Overview of KNF

30th October 2015

Safeguards Section

Contents

Brief History

Global

Fuel Cycle Company

1980s

1982 Established KEPCO NF

1989 Started the commercial production of PWR fuel in Plant1 (200 MTU/yr)

1990s

1992 Established R&D center

1998 Extended the production capacity of PWR fuel and started the commercial production of PHWR fuel in Plant 2
(350 MTU/yr for PWR, 400MTU/yr for PHWR)

2000s

2008 Started the commercial production of PWR tubing (1,400 km/yr)

2010s

2012 Started UAE Project

Main Business

Design and Engineering

- Core design and safety analysis for PWR
- Fuel engineering

Fabrication of PWR and CANDU Fuels

- PWR & CANDU Fuels
- Fuel Components

Fuel Maintenance and Service

- Coolant Activity Analysis
- Poolside Examination, etc

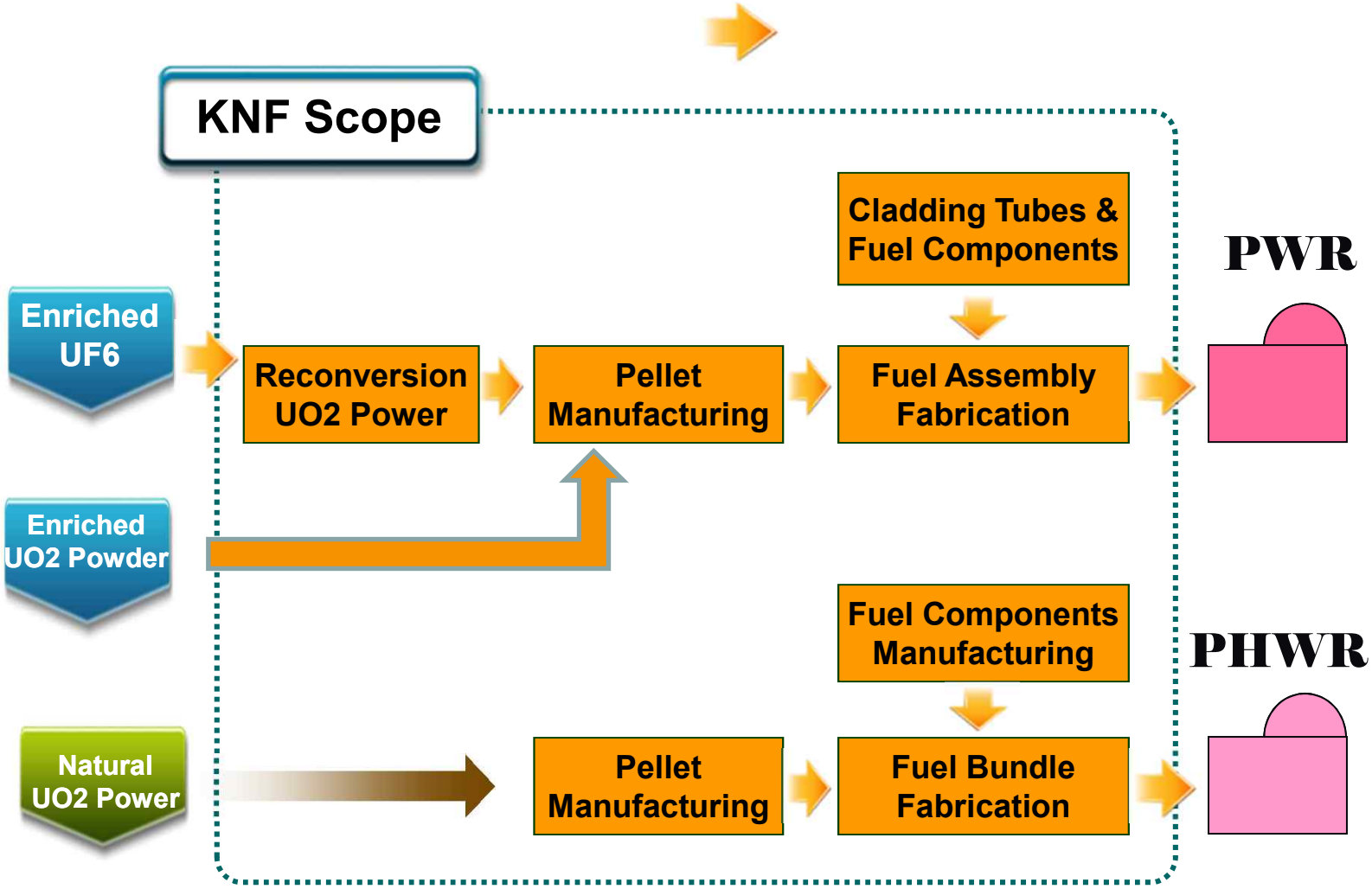
Research and Development

- Nuclear Fuel Components, Materials & Assembly
- Codes, Methodology & Models

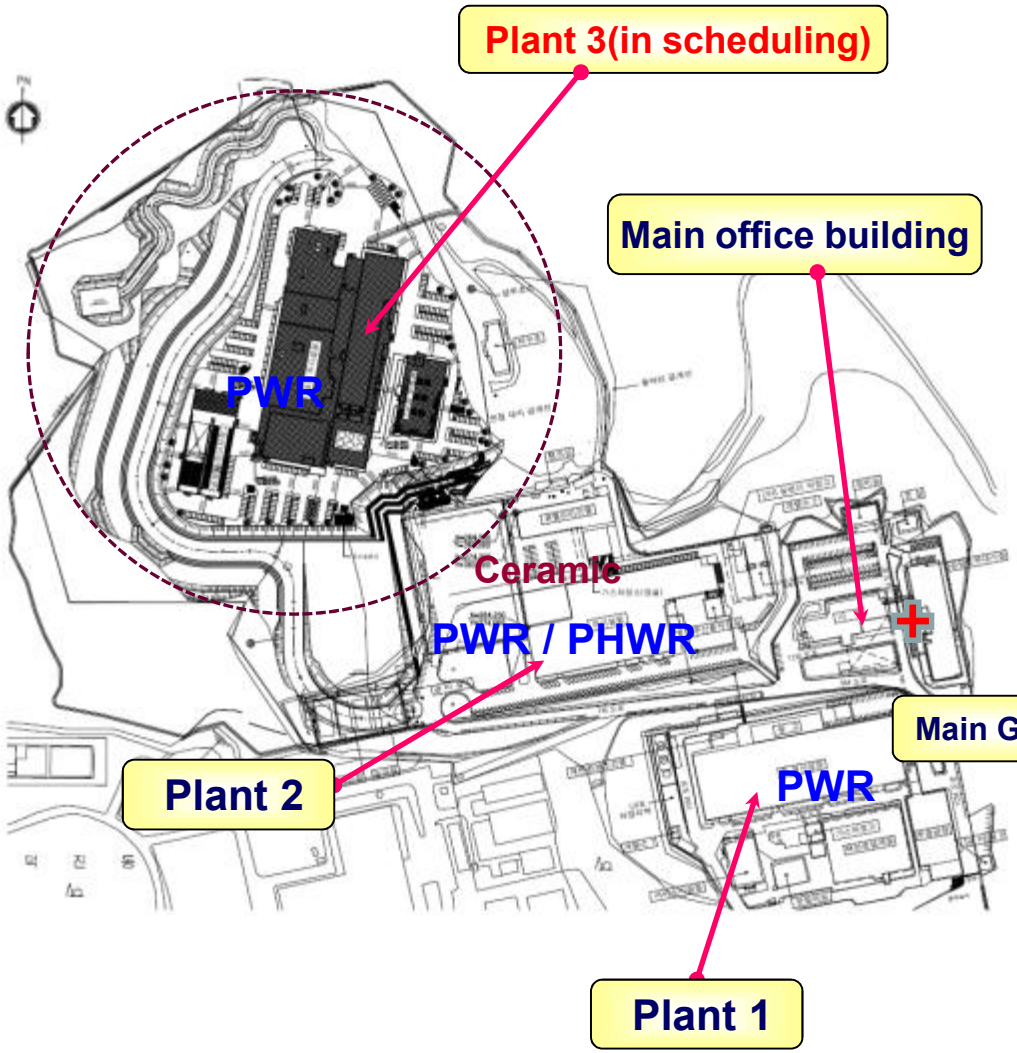
Overseas Business

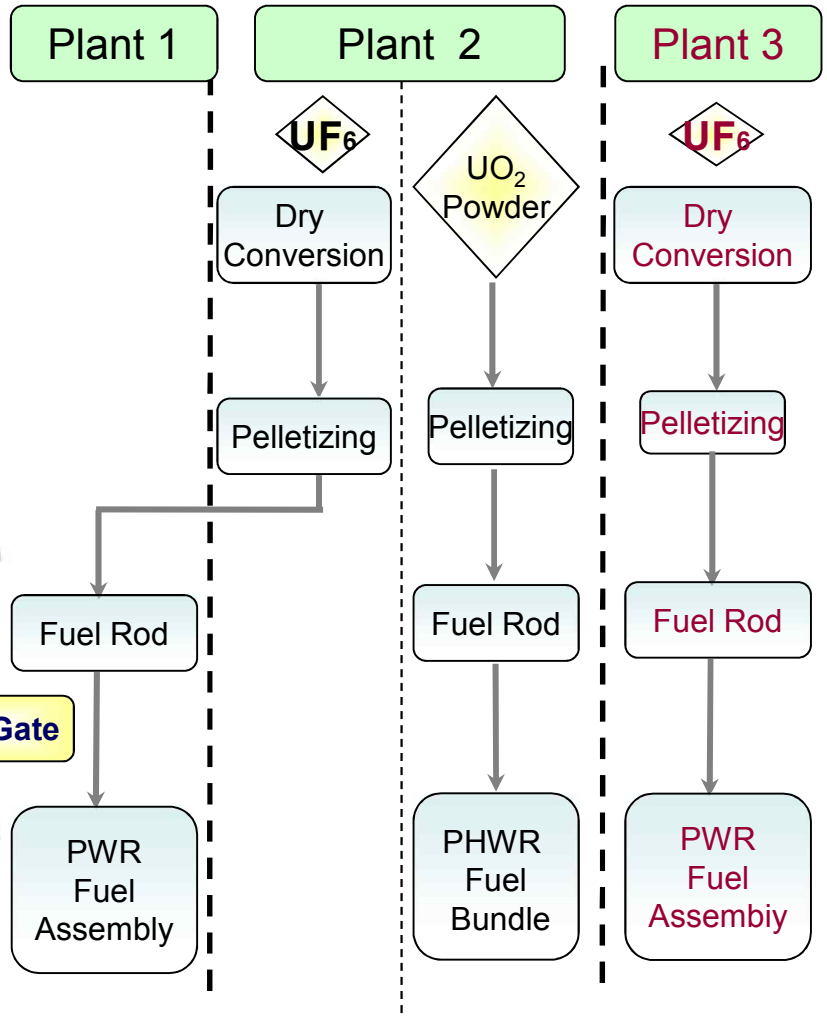
- about UAE

KNF Scope of Fuel Fabrication



The map of the ficilities





Fuel Types

PWR

OPR 1000 Plants
APR 1400 Plants

- PLUS7
- HIPER16

Westinghouse Type Plants

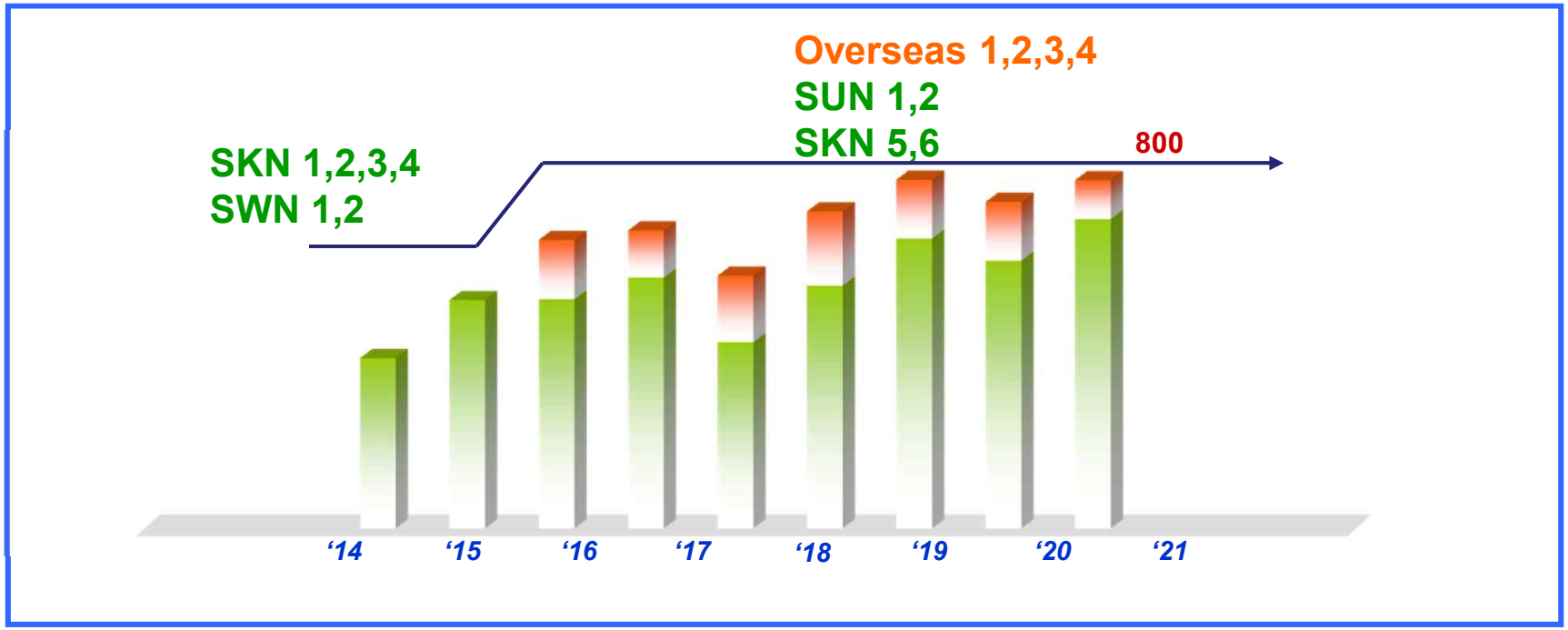
- 16ACE7
- 17ACE7
- HIPER17

PHWR

CANDU fuel

- 37-element standard

Forecasting the demands of PWR Fuel



Year	'14	'15	'16	'17	'18	'19	'20	'21	'22
Total Demand	**372**	**310**	**638**	**659**	**559**	**701**	**771**	**722**	**771**
