Enes Zulovic MIE Aust, CPEng

Specialist HydroPower Mechanical Engineer

Career summary

A Registered Professional Engineer with international experience and passion in the hydro power generation. Enes has comprehensive experience and specialist knowledge in all stages of hydropower projects from planning, turbine model testing, design review, site construction, factory acceptance, installation and commissioning. Services and capabilities include:

- Training in shaft alignment, vibration analyses, practical RCA, integrated approach in problem finding and solution, development of hydropower knowledge transfer programs;
- Technical project management and engineering design review, Preparing technical specifications and tender assessment;
- Shaft and bearing alignment;
- Vibration analyses, diagnostic, testing and investigation;
- Hazard Operability (Hazop) studies, Root Cause Analyses (RCA) and failure investigation;
- Machinery Condition assessment, performance test results evaluation;
- Risk management, selection of engineering measures for risk control;
- Construction and Site installation Supervision, support and site owner's acceptance engineer role;
- Factory Acceptance testing (FAT);
- Oil vapour elimination system: site inspection, design, commissioning;
- Penstock pressure pulsation protection systems, draft tube vortex and air admission systems.

Enes and his team developed engineering integrated practices which were progressively applied during the modernization projects he participated in. His published paper was awarded an Australian Engineering Excellence Award in October 2009 by the Engineers Australia national judging panel.

FOR FURTHER INFORMATION

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Personal details

Name	Enes Zulovic
Year of birth	1953
Nationality	Australian
Qualifications	Bachelor of Science in Mechanical Engineering from University of Sarajevo, Faculty of Mechanical Engineering in Mostar, Bosnia and Herzegovina, 1972-1976.

Fields of expertise

- Training in vertical shaft alignment, rotating machinery vibrations, practical root cause analyses (RCA), hydro power specific knowledge transfer program for engineers;
- Hydro power modernization and refurbishment projects technical governance, design review of feasibility study, preliminary design, detail design of hydro turbine and hydro mechanical equipment;
- Preparation and evaluation of technical specifications and international tender documents for power rotating machinery;
- Shaft and bearing alignment;
- Hazop studies;
- Practical Root Cause Analyses (RCA), failure investigation;
- Factory Acceptance Testing (FAT), site supervision and Commissioning of the hydro turbine equipment - Site Acceptance Testing (SAT);
- Providing technical contract administration, including site installation and construction works and technical project management;
- Vibration Analyses, monitoring, diagnostic, protection, vibration systems;
- Vibration signature testing, investigation vibration testing;
- Preparation of Technical specification for vibration online and portable vibration condition monitoring, diagnostic and protection systems;
- Developing and implementing engineering solutions for mechanical and hydro mechanical hydro power assets;
- Planning of the hydro power assets modernisation projects and major overhauls;
- Implementing and improving Condition monitoring (CM) and asset maintenance practices, (expert knowledge of hydro plant vibration CM;

- Risk management in identifying and tracking high risk, implementing risk mitigation actions and contingency plans;
- Experienced in utilisation of Plant Modernisation and Refurbishment of Hydropower stations methodologies by Electric Power Research Institute (EPRI), USA and International Energy Agency (IEA), Canada named Methodology for modernisation of turbines, generator and protection equipment;
- Developing strategies and asset maintenance improvement plans;
- Proven design of generator bearings oil vapour elimination system supervision of installation and commissioning and adjustment;
- Expert Consultancy works in the Hydro power plant: vibrations, vertical shaft and guide bearing alignment, oil vapour elimination system, pressure pulsation in draft tubes, air admission to the turbines, and penstock pressure pulsations, FAT and SAT;
- Providing professional guidance, support, mentoring and coaching for Graduate Mechanical engineers in Hydro Power.

Professional affiliations

Member of the Australian Institution of Engineers; MIE Aust; (1996 - Present)

Chartered Professional Engineer (CPEng), Colleges Mechanical,

Registration National Professional Engineers Register (NPER).

Member of Technical Committee of International Hydro Vision Conferences, 2014, 2015 and 2016; USA.

Countries of work

Australia, New Zealand, Papua New Guinea, Austria, Spain, Bosnia and Herzegovina, Croatia, Serbia and Slovenia.

