APPENDIX
List of Additional Material

JAC Material:

Web Sites:

www.ObligationsNeeded.com
www.Ameredinst.org
www.PEST-03.org

- Copies of books authored or co-authored:
  - Understanding Electric Power Systems – An Overview of the Technology, the Marketplace, and Government Regulation (Second Edition);
  - Forgotten Roots – Electric Power, Profits, Democracy and a Profession;
  - The Development of Electric Power Transmission – The Role Played by Technology, Institutions, and People;
  - Understanding the Electric Power System – A Review of the Technology and the Market Place;
  - Sham? Shame! - Inside the Electric Power Industry;
  - The Evolution of Electric Power Transmission Under Deregulation;
  - How New Competitive Mechanisms Can Affect Electric System Reliability;
- Copies of published material in 11 notebooks
- Copies of presentations in series of notebooks
- Videotapes of presentations
- Audiotapes of presentations
- Notebook containing my selection of most important writings
- Notebook with press clippings
- Collection of photographs on from Public Service
- A collection of about 20 computer discs with copies of JAC published books and JAC correspondence
- Encyclopedia Articles by JAC:
  - McGraw Hill Yearbook of Science and Technology, 2001
  - Encyclopedia of Energy and the Environment
- Historic Material from Trips to Russia and Iran

Copies of Historic and Rare Books and Writings of Others:

- Historic Books of others:
  - Steinmetz – Engineering Math, 1911
  - Murray – Super Power, 1923
  - Lang – Economies of Scale, 1964
  - Center Magazine – Model for a New constitution, 1970
  - Rustenbakhe – Systems and Procedures, 1983

- Historic Files:

    - Swidler's Memoirs, 1997 (former FPC Chairman) (Complete Original Copy)
    - JAC Data/Analysis – Costs/Benefits Restructuring 204
    - Effectiveness of Federal Power Commission, MIT Study, 1970
    - Economic Analyses of Energy Systems – Procedures
    - History of U.S. National Committee of CIGRE
- Historic Reports on Major Blackouts:
    - 1965-1976 PJM Blackout
    - Foreign Blackouts
    - WSCC Blackouts
    - Other USA Blackouts
    - August 14, 2003 Midwest Blackout
- Books about Electric Power Economics and Rates
- Various Recent Government Reports:
    - Five Year Program – Transmission and Distribution, 2005
    - National Transmission Grid Study (Issues Papers), 2002

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Book I

Publications by J.A. Casazza from 1954-1973

Title	*Publication*	*Date*	*No.*	*Category*
The Coordinated Use of AC and DC Network Analyzers	Proceedings, American Power Conference	1954	I-1	
General Study of Area Supply Methods	AIEE Transactions Paper - No. 55-669	1956	I-2	
Recent Developments in Interconnections Between Public Service Electric and Gas Company and The General Public Utilities System	Pennsylvania Electric Association	1961	I-3	
Peaking Capacity - A Long-Range Study by Simulation	Publication withdrawn at the request of PSEG Management	1961	I-4	
Results of Long-Range Planning by Simulation	Proceedings, American Power Conference	1961	I-5	
Economic Aspects of System Expansion with Nuclear Units	AIEE Transactions Paper - No. 61-961 American Nuclear Congress Paper -	1962 1962	I-6	

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	#45 Power Apparatus and Systems - IEEE	1963		
DC Transmission	IEEE Special Publication	1963	I-7	
Coordinated Regional EHV Planning in the Middle Atlantic States - USA	CIGRE Paper #315 - Paris, France	1964	I-8	
Relationships Between Pool Size, Unit Size, and Transmission Requirements	CIGRE Paper #32-09, Paris, France	1968	I-9	
Reactive Planning at PSEG	CIGRE Committee #3	1968	I-10	
Generation and Transmission Reliability	CIGRE Paper #32-11, Paris, France	1970	I-11	
Electromechanical Equivalents for Use in Power System Stability Studies	IEEE Paper #71-TP-137-PWR, Power Apparatus and Systems, page 2060	1971	I-12	
New Jersey's Energy Needs Now Through the Year 2000	Rutgers University Graduate School of Business Administration Conference, Electrical World	1972	I-13	
R&D and The Energy Crisis	Public Utility Survey of Investment Dealers' Digest	1972	I-14	
The Introduction of Fusion Power Into the Network	Princeton University Fusion Power Seminar Proceedings	1972	I-15	
Electric Power Systems of the Future	81st ASEE Annual Conference, Iowa State University, Engineering Education	1973	I-16	

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Book II

Publications by J.A. Casazza from 1973-1975

Title	*Publication*	*Date*	*No.*	*Category*
Review of Overall Adequacy and Reliability of the North American Bulk Power Systems (Third Annual Review)	National Electric Reliability Council, IRS-TAC Report	1973	II-1	
Possibilities for Integration of Electric, Gas, and Hydrogen Systems	CIGRE Paper, Paris, France	1974	II-2	
Does Hydrogen Have a Role in Future Energy Systems?	9th World Energy Conference Chairman of Seminar #2	1974	II-3	
Review of Overall Adequacy and Reliability of the North American Bulk Power Systems (Fourth Annual Review)	National Electric Reliability Council, IRS-TAC Report	1974	II-4	
The Energy Balance	Environmental Management Journal	1974	II-5	
Methodology of Transmission Planning in the United States	USA/USSR Technology Exchange Program, Power System Planning and Operation	1974	II-6	
USA Electric Power System Planning Practices	USA/USSR Technology Exchange Program, Electric Power System Planning and Operation	1975	II-7	

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Book III

Publications by J.A. Casazza from 1975-1976

Title	*Publication*	*Date*	*No.*	*Category*
Review of Overall Reliability and Adequacy of the North American Bulk Power Systems (Fifth Annual Review)	National Electric Reliability Council, IRS-TAC Report	1975	III-1	
What Can Hydrogen do for an Energy Company?	IGT Annual Board of Director's Meeting Weekly Energy Report ASGE Tech Digest AGA Monthly Combustion	1974 1974 1975 1975 1976	III-2	
A Current View of the Impact of Postponements and Cancellations on Future Electric Bulk Power Supply in the United States	National Electric Reliability Council, IRS Report	1975	III-3	
Nuclear Energy Centers, An Assessment of Impact on Reliability of Electric Power Supply	National Electric Reliability Council, IRS-TAC	1975	III-4	
Methodology of Transmission Policy in the United States	USA/USSR Technology Exchange Program	1975	III-5	
Report of Planning Representatives USA/USSR Technology Exchange Group, Power System Planning and Operation	USA/USSR Technology Exchange Program Power System Planning and Operation	1976	III-6	
Energy Storage	Third Energy Technology Conference Proceedings	1976	III-7	
Energy on Call	IEEE Spectrum	1976	III-8	
The Power Injector	JAC Patent	1976	III-9	
An Assessment of Energy Storage Systems Suitable for use by Electric Utilities	World Electrotechnical Congress, Moscow, USSR	1977	III-10	
National Facility for Testing Utilities' Energy Storage Systems - The Battery Energy Storage Test (BEST) Facility	World Electrotechnical Congress, Moscow, USSR	1977	III-11	
Venture Analysis	Talk at ERDA	1977	III-12	
The Need for Energy Storage	Department of Energy Conference on Energy Storage, St. Simon's Island, Georgia	1977	III-13	
Perspectives on the Development of Fusion Power by Magnetic Confinement	Department of Energy	1977	III-14	
Cogeneration Institutional Considerations	Stone and Webster Coal and Cogeneration Seminar, Baton Rouge, LA	1978	III-15	
Electric Utility Systems in Year 2000	IEEE Winter Power Meeting, New York City	1978	III-16	
Technology & Distributed Energy Sources	CIGRE Meeting - Paris, France	1978	III-17	

Testimony on Cogeneration	New Jersey Energy Hearings	1978	III-18	
The Engineer's Role in the Energy Crisis	Public Utilities Fortnightly	1978	III-19	
French Shutdown Meaningful to U.S. (by Robert F. Wolff)	Electrical World	1979	III-20	
Can Cogeneration Offer Investment Advantages?	EPRI Workshop on Cogeneration - San Antonio, Texas	1979	III-21	
Solvent Refined Coal Potential	Energy Bureau Conference - Washington, D.C.	1980	III-22	
Electricity vs. Gas in the Future	CIGRE International Conference on Large High Voltage Electric Systems - Paris, France	1980	III-23	
Forum on Energy Storage for Solar Applications and Transportation	Engineering Foundation Conference -St. Simons Island, GA	1977	III-24	
Energy Technology III	Proceedings of the 3rd Energy Technology Conference	1976	III-25	

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Book IV

Publications by J.A. Casazza from 1976-1988

Title	*Publication*	*Date*	*No.*	*Category*
IEEE Discussions	Transactions	1956-1971	IV-1	
Energy on Call	IEEE Spectrum	1976	IV-2	
The 1978 French Blackout - Lessons to be Learned from it	Annual Conference of Protective Relay Engineers, Texas A&M University	1980	IV-3	
Testimony on National Energy Policy	Democratic National Committee	1980	IV-4	
Electricity vs. Gas in the Future	CIGRE International Conference on Large High Voltage Electric Systems - Paris, France	1980	IV-5	
Electricity vs. Gas	CIGRE Discussion	1980	IV-6	
Feasibility of UHV	CIGRE Discussion	1980	IV-7	
Letter: Synthetic Fuels & Load Management	Public Utilities Fortnightly	1980	IV-8	
Electric Power System Reliability - The Lessons We Need to Learn CIGRE Executive Report	PES Newsletter CSA Report	1980 1980	IV-9 IV-9A	
Electric System Planning - The Technique and the Substance	International Congress on systems - Caracas, Venezuela	1981	IV-10	
Efficiency of Utilization of the Capital Investment in Transmission Systems	IEEE/PES Conference and Exposition on Overhead and Underground Transmission and Distribution - Minneapolis, Minnesota	1981	IV-11	
Energy in Perspective	IEEE - The Institute	1982	IV-12	
Testimony	U.S. Senate Subcommittee	1982	IV-13	
The Future Availability of Electricity for Electric Vehicles	EPRI Electric Vehicle Review Meeting - Chattanooga, TN	1982	IV-14	
Improved Transmission Utilization	CIGRE	1982	IV-15	
Role of IEEE in Educating about Energy Problems	CIGRE	1982	IV-16	
Role of Research Organizations	CIGRE	1982	IV-17	
Improving Utilization of Transmission	Transmission and Distribution Exposition - Atlanta, GA	1982	IV-18	
Testimony before House Subcommittee on Energy and Water Development	Haring Transcript	March 1982	IV-19	
Testimony before Senate Subcommittee on Energy Research	Hearing Transcript	May 1982	IV-20	
Testimony before Senate Subcommittee on Energy	Hearing Transcript	May 1982	IV-21	

Research and Development of Committee of Energy and Natural Resources				
The Evolution and Importance of Planning Criteria in the Planning Process	Caracas, Venezuela -- World Computation Conference	July 1983	IV-22	
Coordination of Energy Systems	CIGRE	1984	IV-23	
VACAR Study	Monitor Article	June 1984	IV-24	
Nuclear Power: Some Economic Effects of Institutional and Technical Changes	Intersociety Conference - San Francisco, CA	1984	IV-25	
Interconnections Grow in Value	Electrical World	1984	IV-26	
Transmission Uses: Problem and Opportunity	EEI System Planning Committee - Baton Rouge, LA	1985	IV-27	
Nuclear Power: Insuring Its Future	IEEE Winter Power Meeting - New York	1985	IV-28	
Research Needs in Energy, Resources and Environment	Presented to the national Research Council	1985	IV-29	
Regulatory Sales for Resale	Testimony before FERC	1985	IV-30	
Understanding the Transmission Access and Wheeling Problem	Public Utilities Fortnightly	1985	IV-31	
Analysis of the Evolution of Interconnections Between Regions in USA	CIGRE	1985	IV-32	
Development Experience on Systems and Interconnections	CIGRE - Dakar, Senegal	1985	IV-33	
Energy Systems and Energy Storage Systems	Testimony before the House Committee on Electric Energy and Systems	1986	IV-34	
Transmission Systems in a Changing World	Electrical World Conference	1986	IV-35	
Methods and Problems for Determining Generation Reserve Requirements	Southwest Power Pool Planning Committee	1986	IV-36	
The Changing Role of Transmission	MVEA Engineering Conference	1987	IV-37	
Interview -Transmission Access: The High Wire Act Begins	Electrical World	1987	IV-38	
Incentives and Disincentive for Building Transmission in the Future	Electrical World Conference - Washington	1987	IV-39	
Cogeneration, and Small Power Producers	Testimony before the Federal Energy Regulatory Commission	1987	IV-40	
The Planning of Interconnected Power Systems - The Impact of Potential Future Regulatory And Legislative Changes	IEEE -- PES Meeting, San Francisco, CA	1987	IV-41	
The Impact of Potential Future	IEEE PES Summer Power	1987	IV-42	

