

Indian Council for Research on International  
Economic Relations(ICRIER)

The Seoul Forum for  
International Affairs (SFIA)

**8<sup>TH</sup> INDIA-KOREA DIALOGUE**  
20-21 May, 2009  
New Delhi, India

# **KSNP Development through Standardization and Localization And India-Korea Cooperation Program**

21 May, 2009

**Jae In Shin, Sc.D.**  
President  
-PNI-



**PNI**

# CONTENTS

- I** Nuclear Power Renaissance
- II** Nuclear Power Plants In Korea
- III** NPP Standardization And Optimization
- IV** INDIA – KOREA Cooperation Program
- V** Conclusion

# I . NUCLEAR POWER RENAISSANCE

# Revitalization of Nuclear Power Generation

- Fluctuation of Crude Oil Price
- Political Control of Energy Price
- Energy Demand Explosion
- Emission – Free Energy Needs

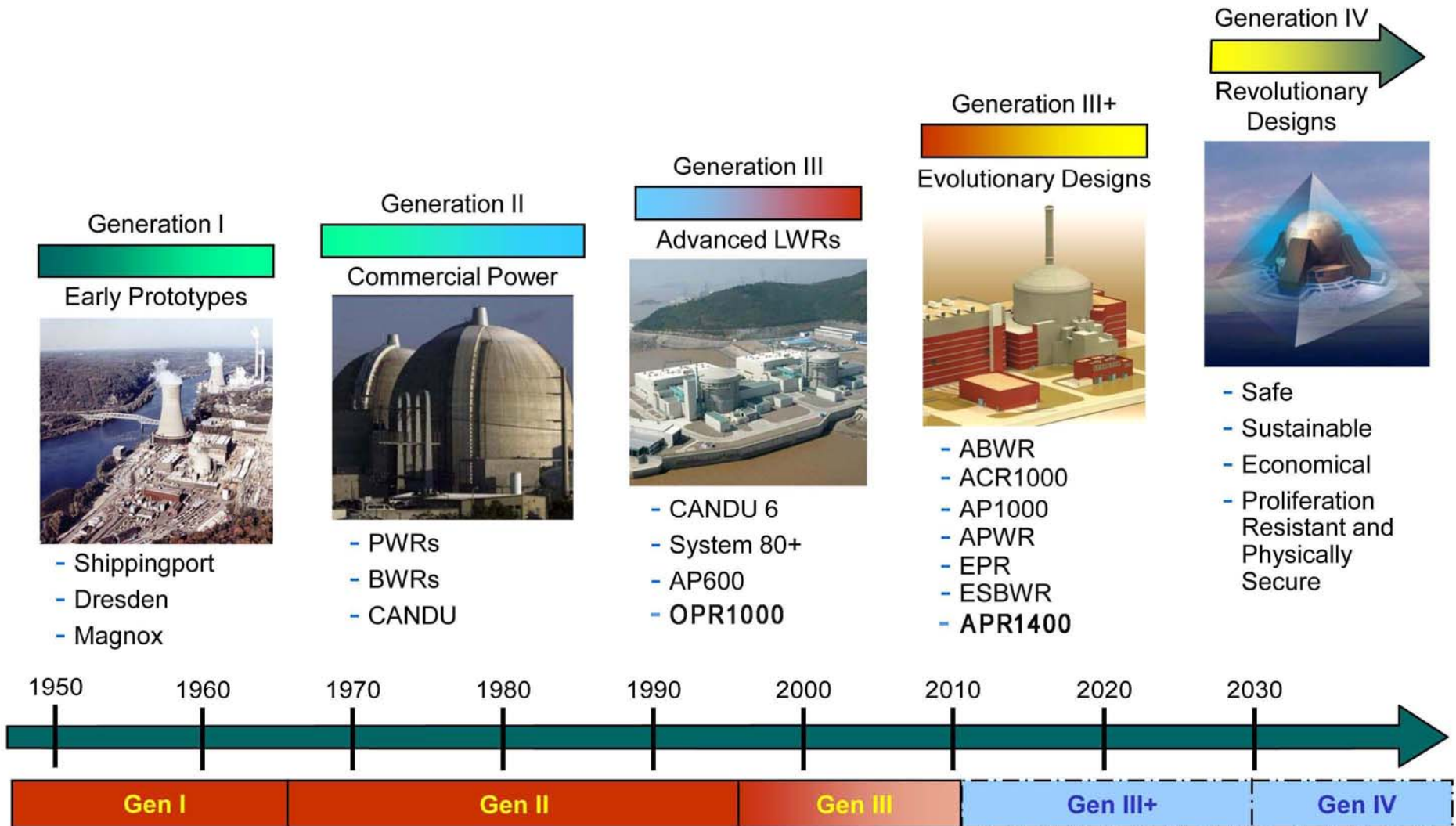


Expansion of NP Market		
	2007	2030
Asia	82 GW	232 GW
N.S. America	116 GW	187 GW
Europe	123 GW	149 GW
Eastern	47GW	111 GW
Africa	2GW	12GW

Energy Security - Key National Policy Objective

Additional 300 Units by 2030

# Gen IV : Next Generation Reactor



Source : Gen. IV International Forum (GIF)

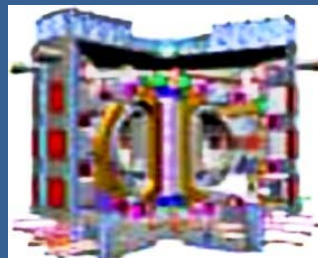
# Nuclear Fusion Power : Dream Energy

Advanced Experimental Rx



KSTAR (2008)

Power Rx



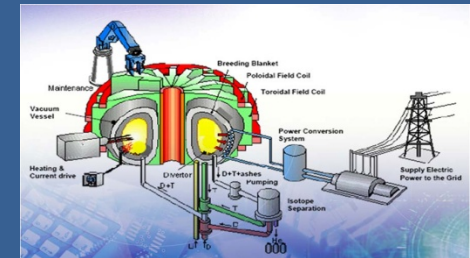
ITER (2018)

DEMO/PROTO



(mid 2020)

Commercial Fusion Power Plant



KSNP (mid 2030)

