SCAP

OECD-NEA SCC and Cable Ageing Project

Akihiro Yamamoto
(Project secretariat)
OECD-NEA Nuclear Safety Division
**SCAP Objectives**

1. Establish a complete *database* with regard to major ageing phenomena for SCC and degradation of cable insulation through collective efforts by OECD/NEA members,

2. Establish a *knowledge-base* by compiling and evaluating collected data and information systematically, with regard to major ageing phenomena for SCC and degradation of cable insulation, and

3. Perform an *assessment* of the data and identify the basis for *commendable practices* which would help regulators and operators to enhance ageing management
### SCAP member countries

<table>
<thead>
<tr>
<th></th>
<th>Management Board</th>
<th>SCC WG</th>
<th>Cable WG</th>
</tr>
</thead>
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<tr>
<td>USA</td>
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- Management Board
- SCC WG
- Cable WG

**Note:**
- 14 countries are joining the project
- The IAEA and the EC are participating as observer
OECD/NEA SCAP (Project)

Management Board

- MB Chair: Prof. Sekimura (Japan)
- SCC Chair: Mrs. Gott (Sweden)
- Cable Chair: Mr. Koshy (U.S)
- SCAP Consultant: Mr. Shultz (Germany)
- Clearing House: ERIN (U.S)
- Technical Secretariat: OECD Halden Reactor Project IFE (Norway)

(Members)
- Belgium
- Canada
- Czech Republic
- Finland
- France
- Germany
- Japan
- Korea
- Mexico
- Norway
- Slovak Republic
- Spain
- Sweden
- U.S

(Observers)
- IAEA, EC
## SCAP (Project) Schedule

<table>
<thead>
<tr>
<th>Year</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
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<tr>
<td><strong>MB</strong></td>
<td>▲ 1st MB (June)</td>
<td>▲ 2nd MB (May)</td>
<td>▲ 3rd MB (June)</td>
<td>△ 4th MB</td>
<td>△ 5th MB Workshop</td>
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<tr>
<td><strong>SCC WG</strong></td>
<td>▲ 1st WG (Oct) 2nd WG (Jan) 3rd WG (May)</td>
<td>▲ 4th WG (Nov)</td>
<td>▲ 5th WG (Mar) △ 6th WG (Nov)</td>
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<td>(2-3 times a year)</td>
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<tr>
<td><strong>Cable WG</strong></td>
<td>▲ 1st WG (Sep)</td>
<td>▲ 2nd WG (Mar) ▲ 3rd WG (Sep)</td>
<td>▲ 4th WG (Feb) ▲ 5th WG (Sep)</td>
<td></td>
<td>(2-3 times a year)</td>
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</table>

**Populating data**
- Database, Knowledge base definition and collection of data

**Assessment of data**

**Development of commendable practices**

5/19
Scope of the SCC Event Database

- The SCC event database addresses passive components degradation or failure attributed to stress corrosion cracking (SCC) occurring at NPP in participating countries.

- The scope of the database includes class 1 & 2 pressure boundary components*, reactor pressure vessel internals and other components with significant operational impact, excluding steam generator tubing.

- The following mechanisms are considered in the database:
  - External chloride SCC
  - Irradiated assisted SCC
  - Inter-granular SCC in austenitic stainless steel and nickel-based material
  - Primary water SCC and trans-granular SCC

*Class 1 and 2 pressure boundary components are defined by the American Society of Mechanical Engineers (ASME) as follows: class 1 includes all reactor coolant pressure boundary (RCPB) components; class 2 generally includes systems or portions of systems important to safety that are designed for post-accident containment and removal of heat and fission products.
<table>
<thead>
<tr>
<th>Country</th>
<th>Organization</th>
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<tbody>
<tr>
<td>BELGIUM</td>
<td>SCK-CEN (Belgian Nuclear Research Centre)</td>
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<tr>
<td>CANADA</td>
<td>CNSC (Canadian Nuclear Safety Commission)</td>
</tr>
<tr>
<td>CZECH REP.</td>
<td>NRI Rez plc (Nuclear Research Institute)</td>
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<tr>
<td>FINLAND</td>
<td>VTT (Valtion Teknillinen Tutkimuskeskus)</td>
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<tr>
<td>FRANCE</td>
<td>IRSN (Institut de Radioprotection et de Surete Nucleaire)</td>
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<td>ASN Directorate for Nuclear Pressure Vessels (DEP)</td>
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<td>GRS mbH</td>
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<td>KINS (Korea Institute of Nuclear Safety )</td>
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<td>Nuclear Engineering Department of Seoul National University</td>
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<td>JAPAN</td>
<td>Tohoku University</td>
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<td>METI/NISA (Nuclear and Industrial Safety Agency)</td>
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<td>JNES (Japan Nuclear Energy Safety Organization)</td>
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<tr>
<td></td>
<td>NEL (Nuclear Engineering, Ltd.)</td>
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<tr>
<td>MEXICO</td>
<td>National Commission on Nuclear Safety and Safeguards</td>
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<td>SLOVAK REP.</td>
<td>VUJE Inc.</td>
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<td>CSN (Consejo de Seguridad Nuclear)</td>
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<td>TECNATOM S.A.</td>
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<td>SWEDEN</td>
<td>Swedish Radiation Safety Authority</td>
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<td>USA</td>
<td>U.S NRC (Nuclear Regulatory Commission)</td>
</tr>
</tbody>
</table>
SCC Working Group