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Regulatory and Legislative Changes on The Planning of Interconnected Power Systems	Meeting -- San Francisco, CA			
Potential Impacts of Free Market Electricity on Utility Pooling and Coordination	MAPPS Megatrends Conference -- Minneapolis	1987	IV-43	
Three Case Studies - Impediments to Power Transfers	Published by the National Regulatory Research Institute	1987	IV-44	
Transmission Systems - Their Evolution in the USA - The Savings They Are Creating	Intersystem Coordination Procedure, presented at IEEE African Meeting - Abidjan, Cote d'Ivoire	1987	IV-45	
Public Utilities Fortnightly Editorial	(actually written by J.A. Casazza and given to Lucien Smartt)	1987	IV-46	
Free Market Electricity: Potential Impact on Utility Pooling and Coordination	Public Utilities Fortnightly	1988	IV-47	
CSA Perspectives	CSA Publication	1988-95	IV-48	

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Book V

Publications by J.A. Casazza from 1987-1990

Title	*Publication*	*Date*	*No.*	*Category*
Comments for the Technical Conference on Independent Power Producers (Docket No. EL87-670-000)	Before the Federal Energy Regulatory Commission	11/87	V-1	
Comments Related to the Federal Energy Regulatory Commission's Policies on the Restructuring of the Electric Power Industry	Before the US Senate Committee on Energy and Natural Resources	2/88	V-2	
(Pre-filed) Testimony (and Exhibits) on Behalf of Idaho Power Company	Before the Federal Energy Regulatory Commission	2/88	V-3	
CSA Perspectives		6/1988	V-4	
Coordination vs. Competition	Presented to the North American Electric Reliability Council Operating Committee, New Orleans, LA	6/1988	V-5	
Arrangements for Transmission Services	Presented at Energy Bureau Seminar - Washington, D.C.	1988	V-6	
Comments Relating to Regulations Governing Independent Power Producers	Before the Federal Energy Regulatory Commission - Docket No. RM88-5-000 and Bidding Programs RM88-5-000	7/1988	V-7	
Summary of Verbal Testimony	Before the Federal Energy Regulatory Commission - Dockets No. RM88-4-000 and RM88-5-000 in relation FERC's Notices of Proposed Rulemaking	7/1988	V-8	
CSA Perspectives		1988	V-9	
Summary of Recent Technical Activities (re: World Energy Conference)	IEEE Power Engineering Review	7/1988	V-10	
Excerpt from "FERC Hears NOPR Alternatives from Industry Leaders	J.A. Casazza article in Electrical World	8/1988	V-11	
Generation Planning and Transmission Systems	CIGRE 1988 Session - Paris, France	1988	V-12	
Executive Summary of CIGRE Meeting	Paris, France	1988	V-13	
CSA Perspectives		88/89	V-14	
Computers, Coordination, and Competition - Keynote Address	PICA Meeting - IEEE - Seattle, WA	5/1989	V-15	
Economic Analysis of Energy Systems	WEC Publication	1989	V-16	
CIGRE Offers a Worldwide View of System Operating Technology	Electric World European Edition	6/1989	V-17	
Pricing Electric Utility Services	Presented at Deloitte, Haskins and Sells' National Public Utilities Industry Specialists Seminar - Atlanta, GA	8/1989	V-18	
Technical Aspects of the Production	Presented at Deloitte, Haskins	8/1989	V-19	

and Transmission of Electric Power	and Sells' National Public Utilities Industry Specialists Seminar - Atlanta, GA			
Challenges to Power System Planning and Operation from Increased Competition	CIGRE Meeting - Florence, Italy	10/1989	V-20	
CIGRE W.G. 37.09 Links Between Power System Planners and Decision Makers in the Energy Policy Area	Report from the USA prepared by J.A. Casazza	12/1989	V-21	
Testimony on Our National Energy Strategy and National Security	DOE Hearing	12/1989	V-22	
Pension Funds - Who Should Control Them	The IEEE Institute	2/1990	V-23	
Issues on Transmission Access	IEEE Plenary Session, Atlanta, Georgia	2/1990	V-24	
CSA Perspectives		1990	V-25	
Quantification of the Environmental Advantages of Electricity	CIGRE - Paris	1990	V-26	
Discussion - Competition and Coordination	CIGRE - Paris	1990	V-27	
Recent Electric Power Developments in Other Countries	Report to Clients	1990	V-28	
The IEEE In Czechoslovakia and Hungary	Report to Clients	1990	V-29	
New Facts Technology - Its Potential Impact on Transmission Utilization	EPRI Workshop, November 15, 1990	11/90	V-30	
A Brave New World: Let's Look Before we Leap	Electricity Journal, November 9, 1009	11/90	V-31	
Recent Electric Power Developments in Other Counties	Power – Gen 90 Conference, Orlando, Florida	12/90	V-32	
CSA Perspective - The Transmission Paradox	London, England	1990	V-33	

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Book VI

Publications of J.A. Casazza from 1991

Title	*Publication*	*Date*	*No.*	*Category*
Electronic Angst - Electric Fields & Effects	Time	1/91	VI-1	
Electric Power Market Forces and the Public Welfare	Electrotechnika, Budapest	3/91	VI-2	
CSA Perspective - Clean Air Act		4/91	VI-3	
Restructuring of Power Generation and Developing Interconnection - An International Perspective	2nd Conference on Power Generation for the 1990s, and Beyond - Melbourne, Australia	4/91	VI-4	
Proposed Summary of Privatization Legislation - Argentina	Letter to Carlos Bastos	6/91	VI-5	
Comments on Issues Raised by the Federal Energy Regulatory Commission on Current State and Future Direction of the Electricity Utility Industry	FERC Hearing	6/91	VI-6	
Links Between Power System Planners and Decision Makers in the Energy (Policy) area	CIGRE W.G. 37.09	8/91	VI-7	
Wheeling and Transmission System Service Policy in North America	IEEE International Conference on AC and DC Power Transmission - London, England	9/91	VI-8	
The Need for Technical Competence, by Decision Makers	CSA Perspectives	Fall 1991	VI-9	
Towards and Australian National Energy Network: An International View	ESAA Transactions Presented in Tasmania	10/91	VI-10	
Transmission Access and the Public Welfare	Indianapolis -- Ideas and Innovation	10/91	VI-11	
Electric Power, Market Forces, and the Public Welfare	IEEE Power Engineering Review	11/91	VI-12	
The National Energy Strategy - Competition and Coordination	Privately Circulated Paper	12/91	VI-13	

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Book VII

Publications by J.A. Casazza from 1992-1994

Title	*Publication*	*Date*	*No.*	*Category*
Public Policy, Leadership and Electric Power	IEEE Aerospace and Electronic Systems	2/92	VII-1	
Jersey Central deal with Pennsy utility periled	Local Newspaper	2/92	VII-2	
Game Plan Guaranteed to Lose	Washington Post Op-Ed Article	2/92	VII-3	
National Policy for Electric Power Transmission Systems	IEEE Position Paper	2/92	VII-4	
Technical Competence, ,Engineering Leadership, and Electric Power	IEEE Power Engineering Review	3/92	VII-5	
Transmission Access and the Public Welfare	Electric Light Power Debate, Ashley Brown, etc.	1992	VII-6	
NVE Transmission Use	CSA Perspectives	4/92	VII-7	
Game Plan Guaranteed to Lose	Unpublished Newsday		VII-8	
New Directions and the Engineer's Role	IEEE Power Engineering Review	4/92	VII-9	
Testimony on Behalf of IEEE on Ex Parte Procedures	FERC Open Hearing	5/92	VII-10	
Discussion of Paper 92 SM 536-3 PWRS	Letter to National Energy Board of Canada	6/92	VII-11	
The Role of Engineering in Transmission Access	7th Conference of Regulatory Unit Commission Engineers, Scottsdale, Arizona	6/92	VII-12	
Introductory Comments	IEEE Power Engineering Society	7/92	VII-13	
An International View on Competition and Coordination	CIGRE Paper 37-101 Paris, France	8/92	VII-14	
Discussion on Competition and Coordination	CIGRE Committee 37 Meeting -- Paris, France	9/92	VII-15	
Need for Analysis on Setting Electric Power Policy	Advertisement in Roll Call	10/92	VII-16	
Retail Wheeling - The Key Technical Questions	Energy Daily Conference on Wheeling	10/92	VII-17	
Transmission & Restructuring an International View	ESAA Conference, Aaclaide, Austria	10/92	VII-18	
Linking Power System Planners, the Public and Energy Policymakers	IEEE Power Engineering Review	1/93	VII-19	
Electric Power Transmission and Restructuring - An International View	IEEE Power Engineering Society - Regina, Canada	1/93	VII-20	
World Economic Developments and Effect in USA	IEEE Plenary Session	2/93	VII-21	

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The American Model: Strengths and Weaknesses	Epure, April 1993	4/93	VII-22	
Energy, Economics, and Environment	IEEE Engineering Review	4/93	VII-23	
The Changing World of Electric Power Transmission	American Power Conference, Chicago	4/93	VII-24	
The Potential Future Interconnection of Electric Systems in Europe, the Former Soviet Bloc, and North Africa	Report on the Unipede Meeting, Tunis	5/93	VII-25	
American Power Conference Comments	1993 Summer Power Meeting - Vancouver, Canada	1993	VII-26	
Recent Developments in Electric Power Transmission	JAC Comments at IEEE Plenary Session	7/93	VII-27	
The Development of Electric Power Transmission - book	Published by IEEE	10/93	VII-28	
The Public Perception of Reliability	Iowa State University		VII-29	
The Changing World of Electric Power	IEEE Plenary Session	1/94	VII-30	
Third Party Access and What Should be Done About it	Power Technology International	1994	VII-31	
Changing World of Electric Power	L-Energca, Electrica, Italy	4/94	VII-32	
Long-term Trends and Problems Electric Power Transmission	Power Energy Review Wily Handbook on Energy and the Environment	5/94 1994	VII-33	

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Book VIII

Published by J.A. Casazza from 1994-1998

Title	*Publication*	*Date*	*No.*	*Category*
Generation Planning in the Presence of Non-Utility Generators	Cigre Paper 37-201, Paris	8/94	VIII-1	
Transmission Access and Wheeling - The Key Questions	Published by EPRI	1/95	VIII-2	
Chapter - Legal Handbook for Engineers - Volume 10	Clark Boardman/Albert Dib	1994	VIII-3	
Views on Scientific Conduct	Science and Engineering Ethics - pgs. 111 -112 - Vol. 1, No. 2	4/95	VIII-4	
Changing Institutional Arrangements in USA	Cigre Committee 37-15, Tokyo	1995	VIII-5	
Effects of Changing Institutional Arrangements in the Generation Area	Cigre Committee 37-15, Tokyo	1995	VIII-6	
Memories of Cooper Union	Cooper Union Memorial Issue	1/95	VIII-7	
Article on Cigre Activities - Deregulation and Restructuring	Power Engineering Review	8/95	VIII-8	
Restructuring of IEEE - Letter to Editor	IEEE Seminar - Scanner	9/95	VIII-9	
Restructuring of IEEE - Excerpt from the Institute	JAC Letter	10/95	VIII-10	
Restructuring of IEEE	Power Engineering Review		VIII-11	
Transmission Access and Retail Wheeling - The Key Questions	EPRI Books - Electricity Transmission Pricing and Technology	1/95	VIII-12	
The Effects of Changing Institutional Arrangements in the Generation Area	Electra No. 163	12/95	VIII-13	
Fact or Fiction - Electric Transactions in an Open Access Market	Letter to Editor/PES Governing Board Power Engineering Review	4/96	VIII-14	
Transmission Access and Retail Wheeling; the Key Questions	Legal Handbook for Architects, Engineers, Contractors, Clark, Boardman, Callaghan	4/96	VIII-15	
Power System Planning With Changing Institutional Arrangements	Paper 2-01 - Cigre, Paris France	8/96	VIII-16	
What the World Thinks About the US Headlong Rush to Open Access	Electrical World	8/96	VIII-17	
An American's View of the Reorganization of the ESI	IEE Journal (Review of UK)	4/97	VIII-18	
The Impact of New Trading Methods	CIGRE, Tours, France -	1997	VIII-19	

on Electric Planning and Operation in Two Regions of the USA	June 1991			
Impact of Open Trading in Power Systems	CIGRE, Tours, France	6/97	VIII-20	
Electric Power Restructuring - How to Learn From Experience of Other	IEEE/IEE Proceedings, Future of Energy Business - Toronto, Canada	11/97	VIII-21	
Power System Planning and Open Trading	CIGRE, Paper 230-02, WG 37.20	9/97	VIII-22	
JAC Quoted - Effect of Reorganization in the UK		11/97	VIII-23	
JAC Quoted -- Reliability	Electrical World	8/97	VIII-24	
Coordination of Technical and Institutional Mechanisms	IEEE Computer Applications in Power	9/97	VIII-25	
Is the Nation Grid Ready for Competition	Electrical World	11/97	VIII-26	
FERC Testimony re: Reliability Risks	FERC Docket PL-98-3-000	2/98	VIII-27	
Effects Inter-Regional Ties	Chicago Tribune	9/98	VIII-28	
JAC Quoted -- Reliability	Open Lines	1998	VIII-29	
Blackouts: Is the Risk Increasing	Electrical World	4/98	VIII-30	
Impact of Different Regulatory Structures on Generation and Transmission Planning	CIGRE - WG 37.20	9/98	VIII-31	