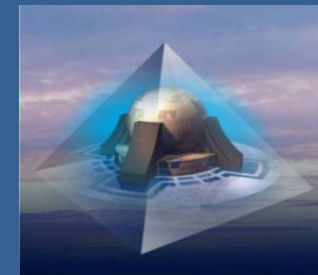
2000

2010

2020

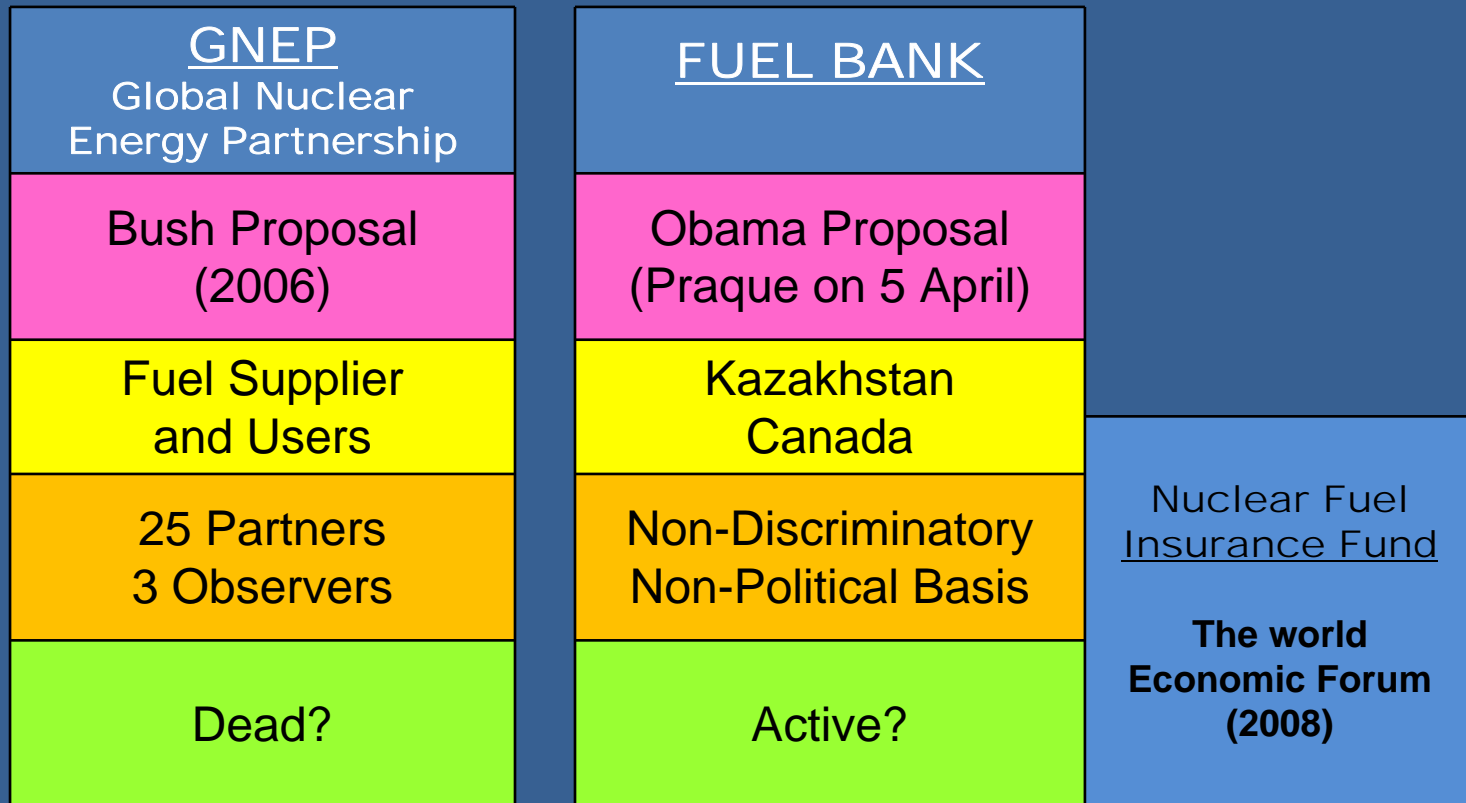
2030

2040



Gen IV Rx

# Multilateral Nuclear Fuel Supply Mechanisms

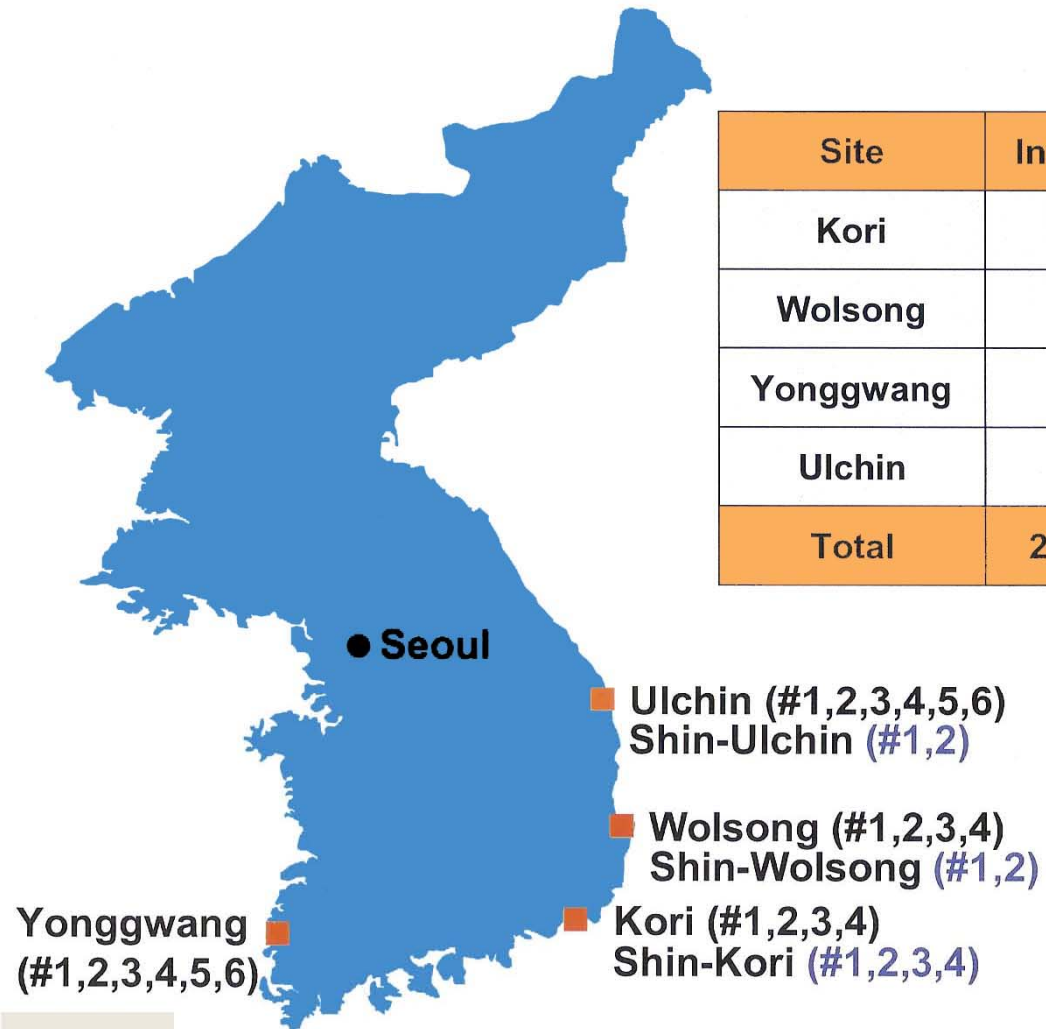


## **II. NUCLEAR POWER PLANTS IN KOREA**

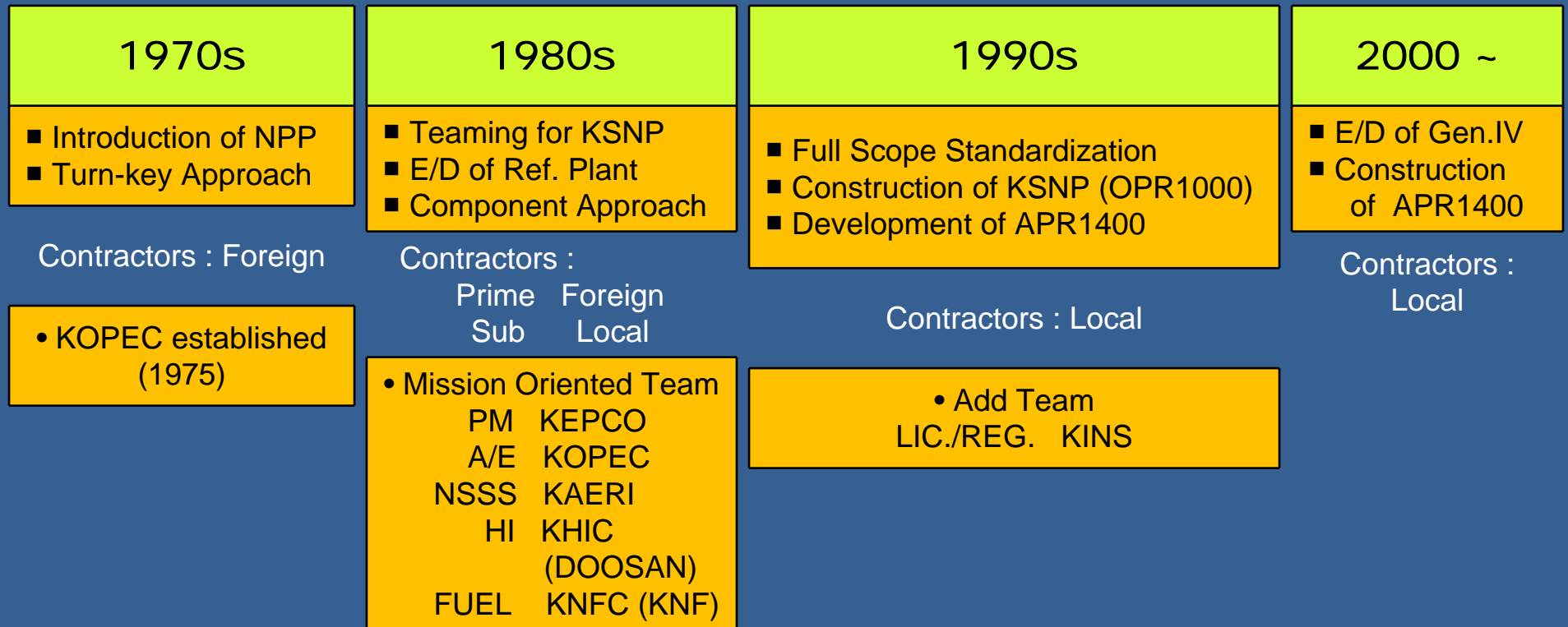
# Status of Nuclear Power Plants

(Unit: MW)