Professional experience

Summary

Acutel Consulting, Tasmania, Australia

2014 – Specialist Hydro Power Mechanical Engineer, Acutel Consulting, Tasmania, Australia

Hydro Tasmania, Generation

2011 - 2014 Specialist Mechanical Engineer; Major Works; Modernisation Projects

2010 - 2011 Specialist Mechanical Engineer, Asset Risk and Strategy

2006 - 2010 Senior Mechanical Engineer; Modernisation Projects; Engineering Delivery

2004 - 2006 Senior Mechanical Engineer (Modernisation Projects); Field Engineering, Power Schemes

2000 - 2004 Senior Mechanical Engineer, Field Engineering, Power Schemes Engineering

Hydro Tasmania, Hydro Consulting

1996 - 2000 Senior Design Mechanical Engineer, Electrical and Mechanical Engineering Group

Public Electric Power Company of Bosnia and Herzegovina Elektroprivreda BiH, Hydro Electric Power Stations on Neretva River, Mostar

1992 - 1995 Senior Maintenance Engineer, operation and maintenance

1985 - 1992 Chief of Department for Mechanical Hydro Plant, development of new power plants

1982 - 1985 Senior Mechanical Maintenance Engineer, operation and maintenance of new power plant

1979 - 1982 Engineer Supervisor Construction / Project Engineer, construction of new power plant

1977 - 1979 Maintenance Mechanical Engineer (Modernisation Project)

Professional experience

2014 - **Specialist Hydro Power Mechanical Engineer, Acutel Consulting**

- Karapiro hydro power plant, Mighty River Power, New Zealand, site commissioning work after 1 year major outage and repair works;
- Training - Hydro Vertical Shaft alignment (Basic and Intermediate) for Eskom, Africa Ugandan Hydro Power Utility engineers, 8 days training, Hobart, Tasmania;
- Consulting Engineering Technical Assistance to Hydro Tasmania involved in workshop works for major refurbishment projects:
    - HPP Cethana 1x100 MW Francis vertical shaft turbine-generator, Underground station;
    - HPP Fisher 1x 40 MW vertical shaft Pelton turbine-generator;
    - HPP Meadowbank 1x 40 MW vertical shaft Kaplan turbine-generator;

    Workshop repair and machining of major equipment (shafts, runner, turbine top covers, guide vanes, thrust and guide bearings, main inlet valves, turbine runners, Pelton nozzles and servomotors, and components and systems; peer review of oil vapour eliminations systems, peer review of calculation of shaft critical speed;
- Publication of paper: *A Novel Approach in Solving High intermittent Vibration at Tungatinah power station*, for Hydro vision Conference 2015, Portland, OR, USA. Presented in July 2015 – This technical paper was voted the best paper, **Awarded 1st place paper in category, HV 2015**;
- Invited as a Guest speaker at Reliability conference, Gold coast, April 2016, Queensland, Australia, Condition Monitoring Stream – “Measuring and Using Machine Stiffness Information to Assist Vibration Analysis and Machinery Problem Solving” - Enes Zulovic - Acutel Consulting – Tasmania, Australia;
- Invited as a Guest Speaker VANZ (vibration) conference: “A NOVEL INTEGRATED APPROACH SOLVING VIBRATION PROBLEMS”; Author: Enes Zulovic, MIEAust, CPEng; Specialist Hydro Power Mechanical Engineer, Acutel Consulting, New Zealand, May 2016;
- Guest Speaker Conference Pump Selection and Operation Excellence: “New Integrated Approach is the right way to achieve smooth and cost effective operation”; Author: Enes Zulovic, MIEAust, CPEng; Specialist Hydro Power Mechanical Engineer, Acutel Consulting, Melbourne, Australia, 2015;

2011 - 2014

Specialist Mechanical Engineer; Major Works; Modernisation Projects

> 1/Kaplan Project: four hydro power plants modernisation project, new Kaplan runner without oils hub, and New turbine governor, and associated equipment; Paloona completed in August 2014, design review, technical specification peer review, workshop supervision, evaluation of turbine and generator shaft alignment as found results and decision making process;

