LANL Turbine Impeller Design
Recent Testing - June 2012
## Recent Testing-June 2012

### EBID Fabricated Impeller

<table>
<thead>
<tr>
<th></th>
<th>CFS</th>
<th>Head (ft)</th>
<th>Available Power (kW)</th>
<th>Power Generated (kW)</th>
<th>Efficiency</th>
<th>Torque (N-m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max</td>
<td>48</td>
<td>9.8</td>
<td>40</td>
<td>5.1</td>
<td>14.4%</td>
<td>427</td>
</tr>
</tbody>
</table>

### LANL Impeller Design

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<tbody>
<tr>
<td>Max</td>
<td>51</td>
<td>10.2</td>
<td>44</td>
<td>4.3</td>
<td>10%</td>
<td>392</td>
</tr>
</tbody>
</table>
Future Improvements

Future improvements of existing turbines

- **Drop 8**
  - Perfect blade pitch
  - Adjust gearing
  - Perfect testing procedures

- **Wasteway 5**
  - Improve blade design
  - Adjust gearing
  - Improve baffles
  - Screw pump?
Future Work and Collaboration

- Increase production and efficiency
- Continue applying for grants, continue collaboration, R&D
- Investigate more turbine sites
  - Referencing Cost-benefit analysis by LANL
- Navigate through FERC licensing and exemption
- Explore Renewable Energy Certificates
- Establish low-head power research center at NMSU
- Explore hydro-kinetics with Sandia National Labs
Future Work and Collaboration

- Low-head hydropower research center NMSU

- Hydrovolts, Los Alamos National Labs, Sandia National Labs
HyPER Turbine Power Output Estimation at Drop 8

**Total Recoverable Energy**

\[ \text{Kinetic Energy} + \text{Potential Energy} = \frac{1}{2} m v^2 + m g h, \text{ Joules} \]

**Total Recoverable Power**

\[ \text{Kinetic Power} + \text{Potential Power} = \frac{1}{2} \rho Q v^2 + \rho Q g h, \text{ Joules/ sec} \]

With two identical turbines, the total recoverable power is

\[ P_R = \sum_{i=1}^{2} \left[ \frac{1}{2} \rho Q_i v_i^2 + \rho Q_i g h \right], \text{ Watts} \]

\[ \rho = 1000 \text{ kg/m}^3; g = 9.81 \text{ m/sec}^2; \]

**Water velocity** \( v_i \) is in m/sec;

**\( Q_i \) is in m\(^3\)/sec; \( h \) is in meters**

For \( Q_{1,2} = 1 \text{ m}^3/\text{sec} \);

\( v_{1,2} = 2 \text{ m/sec} \);

\( h = 3 \text{ m} \);

Estimated \( P_R = 62,860 \text{ Watts} \)

With no overflow, \( Q_{1\text{out}} + Q_{2\text{out}} = Q_{\text{net}} \)

**Effective Head, \( h \) above Tailrace**
FERC:
Micro-Hydro Roadblock
FERC Licensing - Exemption

• Production of power requires either a license or exemption from the Federal Energy Regulatory Commission (FERC).

• Irrigation districts in Utah have advised EBID that the cost of pursuing an exemption or license for a power project costs over $100,000 and takes years. Other states have also reported cost and time problems with the process for low head power.

• Without a statutory change to the FERC process, low head power will never be cost effective enough to be considered by any water provider despite wide spread interest.
FERC Legislation

- HR 5892, Hydropower Regulatory Efficiency Act of 2012 - Passed by unanimous vote
  - Creates “regulatory off-ramp” for non-controversial projects on existing conduits
  - <5MW

- Low Head Hydropower Working Group
  - Working to change FERC regulations from within
  - Proposing streamlined process for small conduit projects
  - <5MW
FERC Progress

- ‘Initial Consultation Documents’ and Public Meetings
- Re-File for exemption
- LANL and Sandia NL support and guidance
- Low-Head Hydro Working Group
- Hydropower Regulatory Efficiency Act 2012
Conclusion

- EBID has proved the ability to fabricate a low cost turbine in-house
  - But without a formal FERC exemption, it is cost prohibitive.

- Continue irrigation water delivery services while utilizing water flow for “green” energy production.

- Clean, emissions free “green” energy production while delivering water to 90,000 acres of irrigated crops.

- System produces renewable energy from existing irrigation canals with potentially thousands of similar locations throughout the West. This is the definition of Domestic Energy Production!

- By allowing irrigation districts to install and manage such turbines, the districts will be better able to operate and maintain the Reclamation projects and protect federal assets.

- Turbines fabrication could create on-the-ground local jobs throughout the year.
Questions

From left, Gary Esslinger, Henry Magallanez, Ross Irwin, and Matt Haines,