Overseas	(0)	(0)	(131)	(104)	(147)	(164)	(130)	(130)	(86)

I. Overview of KNF

II. Nuclear Material Accounting System of KNF

III. Uranium Management

Brief History of Safeguards

- 1975. 11. : Entry into force of the Comprehensive Safeguards Agreements (INFCIRC/153)
- 2004. 2. : Entry into force of the Additional Protocol (INFCIRC/540)
  - Expanded Declaration
  - Complementary Access
- 2008. 7. : Enforcement of the Integrated Safeguards
  - For Optimization of Effectiveness & Efficiency of Safeguards Implementation
  - SNRI, Mail Box System, Residence time
- 2015. 9. : Entry into force of the State Level Approach

Nuclear Material Accounting System

❖ MBA of KNF

◈ KNF facility code : KOR-

◈ KOR- comprises two MBAs : KO1R(PWR) & KO2R(PHWR)

MBA	Initial Material	Product
KO1R	Enriched UF_6 /UO2 powder (< 5 wt% of U-235)	PWR fuel assembly (KSNP and WH types)
KO2R	Natural UO_2 powder	PHWR fuel bundle (CANDU type)

Nuclear Material Accounting System

❖ Process Description (KO1R)

Process	Description	Equipment
Reconversion	- UF_6 vaporization - Conversion from UF_6 to UO_2 powder	- Vaporizer - Kiln
Pelletizing	- UO_2 powder compression (green pellet) - Sintering and grinding	- Press - Furnace - Grinder
Fuel Rod	- UO_2 pellets into cladding tube and rod welding - Visual examination, neutron scan, and leak test	- Welding machine - Rod scanner - Helium leak tester
Fuel Assembly	- Fuel rods Into the skeleton for final product	

