# Qin Fen (Katherine) Zhang

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## WORK EXPERIENCE

2011.3 – Present **Research Engineer, Water Power Program, Environmental Science Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee, USA**

- PI for "Small Hydropower Cost Reference Model" – http://info.ornl.gov/sites/publications/Files/Pub39663.pdf
- CO-PI and Technical Lead for "Hydropower Advancement Project (HAP)" - http://hydropower.ornl.gov/HAP/
- Key personnel for "Deschutes Basin-Scale Hydropower Opportunity Assessment"
- Key personnel for "Water Vision project" – PI for "Hydropower Cost Model"

2009.10 – 2010.11 **Director of Technology, Riverbank Power Corp., Toronto, ON., Canada**

- Critical review on underground & ground closed-loop pumped storage hydro designs;
- Life cycle assessment for pump storage hydro projects and associated electric power systems (funded by NSERC-Canada, a Post-doc research subject);
- Power generation and financial analyses for new sites of hydro development (both Run-of-the-River and Pump Storage projects);
- Technical and financial evaluation for acquisition of existing small hydro facilities;
- Research on variable speed pump-turbine technology and turbine procurement.

2007.12 – 2009.10 **Hydraulic Engineer, Canadian Hydro Components, Almonte, ON., Canada.**

- Selecting and sizing hydro turbines per specific site condition to provide turbine data sheet and quotation document;
- Producing turbine performance curves (both efficiency and cavitations);
- General arrangement of hydroelectric powerhouse (AutoCAD drawings);
- Mechanical design of turbine parts (shaft, bearing etc.);
- Blade vs. Wicket-gate Cam relationships for Kaplan turbines;
- Preparing for generator specifications and load sheet;
- Performing hydrological and hydraulic analyses;
- Helping on bidding documents and purchase agreement; and etc.

2001.7 – 2007.12 **Waterhammer Specialist, associated with HydraTek & Associates Inc., ON.**

- Transient Analysis and Control Measures for Bone Creek Hydro Project (for Canadian Hydro Developers Inc.);
- Transient Analysis for Energy Recovery Hydro Turbines – Several Sites in Las Vegas Water Districts (for Kinectrics Inc.);
- Water-hammer and Water Column Separation Analysis for Masjed e Soleiman Hydropower Plant in Iran.
- Hydraulic Modeling of Split Flow in Distribution Channel of Water and Waste Water Treatment Plants (for XCG consultants Ltd.)
- Preliminary Feasibility Study of a Closed-Loop Pump-Storage Hydro Project in Ontario (for Skypower Corp);

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2000.7 – 2001.1 **Invited Visiting Researcher**, **CEDEX, Madrid, Spain**

1990.5 – 2000.6 **Assistant/Associate Prof., Dept. of Hydropower Engineering; Research Engineer at Hydraulic Research Center (Hydraulic Laboratory), Hohai University, China**

Categories of R&D and consulting projects participated during the 10 years in China:

- Physical model experiments of hydraulic systems (including open channel, water intake, high-speed spillway, pressured water conveyance systems)
- Numerical modeling of transient flow in pressurized pipeline systems
- Planning and feasibility study of small hydropower projects
- Hydraulic and structural design of water conveyance system and powerhouse for small hydropower projects
- Hydraulic and structural design of storm water management and urban flood control system (Including pumping stations, open channel, culverts, river embankment)

Courses Taught:

- Fluid Transients in Systems (postgraduate course in English )
- Hydropower Stations (including Integrated Project for Hydropower Station Design)
- Utilization of Water Resources - Hydrology and Hydropower Development Planning

## PROFESSIONAL AFFILIATIONS

Since 2011 - Member, ASME Hydro Power Technical Committee (HPTC)

Since 2006 - Member, Professional Engineers of Ontario (Canada)

## AWARDS

2000: National Science and Technology Progress Award (Second Prize) by the State Council of China – The highest level of award issued by the government of China - for "*Water-hammer Theory Research and Engineering Applications*" (No. 2000-J-222-2-06)

2010: NSERC Industrial R&D Fellowship (NSERC - Natural Sciences and Engineering Research Council of Canada)

2004-2007: NSERC Doctoral-Level Postgraduate Scholarship

## EDUCATIONS

2009.7 **Ph.D.** Civil Engineering Dept. and Collaborative Environmental Program, University of Toronto, Toronto, Canada

1998.12 **Dr. Eng**. Hydropower Engineering, Hohai University, Nanjing, China

1990.5 **M. Eng**. Hydraulics and River Dynamics, Hohai University, Nanjing, China.

