
Profile: Dr. Michael Znidarich: Owner/Director – Generator & Motor Engineering Consulting Services Pty Ltd (GMECS)

Dr. Michael Znidarich was born on August 22, 1950 in Croatia. He graduated with Associate Diploma of Engineering (Electrical) in 1993, and Associate Diploma of Engineering (Mechanical) in 1995, both from TAFE in Perth, Western Australia. He received his BTech (Electrical), MTech (Engineering and Management), and ME (Electrical) degrees from Deakin University in Melbourne, Australia in 1999, 2001, and 2003 respectively. In 2008 he completed his Ph.D. degree from University of Western Australia related to design of large synchronous electrical machines. He holds Six Sigma Green Belt certification.

Michael completed his electrical apprenticeship in Croatia in 1968. Since emigrating to Australia in the period between 1976 - 2013 he was with GE Energy Services Australia (GEESA), (previously F.R. Tulk & Co, and TGE Energy Services), based in Perth, Western Australia. In the early 1980's he was instrumental in the establishment and development of a world class high voltage coil and bar manufacturing facility, regarded by its clients as amongst the best in the world. During 33 years of operation, more than 150 hi-tech coil and bar windings were produced for large electrical machines, with the enviable record of *never failing the most stringent type tests, and never having a single coil failure during installation of more than 50 hydro generator and turbo generator windings*. This facility had sadly fallen victim of corporate restructuring in 2012.

During the same period Michael made significant contribution to Australian engineering by researching and developing locally based engineering knowledge and capabilities (previously not available in Australia), for full electromagnetic and thermal analysis of large electrical machine design and performance, required to carry out re-design, upgrades and uprates by locally based Australian engineering resources. This knowledge was tested and successfully applied on numerous large electrical machine upgrade and uprate projects, both in Australasian region and overseas (particularly in USA).

Dr. Znidarich is regarded by his peers as one of leading electrical machine experts in Australasian region. For his contribution to Australian engineering, he was recognized as a Fellow of Institution of Engineers Australia (member of EE and IT Colleges), Chartered Professional Engineer (FIEAust CPEng) and Registered Professional Engineer (NER) in Australia, and internationally recognized by IEEE for significant contribution to the profession as a Senior Member (SMIEE) (Member of IEEE Power & Energy Society and IEEE Dielectrics and Electrical Insulation Society).

Experience and Strengths

- 40+ years of experience with design, manufacturing, testing and assessment of HV windings for large electrical machines (large motors, hydro, and turbo);
- In depth experience with design, upgrades and uprates of large synchronous machines, including performance and parameter testing;
- In depth experience with refurbishment, refurbishment specifications, and maintenance of large electrical machines. Professional and accurate report presentation;
- Extensive technical, general management, and project management competence, experience and formal qualifications;

- Electrical and mechanical engineering experience including engineering management, project management, engineering design (electrical and mechanical), and engineering R&D;
- Early trade/craft background with many years of practical “hands-on” experience, combined with highest academic qualifications and many years of applied cutting edge engineering experience, and extensive CAD and 3D solid modelling experience. Produced real life designs are manufacturable and perform their function. An engineer that can *engine-ere*.
- Leadership by authority and example, motivating ability;
- Work enthusiasm, endurance and stamina under adverse conditions;
- Academic ability and excellence, accuracy, and ability to innovate;