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Book IX

Published by J.A. Casazza from 1998-2001

Title	*Publication*	*Date*	*No.*	*Category*
The Impact of Restructuring on Reliability	Presented at NSCE, the 45th IEEE NC Symposium and Exhibition	11/98	IX-1	
Reliability Criteria and Their Enforcement	FERC staff talk	1998	IX-2	
Advanced Technical Training in Electric Power Systems for Those in the Electric Power Business	CIGRE, Paris Paper -- LUC 2-03	1998	IX-3	
How New Competitive Mechanisms Can Affect Electric System Reliability	The Vital Message of the West Coast Blackouts - McGraw Hill	1998	IX-4	
Amerykanski punkt widzenia na reorganizacje przemyslu elektroenergetycznego	Przeglad Elektrotechniczny	4/98	IX-5	
The Current State of Electric Utility Restructuring - The Impact of Cost and Reliability	Presentation to Forum on Electric Deregulation, Eastern Montana Section of IEEE	5/98	IX-6	
Joint Planning of Generation Resources	FERC Presentation	1998	IX-7	
Effect of Electric Power Restructuring on R&D	Electrical Insulation Magazine -- January/February	1/99	IX-8	
Technical Conference on the Capacity Benefit Margin	FERC Docket No. EL-99-46-000	5/99	IX-9	
The Ten Commandments of Transmission Knowledge	Transmission Conference - A Crisis in the Making, Washington, D.C.	5/99	IX-10	
The Effects of Restructuring on Cost and Reliability	IEEE Distinguished Lecturer Program - IEEE Website	1999	IX-11	
Institutional Arrangements for Restructuring the Case for Cooperatives	Fourth International Conference Restructuring - The Power Industry for the Year 2000 and Beyond -- Accra, Ghana	7/00	IX-12	
Computers, Software, and Reliability	IEEE Computer Applications in Power	7/00	IX-13	
Reliability and Tools for Our Times	IEEE Computer Applications in Power	10/00	IX-14	
Impact of Electric Power Restructuring	Cigre Colloquium -- Washington, D.C.	7/01	IX-15	
Small Consumers - What Has Hurt Them and What Can be Done About It	113th Annual Convention, National Association of Regulatory Utility Commissions - Philadelphia, PA	11/01	IX-16	

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Restructuring and Its Impact on Cost and Reliability	**IEEE Lecture - Available at Web Site and on C.D.**	**6/7/00**	**IX-17**	
Our Looming Transmission Disaster	Presented at IEEE Energy Policy Committee	3/01	IX-18	
A National Transmission Survey	Proposal	2001	IX-19	

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Book X

Published by J.A. Casazza from 2001-2003

Title	*Publication*	*Date*	*No.*	*Category*
Electric Power Supply Reliability Declines, Cost Rise	IEEE News and Views	9/01	X-1	
Electric Power Deregulation and the IEEE	IEEE Website	1/01	X-2	
Errant Economics? Lousy Law? Market Manipulation?	Revue Etijdschrift	8/01	X-3	
Electricity Choice: Pick Your Poison	Public Utilities Fortnightly	3/01	X-4	
Electric Utility Restructuring	McGraw Hill Yearbook of Science and Technology	7/01	X-5	
Transmission Choices for the Future	NSF/EPRI Workshop -- Washington, D.C.	3/02	X-6	
Small Consumers - What Has Hurt Them and What Can Be Done About It?	Revue Etijdschrift	1/02	X-7	
Letter to Dr. Schmuel S. Oren re: National Electric Power Policy	Collected Papers, Conference Washington, D.C. (Very Widely Circulated)	8/02	X-8	
Electric Power Restructuring Technical Competence and Engineering Leadership	International Conference on Power Systems Operation and Planning - Abuja, Nigeria	2002	X-9	
Future Structure of Electric Power System and Technology and Institutional Arrangement	International Conference on Power Systems Operation and Planning - Abuja, Nigeria	2002	X-10	
Computational Tools for the Future	International Conference on Power Systems Operation and Planning - Abuja, Nigeria	2002	X-11	
Ethical Responsibility - Are the PES Programs and Activities Up to Code - In My View	IEEE Power and Energy	3/03	X-12	
The Six Networks and Electric Power Policy Engineers, Economists and Ethics	IEEE Summer Power Meeting - Toronto, Canada	7/03	X-13	
Engineering, Ethics, and Electricity	Speak Out Column - IEEE Spectrum	7/03	X-14	
Electric Power National Security and Economic Welfare	Public Utility Law Project www.pulp.tc.html/electricpowernationalsecurity.html	5/03	X-15	
What Impact Did Deregulation Have on the Northeast Blackout	Light	9/10/03	X-16	
Building a Power Grid in Developing Countries	U.S.A.-Africa Research and Education Collaboration Wkshp. Howard University	11/5/03	X-17	
What Caused the Blackout?	Energy	2004	X-18	

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Electric Power, National Security, And Our Economic Welfare	Vanguard TTI Report	2004	X-19
What Really Caused the Blackout?	Vanguard TTI Report	2004	X-20

A

Book XI
Published by J.A. Casazza from 2004-2005

Title	*Publication*	*Date*	*No.*	*Category*
The Impact of the Decline of Engineering Influence in Electric Power Decisions	Vanguard Reinforcements	2004	XI-1	
Final Blackout Report Fails To Address Some Critical Issues, Says "PEST"	Electricity Today	2004	XI-2	
Why Have Lessons Learned Not Been Transferred to the Current Generation	Energy Pulse (IEEE PES Paper)	10/04 6/ 05	XI-3	
Designation of National Interest Electric Transmission Bottlenecks (NIETB)	Office of Transmission and Distribution, Dept. of Energy	9/04	XI-3a	
Aging Transformers Risk	Electricity Today Book	9/04	XI-4	
Critical Grid Factors Some Crucial Items Are Not Discussed and Should Be	IEEE Power & Energy	1/05	XI-5	
Comments of Jack Casazza on FERC Report "Principles for Efficient and Reliable Reactive Power Supply"	FERC Reactive Technical Conference	3/05	XI-6	
Another Blackout Looming: Gov't inaction could leave Millions in the dark again soon	Monitor (Canadian Centre for Policy Alternatives)	3/05	XI-7	
Blackouts and Blunders: The Failure of Electric Power Policies In the United States Part 2	Energy Pulse	3/05	XI-8	
What's Wrong with the Electric Grid?	The Industrial Physicist (article by Eric Lerner) (quotes JAC extensively)	3/05	XI-9	
Electric Power Deregulation? A Bad Idea?	IEEE "Today's Engineer"	5/05	XI-10	
Dissonant Engineers Give	Energy Prospects	9/05	XI-11	

A Wake Up Call

Contributions of the Restructuring of the Electric Power Industry to the August 14, 2003 Blackout	DOE/Canada Workshops	9/05	XI-12
Competition and Reliability in North American Electricity Markets Technical Workshop	Canada-U.S. Power Outage Task Force, Toronto	9/28/05	XI-13
JAC Comments-Katrina	Red Herring	10/05	XI-14
JAC Lecture—Energy Experience	IEEE Session, Detroit, MI	11/05	XI-15
Impact of Deregulation on the Design, Operation and Planning of Electric Power Systems	IEEE Session, Detroit, MI and General Motors	11/05	XI-16

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Book XII

Published by J.A.Casazza from 2006-2007

B

JAC Presentations

DATE	TITLE	AUDIENCE
1953+	Andrew Carnegie	PS Speakers Forum Newark, New Jersey
1948	Power System Stability	PS Cadet Engineer Report, Newark, New Jersey
1953	Tools of the System Engineer (Solution of Unfaulted Networks)	AIEE Educational Committee New York City Lecture
1956	Creating for the Future	University of Pennsylvania Philadelphia, Pennsylvania
1957	Two Machine System (Equal Area Criteria)	AIEE Educational Committee, NYC
1957	Demonstration of Specialized Apparatus	PS Annual Inspection Maplewood, New Jersey
1957	Overall System Design	AIEE Educational Committee, NYC
1957	Your Opportunities	PSE&G Power Systems Engineering Course Graduation, Newark, New Jersey
1958	Long Range Electric System Planning	PS Speakers Forum, Newark, New Jersey
1959	Creating for the Future	Plainfield Engineers' Club, Plainfield, New Jersey
1962	Medicare for the Aged	PS Speakers Forum, Newark, New Jersey
1964	American Policy in Vietnam	PS Speakers Forum, Newark, New Jersey
1964	Low-Cost Generation for Peaking Service	Essex Executive League, Newark, New Jersey
1965	Management of Capital Costs of Electric Facilities	Financial Tours, Newark, New Jersey
1965	Interconnections and Power Pooling	Generation Department Dinner, Newark, New Jersey
1966	The Big New York Blackout	National Society of Power Engineers, New Brunswick, New Jersey
1967	European Practice and Plans for Automatic System Control	EEI System Planning Committee, Boston, Mass.
1967	Survey of Electric Utility System Planning Practices Section II – Subtransmission and Distribution	EEI System Planning Committee, Boston, Mass.
1968	Summary of the Activities of EEI Task Force for Research on Bulk Power System Security from April 16, 1968 until October 2, 1968	EEI Task Force, Washington, D.C.
1968	Future Economic Growth in Bergen County	County Planning Board, Hackensack, New Jersey
1968	Planning for the Future in Public Service	PS Speakers Forum, Newark, New Jersey
1969	Planning for the Future	Financial Tour, Maplewood, New Jersey
1969	Role of Computers in System Operations	IEEE Student Luncheon, New York City
1969	Keystone, Conemaugh, and Interarea Tic Projects	PSE&G Board of Directors, Keystone, PO

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1969	What we in USA Get from CIGRE	CIGRE System Planning and Operating Committee, Paris, France
1971	Electric Department Research and Development Program	PSE&G Board of Directors, Newark, New Jersey
1971	Energy and the Future	Rensselaer Polytechnic Institute, Troy, New York
1972	Panel on Science and Technology	Newark State College Career Conference, Newark, New Jersey
1972	How to Educate the Boss	System Planning and Development Department
1972	Fuel Cells	Press Conference at City Dock Substation
1972	Hydrogen Energy Storage	Press Release
1972	World Approaches to the Energy Problem	MIT Club of Northern New Jersey
1973	The Introduction of Fusion Power into the Network	Princeton University
1973	Hydrogen	TV Show – Channel 52 in New Jersey
1973	The Systems Analysis Needs in Electric Power Systems	University of Missouri – NSF Meeting
1974	Societal Aspects of Technology	IEEE Spectrum
1974	Energy and Morality	Methodist Church Men's Group – Bogota, New Jersey
1974	Hydrogen – The Fuel of Tomorrow	Newspaper Interview, Newark, New Jersey
1974	Energy Supply for the Years Ahead	Old Guard of Summit, Summit, New Jersey
1974	People, Energy, and the Profession	IEEE Awards Night, New Jersey
1974	Electric Vehicles	TV Show – NBC
1974	Energy Storage	Radio Interview – WPAT
1974	PSE&G R&D Summary	PSE&G Board of Directors, Newark, New Jersey
1975	Electricity Supply and Employment in New Jersey	Commission Hoffman, New Jersey Department of Labor and Industry
1975	Power System Protection	CIGRE Study Committee #34
1975	Power Generation – Impact on the Aquatic Environment and the Production of Aquatic Foods	Trenton State University
1975	Megalopolis Need for Energy and a Plan for its Supply	N.J. Society of Professional Engineers – Engineers in Government Practice
1975	NERC Definition for Emergency Transfer Capacity	IEEE Winter Power Meeting
1975	Future Shock and How to Live With It	GE Power Systems Engineers Course – Graduation
1975	Why R&D	PSE&G R&D Quarterly
1975	Coordination of EPRI and the Utilities	EPRI R&D Director's Conference
1975	Reply to "What Happens When Our Oil and Gas Run Out"	Harvard Business Review
1975	Nuclear Power – A Response to a Critic	Letter to Editor of Bergen Record
1976	Nuclear Power	Forum on Nuclear Power
1976	Nuclear Energy and The Environment	Congregational Church, Montclair, Virginia
1976	PSE&G Load Forecasts and Capacity Plans	Security Analysts Conference – Jersey City, New Jersey