1987.7 **B. Eng**. Water Conservancy and Hydropower Engineering, Hohai University, Nanjing, China

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## PUBLICATIONS

### Referred Journal Papers:

1. Zhang, Q., Karney, B.W. Suo, L., and Colombo, A. (2011). "Stochastic analysis of water hammer and applications in reliability-based structural design for hydro turbine penstocks," J. of Hydraulic Engineering, ASCE, 137(11): 1509-1521.
2. Zhang, Q., Karney, B.W. and Pejovic, S. (2011). "Non-reflective boundary design via remote sensing and proportional-integral-derivative control valve". J. of Hydraulic Engineering, ASCE, 137(11): 1477-1489.
3. Zhou, L., Liu, D., Karney, B., and Zhang, Q. (2011). "Influence of entrapped air pockets on hydraulic transients in water pipelines." J. of Hydraulic Engineering, ASCE, 137(12), 1686-1692.
4. Liu, D, Zhou, L., Karney, B., Zhang Q., and Ou, C. (2011). "Rigid-plug elastic-water model for transient pipe flow with entrapped air pocket". J. of Hydraulic Research, IAHR, 49(6): 799-803.
5. Qinfen Zhang, Bryan W. Karney and David L. McPherson. (2008) "Pressure Relief Valves Selection and Transient Pressure Control". J. of AWWA, Vol.100, No.8, p62-69.
6. Qinfen Zhang, Bryan Karney, Heather L. MacLean, Jingchun Feng. (2007) "Life Cycle Inventory of Energy Use and GHG Emissions for Two Hydropower Projects in China". J. of Infrastructure Systems, ASCE. Vol. 13, No. 4, p271-279.
7. YOU Guanghua, LIU Deyou, WANG Feng, ZHANG Qinfen. (2005). "Measurement and Simulation of Load Rejection Transients at Tianhuangping Pump-Storaged Power Plant". J. of Hydroelectric Energy, 2005-01, pp24-27.
8. M. Quecedo, M. Pastor, M.I. Herreros, J.A. Fernandez Merodo, Qinfen Zhang. (2005). "Comparison of two mathematical models for solving the dam break problem using the FEM method". J. of Computer Methods in Applied Mechanics and Engineering, 194, p3984–4005.
9. ZHANG Qinfen, SUO Lisheng. (2000) "Application of Stochastic Analysis of Water-hammer in Structural Design of Penstocks", J. of Hohai University, (ISSN 1000-1980) 28(2), 17-22.
10. ZHANG Qinfen, SUO Lisheng, GUO Wenzhu. (2000) "A Further Study of Stochastic Analysis of Water-hammer Pressure in a Reservoir-pipe-valve System", J. of Hydroelectric Engineering, (ISSN 1003-1243) 2, 56-63.
11. ZHANG Qinfen, SUO Lisheng (1998) "Advances on Stochastic Analysis of Water-hammer and Surge", J. of Advances in Science & Technology of Water Resources, (ISSN 1006-7647) 18(3), 7-11.
12. ZHANG Qinfen, SUO Lisheng, HU Ming (1998). "Experimental Study on Layout of Approach Channels to Intake of River-type Reservoirs", J. of Hohai University, (ISSN 1000-1980) 26(3), 66-70.
13. ZHANG Qinfen, SUO Lisheng. (1997) "Stochastic Model for Transient Analysis in Surge Tanks", J. of Hohai University, (ISSN 1000-1980) 25(5), 41-45.
14. ZHU Dangsheng, ZHANG Qinfen, WANG Mulan. (1996) "Application of Information Entropy Theory to Study of Hydraulic Problems", J. of Hydraulic Engineering, (ISSN 0559-9350) 9, pp33-37.
15. WANG Mulan, ZHANG Qinfen. (1995) "Risk Analysis of Incipient of Cavitation in a Cascade of Orifice", J. Shipbuilding of China, (CN31-1497/U), Oct.1995, 155-161.
16. WANG Mu-lan, ZHU Ke-chue, ZHANG Qin-fen, ZHU Dang-shen (1994) "Application of Information

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Entropy Theory to Study of Velocity Distribution in Open Channel Cross Sections". J. of Hydrodynamics (ISSN 1000-4874), 1994-03, pp276-283.