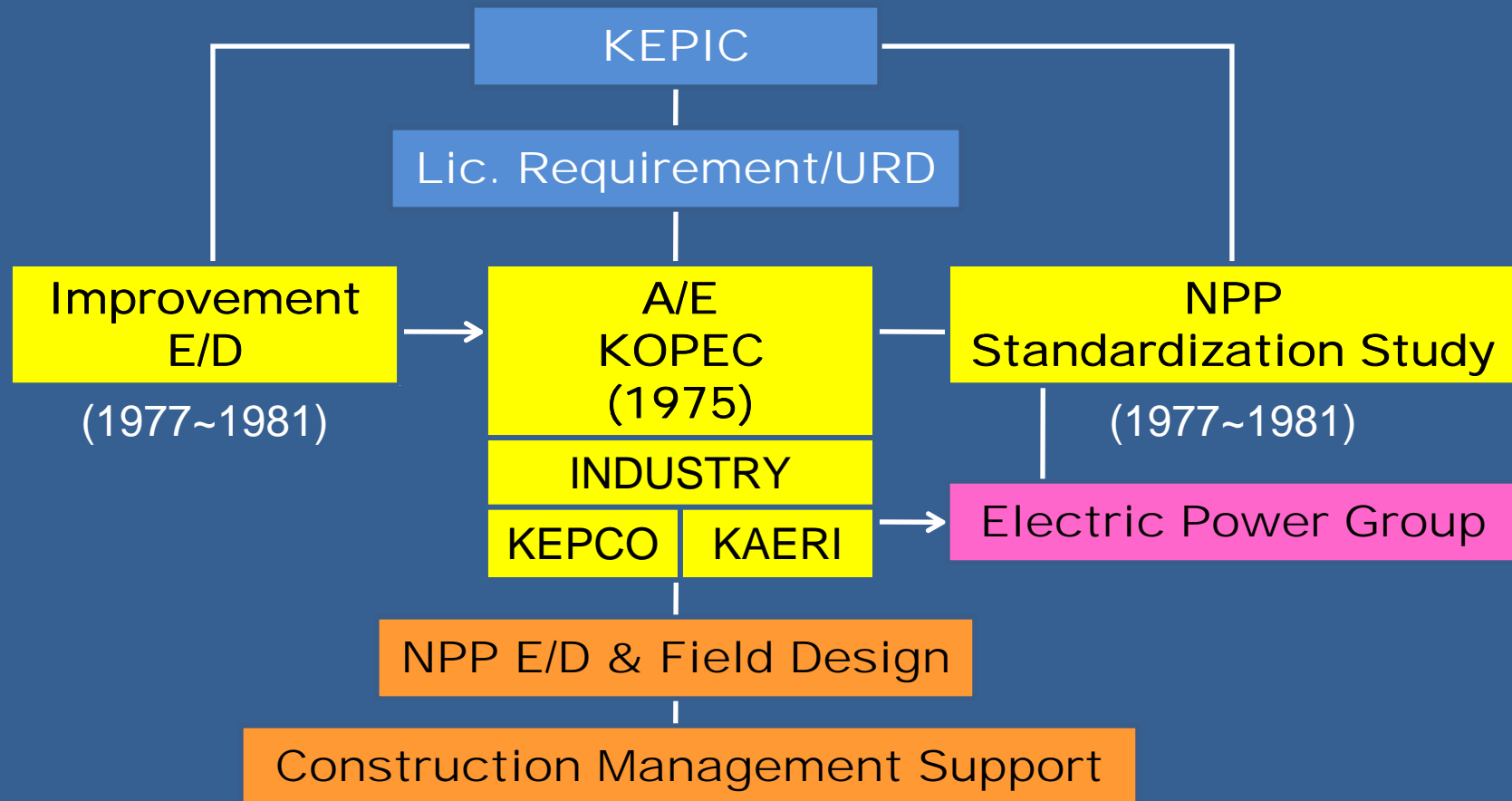
Site	In Operation	Under Const.	Total
Kori	4 (3,137)	4 (4,800)	8 (7,937)
Wolsong	4 (2,779)	2 (2,000)	6 (4,779)
Yonggwang	6 (5,900)	-	6 (5,900)
Ulchin	6 (5,900)	2 (2,800)	8 (8,700)
<b>Total</b>	<b>20 (17,716)</b>	<b>8 (9,600)</b>	<b>28 (27,316)</b>



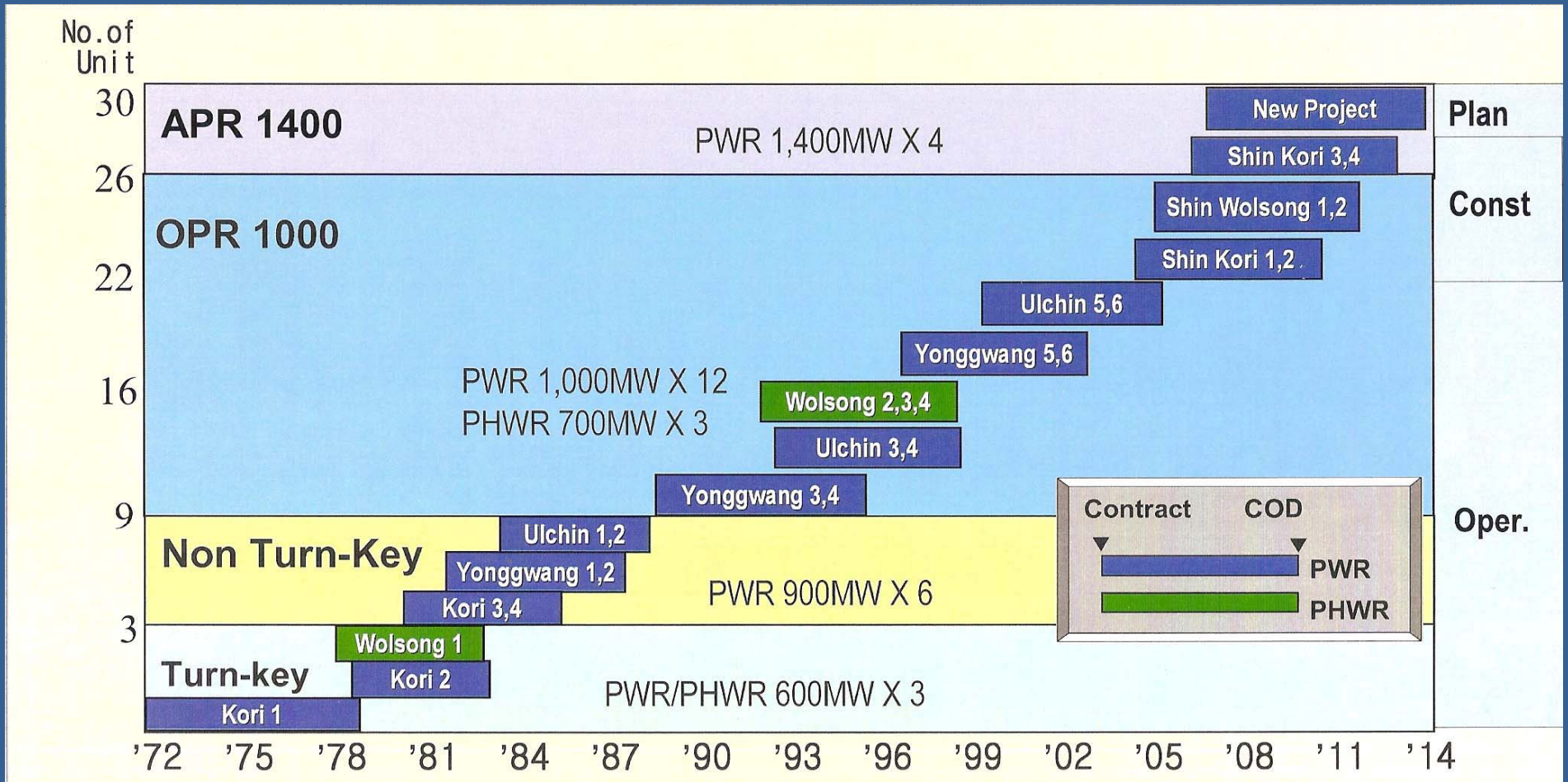
# Policy and Chronology of NPP Development



