

# Nuclear Engineering & Services

## Nuclear Projects Division



newpower, newstandard



# Humaneering

We are trying to harmonize  
"humanity, the environment and engineering",  
while providing for all your needs in the power industry.  
Total customer satisfaction is our utmost goal.

[www.kepco-enc.com](http://www.kepco-enc.com)



2354, Yonggudaero, Giheung-gu Yongin-si,  
Gyeonggi-do, Korea, 446-713  
Tel. 82-31-289-3300 Fax. 82-31-289-4178



# Contents

## Contents

### Vision

### Scope

### Experience

New Nuclear Power Plant Engineering

Operation and Maintenance Services

Radwaste Management Support

Small Power and Research Reactor Development

### Resources

IT Application Tools and Software

Organization & Manpower

### Why KEPCO E&C

### Introduction KEPCO E&C

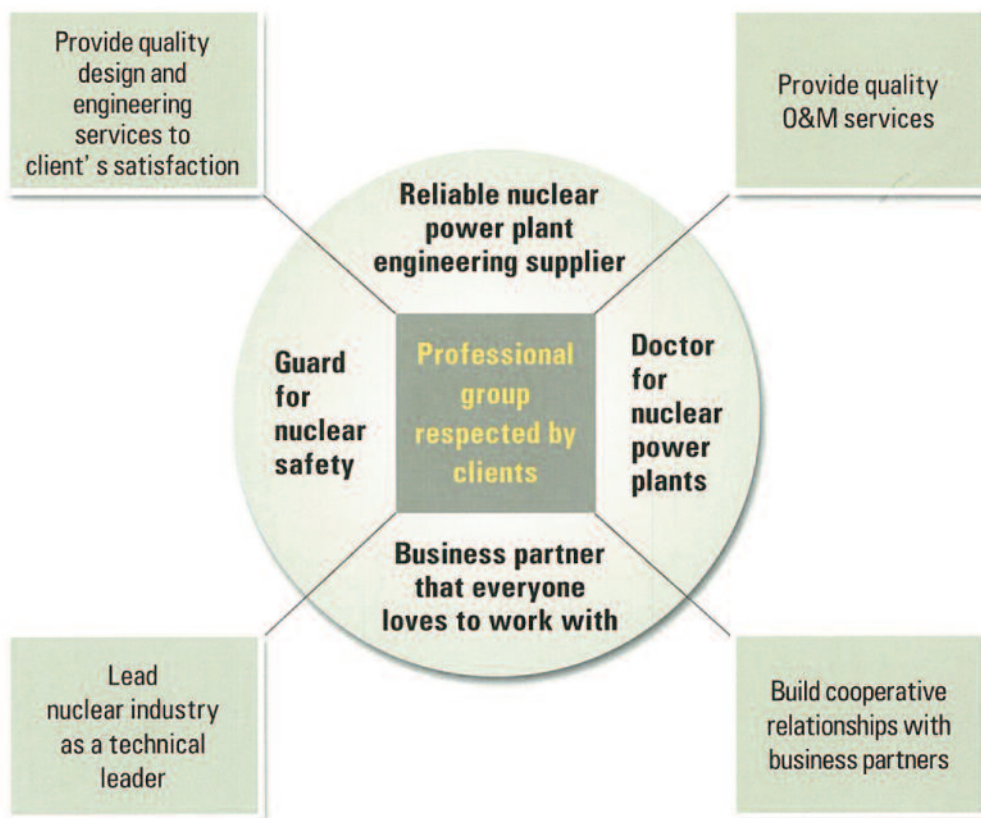


# Nuclear Engineering & Services

## Nuclear Projects Division

### Vision

#### KEPCO E&C Nuclear Projects Division (NPD), a Leading Global Nuclear Engineering Provider

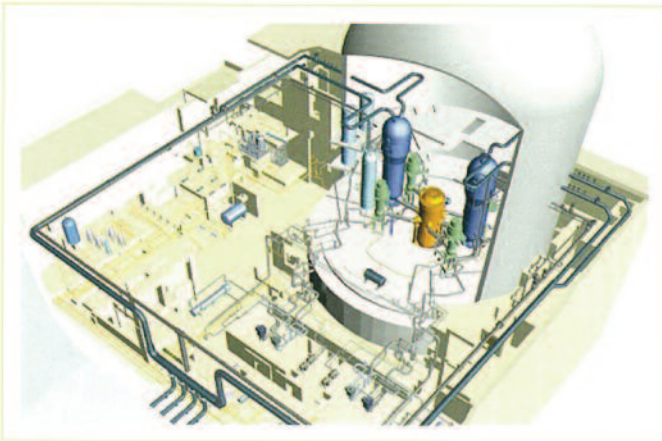




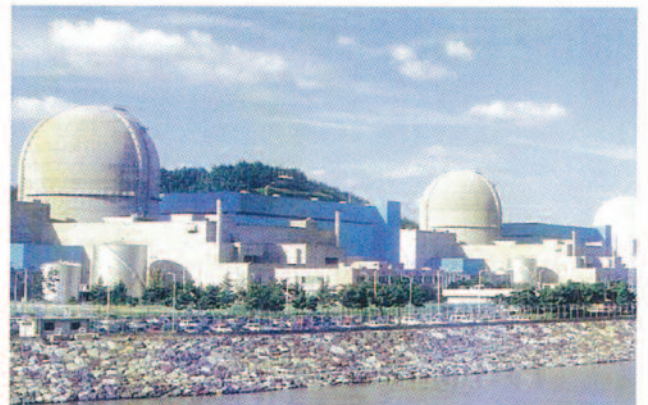
# Scope

**KEPCO E&C NPD provides a complete scope of engineering and support services associated with nuclear power plant design, construction and operation as well as other engineering services requiring highly specialized technical expertise.**