17. ZHANG Qinfen, ZHU Dangsheng, WANG Mulan, (1994) "Application of Maximum Entropy Law in Calculating Suspended Sand Concentration Profile", J. of Waterway and Harbor (ISSN 1005-8443) 1994-02, pp21-25.
18. WANG Mulan, **ZHANG Qinfen**, ZHU Dangsheng. (1993) "Study of Velocity Distribution in Open Channel Cross Sections by Experimental & Field Observations and Information Entropy Theory", J. of Spillway and High Velocity Flow, No.1.
19. Jianxu Zhou, Bryan Karney, Qin Fen (Katherine) Zhang. "A Selective Literature Review on Hydraulic Vibration and Instability Studies in Hydropower Systems". **Submitted to J. of Fluids Engineering, ASME**.

## Other Publications

20. WANG Mulan, ZHANG Qinfen, ZHU Dangsheng (1994). "Information Entropy – A challenge area of Hydraulics". Collection of Research Papers on Spillway and High Velocity Flow (ISBN 7-5616-2938-9/TV·26), Publishing House of Chengdu Technology University, Chengdu, China, Sept. 1994, pp351-355.
21. ZHANG Qinfen, MAO Yan, NI Tianni (1994). "Expert System for Overall Layout of Hydropower Projects". Collection of Research Papers on Computer Science and Technology and Their Applications in High Technology Areas, edited by Jiangsu Province Science and Technology Association. (ISSB 7-5046-1915-9/TP·73), China Science and Technology Publishing House Nanjing, China, September 1994. pp376-380.
22. Zhang Qinfen (1996). "The experience from a research engineer to a professor". J. of Higher Education (Hohai University). 1996 (2). pp76-77.
23. Zhang Qinfen and Zhen Yuan (1997). "How to Improve Teaching and Learning of Computer Courses for Engineering Students". J. of Higher Education (Hohai University). 1997 (2). pp27-29.

## Peer-Reviewed Conference Papers and Presentations:

1. Qin Fen (Katherine) Zhang, Rocio Martinez, Brennan Smith and Wei Zhang (2013). Hydropower Initial Capital Cost Modeling. Accepted as technical paper by HydroVision International 2013, Denver, Colorado, USA, July 23-26, 2013.
2. Qin Fen (Katherine) Zhang, Rocio Martinez, Brennan Smith and Boualem Hadjerioua (2013). Hydropower Initial Capital Cost Modeling. Accepted as technical paper by HydroVision International 2013, Denver, Colorado, USA, July 23-26, 2013.
3. Qin Fen (Katherine) Zhang, Brennan Smith, Patrick March, Marvin Cones, Rajesh Dham and Michael Spray (2012). Methodology and Process for Condition Assessment at Existing Hydropower Plants. HydroVision International 2012, Louisville, Kentucky, USA, July 17-20, 2012.
4. Brennan Smith, Qin Fen (Katherine) Zhang, Patrick March, Marvin Cones, Rajesh Dham and Michael Spray (2012). Best Practices Implementation for Hydropower Efficiency and Utilization Improvement.

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HydroVision International 2012, Louisville, Kentucky, USA, July 17-20, 2012.

