Gabriel Olguín, Ph.D.

POWER SYSTEM EXPERT

Summary of competencies

Dr. Gabriel Olguín is a power engineer with 23 years of professional experience in the power & mining industry and Academia. He is original from Santiago Chile but he has lived, worked and studied in Chile, Sweden, Spain, Australia and Brazil. He has undertaken engineering, R&D and management responsibilities in power utilities, consulting firms and Academia. He worked as a scientist and project manager at ABB CRC in Sweden where he performed research and development in the areas of power systems, HVDC and reliability of complex systems such as HVDC and FACTS control. During his doctoral studies, Dr. Olguin developed methods for stochastic assessment of voltage sags and introduced the concept of voltage sag state estimation. Back in Chile in 2008, Dr Olguin was Technology Manager at the main power transmission utility. In this role, Dr. Gabriel Olguín supported the introduction of new transmission technologies (FACTS, HVDC and Energy Storage) in the Chilean grid and managed innovation programs. Gabriel Olguín is Chile´s CIGRE SC C5 representative and an active member the Association of Engineers of Chile. He was professor in electrical engineering at University of Santiago Chile where he lectured electrical engineering students on Power Transmission and Distribution and supervised diploma workers and junior researchers. He is currently Managing Director of Power Business Ltda. a consulting firm dedicated to support the introduction of new technologies in power systems and Deputy Manager of Innovation and Development at Komatsu Reman Center Chile.

QUALIFICATIONS

- Electrical Engineer, major in power systems, University of Santiago Chile 1987 -1993
- Occupational Risk Prevention Expert, University of Santiago Chile 1993-1994
- Master in Management, University of La Serena, Chile 1998 -1999
- Master in Electrical Engineer, Federal University of Santa Catarina, Brazil 1999 -2000
- Doctor of Philosophy in Electrical Engineering, Chalmers University of Technology, Sweden 2001-2005
- Diploma in Industrial Marketing, University of Chile 2012

COMPETENCES

- Power System studies
- Power Quality and reliability
- HVDC and FACTS applications
- Energy Storage technologies and applications
- Power Markets and regulation
- Multi-cultural and multi-national mindset
- Team leader and motivator

Recent experience

Power Business Chile, Santiago Chile – Managing Director and Consultant

June 2014

Power Business Ltda. is a consulting firm in Santiago Chile with deep knowledge of the Chilean power market and several international connections to leading technology vendors and consultants. The mission of PBChile is to support the integration of emerging technologies into the Chilean Power grid. Mr. Olguin has full responsibility for the organization, the vision, strategy and business model. Recent involvement includes:

- October 2017 – currently – Chilean Energy Commission. Dr. Olguin is acting a local coordinator of systems system studies needed to support the selection of transmission expansion solutions. Studies are being developed by international consultants and aim at identifying transmission expansion solutions among which a 1500km HVDC link is considered.
- March 2016 – Dec 2017 – Chilean Energy Commission. Dr. Olguin and international partners supported the Chilean Energy Commission in the implementation of the new Transmission Law. To do so the team of consultants investigated the state of the art of Transmission Expansion Planning and recommend a methodology to implement the expansion of the transmission system according to the new criteria as indicated in the Law 20937 passed in July 2016. The project also included the organization of an International Seminar on Transmission Expansion Planning and three workshops with local experts.
- August – October 2016 – CIGRE Chile Energy Storage Tutorial. Dr. Olguin designed and delivered a tutorial on Grid Scale Energy Storage for 50 people on 17th October 2016. To do so he took contact with international technology developers to gain knowledge and details of new emerging energy storage technologies.
- February 2016 – E-CL, SIC-SING Interconnection. Dr. Gabriel Olguin assisted the project engineering team with the series compensation of the 630 km long 500kV transmission line. Activities included meetings with vendors to discuss preliminary designs.
- September 2015 – National Energy Commission: Dr. Olguín assisted the National Energy Commission with a study on security of supply presented to the Expert Panel.

