

International Workshop on US-ROK Nuclear Cooperation,  
Jeju International Convention Center,  
May 17, 2017, Republic of Korea

# Current Status and Prospects of U.S.-ROK Nuclear Cooperation

May 17, 2017  
Lee, Kwang-Seok

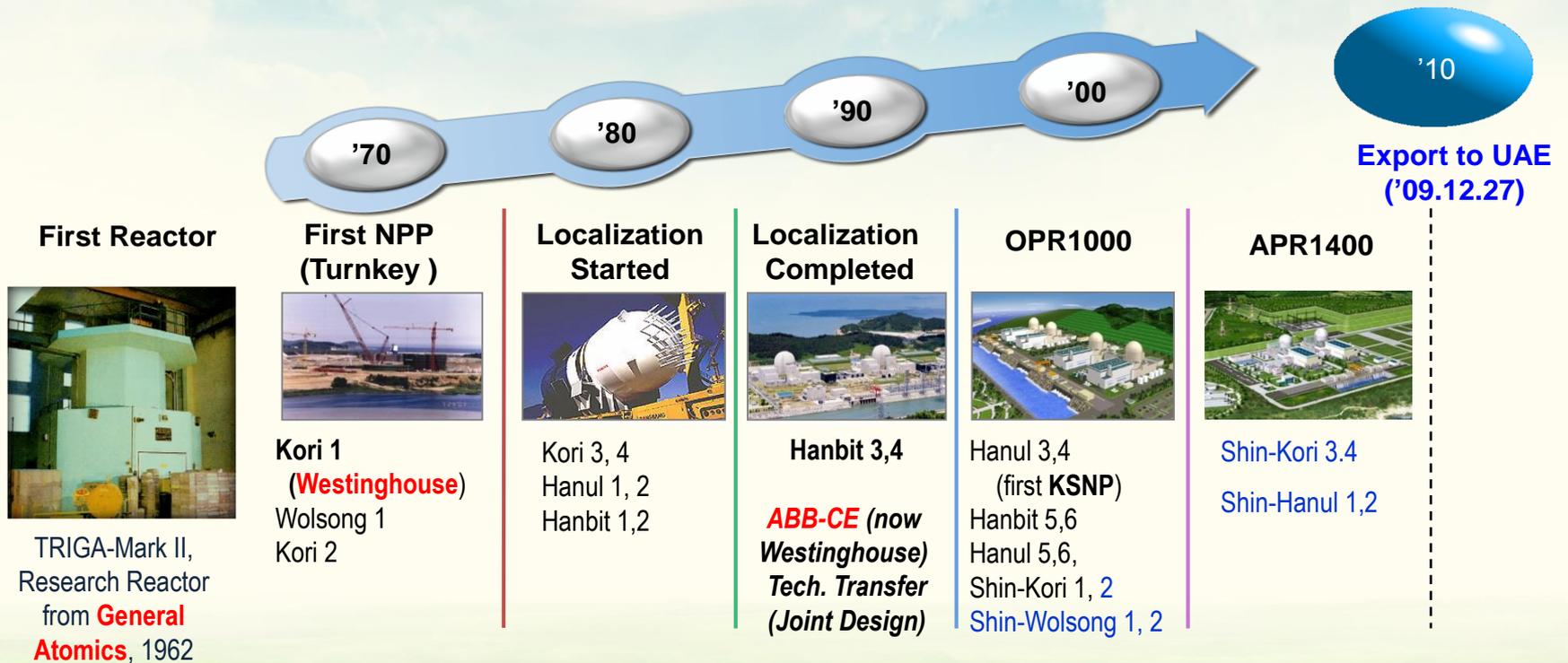


Korea Atomic Energy  
Research Institute



# Korean Nuclear Development with US Cooperation

Last 60 years' US-ROK nuclear cooperation has played a key role for the successful development of nuclear energy in Korea.