SCC Event Database structure – Finalized in Nov 2007

- SCAP SCC is a relational database in Microsoft® Access.
- The data entry is managed via input forms, tables, roll down menus and database relationships.
- Database searches and applications are performed through user-defined queries that utilize the tables and built-in data relationships.
- The data entry forms are organized to capture essential passive component failure information together with supporting information.

Fig.1 Event Database Opening Screen

Fig.2 Event Database Relationships
SCC Event Database structure (The four data entry forms) [1/2]

<1. Failure Data Input>

• Plant name and plant operational state at time of discovery the event.

• Type of event (e.g. through-wall crack with active leakage) and corrective actions taken at the plant.

• A detailed description of plant conditions prior to the event and the plant response and method of detection is recorded.

• All relevant information that characterizes the degraded component is included.

<2. Flaw Characterization>

• Description in free-format of the flaw. For through-wall flaws information about size, for part through-wall flaws information on flaw depth, length and orientation is included.
<3. ISI History>

- Recording ISI programme weaknesses, information about ISI of the affected component or ISI history such as time of most recent inspection is recorded.

<4. Root Cause Information>

- This form consists of fields to describe the age of the component (in-service life time), location of failure, the method of detection and the apparent cause in terms of the different SCC mechanism along with fields describing contributing factors.

  (e.g. Alloying elements, Mechanical properties, pH (For PWR), Conductivity, Surface finish, Chemical history, Repair weld, Crack morphology, SCC mechanism, Specific regulatory actions, boric acid, contamination from inside or outside due to chlorides, sulphides)

- A free format field is provided to describe the root cause analysis.
SCC event database (example of input format)

SCAP-SCC 2007:1 - Form 1

Event Narrative:
The Petrot Power Company has been under periodic inspection since [date]. When visual inspection of piping nozzle stubs was conducted, while adhesive material was identified on the basis of [description].

The adhesive material was analyzed and was confirmed to be a mixture of acid and oil. During the primary coolant piping outage, inspections of the piping nozzle stubs revealed that the adhesive material was observed only around this stub. It was confirmed that the adhesive material is attributed to leakage from the piping nozzle stubs. Inspections were also conducted on the other piping nozzle stubs, and the adhesive material was identified on the piping nozzle stub [No.].

Unplanned Outage Work:

Event Type:

Impact on Plant Operation:

Event Data:

Plant Name and Type:

Plant Operational State:

Complete Event Report:

Multiple Event Report:

References:

Piping Configuration:

Dimensions:

Passive Component Category:

Lead Line:

Event Summary:

Form 2: Flow Sheet Information

Form 3: ISI History

Form 4: Root Cause Information

Form View
### SCC Event Database Field Definitions (Example of form 4)

<table>
<thead>
<tr>
<th>Field name</th>
<th>Type</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>MATERIAL (Base Metal)</td>
<td>Text</td>
<td>Roll-down menu with the following options:</td>
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<tr>
<td></td>
<td></td>
<td>■ Stainless Steel</td>
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<tr>
<td></td>
<td></td>
<td>■ Ni-based Alloy</td>
</tr>
<tr>
<td></td>
<td></td>
<td>■ SS/Carbon Steel (stainless steel clad carbon steel)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>■ Carbon Steel</td>
</tr>
<tr>
<td></td>
<td></td>
<td>■ Low Alloy Steel</td>
</tr>
<tr>
<td>CHEMISTRY HISTORY</td>
<td>Text</td>
<td>Narrative description (can include references)</td>
</tr>
<tr>
<td>SCC mechanism</td>
<td>Text</td>
<td>Roll-down menu with the following options:</td>
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<tr>
<td></td>
<td></td>
<td>■ ECSCC - External Chloride SCC</td>
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<tr>
<td></td>
<td></td>
<td>■ IASCC - Irradiation Assisted SCC</td>
</tr>
<tr>
<td></td>
<td></td>
<td>■ IGSCC - Austenitic Stainless Steel</td>
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<tr>
<td></td>
<td></td>
<td>■ IGSCC - Nickel based material</td>
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<tr>
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<td>■ PWSCC</td>
</tr>
<tr>
<td></td>
<td></td>
<td>■ SICC (Strain-rate induced SCC)</td>
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<td>■ TGSCC</td>
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<tr>
<td></td>
<td></td>
<td>■ Corrosion Fatigue</td>
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SCC event database *(Web based interface and data access policy)*

