

# Chester Ledlie Sandberg

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## Education:

**Stanford University** Stanford, California **Masters of Science (Electrical)**

**Massachusetts Institute of Technology (MIT)** **Bachelor of Science (Mechanical)**

## Professional History

**2008 – Present** **C. L. Sandberg & Associates, LLC** **Owner**  
**Electrical and Mechanical Engineering Consultation**

**2002 – 2008** **Shell Exploration and Production**

Lead team of engineers in development of down hole electrical heaters for oil shale development including patented self-regulating mineral insulated heaters.

**1972 - 2002** **Chemelex – Raychem - Tyco Corporation** **Menlo Park, Ca**

1984 to 2002 **Electrical Engineering Manager and Chief Engineer**  
**Chemelex Heat Tracing Division**

Responsible for engineering software & hardware development and manufacture for \$150 Million division. Developed TraceCalc™, an IBM PC program for heat tracing design. Managing the development and manufacture of hardware and software for an industrial based monitoring and control system based on an Industrial DOS based PC using state of art power line carrier transmission of data. This system is used on the Alaskan North Slope to monitor and control electric heat tracing in severe environments and is now installed in 80 locations through out the world. Developing sensors and network for Raychem Proprietary materials for environmental monitoring and ground fault protection.

1980 to 1985 **Technical Strategy Manager**

1978 to 1980 **Chemelex Consumer Division Manager**

1975 to 1978 **Systems Engineering and Product Manager of Heat Tracing Division**

Systems engineering and technical product management for sales growth of \$3 million to \$50 million in 5 years. Managed 15 engineers and designers for customer heat tracing engineering. Produced technical specifications and literature, manufacturing plans, sales forecasts for critical entry phase of 88% gross margin product line. Built strong team of 8 product managers and 15 systems engineers.

1972 to 1975 **Product Group Manager, OEM**

# **Chester L Sandberg Societies and Licenses**

**Professional Electrical Engineer in State of California      Lic # 011421**

**Professional Control Systems Engineer in State of California      Lic # 001980**

## **IEEE Activities - Awards, Offices held, Committee Membership**

**2000 Elevated to level of Fellow**

**1982-2001 Chair of IEEE 622 WG on Electrical Heat Tracing in Power Generating Stations.**

**1983- 2000 Member Station Design Subcommittee**

**1985- 2002 Member of Energy Development and Power Generation Committee**

1985 Honorable Mention Paper on Fiber Optics at IEEE PCIC

1991 Requested presenter at IEEE IAS Pulp and Paper meeting

1985-1993 Participated in IEEE 515 PCIC Working group on Heat Tracing

1985 to Present Member Production Subcommittee IEEE IAS PCIC

1988 to Present Member Standards and Codes Committee IEEE IAS PCIC

1989 to Present Member Transportation Subcommittee IEEE IAS PCIC

**1980 to Present PES IEEE Member**

1985 to Present IAS IEEE Member

## **Other Society and Memberships**

**ISA Senior Member**

**American Society of Mechanical Engineers Member**

**Society of Petroleum Engineers**

**Member NFPA Code Panel 17 of National Electrical Code**

## Chester L Sandberg - United States Issued Patents

	<b>USA Patent Number</b>	<b>Title</b>
1	9,290,273	Adaptive freeze, snow or ice protection system and method
2	9,051,829	Perforated electrical conductors for treating subsurface formations
3	8,964,360	System to connect and multiplex sensor signals
4	8,881,806	Systems and methods for treating a subsurface formation with electrical conductors
5	8,742,604	Systems and methods for combined flow control and electricity generation
6	8,410,892	Conductive matrix power control system with biasing to cause tripping of the system
7	8,355,623	Temperature limited heaters with high power factors
8	8,224,163	Variable frequency temperature limited heaters
9	8,200,072	Temperature limited heaters for heating subsurface formations or wellbores
10	8,174,231	Mechanical methods for charging a car battery, related systems and infrastructure
11	7,831,133	Insulated conductor temperature limited heater for subsurface heating coupled in a three-phase WYE configuration
12	7,575,052	In situ conversion process utilizing a closed loop heating system
13	7,559,367	Temperature limited heater with a conduit substantially electrically isolated from the formation
14	7,490,665	Variable frequency temperature limited heaters
15	7,481,274	Temperature limited heaters with relatively constant current
16	7,431,076	Temperature limited heaters using modulated DC power
17	7,360,588	Thermal processes for subsurface formations
18	7,353,872	Start-up of temperature limited heaters using direct current (DC)
19	7,121,342	Thermal processes for subsurface formations
20	6,288,372	Electric cable having braidless polymeric ground plane providing fault detection
21	4,849,611	Self-regulating heater employing reactive components
22	4,785,163	Method for monitoring a heater
23	4,750,962	Method of picking up and placing gel material
24	4,733,057	Sheet heater
25	4,698,583	Method of monitoring a heater for faults
26	4,417,782	Fiber optic temperature sensing

