

## **Barry M. Gordon, MSc, P. E., FNACE**

NACE International Fellow and Corrosion Specialist  
US NRC Instructor: “Corrosion and Corrosion Control in LWRs”  
ASME Instuctor: “Corrosion and its Mitigation in Light Water Reactors”

Structural Integrity Associates, Inc.  
5215 Hellyer Avenue, Suite 210  
San Jose, CA 95138-1025

[bgordon@structint.com](mailto:bgordon@structint.com)  
408-978-8200 x 7313  
408-821-6014 (cell)

### **Education**

MS, Metallurgy and Material Science, Carnegie Mellon University  
BS, Metallurgy and Material Science, Carnegie Mellon University (First in Department)  
Additional corrosion courses from MIT, University of Pittsburgh and NACE in Corrosion Science

### **Professional Associations and Awards**

Registered Professional Engineer, State of California – Corrosion Engineering  
Instructor’s Credential, California Community Colleges  
Patent No. 4,950,449 – Inhibition of Radioactive Cobalt Deposition in Water-Cooled Nuclear Reactors  
Patent No. 5,577,083 – Method and Apparatus for Electro-Protection of Piping Systems and Reactor Internals from Stress Corrosion Cracking  
Patent No. 5,590,162 – Beta Battery  
Patent No. 6,128,361 – Coating for Reducing Corrosion of Zr-based Alloys by Beta Particle Irradiation  
R&D Magazine’s 100 award (most significant new technical products of the year) for zinc injection

### **Professional Experience**

2004 to present	Instructor, “Corrosion and Corrosion Control in LWRs” U. S. Nuclear Regulatory Commission
1998 to present	Structural Integrity Associates, Inc., San José, CA Senior Consultant/Associate
1975 to 1998	GE Nuclear Energy, San José, CA Technical Expert – Corrosion Engineering Project Manager – Corrosion Technology
1969 to 1975	Westinghouse Electric – Bettis Atomic Power Laboratory, West Mifflin, PA Materials Engineer

## **Summary**

Mr. Gordon has consulted on various LWR corrosion and material issues for over four decades with special emphasis on stress corrosion cracking (SCC). He has addressed numerous materials and corrosion problems in the LWR industry over a wide range of subjects including reactor internals, piping, fuel hardware, water chemistry transients, repairs, crack growth rate modeling, alloy selection, failure analysis, license renewal, NRC inspection relief, dry fuel storage, corrosion of steel in concrete, decontamination, etc.

He has served as an expert witness testifying for utilities before the Advisory Committee on Reactor Safeguards (ACRS) and Atomic Safety Licensing Board (ASLB). He also chaired and co-authored “Corrosion in the Nuclear Power Industry” for ASM Handbook, Volume 13C (2006) and prepared a chapter on BWR IGSCC for Woodhead Publishing (2012). He also teaches his 32 hour “Corrosion and Corrosion Control in LWRs” class at the U. S. Nuclear Regulatory Commission (NRC). Mr. Gordon has been the SI program manager and/or co-author of over 35 EPRI sponsored programs and reports. He has over 75 technical publications including co-authoring three books on IGSCC in BWRs.

Mr. Gordon was the SI project manager for the Yucca Mountain Project for TRW, Bechtel SAIC and EPRI. He has conducted evaluations on the qualification of the waste package relative to long-term materials corrosion performance, weld residual stresses and long-term corrosion monitoring.

While at GE Nuclear Energy (GENE), Mr. Gordon was responsible for consultation, problem analysis and management of programs on BWR materials/environmental interactions. He developed and qualified the environmental BWR IGSCC mitigation technique, hydrogen water chemistry, prepared the EPRI decontamination guidelines for BWRs and qualified a process for BWR full-system decontamination. Mr. Gordon also co-patented a revolutionary method of inhibiting radioactivity and mitigating IGSCC in nuclear reactors, a process that won *R&D Magazine*’s 100 award as one of the most significant new technical products of the year.

