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Engineering & Scientific Consulting

Robert A. Carnahan, P.E.

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Professional Profile

Mr. Carnahan specializes in failure analysis of engineering components and systems by combining expertise in metallurgical engineering, corrosion, materials science, and mechanical engineering.

Mr. Carnahan has performed failure analysis of a wide variety of machinery and equipment related to aerospace, automotive, construction, maritime, pipeline, power generation, and petrochemical industries. Mr. Carnahan has investigated failures of petrochemical plant equipment including heat exchangers, pressure vessels, and HF storage hardware, and has investigated failures of oil and natural gas pipelines and oil and gas well casings. Mr. Carnahan has performed failure analysis of various gas turbine components. He has investigated failures of various types of water and sewage piping, including cast iron, PVC, and asbestos cement. Mr. Carnahan has investigated failures of fire protection system components including sprinklers, piping (steel and CPVC), and couplings. He has also analyzed a multitude of plumbing product failures.

Mr. Carnahan's skills include fractography, microscopy, microstructural analysis, welding and joining, mechanical testing, and stress analysis. Mr. Carnahan also has experience with laboratory evaluation of microbiologically influenced corrosion (MIC) and has worked on a number of MIC related projects, including oil pipelines, sanitary sewer piping, and heat exchangers.

Prior to joining Exponent, Mr. Carnahan performed metallurgical failure analysis and corrosion investigations of nuclear power plant components for the General Electric Company.

Academic Credentials & Professional Honors

M.S., Metallurgical Engineering, University of Michigan, Ann Arbor, 1980

B.S., Materials and Metallurgical Engineering, University of Michigan, Ann Arbor, summa cum laude, 1979

General Electric Honors Cooperative Program

Tau Beta Pi

Clarence A. Siebert Scholarship, University of Michigan

Licenses and Certifications

Licensed Professional Mechanical Engineer, California, #M31519

Licensed Professional Mechanical Engineer, Arizona, #62030

Licensed Professional Mechanical Engineer, Nevada, #024746

Licensed Professional Mechanical Engineer, Texas, #132350

Licensed Professional Engineer, Utah # 9855287-2202

Licensed Professional Engineer, Michigan # 6201068806

Certified Corrosion and Materials Professional (API 571), American Petroleum Institute

Prior Experience

Senior Engineer, General Electric Company, Nuclear Energy Division, 1980-1986

Senior Engineer, General Electric Company, Aerospace Division, 1987-1988

Professional Affiliations

ASM International (formerly American Society for Metals) (member)

National Association of Corrosion Engineers (member)

American Society of Mechanical Engineers (member)

American society for Testing and Materials, Committee A01 on Steel, Stainless Steel and Related Alloys (member)

Independent Metallurgical Engineering Consultants of California (member)

Publications

McDonald B, Ross B, Carnahan RA. The Bellevue crane disaster. Engineering Failure Analysis 2011 Oct; 18(7):1621-1636

Dracup B, Reza A, Carnahan RA, Christiansen E, Ross B. A case study of two shiploader fires in a coal and pet coke facility. 11th International Conference, Fire and Materials, January 2007.

Kadlec R, Westmann R, Carnahan RA, Haghi M, Deyerl E. Failure analysis of heavy truck trailer axle tubes. Experimental Model Research and Testing of Thin Walled Structures, 1997.

Andrew S, Carnahan RA. Fitness-for-service of chloride ton containers. NACE Corrosion '96, Paper No. 650, 1996.

Foulds J, Carnahan RA. Examination of Sabine 2 hot reheat pipe seam weld cracking. Electric Power Research Institute, RP2253-17, Final Report, June 1994.

Carnahan RA. Alternative alloys for BWR pipe applications. Appendix J, Electric Power Research Institute Report NP-2671-LD, October 1982.

Presentations

Carnahan RA. Tribological coating development for SP-100 sliding interfaces. 5th Symposium on Space

Nuclear Power Systems, Albuquerque, NM, 1988.

Carnahan RA. Field piping sensitization surveillance. International Workshop on Low Temperature Sensitization, Electric Power Research Institute, Palo Alto, CA, 1982.

Selected Reports

Moore D, Rau C, Carnahan RA. Triumph air repair / World Airways arbitration. Exponent FaAA Report, February 2006.

Carnahan RA. Whiting motorcycle headlight examination. Exponent FaAA Report to the United States Department of Justice, May 2005 (Rule 26B Report).

Hertzberg J, Reza A, Carnahan RA. Robertshaw TS-11 and 7000 series gas valve investigation. Exponent FaAA Report, October 2004.

Carnahan RA. Investigation of the whitefly screen damage at Houweling's Nursery. Exponent FaAA Report, March 2004.

Carnahan RA. Investigation of the August 2003 skeg cracking on the M/V St. Lucia. Exponent FaAA Report, March 2004.

Carnahan RA. Monrovia Villas copper pipe failure investigation. Exponent FaAA Report, November 2003.

Carnahan RA. Investigation of Disney Concert Hall exterior panel staining. Exponent FaAA Report, September 2003.

Carnahan RA. Steam turbine blade failure investigation. Exponent FaAA Report, July 2003.

Colwell J, Carnahan RA. Conveyor belt fires at the Wilmington Calciner — Preliminary Report. Exponent FaAA Report, May 2003.

Carnahan RA, Shekerlian S, Saraf V. Investigation of the Cedar Point Insane Tower collapse. Exponent FaAA Report, June 2002.

Rau C, Carnahan RA. Evaluation of the JT8D-200 compressor blade failures. Exponent FaAA Report, March 2002.

Carnahan RA, Moore D. Evalution of the potassium carbonate contactor (V501) failure at the Nuevo Energy Rincon Onshore Facility. Exponent FaAA Report, October 2001.

Carnahan RA. Investigation of La Prensa Grafica printing press bearer damage. Exponent Failure Analysis Associates Report, April 1998.

Carnahan RA, MacNab A. Low NOx burner performance, Boiler No. 3, Century City. Failure Analysis Associates, Inc. Report, August 1994.

Foulds J, Carnahan RA. Examination of failed expansion joint bellows from Craig Station, Unit 2. Failure Analysis Associates, Inc. Report, December 1993.

Carnahan RA. The effect of copper based fungicides on pitting corrosion behavior of aluminum piping. Failure Analysis Associates, Inc. Report, March 1993.

Carnahan RA. Analysis of the couch roll bearing failure at Gaylord Container Corporation. Failure Analysis Associates, Inc. Report, July 1992.

Ross B, Carnahan RA. Examination of Durham Grange fuel storage tanks. Failure Analysis Associates, Inc. Report, September 1989.

Ross B, Carnahan RA. Evaluation of Accupac (hex pump) character toothpaste dispenser failures. Failure Analysis Associates, Inc. Report, August 1989.

Carnahan RA. Examination of a cracked jet pump beam from Peach Bottom 3. General Electric Company Report, July 1983.

MF Aleskey, Carnahan RA. Improvements in jet pump hold-down beam service life. General Electric Company Report, December 1981.

Carnahan RA, Cutt JC. Millstone Point 1 isolation condenser and shutdown cooling system piping cracks. General Electric Company Report, May 1981.