1976	N.J. Energy Picture – 1976	TV Show, Fort Lee, New Jersey
1977	Venture Analysis	ERDA Research Application Coordination Group, Washington, D.C.
1977	PSE&G R&D Program	EPRI Northeast Regional Meeting, New York City
1977	The Engineer's Role in the Energy Crisis	Electro 77, Life Member Session
1985	CIGRE Discussion	Dakar
1987	Role of Engineers in Deregulation	Quote – The Institute
1987	IEEE-AFRICON Presentation	Senegal
1991	JAC Testimony at Congressional Hearings	Press Report
1991	Experts May be Left Out of Electric Industry Decision Making	PUF Editorial
1977	PSE&G Farewell Talk (May)	PSE&G People and Friends
1978	Electric Utility Systems in 2000 (January)	IEEE Panel Session, New York City
1978	Cogeneration Institutional Considerations (January 12)	Stone & Webster Management Consultants, Baton Rouge, LA
1978	CO Generation (May)	S&W Night Training Course, Long Island, New York
1978	Generation and Cogeneration (May 8 and June 12)	Stone & Webster Management Training Course, Glen Cove
1978	Self Help by Cogeneration (June 9)	Presented at the Special Conference of Self-Help Options for Industrial Energy Users, Washington, D.C.
1978	Power Plant and Industrial Fuel Use Act of 1978 (November)	S&W Executive Conference, Long Island, New York
1981	Testimony on Nep III (April)	Congressional Hearings, Washington, D.C.
1985	IEEE – Citation of Honor (August)	IEEE Meeting, Washington, D.C.
1987	Future Availability & Cost of Electricity (July)	Talk to Springfield, Virginia, Kiwanis
1987	One World-Different Needs (November)	Article by Emerson Pugh (Member of the IEEE team featured in article – Africon trip)
1988	Business Opportunities in Africa (February)	Presentation to United States Energy Association of the World Energy Conference, Washington, D.C.
1988	World Energy Needs (February 12)	Voice of America Broadcast Transcript, Washington, D.C.
1988	Arrangements for Transmission Services (June 22)	Energy Bureau Seminar, Washington, D.C.
1988	Operational Problems and Management Audits (August 8)	Deloitte Haskins & Sells seminar, Washington, D.C.
1988	Transmission Systems (September)	Tenera Executive Group, Virginia
1989	Coordination versus Competition (June)	NERC Meeting – New Jersey
1989	Pricing Electric Utilities Services (August)	DH&S Conference, Atlanta, Georgia
1989	Technical Aspects of the Production and Transmission of Electric Power (August)	DH&S Conference, Atlanta, Georgia
1989	Links Between Poser System Planners and Decision Makers in Energy Policy Area (December)	USA Report (CIGRE W.G. 37.091)

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1990	The Restructuring of the Electric Utility Industry (February 5)	USA CIGRE Report
1990	Energy, Economy and the Environment (April 19)	Conference on Power and Energy Policy, San Juan, Puerto Rico
1990	The Evolution of U.S. Power Systems (August)	IEEE Distinguished Lecturer in Czechoslovakia and Hungary
1990	What Engineers Owe Society (October)	Lecture at Cooper Union, New York City
1990	Potential New Technology Affecting Transmission (November 15)	EPRI Workshop
1991	Correspondence with Father Hummert re: Forest Preservation (January 30)	Catholic Digest
1991	Interview with Bernard Finch (May)	Australian ABC Network
1991	Transmission – Questions to be Answered (September 11)	MAPP 1991 Migatsend Conference - _____ MN
1991	Transmission Access and the Public Welfare (October 28)	3rd Annual Transmission Symposium, Washington, D.C.
1992	Energy Management – Business of the Future (May 13)	Executive Seminar – Minneapolis
1992	Role of Engineers in Transmission Access (June 22)	70th Conference of Regulatory _____ Engineers, Scottsdale, Arizona
1992	Development of Utilities Around the World (July 2)	Vancouver, British Columbia
1992	Retail Wheeling – The Key Technical Questions (October 5)	Energy Daily Conference, Washington, D.C.
1992	Electric Power Transmission and Restructuring – An International View (October 21)	Adelaide, Australia
1993	Electric Power Transmission and Restructuring (January)	IEEE Saskatchewan, Canada
1993	Electric Power Transmission and Restructuring (January 10)	IEEE Meeting – Saskatchewan, Canada
1993	Considerations on Pricing of Transmission Services (May 3)	UNIPEDE Meeting – Turis
1993	Potential Future Interconnector of Electric Systems in Europe and North Africa (May 3)	UNIPEDE Meeting – Turis
1993	Structure of Electric Utility Industry (June 3)	U.S. Energy Convention – Washington, D.C.
1993	Exchange of Energy and Reliable Service (November 2)	UNIPEDE Meeting – Baling, Germany
1993	Public Perception of Reliability (December 172)	Iowa State University Meeting, System Security, Armes, Iowa
1994	Changes in Electric Utility Structure World Wide (September 21)	AEP Executive Meeting
1994	Electric Generation Planning (November 8)	IEEE Meeting, San Jose, Costa Rico

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1995	Overview of the US Regulatory System (February 6)	Tour of Baltic Countries – USEA, Washington, D.C.
1995	Foundations for Customer Choice (June 2)	PSERC Meeting, Washington, D.C.
1995	USA Practices (September 11)	DVG Meeting, Heidelberg, Germany
1995	The Changing World of Electric Power (September 18)	Milan Vidmar Electric Institute, Ljubljana, Slovenia
1995	The Effect of Various Policy Issues in Different Nations (September 20)	Bucharest, Romania
1996	Electric Power Industry Restructuring in the United States (March 4)	University of West Virginia, Morgantown, West Virginia
1996	Challenges for Power System Planners and Operators (August 28)	CIGRE Meeting – Paris, France
1996	Electric Power Restructuring in United States (December 5)	Minas Geras Government School, Belo Horizonte, Brazil
1997	Current State of Electric Utility Restructuring – Impact on Cost and Reliability (May 7)	Eastern Montana IEEE Section – Billings, Montana
1997	Effect of Instructional Changes on Planning and Operation (August 25)	San Jose, Costa Rico
1997	Impact of Restructuring on Cost and Reliability (November 2)	Kentucky Association of Cooperatives – Louisville, Kentucky
1998	The Current State of Restructuring (February 2)	IEEE Energy Policy Committee – Tampa, Florida
1998	ISO's – The Reliability Issues (May 27)	OPC/GTC/GSOC Strategy Meeting – Atlanta, Georgia
1998	Impact of Restructuring on Costs and Reliability of Electric Power Systems (May 6)	IEEE Meeting – Buffalo, New Jersey
1998	Effect of Restructuring on Electric System R&D (June 9)	International Symposium on Electric Institutions – Arlington, Virginia
1998	Status and Results of Restructuring (August 26)	Tampa Electric Power Company – Tampa, Florida
1998	What Can be Learned Through CIGRE About How to Restructure (September 1)	CIGRE Meeting – Paris, France
1998	Impact of Restructuring on Reliability (October 29)	IEEE N.C. Symposium – Raleigh, North Carolina
1999	Ten Commandments of Transmission Knowledge (August 31)	AEIC System Reliability Committee – Columbus, Ohio
1999	Impact of Restructuring on Cost and Reliability as Electric Power Systems (September 14)	Illuminating Engineering Society – Buffalo, New York
1999	Electric Power Reliability Consensus (October 29)	Tampa Electric Power – Tampa, Florida
2000	Restructuring and Its Impact on the Cost and Reliability of Electric Power Systems	SIGMA-XI/NJIT Chapter – Newark, New Jersey

	(April 28)	
2000	Strategic Planning and the Future (November 13)	TECO Strategic Planning Workshop – Tampa, Florida
2001	Restructuring and Its Impact on the Cost and Reliability of Electric Power Systems (January 6)	IEEE Web Site
2001	Inside the Electric Power Industry – Past, Present and Future (January 29)	Rose-Hulman Institute of Technology – Terre Haute, Indiana
2001	Restructuring Experience World-Wide (2 day lecture – August 12)	El Salvador Society of Engineering – San Salvador, El Salvador
2002	Future of EPC (April 22)	IEEE Energy Policy Committee Meeting – Washington, D.C.
2004	Impact of Power Industry Restructuring of System Planning and Economics (January 20)	IEEE Section – Syracuse, New York
2004	Transmission Regulatory Issues (May 26)	Pittsburg Section – IEEE – Pittsburg, Pennsylvania
2004	Ethics and Changing Energy Markets (October 27)	University of Notre Dame – South Bend, Indiana
2005	Electric Power Systems (March 3)	WCEE Brown Bag Luncheon – Washington, D.C.
2005	End of An Era – History of Electric Power Transmission (April 28)	Pittsburg Section – IEEE – Pittsburg, Pennsylvania
2005	Effects of Restructuring (September 9)	IEEE Section – Detroit, Michigan
2005	Effects of Future Technical and Regulatory Developments on Transmission Systems (December 6)	Power Engineering Society Meeting – Baltimore, Maryland
2006	Shortage of Power Industry Personnel in the United States (June 19)	IEEE Power Society Meeting – Montreal, Canada
2006	Effects of Future Technical and Regulatory Developments on Transmission Systems (November 8)	Power Engineering Society Meeting – Columbus, Ohio
2007	Risks of Nuclear Power versus Risks of Not Having Nuclear Power (January 22)	Atlanta, Georgia
2007	Role of Hydrogen (January 25)	Atlanta, Georgia
2007	Electric Power Technology for the Future – A Way to Proceed (March 13)	Carnegie Mellon Conference – Pittsburg, Pennsylvania
2007	Forgotten Roots (September 11)	IEEE Columbia South Carolina Section – Columbia, South Carolina

C

AUDIOTAPES: JACasazza Talks

0. JAC 25 Year Dinner Talk

1. Talk at Newark State College Careers Conference, April 1972

2. New Jersey Role in the Energy Crisis, Newark, NJ 1973

3. JAC Presentation IEEE Meeting, July 16, 1987

4. USEA/WEC/Business Opportunities in Africa, February 1988

4X. JAC Herman Halperin Award Talk, 1990

5. MAPP Megatrends Talk, "Restructuring the Industry: Questions to be Resolved" 1991

6. Trends in Competition and Interconnection in Europe and North America, Adelaide, Australia, 10/21/92

7. JAC American Power Conference Luncheon Talk, "Transmission in Changing World", April 13, 1993

8. JAC talk on Restructuring, Costa Rica, August 25, 1997

9. JAC talk in Toronto: "What We Can Learn From Others", November 17, 1997

10. Kentucky COOPS Luncheon Talk, 1999

11. JAC lecture CIGRE Colloquim, 2001

12. Tampa Electric Talk (two tapes), December 1, 1999 (2 tapes)

13. Buffalo IEEE Talk (two tapes), 1999 (2 tapes)

14. IEEE Talk at NJIT, April 2000 Filed with copies of talks

15. Howard University Talk, April 2000

16. Small Customers Talk NARUC Annual Meeting, November 2001, Philadelphia, PA

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RELIABILITY CRITERIA AND THEIR ENFORCEMENT
(From talk by J.A. Casazza to the FERC Staff)
1998

Value of a Human Life

30 or 40 years ago those setting the regional reliability standards wanted to do the right thing. And we had a lot of discussion; I want to mention some of the things we discussed. We know, when there are power interruptions people lose their lives. We all know this. If you look at the statistics for the New York blackouts and what happened in the hospitals, the death rates went up. People with iron lungs died; people with bad hearts tried to walk up a few floors and had a heart attack. The death rates have gone up every time there has been a blackout. Some said, these people are going to die anyway but none of us want to die any sooner than we have to.

Then we started arguing over what a human life is worth. And we began to realize, throughout our entire society people are making this evaluation without recognizing it. To me, my life is worth a lot of money. Each of you probably think the same about yours. How much do you want to see somebody spend to save your life? This is an important question. We began to realize that in building highways, building airports, building airplanes, those responsible are making this decision somewhere along the way. For example, the civil engineers want to build a highway. They can make the lanes wider. If you make the lanes wider, you have fewer fatalities; if the curves are not as sharp, you have fewer fatalities. But these things cost more.

So in all the design inherent in all of our systems, our infrastructure, someone is making an estimate of what a human life is worth, hardly ever realizing it. Some calculations have been made in the past. I don't have them any more, but they were quite interesting. We tried to make sure what we were doing with electric power systems was reasonably consistent. So this question, what a human life is worth is a key one. Some claim that the birth rate went up after the blackouts and that natural laws resulted in replacing the lost lives. We still need to be concerned about them.

What We Can Learn From Others

I want to give you a little background from history, things that I have seen. I go back a long way. I have had dinner once with Edison's son, and we talked about his father. I went back to the office and dictated some notes about his father but when I moved from one job to another I lost them. Part of my history has involved a lot of international activities, I believe that we in the United States were not given by God any particular insight to do things right all the time. We

can learn from a lot of other people and I did want to mention, just briefly an important activity that can help us learn from to others. This is CIGRE. The CIGRE committee I'm on has two principle activities.

One is taking a look in all the countries of the world—on how regulation is affecting their planning and operating. Seeing what works or doesn't work in Egypt or Italy or France, doesn't necessarily mean that it would work the same way here. But we can learn from some of them the impact of regulation on cost, reliability, planning, and operating power systems. We can get ideas. For example, in India, the price paid for generation is increased when frequency is below normal.