Mr. Gordon managed multi-million dollar development programs on corrosion testing, field surveillance, failure analysis and design qualifications at GENE. He has lectured throughout the U.S., Mexico, Canada, Japan and Europe on corrosion phenomena to technical societies, regulatory agencies, utilities and vendors.

Mr. Gordon has supervised senior level materials engineers and has consulted on a broad range of materials problems for other GE businesses. He also managed the materials technical exchange programs among GE, ABB, Hitachi and Toshiba.

Mr. Gordon directed corrosion programs on steam generator materials and nuclear fuel cladding while at Westinghouse. He performed fieldwork on the nuclear aircraft carriers Enterprise and Nimitz and devised and qualified a new surface treatment for zirconium and hafnium alloys for corrosion and hydriding mitigation.

## **Barry M. Gordon - Open Literature Publications**

1. B. M. Gordon, et al., "Steam Generator Management Program: Investigation of Crack Initiation and Propagation in the Steam Generator Channel Head Assembly." EPRI, Palo Alto, CA: 2014. 3002002850.
2. B. M. Gordon, et al., "BWRVIP-190 Revision 1: BWR Vessel and Internals Project, Volume 2: BWR Water Chemistry Guidelines - Technical Basis." EPRI, Palo Alto, CA: 2014. 3002002623.
3. B. M. Gordon, "Non-EAC Corrosion Concerns Affecting Life Extension of Light Water Reactors," Corrosion, Vol. 69, No. 10, October 2013, p. 1039.
4. B. M. Gordon, "Corrosion and Corrosion Control in Light Water Reactors," Journal of Metals, Volume 65, Issue 8, August 2013, p. 1043.
5. B. M. Gordon and K. Wolfe, "Proper Specification of Dissolved Oxygen for Use in Environmental Fatigue Calculations," paper presented at Nuclear Plant Fatigue Applications and Environmentally Assisted Fatigue Workshop, San Francisco, CA, July 31, 2013.
6. B. M. Gordon, "Outside Diameter Stress Corrosion Cracking of Stainless Steel in Light Water Reactors," paper 2539 presented at Corrosion 2013, Orlando, FL, March 17-21, 2013.
7. B. M. Gordon, et al., "Steam Generator Management Program: Assessment of Channel Head Susceptibility to Primary Water Stress Corrosion Cracking," EPRI, Palo Alto, CA: 2012, 1025133.
8. F. P. Ford, B. M. Gordon and R. M. Horn, "Intergranular Stress Corrosion Cracking (IGSCC) in Boiling Water Reactor (BWRs)," Nuclear Corrosion Science and Engineering, Ed. Damien Féron, Woodhead Publishing, Abington Hall, Abington, Cambridge, 2012, p 548.
9. B. M. Gordon, "Non-EAC Corrosion Concerns Affecting Life Extension of Light Water Reactors," paper presented at Corrosion 2012, Salt Lake City, UT, March 11-15, 2012.
10. B. M. Gordon, et al., "Mechanical and Welding Mitigation Guidelines," EPRI, Palo Alto, CA: 2011, 1022878.
11. B. M. Gordon, et al., "BWRVIP-62 Revision 1: BWR Vessel and Internals Project Technical Basis for Inspection Relief for BWR Internal Components with Hydrogen Injection," EPRI, Palo Alto, CA, 2011. 1022844.
12. B. M. Gordon, "BWRVIP-255 BWR Vessel and Internals Project: Mitigation of IGSCC in the Lower Plenum of the BWR with HWC and Noble Metals," EPRI, Palo Alto, CA, 2011. 1022847.
13. B. M. Gordon and S. E. Garcia, "Technical Basis for Water Chemistry Control of IGSCC in Boiling Water Reactors," Proceedings of 15<sup>th</sup> International Conference on Environmental

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Degradation in Nuclear Power Systems – Water Reactors. Colorado Springs, CO. August 7-11, 2011. Eds. J. T. Busby, G. Ilevbare and P. L. Andresen, Eds. J. T. Busby, G. Ilevbare and P. L. Andresen, published by The Metallurgical Society, Warrendale, PA, 2012, p. 2061.

