

<Panel Discussion 2>

Promotion of International and Regional Cooperation on Nuclear Forensics

Overview of the National Nuclear Forensics Program in ROK

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Tokyo Institute of Technology
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Jae-Jun Han

International Nuclear Nonproliferation and Security Academy
Korea Institute of Nuclear Nonproliferation and Control (KINAC)
Republic of Korea

ROK National Program for Nuclear Forensics

❖ 2010 Nuclear Security Summit, Washington, DC

❖ National R&D Program – Planning Stage (2011~2013)

- Establishment of Korean Nuclear Forensics Framework (2011)
- Development of the Fundamental Techniques for Nuclear Forensics (2012)
- Study for Establishment of National Nuclear Material Library (2012)



❖ National R&D Program – Initiation (2013~)

- National Nuclear Forensics Support System Development (2013.7~)
 - **KINAC** funded by NSSC for 5 years (approx. USD 2.8M)



“Korea has also started developing a national nuclear forensics system, including a national response plan, and nuclear forensics library.”

- 2016 NSS Progress Report, Republic of Korea

- Other programs are ongoing (RadLOT, Lab Analysis for Nuclear Forensics, etc)

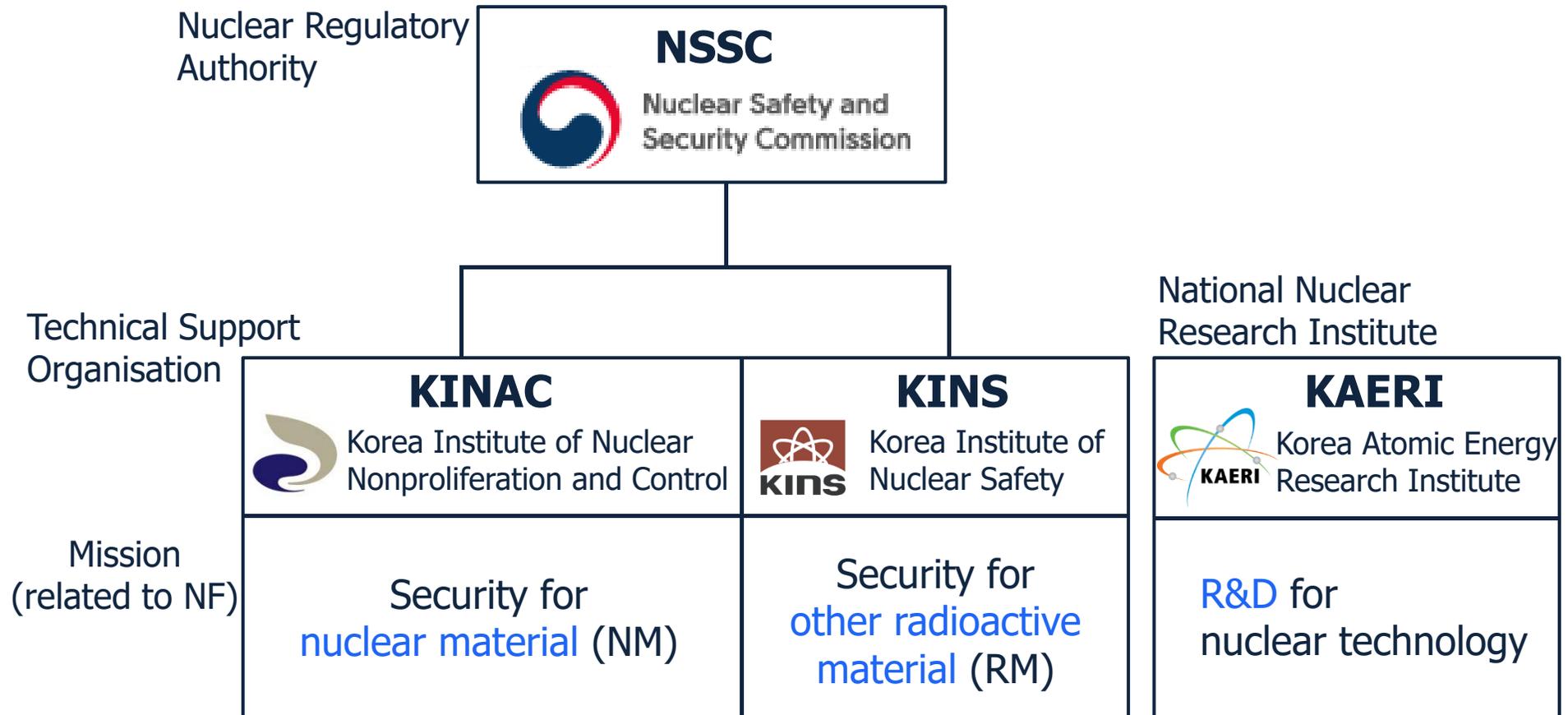
Contents

- ❖ **Strategies for Building Nuclear Forensics Capabilities in ROK**
- ❖ **Inter-agencies' Roles and Responsibilities - Supportive Device**
- ❖ **Development National Nuclear Forensics Library (NNFL)**