- Design and engineering for new nuclear power plants



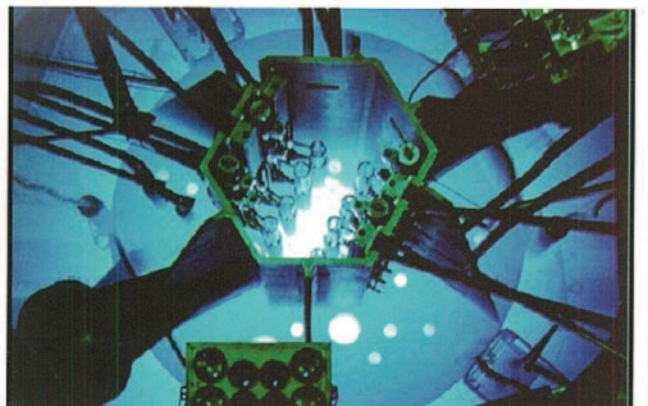
- Operation and maintenance (O&M) services for operating nuclear power plants



- Solution finding for radwaste management



- Development, design and engineering of small power and research reactors



- Project management support services
- Site study and technical support

- Licensing support
- Quality Assurance implementation assistance

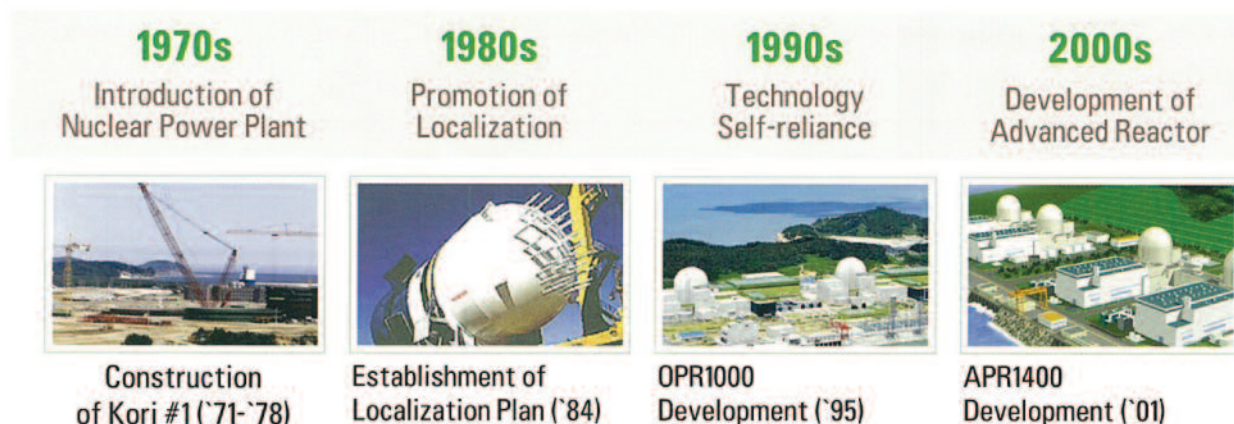


# Nuclear Engineering & Services

## Nuclear Projects Division

## Experience-New Nuclear Power Plant Engineering

### Nuclear Power Development Program in Korea



### New Nuclear Power Plant Engineering Experiences

Plant		Reactor Type	Capacity(MW)	NSSS Supplier	Plant A/E	Commercial Operation
Kori (KRN)	#1	PWR	650	W/H	Gilbert/KEPCO E&C	Apr. 1978
	#2	PWR	587	W/H	Gilbert/KEPCO E&C	Jul. 1983
	#3	PWR	950	W/H	Bechtel/KEPCO E&C	Sep. 1985
	#4	PWR	950	W/H	Bechtel/KEPCO E&C	Apr. 1986
Wolsong (WSN)	#1	PHWR	679	AECL	AECL/KEPCO E&C	Apr. 1983
	#2	PHWR	700	AECL/DOOSAN	AECL/KEPCO E&C	Jun. 1997
	#3	PHWR	700	AECL/DOOSAN	AECL/KEPCO E&C	Jun. 1998
	#4	PHWR	700	AECL/DOOSAN	AECL/KEPCO E&C	Sep. 1999
Yonggwang (YGN)	#1	PWR	950	W/H	Bechtel/KEPCO E&C	Aug. 1986
	#2	PWR	950	W/H	Bechtel/KEPCO E&C	Jun. 1987
	#3	PWR(OPR1000)	1,000	DOOSAN/KEPCO E&C		Mar. 1995
	#4	PWR(OPR1000)	1,000	DOOSAN/KEPCO E&C		Jan. 1996
Ulchin (UCN)	#5	PWR(OPR1000)	1,000	DOOSAN/KEPCO E&C		May. 2002
	#6	PWR(OPR1000)	1,000	DOOSAN/KEPCO E&C		Dec. 2002
	#1	PWR	950	Framatome	Framatome/	Sep. 1988
	#2	PWR	950	Framatome	Framatome/KEPCO E&C	Sep. 1989
	#3	PWR(OPR1000)	1,000	DOOSAN/KEPCO E&C		Aug. 1998
	#4	PWR(OPR1000)	1,000	DOOSAN/KEPCO E&C		Dec. 1998
KEDO LWR	#5	PWR(OPR1000)	1,000	DOOSAN/KEPCO E&C		Jul. 2004
	#6	PWR(OPR1000)	1,000	DOOSAN/KEPCO E&C		Jun. 2005