The second important activity is the compiling of an international glossary of terms. There are many glossaries of terms in existence. The Institute of Electrical and Electronic Engineers have put one together. And the basic problem that we face, is that by the same English words people do not mean the same things. If you pick up almost any contract, the first part has a section of definitions. All lawyers write definitions, and they all ~~offer~~. This is a world-wide problem. American firms are involved in other countries and European firms are beginning to own American properties. This problem of the words and what they mean is a very important one. An international glossary giving the definitions assigned by the various organizations will be a valuable contribution. This glossary should we available in a few months. I spend about one month a year representing the United States in some of these activities because I try to bring back to the USA, what's going on in other countries. If any of you want to find out how to obtain this information, call me or contact me by FAX.

<u>What Others Can Do to You</u>

I want to tell you about the first major USA blackout. Con Ed used to be an isolated company. It was not interconnected with any other system outside of New York. They did not want to be in interstate commerce since they did not want to be under the jurisdiction of the Federal Power Commission. At this time, I was working for the Public Service Electric and Gas Company across the river in New Jersey. Our studies showed that by putting a tie line to Staten Island, we could both save a lot of money. They could provide emergency generating capacity to use and we could provide it to them. We could put in less generation, reduce our reserves and save money. We went to see them two or three times and said look, we want to make a study of an interconnection between us. They said: "No".

Finally, Con Ed's views changed. In about late '50's, we sat down and made some studies and agreed that we should build a transmission line to Staten Island from New Jersey. And at this time I was in charge of planning in my company and I presented the project to the top PSEG officials. Quite a bit of money was involved, and it was a new business relationship. At that time they

asked me, "are you sure that when we interconnect with these people they can't do some thing to hurt us?" I said "we have made joint studies of the next 10 years. Everything that they plan to do and what we plan to do. We checked it all out and there is no problem."

We then committed to spending this money, putting this tie in, by signing a contract with Con Ed. And then we started studying another tie, the 500-kv tie from New Jersey to New York. In the process a meeting was held in Syracuse, to discuss the studies of 500-kv tie. At the end of the meeting Walter Fisk, who was in charge of the planning at Con Ed said "I want to tell you people something. You're going to read in the paper tomorrow about it." He said "I personally didn't know about it, but our Chairman of the Board has committed to putting a 1,000 megawatt unit I New York City. He wants to do this because we've got a very negative image and we want to seem progressive. We want the largest generator in the United States and we're going to put in the 1,000 megawatt unit.

The people at this meeting were astounded, particularly the man from Niagara, Mohawk. I thought he was going to have a heart attack. He said, "well, we've been making studies with you for a year. You didn't mention it. Walter Fisk apologized saying, "the Chairman of the Board made the decision on his own." That's an example of the real world.

Early Reliability Enforcement

What has this got to do with blackouts? I will explain further. The next step was to study the effect of the 1000 megawatt unit. All except Con Ed were convinced that they couldn't operate this unit at 1000 Mw. If the unit tripped out lines as far west as Ohio would burn down. The Chief Executives of the affected companies had a meeting with the Con Ed Chief Executive. They asked Con Ed to limit the output of the unit to 600 Mw. Their initial reaction was no. We won't . The other chief executives said then we will then open all the ties to New York City and you're on your own. We will not burn down our lines because of a decision you made without study. Finally Con Ed agreed to the limit. So this is an example of how reliability was enforced in the real world.

When I went back to my office we thought a little more and we said how can we be sure that their word is good? They had agreed to operate the unit at a lower output then it was capable of, and also agree to operate certain amounts of spinning reserves to cover a unit trip out . Since about 70% of the unit output came through New Jersey from Pennsylvania, and the west on a trip out . this flow had to be reduced very quickly so it wouldn't burn down the lines. They had agreed to do that, but we said how can we be sure they're going to do it?

We decided to put a special relay on this line to New York so that if this unit tripped out, and they didn't do what they were supposed to do, it would trip the line and not cause a problem in our system or the other systems. What this was

akin to cutting the ties to the other climbers in mountain climbing. You know, interconnections are like mountain climbing, where you tie a rope around your waist to the others. The idea is that if one of you slips the others keep you from falling. This relay would "cut the rope." We told them at what particular point and conditions this tie should trip.

About four years later I'm driving from Newark up the New Jersey turnpike to go to my home in northern New Jersey, and I looked over at Manhattan Island and saw everything go black. I'll never be able to forget how I felt. I said God, Jack, what have you done? What have you done to all those poor people in New York? I just felt I had done something terrible and the proof was right there in front of me.

It turned out that the relay didn't have anything to do with it, but for about two or three hours I just felt I had trapped people,--personally trapped those people in subway trains and buildings. Afterwards we recognized that the steps we had taken could have been valuable in preventing the blackout from spreading further.

This is one of the things that you learn from blackouts. The reliability enforcement must come abut through both institutional and technical mechanisms. We had a technical means, the relay, and an institutional means which basically forced them to lower the output and operate under in certain ways which helped limit the blackout spread.

Reliability enforcement generally requires a combination of technical means and institutional means. You get enforcement not just by writing the rules. You get enforcement by combining rules with some technical means that enforce them. Economic penalties can be levied. That's a lot harder to do than install a relay that is set and all know when the tie is going to be cut. Period. And they know they will suffer the consequences for their actions. This was easier to do with the vertically integrated company. Now with all of these different players that we have both the institutional and technical means become more complex.

Blackout Reports and What They Say and Don't Say

The second blackout I want to discuss is the blackout in 1967. We shut down five states and some outages lasted for a number of days. The Governor of New Jersey a day after the blackout, met with the officials from the utilities and said "I don't care what you do or how you do it, but don't ever let this happen again." We tried to tell him that we will do everything to minimize the probability, but no one, except God, can tell you this isn't going to happen again.

We made an investigation of this blackout. I want to tell you a bit about the blackout and its causes at a substation called Plymouth Meeting. It had a 220-kv bus. Some generators connected at the bus and the bus was operated in two

parts. When the load built up to a certain point some of the transmission lines going out of one side of this station would be overloaded. The operators were supposed to transfer some of the generator over to the other side to balance the loading of the transmission system. This was supposed to happen at about 10:00 in the morning.

This particular day the man in charge of this operation had with him a new operator he was supposed to be training. The man who was in charge was ill. He had diarrhea (it is not in the reports). He said to the trainee—"You handle it while I'm gone." Well, during this period the load was building up, and this generator was supposed to be transferred and it wasn't. So the loading on a 220-kv circuit got heavier and heavier. And when it gets heavier it gets hotter and it expands. It sagged down into some 4-kv circuits. The transmission circuits and some generation were lost and some load was lost. The frequency went down to about 52 cycle and everything stabilized. And this went on 10 to 12 minutes during which time the operators were trying to recover. And then all of a sudden, wham. Everything went. Most of the five states were interrupted. Apparently there had been a second disturbance.

What caused it? During this 10 minute period where the frequency was low the voltage in a number of areas was declining. It go to the point where at a station called, Brunner Island, it got so low that certain special relays on the generators operated. If the voltage gets low enough these relays were supposed to automatically cause the generator field to go to the maximum-to give you the maximum vars to pick up the voltage.

What happened at Brunner Island when the voltage got low? The relays instead of raising the field to a maximum, they lowered it to the minimum. It was the first time that they had operated and nobody knew about the connection error. This was the second trigger.

The reasons I'm telling you this is because we put together some official reports and not all of this is in the reports. The people I worked for were decent, honest people. They told me, "Jack, we want the truth. We want you to put in the report everything that happened. We've got to learn what happened, who was responsible, to determine what we have to change." And we did a complete report and it went to them. And they said well, before we make it public we've got to let the attorneys see it.

And the attorneys of the companies looked at them and asked us to take some things out. "Because" they said, "we're going to end up being sued for negligence if some of this stays in." That's the real world. The first one was the original one which had a black binder on it. This is the one that told the complete story. The second one had a white binder. This is the one with the changes by the attorneys that was released to the public and this is the one that went to the Governor's Office and others.

Formation of NERC

Because of this blackout and the New York blackout, a number of us got together. We agreed that we've got to do something that will keep one company from doing things that will hurt another company. How do we do this? How do we control ourselves? Some people said we'll let the Federal Government do it. Most said no. The Federal Government should not do this. We should police ourselves. We don't want an outside policeman. We know what we're doing to each other. We are smart enough to do this. Let's do it ourselves. As a result we began forming the Regional Reliability Councils. I was one of the eight people involved who met in St. Petersburg, Florida and outlined what was needed.

Reliability Enforcement by the Reliability Council

The big question was and is "how do you enforce the rules?'" This is the problem of every police department. The answer we came up with was something a lot of people laughed at when first mentioned. Moral suasion. Moral suasion, what is that? What techniques do you use? An example was provided by the MAAC reliability organization. All plans had to be submitted for review and approval that would affect other companies. If it affected only your system, it's your business.

Based on each reliability review we would write a report. If we found a particular company was planning to put in a generator or a line or were operating in a manner whereby they were going to adversely affect the reliability of other systems, we would draft a report saying this. Before the report would go out we would submit it to the companies who were creating reliability risks to review ahead of time.

And almost always they would back off and change what they were doing. Again, because of the lawyers. The lawyers said if such a report goes out, and it is in the public domain, and it states that you are not planning on operating in accordance with established criteria and you have some kind of interruption, you're going to be sued. It's going to be prima facie evidence that you did not comply with good practice, and you're going to be guilty of negligence. So this "moral suasion" worked because the reliability council could write a report which would have an effect on their decisions. Companies did not want these reports public, and would revise their plans and procedures. This was an institutional means to protect reliability.

An example of a technical to enforce reliability was provided on the west coast. Loop flow and parallel path flow was preventing the Southern California Edison from importing low cost power from its plants in Arizona. Southern California wrote letters, did everything in their power to try to get this situation resolved, without success. One night Southern California opened some breakers and

stopped the undesirable flow. A technical means was used to force the issued to resolve the institutional problem . As soon as the breakers were open , they got the attention of those causing the flow. It's like hitting them with a 2 x 4. They only kept the breakers open for one day, but it was enough to get them to sit down at the table and they resolved the problem.

Let's talk about Texas. Texas was another region that didn't want to be under Federal jurisdiction. One of the companies, Central and Southwest, had properties on both sides of the point where the ties were open. They had properties in Oklahoma and they had properties in Texas. And the SEC told them you are not operating an integrated system, you've got to connect these two systems or sell one of them. The rest of the Texas companies said you're not going to interconnect them because that will put us in interstate commerce and under the control of those negotiations in Washington. Texas had always wanted to, as John Wayne said, "Take care of your own needs. You don't depend on anyone else."

They had a real problem. Central and Southwest said we are going to interconnect, and they closed a tie and connected Texas with the rest of the United States, other companies opened breakers. Litigation was initiated.

Studies made by a consulting firm recommended AC ties, 345-kv ties between Texas and the rest of the United States,. The rest of the Texas companies would not go along with this plan. The reason was the reliability problem. They were planning to put in the South Texas project for a total of 2000 MW. If tripped out, 90% of what it was supplying would be coming through the rest of the United States and causing transmission problems.

The litigation was going on and we were asked to try to find a solution. The solution we found was a combination technical and institutional one. By putting in DC ties, the loss of these large units wouldn't effect all these other systems. That's what kept the other systems satisfied.

The second concern was the DC tie would put them into interstate commerce and under FERC jurisdiction. A very prestigious Washington law firm was involved. They got into new federal legislation a specification that if an interconnection was ordered by the Federal Energy Regulatory Commission for you to connect with another state, this did not put you into interstate commerce. After the legislation was passed, FERC ordered the interconnection. The DC tie went in. And that's how the problem in Texas was solved. The technical means and an institutional means, legal means, solved the problem.

The French Experience with VARS

Let me talk to you for a few minutes about the blackout of France. Some of you weren't even born in 1978 were you? No, I guess you weren't. All of France was

blacked out. It was December 7, 1978. I remember it because December 7 is a date you don't forget if you were alive in 1941. All of France was blacked out and there was great concern in the US Government as to why. There were some rumors that this was sabotage. At the time Electricity de France was having problems with their labor unions. Electricity de France said "we have to do maintenance on weekends" and the French workers said, "we don't work on weekends." EDF had found that there were cases where the union workers were delaying maintenance and causing problems.

Well, anyway, the US Government wanted an investigation. I went over did a review of what happened. The interesting thing is that the situation on the day that they had the blackout was exactly the same as the day before. And the day before they had had no interruption or problem. Same load. Same units available. Basically exactly the same situation. And we began to ask why was it okay this day and not on this day?