Strategies for building NF capabilities in ROK (1)

❖ Consideration of National Regulatory System of RN Materials

(Radiological and Nuclear)



- ✓ Cooperation between national institutes is imperative to implement NF efficiently in ROK

Strategies for building NF capabilities in ROK (2)

❖ Based on International Guidelines

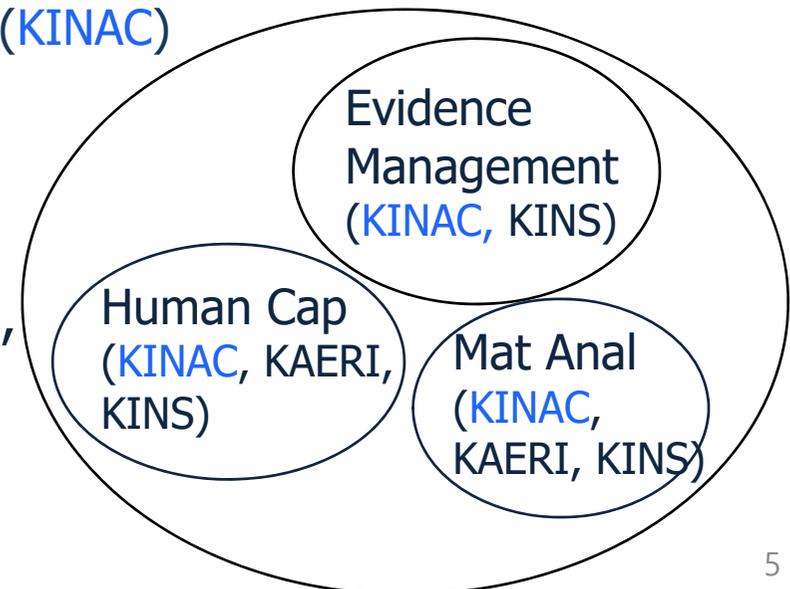
- National Framework → **KINAC NF R&D Program**
 - Survey of existing technical capabilities,
 - National response plan,
 - National NF library (NNFL), etc.
- Key elements
 - NF Evidence Management
 - Material Analyses and Interpretation
 - Human Capital

✓ NF National Framework created by KINAC, key elements developed by expert organisations

Nuclear Forensics Fundamentals
(IAEA, ITWG, GICNT, etc)



NF National Framework
(**KINAC**)



Strategies for building NF capabilities in ROK (3)

