Session 17: IEA Hydropower Annex-XI
Renewal and Upgrading of Hydro Plants

Introduction to the work of Annex-XI

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Annex-XI Operating Agent
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There are growing concerns not only in Japan but also in other industrialized nations about the aging of hydropower facilities. There is a growing expectation for hydropower as a future key player in low-carbon society, as it represents a domestic, affordable and CO2-free source of energy.

In the western world, small- or medium-sized pumped-storage hydropower is gaining renewed recognition as a load-balancing system to complement the intermittent wind and solar power.

The taskforce is trying to gather as many good practice examples as possible from around the world on the renewal and upgrading of existing hydropower plants.

The information will be used to identify and convey effective policies, assistance measures and innovative technologies to the rest of the world.
1. Member Countries:
   Japan (OA), Norway and USA

2. ExCo Member Countries
   Brazil, Finland, Canada

3. Other Countries
   New Zealand (Meridian Energy, Genesis Energy, Mighty River Power)
   Australia (Hydro Tasmania)
   Austria, Nepal, South Africa, Sweden, Switzerland, etc.
   (Tentative)

4. Other Organizations
   IHA
Flow Chart of Case Collection

[STEP-1] 1st round Case Collection by trigger causes

[STEP-2] Classification / Screening / Selection

[STEP-3] 2nd round Case Collection by key points

[STEP-4] Analyzing and Reporting

Outline Questionnaire to enterprises

Data format for key points of Category-1 and -2 (For collecting overview information)

By key points (Category-1, and -2)

Data format for key points of Category-1

Data format for key points of Category-2

Literature survey

Classifying Screening

Selection for detailed survey

Detailed Questionnaire to enterprises

Analyzing Reporting
Conceptual Life Cycle

Degradation with time

Start of operation

Renewal / Upgrading after accidents/disasters or recurrence of malfunction

Renewal / Upgrading before/after breakdown

Renewal / Upgrading concerning environment / performance / safety / third-party relation

Usual maintenance work
### Trigger Causes of Renewal and Upgrading

<table>
<thead>
<tr>
<th>Trigger Causes</th>
<th>Expected Performance</th>
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</thead>
<tbody>
<tr>
<td><strong>(A) Ageing and recurrence of malfunction</strong></td>
<td>(a) Improvement of efficiency</td>
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<td>(b) Improvement of durability and safety</td>
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<td></td>
<td>(c) Cost reduction</td>
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<td></td>
<td>(d) Easy maintenance with less labor</td>
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<td><strong>(B) Environmental deterioration</strong></td>
<td>(a) Sedimentation reduction</td>
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<td>(b) Improvement of river environment</td>
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<td><strong>(C) Needs for higher performance</strong></td>
<td>(a) Addition of units, Expansion of power &amp; energy</td>
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<td>(b) Role change of hydropower generation</td>
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<td>Addition of new functions</td>
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<td><strong>(D) Needs for safety improvement</strong></td>
<td>(a) Improvement of safety</td>
</tr>
<tr>
<td><strong>(E) Needs due to third party factors</strong></td>
<td>(a) Sustainable operation</td>
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<td></td>
<td>(sometimes accompanied by power reduction)</td>
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<tr>
<td><strong>(F) Accidents / Disasters</strong></td>
<td>(a) Recovery</td>
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</tbody>
</table>
Coverage of Collected Cases in Japan

(A) Degradation due to ageing
(D) Safety improvement
(C) Higher performance
(B) Environmental deterioration

Renewal
(Maintaining Existing Value)

Upgrading
(Adding New Value)

Developing

Developed

Sufficient
Starving

- Countermeasures for earthquake
- Higher-Specification
- Safety improvement
- Cost reduction
- Maintenance-free
- Multi-purpose
- Ancillary Services
- Asset Management
- Consistent development of river systems
- Expansion of unit no.
- Resettlement
- Fishes
- Animals and plants
- Landscape
- Sedimentation and Turbid Water
- Life extension/Demolition/Renovation
- Conversion to other purpose
- Design defect
- Third party factors
- Accidents/Disasters
- Earthquake
- Flood

Total: 39 cases
Category-1. Public Policies, Facilitation Measures, etc.

a) **Energy policies of Countries & States**
   ⇒ In connection with the state of affairs in the country,
   *(stored resources, development level, economic level
   and environmental awareness level)*

b) **Investment incentives**;
   Feed-in-Tariff (FIT),
   Renewable Portfolio Standard (RPS),
   Subsidies, Financial assistance, Tax deductions, etc.
   ⇒ The extent to which these incentives are utilized and
effective will be analyzed
Category-1. Public Policies, Facilitation Measures, etc.

c) **Integrated management of water resources and river systems**
   ⇒ The integrated development of water resources and river systems (domestic or international) will be collected and analyzed including sediment management.

   d) **Asset management, strategic asset management and Life cycle cost analysis**
      ⇒ Collected and analyzed to determine the method, scale, and timing.
Category-1. Public Policies, Facilitation Measures, etc.

e) Projects justified by the Non-monetary valuation of stabilizing unstable power system in the up-coming low-carbon society
⇒ Cases of adjustment functions, the use of non-power dams and increased output will be collected to analyze new values of hydropower

f) Environmental conservation and improvement
⇒ Cases of measures for sedimentation, protection of fish and birds, GHG emission and mitigation are collected. Safety improvement and aseismic reinforcement are also collected.
Category-2. **Modern Technologies, Systems, material, etc.**

a) Technological innovation & deployment expansion of electro-mechanical (E/M) equipment  
b) System and Reliability Improvement in Protection & Control (P&C)  
c) Technological innovation, deployment expansion and new materials used for civil and building works  
d) Integration of other renewable energies into hydropower systems
## Activity Schedule of Annex-XI

<table>
<thead>
<tr>
<th>Work Item</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
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</thead>
<tbody>
<tr>
<td>1. Agreeing on and starting the new ANNEX</td>
<td>24th</td>
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<td>2. Formulating a detailed activity plan</td>
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<td>4. Collecting cases</td>
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<tr>
<td>1st round Case Collection</td>
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<tr>
<td>Screening</td>
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<td>2nd round Case Collection</td>
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<td>5. Analyzing and evaluating cases</td>
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<td>6. Creating and releasing reports</td>
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<td>7. Workshops, etc.</td>
<td>*-1: Sacramento, USA, July 19th</td>
<td>*-2: Tokyo, Japan, February 2012</td>
<td>*-3: Washington, D.C., USA, May 30th</td>
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<td>8. ExCo meeting</td>
<td>24th</td>
<td>25th</td>
<td>26th</td>
<td>27th</td>
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</tbody>
</table>

*1: Sacramento, USA, July 19th.  
*2: Tokyo, Japan, February 2012.  
*3: Washington, D.C., USA, May 30th  
*4: Bilbao, Spain, October 2012
The End