

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
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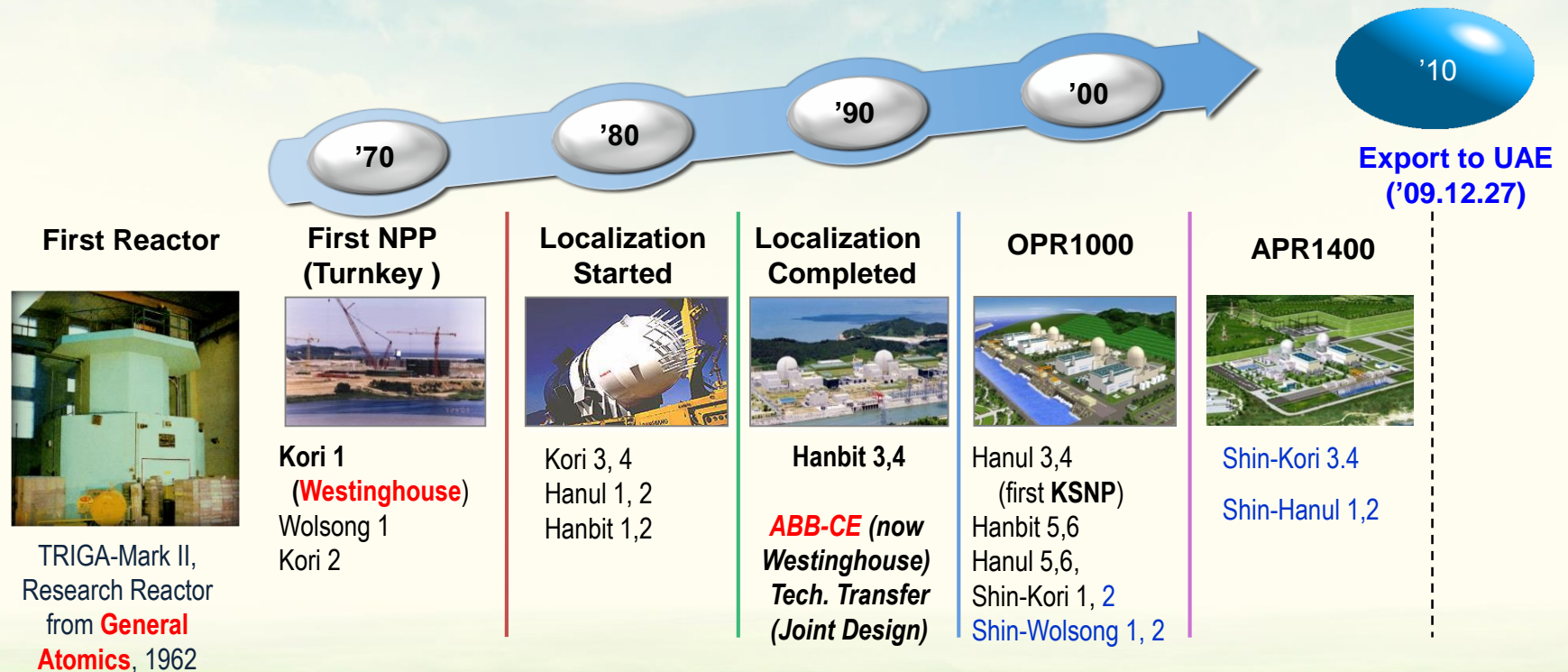


Korea Atomic Energy
Research Institute



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**
 - 35th 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

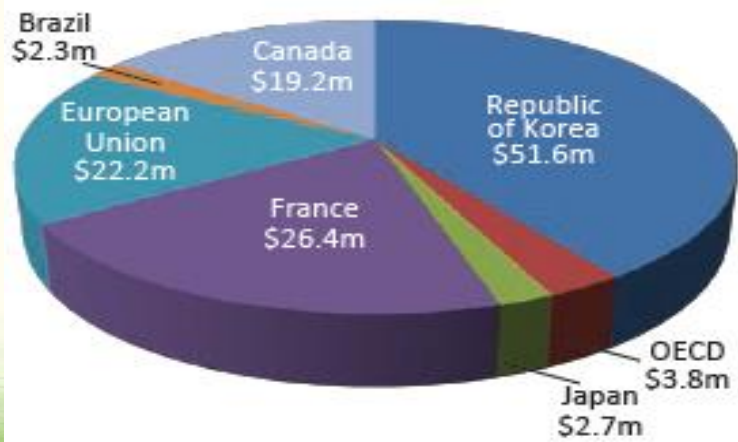
- **ROK → US**

- 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)

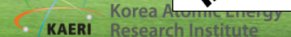
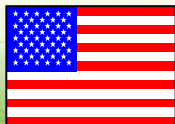
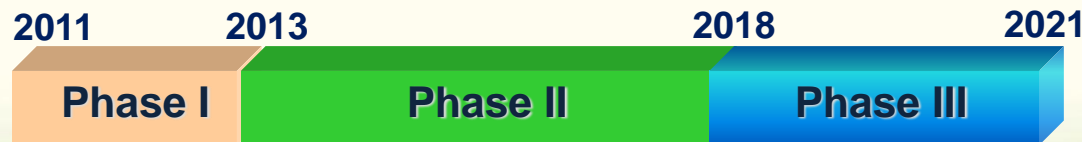
Korea and the U.S. launched the Joint Fuel Cycle Study in 2011 for investigating jointly further the electrochemical recycling technology.