❖ Overview of Implementing Nuclear Forensics

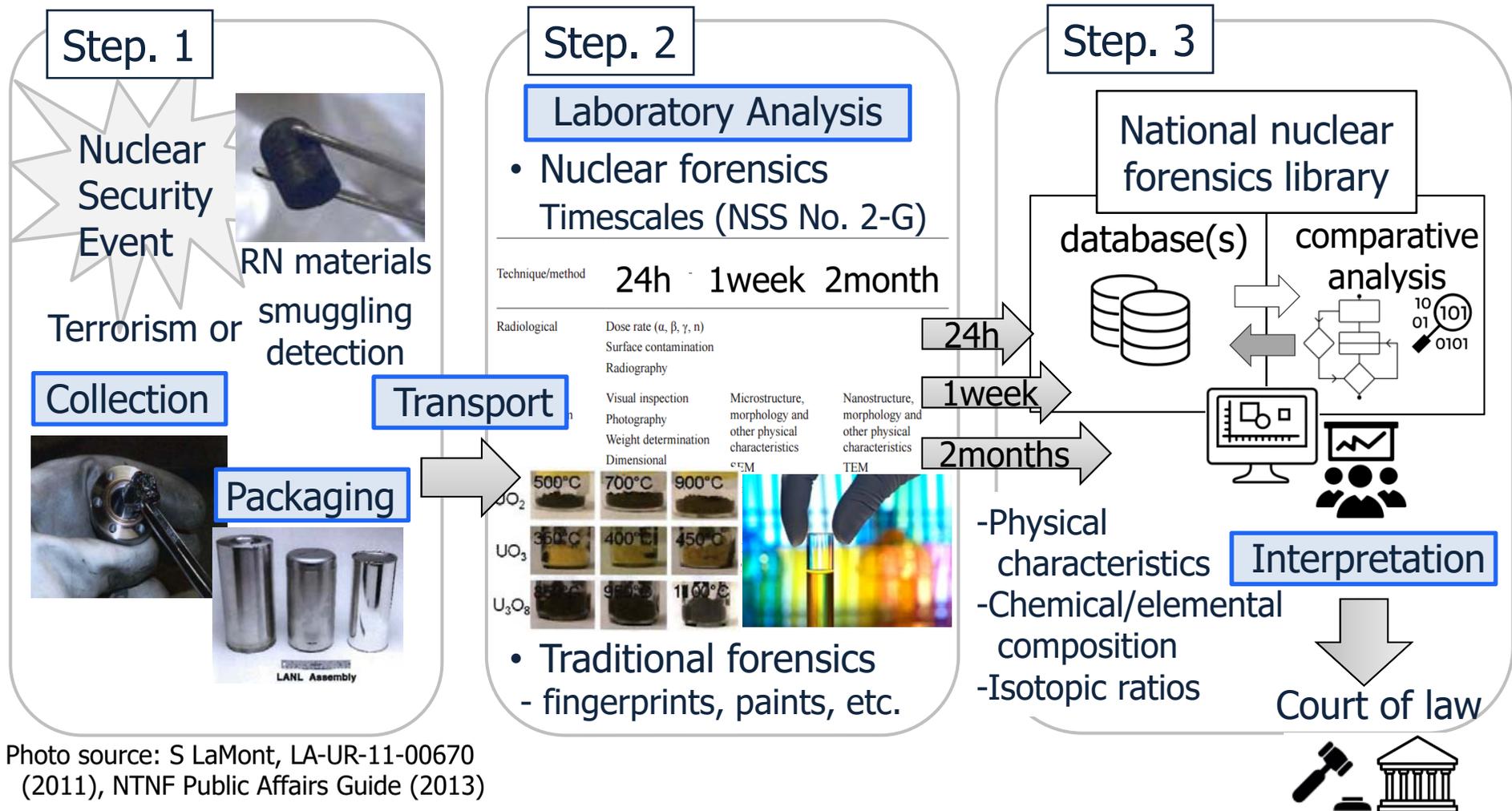


Photo source: S LaMont, LA-UR-11-00670 (2011), NTFN Public Affairs Guide (2013)

→ Inter-agencies' roles and responsibilities are very important over the process

Inter-agencies' Roles and Responsibilities (1)

❖ Nuclear Security Event Awareness Raising Workshop

'15.11.11~13, KINAC/INSA (ROK-US PCG Cooperation)

- Objectives
 - To increase NF awareness in ROK
 - To perform exercises of response to radiological Terrorism
 - Participants
 - (ROK) NSSC, NIS, KINAC, KINS, KAERI, KIRAMS, KHNP, etc.
 - (US) NNSA, FBI, (AUS) ANSTO
 - Agenda
 - Introduction to nuclear security events, nuclear forensics, the national response plan and roles of interagency
 - Table top and field exercises
 - Review on current status of the national response plan
- ✓ A foundation to build the ROK consultancy meeting, and to revise “the **National Response Manual** for Radiological Emergency”



Inter-agencies Roles and Responsibilities (1)

– Supportive Device Development

❖ **Background for Supportive Device Development**

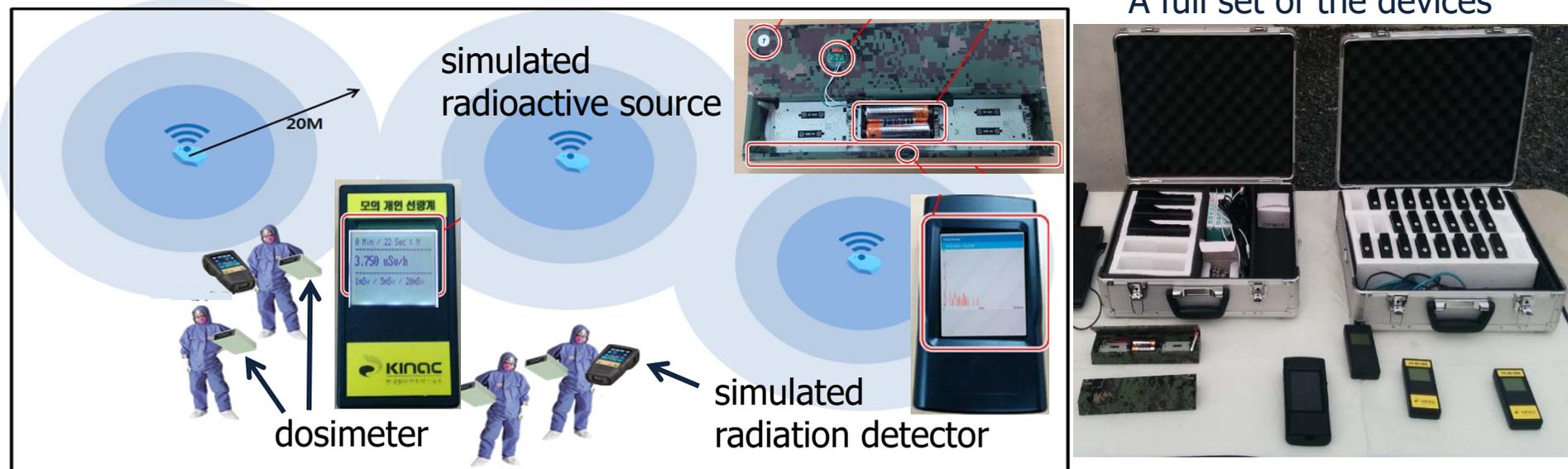
- To effectively collect/preserve evidence in a radiological crime scene, on-scene investigators to be fully exercised - detecting, locating and recovering RN materials
 - For field exercises, an allowable sealed source is the very small amount due to radiological risk to trainees
 - Normally, their cumulative dose manually estimated using posted information on the ground
- A more realistic training system required for the field exercise