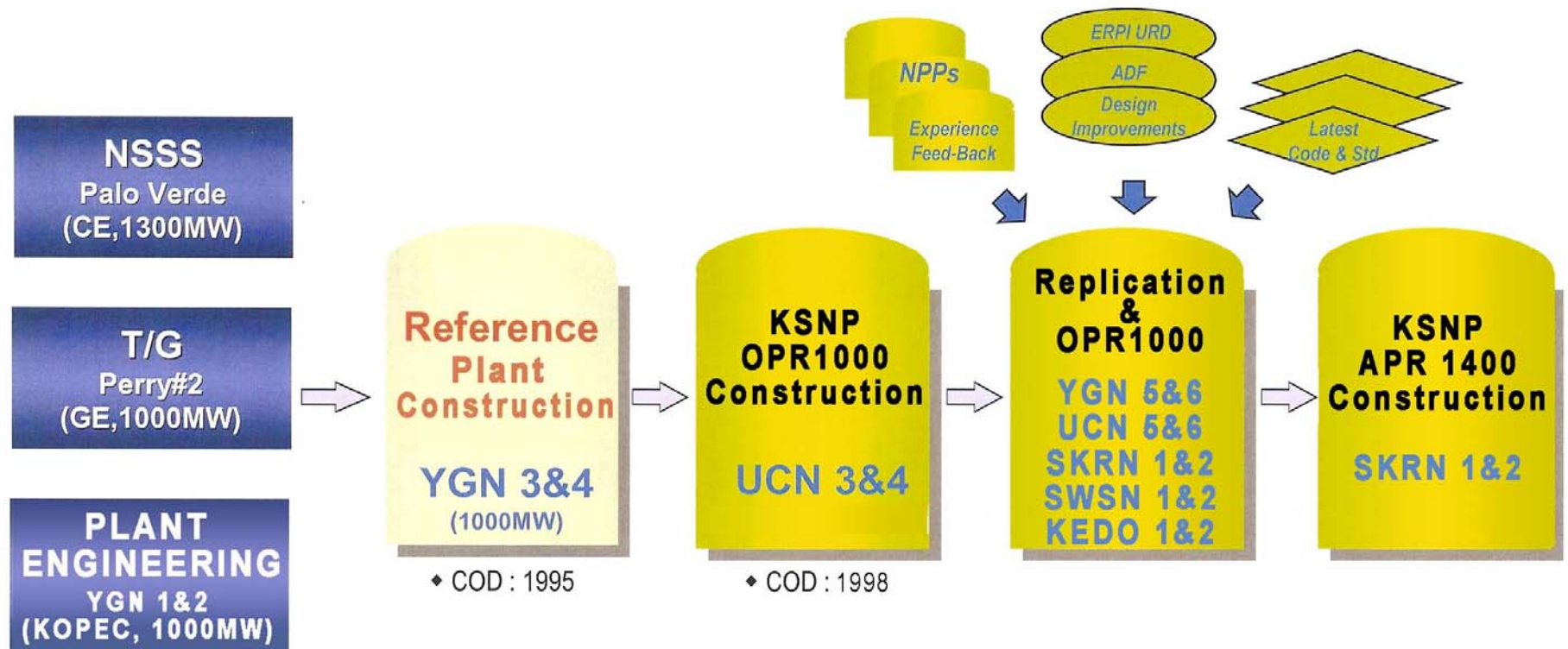
# Initiation of KSNP Development



# Operation and Construction Status



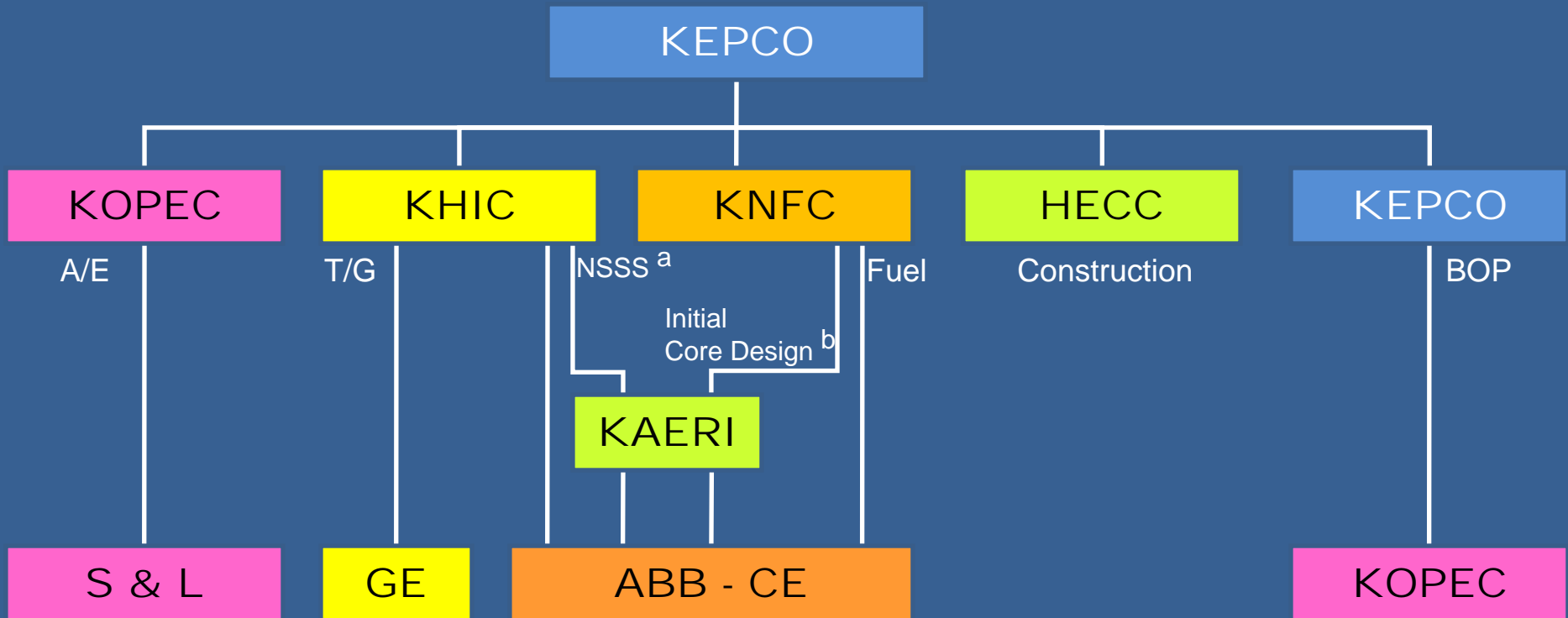
# KSNP Development Process



## Duplication vs Replication

Selection of Reference Unit

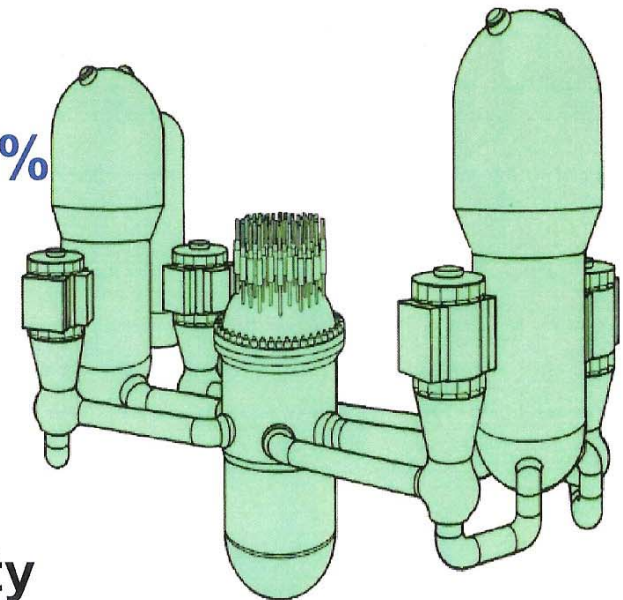
# YGN 3&4 Contractual Structure



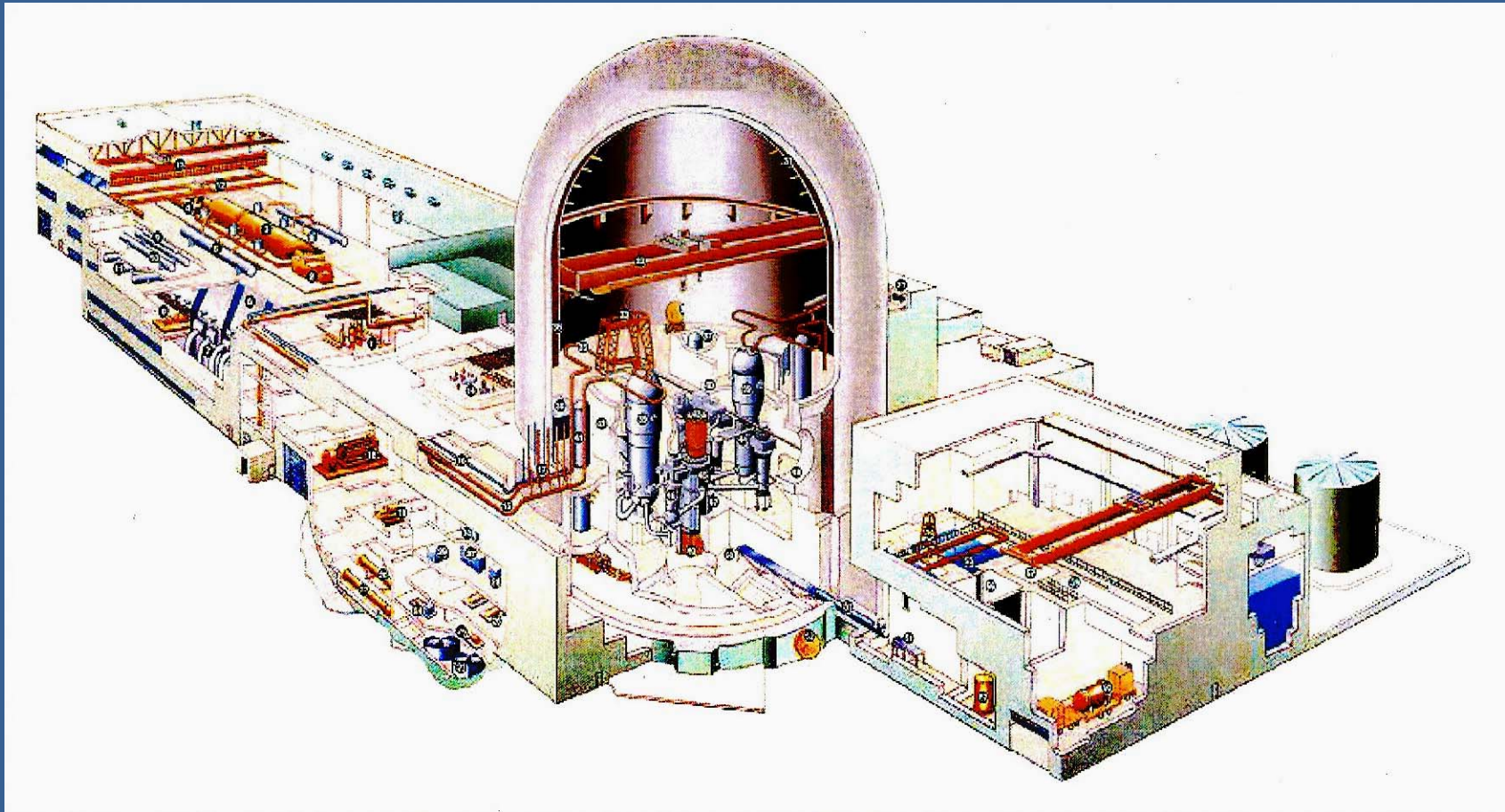
\* a : Currently NSSS design by KOPEC  
 b : Currently Nuclear fuel design by KNF