14. B. M. Gordon and S. E. Garcia, “Effect of Water Purity on Stress Corrosion Cracking of Stainless Steel and Nickel Alloys in BWR Environments,” paper presented at the Nuclear Plant Chemistry Conference 2010, Quebec City, Canada, October 3-7, 2010.
15. B. M. Gordon and S. E. Garcia, “Effect of Water Purity on Intergranular Stress Corrosion Cracking of Stainless Steel and Nickel Alloys in BWRs,” paper presented at Fontevraud 7, Contributions of Materials Investigations to Improve the Safety and Performance of LWRs, Avignon, France, September 26-30, 2010.
16. B. M. Gordon and A. J. Giannuzzi, “Technical Basis for Code Acceptance of PWSCC Mitigation by Peening,” EPRI, Palo Alto, 2010. 100xxxx.
17. B. M. Gordon, et al., “BWRVIP-226: BWRVIP Vessel and Internals Project: Feasibility Evaluation of BWR Hydrogen Injection for ECP Reduction during Startup,” EPRI, Palo Alto, CA: 2009. 1019074.
18. B. M. Gordon, et al., “BWRVIP-212: BWR Vessel and Internals Project, Evaluation of Crack Growth Rates of Nickel-Base Alloys 52, 152, and 690 in BWR Environments,” EPRI Report Number: 1018890, April 14, 2009.
19. B. M. Gordon, et al., “BWRVIP-190: BWR Vessel and Internals Project, BWR Water Chemistry Guidelines—2008 Revision,” EPRI, Palo Alto, CA: 2008. 1016579.
20. N. Cofie, A. J. Giannuzzi and B. M. Gordon, “BWRVIP-14-A: BWR Vessel and Internals Project, Evaluation of Crack Growth in BWR Stainless Steel RPV Internals,” EPRI Palo Alto, CA: 2008 1016569.
21. B. M. Gordon, R. Gnagne and D. Lee, “BWRVIP-186: BWR Vessel and Internals Project, Effect of Water Chemistry and Temperature Transients on the IGSCC Growth Rates in BWR Components,” EPRI, Palo Alto, 2008. 1016485.
22. T. Griesbach and B. M. Gordon, “Materials Ageing Management Programs at Nuclear Power Plants in the United States,” paper presented at Second International Symposium on Nuclear Power Plant Life Management, Shanghai, China, October 16, 2007.
23. B. M. Gordon, “Historic Studies on the Effects of Cold Work on the Stress Corrosion Cracking of Stainless Steels in BWR Environments,” paper presented at “Workshop on Cold Work in Iron- and Nickel-base Alloys Exposed to High Temperature Water Environments,” Mississauga, ON, June 4, 2007.