> 2/Tungatinah units 5, 1 and 2: design review, technical specification, commissioning program review, turbine and generator shaft and guide bearing alignment evaluation of as found results and member of decision making team for corrective actions: new thrust block, stator to rotor axial alignment, shaft throw, levels ; rotor balancing, shaft alignment, vibrations levels and efficiency testing;

> Tungatinah unit 1high vibration problem eliminated by performing RCA analyses and applying integrated approach and finding solution; Implemented by installing two radial beams to support concrete foundation and eight radial stiffeners to the thrust bracket;

Achievements:

> TU1 Resonant Vibrations reduced and machine operate safely;

> **Paper "Tungatinah Vibration station" voted as the best conference paper at 16th HPEE in Hobart, Tasmania, August 2014**;

2010 - 2011

Specialist Mechanical Engineer, Asset Risk and Strategy

Asset risk and 10 years asset strategy for hydro turbines, hydro mechanical equipment, generators, oil and air coolers, cooling water systems, and oil vapour eliminations system;

Poatina 6 x 60 MW Pelton vertical shaft turbine-generators, Underground station Development, Due Diligence study and review of preliminary and detail design and commissioning of installation of new penstock pressure pulsations protection systems;

2006 - 2010

Hydro Tasmania, Generation; Modernisation, Hobart, Tasmania, Australia; Senior Mechanical Project Engineer

Modernisation projects

1/ POATINA POWER STATION 6 X 60 MW; VERTICAL SHAFT PELTON TURBINES,

> New Pelton runners with output upgrade to 60 MW from 55 MW; new turbine governor PLC by L&S, USA;, new turbine guide bearing by Michell, UK;

- Responsible for engineering decision for on-site disassembly, site erection, pre - commissioning and commissioning of three (3) vertical shaft Pelton turbines 60 MW and mechanical plant;
- Designed new oil vapour exhausting fan and Coalescer filter unit for the upper guide and thrust bearing, supervising site installation and successful commissioning;
- Developed technical specification and requirements for the procurement of two new oil heat exchangers;
- Factory Acceptance Test (FAT): Workshop works: final machining of new turbine guide bearing, turbine shaft, turbine main inlet ball valve, thrust bracket, penstock- turbine isolating ball valve; FAT of turbine governor and high pressure unit;
- Acceptance engineer for shaft alignment, rotor balancing, vibrations, Site pre-commissioning and commissioning works;

Achievements:

- Excellent technical results of modernization works presented in paper "Poatina World Class operation" awarded by Tasmania Engineering Excellence Award in July 2009 and National Engineering Excellence Award December 2009, Canberra;
- Implementation of solution for FCAS operation on Pelton unit PO5 by replacing deflector type of engagement '"Push Out" with new "CUT IN"" type by Andritz, preventing flooding of the turbine guide bearing and station MIV (TIV) pit;
- Turbine bearing operating temperature reduced and no oil loss in operation;
- Shaft resonance at 480 rpm speed eliminated by combination of the turbine runner factory precision balancing, removing auxiliary generator, precision shaft and bearing alignment, rotor balancing; Achievement: Removal of the structural resonance.

2/ GORDON HYDROELECTRIC SCHEME

Gordon Power Station, machines 1&2, 150 MW each; vertical shaft Francis turbines; Modernization of turbines, generators, turbine governors, AVR, control, protection and auxiliary mechanical plant for the 450 MW installation comprising of two 150 MW Francis turbine units operating under 196 m head. Total project cost estimate $40 million.