# Design Features of OPR1000

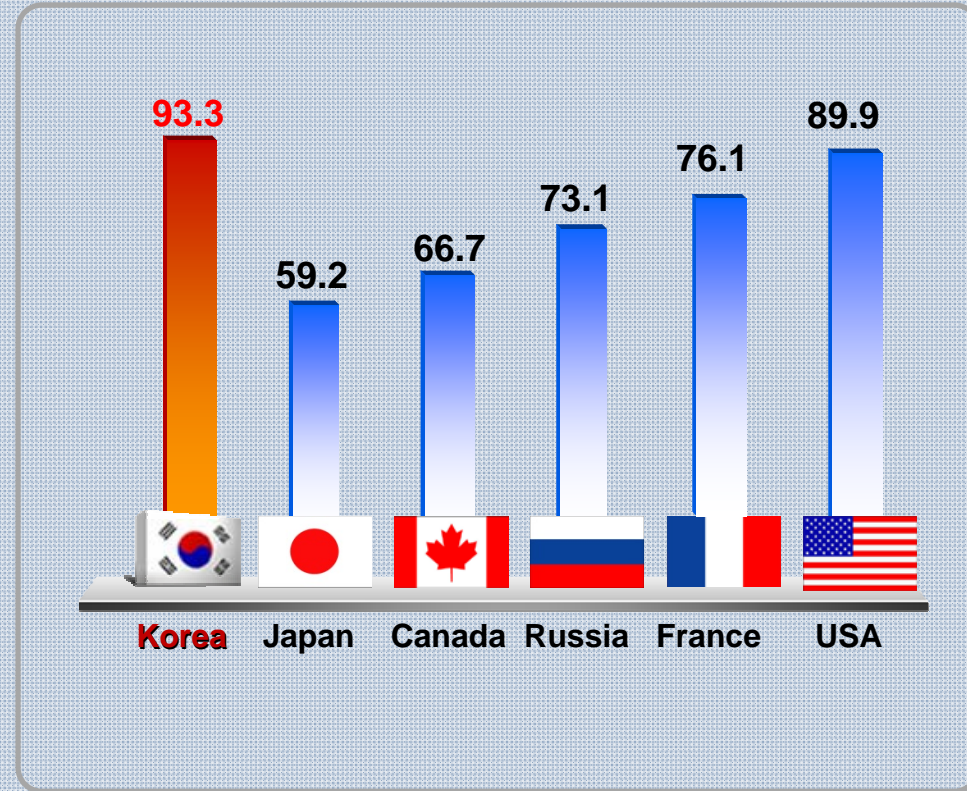
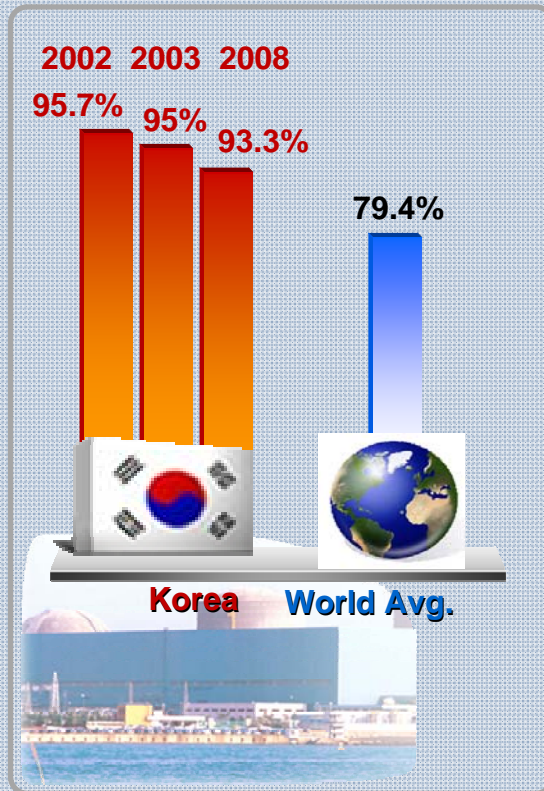
- **2 Loop RCS Design**
- **Power Level : 1,050MWe / 2,825MWt**
- **Plant Design Life : 40 years**
- **Plant Availability (Target value) : 80~87%**
- **Advanced Design Features**
  - **Human Factors Engineering**
  - **Design against Severe Accident**
  - **Leak Before Break (LBB) Concept**
  - **Increased Operability and Maintainability**
  - **Lower Occupational Radiation Exposure**



