Countermeasures for the Falsification of Quality Verification Documents

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Acronyms

- NSSC: Nuclear Safety and Security Commission
- KINS: Korea Institute of Nuclear Safety
- KHNP: Korea Hydro & Nuclear Power
- QVD: Quality Verification Document
- EQ: Equipment Qualification
- CGI: Commercial Grade Items
- CGD: Commercial Grade Dedication
- CFSI: Counterfeit, Fraudulent and Suspect Item
60 falsified certificates in Quality Verification Documents (QVD) of the commercial grade items (CGI) were reported to the regulator.

- The falsified certificates were discovered in CGIs as well as in quality group items.

- Since January 2013, authorities have been conducting complete enumeration investigations on all NPPs both in operation and under construction.
Examples of Falsified Equipment Qualification (EQ) Report

- While looking into insider information, filed to "the NSSC Shinmungo", an anonymous tip-off channel, the falsification of equipment qualification (EQ) report of control cables supplied to Shin-Kori Units 1 & 2 and Shin-Wolsong Units 1 & 2 was found.
  - Test results in the EQ reports were falsified by the certified testing institutes.

![Forged Test Profile](image1.png)

![Original Test Profile](image2.png)
Examples of Falsified Equipment Qualification (EQ) Report

- NSSC ordered immediate shutdown of affected operating units.
  - Shin-Kori (SKN) Units 1 & 2 and Shin-Wolsong (SWN) Unit 1 (at the time, SKN Unit 1 was already in scheduled outage for maintenance).
  - Other affected units, SKN Units 3 & 4 and SWN Unit 2, were still under construction.

- It was decided that the investigation would be expanded to all nuclear power plants and complete enumeration investigations be conducted.
  - Detailed plans for complete enumeration investigations on the QVDs and EQ reports have been drawn and implemented.
## Investigation for Operating NPPs

<table>
<thead>
<tr>
<th>Scope</th>
<th>QVDs</th>
<th>EQ Reports (Environmental &amp; Seismic)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Past 10 years (Jan.1.’03~Dec.31.’12) In case of SKN 1&amp;2 and SWN 1&amp;2, purchase cases of supplied items after their commercial operation</td>
<td>All documents published after Oct, 1996. Materials purchased during construction were also investigated as their operation licenses were issued after 1996.</td>
<td></td>
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<table>
<thead>
<tr>
<th>Subject</th>
<th>QVDs</th>
<th>EQ Reports</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Domestic manufactures' documents that were issued by the third domestic institutes (documents issued by the manufacturers were excluded) • Documents that domestic manufactures commissioned to foreign testing institutes (‘08~’10)</td>
<td>• Issued by domestic manufacturers and testing institutes • Documents that domestic manufactures commissioned to testing institutes, both domestic and foreign. * Seismic Category I among non-safety grade, other than safety grade(based on FSAR)</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Method</th>
<th>QVDs</th>
<th>EQ Reports</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Domestic: visit institutes and compare • Foreign: official letter, e-mail or visit</td>
<td>• Issued by manufacturers: review technical validity by checking raw data, and etc., • Commissioned to foreign institutes: review the original documents</td>
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</table>
## Investigation for Constructing NPPs

<table>
<thead>
<tr>
<th></th>
<th>QVDs</th>
<th>EQ Reports (Environmental &amp; Seismic)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Scope</strong></td>
<td>For the newly-built 3 NPPs which started operation within 3 years and 5 NPPs under construction, investigation includes all QVDs supplied during the whole construction period. (SKN Units 1, 2, 3, &amp; 4, SWN Units 1 &amp; 2)</td>
<td></td>
</tr>
</tbody>
</table>
| **Subject**      | • Domestic manufactures' documents that were issued by the third domestic institutes (documents issued by the manufacturers were excluded)  
• Documents that domestic manufactures commissioned to foreign testing institutes (applied to SKN 3&4) | • Issued by domestic manufacturers and testing institutes  
• Documents that domestic manufactures commissioned to testing institutes, both domestic and foreign.  
* Seismic Category I among non-safety grade, other than safety grade (based on FSAR) |
| **Method**       | • Domestic: visit institutes and compare  
• Foreign: official letter, e-mail or visit | • Issued by manufacturers: review technical validity by checking raw data, and etc.,  
• Commissioned to foreign institutes: review the original documents |
Typical Items Supplied with False QVDs

- Shafts
- Support Studs
- Hexagonal Nuts
- Bolts
Typical Items Supplied with False QVDs

- ESWP Drain Pipes
- Air Filters
- Pullies
- Sleeves
Typical Route of QVD Forgery

- **Utility**
- **Manufacturer**
- **Material Supplier (Distributor)**
- **Testing Entities**
- **Material Manufacturer**

**Purchase Order** (Require QVDs)

**Product Delivery** (with falsified QVDs)

**Document Forgery**
Investigation results of QVDs (As of December, 2013)

- For all 23 operating NPPs, the investigation and follow-up corrective action has been completed before permitting the re-criticality.
- For 5 NPPs under construction, the investigation and follow-up corrective action is near completion. It should be completed before issuing the operating license.