- The database is located at the NEA (https://www.nea.fr/scap) and the server is secure with username and password to input data, and retrieve data.
- There are 3 level of the access (Clearing house, National representative, Operator)
- The web interface was launched in October in 2007 and usernames and passwords for the national representative were sent to them.

![Figure. Interactions (3 levels of the access)](image-url)
<table>
<thead>
<tr>
<th>Country</th>
<th>Number of SCC events (On-line version)</th>
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<td>CANADA</td>
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<td>CZECH Rep</td>
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<td>FRANCE</td>
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<td>JAPAN</td>
<td>58</td>
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<td>KOREA Rep</td>
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<td>MEXICO</td>
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<td>SWEDEN</td>
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<td>SLOVAK Rep</td>
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<td>USA</td>
<td>60</td>
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<tr>
<td>Total</td>
<td>367</td>
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SCC working group approach

Event database
- Failure Data Input
  - Plant name, operational state...
  - Type of event
- Flaw Characterization
  - Size, depth, length...
- ISI History
  - ISI history
  - Qualified inspection technique
- Root Cause Information
  - Age of the component
  - Method of detection
  - SCC mechanism
  - Alloing elements,
  - Mechanical properties
  - pH (For PWR), Conductivity...
  - Surface finish
  - Repair weld
  - Crack morphology
- General information
  - National regulations
  - ISI
  - What to do when a crack is found
    (e.g. extend ISI, crack disposition, repair...)

Knowledge base

Evaluation
- PWR
  - PWSCC
  - 
  - e.g. (Reactor Vessel)
    - RPVH Nozzle
    - BMI Nozzle
    - (Inlet) Nozzle SE

- BWR
  - IGSCC
  - 
  - e.g.
    - Shroud
    - PLR Piping

Identify Commendable Practices

Examples:
1. Situation understood

2. Problem
   (Don’t understand but plant can continue to operate)

   PWSCC: disposition, proactive actions
   IASCC: mitigation

   (prevent or mitigate future failures before they occur)

3. New case
   (Recommendation)
   - Short term
     (e.g. overlay)
   - Long term
     (e.g. crack growth rate measurement, research)
Cable Working Group

Scope of the Cable Database

• The Cable database covers the following
  • Safety related cables that support the ECCS,
  • cables important to safety i.e. other cables desirable to prevent or mitigate design bases events,
  • cables important to plant operation i.e. cables that could fail and cause a plant trip or reduction in plant power.
• Cables with voltage ratings up to 15 kV AC and 500 kV DC, including Instrumentation & Control cables.
• Cables Types: Coaxial, Triaxial, Fiber optic and hybrid
• Insulation Types: XLPE, SiR, PVC, EPR, CSPE, EPDM, EVA and other
• Conductor Material: copper, copper-tin, aluminum, glass, pmma and other
• Connector assembly is out of scope
Cable Database structure – Finalized in Feb 2008

- The Cable database is a relational database, operating on MySQL software chosen by the Clearinghouse.
- The data entry to the database is managed via tables, and roll down menus.
- Database searches and applications are performed through user-defined queries.
  - Part 1. Technical data of cable
  - Part 2. Cable maintenance data / Condition monitoring
  - Part 3. Data for the cable failure events
  - Part 4. Cable environmental qualification data
  - Part 5. Plant and cable environmental condition
  - Part 6. Mitigation of cable-installed environment
  - Part 7. Cable replacement
  - Part 8. Regulatory information for cable
  - Part 9. Description of condition monitoring techniques

Fig. 3 Database Opening Screen
*These figures are from trial cable database and will be improved by the Clearing House
Future steps and intended outcomes

<Current status>
- The scope of the database and the database structure and format has been defined.
- The project is currently in the phase of populating data and assessing the data

<Next steps>
- Define topics for Knowledge base (2008)
- Assessment of data and development of commendable practices (2008-2009)
- Workshop (2010)

<Intended outcomes>
Project’s outcomes will be used by the NEA member countries to:
- Support regulatory authorities’ reviews of ageing management programmes
- Evaluate how operating experience and state-of-the-art technology are incorporated into plant operating practices