# Birds Eyes View of OPR1000

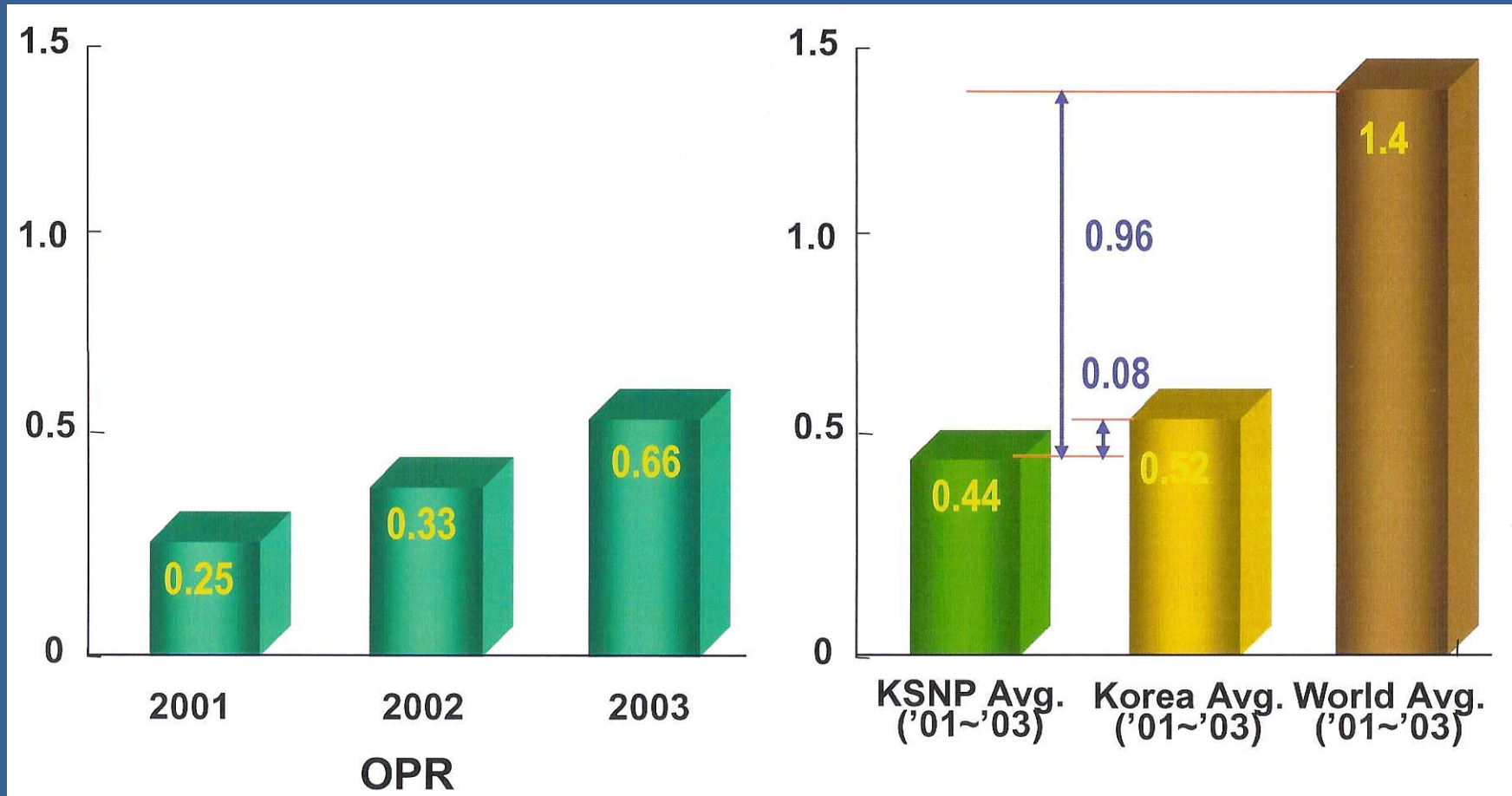


# Operation Excellence of KSNP - Capacity Factor(%)



※ Source: Nucleonics Week, February 2009

# Operation Excellence of KSNP - Unplanned Trip (Trip/Unit)



## Operation Excellence of KSNP - One Cycle Trouble Free(OCTF)

Plant	COD	Operation Years	Reactor Years	OCTF
YGN #3	Mar. '95	9.4	8	3
YGN #4	Jan. '96	8.7	8	3
UCN #3	Aug. '98	6.0	6	3
UCN #4	Oct. '99	4.8	5	-
YGN #5	May. '02	2.3	3	-
YGN #6	Dec. '02	1.7	2	1

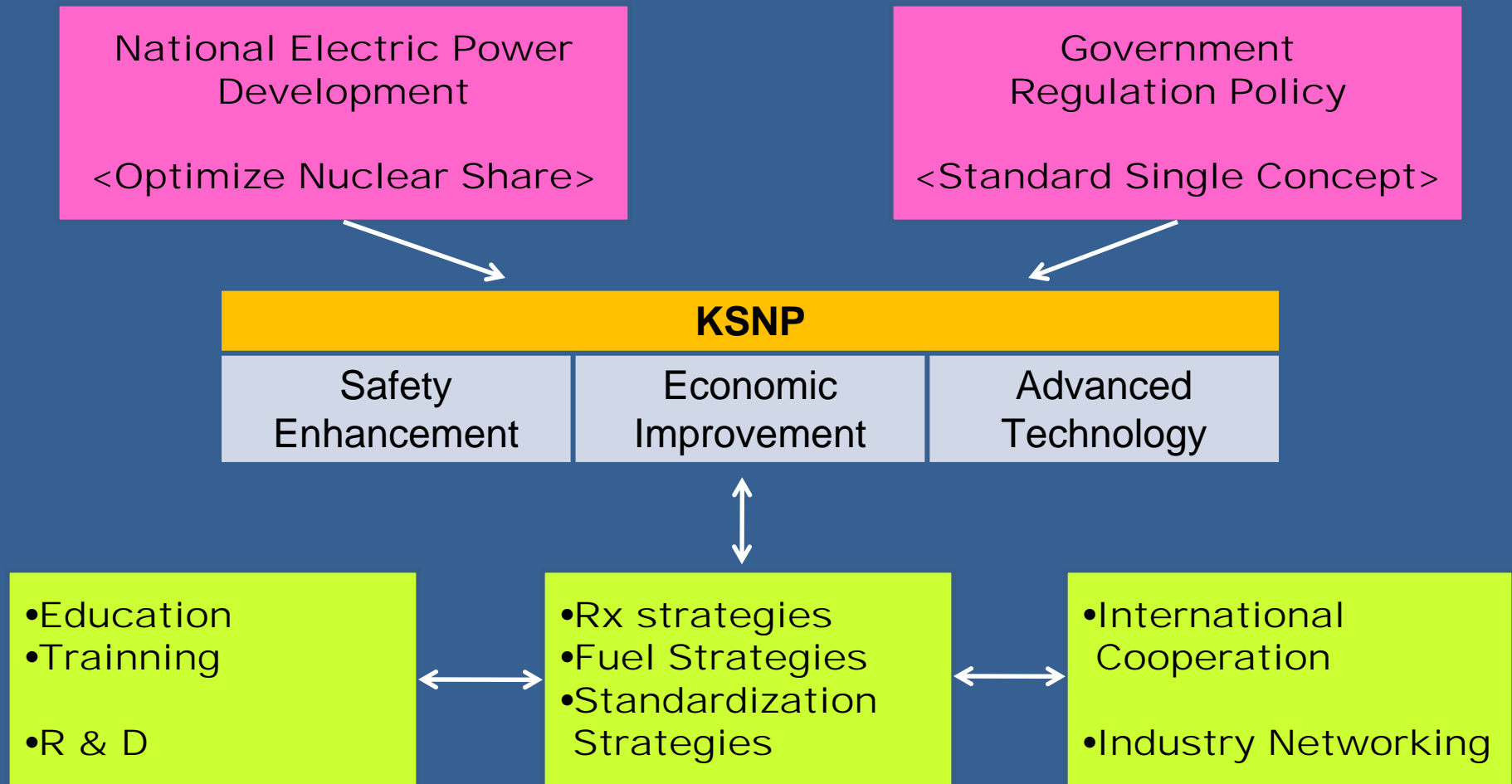
# Generation Cost by Energy Sources (₩/kWh)

	2002	2003	2004	2005	2006	2009
Nuclear	39.55	39.75	39.52	39.10	38.13	39.40
Coal	42.37	42.16	42.86	43.54	38.43	40.96
Oil	70.43	75.03	80.06	91.10	114.90	117.04
Hydro	54.71	57.79	62.41	72.01	84.38	149.50
Wind	-	107.66	107.66	107.66	107.29	107.70
Solar	-	716.40	716.40	716.40	694.32	711.25

