

# Hydro Green Energy: An American Waterpower Company & America's First Commercial Hydrokinetic Power Producer



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# About Hydro Green Energy

- Houston-based renewable energy systems developer and integrator
- HGE owns U.S. Patent # 6,955,049, two international patents (South Africa, Mexico)
- 100+ pending or issued in U.S. or overseas
- First commercial hydrokinetic power project began power generation in Feb. 2009
- Series-B funding on verge of closing
- 20+ U.S. projects in company pipeline (5 MW to 70 MW in size)
- Created 61 jobs over 2 years in 7 states for 1<sup>st</sup> project
- Variety of application points for technology



# Hydro Green Energy's Products

- **Hydro+™**

Hydrokinetic turbines deployed in tailrace of existing facility

- **Lock+™**

A patented, power-generating lock door in an auxiliary or active navigational lock

- **Efficiency+™**

Deployed in the cooling water discharge systems at thermal power plants (coal, nuclear) for energy recovery/efficiency or on-site generation purposes - non FERC jurisdictional (inside the fence)

- **River+™**

Multi-unit, multi-array hydrokinetic power systems are deployed in open rivers to generate baseload renewable power up to 70 MW



# About Our Patented HK Turbine

Generic Device Specifications	
Power Conversion	Mechanical – Patented Shroud Chain Drive
Electrical Output	Synchronized with Grid
Foundation	Surface-Suspended, Anchored Barge
Generator	AC Induction, Above Water on Platform
Dimensions	
Rotor Diameter	12 feet
Exit Duct Length	8 feet
Exit Duct Area	200 feet <sup>2</sup>
Runner depth below surface	9 feet nominal (shaft centerline)
Weight Breakdown	
Structural Steel	12,000 Pounds
Rotor (including shaft, blading and shroud)	12,000 Pounds
Exit Duct	10,000 Pounds
Power	
Rotor Rotational Speed	21 revolutions per minute (RPM)
Number of Blades	Three
Rotor Tip Speed at 21 rpm	3.67 meters per second
Cut-in Water Velocity	1.33 meters per second
Maximum Rated Water Velocity	3.5 meters per second
Rated Electric Power	100 kW @ 3.5 m/s
Capacity Factor	Up to 100% - site specific
Availability Factor	>99.0 %
Turbine Coefficient of Performance [Cp]	0.62 at design flow (gross power at shaft)



# Overview: The First Project

- City of Hastings, MN 4.4MW hydroelectric facility
- A surface-mounted array of hydrokinetic turbines
- 2 units: nameplate capacity of 100 kW and 150 kW
- Up to a 5.7% increase in existing plant capacity
- First commercially-operational, FERC-licensed HK plant in U.S.
- Can be duplicated at hydro sites worldwide



City of Hastings Hydro Project - 4.4 MW  
Mississippi Lock and Dam #2



Array

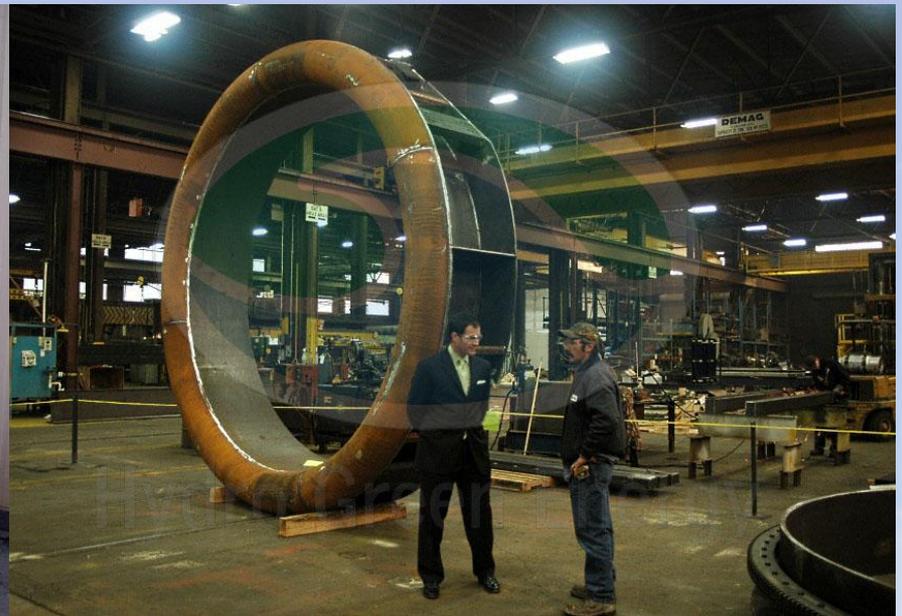
Substation, grid connection, metering facility all  
less than 250 feet from array = LOWER  
PROJECT COSTS