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24. F. P. Ford, B. M. Gordon and R. M. Horn, "Corrosion in Boiling Water Reactors," ASM Handbook Volume 13C, Corrosion: Environments and Industries, A. D. Cramer and B. S. Covino, Jr. Eds, ASM, Metals Park, OH, 2006, p 341.
25. B. M. Gordon, "Introduction to Corrosion in the Nuclear Power Industry," ASM Handbook Volume 13C, Corrosion: Environments and Industries, A. D. Cramer and B. S. Covino, Jr. Eds, ASM, Metals Park, OH, 2006, p 339.
26. B. M. Gordon, M. Taylor and R. Arthur, "Climatic Corrosion Considerations for Independent Spent Fuel Storage Installations in Marine Environments," EPRI, Palo Alto, CA: 2006. 1013524.
27. B. M. Gordon, M. Taylor and A. Deardorff, "Effects of Marine Environments on Stress Corrosion Cracking of Austenitic Stainless Steels – An Evaluation of the NISA and CRIEPI Spent Fuel Storage Canister Project," EPRI, Palo Alto, CA: 2005. 1011820.
28. B. M. Gordon, "Effect of PWR Water Chemistry on PWSCC," EPRI White paper, July 2005.
29. B. M. Gordon, et al., "Enhanced Crevice Corrosion Criteria in RI-ISI Evaluations," EPRI 101195, Palo Alto, CA, November 2005.
30. B. M. Gordon, et al., "BWR Vessel and Internals Project, BWR Water Chemistry Guidelines – 2004 Revision (BWRVIP-130)," EPRI TR-1008192, Palo Alto, CA, October 2004.
31. B. M. Gordon, et al., "Expert Panel Workshop for Hanford Site Double-Shell Tank Waste Chemistry Optimization," RPP-22126, CH2M-Hill Hanford Group, Inc., September 2004.
32. B. M. Gordon, "BWRVIP-98: BWR Vessel and Internals Project Technical Basis for Guidelines for Performing Weld Repairs to Irradiated BWR Internals," EPRI 1006385, Palo Alto, CA, December 2001.
33. B. M. Gordon, et al., "Performance Confirmation for the Candidate Yucca Mountain High-Level Nuclear Waste Repository," EPRI 1003032, Palo Alto, CA, December 2001.
34. B. M. Gordon, A. J. Giannuzzi and K. Wolfe, "BWRVIP-97: BWR Vessel and Internals Project Guidelines for Performing Weld Repairs to Irradiated BWR Internals," EPRI 1003020, Palo Alto, CA, November 2001.
35. B. M. Gordon, "Interim Welding Guidelines for BWR Internals (BWRVIP-90)," EPRI 1001195, Palo Alto, CA, June 2000.
36. S. S. Tang, M. L. Herrera, B. M. Gordon, G. M. Gordon and S. Lu, "Weld Residual Stress Analyses of Closure Lid Welds for the Waste Packages at the Potential Yucca Mountain Repository," paper presented at the 2000 ASME Pressure Vessels and Piping Conference July 23-27, 2000, Seattle, WA.

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37. B. M. Gordon, et al., "BWR Vessel and Internals Project, BWR Water Chemistry Guidelines – 2000 Revision (BWRVIP-79)," EPRI TR-103515-R2, Palo Alto, CA, February 2000.
38. B. M. Gordon, et al., "Technical Justification for the Extension of the Interval between Inspection of Weld Overlay Repairs", paper presented EPRI at the 5<sup>th</sup> Piping and Bolting Inspection Conference, San Antonio, TX, June 23-25, 1999.
39. B. M. Gordon and H. L. Gustin, "Technical Justification for the Extension of the Interval Between Inspections for Weld Overlay Repairs," EPRI TR-110172, Charlotte, NC, February 1999.
40. B. M. Gordon, et al., "BWR Vessel and Internals Project, Technical Basis for Inspection Relief for BWR Internal Components with Hydrogen Injection (BWRVIP-62)," EPRI TR-108705, Palo Alto, CA, December 1998.
41. B. M. Gordon, "Status Report on BWR Full System Decontamination," paper presented at the Radiation Field Control Seminar, Seattle, WA, August 17, 1993.
42. B. M. Gordon and D. A. Hale, "Monitoreo en Linea en la Industria Generadora de Energia," paper presented at IMICORR 93, Veracruz, Mexico, June 23, 1993 published in proceedings of same IMICORR, Mexico City, June 1993.
43. B. M. Gordon, "Topical Report on FSD for BWRs," paper presented at the Fifth Workshop on Chemical Decontamination, Charlotte, NC, June 8-9, 1993.
44. B. M. Gordon, "BWR Structural Materials Corrosion - A NACE 50th Anniversary Perspective," paper #93175 presented at Corrosion 93, NACE, New Orleans, March 8, 1993.
45. A. Hunsbedt, B. M. Gordon, D. Little and R. F. Steigerwald, "The Operation of RVACS in a Coastal Environment," paper presented at the 1992 International Conference on Design and Safety of Advanced Nuclear Power Plants, Japan, 1992.
46. B. M. Gordon, et al., "Hydrogen Water Chemistry for BWRs-Materials Behavior-Final Report," EPRI TR-100304, Palo Alto, CA, February 1992.
47. B. M. Gordon, et al., "Full-System Decontamination of a BWR Using the LOMI Process," EPRI TR-100049, Palo Alto, CA, October 1991.
48. J. E. Oesterle, B. M. Gordon, H. A. Levin and J. M. Skarpelos, "The Effects of Sodium Pentaborate Injection at BWRs," NSAC-171, EPRI, Palo Alto, CA, September 1991.
49. B. M. Gordon, "Full System Decontamination for BWRs," paper presented at the Fourth Seminar on Chemical Decontamination of BWRs, Charlotte, NC, June 4-5, 1991 published in proceedings of same 91-WH-53, EPRI NDE Center, Charlotte, NC, 1991.

