Grid Interconnection of Micro Hydropower: Experience Sharing from Nepal

Jiwan Kumar Mallik
Renewable Energy for Rural Livelihood (RERL), Nepal

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Setting the Scene

• Though access to electricity is above 90%, the per capita energy consumption is just 190kWhr and it is below the average of South Asia.
• The electricity access is below Tier 3 of the Multi Tier Framework.
• There is limited possibility to add further Micro/Mini Hydro.
• Thus Interconnection of MHP to MHP or MHP to national grid will help to increase per capita energy consumption and Tier level.
• However, you have to be careful while distorting already running MHPs.

90.7% of population have access to electricity - unreliable

Source: ESMAP, World Bank
Energy Access through MHP Interconnection

- It is not always necessary to add new generation asset for Energy Access.
- Surplus-deficit energy can be managed by interconnecting MHP to MHP.
# Interconnected MHP Clusters in Nepal

<table>
<thead>
<tr>
<th>Name of Cluster</th>
<th>Number of Projects Inter-Connected</th>
<th>11 kV Transmission (distance of inter-connection)</th>
<th>Rated Capacity (kW)</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baglung Local Grid</td>
<td>6 MHPs</td>
<td>7 km</td>
<td>9-23 kW</td>
<td>Completed in 2011</td>
</tr>
<tr>
<td>Gulmi Local Grid</td>
<td>2 MHPs</td>
<td>1.5 km</td>
<td>135 kW and 83 kW</td>
<td>Completed in 2014</td>
</tr>
<tr>
<td>Taplejung Local Grid</td>
<td>5 MHPs</td>
<td>40 km</td>
<td>36 kW to 95 kW</td>
<td>In-progress: July 2018</td>
</tr>
</tbody>
</table>
Need for Grid Interconnection of MHP

- Energy consumed (typically 28%)
- Wasted energy due to lack of productive end-use

Plant Capacity

0 10 20 30 40 50 60 70 80 90 100

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24

Hours

1st. consequence: under voltage
2nd. consequence: compulsory loadshedding

Unserved peak demand due to capacity limit
Advocacy initiated in 2011

Decision to interconnect MHP of less than 100kW capacity in July 2014

First PPA concluded in February 2016

First Interconnection completed in January 2018
Pilot Grid Interconnection Project: Salient Features

- Capacity: 23 kW
- Design discharge of 370 lps and gross head of 11.4 meters
- Construction of MHP completed in June 2013
- The national grid encroached its catchment during construction and all 240 HHs potential consumers switched to the national grid
- PPA rate- USD 4.8 cents/kWhr for 8 months (wet season) and USD 8.4 cents/kWhr for 4 months (dry season)
- Total Annual Energy Generation of 178,245 kW-hr

After breakthrough of the Syaurebhum Grid Interconnected MHP, two more MHPs of 40kW and 90kW have been interconnected to the Grid.
The technology for interconnection of Micro Hydro to the Grid is different than Large Hydro.

IRR with ELC - 20.85%
IRR with Governor - 13.28%
Technical Aspects of Interconnection
Sensitivity Analysis

Only interconnection cost has been considered in CAPEX (cost of construction of MHP not included)
Here, MHPs cannot use/sell electricity, in case of grid outage.
Allow the MHP owner to be the Pro-sumers of electricity in their vicinity, rather than an IPP.
Impact of Grid Interconnection of MHP

• The voltage of feeder line increased, and thus enhanced the power quality of feeder line.

• Distributed generation helped to minimize the power loss of T&D by injecting power near the load center.

• Plant load factor increased significantly, and therefore increased the economic sustainability of the MHP.

• Redundant MHP is utilized to generate revenue for local development.
Challenges of Grid Interconnection of MHPs

• Simple connectivity – a solution of compact device
• Sustainability – Involvement of the Private Sector
• Finding subsidy for Interconnection until the technology is readily available in the Nepalese market
• Distribution Grid Code – Code for connectivity
• PEA/SPPA policies
• Moving analog to digital ELC with Droop characteristics
Replication of Nepal’s Learning in Pakistan

• Nepal has supplied many ELCs to Pakistan for off-grid MHPs
• Concept of Local Grid is initiating by AKRSP Pakistan in Chitral district
• Two local grid in two different valleys
• 7 MHPs of capacity ranges between 50kW to 800kW in 15 Km length
• Techno-institutional learning’s of Nepal shall be exchanged with AKRSP Pakistan to avoid pitfalls and leap-frog to advance stage.
Thank You

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For more information contact @ jiwan.mallik@apec.gov.np or jiwanmallik@gmail.com