MARC DUPUIS

Born in Quebec City, November 11, 1956
Married
Bilingual: French, English

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SUMMARY

- Chemical Engineer with more than thirty of experience in research and development in the aluminium industry.
- Have been mainly involved with mathematical modelling of industrial processes dealing with thermo-electric, thermo-mechanic, electro-magnetic and hydrodynamic phenomena.

EDUCATION

- **Ph.D. Chemical Engineering - C.R.S.N.G. Scholarship** **1984**
  Laval University
- **M.A.Sc. Chemical Engineering - Alcan Scholarship** **1982**
  Laval University
- **B.A.Sc. Chemical Engineering** **1980**
  Laval University

ADDITIONAL TRAINING

- Courses on many commercial **simulation packages**
  - fluid flow: FLUENT, FIDAP, CFDS-FLOW3D, TASCflow, CFX-4
  - stress, heat transfer and electro-magnetic: ANSYS
  - pre and post processing: PATRAN
  - process flowsheet: ASPEN PLUS

AFFILIATIONS

- Member of the Order of Engineers of Quebec (OIQ)
- Member of the Canadian Institute of Mining, Metallurgy and Petroleum (CIM)
- Member of the Minerals, Metals and Materials Society (TMS)
- Member of the Canadian CFD Society (Director 1994 -1997)

EXPERIENCE

GÉNISIM INC. 1994 – 2014

GéniSim Inc. is 100% own by Marc Dupuis

CONSULTANT IN NUMERICAL SIMULATION

Have developed customized version of thermo-electric mathematical models of the Hall-Heroult cell and provided support for theirs successful applications. Have developed and commercialised Dyna/Marc, a software that simulates the dynamic behaviour of an aluminum reduction cell.

ALCAN INTERNATIONAL LTD. 1984 - 1994

Arvida Research and Development Center

Operating three research centers internationally, this company holds the technological mandate for Alcan.

SENIOR RESEARCH ENGINEER *1991 - 1994*

In charge of the research and development of mathematical models dealing with the thermo-electric, thermo-mechanic and magneto-hydrodynamic phenomena of the Hall-Héroult cell.

PRINCIPAL RESEARCH ENGINEER *1987 - 1991*

Research and development of mathematical models dealing with the thermo-mechanic phenomenon of the Hall-Heroult cell. In charge of the thermo-electric cathode design of many experimental cells.

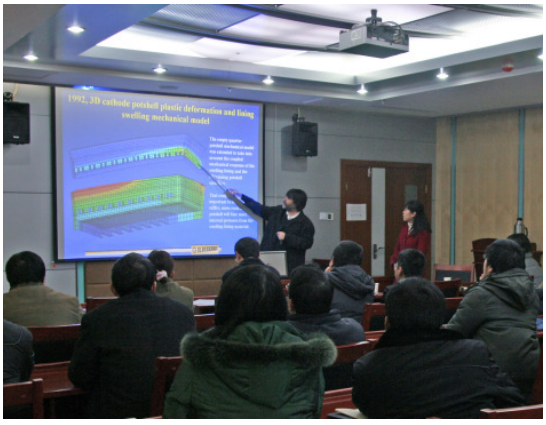
*RESEARCH ENGINEER - **postdoc C.R.S.N.G. Scholarship*** *1984 - 1987*

Research and development of mathematical models dealing with the thermo-electric phenomenon of the Hall-Héroult cell.

SELECTED PERSONAL ACHIEVEMENTS

As a consultant:

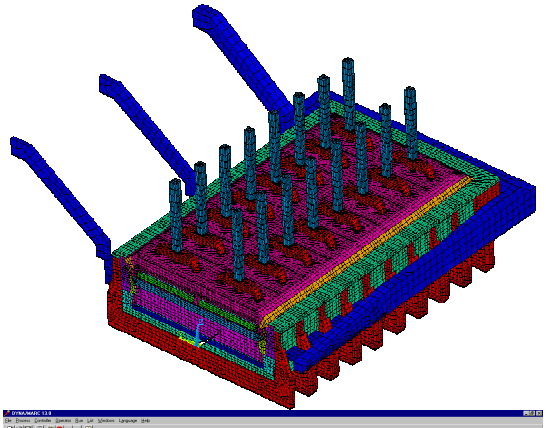
- Gave 1 month training in GAMI Institute in Guiyang China to GAMI's team of mathematical modellers.