Inter-agencies Roles and Responsibilities (2) – Supportive Device Development (Cont'd)

❖ Development of a Detector coupled with Simulation Sources

- Bluetooth Low Energy (BLE) beacon technology
- The intensity of signals can be converted to the distance between the detector and sources

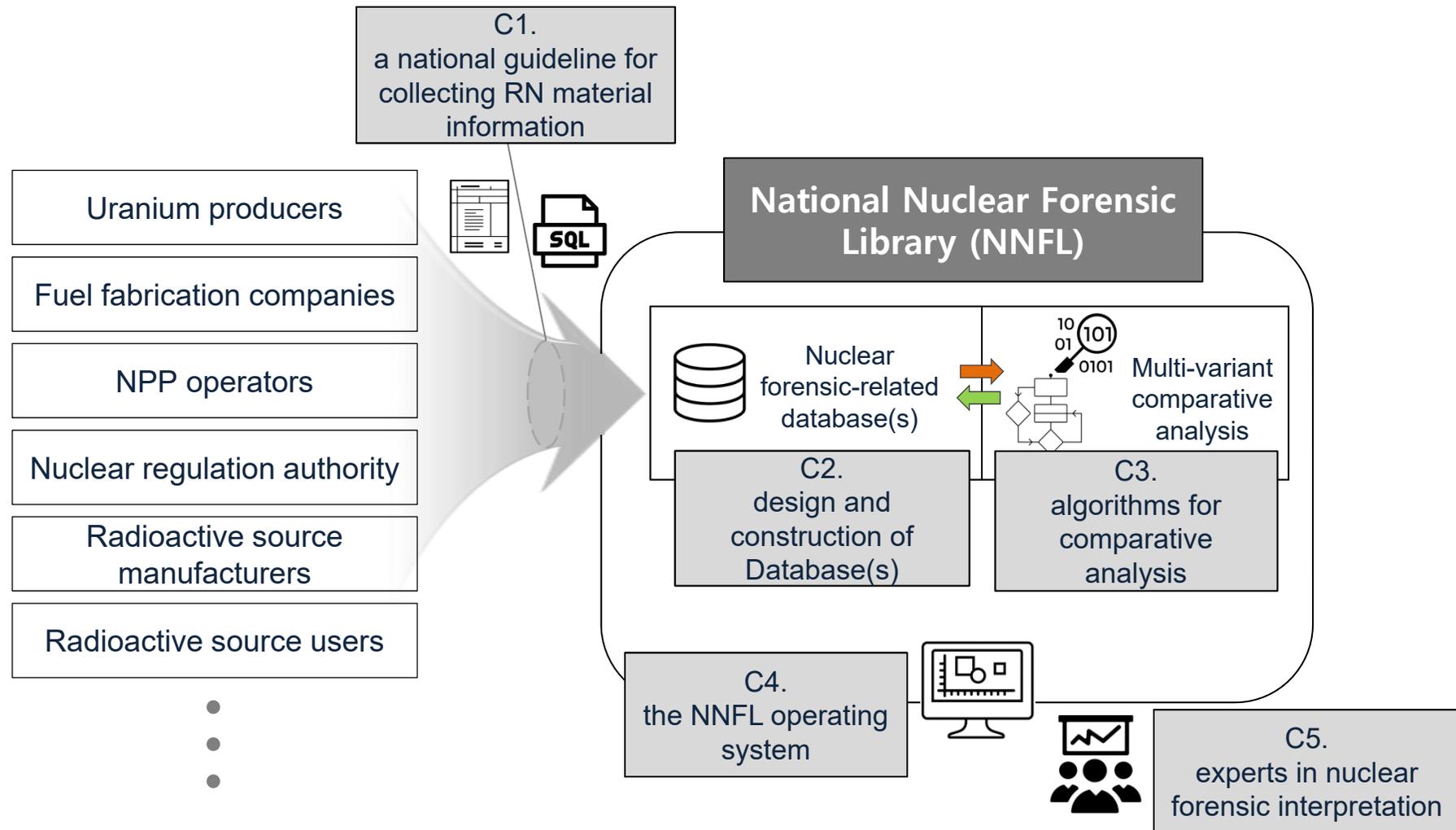


S Lee et al, ANS, Winter meeting (2015), J Kim et al, KNS, Spring Meeting (2016)