※ Incl. Decommissioning Cost (₩5.55/kWh)

# **III. NPP STANDARDIZATION AND OPTIMIZATION**

# 1<sup>st</sup> Phase Activities for KSNP Development



# CONCEPT

- 4~6 Units Construction in a group  
<Replication, not Duplication>  
<Est. Cost Reduction 8~18%>
- Minimize the Innovative Tech. Application  
<One-Stop Licensing>

## Areas & Process

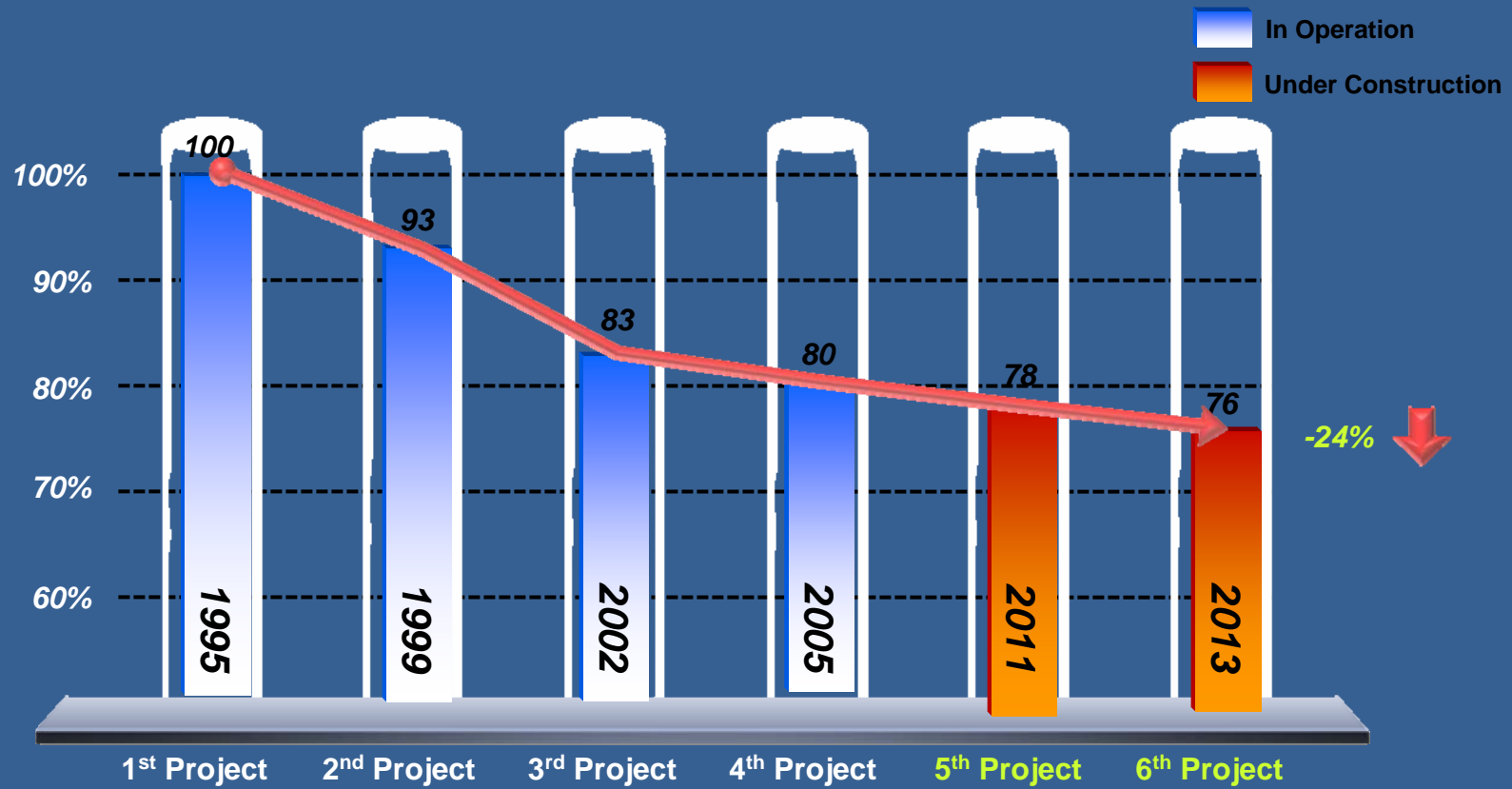


- Licensing & Regulation  
<Requirements, Industrial Codes/Standards, QA>
- Planning  
<Mix Ratio, Financing, Contractors, Schedule>
- E/D, Construction  
<E/D, Procurement, Construction>
- O/M <Test, Qualification, Methodology>

# Benefits – Construction Cost

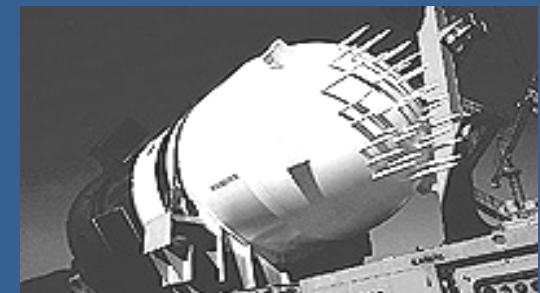
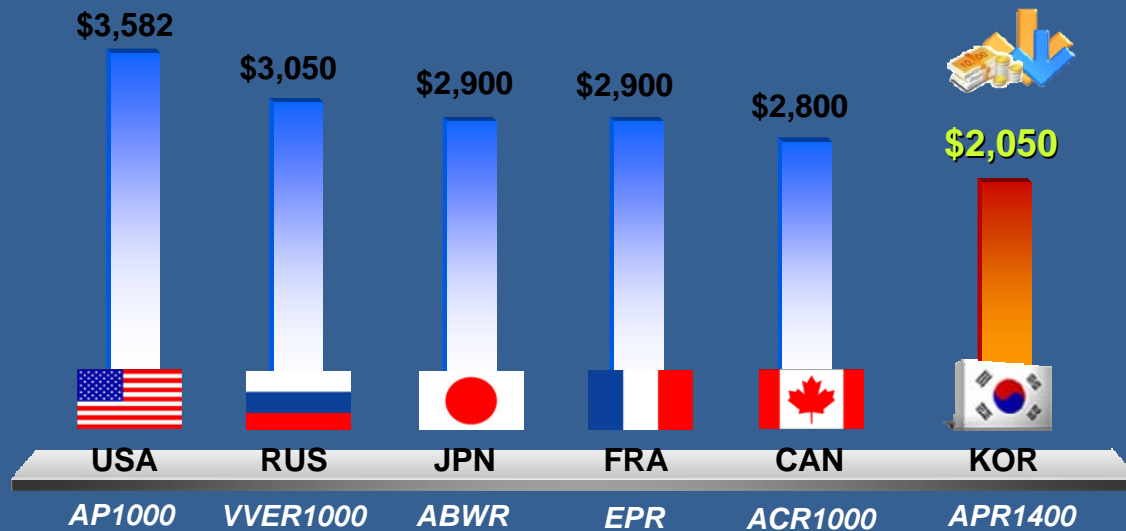
◆ <b>Replication</b>	3~4%(of Total Construction cost)
◆ <b>Partial Duplication</b>	2~4%
◆ <b>Construction Time Savings</b>	4~8%
◆ <b>O/M</b>	One Simulator and Training Center Exchangeable Spare Part Sharing of Intrastructure & Manpower