**JSCNEC has been a basic mechanism and central forum for governmental to governmental nuclear energy cooperation.**

- ◆ **Established in 1976 as JSCNOET (Joint Standing Committee on Nuclear and Other Energy Technologies)**
  - Evolved to JSCNEC (Joint Standing Committee on Nuclear Energy Cooperation) in mid-1990's
- ◆ **Covering Wide Spectrum of Nuclear Energy Fields**
  - Nuclear energy policy, Nuclear R&D, Nuclear safety, Safeguards, Emergency preparedness, Nuclear fuel cycles, etc.
- ◆ **Annual Meeting in the U.S. and in the ROK alternately**
  - 35<sup>th</sup> Meeting held on October 2016 in Seoul

# Evolution of the Cooperation Relationship

The US-ROK nuclear relationship has been evolved from one-way assistance to both-way partnership.

- **US → ROK**

- Uranium conversion and enrichment services
- NPP components (RCP, MMIS, RVI, ...) from Westinghouse
- Pumps and valves through international bidding
- Westinghouse in the KEPCO consortium for UAE NPP's

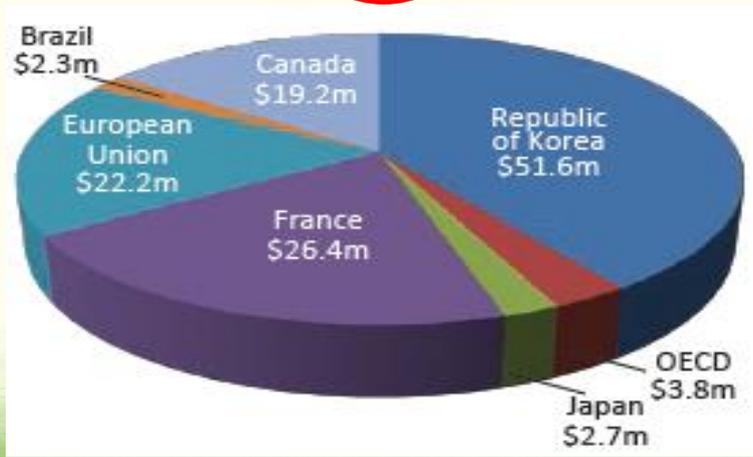
- **ROK → US**

- NPP components (reactor vessels, steam generators, condensers, ...) for AP1000 in the US and China from Korean industry (Doosan, ..)
- Repairing Palo Verde NPP (KEPCO KPS)
- Design work and technical consulting (KEPCO E&C)

**Collaboration for the development of advanced nuclear technologies: Gen-IV Systems, Fuel Cycles, SFR, Safeguards, ....**

# Cooperation for Advanced Technologies

The US and Korea have been cooperating for developing advanced nuclear technologies through bilateral and multilateral mechanisms.



Funding since I-NERI inception (2013 I-NERI Report, US)

VHTR	●	●	●	●	●	●	●	●	●
GFR		●	●	●		●			
SFR		●	●	●	●		●	●	
SCWR	●	●		●					
LFR		●		●					
MSR		●	●						

# Mutually Beneficial Industrial Cooperation

**Nuclear cooperation between the two countries brings mutual technical, commercial and even political benefits to both countries.**



Installation of the Barakah-1 nuclear reactor



U.S. NRC commissioner's visit to the Barakah site

- Westinghouse and other U.S. companies are now expected to earn more than \$2 billion in the UAE project.
- The U.S. Ex-Im Bank estimated that the UAE project is supporting approximately 5,000 American jobs across 17 states.

# Cooperation on Fuel Cycle Technologies

The US and Korea have been cooperating also for developing nuclear fuel cycle technologies.

