The Status of Radioactive Material Transport in Korea

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- Territory: 100,363 km$^2$
- Population: 51.83 million
Trend of Power Generation per Source (GWh)
Major Nuclear Facilities in Korea

- **Nuclear Power Plant (NPP)**
  - 24 units in operation
  - 2 units have been shut down permanently

- **Research Reactor (RR) / Educational Reactor (ER)**
  - HANARO (RR)
  - AGN (ER)

- **Nuclear Fuel Cycle Facility (FC)**
  - Fuel Fabrication Plant for NPP
  - Fuel Fabrication Facility for RR
  - Post-Irradiation Examination Facility (PIEF)

- **Radioactive Waste Management Facility (RW)**
  - RI Waste Management Facility
  - Wolsong LILW Disposal Center (WLDC)
Radiation Users in Korea (Sep. 30, 2019)

<table>
<thead>
<tr>
<th>Sector</th>
<th>Notified Users&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Permitted Users&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medical</td>
<td>14</td>
<td>182</td>
<td>196</td>
</tr>
<tr>
<td>Industry</td>
<td>5,803</td>
<td>1,021</td>
<td>6,824</td>
</tr>
<tr>
<td>Research</td>
<td>272</td>
<td>67</td>
<td>339</td>
</tr>
<tr>
<td>Education</td>
<td>131</td>
<td>163</td>
<td>294</td>
</tr>
<tr>
<td>Public</td>
<td>801</td>
<td>58</td>
<td>859</td>
</tr>
<tr>
<td>Military</td>
<td>74</td>
<td>33</td>
<td>107</td>
</tr>
<tr>
<td>Total</td>
<td>7,095</td>
<td>1,524</td>
<td>8,619</td>
</tr>
</tbody>
</table>

<sup>a</sup> Radioisotope users and Radiation Generator Users are Included
Transport of Radioactive Materials in Korea

- **Domestic Transport**
  - **Road**: Radioisotopes, Radioactive Waste (LILW), Nuclear Fuels ($\text{UO}_2$, $\text{UF}_6$), Spent Nuclear Fuel Assemblies
  - **Sea**: Radioactive Waste (LILW)

- **International Transport**
  - **Air**: Radioisotopes
    - Main port: Incheon International Airport
  - **Sea**: Large amount of RIs, Fissile ($\text{UO}_2$, $\text{UF}_6$), Fresh Nuclear Fuels
    - Main Port: Busan Port
  - **Countries of Import/Export of RAM**
    - Import from: USA, Canada, South Africa, Russia, France, UK etc.
    - Export to: Asian countries.
Transport of LILW through Sea

- **Sea Transport**
  - Exclusive INF Class 2 ship is used
    - Transport capacity: 190 IP-2 Packages (1,520 Drums (320 L)), 8 drums/package
  - Normally transport 125 packages of IP-2 (1,000 drums)
  - 3~4 shipments per year from NPP sites to Disposal Facility
Transport of Spent Fuel

- Transport of SNF has been carried out between storage facilities inside NPP sites
- Capacity of storage facilities in NPP sites will be successively reached to the saturation point in **Near Future**
Transport of Fresh Fuel

- Transport of fissile materials for nuclear fuel fabrication (UO2, UF6)
- Transport of fresh nuclear fuels for commercial reactors
## Status of Transports in Korea (2017)

<table>
<thead>
<tr>
<th>Types</th>
<th>Radioactive contents</th>
<th>Packages</th>
<th>Modes of transport</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excepted</td>
<td>-Medicine &amp; Research</td>
<td>286,000</td>
<td>Road</td>
</tr>
<tr>
<td></td>
<td>-Industry</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type A</td>
<td>-Medicine &amp; Research</td>
<td>212,000</td>
<td>Road</td>
</tr>
<tr>
<td></td>
<td>-Industry</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>-Industrial radiography</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type B</td>
<td>-Medicine</td>
<td>5,000</td>
<td>Road</td>
</tr>
<tr>
<td></td>
<td>-Industry</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>-Industrial radiography</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type IP</td>
<td>-LILW, etc.</td>
<td>740</td>
<td>Road and Sea</td>
</tr>
<tr>
<td>Fissile</td>
<td>-UF$_6$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Materials</td>
<td>-Fresh nuclear fuels</td>
<td>318</td>
<td>Road</td>
</tr>
<tr>
<td></td>
<td>-Spent nuclear fuels</td>
<td>421</td>
<td>Road</td>
</tr>
</tbody>
</table>