<table>
<thead>
<tr>
<th>Replaced Materials for 20 Operating NPPs</th>
<th>Reviewed QVDs</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>21,681</td>
<td>Forged</td>
</tr>
<tr>
<td></td>
<td></td>
<td>247</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Unidentified</td>
</tr>
<tr>
<td></td>
<td></td>
<td>408</td>
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</table>

<table>
<thead>
<tr>
<th>Construction Materials of Newly Built SKN 1&amp;2, SWN 1</th>
<th>Reviewed QVDs</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>109,558</td>
<td>Forged</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1,178</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Unidentified</td>
</tr>
<tr>
<td></td>
<td></td>
<td>14,746</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>5 NPPs under construction(SKN 3&amp;4, SWN 2, SHN 1&amp;2)</th>
<th>Reviewed QVDs</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>163,696</td>
<td>Forged</td>
</tr>
<tr>
<td></td>
<td></td>
<td>800</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Unidentified</td>
</tr>
<tr>
<td></td>
<td></td>
<td>45,678</td>
</tr>
</tbody>
</table>

| Total                                              | 294,935       | Forged  |
|                                                    |               | 2,225   |
|                                                    |               | Unidentified |
|                                                    |               | 60,832  |
Types of Forged Quality Verification Documents

Types of 247 Forged QVDs:
CMTR, Inspection, NDE & Heat Treat. Report, etc.

- Re-use of old version, 105
- Arbitrary issue, 71
- Forged test results, 66
- Others, 5
Corrective Actions for the Falsified QVDs

- For the case a QVD confirmed to be falsified, non-conformance report (NCR) should be issued by the utility after identifying the installation status and assessing the impact to the safety of the related NPP.

- Item affected by the falsified QVD shall be replaced or,
  - May be allowed for ‘use as is’ if the affected item can be re-qualified and/or ensured to be operable through the safety assessment.

- Item for which investigator could not check whether the related QVD is genuine or not
  - Supplier should prove the QVD is genuine
  - Otherwise the non-confirmable QVD is regarded as non-genuine
Falsification of Equipment Qualification (EQ) Reports

- Investigation results of EQ reports (As of December, 2013)
  - For all 28 NPPs, both operating and under construction, the investigation is completed.
  - Currently, corrective actions are being taken (Re-test, Re-analysis or Replacing with qualified one, etc.)

<table>
<thead>
<tr>
<th>Equipment Qualification</th>
<th>Environmental Qualification</th>
<th>Seismic Qualification</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 operating NPPs</td>
<td>342</td>
<td>20</td>
<td>2</td>
</tr>
<tr>
<td>3 recently const’d, 5 const’ing NPPs</td>
<td>159</td>
<td>13</td>
<td>28</td>
</tr>
<tr>
<td></td>
<td>501</td>
<td>33</td>
<td>30</td>
</tr>
</tbody>
</table>
Types of Forged Equipment Qualification Reports

Types of 62 Forged Eq's

- Forged graph in test result: 29
- Forged test conditions: 19
- Forged the authorized EQ by supplier: 11
- Self forged their own test result: 2
- Others (un-verified items): 1
Corrective Actions for the Falsified EQ Reports

- For the equipment confirmed to be supplied with falsified EQ reports, the utility shall prove that the equipment shows required performance at the prescribed mild/harsh conditions
  - by conducting additional tests with observation by regulatory inspectors, or
  - by using other documentary/circumstantial evidence as appropriate.

- Otherwise the equipment shall be replaced by properly qualified substitutes at the soonest time reasonably practicable.
Lessens Learned from Investigation

• To identify a root cause and to recommend corresponding countermeasure, an ad-hoc committee was established in June 2013
  – “Special Committee on QA in NPPs” under the Nuclear Safety and Security Commission (NSSC) and KINS
  – Two times of interim reports were issued and final report is under preparation.