Shin-Kori (Shin-KRN)	#1	PWR(OPR1000)	1,000	DOOSAN/KEPCO E&C		Suspended
	#2	PWR(OPR1000)	1,000	DOOSAN/KEPCO E&C		Suspended
Shin-Wolsong (Shin-WSN)	#1	PWR(OPR1000)	1,000	DOOSAN/KEPCO E&C		Dec. 2010
	#2	PWR(OPR1000)	1,000	DOOSAN/KEPCO E&C		Dec. 2011
Shin-Kori (Shin-KRN)	#1	PWR(APR1400)	1,400	DOOSAN/KEPCO E&C		Mar. 2011
	#2	PWR(APR1400)	1,400	DOOSAN/KEPCO E&C		Mar. 2012
Shin-Ulchin (Shin-UCN)	#3	PWR(APR1400)	1,400	DOOSAN/KEPCO E&C		Jun. 2012
	#4	PWR(APR1400)	1,400	DOOSAN/KEPCO E&C		Jun. 2012
	#1	PWR(APR1400)	1,400	DOOSAN/KEPCO E&C	KEPCO E&C	Dec. 2015
	#2	PWR(APR1400)	1,400	DOOSAN/KEPCO E&C		Dec. 2016



# Experience-New Nuclear Power Plant Engineering

## ● Development of OPR1000 (Optimized Power Reactor 1000)

### Strategy of Design Improvement

- Enhance safety level over the previous units
- Improve plant operability and maintainability by
  - Optimizing and simplifying systems/facilities/structures
  - Minimizing radiation exposures
- Enhance constructability by
  - Adopting new construction methods
  - Implementing area completion concept
- Reduce construction cost by
  - Shortening construction schedule
  - Optimizing plant building and equipment layout

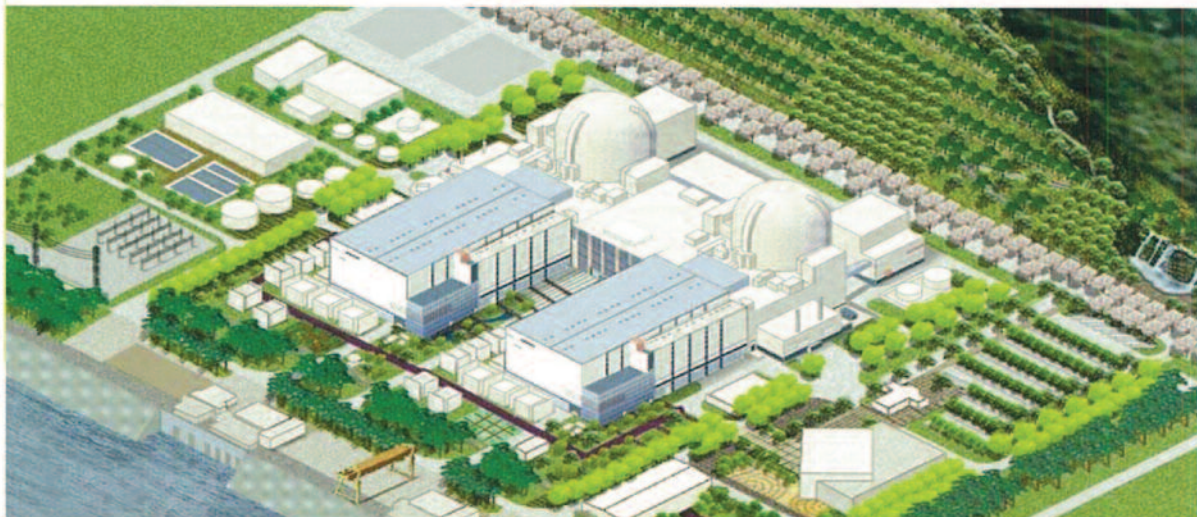
### Construction Period of OPR1000

- First concrete to fuel loading: 46 months
- First concrete to commercial operation: 52 months

### Major Design Characteristics of OPR1000

Capacity	NSSS Thermal Power Rated Electric Power	2,825 MWth 1,000 MWe
Performance	Design Life Time Availability Refueling Interval	40 years Average 87% 18 months
Safety	Core Damage Frequency Containment Failure Frequency Safe Shutdown Earthquake Thermal Margin Station Blackout Coping Time	$< 10^{-5}/\text{ry}$ $< 10^{-6}/\text{ry}$ 0.2g Greater than 10% Minimum 4 hours