## Chester L Sandberg Selected Technical Papers and Publications

55. Chet Sandberg, P.E., Keith Thomas, Scott Penny, **The Use of Coiled Tubing for Deployment of Electrical Heaters in Downhole Applications**, SPE/ICoTA Coiled Tubing & Well Intervention Conference & Exhibition Houston, Texas, USA, 22–23 March 2016.
54. Dave Burns P.E., Edward de St Remey, Chet Sandberg P.E., **MI Heater Cable Design and Deployment Advances in Downhole Applications**, PCIC Europe LO-80, London June 2015
53. Chet Sandberg, C L Sandberg & Associates, LLC, Keith Thomas, MCAAA, Ltd, Arthur Hale, Oil and Gas Consultant , **Advances in Electrical Heating Technology for Heavy Oil Production, Number SPE-165323-MS** , Calgary Alberta 2014
52. Chet Sandberg, Arthur Hale, Anthony R. Kovscek, **History and Application of Resistance Electrical Heaters in Downhole Oil Field Applications**, Society of Petroleum Engineers, Number SPE-165323-MS , April 2013
51. Bradford Roberts, Chet Sandberg, **The Role of Energy Storage in the Development of Smart Grids**, Proceedings of the IEEE, Vol 99, No. 6, June 2011
50. Matthew Senesky, Hao Qian, Kosha Mahmoodieh, Shahrdad Tabib, and Chet Sandberg, **Battery Module Balancing With A Cascaded H-Bridge Multilevel Inverter**, Sandia Electrical Energy Storage Applications and Technologies Conference, October 17-19, 2011, San Diego, California. Oct.17, 2011
49. Bradford P. Roberts, Life Senior Member IEEE, and Chet Sandberg, Fellow IEEE, **The Role of Energy Storage in Development of Smart Grids**, Proceedings of the IEEE, Vol. 99, \_2011 IEEE No. 6, June 2011
48. Kostas Samaras, Chet Sandberg, Chris J. Salmas, Andreas Koulaxouzidis, **Electrical Surge Protection Devices For Industrial Facilities – A Tutorial Review**, IEEE Transactions On Industry Applications, Volume 43, No 1 January February 2007
48. Jim Beres, Franco Chakkalakal, William M. McMechen, & Chet Sandberg, **Safer Sulphur Transfer**, IEEE Industry Applications Magazine, July – August 2006
47. Chet Sandberg P.E., Roy M. King, P.E., Hong Nguyen, Melvin R. Foster, **Analysis for Arctic Valve Heat Tracing Requirements**, IEEE PCIC Conference Toronto Canada, September 2001
46. Chet Sandberg P.E., Bob Holmes, Jim Beres, **Control and Monitoring of Electrical Heat Tracing**, IEEE PCIC Conference Toronto Canada, September 2001
45. Nayyar, Mohinder (general Editor), Chet Sandberg et al, Chapter B6, **Piping Handbook**, Seventh Edition, Heat-Tracing of Piping Systems, McGraw-Hill, 2000
44. Chet Sandberg et al, **Standards, Power Distribution, Monitoring and Control Of Electrical Heat Tracing, a Global View**, IEEE IAS Rome 2000 Conference, October 13, 2000