The answer was that when the load picked up in the morning, they had failed to schedule all generators in service soon enough to provide needed reactive power. The voltage began to decline. And once the voltage started to decline, it just kept going down, down, down and they had a voltage instability problem. This is 1978. That's not different from what they had on the west coast in 1997. This is the problem of how people operate the system. People who fly airplanes and who operate electric systems are human beings and you need to recognize this. And I don't care what you put into the regulations, what you approve or don't approve, it is—you're going to have this happen once in a while. In France they made some technical changes and they made some institutional changes in the way they operate. And they put in some computer systems and other things.

The Future

In the past when you had vertically integrated companies, each controlling all sources in their systems, the heads of these two companies could talk with one another and they could work reliability problems. Now with as many different players that we have, it is going to be much more difficult to work out.

We're going into the future with security coordinators, ISOs, control areas, power exchanges, and RTGs. All of these people have overlapping jurisdictions. The big question is who is going to be in charge? It's a real question here because with this overlapping, it's not clear who is in charge. I think we're heading, right now, from a reliability viewpoint into a chaotic situation. And I know FERC, NERC and all others are concerned.

Some key questions are. How may power exchanges should you have for each ISO? How may ISO's for each power exchange? How many control areas for each? What's the right ratios of some of these things here in order to have it

viable and make it workable, keep reliability and save money? This is the challenge for the future. The future is bound to be interesting!

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My Memories of Cooper Union, 1941-1944

by J. A. Casazza

It was early in September of 1941 when 100 new Cooper Union engineering students embarked for Green Engineering Camp for our Freshmen orientation. Very few of us knew each other and we were all somewhat frightened and concerned about this new world we were entering. Almost all of us came from poor families and Cooper Union was providing for us a way up. The spirit at Green Engineering Camp, for those few days, foretold the future. All of us enjoyed the activities, listened to the guest speakers, underwent physical exams, and got to know our fellow students and faculty. War clouds were on the horizon, but this was a time of great happiness, enthusiasm, and camaraderie. After orientation, we returned to school and entered upon the difficult—yes it was very difficult for me—program for engineering students. For some of us, it was quite a shock to realize how hard we had to work to meet Cooper's standards. In high school life had been easy, and many of us had established outstanding academic records with very little work. Cooper Union was a different world!

In the fall of 1941, the administration had decided to open Cooper Union's Green Engineering Camp for weekend student visits. Some of us leapt at the chance of going to Green Engineering Camp. A number of us went over the Thanksgiving weekend and spent four delightful days playing touch football, falling off a makeshift bridge (it was not designed by a future civil engineer) into the ice cold waters of the creek, playing charades and other games in the evening and sitting by the fire talking about the future. Little did we know that in just a few days, December 7, 1941, an event would take place that would change our lives.

Most of us did not even know where Pearl Harbor was when we first heard the news on the radio. I will always remember the next day, December 8th, sitting in the basement lunchroom with the entire student body listening to the words of Franklin D. Roosevelt as he addressed our Congress. We just looked at each other, saying little, each recognizing in his or her own way what these events meant. Immediately after Pearl Harbor some enlisted and went off to war. I am not sure what happened to many of them since I had only known them a few months. I hope they are all still well and can recall those days.

It had been decided that Cooper Union should become a training institution for the special Army program for officers. To prepare for this we converted from a semester basis to a four-term a year basis, with each term being 12 weeks. I remember the difficulty in making the adjustment, but with good spirit it was made by the faculty and the students. (After the change, the Army decided not to use Cooper.)

Those of us continuing with our education would read daily of battles where many Americans were being killed and where the Japanese and Germans were making significant advances. Slowly, the tide began to change in North Africa, Europe, and the islands of the Pacific. I am sure many Cooper alumni and some students who had entered in my Freshmen class were involved.

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With millions being sent off to war, there was a major shortage of manpower existing on what was called the "home front." Wives and mothers were working the night shift in factories building planes, ships, and weapons. Many foods were rationed. At home I can remember my mother saying we have no more meat or butter coupons.

At Cooper Union we went to classes all year round, with no summer vacation. We had very few holidays, and one week off between terms. During one of these weeks, a large group of Cooper Union students, my memory says about fifty, volunteered to help pick the apple crop in Marlborough, New York. I clearly remember the spirit on the trip up the Hudson on the Day Line and the activities at the dormitory (a converted barn) at the Canzonari farm. A few of our group even went swimming in a half filled pool on a cold day in October.

Classes had been expedited and by then I was a junior. On the day I turned 18, I signed up in the Navy V-7 program designated to provide engineering officers. I remained at Cooper a while longer and was soon given orders to proceed to Cornell University. While at Cornell, I began to really appreciate the education I had received at Cooper Union. Cornell, one of the fine Ivy League schools, was significantly easier than Cooper Union. Along with me at Cornell were other former Cooper students. Those of us from Cooper established outstanding academic records at Cornell, graduating either number one in their classes or very close to the top. These achievements provided demonstrations of the kind of education we had been given at Cooper Union. After receiving additional training in Princeton and at the Naval Academy, I was commissioned an Ensign and assigned to a ship in the Pacific. Before I could reach the ship, the atomic bomb had been dropped and the war had ended. I have asked myself many times if the killing of tens of thousands of innocent people in Japan had saved my life. I feel it saved the lives of hundreds of thousands of other Americans. Was it a proper and moral act? I keep believing the answer is yes.

As I look back after 50 years, the thing that impresses me most was the willingness for all Americans to work together, to sacrifice, and to risk their lives for a common cause. The spirit, dedication, friendship determination, and good humor of all at Cooper Union was a part of this effort that I will always prize, even though I had been a very small part of it.

The achievements of the American people in the number of ships, planes, equipment produced in a few years, the training of millions in how to use these weapons, and in keeping a national economy going with a fraction of its regular work force remains a most remarkable achievement. Sometimes, when I hear discussions of our present problems, see how long it takes us to repair our bridges and roads, or read about our debates in congress, I want to remind them of what was done in 1941-1945.

Jan/1995 Jac

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VIDEOTAPES: JACasazza Lectures and Presentations

1. 12/86 MAPP Presentation—"A Question of Open Access"
2. 2/88 Invest-America Cable TV Program, Interview of JAC
3. 7/88 FERC Hearing Presentation—Martha Hesse Rebuff
4. 5/2/89 JAC PICA Talk, "Evolution—Computer Use in Power", Seattle, WA
5. 8/5/89 DH&S Workshop Talk
6. 11/20/89 Invest America Cable TV Program
7. 2/90 IEEE PES Winter Pwr Mtg
   Herman Halperin Award Acceptance Speech
   Announcement of Peter Cooper Fund
8. 8/90 Presentation in Hungary—IEEE/PES Distinguished Lecturer Program
9. 10/3/90 Cooper Union Sophomore Seminar "What Engineers Owe Society"
10. 10/17/90 IEEE Pension Talk
11. 4/91 JAC Talk in Australia
12. 10/91 Tasmania Presentation by JAC—"Towards an Australian National Energy Network: An International View
13. 1/20/92 Public Power Policy and Leadership—Cooper Union
14. 7/13/92 IEEE Plenary Speeches—Various Speakers (2 tapes)
15. 2/1/93 IEEE Winter Power Conference
16. 12/17/93 Concordia Workshop, Iowa State (2 tapes)
17. 2/1/94 IEEE Winter Power Conference (2 tapes)
18. 9/94 Presentation at AEP on Foreign Practices
19. 11//8/94 IEEE Costa Rica—Electric Generation Planning
20. 5/98 IEEE Eastern Montana Section Deregulation Video

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21. 2/00 Impact of Restructuring on Cost and Reliability

22. Spring 00 Talk at Howard University

23. 12/02 Restructuring: Good? Or Bad?—American Education Institute

24. 8/14/03 JAC on Brian Williams—MSNBC Blackout Interview

25 Korean abstract (2004)

G

HERMAN HALPERIN AWARD TO J.A. CASAZZA
PRESENTATION BY B. DON RUSSELL
Professor, Texas A&M University
(Chairman, IEEE Power Engineering Society
Awards and Recognition Department)
(1990)

Mr. Casazza is the President of Casazza, Schultz & Associates, Inc. of Arlington, Virginia. He studied at Cooper Union and Cornell University and joined Public Service Electric & Gas of Newark, New Jersey in 1946. He rose to the position of Vice President of Research and Planning before leaving in 1977 to join Stone & Webster Management Consultants. Over a period of 30 years, Mr. Casazza has made outstanding contributions to the development and utilization of electric power transmission systems throughout the world. He is internationally recognized for his work and held in high esteem by transmission system engineers in the United States and in foreign countries.

His accomplishments are far too numerous for me to mention here today but they include the introduction of the first use of dispatch computers by U.S. utilities to perform transmission system contingency analysis and to evaluate corrective actions and his pioneering applications of the use of high voltage phase angle regulators to increase utilization of transmission facilities.

We gain insight into the contributions of Mr. Casazza through comments made by the individuals who supported his nomination. Allow me to read you a few of those. I quote:

> "By finding ways to measure the magnitude of benefits from improvements in transmission network performance, Jack Casazza has encouraged both the more efficient and effective use of the transmission networks and the construction of network additions. More than to any other man, the electric consumers of this country owe a debt for showing the way to reduce costs, and to reduce the need for new generating capacity by using the transmission networks to best effect."

Another nominator of his, an IEEE Fellow and a member of the National Academy, writes the following:

> "His significant contributions to the advances in the interconnection, coordination, and pooling among individual electric power systems, — to the development and refinement of methods for quantitative measurement of transmission system capabilities, — and to the utilization of electric power

transmission networks in a manner that balances the considerations of reliability on one hand, and economy on the other hand, place him among a small group of individuals who through the merging of the theoretical and the practical in their work, established the foundation for the widely interconnected electric power systems of today."

Few of us can aspire to more than to have those kinds of words said about us in our careers. I am very pleased to give you Mr. Casazza. He was elected Fellow of the IEEE in 1975 and a Life Fellow in 1989 and is very active today in our field. His citation reads:

"For leadership in developing the electric power transmission systems and innovative methods for improving their reliable utilization."

IEEE President Bayless will, on behalf of the IEEE, present the Herman Halperin Electric Transmission and Distribution Award to Mr. John A. Casazza.

Prepared Remarks — Not used in Presentation

6

Herman Halperin Award Acceptance Speech

at the Award Luncheon

February 6, 1990

in Atlanta, Georgia

by

John A. Casazza

Life Fellow

IEEE

Thank you Carl, I appreciate those kind words. I am reminded of a story about the introduction of Tom Edison at a dinner. The toastmaster dwelled at length on his many inventions, concentrating as his invention of his talking machine. The aged inventor smiled and said, "I thank the gentleman for his kind remarks but I must correct him. God invested the talking machine. I only invented the first one that could be shut off."

The recognition of one's achievements by one's peers is heartwarming. I feel I have been particularly fortunate to have lived in a period of time bridging from Thomas Edison, to digital computers, nuclear power, and EHV systems and to have worked with so many fine people. I have been blessed to have had many others contribute to my knowledge and my success. It is appropriate that I acknowledged some of these people, particularly:

- Peter Cooper - the visionary who almost 150 years ago contributed funds to pay for my complete education.

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- Eric Gross - the tireless fighter for quality education in power system engineering, who taught me in school and encouraged me throughout my career.

- Howard Sels - an early associate of Fortesque, Evans, and Wagner at Westinghouse, for his creative mind and technical knowledge, who gave me the opportunity and resources to explore new and better ideas.

- Robert Hooke - the former Transmission Planning Engineer at Public Service and my first boss in planning work, who always stressed to those working for him that an engineer should contribute more to society then he takes from it.

- Edwin Synder - former Chairman of the Board, of Public Service Electric & Gas, with whom I worked closely in both founding EPRI and developing the PJM Mine Mouth Generation and EHV Transmission Projects. He was an industry leader who believed in the primary importance of people, both the general public and his employees.

- Herman Halperin - whom I knew through most of my career. Herman's ideas frequently provided a foundation for the work of many others including mine. I deeply appreciate the establishment of this award by Herman and his wife Edna.

- Last but not least, I want to thank my wife Madeline, who is here today who fully supported me and sacrificed many times, so that I could pursue technical matters that interested me. Her support was essential to my accomplishments.

Today, I see before me some of the best brain power and knowledge in this country concerning the economics and reliability of electric power systems. I am dismayed that more of this talent is not being utilized by our government in establishing national transmission policy. All branches and all levels of our government presently lack technical personnel with a competent knowledge of transmission systems. This has been clearly demonstrated by the recent inadequate FERC report on transmission policy. And I will say inadequate is a kind word. There are currently no good mechanisms for your knowledge to be utilized in setting national policy.

We engineers need to learn how to take a leadership role. We need to learn to speak out both in public and where we work, even if we will have to suffer penalties for doing so. I am fully aware of these penalties which can be imposed by government agencies and by individuals in the companies for which you work. The people of Eastern Europe have shown what can be done if courageous individuals begin to address problems frequently and openly. We are at a particular moment in our history when we can trigger events which will change the future if we speak out.