Achievement:

Shaft resonance at 6.5 Hz normal speed eliminated by combination of the turbine runner on site dynamic balancing, increasing stiffness of the stator frame, new turbine wedge type guide bearing, removing auxiliary generator, precision shaft and bearing alignment, rotor precision balancing and resulting in the removal of the machine restraint to operate above 125 MW;

Mechanical Team Leader/project engineer; site commissioning acceptance engineer, workshop witness engineer; Site installation, major innovative works: In Place Machining from USA, on site heating by Manning's, USA of rotor hub for disassembly of the rotor

poles and stator removal; runner wear ring replacement, on site turbine runner dynamic balancing,

- Turbine runner on site dynamic balancing achieved As Left the balance grade of G 1.4 from As Found balance grade of G 48;
- Modifications and repair, replacement works: MIV hydraulic control , new turbine guide bearing, new wear rings, cooling water system upgrade, air admission system upgrade, new oil vapour elimination system: exhaust fan and Coalescer filter system;
- Rotor on site dynamic two planes balancing;
- Acceptance engineer for the Pre- commissioning and commissioning works;
- Vibration levels at the turbine guide bearing journal reduced from 700 microns peak to peak to 100 microns peak to peak; no shaft resonance at 6.5 Hz occurring during machine over speed and load rejection transients;
- Conducting engineering review on Fuji proposals for generating units GO 1&2 modernisation – Mechanical equipment: vibration countermeasures, vibration test reports, turbine bearing, thrust bracket, shaft seal, air admission system, oil vapour elimination system to upper and lower guide bearings and carbon dust, cooling water, main inlet valve control system modifications, etc. regarding to the Modernisation project Phase 1 – Feasibility Study submitted by Fuji- Japan;
- Providing engineering solution for the elimination of the wear ring cavitation damages to Fuji engineers: accepted and implemented;
- Preparing evaluation of the Skilled Engineering capability to carry out the unit GO2 modernisation on-site installation work. Total cost estimate of site installation works of $ 5 million per machine;
- Risk assessment for over speed test in regards to the occurrence of shaft resonant frequency at 6.5 Hz for the Fuji tests carried out in January 2003;
- Member of testing and evaluation the Fuji vibration and pressures tests on machines 1 and 2;
- Preparing Technical Specification for wear rings, turbine guide bearing, and shaft seal.
- Project management, preparing technical specification for the stator air coolers for Gordon machines 1 &2, procurement and witnessing test at manufacturer workshop, installed in July 2004;
- Preparing Technical specification for guide vanes bushes replacement; Installed in November 2003.

3/ MODERNISATION PROJECT TUNGATINAH POWER STATION

5 x 26 MW vertical shaft Francis turbines, originally commissioned in 1953/56; Current phase: Site completion of units' no. 5, 1 and 2; preliminary and detail design and manufacture;
Total cost estimate $60 million.

Team member/ Mechanical and Turbine equipment/ Representing Power Scheme Engineering /Site inspection and workshop inspection with Mechanical Design Engineer, Alstom - France

> New turbine runner with output upgrade to 30 MW from 25 MW;
> Evaluation of Alstom, France mechanical design proposals;
> Preparing Technical specification and determining acceptance criteria;
> Definition of problems and preliminary discussion about possible solutions: lower guide bearing, turbine hydrostatic water bearing, runner, spiral casing, turbine relief valve, and turbine governor, thrust bearing;
> Site testing program for of hydraulic instability; carry out tests and evaluation of test results.

4/ TREVALLYN POWER STATION 4 X 27 MW, ORIGINALLY COMMISSIONED IN 1955

> Modernisation works (turbine runner replacement, turbine output increase to 30 MW, completed on units 3&4 in 2006;
> Providing engineering technical advice for turbine guide bearing selection;
> Draft tube pressure and penstock pressure pulsations acceptance criteria, vibration Acceptance standards, and vertical shaft and guide bearing alignment.

2002 Gordon HPP – Penstock Pressure Pulsation Event

> Analyzing result of the event and finding problem: self-excited penstock resonance - penstock pressure pulsations cause by leaking turbine inlet valve;
> Preparing penstock pressure pulsation testing program to initiated the penstock pressure pulsation by draining water from closing side of the sliding seal of the ball type turbine inlet valve;
> Member of team conducting Route Cause Analyses (RCA);
> Member of site testing and solution team, execution of the onsite testing of the protection system implemented by the Hydro Tasmania and reviewing report;
> Preparing and Implementing recommendations state-wide.

2000-2001 Gordon HPP Machine #1 Overhaul project engineer

Implementing improved the shaft and guide bearing alignment, axial position of the runner, thrust bearing bracket soft foot in 2001 resulting in the reduced vibration level from 700 microns to 350 microns peak to peak.