## ◆ DUPIC

- '91 Launched DUPIC feasibility study (Korea-Canada-US Joint Program)
- '93 Started technical verification program of DUPIC Concept
- '98 Completed installation of DUPIC Fuel Development Facility (DFDF) at KAERI and Facility Attachment (FA) of IAEA
- '99 Joint Determination with the US for using US-origin spent fuel at DFDF



## ◆ Pyroprocessing

- '02 Work For Others (WFO) on pyroprocessing safeguards
- '03 Started I-NERI and Permanent Coordinating Group (PCG) program with the US on pyroprocessing technologies
- '06 1st ROK-US Nuclear Fuel Cycle Forum and WFO project
- '07 Completed installation of Advanced spent fuel Conditioning Process Facility (ACPF) and FA
- '11 Joint Fuel Cycle Study (JFCS)

# Joint Fuel Cycle Study (JFCS)

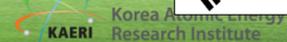
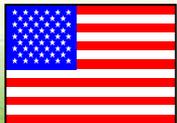
Korea and the U.S. launched the Joint Fuel Cycle Study in 2011 for investigating jointly further the electrochemical recycling technology.

## ◆ Working Groups

- Electrochemical Recycling
- Safeguards and Security

## ◆ Progress of JFCS

- '11.04 : 1<sup>st</sup> Steering Committee
- '11.07 : Phase I ('11~'12)
- '12.12 : Confirmed technical feasibility on Lab-scale basis
- '13.07 : Phase II-A ('13~'14)
- '15.01 ~ : Phase II-B ('15~'17)



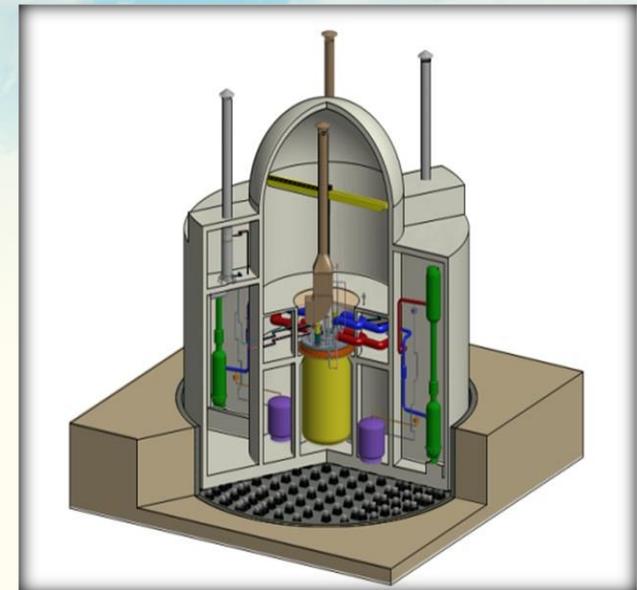
# Collaboration on SFR (KAERI-ANL)

Since 2012, KAERI and ANL have been collaborating for the development of Prototype Gen-IV SFR.



*KAERI-ANL MOU Signing Ceremony (2014.8)*

■ “The technical cooperation between KAERI and Argonne plays a critical role in advancing cutting-edge technologies in nuclear energy,” said Argonne Director Peter Littlewood.



**PGSFR Schematic**

- **Prototype Generation IV SFR (PGSFR)**
  - 400 MWt, 150 MWe capacity
  - LEU-Zr Metallic fuel
  - Licensing approval: 2020

# Variety of Collaborations

**Korea and the U.S. have been in collaboration  
in variety of other areas.**

- ◆ **Permanent Coordinating Group (PCG) since 1994**
- ◆ **NRC-NSSC Steering Committee Meeting (SCM) since 2015**
- ◆ **APR1400 NRC DC**
  - Full certification review of APR1400 by US NRC from March, 2015
- ◆ **Minimization of the Use of HEU**
  - Development of high density LEU-Mo fuel for the conversion of research reactors from HEU fuel to LEU



**U.S. NRC**  
United States Nuclear Regulatory Commission  
*Protecting People and the Environment*

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Office of Public Affairs, Headquarters  
Washington, DC, 20555-0001  
www.nrc.gov • opa.resource@nrc.gov

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CONTACT: Scott Burnell, 301-415-8200

March 4, 2015

**NRC To Begin Full Certification Review of APR1400 Reactor**

The Nuclear Regulatory Commission has [docketed for review](#) Korea Electric Power Corp. and Korea Hydro and Nuclear Power's application to certify the APR1400 reactor design for use in the United States.