Because of my firm belief in the ability of engineers to help develop a better world, I am contributing the $2,000 I am receiving from the Halperin Award, plus an additional $18,000 of my own funds, to establish the "Peter Cooper Fund for Advancing

Government Technical Competence." This fund will be administered by Cooper Union and will have two key objectives:

1. To improve the education of engineers so they can better influence government policy.

2. To develop a prototype program for national use in other institutions.

Only when engineers understand how their technical contributions are being used, how they effect this society in which they live, how they affect peoples lives, and speak out on these issues can our country reverse this downward cycle in which we find ourselves. Only then will they be able to effectively counter the theoretical economists who want to throw away more than 50 years of evolutionary learning about the economics and reliability of electric power systems. Only then will they be able to counteract the members of the legal profession who develop government procedures that stymie productivity improvements and make technical innovation less rewarding.

I visualize this start as the planting of a seed. We are most anxious that these efforts be copied and followed in other parts of the country. If any of you, or your organizations, would like to help support this work through personal efforts or financial contributions, please contact me.

If the people in Eastern Europe and other places in the world have sufficient courage to stand up and cast aside those who were not interested in the long-range future of their society, but solely in their personal power and wealth, can we do any less? We too need to overcome fear and greed. I leave this challenge with you.

My Experience with the Muslims
By Jack Casazza

CIGRE - PARIS 1960's

I first had extensive contacts with people from the Muslim faith while attending CIGRE meetings in Paris. A few came from the Middle East, and a few came also from Iran. My wife and I talked with them at the various receptions, bus rides and other contacts about our families and our work. They were always friendly and courteous.

AKHTAR IMAM – 1970's

About 1970 I was working at the Public Service Electric & Gas Company as Assistant Manager of Planning and Research. We received a request from Lehigh High University to employ for six months a recent graduate of their electrical engineering master's program, a man from Pakistan named Akhtar Imam. The proposal was this individual would work for us and we would not have to pay him, but we would give him experience and help him to learn how we did our planning in the PSEG system. He started work with us and we were quite pleased with his activity. He worked hard, tried to learn everything, and obviously had a good education.

After his experience with us, Akhtar went back to Pakistan, his home, where he obtained a high position in the Power Ministry. His family had been allied to the Bhutto family which was then in power. The political situation in Pakistan was turbulent. His father, being of importance in the Bhutto group, was assassinated one night in his home. He told me men came into the home and shot and killed his father.

He, his wife, and his children left Pakistan immediately fearing for their own lives. I believe they went to Nicaragua where they tried to get by, but things were difficult for them. And finally about 1975

they came to the United States. I did not know what was happening to him during this period, but one night I was called by a friend of mine who worked for ConEdison Company, saying there is a man over here staying at a New York hotel with a wife and two children who is in a very bad situation. He doesn't have any money and his children have not eaten for more than two days now. I said, well, who is it. He said it was Akhtar Imman. I said I know him; please give me his phone number.

I called him and invited him to dinner at my house. I went over to New York and picked him and his family up in my car and took him to my home. My wife had been concerned as to what kind of food to give to the Muslim family, so she called the Pakistan embassy and was told the diet restrictions they had. The net result was my wife cooked a very fine fish dinner for them with fish, rice, and appropriate vegetables. The children when they sat down to eat, were so hungry they just stuffed themselves. In fact, they ate so much that about 15 minutes after eating they both threw up. But Akhtar really appreciated our giving them food when they were hungry. He also appreciated our subsequent help to get him a job for a little while in New York City.

After a short time he went to the United Arab Emirates. He did not go back to Pakistan, still fearing for his life and his family. Through the years we kept in touch. He would send me a Christmas card every year in the beginning, and later on he would send it to me by e-mail. He was a fine, decent person who had had a very difficult life. In the United Arab Emirates things became financially far improved for him, and he became an engineer involved in the expansion of the country. He always remembered, however, the fact that we had fed him and his family when they were hungry.

Most recently I received a message from him stating that he was going back to Pakistan. He must be about 70, 75 years old now, and I think he's going back to his homeland to die. I have attached a copy of this message from him, which reports on what his children are doing and his wife. He also asked God to bless us.

EGYPT - KHALID 1990's

I had some experience with the Muslims in Egypt in the 1989-1990 period. I was working on an assignment to help them redesign or rearrange the management and operation of their electric power systems. I was driven back and forth to the various meetings and locations by a Muslim man named Khalid. And we had a lot of time riding through the heavy traffic to talk about many things. He was open-minded and liked to talk about right and wrong. On a Saturday evening he took me to mass at the only Catholic Church in Cairo where he waited for me, and took me back to my hotel after mass.

He was very concerned with God, abortion, and the ethics of the various countries. He was totally convinced that God was going to punish the United States for the several million babies we had killed through abortion each year. His mother had a great influence on him from a religious viewpoint. In his personal life he and his wife had been married almost 10 years and had no children. Finally she became pregnant. On one of the visits to the doctor, the doctor told them "I have bad news for you. The baby will not be normal. You should have it aborted." Khalid said he didn't know what to do, and his wife didn't know what to do, so they went to see his mother. His mother, a devout Muslim, told him to wait and see what God sends you. The baby was born completely normal! His son, at that time, four years old. He told me he says a prayer thanking God every time he sees his son running and playing.

Also one day, when riding in the car, he asked me if I would like to see the Muhammad Ali shrine. I asked him, do you mean Muhammad Ali the boxer? He said, yes. I said, well, I don't think I'd like to see Muhammad Ali's shrine. I didn't know you had one in Egypt for him. He said "I want you to see this." And he took me to a huge walled structure extending over several hundred acres. He took me showed me around. He explained to me that Muhammad Ali had become the leader for Egypt by

tricking his enemies. He had built a narrow passageway to enter to his palace, sort of a narrow passage was about five feet deep and about three feet wide. He invited all his enemies to come for a peace meeting at his castle, and as they were coming in through the narrow opening one at a time and unable to defend themselves he had thousands of them all killed and was able to seize total power. They were buried in Cairo in what is now known as the "City of the Dead". I said this doesn't seem right to me either, Khalid. He said, no. It didn't seem right to him, but that's how people came to power in Egypt many years ago. I believe he wanted me to understand some things about his country. This misunderstanding about which Muhammad Ali we were talking about demonstrated the problems of communication.

Before I left he asked me if I would meet his mother and talk with her. I said yes, but before we could get the time to do it, business took up all the time and I never did have the meeting with his mother. He apparently thought she was very wise and could provide guidance for Americans as well as Egyptians.

IRAN 2001

In 2001, I was asked to visit Iran and meet and deliver some lectures about electric power policy at Shariff University. I agreed. I was not being paid, but my expenses were to be paid. I went over with a group of three Americans, two Italians, two from the U.K., and we went to Iran where we were received graciously in a nice hotel and delivered our lecturers. We were also flown to both Isfahan and Shiraz where we visited sites of historical interest and got to experience the local restaurants, technical facilities, and local workers.

As we traveled, I talked often and freely with the students and guides about problems between our countries. I told them of our concerns about some of the Iranian policies and asked why they didn't work to change them. They agreed that the way things are decided in Iran needed to be changed. They

felt that riots and street protests would lead to bloodshed and many deaths. Their view was that time was on the side of change, and with patience those in control now would die and be replaced by individuals from their generation.

We were also fortunate to be invited to sit in on several important assemblies at Shariff University with the whole student body. We were startled to see that there were more women in attendance than men. This is a technical university. The purpose of one meeting in one assembly was a visit from a government official to talk to them about their major assignment for the future in their graduate school studies. He said the country, which had about 40 million population, had to find ways for it to survive after its oil ran out. And that they wanted their students in the university to have as one of their top projects to be investigating and doing research on the various alternatives to help them survive when their oil money was no longer flowing to keep their economy healthy.

They talked to me quite a bit about what ideas I had, and I told them things I thought they might look into. I got invited to a meeting of the Board of Directors for the electric company that ran the whole electric power system in Iran, and I met with some of them and talked with them for about two hours. I was asked what I thought about certain things, and I always answered honestly as best I could. Later on they asked me if I would be willing to do an interview on Iranian television. And I did so, about a 15 minute interview where they asked me questions and I answered them.

We had several farewell parties. At some of them the students brought their little sisters and brothers. One of them brought his mother. They gave us flowers and sang songs for us. They wanted us, the people from other countries, to meet their families and understand them. And we tried to do so. We left with all in good spirits and hopes for a future cooperation and working together.

Later on in 2001, September 11th, occurred, and you all know what happened there. The people I had been working with in Iran and talking to, sent me several dozen e-mails telling me how sorry they

were for what had happened in the United States. They said that killing innocent people was not what the Koran said. They sent me some messages after that, but gradually after a period of time there were no more message, and my messages to them didn't go through any more. My last message to them I said "I pray that God will find ways for our countries to be friends in the future", and I signed it best regards, Jack Casazza.

CONCLUSIONS

You can see from these experiences, Akhtar, Egypt and Iran, that I feel there is great hope in working with Muslims and trying to get along together. There is no reason why we should be enemies in the future, even though some in leadership positions on both sides find it difficult in their hearts to talk to those involved that have different religious beliefs.

Jack Casazza

May 22, 2008

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Matter and the Holy Trinity

June 7, 2009 was the Feast of the Most Holy Trinity. I attended mass on this day at Nativity Roman Catholic Church in Burke, Virginia. The celebrant was Fr. Wilson, an Augustinian Father.

As part of his homily he discussed the difficulty of people in understanding how there can be one God in three persons. He particularly emphasized the deep thought that St. Augustine had given to this question and his writings on the subject. His homily stressed that very complex questions such as these are difficult for the human mind to comprehend.

During the homily a thought struck me. Most of my life I have dealt with the physics of matter. Matter constitutes all the material substance that exists in the universe. We are not puzzled by the fact that matter can exist in three forms: first, there is all existing matter; second there is matter that has been enlivened to form cells which reproduce, create additional forms of life, and generally are an active mechanism for changing the world; and third there are electric and magnetic fields and radiation produced by matter giving it the ability to influence and change forms of matter.

In these three forms of matter, the basic material, the living material, and the fields I see a strong similarity to God, Jesus Christ, and the Holy Spirit. Doesn't matter having three forms also help explain the complexities of the Holy Trinity with one God in three persons? Perhaps it can explain how the universe was created.

I have been concerned for some time with fields. If the Blessed Trinity were involved in the creation of a world of matter, fields, and cells, is it not possible for the same process which created living cells to have created living fields?

These pose some perplexing and interesting questions.

J

JACK CASAZZA

An Interview Conducted by

Loren J. Butler

Center for the History of Electrical Engineering

February 1, 1994

Interview #184

For the

Center for the History of Electrical Engineering

The Institute of Electrical and Electronics Engineers, Inc.
and
Rutgers, The State University of New Jersey

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INTERVIEW: Jack Casazza
INTERVIEWED BY: Loren J. Butler
DATE: February 1, 1994
PLACE:

Butler: Why don't you begin by telling me about your student days and how you got started in your power engineering career?

Casazza: Well, in high school I decided I wanted to be a scientist and win a Nobel Prize, all those glamorous things. I had some very good instructors. I went to Stuyvesant High School, an excellent technical school in New York, and ended up getting into Cooper Union, where I had some choices to make. At first, I thought I would like to be a civil engineer, to build roads and bridges, and then at the end of my freshman year I switched to electrical engineering. A little way along there I decided I wanted to work with the electric power. It seemed to me that electronics and some of the things which were just becoming of interest were kind of less important than keeping the lights on, the motors running, and keeping manufacturing going; that to me was the real challenge.

Butler: You mentioned that at first you were interested in science and then you went to college and found yourself in engineering. Do you remember a conscious transition or was your interest in science really just a part of your interest in engineering?

Casazza: To me they were one. When I went to school science and engineering were one. There wasn't this sharp classification there, where there are physicists

such as solid state physicists and earth scientists. Science and engineering covered a large area and there was far less specialization, and I just decided that I would like to get into the engineering end of it. This was partly because I was very poor. My family didn't have any money and I got through college on scholarships for four years. Important to me along with doing what I wanted to do was trying to make some money to help my parents out and get independent. So engineering offered that opportunity. I had decided early in my career that all I could do was four years because I had obligations.

My mother did a lot of things. She took in sewing. My father frankly had a manual labor job. That's all he was ever able to do because he had left school in the sixth grade. I had some things I wanted to do for my family too. So engineering for four years was what I thought I would do.

I started in Cooper Union about September 1941. In December 1941 the world changed and all of a sudden we had a war and we were going to school six days a week, eight hours a day, no vacations. We even went to school on Christmas Day because other people were dying while you were fortunate enough to be allowed in school. I had entered college fairly young, so by the time I turned eighteen I had completed my sophomore year.

I joined the Navy and by the time I finished my junior year at Cooper Union they sent me off to active duty. Lo and behold, the Navy took me out

of Cooper Union and sent me to Cornell, which was in some ways a treat for me. At Cooper Union, I had been working six to eight hours a day to make some money, and at Cornell I didn't have to work.

Butler: Because you were in the Navy.