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50. B. M. Gordon, "BWR Full System Decontamination," paper presented at the EPRI Radiation Control Seminar, Palo Alto, CA, April 11, 1991, published in proceedings of same, EPRI, Palo Alto, CA, May 1991.
51. B. M. Gordon, "Plant Materials Corrosion Issues When Zinc Ion is Present," paper presented at the EPRI Workshop on BWR Zinc Injection in Normal and Hydrogen Water Chemistry, Parsippany, NJ, September 13, 1990 published in proceedings of same, EPRI, Palo Alto, CA, October 1990.
52. B. M. Gordon, "Decontamination Corrosion Testing Results," paper presented at the Third Seminar on Chemical Decontamination of BWRs, Charlotte, NC, December 6-8, 1988 published in proceedings of same, EPRI NDE Center, Charlotte, NC, 1989.
53. G. M. Gordon, B. M. Gordon and K. S. Ramp, "Quantification of Benefits of Improved Water Chemistry Implications for BWR Piping," paper presented at the EPRI Workshop on Quantifying the Effect of Improved Water Chemistry on Corrosion Cracking, Rockville, MD, November 3, 1988.
54. B. M. Gordon, "Corrosion Issues in the BWR and Their Mitigation for Plant Life Extension," paper presented at the ANS Topical Meeting on Nuclear Plant Life Extension, Snowbird, UT, July 1988.
55. B. M. Gordon and G. M. Gordon, "Decontamination and Materials Corrosion Concerns in the BWR," paper presented at the 1988 JAIF International Conference on Water Chemistry, JAIF, Tokyo, Japan, April 1988.
56. B. M. Gordon and G. M. Gordon, "Resolution of Corrosion Problems in Boiling Water Reactors," Corrosion, Metals Handbook Volume 13, ASM, Metals Park, OH, September 1987.
57. B. M. Gordon, De. E. Delwiche and G. M. Gordon, "Service Experience of BWR Pressure Vessels," paper presented at the ASME Pressure Vessels and Piping Conference, San Diego, CA, June 1987.
58. B. M. Gordon, "BWR Water Chemistry and Erosion-Corrosion," paper presented at EPRI Workshop on Erosion-Corrosion of Carbon Steel Piping, Washington, D.C., April 1987.
59. B. M. Gordon, et al., "Hydrogen Water Chemistry for BWRs-Materials Behavior," EPRI NP-5080, Palo Alto, CA, March 1987.
60. B. M. Gordon and G. M. Gordon, "Materials Aspects of BWR Plant Life Extension," paper presented at the 13<sup>th</sup> Water Reactor Safety Research Information Meeting, Gaithersburg, MD, October 22-25, 1985, published in Nuclear Engineering and Design, 98, 1987.
61. B. M. Gordon, "BWR Material Life Extension Through Hydrogen Water Chemistry," paper presented at the Operability of Nuclear Power Systems in Normal and Adverse

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Environments, Albuquerque, NM, September 1986, published in proceedings of same, ANS, LaGrange, IL, 1987.