Hydro Green Energy



# Hastings Project Parts & Assembly



# Fabrication



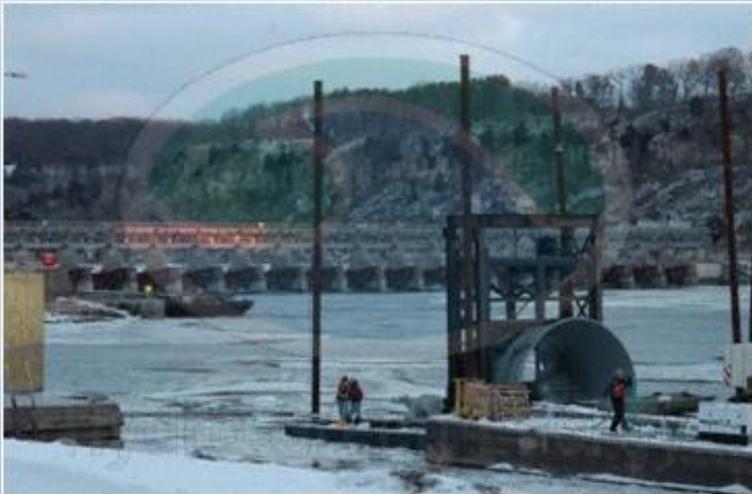
CONFIDENTIAL AND PROPRIETARY - DO NOT  
DUPLICATE OR DISTRIBUTE



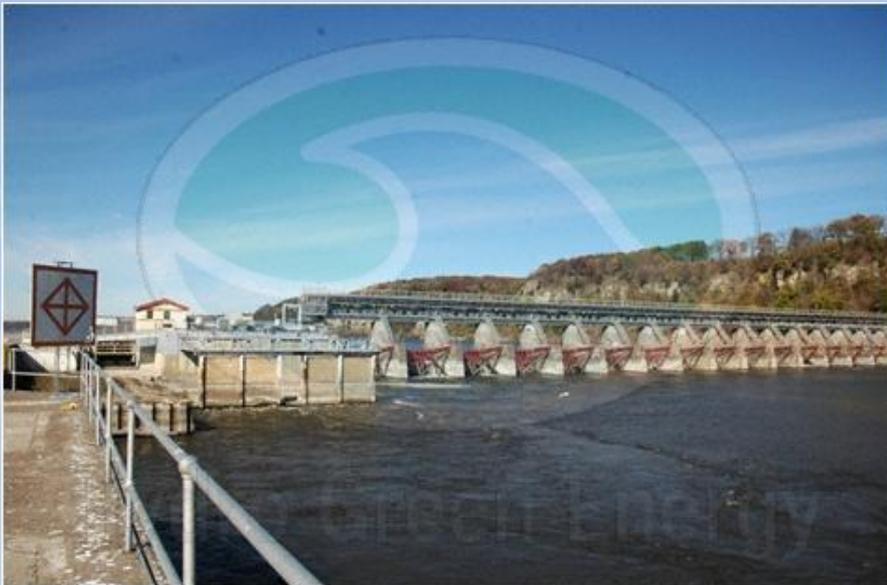
# Delivery



# Installation



# The Project Site: Hastings, MN Before & After



# Hydro+ : Lessons Learned

- Hydro+ - 100 -150 kW nameplate per unit
- Hydro+ - KISS: remove failure modes
  - Aluminum cast blades – no composites
  - No variable pitch
  - No wicket gates
  - Surface generator – no flooding
- Lessons learned:
  - Full shop fabrication (none in field)
  - Full shop runtime checkout (mechanical, E&I) to QA (not in field)
  - Minimize work to be done on water => prefab modules



# Working with the U.S. Army Corps of Engineers (USACE)

- Challenges

- Large organization – districts, divisions, D.C.
- Civilian Works (CW) vs. Military Command
- Existing culture relative to risk taking
- Existing culture relative to hiring
- Communications from district to district vs. D.C. – not always the same
- Commander in Chief energy goals – action items
- USACE playbook – update the mission for clean energy

# Project Interactions with USACE

- Hastings, MN – hydrokinetic
- Navigational lock & dams
- Hydro at non-hydro dams

# Hastings, MN Project

- Hastings, MN – hydrokinetic
  - Not tethered to dam structure (6-10,000# gravity anchors)
  - MOA
    - Engineering review
    - Electrical review
    - Safety
    - Removal
    - Operating plan
  - Approval of Articles of FERC License

# Recommendations for Future Working Relationship

- Hire employees (green jobs) to be more responsive to developers
- Divide and conquer - Dedicate employees to specific projects (don't overload)
- Need new directive to allow drawings to be released at Preliminary Permit stage (background checks, TISC cards, other?)
- Understand timelines = developer \$\$\$'s
  - 408 and 404
- Strive to meet “comments” early

# Contact Information

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