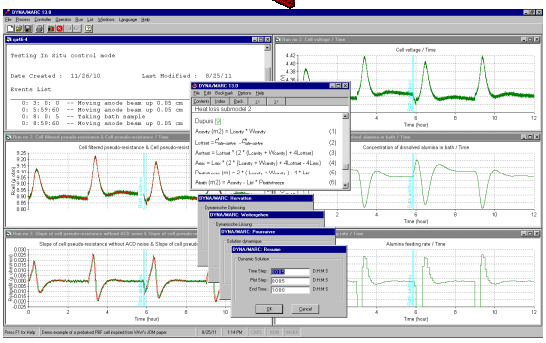
- Participated as international guest speaker to the ALEL 02 International Aluminium Electrolysis Seminar organized by the JNARDDC in Nagpur India.

- Was also on the panel of the Indian Aluminium Electrolysis Roadmap.

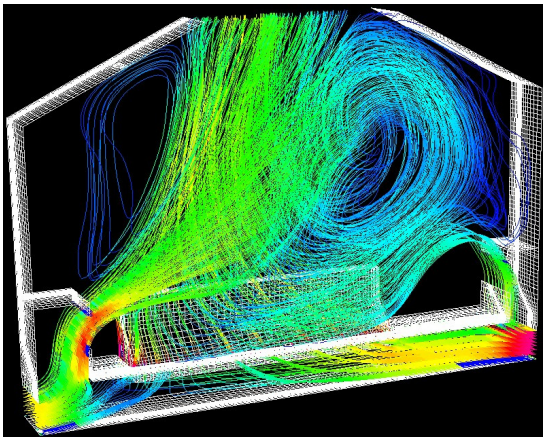
- Has developped a 3D full cell and external busbars thermo-electric model that constitutes a step further towards the development of a fully "multi-physic" unified aluminium reduction cell model.



- Have developed the software **Dyna/Marc** that simulates the dynamic behaviour of an aluminum reduction cell. **Dyna/Marc** is commercialised by GéniSim Inc.



- Has developped a full-scale 3D ventilation model that is able to reproduce the ventilation pattern in modern smelter "potroom" based the CFX-4 commercial code in order to have assess to the differential Reynolds flux turbulence model that in 3D requires the solution of 10 partial differential equations.



- Has provided to Lauralco the modeling tools (both 3D ANSYS based thermo-electric models and Dyna/Marc cell simulator that helped them become the most efficient smelter of the industry.

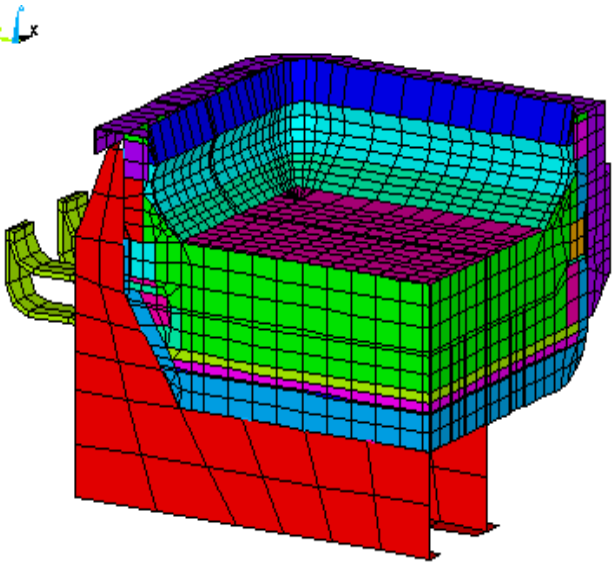
		START-UP	LATEST POTS
		1992	1998
PRODUCTION :			
▪ Production per pot/day	(kg)	2245	2466
▪ Current efficiency	(%)	94.5	96
POWER :			
▪ Amperage	(kA)	295	319
▪ Pot voltage	(V)	4.330	4.185
▪ DC kWh/t		13 650	13 000
CONSUMPTIONS :			
▪ Gross carbon	(kg/t)	540	493
▪ Net carbon	(kg/t)	410	397
▪ Anodes cycle-shifts-8 hours		80	90
METAL PURITY :			
▪ Iron	(ppm)	---	700
▪ Silicon	(ppm)	---	240
POT CONDITION :			
▪ Anode effects	(pot/day)	0.40	0.20