Gabriel Olguín, Ph.D.

POWER SYSTEM EXPERT

- September 2014 – October 2015: Energia Austral HVDC transmission project. Gabriel Olguin was the technical advisor for the HVDC subsea transmission project. In this role he updated the CAPEX to new transmission conditions, evaluated cable-landing sites and managed subcontractors to select OHTL routes and assess new landing sites. Other activates involved evaluation of sea electrodes, involvement of cable vendors and HVDC converter vendors for updating of transmission project CAPEX.
- May 2015 – August 2015: Assessment of Ancillary Services Market and BESS technology. Mr. Olguín together with a team of three consultants undertook a study to assess the new regulation for ancillary services DS130 and the opportunities to introduce Battery Energy Storage in the market. Client: confidential.
- September 2014 – February 2015: SIC-SING Power Interconnection study. In collaboration with Manitoba Hydro International, Gabriel Olguín, supported the Chilean Energy Commission, CNE, in the selection of the power interconnector technology. Mr. Olguin acted as MHI local coordinator and MHI's Business Developer.
- September - October 2014: OPAL-RT Business Development support. The activity involved the development of a seminar on Real Time Digital Simulation. Gabriel Olguín and his team identified, invited and followed up about 43 professionals who attended the seminar.

March 2016 – currently

Komatsu Reman Center Chile

Deputy Manager of Innovation. Dr. Gabriel Olguin manages a team of engineers and leads innovation projects within Komatsu Reman Center Chile. His responsibilities include rising funds for research and development and management of the R&D team. Project under his supervision includes:

- Development of capabilities to design and build large rotating machines – A 2MW alternator has been designed and is currently being constructed. The project has awarded a 100Kusd grant from the Chilean Economic Development Agency CORFO.
- Advance preventive maintenance of large mining machinery through Machine Learning - The project looks at implementing Electrical Signature Analysis of main components at mining trucks. The project has been awarded a tax reduction incentive by the Chilean Economic Development Agency CORFO.
- Redesign of parts and component of mining machinery

March 2010 - June 2016

University of Santiago, Department of Electrical Engineering

Professor of power systems: Gabriel Olguín is professor of Transmission and Distributions Systems. He also supervises diploma workers and junior researchers.

HVDC&PE Executive Consultant, SKM Ltda. Santiago Chile

Nov. 2012 – June 2014

•The Power Electronics Senior Executive Consultant provides technical expertise to HVDC and Power Electronics projects around SKM global activities. To do so, he identifies market trends, client needs and internal capability gaps required to prepare SKM for future successful support to client's projects. In this role Gabriel Olguín delivered talks to utility clients, the regulator and stakeholders about transmission systems and new technologies.

Involvements included the supervision, management and execution of front end engineering studies associated to HVDC and power electronics, submarine cables, location of converter stations, and evaluation of electrodes for HVDC. Gabriel Olguín also participated in Due Diligence of transmission assets in Chile.

Gabriel Olguín had also business development responsibilities. In this role he visited clients and established relationship with managers at power utilities and the regulatory office. He also delivered talks at seminars and mini-lectures at client´s facilities in Chile and abroad.

Gabriel Olguín, Ph.D.