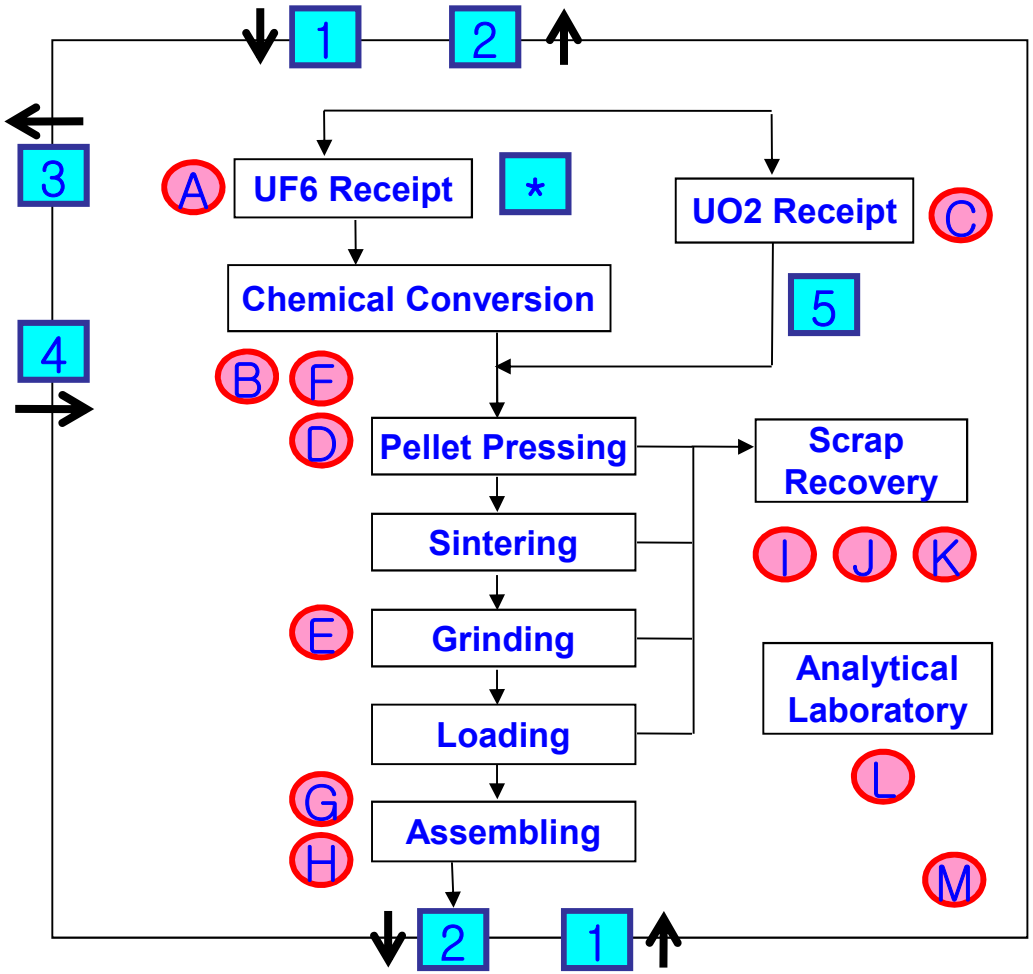
Nuclear Material Accounting System

❖ Process Description (KO2R)

Process	Description	Equipment
Pelletizing	- UO_2 powder blending with U_3O_8 powder and others - Powder compression (green pellet) - Sintering and grinding	- Tumbler, press - Sintering furnaces - Grinding machines
Fuel Rod	- Weight measurement - Pellets into fuel rod - Rod welding	- End cap welder
Fuel Bundle	- Rod positioning and assembly - Bundle inspection and packing	

Nuclear Material Accounting System

❖ KMPs of KO1R



[Note]