1996-2000

Hydro Tasmania, Consulting, Hobart, Tasmania, Australia

Electrical and Mechanical Engineering Group specializes in design of new mechanical and electrical hydro plant, upgrading older hydro stations. The services cover: turbines and large gates and valves, auxiliary power systems, Control and governing systems, performance analyses, instruction, manuals and documentation, site supervision, testing and commissioning, investigation, technical advice and safety reviews.
Reporting to Mechanical Team Leader.

Technical Project Manager and Design Mechanical Engineer

Internal projects included:

Asset management/Mechanical Protection project

> Preparing Testing procedures for Intakes Gates, Anti Vacuum Valves, Pressure Relief Valves, Butterfly Valves, Radial Valves, and Wheel Gates.

Plant Modernisation/ Efficiency Improvement and Plant Up rating data

> Preparation of relevant data for efficiency improvement and uprating project of the Hydro Tasmania power stations (26 operating).

Plant Modernisation /Lake Echo Power station (PS): 1x32 MW

> Machine Control and Protection Upgrade Conceptual design, plant inspection and recommendations to improve performance and reliability.

Poatina PS: 6x50 MW, Pelton turbines; Plant Modernisation:

> Conceptual and detailed design, specification preparation, conducting site commissioning, including site inspection and condition assessment of equipment of upgrade of new cooling water pumps, automatic water filter, thrust bearing oil vapour seals, air admission system.

Project Manager/Design Engineer/Commissioning Engineer

Hydro Power Station Dewatering modernisation projects

Hydro Power stations: Bastyan: 1x80 MW - Francis; Mackintosh: 1x 80 MW - Francis; Rowallan: 1x 11 MW – Francis; Wayatinah 5x15 MW, Tungatinah 5 x 25 MW, Tarraleah 6x 15 MW, Reece 2x115 MW, John Butters 1x144 MW:

> Conceptual and Detailed design, Procurement, Supervision, Commissioning, and reporting of the refurbishment of the dewatering pumping systems;

External projects included:

Bendeela Power and Pump Station, 2x 15 MW – Reversible Francis Pump-turbine, NSW, Australia

Project manager/Design Engineer

> Site inspection, condition assessment, conceptual and detailed design of modification of seals at the trunnion and disc of the Butterfly valve: D = 2200 mm; H = 120 m; Flow rate Q = 40 m^3/s

Ramu PS, 5 x 15 MW - Francis, Papua New Guinea

Technical Project Manager/Design Engineer

> Site visits and condition assessment of associated equipment related to the draft tube pressure pulsation at the Francis turbine;

> Conceptual design of modifications to reduce draft tube pressure pulsation.

Mt Stromlo Mini Hydro Power Plant

> Preparation of technical specification for Butterfly and Pressure Relief valves.

Zhejiang Shanxi Water Supply Project 350 MW, China

> Preparation and submission of Technical proposal data for the Asia Development Bank (ADB) for the Mechanical Generating Plant Consultancy Work. (Awarded The Hydro Tasmania Consulting).

1977 - 1995 Hydroelectric power plants on Neretva River, Mostar, Bosnia and Herzegovina, Europe

Hydro power utility managing Five hydro power stations in operation with total capacity of 710 MW and generation of 2,500 GWh per year; two (2) underground HPS and three (3) surface HPS. New hydro power development feasibility studies: four (4) new hydro power stations, and five (5) hydro power stations under pre-feasibility stage.

1985-1995 Senior Engineer, Reporting to Plant Technical Manager

“Middle Neretva: hydroelectric project (3 new HPP, total capacity of 420 MW): Engaged on new hydroelectric power plant selection, plant layout and design, technical content of specifications, tenders and feasibility studies and installation and commissioning supervision for hydroelectric and water resource projects.

Engineering Assignments have included hydropower project “Upper Neretva”: 450 MW, four (4) hydro power plants; preliminary design and feasibility study.