# Revision of US-ROK 123 Agreement

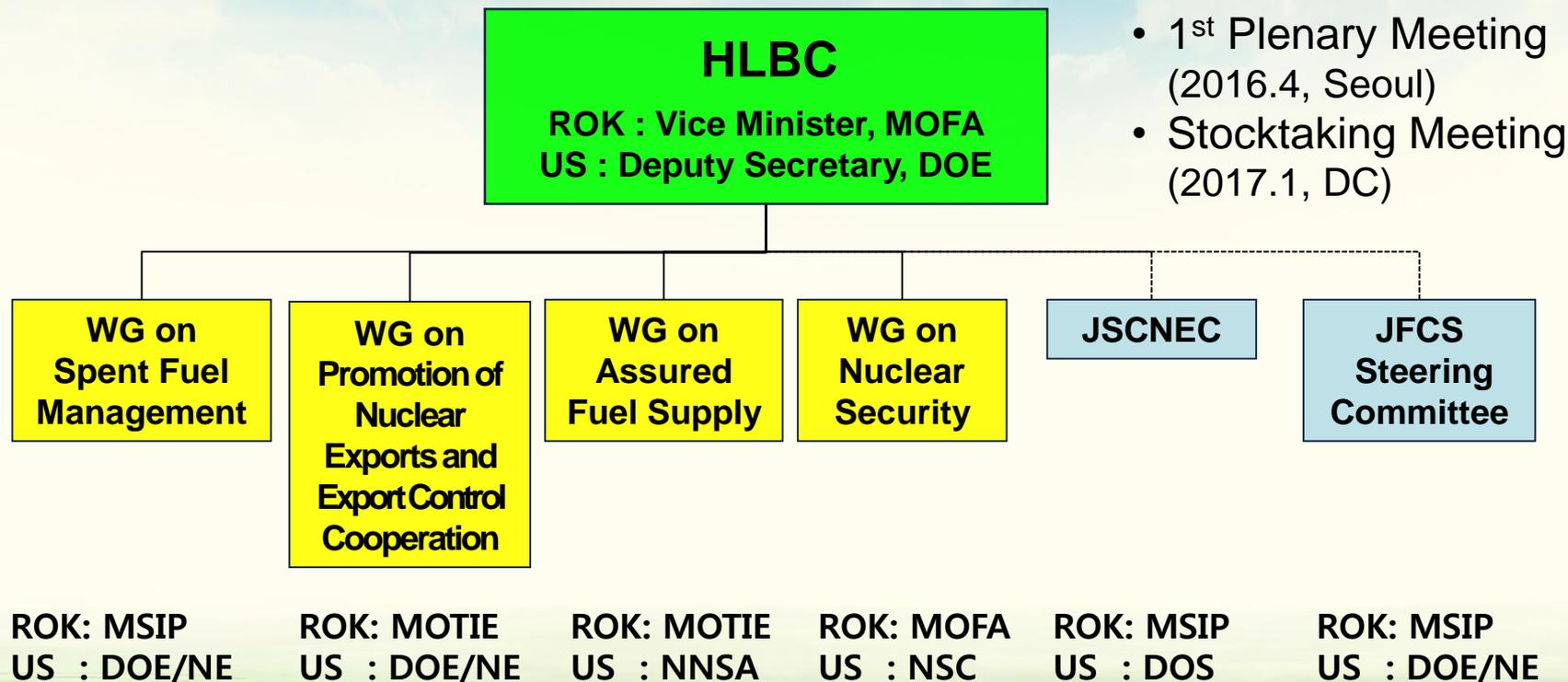
The new agreement that entered into force in 2015 will serve as a new framework to realize the common vision of two countries.