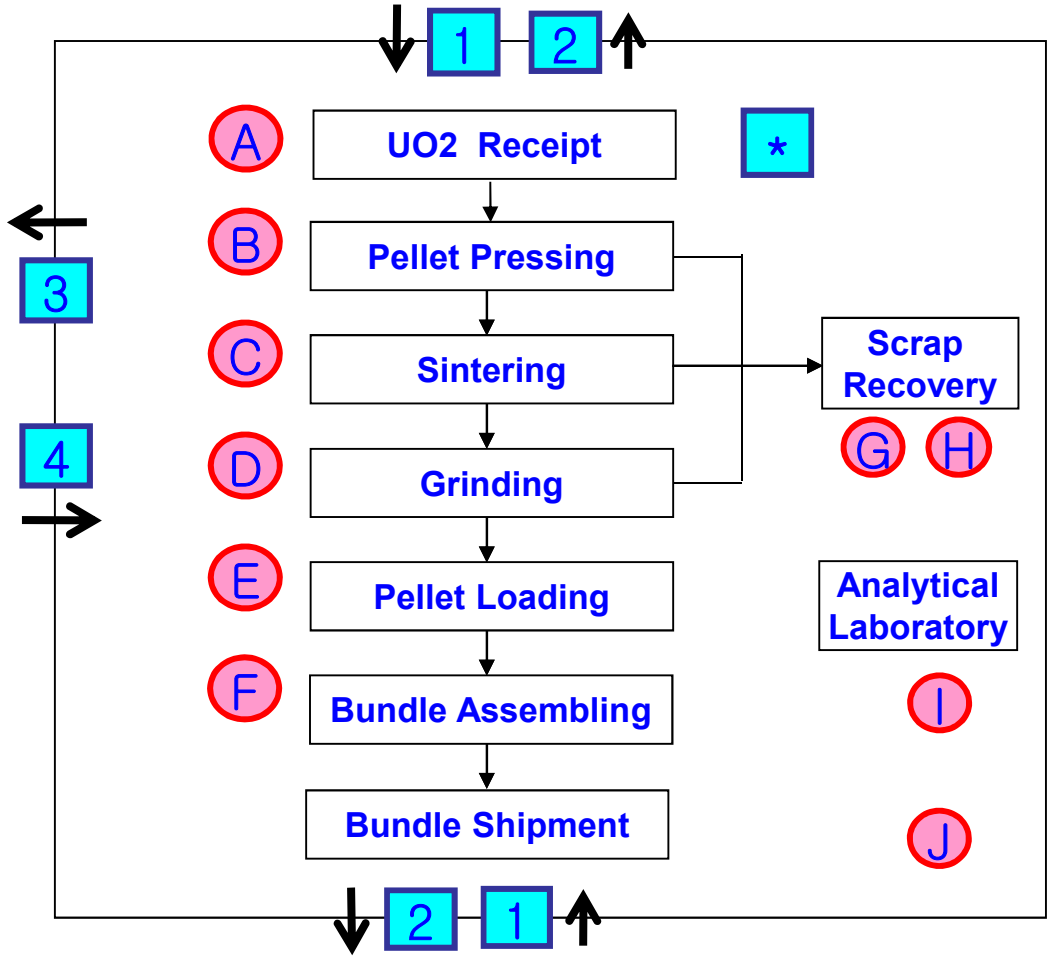
: Process

: Flow KMPs

: Inventory KMPs

Nuclear Material Accounting System

❖ KMPs of KO2R



[Note]

: Process

: Flow KMPs

: Inventory KMPs

Nuclear Material Accounting System

❖ Characteristics of Nuclear Material Accountancy at KNF

❖ The diversity of uranium

- ➢ Physical form : powder, pellet, fuel rod, fuel assembly and scraps
- ➢ Chemical form : UF6, UO2, U3O8, Gd2O3/UO2, etc.

❖ Uranium in the bulk form.

- ➢ Quantities of uranium in the containers are different from one another.
- ➢ All containers containing uranium shall be individually weighed.

❖ A large number of items : 15,000 ~ 20,000 items

❖ Frequent and complicated movement of uranium

- ➢ Uranium constantly flows from one process to the next process.
  (Flow rate : about 1.5 ton-U/day)

☞ Nuclear material accountancy at KNF is very complicated and accounting data should be controlled by computer system.

Nuclear Material Accounting System

❖ Safeguards Activities of IAEA

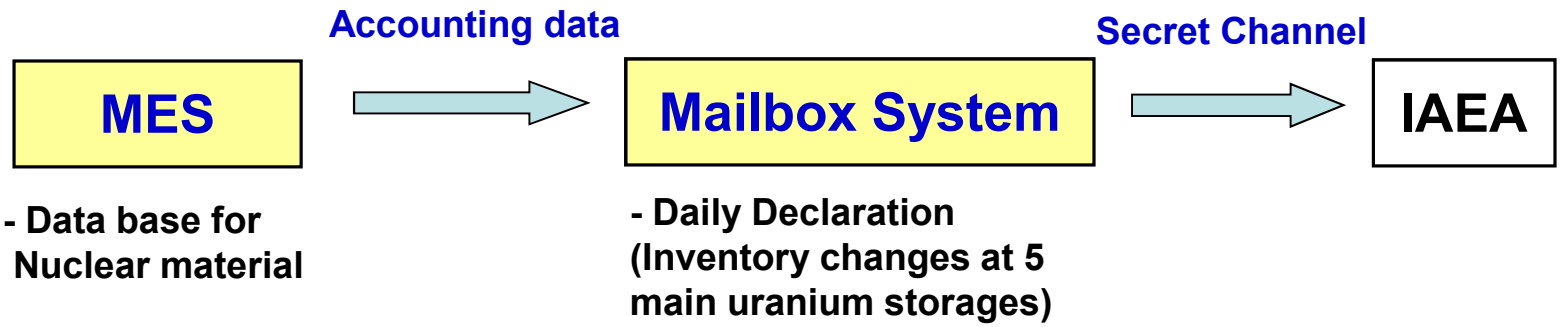
❖ Inspection : 1 PIV and 3 SNRIs per year on the average