• It seems that root causes are relatively complex and have been built up for long-time.
  – Thus countermeasure must be viewed from a long-term perspective and also a phased approach must be taken.
Root Causes

- It is widely accepted that the root cause of the QA problem is the combination of the deregulation and financial crisis, both experienced in late 1990s.
- Couples of relevant legal provisions were abolished related with
  - a license for nuclear manufacturer
  - a license for EQ testing entity
  - a regulatory inspection for manufacturing of pressure retaining NPP components
- Since then, those regulations were left to autonomy of nuclear industry.
- The economic pressure under nationwide financial crisis seemed to distort the QA system before the industrial autonomy got matured enough
  - lowest-price bidding system in purchasing the NPP components,
  - outsourcing of wide range of licensee activities, even including quality verification, etc.
Root Causes (Cont.)

- As other possible reason, the ‘complacency’ may have been brought up in nuclear industry
  - encouraged by good performance of NPP operation for a long period of time,
  - and also by winning an overseas contract, to build 4 NPP units at the UAE, at the first time in Korea’s nuclear history.

- This may have led to both a lax quality management and moral hazards in Korean nuclear community
Countermeasures Taken to the Forged QVDs & EQ Reports

- To further encourage anonymous reporting
  - “Nuclear Safety Ombudsman System”
- To strengthen the management of equipment testing entities
- To introduce regulatory program for vendor inspection
- To strengthen regulatory oversight for licensee QA program
- To set up computerized configuration management system for all safety-related items
- To set up a system of ‘Learning from the Failure’
Encouragement of Reporting Corruptive Actions

- To encourage people to tip off corruptive actions, ‘NSSC Shinmungo’ was scaled up to ‘Nuclear Safety Ombudsman' on June 4th, 2013.
  - 15 cases were filed to the Ombudsman: Investigations on 8 cases have been completed; 2, underway; 3, concluded; and 2, referred to other ministries.

- Incentives prepared for whistleblowers
  - Monetary incentives up to 1 billion KRW (1 million USD) is given to a whistleblower. A legal leniency program is prepared for a person who voluntarily reports a corruptive action which he or she is involved in.

⇒ The Nuclear Safety Act was revised after deliberation of the National Assembly in May 2014.
Certification System for Equipment Qualification Institutes

- Legal basis was prepared to commission the work of testing and certifying parts and items only to the institutes that NSSC designate
  - The institutes will be given with regulatory authorities to be legally able to conduct regular inspections, impose corrective actions and cancel certificates.

- Legal fiction will be used to regard staff of the institutes as government officials so that the staff can be given with greater responsibilities by the civil and criminal laws.

⇒ The Nuclear Safety Act was revised after deliberation of the National Assembly in May 2014.
Expanding Scope of Vendor Inspection

- The scope of the regulatory inspection is to be extended from the nuclear licensee (KHNP) to plant designers, manufactures of equipment and part suppliers.

  - Legal basis has been prepared to grant NSSC with authority to inspect equipment and part suppliers.

  - When the operator makes a contract with a supplier, the operator is obliged to report the contract to NSSC.

  - A new article was added to the Act; Not only the operator but suppliers are obliged to report non conformance of safety-related equipment whenever they find one.

⇒ The Nuclear Safety Act was revised after deliberation of the National Assembly in May 2014.
Expanding Scope of Vendor Inspection

- Increment of inspection demand for supply chain
  - Enormous number of main contractor and primary subcontractor, about 700 (500 for const., 200 for operation), requires a regulation

- Selection guide for suppliers (Ref. NRC Vendor Selection Strategy)
  - Prior inspection experience
  - Scope, number and priority of supply
  - Complexity of product or service
  - Susceptibility to counterfeiting or cyber security issues
  - Industry experience with product or service
  - New or advanced technology (Ex: RCP, MMIS)
  - Significance to pending regulatory actions
  - Relation with respect to allegation (Ombudsman)
The interval of a quality assurance inspection was shortened from two years to one year, and the scope was extended to include part suppliers. It is expected for the inspection to better focus on current issues.

A new quality assurance inspection will be first carried out for Shin-Wolsong Units 1&2 (May 20~24), Wolsong Units 3&4 (May 27~31), Hanbit Units 1&2 (June 24~28) and Hanul Units 1&2 (Sept 2~6) and later extended to all NPPs.
Equipment / Parts Tracking and Management System

- An IT-based tracking and management system is in the process of establishment in order to detect and prevent any accident and event occurring from failure of equipment and parts.

- The history of equipment and parts, from their design, manufacturing stages to failure, maintenance, replacement and disposal will be recorded in the system so as to replace them in a pre-emptive manner.
Thanks for your attention, valuable questions and comments