5. Patrick March, Brennan Smith, Qin Fen (Katherine) Zhang, and Rajesh Dham (2012). Data-Based Performance Assessments for the DOE Hydropower Advancement Project. HydroVision International 2012, Louisville, Kentucky, USA, July 17-20, 2012.
6. Rajesh Dham, John R. Gasper and Qin Fen (Katherine) Zhang (2012). Developing Methods and Technologies for Optimizing Generation at Existing Hydropower Facilities. HYDRO 2012, Bilbao, Spain, October 29 – 31, 2012.
7. Pejovic, S., Zhang, Q., Karney, B. and Gajic, A. (2011). Analysis of Pump-Turbine "S" Instability and Reverse Waterhammer Incidents in Hydropower Systems. IARH 4th International Meeting on Cavitation and Dynamic Problems in Hydraulic Machinery and Systems, October, 26-28, 2011, Belgrade, Serbia (invited keynote paper).
8. Bryan Karney, Katherine Zhang, Cory Williams, Richard Slopek (2009). Transient Performance Evaluation and Control Measures for Bone Creek Hydropower Project. Waterpower XVI Conference, Spokane Washington, USA, July 27-30, 2009.
9. Karney, B., Q. Zhang, S. Pejovic (2008). "Non-reflective boundary design through remote sensing and PID control valve." Surge Analysis–System Design, Simulation, Monitoring and Control. 10th International Conference on Pressure Surges, Edinburgh, U.K., May 14-16, 2008, 243-256.
10. Liu, D., Wang, F., Zhang, Q. and Karney, B.W. (2008). "Pump-turbine runner lifting during load acceptance: an exploration of possible causes." Surge Analysis–System Design, Simulation, Monitoring and Control. 10th International Conference on Pressure Surges, Edinburgh, U.K., May 14-16, 2008, 65-79.
11. Zhang, Q. and Karney, B.W. "Energy recovery turbines in water supply systems: hydraulic applications and constraints". HydroVision International 2008, Sacramento CA, July 2008, on CD.
12. S. Pejovic, B. W. Karney, Q. Zhang, and G. Kumar (2007). Small Hydro, Higher Risk. IEEE Electrical Power Conference, Oct. 25-26, 2007 in Montreal, Canada. on CD.
13. Pejovic, S., Karney, B.W. and Zhang, Q. (2004). "Water column separation in long tailrace tunnel," 17th International Conference on Hydro-Turbo, Brno, Czech Republic, October 18-22, 159-168.
14. Liu D. Y., Zhang Q. F., Xu H.M. (2004). "Hydraulic experiment of arc-shaped gate on the Qinhuai River". Proceedings of ISEH & IAHR-APD'04 conference, Hong Kong, Dec. 15-18, 2004.
15. Zhang, Q. and Karney, B.W. (2003). "Pipe systems with micro-turbines: water hammer considerations". Proceedings of FEDSM'03 4th ASME_JSME Joint Fluids Engineering Conference, Honolulu, Hawaii, July 2003.
16. Zhang, Q., Karney, B.W., Joksimovic, D. and Ferguson, L. (2002). "An algorithm for calculating flow depth and discharge in a distribution channel". Proceedings of the First Annual Environmental & Water Resources Systems Analysis (EWRSA) Symposium (in conjunction with the Water 2002 ASCE-EWRI Conference). CD-Rom: Session ??, Roanoke, Virginia, May 2002, pp??.
17. ZHANG Qinfen, SUO Lisheng. (2000) "Stochastic Analysis of Water-hammer in a Reservoir-pipeline-valve System", Proceedings of 8th International Symposium on Stochastic Hydraulics (ISSH'2000), Beijing, China, July 2000.

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18. ZHANG Qinfen, ZHU Dangsheng, WANG Mulan, (1994) "Application of MEP to Study of Suspended Sediment Concentration Distribution in Open Channel Cross-Sections", Proceedings of 9th Congress of the Asian and Pacific Division of the International Association for Hydraulic Research (IAHR), Vol. 2, 306-312, Singapore, August 24-26.
19. WANG Mulan, ZHANG Qinfen, Wang De-Chang et al. (1992) "Application of Information Entropy Theory to Study of Velocity Distribution in Open Channel Cross-Sections", Proceedings of 6th IAHR International Symposium on Stochastic Hydraulics.
20. WANG Mulan, Zhu Guang-Cui, ZHANG Qinfen (1992) "Extended Risk Analysis in predicstion of Local Scour Downstream of Ski-jump Spillway", Proceedings of ISHRNL.

## Conference Posters and Presentations (including co-authored):

1. Qin Fen (Katherine) Zhang, Rocio Martinez, Brennan Smith and Boualem Hadjerioua (2013). Integrated Modeling and Design Tool for Energy Cost Reduction of Small Hydro Projects. A poster presentation, HydroVision International 2013, Denver, Colorado, USA, July 23-26, 2013.
2. Wei Zhang, Qin Fen (Katherine) Zhang, Brennan Smith and Rajesh Dham (2012). Material Challenges and Opportunities in Conventional Hydropower. ASCE Conference on Materials Challenges in Alternative & Renewable Energy. Florida, USA, February 26 – March 1, 2012.
3. Zhang, Q. (2009). “Lifecycle inventory of energy use and greenhouse gases emissions for hydropower projects,” IEEE Canada, Electrical Power and Energy Conference 2009, Montreal, Hydro Power and Storage Technology section, 23 October.
4. Karney, B.W. with Zhang, Q. (2006). "Active hydraulic devices and transient control," CWN Research Conference, Montreal, Quebec, Nov.
5. Zhang, Q. with Karney, B.W. (2004). “Transient analysis and energy recovery hydro turbines in water supply systems,” a poster presentation at Connecting Water Resources 2004, a CWN conference, June 20-22, Ottawa, Canada.

## Recently Published Project Reports

1. A series of Publications (2011-2012) for “Hydropower Advancement Project (HAP)” - http://hydropower.ornl.gov/HAP/
2. Zhang Q., Smith B., Zhang W. (2012). Small Hydropower Cost Reference Model Report http://info.ornl.gov/sites/publications/Files/Pub39663.pdf
3. Zhang Q., Martinez R., Saulsbury J. et al. (2013). Technical and Economic Feasibility Assessment of Small Hydropower Development in Deschutes River Basin.