- ✓ As a supportive tool for establishing inter-agencies roles and responsibilities in the field exercise
- ✓ Utilised in “the 2016/2017 ROK National Radiological Emergency Response Exercise” including detecting, locating and recovering RN materials

National Nuclear Forensics Library : Overview of Essential Constituents

❖ Development of an NNFL (schematic)



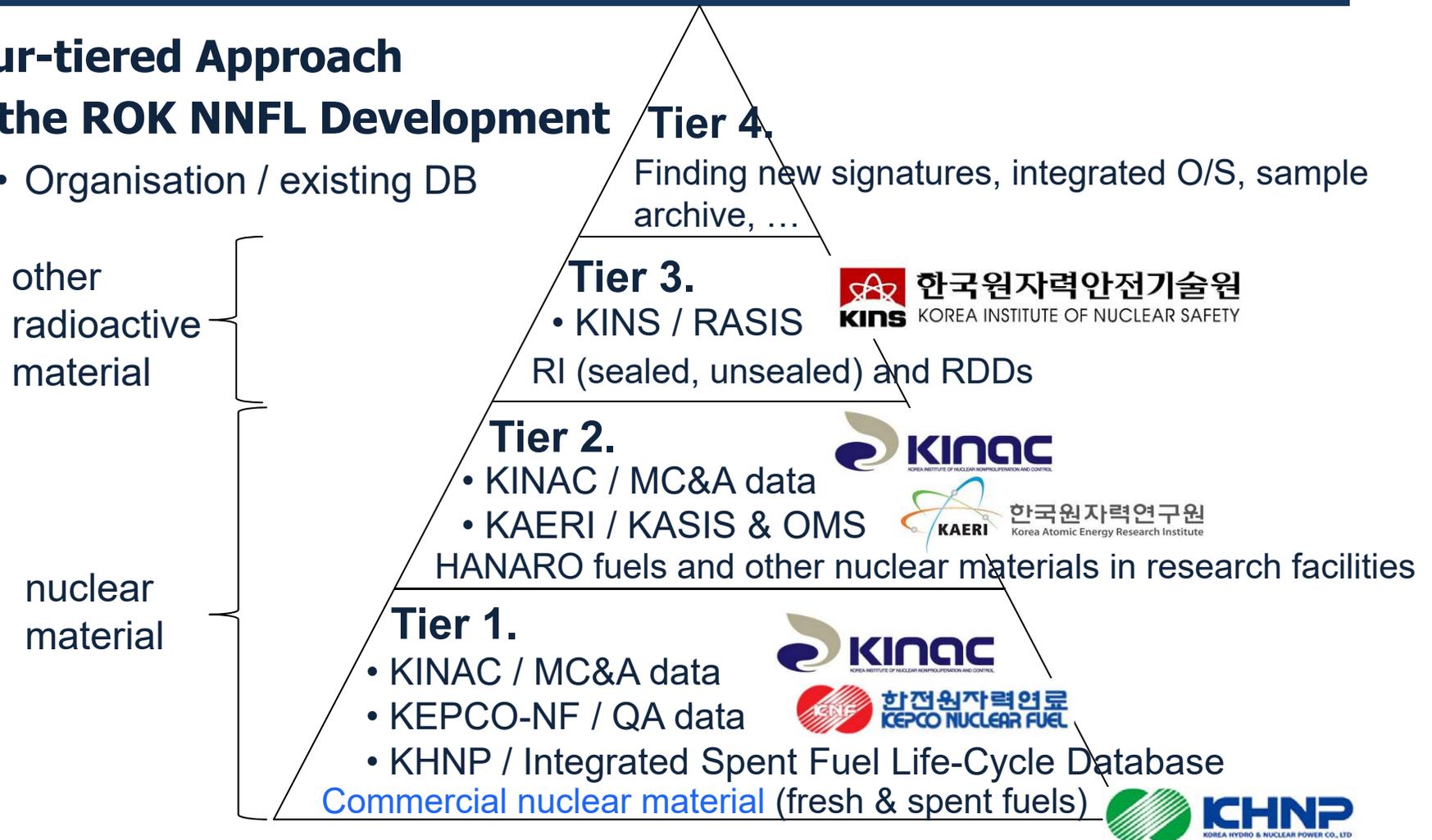
- ✓ (Ultimate Goal) the NNFL system applicable for all NM and RM within ROK
- ✓ (Current Status) Under development of the NNFL system for partial NM

National Nuclear Forensics Library

: Leveraging the Existing Information (1)

