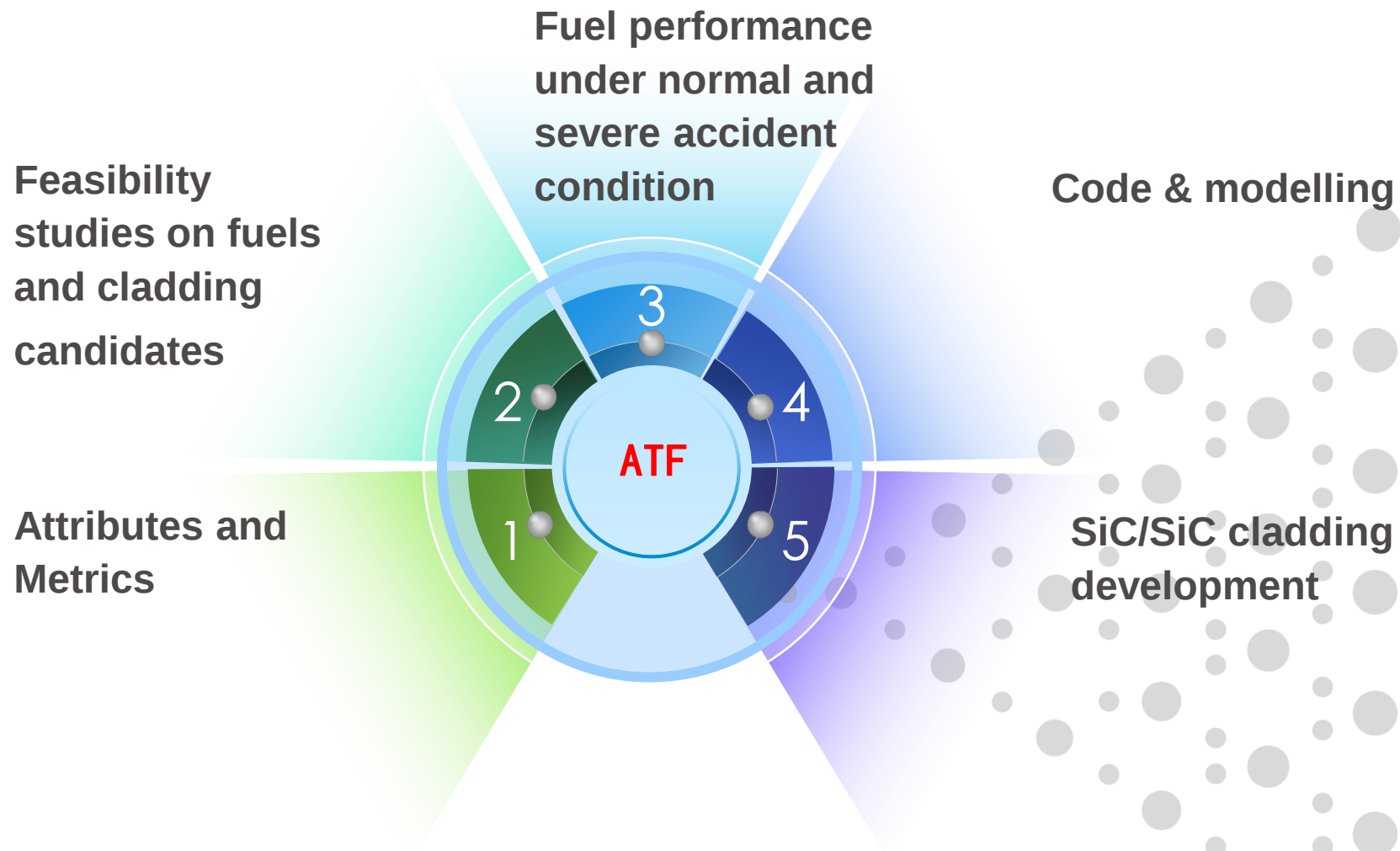


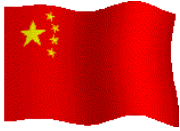
氢化物取向测定



微观组织的TEM观察分析

CGN S&T Innovative Program – ATF technology research (Proposal submitted)





U.S.-China Civil Nuclear Energy Cooperation Action Plan 6th Joint Technical working groups meeting

Steering Committee Co-Chairs

U.S. – Peter B. Lyons (DOE)

China – Yongsheng Xu 许永盛 / Weiping Hao 郝卫平 (NEA)