43. Doug Brooks, et al, **Reducing The Final Cost Of Ownership Of Electric Heat Tracing Systems In Northern Alberta**, IEEE-PCIC PCIC-2000-18, San Antonio Texas, September 12, 2000
42. Chet Sandberg, **An Example of Data Management in Process Equipment**, CPI Exposition, Javits Center NY, Nov 18, 1999
41. Chet Sandberg, **Notes on Panel Discussion on Electrical Heat Tracing**, C. Sandberg Moderator, IEEE PES July 21, 1999 Edmonton Alberta, Canada
40. Chet Sandberg, **Electrical Heat Tracing Can Minimize Piping Temperature Variation**, PM Engineer, BNP Publications, April 1999
39. Sandberg, Chet, Fluids, **Piping and Heat Tracing Data Management**, Chemputers Chemical Engineering Exposition, Houston Texas June 4, 1998
38. Sandberg, Chet, Zylstra, Henry, **Ground Fault Circuit Breakers for Heat Tracing**, 1998 IEEE PCIC Conference, Indianapolis IN, Sept 1998
37. Sandberg, Chet, **Heat tracing system selection**, Chemical Processing, November 1997, Putman Publishing, pp 65-71
36. Sandberg, Chet, **Trace-heating optimization for cost effective operation**, Petroleum Technology Quarterly Autumn 1997, Crambeth Allen Publishing Co UK, pp 97-103
35. Sandberg, Chet, **Minimizing Piping Temperature Variations**, Process Heating, July/August 1997, Pages 24-27
34. Sandberg, Chet, Van Hoorickx, **Computerized Engineering for Process Industry Heat Tracing Design Optimization**, Chemputers Conference, Frankfurt Germany, October 29, 1996
33. Sandberg, Kuse, Rafferty, McBride, **Secondary Factors in Electrical Heat Tracing Design**, 1996 IEEE PCIC Conference, Philadelphia PA, Sept 1996
32. Peter Baen,... Chet Sandberg, **Safety Considerations in Electrical Heat Tracing**, IEEE Industry Applications Magazine, Vol 2, No 2 March/April 1996
31. Sandberg, Whitney, Nassar, Kuse, **Intelligent Distributed Heater Used for Industrial Applications**, 1995 IEEE International Conference on Systems, Man and Cybernetics, Vancouver, British Columbia, Canada October 22-25, 1995
30. Chet Sandberg, Jim Daues, **Control, Monitoring and Electrical Distribution for Reliable Electrical Heat Tracing Systems**, ISA Anaheim California, October 1994
29. Peter Baen, Chet Sandberg, **Safety in Electrical Heat Tracing**, IEEE PCIC Conference, Vancouver Canada, September 12-14, 1994
28. Chet Sandberg, **Electrical Heat Tracing Systems for use in Pulp and Paper Mills** IEEE Pulp and Paper Conference, Hyannis MA June 21, 1993