◆ Working Groups

- Electrochemical Recycling
- Safeguards and Security

◆ Progress of JFCS

- '11.04 : 1st 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)



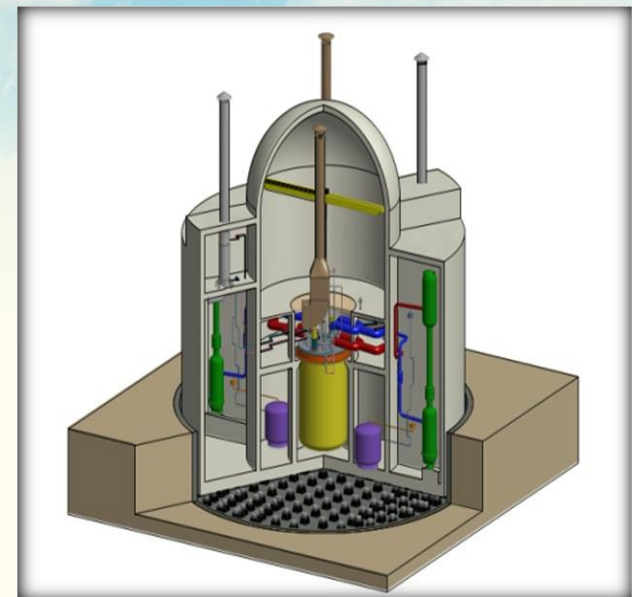
Collaboration on SFR (KAERI-ANL)

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



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Revision of US-ROK 123 Agreement

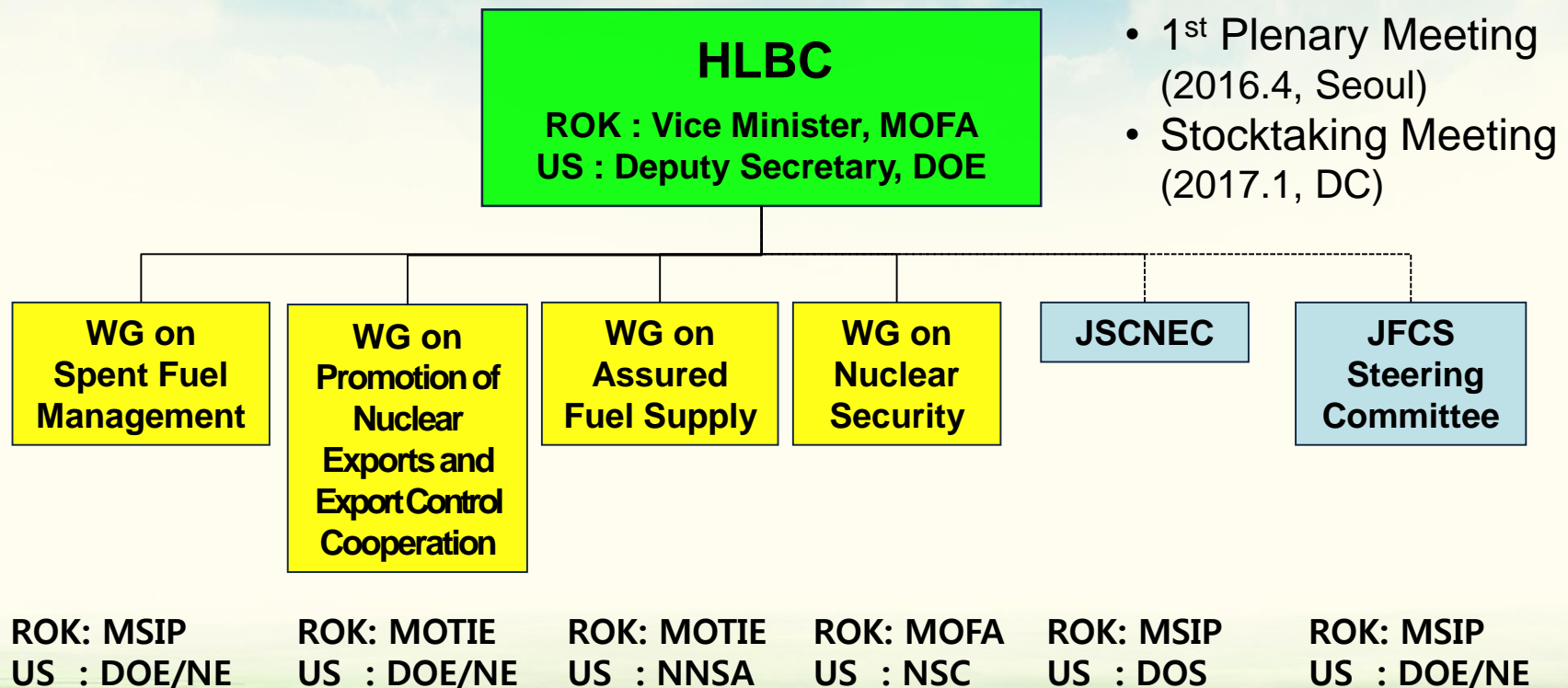
The new agreement that entered into force in 2015 will serve as a new framework to realize the common vision of two countries.