Tableau no. 1 : Lauralco's results

At Alcan, in chronological order:

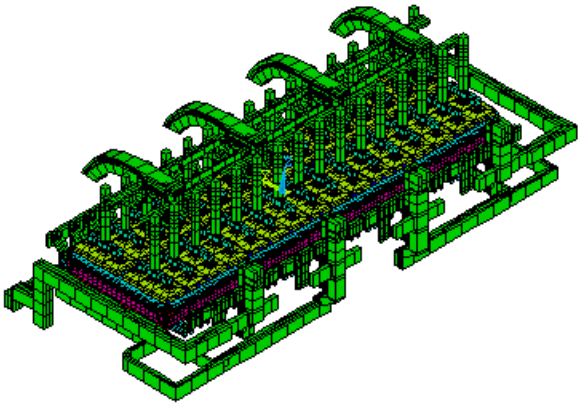
- Developed and validated a model of the three dimensional thermo-electric behavior of a Hall-Heroult cell prebake anode. I had the privilege of presenting this work to the President of Alcan, as one of the main accomplishments of the Arvida research and development center in 1984.

- Developed and validated a model of the three dimensional thermo-electric behavior of a Hall-Héroult cell cathode including the prediction of the steady state freeze profile. This work, done in 1985, gave Alcan, way ahead of its competitors, a very powerful tool to design a Hall-Héroult cell cathode.

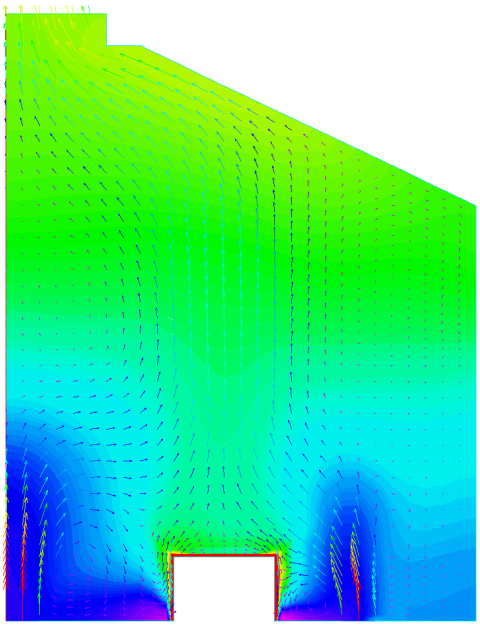


- Developed and programmed, in 1986, a user interface that regrouped under one environment many different Fortran programs developed over a period of ten years. These programs, as a whole, represented Alcan's magneto-hydrodynamic modelling capabilities. After the implementation of the user interface, a typical MHD run could be processed much faster. Moreover, input errors were reduced and file archiving was handled more rigorously.
- Designed, using 3D thermo-electric cathode models, four cathode linings prototyped by Alcan between 1987 and 1991. Comparison of predicted versus measured behavior were within 5% in each case, demonstrating the value of the numerical tools developed.

- Formed and directed, between 1987 and 1992, a team of five research professionals among which, three were external consultants. This team successfully developed many models of the thermo-mechanic and chimio-mechanic behavior of a Hall-Héroult cell. This research effort gave Alcan, for the first time, design tools in this area of cell design.
- Was system manager, between 1989 and 1994, of a network of six Silicon Graphics workstations. Among other things, I installed and maintained network licenses for many commercial packages. Under my supervision, the usage of the workstations network by my co-workers and myself was smooth and efficient.
- Developed, between 1991 and 1993, a new generation of electro-magnetic and magneto-hydrodynamic models of the Hall-Héroult cell, within a very limited budget. This new generation of models is based on commercial finite element packages. This new generation of models will, for one thing, allow the possibility to represent the real geometry of the system.



- Developed, in 1993, a model of the hydrodynamic behavior of the air in the potroom of an aluminium smelter. To do so, I used the commercial package CFDS-FLOW 3D. The model takes advantage of the availability of the Reynolds Flux turbulence model to be able to represent the anisotropic properties of the turbulent natural convection flow over the pots. By doing so, it was possible, for the first time, to reproduce, in a model, the experimental flow pattern I measured nine years earlier, during my graduate studies on the subject.