- ◆ **Based on Mutual Respect for the Other's Needs and Programs**
- ◆ **Encouraging Strategic Partnership**
  - Promotion of peaceful uses of nuclear energy and nuclear trade
  - Ensuring safety, safeguards and security
- ◆ **Incorporating Mature Form of Collaboration Based on Mutual Trust**
- ◆ **Facilitating Consent Arrangements on a Long-term, Predictable and Reliable Basis**



# High-Level Bilateral Commission (HLBC)

HLBC facilitates strategic cooperation and dialogue regarding areas of mutual interest including the civil nuclear fuel cycle.



# Common Vision

**Korea and the U.S. share common vision of nuclear energy based on mutual understanding and trust as global strategic partners.**

- ◆ **Peaceful Uses of Nuclear Energy to Address Climate Change and Energy Security**
- ◆ **Global Solution to Long-term Spent Fuel Management**
- ◆ **Ensuring Nuclear Safety, Safeguards and Security**
- ◆ **Leading Cutting-edge Nuclear Technologies**
- ◆ **Strategic Collaboration for Mutual Benefits in Nuclear R&D and Business Areas**

# Challenges in Nuclear Energy

The US and Korea are facing their own nuclear energy challenges that they have not experienced before.

- **U.S.**

- Losing competitiveness of nuclear power in the U.S.
- Declining US nuclear industry
- Losing global competitive edge of nuclear technology
- Losing global influence to Russia and China (safety, security, nonproliferation standards)
- Pending spent fuel management issues

- **ROK**

- Elevating public concerns on nuclear safety and spent fuel management
- “Out of Nuclear” movements in Korea
- Reorganizing energy mix while ensuring energy security and air quality
- Pending further nuclear export

# Strengths in Nuclear Energy

The US and Korea have their own strengths in nuclear energy that could complement each other.