POWER SYSTEM EXPERT

Deputy Manager for Study of Technologies at Transelec S.A. Santiago Chile

May 2009 – Oct 2012

- The Deputy Manager for Study of Technologies manages all necessary processes to ensure new technologies are properly assessed and available to Transelec to make the transmission system more efficient and secure. To do so, Deputy Manager and his team monitors power transmission technology with particular focus on cutting edge technologies that can be applied to existing transmission assets to increase transmission capacity. Studies necessary to ensure safe and reliable integration into the grid of these technologies are undertaken with internal or external resources under his supervision. Technologies that were studied included HVDC (LCC & VSC), series compensation, dynamic rating, high capacity conductors, battery energy storage, phasor measurement units, static var compensator, statcoms and AC and DC insulated power cables. These studies enabled Transelec to undertake cutting edge technology projects like the dynamic reactive power compensation project that introduced the very first Statcom in Chile and allowed to increase transmission capacity of the 500kV corridor in 200MW. A second statcom was commissioned in the northern part of the SIC during 2013 that increased the transmission capacity of a 220kV corridor in 80MW.
- The Deputy Manager is a part of the strategic technology group that looks for technology that can increase the value of existing transmission assets.
- The Deputy Manager for Study of Technologies also manages all necessary system and engineering studies for the proper design of converter stations for the Energia Austral HVDC project. The project aims at transmitting 1GW from Aysen to the Central Interconnected System over a distance of about 1000km. The HVDC link would include OHTL as well as subsea cable. To support the development of the project, power system studies as well as engineering studies were undertaken with international consultants. Power system models were prepared in PSS/E to perform the simulation studies, in particular load flow, short circuit, transient stability and reliability. Support is also given to the basic engineering phase of the project by leading consultants in charge of basic design of converter stations.
- The Deputy Manager for Study of Technologies is also involved in knowledge management. In this role he was the deputy director of the academic Network for Transmission Studies, known by the acronym RET (www.ret.cl). RET is an academic network in which seven universities and Transelec collaborates to undertake research and studies. Most of the activities are in the form of diploma works that are given to students, but the scope of the collaboration includes other forms too, like cofounding of visiting researches, exchange of publications and talks, etc.

Head of Engineering Studies for Hidroaysen HVDC project at Transelec

February 2008-May 2009

- The Head of engineering studies for Hidroaysen project is responsible for the conceptual design of the HVDC link, its safe and secure integration into the Central Interconnected System and all studies related to power system performance. For this purpose as a Head of Engineering studies Gabriel leads a team of engineers that performs system studies such as load forecast, generation and transmission expansion, load flow, short circuit, transient stability, reliability and others. Studies are performed with internal and external resources. In order to select the transmission solutions, HVDC technology studies are undertaken to decide voltage level and sea cable technology. Preliminary basic designs of the HVDC link were developed together with HVDC vendors and cable contractors. For this purpose as a Head of Engineering Studies I kept close contact with the major HVDC (ABB, Siemens, Alstom) and cable contractors (Prismian, ABB, Nexan) and served as engineering counterpart.

Senior Scientist at ABB Corporate Research, Vasteras Sweden

June 2005-March 2008

- The Senior Scientist is responsible for the complete R&D project in his portfolio. In particular Gabriel heads two projects: protection of power generator and reliability of HVDC. For this purpose as a scientist Gabriel prepares and defends project proposal, deliver presentations,

Gabriel Olguín, Ph.D.

POWER SYSTEM EXPERT

organizes the project team and control its physical and financial progress. As a scientist at ABB Corporate Research Gabriel filed three patents in the field of protection:

- **Ground fault detection**; Patent number: 7719285; Stefan G. Johansson, Marek Fulczyk, Tord Bengtsson, Sture Lindahl, **Gabriel Olguin**. Abstract: The invention relates to a ground fault detection arrangement for a synchronous three-phase electrical machine, and an electrical system comprising a ground fault detection arrangement and a synchronous three-phase electrical machine. The ground fault detection arrangement injects an off-nominal frequency voltage between a neutral point of the synchronous three-phase electrical machine and ground and measure resultant currents to detect a ground fault.

- **System and method to determine the impedance of a disconnected electrical facility**; Patent number: 7772857; **Gabriel Olguin**; Abstract: A signal injection unit injects a test signal at a main frequency between a reference point of an electric circuit and ground, where the electric circuit is connected with the facility and injects another test signal at a second main frequency between a reference point of the electric circuit and ground. A signal conversion unit measures first and second response voltages and first and second response currents in the electric circuit, where the response voltages and the response currents result from the test signals. A processing device determines impedances to ground of the facility from the response voltages and the response currents, analyses impedances to ground of the facility, where this analysing includes comparing each determined impedance to ground with a predetermined value, and determines a safety state of the disconnected electrical facility based on the analysed impedances to ground.