- Developed and taught, in 1993 and 1994, with the help of an external consultant, two courses on the mathematical modelling of Hall-Héroult cells. These courses provided the opportunity to transmit the expertise acquired over the last ten years in the field of computer assisted design of Hall-Héroult cells.

THESIS, PATENTS & SELECTED INTERNAL REPORTS

- Simulation mathématique de la circulation d'air dans les salles du cuves, 1980, Alcan
- Simulation mathématique de la circulation d'air dans les salles de cuves d'électrolyse de l'aluminium, 1981, M.A.Sc. Thesis
- Simulation mathématique de la circulation d'air dans les salles de cuves d'électrolyse de l'aluminium, 1984, Ph.D. Thesis
- Comportement thermo-électrique d'une anode; étude théorique et expérimentale, 1986, Alcan
- Modèle tri-dimensionnel de simulation du comportement thermo-électrique d'une cathode, 1987, Alcan
- Thermo-electrical design of a reduction cell, 1989, Alcan
- Analysis of early failure of the carbon block, 1991, Alcan
- Compte rendu de la conférence AIME 1992, 1992, Alcan
- An overview of ANSYS based modelling, Alcan Reduction Group - ARDC, 1993, Alcan
- Validation de modèle thermo-électrique d'une cuve : modèle quart de cuve, 1993, Alcan
- User guide for developing thermo-electric cathode models, 1994, Alcan
- Summary of mathematical models built between 1984 and 1994 in the reduction group at the Arvida laboratory, 1994, Alcan
- Modèle ANSYS du four à arc de calcination de l'anthracite, 1994, CompuSim
- Description of the dynamic cell model as implemented in the Excel worksheet, 1995, GéniSim
- Modèle ANSYS de la procédure de roddage des blocs de cathode, 1995, GéniSim
- Modèle TASCflow3D du système de captation des émanations de gaz produits lors du démarrage d'une cuve Söderberg, 1995, GéniSim
- Modèle ANSYS de l'anode P155, 1995, GéniSim
- Computation of heat transfer coefficient tables establishing boundary conditions between hot surfaces and their surroundings, 1996, GéniSim
- Modèle TASCflow3D du distributeur de métal d'une table de coulée de lingots de laminage, 1996, GéniSim
- Les modèles thermiques, 1997, CQRDA cours d'électrolyse
- Process Simulation, 1997, TMS Industrial Aluminum Electrolysis course
- Dyna/Marc version 1.0 User's Guide, 1998, GéniSim
- Dyna/Marc version 1.1 User's Guide, 1998, GéniSim

- Dyna/Marc version 1.2 User's Guide, 1998, GéniSim
- Dyna/Marc version 1.3 User's Guide, 1999, GéniSim
- Feedback on a new control strategy for aluminium electrolysis using Cry-O-Therm sensors, 1999, GéniSim
- Dyna/Marc version 1.4 User's Guide, 1999, GéniSim
- Dyna/Marc version 1.5 User's Guide, 2000, GéniSim
- Modèle CFX-4 du four de refonte expérimental du CRDA et d'un four industriel à six brûleurs, 2001, GéniSim
- Dyna/Marc version 1.6 User's Guide, 2001, GéniSim
- Description of the KS and T39 3D thermo-electric cathode side slice models, 2001, GéniSim
- Results of the October 2001 thermal blitz campaign, 2001, GéniSim
- Validation of the KS and T39 3D thermo-electric cathode side slice models, 2001, GéniSim
- Lining designs of the second generation lower energy prototypes, 2001, GéniSim
- US patent 6,294,067: 3 component cathode collector bar, 2001, Alcoa
- Results of the June 2002 thermal blitz campaign, 2002, GéniSim
- Validation of the KS 3D thermo-electric cathode side slice model at 126 kA, 2002, GéniSim
- Dyna/Marc version 1.7 User's Guide, 2002, GéniSim
- Dyna/Marc version 1.8 User's Guide, 2003, GéniSim
- Results of the May 2003 thermal blitz campaign, 2003, GéniSim
- Impact of porosities on busbar voltage drop, 2003, GéniSim
- Description of the Hirakud 3D thermo-electric cathode side slice model, 2003, GéniSim
- Dyna/Marc version 1.9 User's Guide, 2006, GéniSim
- Hatch EMAL smelter project review (DX technology review part), 2007, Hatch
- NEUI trip visit report, 2007, GéniSim
- Dyna/Marc version 1.95 User's Guide, 2010, GéniSim
- Dyna/Marc version 12.0 User's Guide, 2011, GéniSim
- Dyna/Marc version 13.0 User's Guide, 2011, GéniSim
- Dyna/Marc version 14.0 User's Guide, 2012, GéniSim