### Bird's-Eye View of OPR1000





# Nuclear Engineering & Services

## Nuclear Projects Division

### Experience-New Nuclear Power Plant Engineering



#### Development of APR1400 (Advanced Power Reactor 1400)

##### APR1400 Developed as One of National R&D Projects

- Government and Korean nuclear industries participated
  - KHNP, KEPCO E&C, KAERI, KNFC, DOOSAN, KINS
- KEPCO E&C participated in NSSS system design and architect engineering
- Project period : '92.12 ~ '01.12 (9 yrs)

##### Advanced Design Features (ADFs) Implemented

- Severe accident mitigation
- In-Containment Refueling Water Storage Tank (IRWST) design
- Quadrant divisional separation
- Advanced Man-Machine Interface System (MMIS) implementation

##### Construction Period of APR1400

- First concrete to fuel loading: 42 months
- First concrete to commercial operation: 48 months

##### Major Design Characteristics of APR1400

Capacity	NSSS Thermal Power Rated Electric Power	4,000 MWth 1,400 MWe
Performance	Design Life Time Availability Refueling Interval	60 years Average 90% 18 months
Safety	Core Damage Frequency Containment Failure Frequency Safe Shutdown Earthquake Thermal Margin Station Blackout Coping Time	$< 10^{-5}/\text{ry}$ $< 10^{-6}/\text{ry}$ 0.3g Greater than 10% Minimum 8 hours

##### Bird's-Eye View of APR1400





# Experience-Operation and Maintenance Services

KEPCO E&C has devoted its vast resources to the safe and reliable operation of nuclear power plants by providing high quality solutions for improving performance, reducing operating cost and efficiently managing plant lifetime.

## ● KEPCO E&C NPD's O&M Services

### Equipment Refurbishment

- Steam generator replacement engineering support

### System Improvement & Upgrade

- Power uprate engineering

### Licensing Support

- Improved technical specification (ITS) development
- Valve performance assessment

### Plant Lifetime Extension & Management

- Periodic safety review
- Component integrity monitoring & assessment

### I&C Modernization

- Digitalization
- Automation

## ● Major O&M Experiences

### Kori Unit 1

- Steam generator replacement engineering support
- Main generator replacement
- Feasibility study related to reactor vessel head replacement
- Licensing renewal
- Main control room (MCR) upgrade
- Simulator design
- I&C digital design
- HVAC system upgrade
- Process cabinet & plant computer replacement
- Cable management support

### Kori Units 3, 4

- Power uprate engineering
- Component cooling water (CCW) heat exchanger replacement

### Kori Site

- Alternate AC diesel generator (DG) engineering and procurement support

### Yonggwang Units 1, 2

- CCW heat exchanger replacement support





### Experience-Radwaste Management Support



#### ● Spent Fuel Management Support

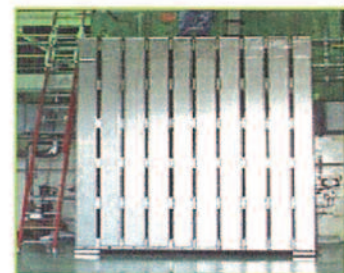
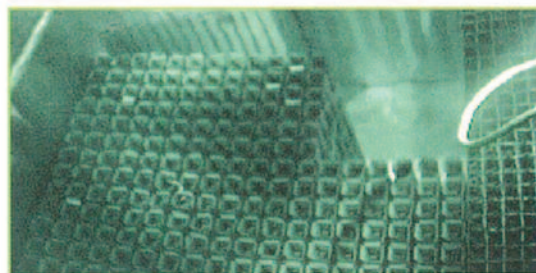
KEPCO E&C NPD provides high level radwaste management services that include reracking of spent fuel, dry cask storage of spent fuel and spent fuel transportation casks for replacing spent fuel storage racks in order to increase spent fuel storage capacity.

#### Present Condition of Spent Fuel storage

- PWR plants : Reracking for wet storage
- CANDU plants
  - Wet storage : extension of existing storage bay with upgrade
  - Dry storage : SILO (Dry storage facility)

#### Major Experiences

- PWR plants
  - Conceptual design of interim storage facility
  - High density storage rack
    - : Ulchin units 1, 2, 3, 4
    - : Kori units 3, 4
    - : Yonggwang units 1, 2, 3, 4
- CANDU plants
  - Transfer equipment in Wolsong units 2, 3, 4
  - Enlargement of Wolsong dry storage site
  - Spent fuel tray stack step raise



Spent Fuel Storage and High Density Rack

#### ● D&D (Decommissioning and Decontamination)

KEPCO E&C NPD has made mid and long term efforts to develop D&D technologies for safe and economical decommissioning as the number of operating nuclear power plants is increasing.