*Only transported within NPP sites*

### Legal Framework

<table>
<thead>
<tr>
<th>Act</th>
<th>Nuclear Safety Act ↔ bases and fundamental matters of regulations</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Article 71 ~ 77</td>
</tr>
<tr>
<td></td>
<td>notification, technical requirements, design approval, inspections, etc.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Presidential Decree</th>
<th>Enforcement Decree of the Act ↔ particulars entrusted by the Act</th>
</tr>
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<tr>
<td></td>
<td>Article 108 ~ 114</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Prime Minister’s Ordinance</th>
<th>Enforcement Regulations of the Act ↔ particulars entrusted by the Act and the Presidential Decree</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Article 98 ~ 110</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>NSSC Regulations and Notices</th>
<th>Regulations on Technical Standards for Radiation Safety Control, etc. ↔ technical standards &amp; particulars entrusted by the Act, Enforcement Decree and Enforcement Regulations</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>NSSC Notices</td>
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</tbody>
</table>
Applications of IAEA Transport Regulations

- Nuclear Safety Act (NSA) includes requirements for radioactive material transport regulation based on IAEA Transport Regulations
  - Review SSR-6 2018 edition to apply on the NSA, Presidential decree, Regulations and the NSSC Notice.
Regulatory Framework

**Implementer & Promoter**

- President
  - Prime Minister

  - AEPC
    - Atomic Energy Promotion Committee
  - MOTIE
    - Ministry of Trade, Industry and Energy
  - MSIT
    - Ministry of Science and ICT

  - Korea Hydro & Nuclear Power Co., Ltd (KHNP)
  - Korea Radioactive Waste Agency (KORAD)
  - Korea Atomic Energy Research Institute (KAERI)

**Regulator**

- NSSC
  - Nuclear Safety and Security Commission

  - KINS
    - Korea Institute of Nuclear Safety
  - KINAC
    - Korea Institute of Nuclear Nonproliferation & Control

**Regulatory Expert Organizations**

- KoFONS
  - Korea Foundation of Nuclear Safety
  - Implementer & Promoter
  - Regulator
# Competent Authority and related organizations

| **Nuclear Safety and Security Commission (NSSC)** | • National Competent Authority (Top Regulatory Authority)  
• To establish regulatory polices, make rule and enforce on nuclear facilities and activities to ensure safety and security |
| **Korea Institute of Nuclear Safety (KINS)** | • Conducts safety reviews and inspections for nuclear & radiation users, radioactive waste management, transport  
• Radiation emergency response |
| **Korea Institute of Nuclear Nonproliferation And Control (KINAC)** | • Nuclear Safeguards, Physical Protection, Cyber security  
• Export control |
| **Korea Foundation of Nuclear Safety (KoFONS)** | • Manages radiation workers’ records of radiation dose, gives training for radiation workers  
• Manages the Nuclear Safety Fund |
Practices: package design approval (NSA article 76)

- **Nuclear fuel packages**
  - Fresh fuel packages: PIONEER L/S, (PIONEER-G L/S)
  - Spent fuel packages: KSC-1, KN-12, KN-18, HI-STAR 63, (KORAD-21)

- **Other radioactive material packages**
  - KEPCO-TSV-100K (for 100 kCi of H-3)
  - KORAD-Type B-II (for solidified rad. waste, HIC for ion exchange resin)
Practices: packaging inspections (NSA article 77)

- Inspections are necessary for Packagings;
  - Type B(U), B(M), C and Packages not excepted from Fissile

- Inspections
  - Manufacture inspections
    - When manufacturing those packagings, it should be inspected.
  - Regular inspections
    - Every 5 years after Manufacture Inspection

- Inspection items
  - Visual Inspection, Load test for lifting attachments, Radiation shielding performance, Pressure (1.5 MNOP), Containment, Heat transfer, etc.
Practices: notification (NSA article 71)

- Notification should be completed before 5 working days to transport followings in Korea:
  - Type B(U), B(M), C packages
  - Packages not excepted from Fissile
  - Radioactive waste (LILW) exceed 1.6 m³
  - Packages transported under special arrangement
    - It should have been approved in advance

- Notification should be made to enter Korean airport/sea port or to pass through Korean Territory with followings:
  - Type B(M) packages
  - Type B(U) packages containing more than $3,000 A_1$ (or $A_2$), or 1,000 TBq, whichever is the lower
  - Type C packages containing more than $3,000 A_1$ (or $A_2$), or 1,000 TBq, whichever is the lower
Practices: transport inspections (NSA article 75)

- **Regular transport inspection** (~ 130 inspections /year)
  - NPP, Research Reactor, KEPCO-NF, KORAD
  - Suppliers, Industrial radiographers

- **Inspections done at every transport** (~ 40 inspections /year)
  - Spent Fuel
  - Packages containing more than 30 $A_1$ (or $A_2$)
  - Shipments under special arrangement
  - LILW exceeding 1.6 m$^3$

- **Findings and events**
  - No accidents
  - Incomplete check list and transport documents
  - Neglection of replacement into Korean Marking and Labelling
Challenges

- **Distant transport of spent fuel (SF)**
  - SF have been transported between NPPs in same site.

- **Dual purposed cask**
  - SF from PWR have been stored in storage pools in newer neighboring NPPs.
  - Some site do not have newer NPP and need to consider dry storage.

- **Others**
  - Public acceptance and political consensus.
Thank you for listening!!!

감사합니다

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