SELECTED PUBLICATIONS

- Simulation mathématique de la circulation de l'air dans une enceinte avec ouvertures et sources chaudes localisées, Can. J. Chem. Eng., 63, 155-161, (1985)

- Simulation bidimensionnelle de phénomènes de convection naturelle et force en formulation primitive, Can. J. Chem. Eng., 65, 550-558, (1987)

- La modélisation de la turbulence dans une enceinte avec ouvertures et sources chaudes localisées, Can. J. Chem. Eng., 67, 713-721, (1989)

- Cathode shell stress modelling, Proceedings of the 120th TMS Light Metals Conference, 427-430, (1991)

- Thermo-electric coupled field analysis of aluminium reduction cells using the ANSYS parametric design language, Proceedings of the ANSYS fifth international conference, volume 3, 1780-1792, (1991)

- Thermo-electric analysis of aluminium reduction cells, Proceedings of the 31st annual conference of CIM, Light Metals section, 55-62, (1992)

- Hall-Heroult cell, cathode shell modelling: impact of sodium swelling on the loading forces, Proceedings of the 31st annual conference of CIM, Light Metals section, 115-129, (1992)

- Turbulence modelling of air circulation in an enclosure with multiple openings and local heat sources, Proceedings of the 32nd annual conference of CIM, Computer Software section, 229-236, (1993)

- Thermal study of the coke pre-heating technique for a Hall-Heroult cell, Proceedings of the 32nd annual conference of CIM, Light Metals section, 93-100, (1993)

- Shell design technique considering the sodium swelling phenomena of carbon cathode blocks, Proceedings of the 32nd annual conference of CIM, Light Metals section, 125-130, (1993)

- Thermo-electric analysis of the Grande-Baie Aluminium Reduction Cell, Proceedings of the 123rd TMS Light Metals Conference, 339-342, (1994)

- Evaluation of thermal stresses due to coke preheat in a Hall-Heroult cell, Proceedings of the ANSYS sixth international conference, volume 1, 3.15-3.23, (1994)

- Thermo-electro-magnetic modelling of a Hall-Heroult cell, Proceedings of the ANSYS sixth international conference, volume 4, 9.3-9.13, (1994)

- Modeling of Aluminum Reduction Cells Using Finite Element Analysis Techniques, Proceedings of the 124th TMS Light Metals Conference, 295-299, (1995)

- Process Simulation of Aluminum Reduction Cells, Proceeding of the 125th TMS Light Metals Conference, 451-457, (1996)

- Optimization of Anthracite Calcination Process in a Vertical Electric Arc Furnace, Proceedings of the 125th TMS Light Metal Conference, 597,602 (1996)

- Using a Steady-State Model of an Aluminum Reduction Cell to Investigate the Impact of Design Changes, Proceedings of the 35th annual conference of CIM, Light Metals section, 419-429, (1996)

- Simulation of the Dynamic Response of Aluminum Reduction Cells, Proceedings of the 126th TMS Light Metal Conference, 443,447 (1997)

- Estimation of the Gas Exhaust Rate Required on an Aluminium Reduction Cell during Start-up using TASCflow3D, CFD97 Conference Proceedings, 8-3,8-8, (1997)

- Computational of Aluminum Reduction Cell Energy Balance using ANSYS Finite Element Models, Proceedings of the 127th TMS Light Metal Conference, 409,417 (1998)

- Using ANSYS Based Aluminum Reduction Cell Energy Balance Models to Assist Efforts to Increase Lauralco's Smelter productivity, Proceeding of the ANSYS 8th International Conference, volume 2, 2.233-2.240, (1998)

- Development of a 2D+ Dynamic Model of an Aluminum Reduction Cell, Proceedings of the 38th annual conference of CIM, Light Metals section, 41-55, (1999)

- Thermo-Electric Design of a 400 kA Cell using Mathematical Models: A Tutorial, Proceedings of the 129th TMS Light Metal Conference, 297-302, (2000)