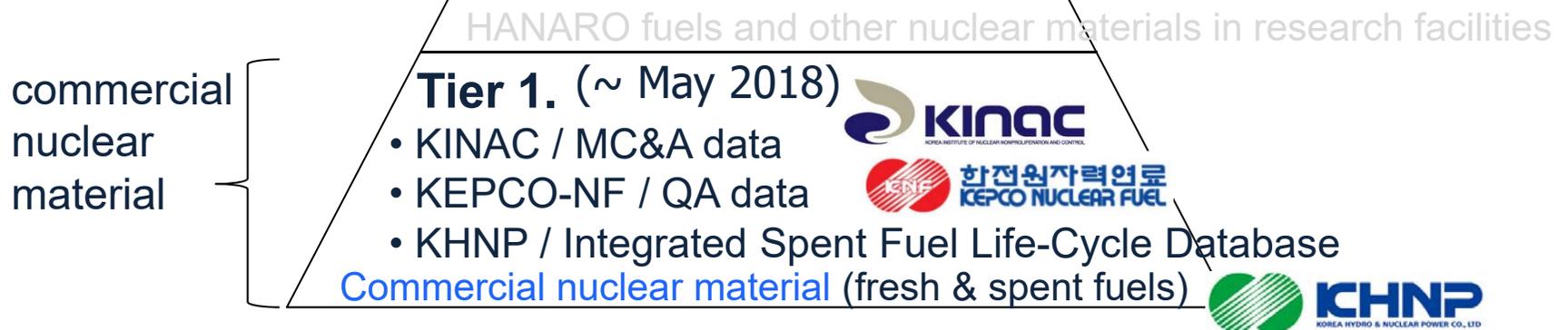
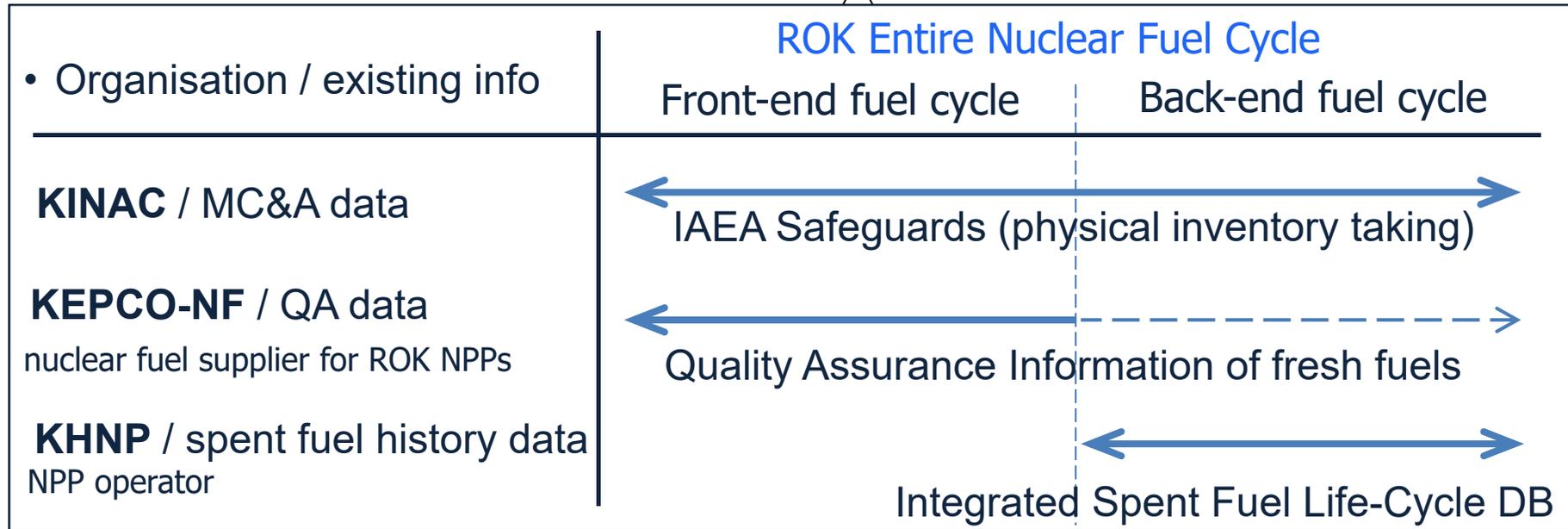
❖ Four-tiered Approach to the ROK NNFL Development

- Organisation / existing DB



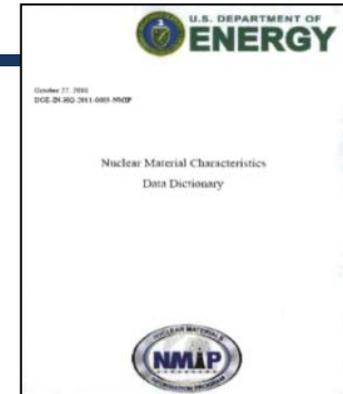
- ✓ The RN materials in ROK can be categorised according to the purpose.
- ✓ Given the size of nuclear and radiation industries in ROK, a tiered approach has been introduced