#### Major Experiences

- A study on the strategy for development of nuclear D&D technologies in Korea
- KRR (Korea Research Reactor) 1&2 decommissioning project
- Uranium conversion facility restoration project



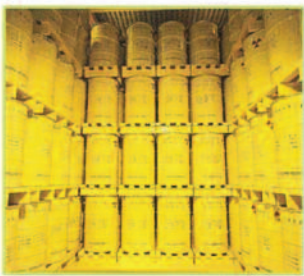
# Experience-Radwaste Management Support

## ● Design of Radwaste Disposal Facility

KEPCO E&C NPD has performed a research project on trench repository by building a pilot burial site for low or intermediate level radioactive wastes, and is currently performing design of the construction of a radwaste disposal facility, the site of which was recently selected in Gyeongju after a long debate at the national level.

### Scope of Work

- Waste characterization
- Disposal facility design ; near surface or rock cavern disposal
- Performance assessment
- Cost estimate
- Construction management



Panoramic View of Radwaste Disposl Facility



### Experience-Small Power and Research Reactor Development

#### ● Development of SMART (System-integrated Modular Advanced Reactor)

KEPCO E&C NPD participates in the system/structure design and architect engineering for the development of SMART Plant, where SMART Plant development project is one of national R&D projects under the leadership of Korea Atomic Energy Research Institute (KAERI).

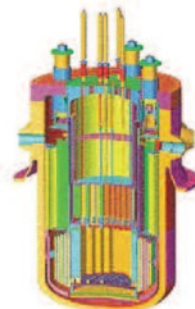
#### Application of SMART

- Seawater desalination plant and small scale power generation plant, etc.

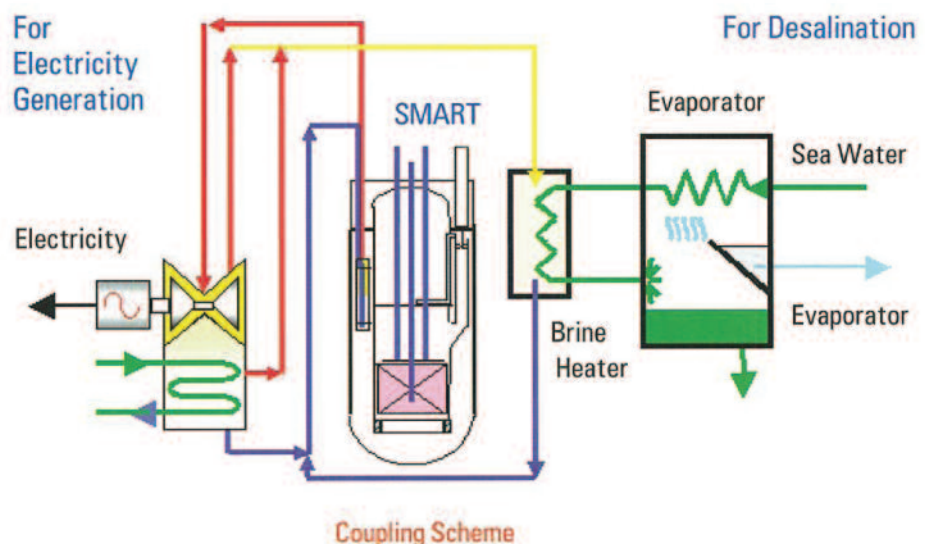
#### Design Features of SMART

- Integral PWR (330 MWth)
- Innovative design with inherent safety and passive safety features technology
- Economic improvement through system simplification, higher availability, shorter construction time, etc

SMART Pilot Plant



3D View of SMART  
Reactor Vessel Assembly





# Experience-Small Power and Research Reactor Development

## ● Development of HANARO Research Reactor

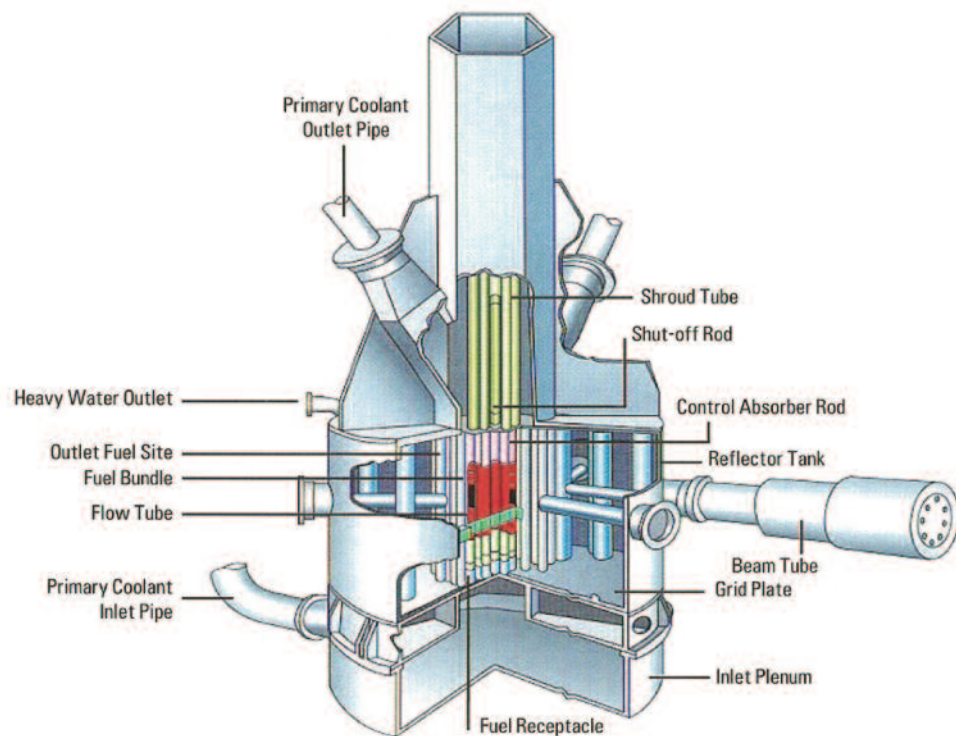
KEPCO E&C NPD participated in the design of HANARO as an architect engineer during the period of 1985.12 - 1992.12.