PIV	SNRI
● Frequency : 1 PIV/year ● Period : 6 days/PIV ● Inspector : 5~6 people/PIV	● Frequency : 3-4 SNRIs/year ● Period : 2 days/SNRI ● Inspector : 4~5 people/SNRI
About 30 PDIs per year	About 30 PDIs per year

❖ KINAC's inspectors also perform inspection activities along with IAEA inspectors during PIV and SNRI

Nuclear Material Accounting System

❖ Computer System for Daily Declaration



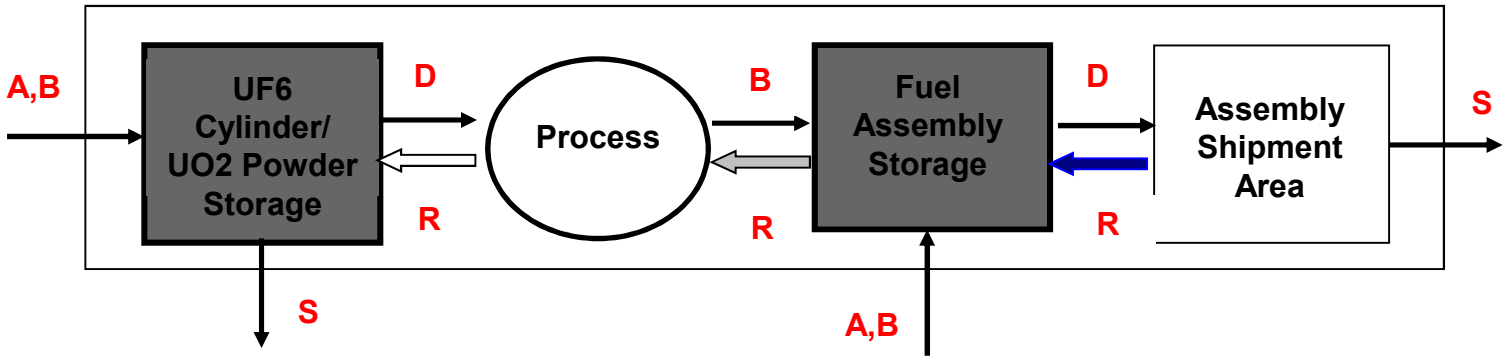
※ MES (Manufacturing Execution System) is the integrated computer system of KNF.

- ❖ The mailbox system is compatible with MES computer system for daily declaration.
- ❖ KNF provides information on inventory change to IAEA every day and daily declaration is essential to SNRI implementation.