# Capital Cost Reduction of KSNP



# KSNP Cost Competitiveness

## Unit Construction Cost (cents/kWh)

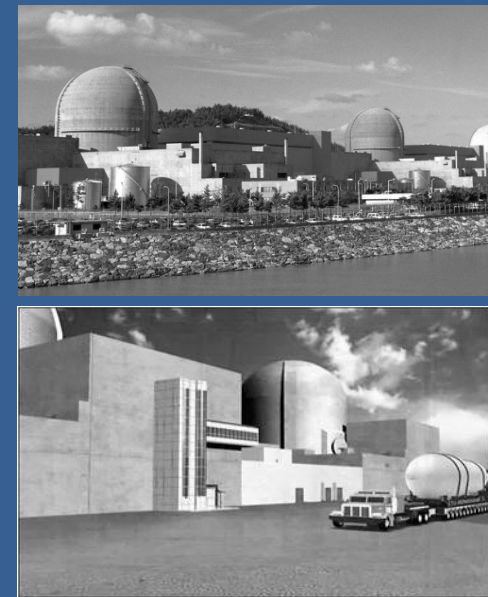
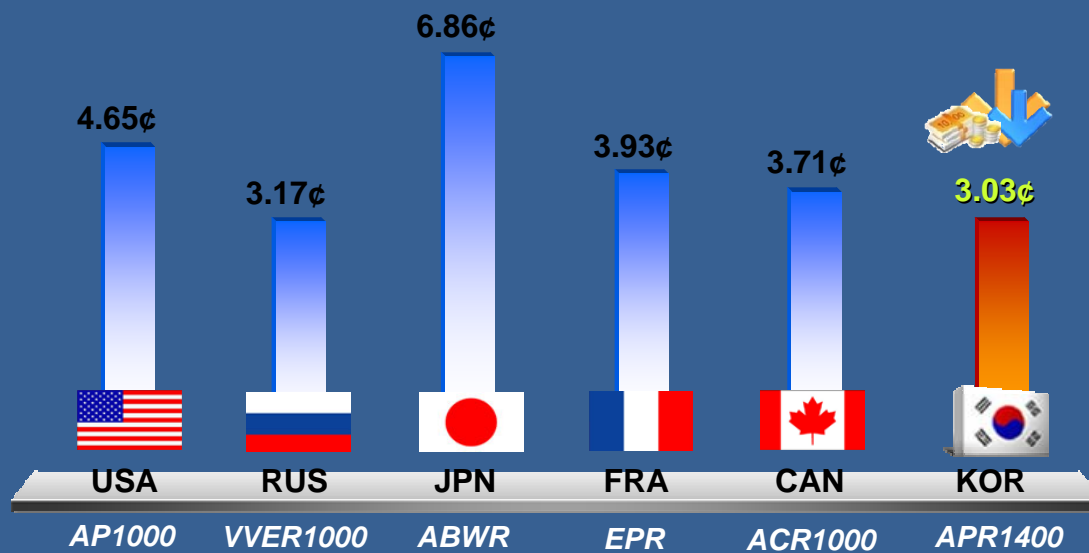


as of 2008

※ Source: World Nuclear News (World Nuclear Association, 2008)

# KSNP Cost Competitiveness

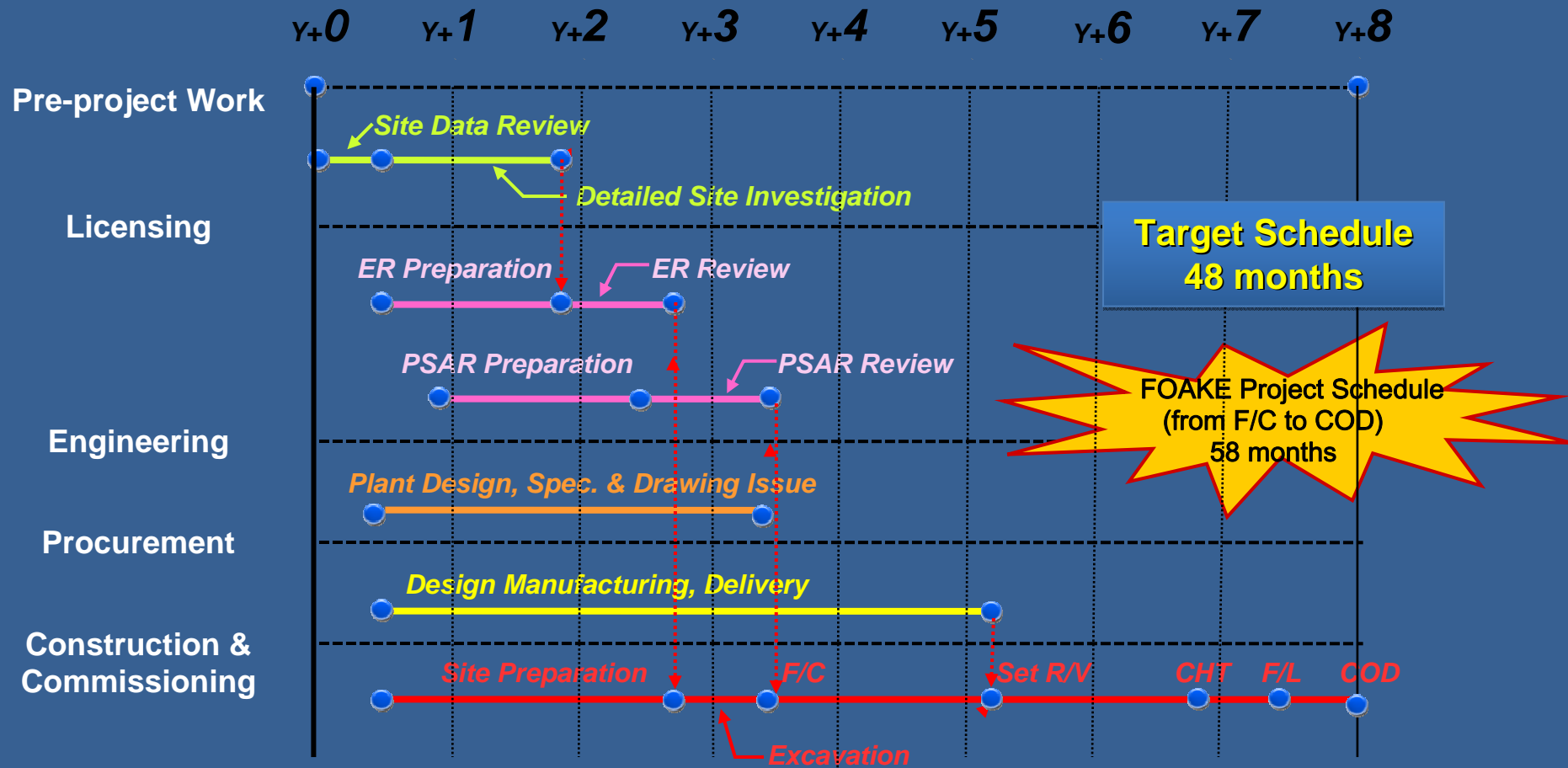
## Unit Generation Cost (cents/kWh)



※ Source: Projected Costs of Generating Electricity (OECD/NEA, 2005)

# KSNP Cost Competitiveness

## Target Schedule for APR1400



## **IV. INDIA-KOREA COOPERATION PROGRAM**

## IV. India-korea cooperation program

- **Joint Study for NPP Optimization and Standardization**
- **Manpower Training & Information Exchanges**
- **Joint Study for Next Generation Rx Policy**

# Joint Study for NPP Optimization and Standardization

## GROUP A

- PHWR-PWR Inter-Link Study
- Advanced Fuel Cycle Management

## GROUP B

- NPP System Optimization & Standardization
- NPP Operation and Maintenance (PHWR & PWR)

## GROUP C




- Project Management
- Financing

# Information Exchanges



**India-Korea Nuclear Industry Seminar**

# Joint Study for Next Generation Rx Policy

-  **GROUP A : Generation IV Rx**
-  **GROUP B : Advanced Fuel Cycle Management**
-  **GROUP C : Nuclear Fusion Power Plant System**

# V. CONCLUSION

# CONCLUSION (I)



**Nuclear Power Generation is Reemerging to be a Preferred Electricity Generation Method**  
(Worldwide ~65 Additional Countries Plan to Adopt NPP)



**Safety and Economics of NPPs are Top Tier Issues for Sustainable Nuclear Power Generation**



**Optimization & Standardization of NPP Systems are Single Solution to Reach Safety and Economic Goal**



**Strong Government Support and Long-term Policy are Essential for Successful National Nuclear Power Development**

## CONCLUSION (II)



**KSNP(OPR1000, APR1400) has Remarkable and Outstanding Operation Experiences**



**Korea Nuclear Society Possesses Qualified Skilled Manpower which Transfer Technology to other Industry (ex. Shipbuilding)**



**Korea Nuclear Industry is Effectively well Organized**



**India-Korea Joint Cooperation in Nuclear Power Fields are Highly Recommended**

## CONCLUSION (III)



**Early India-Korea Nuclear Industry Cooperation are Recommended**



**Joint Nuclear Power Technology Development such as PHWR-PWR Inter-Link is Unique Subjects for both Countries**



**For Effective Licensing and Regulations, Governmental Experience Exchanges are also Recommended**

# THANK YOU