27. Chet Sandberg, **Electrical Heat Tracing Systems for use in Pulp and Paper Plants; Considerations for the 1990's** ISA Pulp and Paper Industries Division Symposium (in conjunction with TAPPE), Nashville, TN March 21 -25, 1993
26. Chet Sandberg, **"Impedance Match" Personal Computers with Engineers**, IEEE Pulp and Paper Conference, Portland Oregon, April 1992
25. Vera Lam and Chet Sandberg, **"Choose the Right Heat-Tracing System"**, Chemical Engineering Progress, March 1992 pages 63-67
24. Chet Sandberg, Ken McCoy, **Detecting Hydrocarbons with Cross-Linked Sensing Cable**, INTECH February 1992
23. Chet Sandberg, Mike Masia, **Hydrocarbon Leak Detection with a Distributed Sensor System that is Vapor Insensitive**, ISA Conference, Anaheim Calif., Oct 29, 1991
22. Chet Sandberg, **Update on IEEE Working Group 622 Electrical Heat Tracing Systems (IEEE622) and Related Standards**, 90 JPGC 631-2 EC, IEEE Power Engineering Society, Joint Power Generation Conference, October 24, 1990
21. Chet Sandberg, Don Nolte, **Use of the Personal Computer in the Design of Electrical Heat Tracing**, 90 JPGC 633-8 EC, IEEE Power Engineering Society, Joint Power Generation Conference, October 24, 1990
20. Chet Sandberg, **"Impedance Match" Personal Computers with Engineers**, IEEE PCIC Conference, Houston Texas, September 1990, PCIC-90-46
19. C. J. Erickson, N. R. Rafferty, J. D. Lyons, C. L. Sandberg, **A Study of Steam vs Electrical Pipeline Heating Costs on a Typical Petro-Chemical Plant Project**, IEEE PCIC Conference, Houston Texas, September 1990, PCIC-90-2
18. Richard Huff, Chet Sandberg, **Design, Commissioning and Operational Experience of a Heat Tracing System with Extensive Electronic Monitoring**", IEEE Industry Applications Volume 26 Number 6 (ISSN 0093-9994) November/December 1990
17. Chet Sandberg, **Electric or Steam Heat Tracing, The Choice is Yours**, Hydrocarbon Processing Magazine, February 1989
16. Chet Sandberg, **Aspects of a Continuous Leak Detection System for Pipes and Pipelines**, IEEE PCIC Conference, Dallas Texas, 1988
15. Chet Sandberg, **Analysis of Heat Tracing Pipe Temperatures as a Function of Physical and Operational Parameters**, 87 SM 427-8 IEEE Summer Power Conference, San Francisco, July 12, 1987
14. Chet Sandberg, Leonard Haile, **Fiber Optic Applications in Pipes and Pipelines**, IEEE PCIC Conference, Philadelphia 1985
13. Chet Sandberg, Mark McCulloch, **Fluoroptic Thermometry, A New Tool for Temperature Measurement in Semiconductor Plasma Etch, Sputtering, and Ion Implantation**, ASME 84-WA/HT-91, Presented at ASME Winter Meeting, New Orleans LA, Dec 1984

12. Chet Sandberg, John Gerling, **Fluoroptic Thermometry, A New Tool for Temperature Measurement in Severe Electromagnetic Environments**, ASME 84-HT-50, Presented at ASME Heat Transfer Conference, Niagara Falls NY, Aug 1984
11. Mei Sun, James Kim, Chet Sandberg, **Advances in Fluoroptic Thermometry, New applications in Temperature Measurement**, ISA Regional Meeting, March 1985, Boston Mass
10. Chet Sandberg, Brian Duggan, **Advances in Fluoroptic Thermometry, A New Tool for Temperature Measurement of Semiconductor Surfaces**, SemiTech 1985
9. C. L. Sandberg, J. A. Stassen, **Some Aspects of Cryogenic Tank Frost Heave Prevention, Cryogenic Processes and Equipment in Energy Systems**, ASME, Presented at ASME Century 2 Pressure Vessels and Piping Conference, San Francisco CA., 1980
8. C. L. Sandberg, T. Klopach, **A Mechanical Coupler with Performance Superior to a Socket Weld**, ASME 80-C2/PVP-37, Presented at ASME Century 2 Pressure Vessels and Piping Conference, San Francisco CA., 1980
7. Robert Benson, Regis Flot, Chester Sandberg, **The use of Shape Memory Effect Alloys as an Engineering Material**, Materials Conference, Wright Patterson Airforce Base 1977
6. Chet Sandberg, Roger Goodrich, **Blanket and Strip Heaters: New Design Options for Heat, Appliance Engineer**, August 1977, Dana Chase Publications
5. M. Silverman, C Sandberg, **Self Limiting Electric Heat Source for Energy Optimization and Performance Reliability**, IEEE Appliance Technical Conference, Paper No C76-427-0-IA, Purdue University, West Lafayette, Indiana, April 29, 1976
4. Chester Sandberg, **Design Considerations for Low Watt Density Blanket and Strip Heaters**, IEEE Domestic Appliance Industry Committee of the Industry Applications Society, June 20, 1974, Chicago, Illinois
3. Joseph Oakes, Chet Sandberg, **Some Aspects of a Self-Limiting Resistive Electric Heating Element**, IEEE PCIC Philadelphia 1972
2. Chester L Sandberg, Richard Yules, MD, **Two Aids for Cinefluorography**, Radiology, Vol 91, No 4, Pages 821-822 October 1968
1. Chester L Sandberg, Richard Yules MD, **The Bite-Ometer**, Archives of Otolaryngology, Vol 89, April 1969, Pages 682-684