Session 20: Hydro Plant Rehabilitation and Refurbishment

Part A IEA Hydropower Annex-XI

Renewal and Upgrading of Hydropower Plants

Introduction to the work of Annex-XI

Wednesday 9 October, 2013

Annex-XI Operating Agent

Takashi AKIYAMA
Roles of Hydropower

- **Features**
  - Low Cost
  - Purely Domestical
  - Clean
  - Renewable
  - Output Stability
  - Instant Start

- **Roles**
  - Leader of Power Supply
  - Main Player in the Low-carbon Society
  - Provider of Ancillary Service

- **Changes**
  - Environmentally-conscious
  - Deterioration of Facilities
  - Development of Engineering
  - Changes of needs
Outline of Annex-XI activities

(Background)

1. There are growing concerns not only in Japan but also in other industrialized nations about the aging of hydropower facilities.
2. 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.
3. 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.

(Purpose)

• 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, Australia and USA

2. **ExCo Member Countries**  
   Finland, France, Brazil, Canada

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

4. **Other Organizations**  
   IHA (Tentative)
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

Literature survey

Outline Questionnaire to enterprises

Classifying Screening

Selection for detailed survey

In-depth Questionnaire to enterprises

Analyzing Reporting

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
Conceptual Life Cycle

Degradation with time

Usage limit line

soundness

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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<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>(c) Cost reduction</td>
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<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></td>
<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>
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<td><strong>(E) Needs due to third party factors</strong></td>
<td>(a) Sustainable operation</td>
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<td>(sometimes accompanied by power reduction)</td>
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<td><strong>(F) Accidents / Disasters</strong></td>
<td>(a) Recovery</td>
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</table>
Coverage of Collected Cases in Japan

(A) Degradation due to ageing
- Life extension/Demolition/Renovation: 16 cases

(B) Environmental deterioration
- Resettlement
- Fishes: 1 case
- Animals and plants
- Landscape
- Sedimentation and Turbid Water: 4 cases

(C) Higher performance
- Expansion of unit no.: 4 cases
- Maintenance-free
- Multi-purpose
- Cost reduction: 2 cases
- Ancillary Services: 1 case
- Asset Management: 1 case

(D) Safety improvement
- Countermeasures for earthquake: 4 cases

(E) Third party factors
- Conversion to other purpose: 2 cases

(F) Accidents/Disasters
- Earthquake: 2 cases
- Flood: 2 cases

Total: 44 cases
Category-1. Public Policies, Facilitation Measures, etc.

a) Energy policies of Countries & States

b) Investment incentives;
   Feed-in-Tariff (FIT), Renewable Portfolio Standard (RPS)

c) Integrated management of water resources and river systems

d) Asset management, strategic asset management and Life cycle cost analysis

e) Projects justified by the Non-monetary valuation of stabilizing unstable power system in the up-coming low-carbon society

f) Environmental conservation and improvement
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
## Work Item Schedule

<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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<tr>
<td>2. Formulating a detailed activity plan</td>
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<td>4. Collecting cases</td>
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<td>1st Round Data Collection</td>
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<tr>
<td>Screening</td>
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<td>2nd round Data 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>
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<td>8. ExCo meeting</td>
<td>24th</td>
<td>25th</td>
<td>26th</td>
<td>27th</td>
<td>28th</td>
<td>29th</td>
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*:-1 : Sacramento, USA, July 2011  
*-2 : Washington, D.C., USA, May 2012  
*-3 : Bilbao, Spain, October 2012  
*-4 : Oslo, Norway, June 2013  
*-5 : Innsbruck, Austria, October 2013
The End