Action Plan Co-Chairs

U.S. – Stephen Kung (DOE)

China – Jian Rong 荣健 (NEA)

Coordination Support

– R. Beatty (ORNL) / C. Brown (DOE)

– Rui Zhang 张睿 (NEA)

Fuels & Materials Development

– Jon Carmack (INL)
– Chen Huang, 黄晨 (CIAE)

Fast Reactor Technologies

– Chris Grandy (ANL)
– Hong Yu, 喻宏 (CIAE)

Separation Technologies

– Jim Laidler (ANL) / **Bob Jubin (ORNL)**
– Weifang Zheng, 郑卫芳 (CIAE)

Safeguards & Physical Protection

– Ike Therios (ANL/NNSA)
– Daming Liu, 刘大鸣 (CIAE)

Spent Fuel Storage and Repository Sciences

– P. Swift (SNL) / W. Boyle (DOE)
– Ju Wang, 王駒 (BRIUG)

High Temperature Gas Reactor Technologies

– David Petti (INL)
– Yuliang Sun, 孙玉良 (THU)

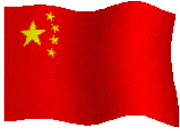
Nuclear Safety Enhancement

– Kemal Pasamehmetoglu (INL)
– **Wenqi Zhang, 张文其 (CNNC)**
– **Tong Liu, 刘彤 (CGNPC)**

ANL: Argonne National Laboratory
CIAE: China Institute of Atomic Energy
INL: Idaho National Laboratory
NEA: China National Energy Administration

BRIUG: Beijing Research Institute of Uranium Geology
CNNC: China National Nuclear Corporation
ORNL: Oak Ridge National Laboratory
SNL: Sandia National Laboratories

CGNPC: China General Nuclear Power Co.
DOE: U.S. Department of Energy
NNSA: U.S. National Nuclear Security Administration
THU: Tsinghua University



U.S.-China Civil Nuclear Energy Cooperation Action Plan 6th Joint Technical working groups meeting



Nuclear Safety Enhancement Working Group

U.S. Co-Chairs: ***Kemal Pasamehmetoglu*** (U.S.)

Jon Carmack (U.S.)

China Co-Chairs: ***Tong Liu*** (China)

And **Zhang Wenqi** (China)

Task 1 – Accident Tolerant Fuel Attributes and Metrics

Task 2 – ATF R&D, Qualification, and Licensing Infrastructure

Task 3 – Advanced Analysis and Methods

Task 4 – Innovative ATF Assessment

Task 1 – Accident Tolerant Fuel Attributes and Metrics

- Purpose – communicate and exchange information on the attributes and metrics used for ATF.
- Deliverables –
 - ATF Attributes and Metrics report – U.S. Fall 2013
 - Comment on ATF Attributes and Metrics report – China – Spring 2014.
- Future Activities
 - Participate in international ATF coordination meetings arranged through international nuclear leadership organizations (i.e. NEA and IAEA).

Task 2 - ATF R&D, Qualification, and Licensing Infrastructure

- Purpose – Establish coordination of ATF research, development, qualification, and licensing infrastructure needs and resources.
- Deliverables –
 - Information exchange on resource development and planning – U.S. and China – Spring 2014
 - Site specific visits and tours of ATF infrastructure – U.S. and China (for example; INL and ORNL, CGN and CNNC) – Summer/Fall of 2014
- Future Activities

Task 3 -Advanced Analysis and Methods

- Purpose – communicate national strategies for development of ATF analysis needed for qualification and licensing
- Deliverables –
 - Provide overview of advanced fuel performance and simulation in U.S. (U.S. Summer 2013)
 - Provide overview of advanced fuel performance and simulation in China (China Summer 2013)
 - Participate in the IAEA sponsored meeting “Technical Meeting on Modeling of Water-Cooled Fuel Including Design-Basis and Severe Accidents” in Chengdu, China – October 28-Nov 1, 2013.
- Future Activities
 - Identify benchmark fuel performance analysis for comparison
 - Conduct comparison fuel performance analysis of common ATF system

Task 4 - Innovative ATF Assessment

- Purpose – Communicate advanced and next stage accident tolerant fuel concepts having longer term deployment possibilities
- Deliverables –
 - To be determined
- Future Activities
 - Identify a forum and venue (example, TOPFUEL, GLOBAL international meetings) for coordinated technical exchanges (i.e. special sessions).

Thank you for your attention