- **Circuit Breaker with Improved Re-Closing Functionality**; 8279567; Tord Bengtsson, **Gabriel Olguin**, Jianping Wang. Abstract: A circuit breaker for protecting a power line. The circuit breaker includes a control unit and a circuit breaking element disconnecting the power line from a power source. The control unit detects a fault on the power line, opens the circuit breaking element, which opening starts a disconnection time interval, injects a test signal into the power line, measures a response, determines an impedance of the power line from the response, analyses the impedance during the time interval based on comparing the impedance with a reference threshold, determines a permanent or a temporary fault based on the analysed impedance, re-closes the circuit breaking element after the time interval if the fault is temporary and keeps the circuit breaking element open after the time interval if the fault is permanent.

Researcher and Ph.D. candidate at Chalmers University Sweden

September 2001-June 2005

- The Researcher is responsible for the execution of a research project assigned to him. The research project assigned to Gabriel aimed at finding stochastic methods for voltage sag performance assessment of power systems. His work was done under supervision of professor Math Bollen. In addition to perform the research, duties included teaching activities in the international Master program in power engineering. Gabriel did teach courses like power systems, power quality and reliability. As a researcher and Ph.D. candidate he also had the opportunity to perform collaborative research at other universities, in particular he spend 8 months in 2004 as a visiting researcher at University of Manchester Institute of Science and technology (UMIST) under supervision of Professor Daniel Kirschen.

Planning Engineer at EMEC S.A. (today CONAFE), Coquimbo Chile

May 1995 - September 2001

- The planning engineer performs conceptual engineering associated to new power distribution assets. As a planning engineer Gabriel performs system studies such as distribution load flow, short circuit, reliability and others. He also performs economic evaluation of alternative solutions and provides advice as for the most suitable distribution solutions for a given situation. As a planning engineer at EMEC, Gabriel also had the opportunity to perform many distribution and planning studies like load forecast, selection of conductors and route for new feeders, location of new substations, specifications of primary equipment, etc. He was also very much involved in distribution tariff setting studies.

Gabriel Olguín, Ph.D.

POWER SYSTEM EXPERT

Distribution Engineer at CHILQUINTA S.A. Valparaíso Chile

January 1994 – May 1995

•The distribution engineer performs conceptual and detailed engineering associated to new power distribution assets. As a distribution engineer at CHILQUINTA, Gabriel was in charge of evaluation the change of primary voltage 13,8 to 23kV in Valparaiso

Affiliations

Member of CIGRE, Chilean SCB4 and SCC5 representative

Member of Chilean Association of Engineers

Member of Chilean Institute of Engineers

Languages

•English, fluent

•Spanish, native

•Portuguese, fluent

•Swedish, basic

Publication and Academic involvements

Dr. Gabriel Olguin has a number of publications on voltage dip performance assessment of power systems, voltage dip state estimation, dynamic rating of transmission lines, FACTS solutions to transmission systems such as SVC and STATCOMS and High Voltage Direct Current Transmission, HVDC.

Books

Editor Edgardo D. Castronuovo, “Optimization Advances in Electric Power Systems” Chapter 9: Optimal Placement in Power System, **Gabriel Olguin** and Tuan A. Le Nova Publishers, 2008, ISBN: 978-1-60692-613-0

Journal and conference papers

Matus, M.; Saez, D.; Favley, M.; Suazo-Martinez, C.; Moya, J.; Jimenez-Estevez, G.; Palma-Behnke, R.; **Olguin, G**.; Jorquera, P.; , "Identification of Critical Spans for Monitoring Systems in Dynamic Thermal Rating," Power Delivery, IEEE Transactions on , vol.27, no.2, pp.1002-1009, April 2012

L. Vallejos, J. Rayo, **G. Olguin**, J.M. Santos “Dimensionamiento de electrodos de puesta a tierra tipo anillos para enlaces HVDC”, CIGRE - ERIAC 2009, Puerto de Iguazú, Argentina.