Notable Projects

- **1981** – First Turbo Generator Rotor Rewind by an Australian Company Including Design and In-House Manufacturing of the Windings – 100 MW Directly Cooled English Electric Design for Tallawarra PS/ELCOM NSW. Project Included Complete Reverse Engineering, Design of New Winding and Elimination of Slot Liner Migration Problem;
- **1983** – The First in Australia Design and Manufacture of Fully Transposed Bar (360° Roebel) for Liapootah Hydro PS (31 MVA, 11kV, 20 Pole) for Hydro Electric Commission Tasmania;
- **1985** – Design and Manufacture Fully Transposed Bar (360° Roebel) for Tungatinah Hydro PS (31.25 MVA, 11kV, 10 Pole for 2 Machines) for Hydro Electric Commission Tasmania;
- **1985** – Design and Manufacture 2 Sets of Windings for Wayatinah Hydro PS (15 MVA, 11kV, 24 Pole) for Hydro Electric Commission Tasmania. Due to Correctly Implemented Winding Transposition, Windings Operated 25°C Cooler when Compared to Competitor’s Windings;
- **1988** – Design, Manufacture and Install Stator Windings for 60 MVA, 11 kV, 28 Pole Warragamba Dam Hydro Generator. The Winding was Re-Designed to Roebel Bar Configuration, and was the First Project in Australia Where an Outside Contractor (Transfield Tulk) was Fully Responsible for Dismantling, Refurbishment, Reassembly and Recommissioning of the Machine.
- **1991** – Successfully Complete R&D Project to Locally Develop an Australian HV Insulation System Capable of Meeting Most Stringent Accelerated Ageing Testing (Voltage Endurance and Thermal Cycling);
- **1994** – Design and Manufacture HV Winding for 60 MVA, 11 kV, 6 Pole Synchronous Condenser for Transpower NZ. Winding Re-Designed to Single Turn Roebel Bar with Machine Output Upated to 72 MVA. Project Repeated in 2012 for Sister Machine;
- **1994 – 1995** – Design and Manufacture 20 Sets of Hydro Generator Stator Windings for Seven Hydro Electric Power Stations in Indonesia (5 – 10 MW). Project Carried Out in Partnership with ELIN from Austria. In Most Cases Machine Output was Upated.
- **1994 – 1995** – Design, Manufacture and Install Stator Windings for 66.7 MVA, 11 kV, 40 Pole Eildon Hydro Generator in Victoria. Two Turn Original Design was Converted to Single Turn Roebel Bar, which Resulted in Considerable Winding Loss Reduction and Lower Stator Winding Operational Temperatures;

- **1999 – 2009** – Complete Engineering Design for Refurbishment, Upgrade, and Uprate of 8 Hydro Generators for Roxburgh PS, for Contact Energy, New Zealand. Work Scope Included New Stator Cores, New Stator Windings, and Re-Insulation of Rotor Poles. Stator Windings Were Subjected to the Most Stringent Accelerated Ageing Testing (Voltage Endurance and Thermal Cycling). Generators Uprated from 44.44 MVA to 50 MVA;
- **2003** – Design and Manufacture Complete Set of 167 MVA, 13.8 kV, 8 Pole Synchronous Condenser Stator Windings (360° Roebel Bars) for New York Power Authority;
- **2003** – Design and Manufacture Complete Set of 162 MVA, 14 kV, 2 Pole Turbo Alternator Stator Windings (360° Roebel Bars) for Peterborough PS in UK. End Winding Support Re-Designed to Allow for Axial Thermal Expansion and Mitigate Double Frequency Vibrations;
- **2003 – 2006** – Complete Engineering Design for Refurbishment, Upgrade, and Uprate of 6 Hydro Generators for McKay PS, for Southern Hydro in Victoria. Work Scope Included New Stator Windings, Re-Insulation of Rotor Poles, Provision of Solid State Excitation System, and New Up-Rated Sliprings. Complete Power Station Output was Uprated from 96 MW to 150 MW (an Uprate of **56.25%**);
- **2004 – 2006** - Complete Engineering Design for Refurbishment, Upgrade, and Uprate of 4 Hydro Generators for Kareeya PS, for Stanwell Corporation in North Queensland. Work Scope Included New Stator Windings, and Re-Insulation of Rotor Poles. The Four Machines were Uprated from 22.5 MVA to 24.0 MVA;
- **2006 – 2008** – Design and Manufacture Windings for Three 27 MVA MG Sets for AMTRACK in USA. MG Sets are Used for DC Power Supply to AMTRACK Rail System. Both Synchronous Motor, and Single Phase Generators Uprated by 30%;
- **2007** – Design, Manufacture and Install Stator Windings for 12.5 MVA, 12.5 kV, 2 Pole Turbo Generator for University Campus in Hawaii. Multi Turn2 Pole Coil Required Special Flexible Insulation System, which was Specifically Developed for this “One Of” Rewind. Later On, this Insulation System was Subjected to Exhaustive Type Testing, and Developed Into Standard GE Insulation System Under Code Name GEGard 400 HVII;
- **2007 – 2009** – Design and Manufacture Seven Improved Slipring Assemblies for 350 MVA Tumut 3 Hydro Generators, and Seven Improved Slipring Assemblies for 137.5 MVA Murray 2 Hydro Generators. The Aim of the Projects was Reduction of Slipring Operational Temperatures, which was Successfully Accomplished;
- **2008** – Complete Design Engineering, and Engineering Installation Consultation for Rewind and Refurbishment of 60 000 HP, 13.2 kV, 14 Pole Pump Motors for Mark Wilmer Pumping Station in Arizona USA. Truly Multinational Effort, with Australian Engineering, Winding Manufacture in Canada, and Rewind by USA Crews. TGE Energy Services Engineering Coordinated Project Execution and Received Highest Praises from Central Arizona Project Management;
- **2008 – 2011** – Complete Engineering Design for Refurbishment, Upgrade, and Uprate of 4 Hydro Generators for West Kiewa PS, for AGL in Victoria. Work Scope Included New Stator Cores, New Stator Windings, and Re-Insulation of Rotor Poles. Although the Uprated Machine is Capable of 25 MVA, the Uprate was Limited to 18.1 MVA by Hydraulic System Constraints.