- ◆ **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.**

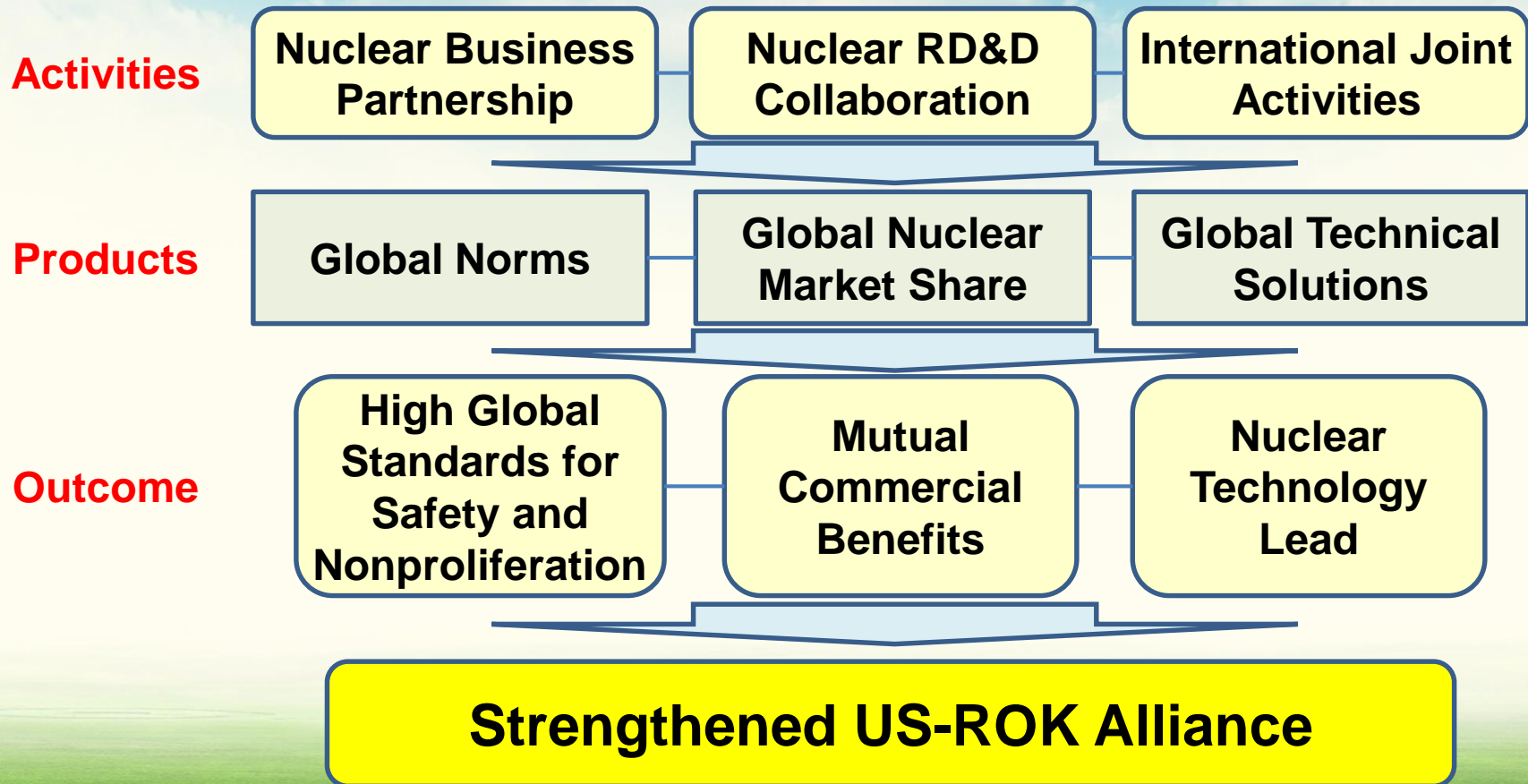
- Accumulated knowledge and expertise
- Public understanding on nuclear energy
- Interest for SMR's and advanced reactors
- Global political influence
- Financing capacity
- Brand Power

- **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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