- Development of a 3D Transient Thermo-Electric Cathode Panel Erosion Model of an Aluminum Reduction Cell, Proceedings of the 39th annual conference of CIM, Light Metals section, 169-178, (2000)

- Usage of a Full 3D Transient Thermo-Electric F.E. Model to Study the Thermal Gradient Generated in the Lining during a Coke Preheat, Proceedings of the 130th TMS Light Metal Conference, 757-761, (2001)

- 3D Modeling of the Ventilation Pattern in an Aluminum Smelter "Potroom" Building using CFX-4, CFD2001 Conference Proceedings, 161-166, (2001)

- Computation of Accurate Horizontal Current Density in Metal Pad using a Full Quarter Cell Thermo-Electric Model, Proceedings of the 40th annual conference of CIM, Light Metals section, 3-11, (2001)

- Modeling Power Modulation, Proceedings of the 131st TMS Light Metal Conference, 489-493, (2002)

- Using ANSYS to Model Aluminum Reduction Cell since 1984 and Beyond, Proceedings of the ANSYS 10th International Conference, available only on CD, (2002)

- Using Mathematical Models to Improve the Thermal Balance of Hall-Héroult Cells, Prooceeding of the International Seminar on Aluminium Electrolllysis (ALEL 2002), available only on CD, (2002)

- Towards the Development of a 3D Full Cell and External Busbars Thermo-Electric Model, Proceedings of the 41st annual conference of CIM, Light Metals section, 25-39, (2002)

- Performing Fast Trend Analysis on Key Design Parameters, Proceedings of the 132nd TMS Light Metal Conference, 255-262, (2003)

- Thermo-Electric Design of a 500 kA Cell, Article in the International Aluminium Jounral from Verlag, 79(7/8), 629-631, (2003)

- Indian Aluminium Smelters Roadmap Selects Mathematical Modeling as Key Strategic Activity, available on GéniSim website, (2003)

- Calculating Temperature Under Hood of a Prebake Anode Cell, Proceedings of the 42nd annual conference of CIM, Light Metals section, 47-55, (2003)

- Demonstration Thermo-Electric and MHD Mathematical Models of a 500 kA Al Electrolysis Cell , Proceedings of the 42nd annual conference of CIM, Light Metals section, 3-20, (2003)

- Demonstration thermo-electric and MHD mathematical models of a 500 kA aluminum electrolysis cell: part2, Proceedings of the 133rd, TMS Light Metal Conference, 453-459, (2004)

- Accurate assessment of the Hirakud smelter aluminium reduction cell thermal balance using only temperature measurements, Proceedings of the 43rd annual conference of CIM, 525-533, (2004)

- Modeling aluminium reduction cell since 1980 and beyond, presentation at the Workshop in numerical simulations for the aluminum industry, École Polytechnique Fédérale de Lausanne, available on EPFL and GéniSim websites, (2004)

- Thermo-electric design of a 740 kA cell, is there a size limit ?, Article in the International Aluminium Jounral from Verlag, , 81(4), 324-327, (2005)

- Weakly coupled, thermo-electric and MHD mathematical models of an aluminium electrolysis cell, Proceedings of the 134th, TMS Light Metal Conference, 449-454, (2005)

- Study of the thermally-induced shell deformation of high amperage Hall-Héroult cells, Proceedings of the 44th annual conference of CIM, 35-47, (2005)

- Impact of using selective collector bar rodding on the MHD stability of a 500 kA aluminium electrolysis cell, Proceedings of the 44th annual conference of CIM, 19-33, (2005)

- Excess AlF_3 concentration in bath control logic, National Conference on Advancements in Aluminium Electrolysis, Indian Institute of Metals, Angul Chapter, (2006)

- MHD and potshell mechanical design of a 740 kA cell, Article in the International Aluminium Jounral from Verlag , 82(5), 442-446, (2006)

- Thermo-chemo-mechanical modeling of a Hall-Héroult cell thermal bake-out, Proceedings of the 135th, TMS Light Metal Conference, 669-674, (2006)

- Busbar sizing modeling tools: comparing an ANSYS® based 3D model with the versalile 1D model part of MHD-Valdis, Proceedings of the 135th, TMS Light Metal Conference, 341-346, (2006)

- Comparing the MHD cell stability of an aluminium reduction cell at different metal pad height and ledge thickness, Proceedings of the 45th annual conference of CIM, 479-497, (2006)