- **U.S.**

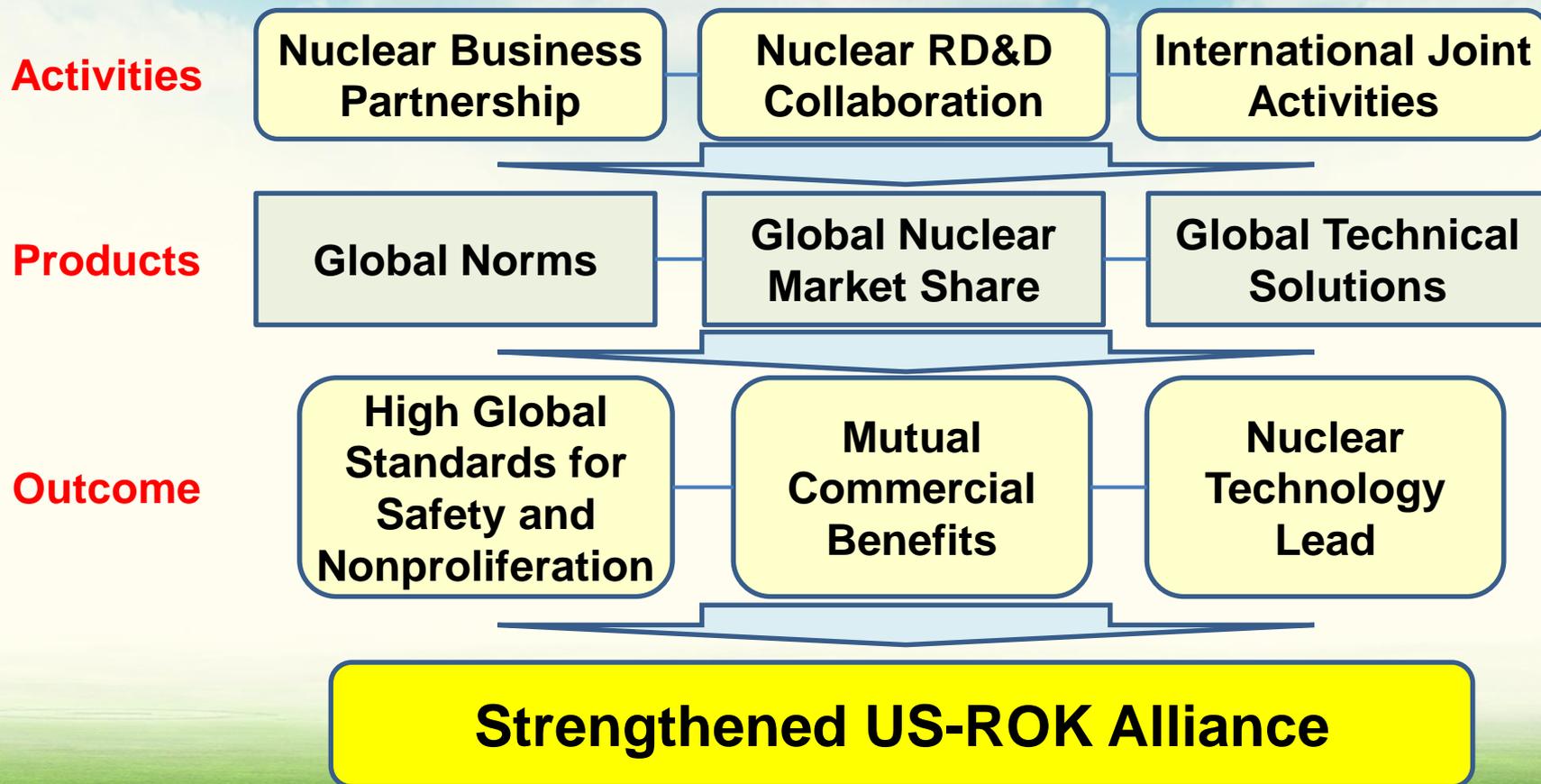
- Accumulated knowledge and expertise
- Public understanding on nuclear energy
- Interest for SMR's and advanced reactors
- Global political influence
- Financing capacity
- Brand Power

- **ROK**

- Robust nuclear industry with sound supply chain
- Skilled and educated manpower and up-to-date experience
- Role model for nuclear energy development
- International cooperation with newcomer countries

# Frame for Future Nuclear Cooperation

Korea and the U.S. can strengthen their alliance through nuclear cooperation between the two countries.



# Areas of Further Opportunities

**There are many areas of opportunities for the US and Korea to work together through various governmental and civil channels.**

## ◆ **Nuclear Business Partnership**

- Strategic collaboration in third markets
- Further nuclear trade including joint ventures and investment

## ◆ **Nuclear RD&D Collaboration**

- Spent fuel management technologies: storage, transportation, and disposal
  - Advanced technologies to minimize the impact of spent fuel management
- Further collaboration on SFR including metal fuels, licensing, joint design and demonstration (involving nuclear industry)
- Development and demonstration of LEU U-Mo Fuel, Development of LEU-based Fission Moly production technologies

## ◆ **International Joint Activities**

- Joint support for newcomer countries (IAEA TC, INPRO, PUI, IFNEC, ...): ROK as a role model
- Forming global standards of safety, safeguards, and security

# Conclusion

## PAST



The US-ROK nuclear cooperation has been strong and productive, helping the remarkable nuclear development in Korea.

## PRESENT



The new nuclear cooperation agreement has been in place, reflecting the parity of the two countries and enabling further opportunities of cooperation.

## FUTURE



Further collaboration in various areas will bring multi-facet benefits to both countries, leading to strengthening of US-ROK alliance.

### One-way Assistance Relationship



### New Framework of Cooperation



### Both-way Strategic Partnership





# Thank You!



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