HANARO (High-flux Advanced Neutron Application Reactor) is a 30MWth multi-purpose research reactor producing high neutron flux, and has been operated at KAERI since 1995.

### Major Design Characteristics of HANARO

• Type	: Open-tank-in-pool
• Maximum thermal power	: 30MW
• Coolant	: Light water
• Reflector	: Heavy water
• Fuel material	: U3Si in aluminum matrix
• Fuel enrichment	: 19.75% w/o
• Absorber material	: Hafnium
• Secondary cooling	: Cooling tower
• Reactor building	: Confinement

**Currently a 20 MW class multi-purpose research reactor is being developed for overseas market based on HANARO model.**



Cutaway View of HANARO



# Nuclear Engineering & Services

Nuclear Projects Division

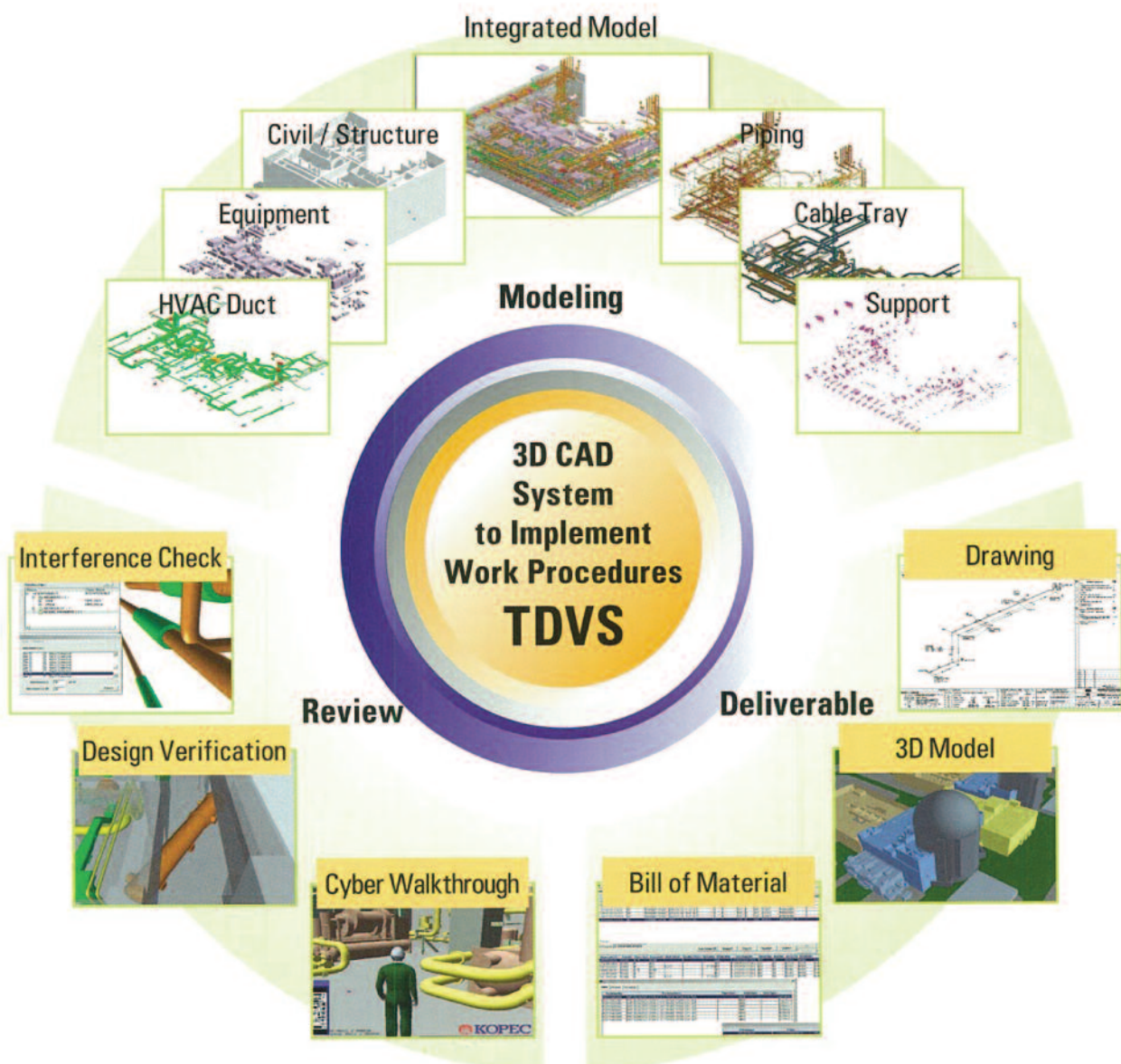
## Resources-IT Application Tools and Software

### 3D CAD (3 Dimensional Computer Aided Design)

3D CAD system has been developed to improve and streamline an existing engineering process and is being effectively applied to nuclear power plant engineering.