G. Rogers, R. Fuentes, **G. Olguin**, J.M. Santos “ Diseño preliminar de sistema de filtros armónicas AC para el proyecto HVDC Aysén – SIC. CIGRE - ERIAC 2009, Puerto de Iguazú, Argentina.

R. Rubio, **G. Olguín**, J. Mendoza, P. Alonso, L. Yu, “Confiabilidad del Sistema de Potencia Auxiliar de Estaciones HVDC y su Impacto en la Disponibilidad del Enlace”, IEEE PES conference Colombia 2009.

E. Espinosa-Juarez, A. Hernandez, **G. Olguin** “An Approach Base on Analytical Expressions for Optimal Location of Voltage Sags Monitors”, IEEE Transactions on Power Delivery, in print.

Roberto Chouhy Leborgne, **Gabriel Olguin**, Jose M. Carvalho Filho, Math H. J. Bollen, “Effect of PQ-Monitor connection on Voltage Dip Indices: PN vs PP Voltages, In: Electric Power Quality and Utilization, Magazine Vol. II, No 1, 2006

S.M. Pérez, J.J. Mora and **G. Olguin** “Maintaining Voltage Profiles by using an Adaptive PSS“, In proceedings of 2006 IEEE PES Transmission and Distribution Conference and Exposition, Latin America, Venezuela

Gabriel Olguín, Ph.D.

POWER SYSTEM EXPERT

Giraldo, LC; Mora, JJ; **Olguin, G**. "Análisis de sensibilidad del método de inyección subarmonica de protección del 100% del estator de un generador ante fallos a tierra" In: Congreso Internacional Sobre Uso Racional y Eficiente de la Energía, Noviembre 2,3 y 4 de 2006, Santiago de Cali, Colombia.

Olguin, G., Aedo, M., Arias, M., Ortiz, A. "A Monte Carlo Approach to the Method of Fault Positions for Stochastic Assessment of Voltage Dips (Sags)". IEEE PES Transmission and Distribution Conference and Exhibition, August 14-18 2005, Dalian, China.

Olguin, G. "An Optimal Trade-off between Monitoring and Simulation for Voltage Dips Characterization of Transmission System". IEEE PES Transmission and Distribution Conference and Exhibition, August 14-18 2005, Dalian, China.

Olguin, G., Karlsson, D. Leborgne, R. "Stochastic Assessment of Voltage Sags (Dips): The Method of Fault Positions versus a Monte Carlo Simulation Approach". In Conference Proceedings of IEEE St. Petersburg Power Tech 2005, 27-30 June 2005, St. Petersburg, Russia.

Olguin, G., Bollen M., Karlsson D. "Voltage Sag Estimation in Power Systems via Optimal Monitoring and Stochastic Assessment", submitted to IEEE Transactions on Power Systems, manuscript number TPWRS-00181-2005.

Olguin, G., Vuinovich, F., Bollen, M.H.J. "An Optimal Monitoring Program for Obtaining Voltage Sag System Indices" IEEE Transaction on Power Systems, manuscript number TPWRS-00257-2004.R1, in print.

Olguin, G. Leborgne, R. Coelho, J. "Ensuring Electromagnetic Compatibility by Analytic Study of Voltage Dips Caused by Faults". In Proceedings of IEEE Induscon Conference 2004, October 12-15, Joinville, Brazil.

Referees

ABB CRC Sweden – Dr. Mikael Dahlgren – R&D Manager Corporate Research Center Vasteras Sweden - mikael.dahlgren@se.abb.com

ABB HVDC – Jan G. Johansson – Marketing Director America jan.g.johansson@se.abb.com

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CDEC SING Chile – Juan Carlos Araneda – Development Manager - juan.araneda@cdec-sing.cl

EC-L - Javier Godoy – Engineering Manager - Javier.Godoy@e-cl.cl