Publications:

- [1] Znidarich M.M. (2008) ***'Hydro Generator Stator Cores, Part 1 – Constructional Features and Core Losses'***, Australasian Universities Power Engineering Conference AUPEC 08, Sydney (Presented at AUPEC08, Sydney, December 2008)
- [2] Znidarich M.M. (2008) ***'Hydro Generator Stator Cores, Part 2 – Core Losses, Degradation Mechanisms, Testing and Specification'***, Australasian Universities Power Engineering Conference AUPEC 08, Sydney (Presented at AUPEC08, Sydney, December 2008)
- [3] Znidarich M.M. (2008) ***'Hydro Generator High Voltage Stator Windings, Part 1 – Essential Characteristics and Degradation Mechanisms'***, IEAust. Australian Journal of Electrical and Electronics Engineering, Vol. 5, No. 1, pp. 1-18
- [4] Znidarich M.M. (2009) ***'Hydro Generator High Voltage Stator Windings, Part 2 – Design for Reduced Copper Losses and Elimination of Harmonics'***, IEAust. Australian Journal of Electrical and Electronics Engineering, Vol. 5, No. 2, pp. 119-135
- [5] Znidarich M.M. (2009) ***'Hydro Generator High Voltage Stator Windings, Part 3 – Stator Winding Slot Support Systems'***, IEAust. Australian Journal of Electrical and Electronics Engineering, Vol. 6, No. 1, pp. 1-10
- [6] Znidarich M.M. (2009) ***'Hydro Generator High Voltage Stator Windings, Part 4 – Type and Routine Production Testing'***, IEAust. Australian Journal of Electrical and Electronics Engineering, Vol. 6, No. 2, pp. 93-108 (This Paper Was Awarded Madsen Medal for the Best Paper in the Discipline of Electrical Engineering that Was Published in the Australian Journal of Electrical and Electronics Engineering in 2009)
- [7] Haq, S., Omranipour, R., Hanna, G., Lucas, W., Znidarich, M.M. (2012) ***'Flexible Medium Voltage Stator Coil Insulation System for On-Site Winding'***, Presented on IEEE International Symposium on Electrical Insulation San Juan. Puerto Rico, USA, 10-13 June 2012
- [8] Znidarich M.M. (2013) ***'Upgrading and Uprating of Hydro Generators: An Australian Perspective'***, IEAust. Australian Journal of Electrical and Electronics Engineering, Vol. 10, No. 1, pp. 75-84

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