National Nuclear Forensics Library : Leveraging the Existing Information (2)



- ✓ Fully utilising existing information of the current management system to provide efficient guideline for constructing the ROK NNFL
- ✓ Legal basis needs to be established for collecting the information

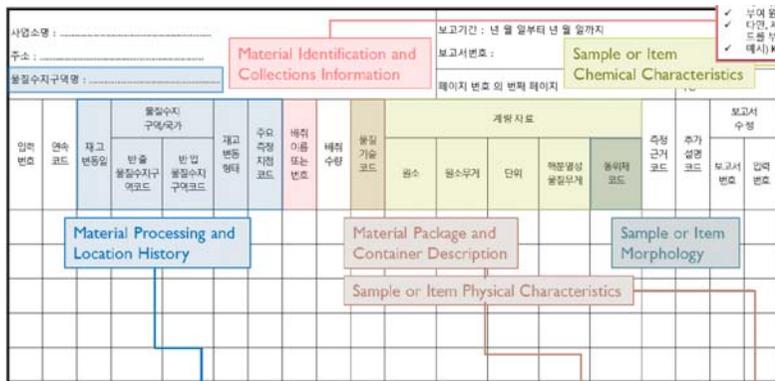
National Nuclear Forensics Library : Leveraging the Existing Information (3)



❖ KINAC – MC&A data



- IAEA Safeguards Reporting (CODE 10)
 - ICR (inventory change report) information was categorized by the Nuclear Material Characteristics Data Dictionary (DOE)
- ICR(inventory change report)



A	Material Identification and Collection Information
B	Material Package and Container Description
C	Sample or Item Physical Characteristics
D	Sample or Item Chemical Characteristics
E	Sample or Item Morphology
F	Material Processing and Location History

❖ KEPCO NF – QA data



- Partial QA data set was being reviewed.
- (All information cannot be shared due to the patent issue)

❖ KHNP – Integrated Spent Fuel Life-Cycle Database

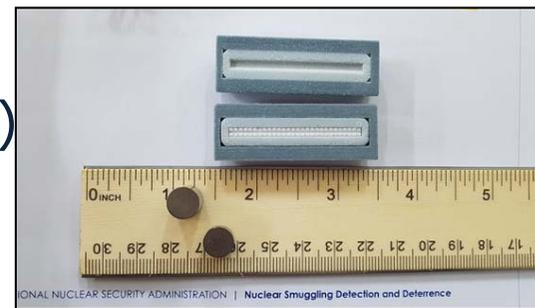


- Fuel No., Fuel Type, (Calculated) Burnup, discharge date, Initial Enrichment, Stored pool information etc.

Inter-agencies Roles and Responsibilities - NNFL

❖ National Nuclear Forensics Library Workshop '17.3.29~31, KINAC/INSA (ROK-US PCG Cooperation)

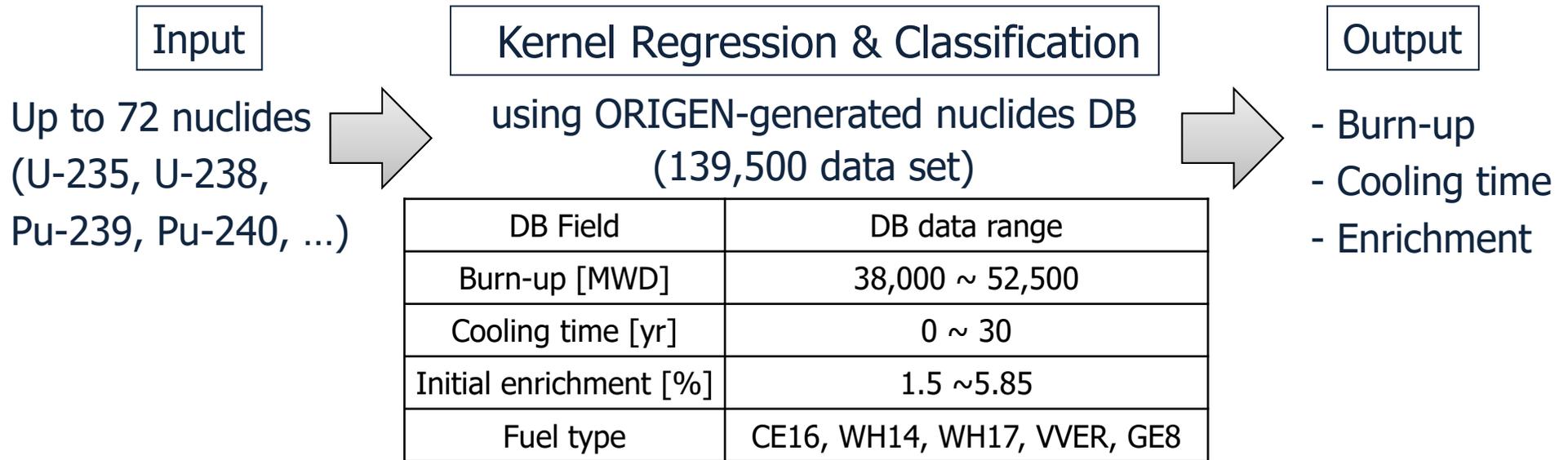
- Objectives
 - To emphasize an NNFL necessity
 - To share the NNFL current status in ROK and US
- Participants
 - (ROK) NSSC, NIS, KINAC, KINS, KAERI, KEPCO NF, etc.
 - (US) DOE/NNSA, PNNL, LANL, ANL
- Agenda
 - Current Status of the US/ROK NNFLs
 - Legislation Research for Implementing NF in ROK
 - DB Design and Management for NM & RN materials
 - Comparative Analysis Techniques for NF
 - Leveraging Existing Information for NNFLs