1979-1985 Resident Engineer (Mechanical) then Senior Engineer Grabovica hydroelectric scheme, Bosnia, Europe

Construction of new hydro power plant Grabovica 2 x 60 MW;

Responsible for supervision of installation, construction, “Litostroj” Factory acceptance testing, and site commissioning of two 60 MW vertical Kaplan turbines and generators, including associated supporting electrical and mechanical plants(turbine governor and hydraulic power unit, cooling water, air compressors, station dewatering system, station cranes and lifting equipment, brakes and jacks, draft tube gates, hydro mechanical equipment and 220 kV transmission lines.

1977 – 1979 Consultant Engineer Work

Djerdap (Iron Gate) Hydro Power Station: 6x190 MW – Kaplan turbines
Originally installed between Yugoslavia and Romania on Danube River (6+6) x 190 MW Kaplan turbines.

> Consultant and member of the International commission to study the problem of the cracks in turbine stay ring vanes on turbine type Kaplan 6x 190 MW - largest of their type in the world. Investigation of the cracks of turbine stay ring vanes. [1989 to 1991];

> Assessment of the proposed tests and evaluation of testing results.

1977 - 1979 Mechanical Engineer

Modernisation project: Jablanica underground hydro power station 5 x 25 MW vertical shaft Francis turbines;

Generating unit number 1 new turbine Francis runner, rotor poles, turbine governor PID, turbine guide bearing, turbine inlet valve hydraulic control, and machine output increased from 25 MW to 30 MW. Member of team for Site condition inspection, site installation, factory acceptance testing, pre commissioning and commissioning works.

Publications/Technical papers

AUTHORED AND PRESENTED BY ENES ZULOVIC

2015 Zulovic E.: A Novel Approach Solving High Intermittent Vibration following Modernization and Upgrade Project, 2015 Hydro Vision International Conference, Portland, OR, USA, **Awarded the First Place Technical Paper**.

2014 Zulovic E.: *Preventing Problems through Past Experience*, published in HRW, Volume 22. No.6, November – December 2014.

2014 Zulovic E., *Strengthening predictive maintenance framework through Vibration Analyses*, author and presenter; Condition Monitoring Driven Reliability conference, 25-26 August, 2014, Brisbane, Australia.

2014 Zulovic E., Vandervelde J., *Tungatinah Vibration station*, 16th Hydro Power Engineering Exchange (HPEE) conference, Hobart, August 2014, awarded the best paper.

2012 Barnbaum G., Mechanical Risk Manager, Zulovic E., Specialist Mechanical Engineer; Dr. Porter J., Mechanical Engineer, paper presented *Lessons Learned from Serious Penstock Pressure Pulsations - Detection and Prevention - the Final Solution After 8 yrs.;* HPEE 15th conference, New Zealand, 2012.

2013 Zulovic E., *Managing risk in hydro power plants knowledge transfer*; paper presented at Hydro Vision Conference USA, Denver, Colorado, July 2013.

2009 Zulovic, E., Kaica, F., *Poatina World Class Operation*; paper submitted for Engineering Excellence Tasmania; Hobart; State Award Winner, July 2009; and National Winner of Engineering Excellence Award , Canberra, November 2009.

2008 Zulovic, E., *Improving the Shaft Alignment*, published in Hydro Review Worldwide (HRW), USA, in October 2008.

2006 Zulovic, E., Henderson, P.: *Shaft alignment challenges*; 12th Hydro Power Engineering Exchange (HPEE), Tasmania, 2006.

2005 Zulovic, E., Caney K., "*Penstock Pressure Pulsation; Hydro Tasmania's Practical Experience*, published in Waterpower XIV Conference in Austin, Texas, USA, in 18 - 22 July, 2005.

2003 Zulovic, E., *Overcoming Oil Vapour ContaminationA Case Study from Australia*, published in Hydro Review Worldwide (HRW), USA, in September 2003.

2002 *Oil vapour contamination in hydro power plants*; A paper presented on 10th Hydro Power Engineering Exchange (HPEE) International conference, Cooma, NSW, Australia, April 2002.