#### **TDVS (Tri-dimensional Design Verification System) : Standard 3D Design System to Implement Design Work Procedures**

- Implement & manage design work cycles
- Verify design and produce design output
- Increase design productivity & quality





# Resources-IT Application Tools and Software

## Information Management System

The IPIMS (Integrated Plant Information Management System) has been developed for

- Improvement of Engineering Quality & Performance
- Project Information Portal
- Concurrent Engineering
- World Wide Collaboration

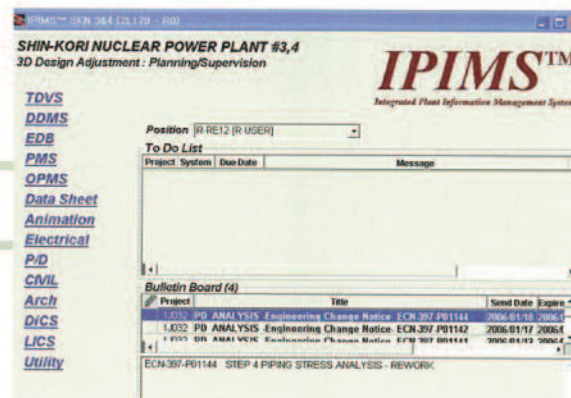
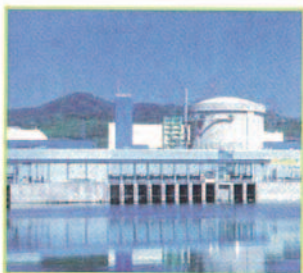
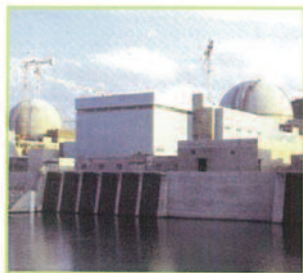
### IPIMS Scheme and Function

#### Intelligent 2D System

- Logical drawing production  
- including P&ID
- Tagged data generation  
- submitted to DB

#### 3D CAD System

- Physical 3D modeling & integration
- Interference & accessibility check
- Production of drawing & bill of material
- Management of 3D design process



#### Engineering DB System

- Engineering data control
- Engineering data integration and check
- Data link with 3D CAD model

#### Dwg. & Doc. Mgt. System

- Drawing & document management
- Workflow control
- Archiving & revision control
- View & print of deliverables