62. M. E. Indig, B. M. Gordon, R. B. Davis and J. E. Weber, "Evaluation of In-reactor Intergranular Stress Corrosion Cracking Via Electrochemical Measurements," paper presented at the Second International Symposium on Environmental Degradation of Materials in Nuclear Power Systems, Monterey, CA, September, 1985, published in proceedings of same, ANS, LaGrange, IL, 1986.
63. B. M. Gordon, et al., "Environmentally Assisted Cracking Resistance of BWR Materials in Hydrogen Water Chemistry," paper presented at the Second International Symposium on Environmental Degradation of Materials in Nuclear Power Systems, Monterey, CA, September, 1985, published in proceedings of same, ANS, LaGrange, IL, 1986.
64. B. M. Gordon, "Decontamination Guidelines for Materials and Corrosion Concerns in Boiling Water Reactors," EPRI NP-4749LD, Palo Alto, CA, July 1986.
65. B. M. Gordon and G. M. Gordon, "Mitigation of Pipe Cracking for BWR Plant Life Extension," paper presented at the International Conference and Exhibition on Nuclear Power Plant Aging, Availability Factor, and Reliability Analysis, San Diego, CA, July 1985, published in proceedings of same, ASM, Metals Park, 1985, p. 287.
66. R. L. Cowan, B. M. Gordon, E. Kiss, L. L. Sundberg and R. B. Adamson, "Hydrogen Water Chemistry Operating Experience," paper presented at the Post SMiRT Conference, Ispra, Italy, August 1985.
67. B. M. Gordon, et al., "Hydrogen Water Chemistry for Boiling Water Reactors," EPRI NP-3959SP, Palo Alto, CA, July 1985.
68. B. M. Gordon, "Development and Qualification of Type 316 Nuclear Grade Stainless Steels for BWRs," paper presented at the Symposium of Recent Advances in the Development and Application of Corrosion Resistant Alloys, SRI International, Menlo Park, CA, May 8, 1985.
69. B. M. Gordon, Corrosion and Corrosion Control in BWRs, GE NEDO-24819A, Class 1, December 1984.
70. J. N. Kass, M. T. Wang, W. L. Clarke, T. K. Odegaard, W. L. Walker and B. M. Gordon, "Decontamination of Power Reactors: The Costs, Benefits, and Consequences," paper presented at ANS Executive Conference, Springfield, MA, September 1984.
71. B. M. Gordon, et al., "Mitigation of Stress Corrosion Cracking Through Suppression of Radiolytic Oxygen," paper presented at the International Symposium of Environmental Degradation of Materials in Nuclear Power Systems-Water Reactors, Myrtle Beach, SC, August 1983, published in proceedings of same, NACE, Houston, 1984, p. 893.



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72. B. M. Gordon, et al., "Corrosion Resistance Improvement of Ferritic Steels Through Hydrogen Additions to the BWR Coolant," paper presented at the Topical Conference of Ferritic Alloys for Use in Nuclear Technologies, Snowbird, UT, June 1983, published in proceedings of same, TMS-AIME, New York, 1984, p. 65.
73. B. M. Gordon, et al., "Oxygen Control as a Possible BWR Pipe Cracking Remedy," paper presented at SMiRT-6 Post Conference, Paris, France, August 1981, published in Structural Integrity of Light Water Reactor Components, Applied Science, New York, 1984.
74. B. M. Gordon, et al., "Effectiveness of Hydrogen Additions for Mitigation of Stress Corrosion Cracking in BWR Environments," paper #20 presented at Corrosion 81, NACE, Toronto, Ontario, April 1981.
75. B. M. Gordon, "Alternate Water Chemistry for Boiling Water Reactors," paper presented at the Golden Gate Metals and Welding Conference, San Francisco, CA, January 1981.
76. B. M. Gordon, "The Effect of Chloride and Oxygen on the Stress Corrosion Cracking of Stainless Steel: Review of Literature," Materials Performance, Vol. 19, No. 4, April 1980, p. 29.
77. B. M. Gordon and M. E. Indig, "Progress Towards Oxygen Suppression in the BWR," Trans. of ANS, Vol. 35, ANS, LaGrange Park, IL, 1980.