Conferences and courses

ATTENDEDAND/OR PRESENTED BY ENES ZULOVIC

2015	**Hydro Vision International Conference, Portland, OR, USA, presenter, voted the Best paper, July 2015.**
2014	Condition Monitoring Driven Reliability conference, Brisbane, 25-26 August 2014, presenter.
2014	16th Hydro Power Engineering Exchange (HPEE) conference, Hobart, August 2104, co-author, **Best Paper award**.
2012	Advanced Vibration training; Doug Franklin, BC Hydro; 5 days training, Hobart, Tasmania.
2010	Advanced HAZOP, 2 days training, Melbourne, Victoria, Australia.
2008	Practical HAZOP for engineers and technicians, 2 days training, IDC Technologies, Melbourne, Victoria, Australia.
2007	Vibration Diagnostic Course, 4 days workshop course, by D. Franklin from BC Hydro Canada; Launceston, Tasmania Australia.
2007	Hydro Turbine Generator Asset Management Course, 3 days workshop course by GE Hydro, Canada; Hobart, Tasmania, Australia.
2006	12Th Hydro Power Engineering Exchange (HPEE) International Conference, Launceston, Tasmania, Australia, Author.
2006	Vibration training Category III Vibration Analyst, 4 days workshop course, by the Vibration Institute of Australia, Melbourne, Victoria, Australia.
2006	Leadership in Action, training by Impact Solutions and Mettle Group; Hobart, Tasmania, Australia.
2006	Scot work Negotiating Skills; 3 days training by Scot work New Zealand, Hobart, Tasmania, Australia.
2006	Employee Engagement, 2 days training by Mettle Group, Strathgordon, Tasmania, Australia.
2006	Scotwork negotiation, 1 day training, by Scotwork, Hobart, Tasmania, Australia.
2005	Bently Nevada System 1, Training by Bently Nevada, 1 day, Hobart, Tasmania, Australia.
2004	Life skills program, 6 weeks sessions, by Werse Fitzgerald Associates, Hobart, Tasmania.

2004 Assertiveness and Conflict resolution, 2 days, by Developing Potential (Australia), Hobart, Tasmania.

2004 Speaking Confidently to Groups, 1 day by Developing Potentials, Hobart, Tasmania.

2003 Alliance partner selection – Alstom/France, project Tungatinah 5x25 MW, Modernisation Project, 2 days workshop, Hobart, Tasmania.

2003 Reliability Based Maintenance (RBM) 2 days course, by MSc - CSI Hobart, Tasmania, Australia.

2002 Reliability Centred Maintenance (RCM); 1 day, by Shell, Tasmania, Australia.

2002 Root Cause Analyses (RCA), 3 days course by Shell, Tasmania, Australia.

2002 10th Hydro Power Engineering Exchange (HPEE) International Conference Cooma - Snowy Hydro, NSW, Australia, Author.

2001 Condition Based Maintenance 3 days' course by Pacific Power International, New Norfolk, and TAS, Australia.

2001 Advanced Vibration Diagnostic, by CSI 3 days training, Melbourne, VIC, Australia.

2001 Bently Nevada Vibration monitoring, 2 days course, New Norfolk, TAS, Australia.

2000 Writing Winning Technical Documents, 2 days course, Melbourne, Victoria, Australia

1999 Applied Vibration Diagnostic Course, 4 days workshop course, Bently Nevada, Sydney, NSW, Australia.

1999 Pump Application, Operation, Specification, Installation and Commissioning, 1-day course, ASTECH, Launceston, Tasmania, Australia.

1998 Risk Management Short Course, Engineering Education Australia, Melbourne, Victoria, Australia.

1989 6th Conference of Hydro power plants, Croatia, Author.

1987 Participant at the International Conference of 40th Anniversary of Turboinstitut, Slovenia.

1986 Conference on Vibration in Hydraulic Systems, Belgrade, Yugoslavia, Author.

1985 5th Conference of Hydropower and Pump Stations, Yugoslavia, Author.

1985 Seminar for Upgrading and Reconstruction of Hydro Plants, Yugoslavia, Author.

1982 Conference on Construction of Hydro Power Plants of the Middle Neretva Project, Author, Mostar, Yugoslavia.

1982 International Conference of the 35th Anniversary of Turboinstitut, Slovenia, Author.