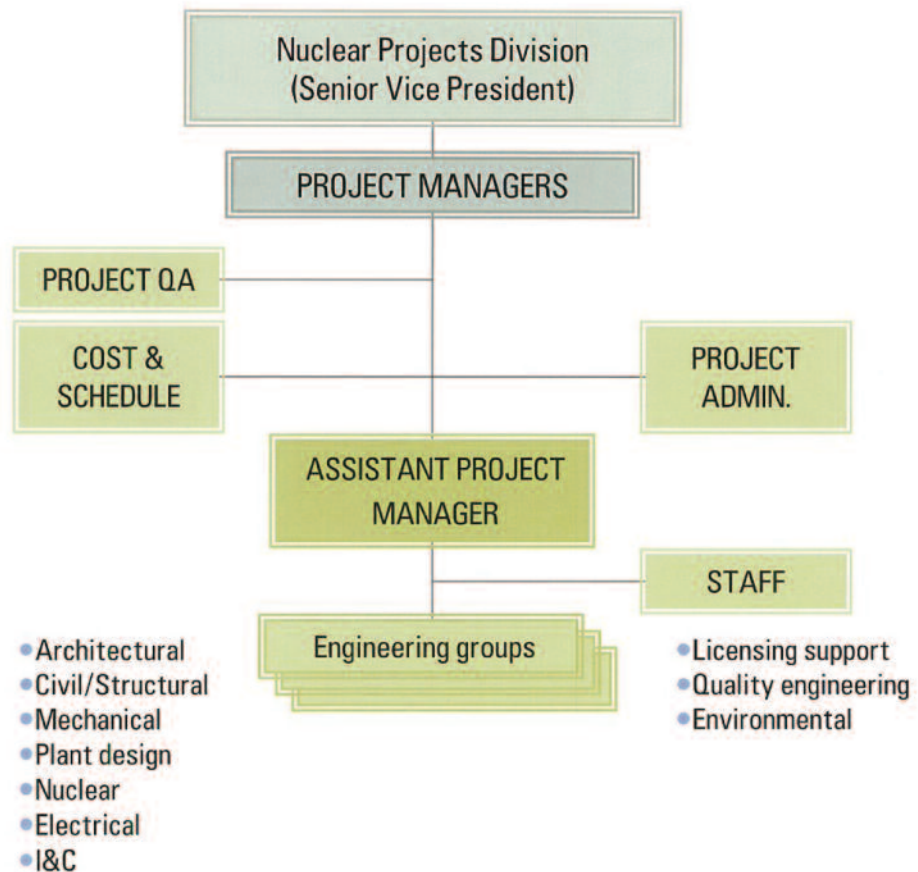
# Nuclear Engineering & Services

## Nuclear Projects Division

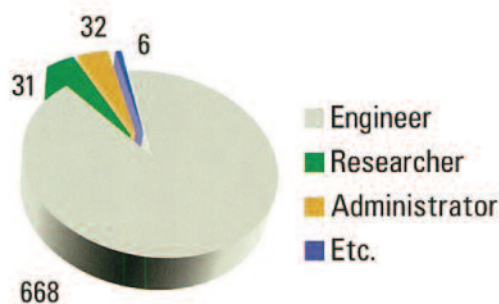
### Resources-Organization & Manpower



#### Organization of Nuclear Projects Division

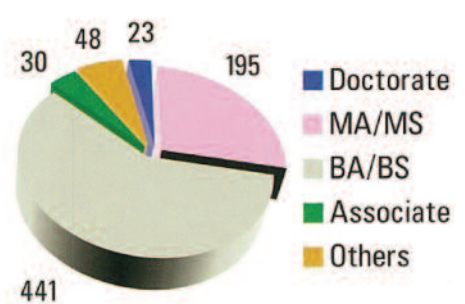


#### Manpower of Nuclear Projects Division



Distribution by Job Classification

737



Distribution by Academic Qualifications

737



# Why KEPCO E&C

## ● Abundant First Hand Experiences in Nuclear Power Plant Engineering and Technical Support Services; NSSS System Engineering and A/E

### Total Units: 30 Units

- In operation : 20 Units
- Under construction : 4 Units
- Under design : 4 Units
- Suspended (KEDO) : 2 Units

### Total Capacity: 29,316MWe

- Unit size class (MWe) : 600, 700, 900, 1000, 1400

### Reactor Type: PWR, CANDU-PHWR

- PWR : WEC type, Framatome type, OPR1000, APR1400
- PHWR : CANDU-6

## ● Experienced and Lively Design and Engineering Workforce with Average Age of 46





# Nuclear Engineering & Services

Nuclear Projects Division

## Why KEPCO E&C

### ● Maintaining Global Standards in Nuclear Power Plant Engineering

**Current State-of-the-Art Technology**

**Advanced Computer Codes**

**Proven In-house Design Standards**

**Sophisticated Project Management System**

**Efficient Drawing & Document Management System**

### ● Overseas Experience

**Technical Services for Lungmen NPPs, Taiwan**

**Consulting Services for China Guangdong Nuclear Power Co., China**

**Participation in NuStart COL with AP1000, USA**

**Support of S&L in Bruce Power Station Restart Engineering Services, Canada**

**Feasibility Studies of NPP Construction in Romania, Vietnam & Indonesia**





# Introduction to KEPCO E&C

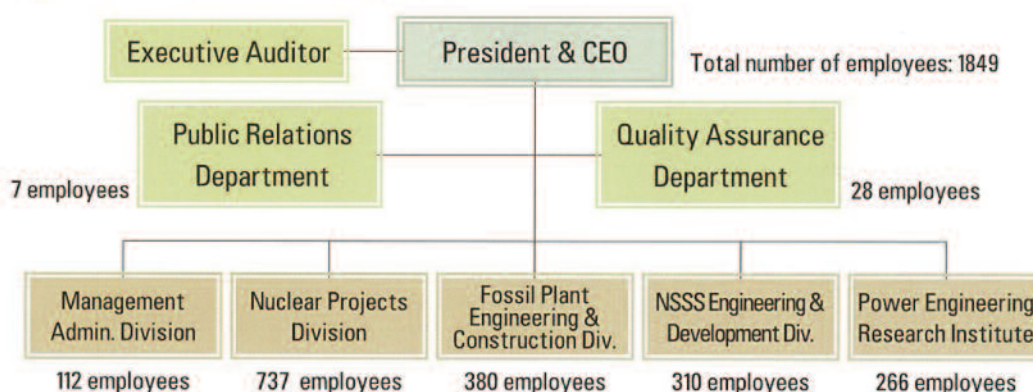
## Brief History

- Established as Government Owned Power Plant Architect Engineering (A/E) Company in 1975
- Become A/E Prime Contractor for Nuclear & Fossil Power Projects in 1987
- Absorbed System Design of Nuclear Steam Supply System (NSSS) from Korea Atomic Energy Research Institute in 1997, and Emerged as a Total NSSS-A/E Company

## Scope of Services

- Engineering of New Power Plants (Nuclear and Fossil)
- Engineering of Transmission & Distribution Systems
- Engineering and Supply of Environmental Facility
- Construction Engineering of Transportation & Industrial Infrastructure
- Operation & Maintenance Services for Operating Power Plants

## Organization and Manpower



## Financial Status

### Balance sheet (\$ in Millions)

Item	2001	2002	2003	2004	2005
Total Assets	167	203	227	256	273
Liabilities	61	66	60	69	75
Equity	106	137	167	187	198

### Sales and Operating Income (\$ in Millions)

Item	2001	2002	2003	2004	2005
Sales	174	214	235	252	275
Operating Income	19	39	39	11	7