✓ A chance to check the interim results of NNFL development in ROK

Algorithm for Comparative Analysis (1)

❖ Development of a Spent Fuel Inference Model



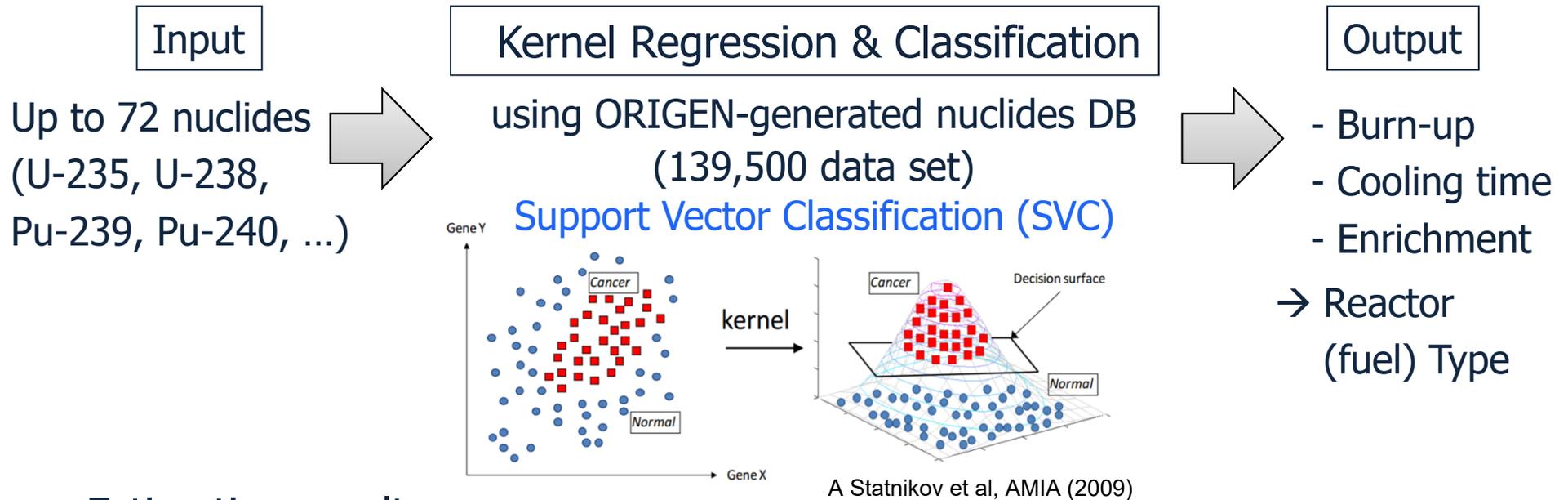
- Estimation results
- ORIGEN-based spent fuel history estimation

No. of measured nuclides	Burn-up (43.5 GWD)	Cooling time (7.00 years)	Initial enrichment (3.00 %)
	Estimated values		
Highest 1	45.5	9.43	3.04
High rank 5	43.5	6.79	3.00
High rank 15	43.5	7.00	3.00
High rank 30	43.5	7.00	3.00
All nuclides used	43.5	7.00	3.00

High accuracy

Algorithm for Comparative Analysis (2)

❖ Development of a Spent Fuel Inference Model



• Estimation results

- Inference of reactor type using experimental data (SCOMPO)

Calvert Cliffs-1		Estimation (SVC)
Sample 3	WH14 →	WH14
Sample 9	WH14 →	WH14

- ✓ Regression and Classification are developed, based on the Origen-generated nuclides DB (point reactor kinetics)

Thank you very much

Contact Information

Jae-Jun HAN, email: jjhan@kinac.re.kr

(Director) Seung Ho JEONG, email: shjeong@kinac.re.kr