- Thermo-electro-mechanical modelling of a Hall-Héroult cell coke-bed preheating, Proceedings of the 45th annual conference of CIM, 525-542, (2006)

- Cell voltage noise removal and cell voltage (or resistance) slope calculation, Proceeding of the 12th IFAC Symposium on Automation in Mining, Mineral and Metal Processing, 490-492, (2007)

- Modelling thermal dynamic response to a 3-hour total power shutdown event, Proceeding of the 9th Australasian Aluminium Smelting Technology Conference, available only on CD, (2007)

- Impact of the vertical potshell deformation on the MHD cell stability behaviour of a 500 kA aluminium electrolysis cell, Proceedings of the 137th, TMS Light Metal Conference, 409-412, (2008)

- Challenges in stub hole optimization of cast iron rodded anodes, Proceedings of the 138th, TMS Light Metal Conference, 1067-1072, (2009)

- Mathematical modelling of aluminium reduction cell potshell: improvements and applications, Article in the International Aluminium Journal from Verlag, 86(1/2), 34-38, (2010)

- Mathematical modelling of aluminium reduction cell potshell deformation, Proceedings of the 139th, TMS Light Metal Conference, 417-422, (2010)

- Development and application of an ANSYS® based thermo-electro-mechanical anode stub hole design tool, Proceedings of the 139th, TMS Light Metal Conference, 433-438, (2010)

- Retrofit of a 500 kA cell design into a 600 kA cell design, Article in the International Aluminiun Journal from Verlag, 87(1/2), 52-55, (2011)

- Development and application of an ANSYS based thermo-electro-mechanical collector bar slot design tool, Proceedings of the 140th, TMS Light Metal Conference, 519-524, (2011)

- Using ANSYS and CFX to Model Aluminum Reduction Cell since 1984 and Beyond, Toronto ANSYS Regional Conference, (2011)

- Testing the *In Situ* aluminium cell control with the Dyna/Marc cell simulator, Proceedings of the 50th annual conference of CIM, 85-107, (2011)

- Testing Cell Controller Algorithms Using a Dynamic Cell Simulator, Article in the International Aluminiun Journal from Verlag, 88(1/2), 50-55, (2012)

- Modeling Cathode Cooling after Power Shutdown, Article in the International Aluminiun Journal from Verlag, 88(1/2), 65-68, (2012)

- Modeling Cathode Cooling Due to Power Interruption, Proceedings of the 141th, TMS Light Metal Conference, 923-928, (2012)

- Depth Analysis and Potentiality Exploitation on Energy-Saving and Consumption-Reduction of Aluminum Reduction Pot, Proceedings of the 141st, TMS Light Metal Conference, 601-606, (2012)

- Energy Saving from a Reduction Pot, Article in Aluminium International Today, March/April, 41-44, (2012)

- Measuring Bath Properties using the STARprobe™, ICSOBA 19th International Symposium, (2012)

- Testing a new STARprobe™ Measurement Based Ratio Control Algorithm Using a Dynamic Cell Simulator, Article in the International Aluminiun Journal from Verlag, 89(1/2), 76-80, (2013)

- In Depth Analysis of Energy-Saving and Current Efficiency Improvement of Aluminum Reduction Cells, Proceedings of the 142nd, TMS Light Metal Conference, 537-542, (2013)

- Production Application Study on Magneto-Hydro-Dynamic Stability of a Large Prebaked Anode Aluminum Reduction Cell, Proceedings of the 142nd, TMS Light Metal Conference, 603-607, (2013)

- What is the STARprobe™ and How it Can Help You Improve your Bath Ratio and Temperature Control, Article in Light Metal Age, October, (2013)

- The STARprobe™: A New Technology Allowing Simultaneous Measurements of Four Cryolitic Bath Properties in Only Four Minutes, Canadian International Aluminium Conference (CIAC), October, (2013)

- Further Improvement of Aluminium Reduction Cell Resistance Slope Calculation, Materials Science & Technology Conference Proceedings, (2013)

- Newest MHD-Valdis Cell Stability Studies, Article in the International Aluminiun Journal from Verlag, 90(1/2), 42-44, (2014)

- Influence of the Cathode Surface Geometry on the Metal Pad Current Density, Proceedings of the 143th, TMS Light Metal Conference, 479-484, (2014)