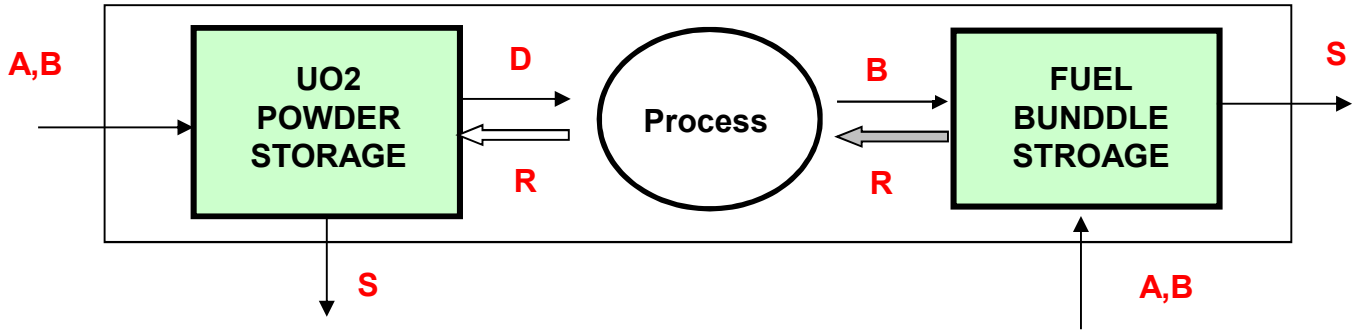
Nuclear Material Accounting System

❖ Daily Declaration Code

❖ KO1R



❖ KO2R

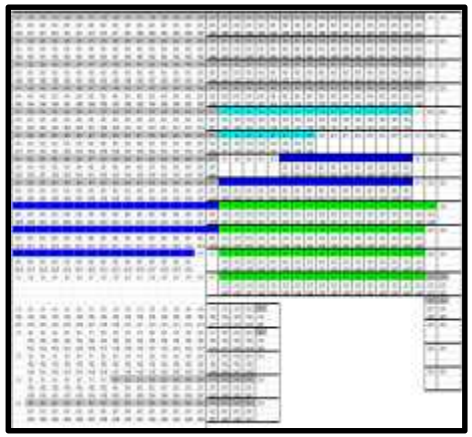


- *A = Arrival of NM*
- *B = Birth*
- *D = Death*
- *R = Return to /from process*
- *S = Shipments from the facility*
- Nuclear material reported through daily declaration shall be kept in storage for at least 3 days

Nuclear Material Accounting System

❖ MES(Manufacturing Execution System)

- **Major function of MES**
  - ➢ Production control
  - ➢ Quality control
  - ➢ Nuclear material accountancy
- **Functions of MES for Accountancy**
  - ➢ Map of Uranium Stock
  - ➢ Uranium transfer management
  - ➢ History of warehousing & release for Uranium storage



Map of Fuel Assembly Storage

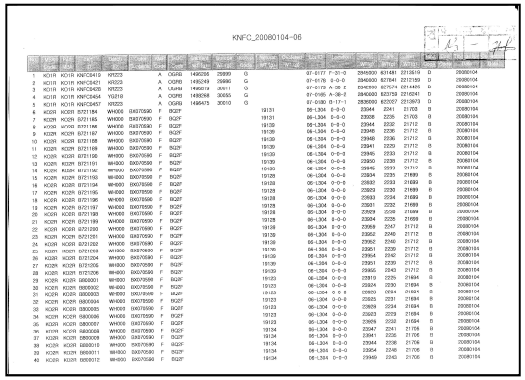
Warehousing/release data
for Uranium Storage

Nuclear Material Accounting System

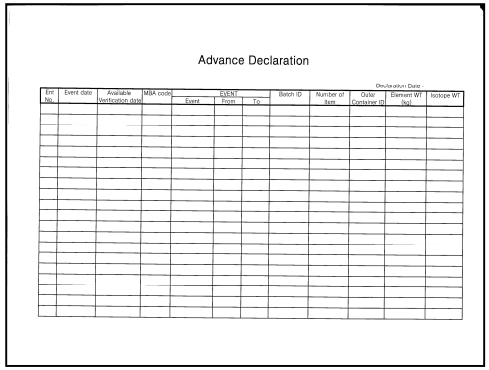
❖ Functions of Mailbox Systems

- **Daily Declaration** : KNF declares details of nuclear material transfer for 5 main storage areas every day.
- **Advanced Declaration :** KNF declares details of planning for the next month regarding shipping or receipts by the 25th of every month.
- **Force Majeure** : It is possible to send force majeure in case KNF can't implement inspection such as a malfunction of computer systems or transport equipment.

❖ Samples of Mailbox Declaration Form



Daily declaration form



Advance declaration form

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Uranium Management

❖ Uranium Storages

Classify	Storage	Max. capacity (ton-U)	Remark
KO1R	UF6 storage 1	280	Mail box
	UF6 storage 2	420	
	UO2 powder(low-enrichment) storage	50	Mail box (UAE)
	Uranium storage1 (powder, pellet, scrap)	220	
	Uranium storage2 (powder, pellet, scrap)	23	
	Gd uranium powder storage	9	
	Gd uranium pellet storage	15	
	Fuel assembly storage	784 FA	Mail box
KO2R	UO2 powder(natural) storage	200	Mail box
	Fuel bundle storage	250	Mail box

Uranium Management

Main Storages

(1) UF6 Storage

(2) UO2 Powder Storage (Low-enrichment)

(3) PWR Fuel Assembly Storage

(4) PHWR Powder Storage (Natural)

(5) PHWR Fuel Bundle Storage

Uranium Management

Feed materials & Containers

30B Cylinder
(UF6)

3516 container
(UO2 powder)

Powder drum
(Natural UO2 powder)

B drum

PD box

UD drum

Uranium Management

Identification Control

❖ **Uranium enrichment card**

- The enrichment percent
- Cylinder No.
- Order designation
- Gross/Tare/Net/U/U-235 weight
- U-235 percent
- Date of receiving
- Signature

Uranium Management

A complete view of Uranium storage

Pellet(scrap) storage rack

Powder(scrap) storage rack


Q&A

Thank for your listening !