Casazza: I was in the Navy, and they paid me a salary to go to school. I didn't have to work. From there I had a number of assignments in the Navy. I ended up aboard ship. I was an electrical officer on the U.S.S Springfield, which was a light cruiser. At the age of about twenty I had fifty men working for me. I was very frightened because these people were experienced and I had no practical experience and I had to take care of all the electrical equipment on this large ship. I didn't know much about it and in many ways it was very good for me. I began to realize that what I learned at school was only a small fraction of what you needed to know to do useful work. The Navy educated me some more and sent me to a number of different schools. At about that time the Navy was organizing millions of people, and I was more than ready for the invasion of Japan. Guess what happened? Truman dropped the atomic bomb, the war was over. Frankly I am sure that I benefitted considerably from his decision to drop that bomb. I know 70,000 people died at Hiroshima and 35,000 at Nagasaki but maybe I am alive because of it; I don't know. So that's part of it.

Butler: So you were in the Pacific?

Casazza: Well, that was part of history. Before I left the Navy, I talked to a number

of my professors and said, "Should I go to graduate school? What should I do?" Now I had a little money from Navy salary and they said, "Why don't you work for a couple of years and then decide on graduate school." Through some personal contacts I got a job with Public Service Electric and Gas Company in New Jersey, where for two years I was on a training program. I worked in every department in the company. I learned how to operate power plants, and I learned how to handle customers' complaints when they were angry about the bills. I qualified as a lineman to climb poles and towers. Compared to going to school continuously and all that time in the Navy, this was a lot of fun, and for two years I just learned.

Then I got a job in their planning department. About the time I began to like this planning work, I decided, "Well, let me put off going back to school," and then I decided to get married and then to wait until later, and just never went back for another degree. But I did have the benefit of an awful lot of training through the company programs. The company paid for me to take probably the best graduate course in electrical power engineering given by the General Electric Company up in Schnectady. It was two days a week, full-time essentially, and I commuted to Schnectady and graduated a week or two weeks before my son was born. My wife was staying home alone during that nine month period. But it was a very fine course. I met a lot of very fine people. I started to meet people like Sel Crary. I don't know if you ever have heard of Sel Crary. These are some names you might want

to get, really important people in the history of electric power: Sel Crary, Charles Concordia.

Butler: I think Mr. Concordia is being interviewed tomorrow.

Casazza: Gabriel Kron, a very fascinating man. What I could do with the history of Gabriel Kron. He was thrown out of the University of Michigan. I'll tell you a little bit about him that's not in my book; I did something else. He was thrown out of the University of Michigan because he was always fighting with the instructors, at something like sixteen. He decided to work his way around the world, and came to Hollywood. He was very brilliant. He had so many problems because his professors were a couple of light years behind him. He got back to Hollywood, signed a contract for $10,000 or so to work on his new experimental movie camera, and the company that gave him the contract paid him the money up front and went bankrupt. So he had a year or two with no work to do. He came to New York City. In the public library he started to read books on mathematics and became the inventor of something called tensor analysis. It became quite important but then he worked for GE. He was unusual and was not easy to work with because he was ahead of his time. You have to mention him in the history of electrical engineering because he was a character. You know about Edison and some of the other people.

Anyway, I worked with Public Service in planning and went through a number of different jobs. Well, at first I started planning the low voltage

feeders that go along the streets, distribution circuits. From there I went to planning in the general office where I planned new substations and approved budget items and started to deal more with the handling of money, approving expenditures. In the beginning I did design work, and then I began to move in the money end, and later I began to handle the decisions on large items. Should we build this fifty million dollar line and that kind of thing. I kept moving up in terms of the value of the projects I was involved in until I got to the point after about fifteen years that I was handling a budget of about over one billion dollars a year.

Part of this was because the key people in the company were engineers. The managers were engineers, and they trusted engineers. Occasionally, they would let the accounting and other people do these things, and they would mess them up because they did not understand the basic components of the project. Things would get left out. You needed seven circuit breakers at four million dollars and they wouldn't get it in the cost. It took somebody who understood the project, and the engineering knowledge was essential to putting together the financial figures. The people on the top learned that, and they started giving these responsibilities to engineers. They were engineers, so they were more comfortable with other engineers doing it.

I was in the planning department and later on I took over the research department handling all research. We used to have a research budget of

about seventy million dollars on top of this capital budget of over one billion dollars and I ended up doing a lot of things.

Finally I was promoted to doing not just the electric system for New Jersey, but also taking on responsibility for the gas system. I enjoyed this work until about the point where the people I had worked for through the years retired and they brought in some new people from outside whom I didn't enjoy working with.

I stayed a little while. I talked with one of my good friends, including the former chairman of the board who had retired. He said, "Look. You are not going to be happy here the next ten years. These new people coming in don't think technology and technical skill and technical information are important. They think this can be done by the accounting types or the financial types." Well, they weren't good managers, frankly, because I think a good manager understands the financial, technical, and the political aspects; you've got to understand it all. They brought in some new people who were not particularly good in my mind and I had a choice of staying and griping every day or leaving, so I left.

My wife thought I was a little out of my mind because I gave up my chauffeured Cadillac, I gave up my helicopter, and I went to work someplace where my privileges were far less, although I did get a considerable pay increase. I was there for a little while and then I had a chance to buy a small business. That is the ultimate freedom, I think, being

an entrepreneur owning your own business. I bought a small consulting firm in Washington, and we moved down there.

In the beginning things were rough. I went from a staff of 350 to having my wife run the xerox machine, but we did it and we persevered and now we have a very successful company. So we boot strapped ourselves up and I was fifty-three when I did that. Doing that at the age of fifty-three I would recommend to anybody. It invigorates you; you have a new challenge and a tough one, just like mountain climbing. If you get to the top of the mountain, you feel good. But that's a quick summary.

Butler: Can I ask a couple of questions about PSE&G? Are they unusual? Do you know about other utilities, can you compare these to PSE&G?

Casazza: Originally, I went there because it was about the fourth largest utility in the United States, exceedingly progressive. They had pioneered in a lot of things, the people working there were forward-looking, and they thought long-range. They gave young people an opportunity to work on things that were not needed tomorrow. A long-range perspective was what they had. Their managers were good, they were mostly engineers, and engineers tend to look long-range. But some of these long-range projects caused some of the management problems. There were a couple of them that didn't work out very well. For example, there was the concept, you may have heard of, the floating nuclear plants off of New Jersey.

Butler: In fact only recently I've heard about this. Can you talk more about it?

Casazza: I was involved with the economic evaluation. Another department did the designs for those floating nuclear plants. Originally there were two plants, two units, one thousand megawatts each, a million kilowatts each, which were going to be built. Frankly, I made the presentation to the board of directors saying that we thought this was a good idea. There were a lot of technical advantages, among them being that one of the things you must do in nuclear plants is build them to be earthquake-proof. If you put it on a barge, earthquakes can't affect you. The best place to be during a San Francisco earthquake is out on the water in a boat; that rocking isn't going to bother you. You've got a lot of water underneath you that is going to protect you.

But then the company that was building it, Offshore Power Systems, which was 50% Westinghouse and 50% Tenneco, began to say, "Look. We can't just do two. It's costing too much to build these. We have to get more orders, or otherwise we'll have to withdraw." Anyway, they went out and tried to get some more orders. Nobody else would give them any more orders, so they said to us, "Why don't you buy two more?" At that particular point, some of us who had been in on the original study said, "No. Don't buy two more." Well, everybody said that Offshore Power Systems would go under and they had some of our money, since we gave them progress payments, down payments. And so the final decision was contrary to our recommendation; the company was to go forward and buy

two more. They did, and the project just couldn't make it anyway, even with two more. They had to try to sell more units. They couldn't.

The need for the electricity tapered off. They were having financial problems, and we didn't need what we had committed ourselves to. It's like buying four cars when you only need one. The net result of all of this was an attempt to abort the project but we couldn't abort it because the contract said that whoever aborted it had to pay all the other costs of the other company. This was hundreds of millions of dollars. This was a very difficult situation.

Butler: It is.

Casazza: The other side wanted to stop because there was no money, but they couldn't tell us they wanted to abort because they would have had to pay all of our costs, which were considerable. So we went on for another year or two, and there was almost an extra several hundred million dollars spent in this game of "chicken."

Butler: When was this going on?

Casazza: 1970. Neither side could tell the other. Finally, somehow, after I left, it was reconciled, but there was about five hundred million dollars lost on the project. I don't know how much of this you can put in the history, but it's an interesting story how these things come about.

This is one reason why I wrote my book on transmission;[1] I saw a lot of these things happen. Somehow or other I think the younger generation ought to learn about them. My reasoning is that we who are older and have lived through things have an obligation to pass on some of the good and bad, and in terms of people, not just ideas, in terms of people, projects, institutions. So I hope the history you'll do will do that. Don't just make it dull technical stuff, which is terrible. We have a lot of kids in college who are going to go through some similar things. There will be projects they'll get involved with which ought to be stopped and they won't know how to stop them, and that kind of thing.

The penalty in some cases for society is very large; who paid for those five hundred million dollars? People who use the electricity in New Jersey, that's who paid for it. The public doesn't know that they paid that much. The Public Service Commission knows but an accommodation was made between them and the utilities so the utilities could recover it in their costs over ten years. They let them recover fifty million a year for ten years through extra charges in the price of electricity.

Is this engineering? It is really, because I think you need people to understand both the projects and understand the financial aspects. The one thing I feel is lacking among engineers, and I stress very strongly in the

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1 Casazza, John A., *The Development of Electric Power Transmission, The Role Played by Technology, Institutions, and People,* The Institute of Electrical and Electronics Engineers, Inc., October 1993.

book, are the societal obligations of the engineer. (I give a lot of references in it.)

An engineer has an obligation to use his creative talents, his technical knowledge, to build things that help mankind, while making a nice living for himself. I don't mind that at all. But you have this obligation to give to society a lot of good things, and as a result of giving these to society, you need to look at the consequences of your technology. Are you doing things that have bad environmental effects? Are you doing things that are going to hurt the poor? This is the factor in my career which was impressed on me many, many times by the excellent people I worked for. This was my employment background, and these were good decent people. I used to have a boss who used to always ask me, "How do you justify our position of importance, the salaries we take home? How do you justify this, Jack? Why should we be here doing this, why shouldn't somebody else? Why shouldn't the state government take over? The answer is that we can do a better job and have greater societal concerns than the politicians do. That's how you justify your existence in an engineering project and an engineering role."

I think too many engineers fail to ask these things during their careers. It's philosophy, and the history and the philosophy have to be mixed. My boss was a fine man, and said that the engineer has the obligation to return to society more than he takes from it. If we don't do this, the world goes to

hell, because we are the builders. Look at those buildings. I mean, look at the lighting system, look at the electric power system, the communication, the computers; we have this obligation to contribute to society more than we take from it, and if we don't, then it is a sad world. I think that is an awfully important part of the history in my technical work.

I did an awful lot of technical work, but overriding this technical work and (a lot of it is described in here, and I've got about fifty papers and have made hundreds of speeches) is the fact that the engineer has his societal role, which is not stressed to our students today. It was stressed where I went to school, which was Cooper Union, and it was stressed by the people I worked for, who were exceedingly decent people. A couple of them were very religious, not my religion, but they stressed that we think of right and wrong, not just what was cheaper. I learned to think of those terms.

Butler: You say that this was discussed when you were in school. Your professors talked about it in the context of problems.

Casazza: Yes. In the beginning of World War II, we were listening to football games. In fact, I was listening to the football game when the program was interrupted. I was listening on the radio. The program was interrupted with, "We just received a bulletin that the Japanese bombed Pearl Harbor." I turned to my father and said, "What's Pearl Harbor?" He said, "I don't know; it must be in Florida."

We didn't know what had happened, but the next day we were at war, and

then everyone began to realize a lot of people were going to be killed and all of a sudden people began to think not only of their own rights and privileges, but also of their obligations. What did they have to contribute to beat those people? The Nazis in Germany, the Japanese who had bombed us, what did we have to do, what were our duties? I was still going to school, when our duties and obligations started to be stressed. Modern education has practically none of this, but it was in the time we were living in.

Dickens would say, "It was the best of times, and the worst of times," because friends, neighbors, classmates were being killed; you would see the reports. Your attitude was completely different than the modern kids', "Well, what I am entitled to?" It was, "What should I contribute?" I think this carried over with the professors and in their work. In my generation it was a different time. As I said, it was a bad time because a lot of people were hurt but it was a good time because people worked together so much better except for a few cheaters on the rationing stamps. You had rationing stamps--you would get a stamp for a pound of butter. People worked together unbelievably well because they saw a cause that they believed in. That carried over in some of our work in engineering.

Butler: You have been a little disappointed with the younger generations.

Casazza: I think the faculty in the universities is the prime problem; the faculty members are basically selfish. They are not willing to work long hard

hours. I have given a lot of research money to schools. When I was over at Public Service, I gave out grants of $300,000 to $400,000 to schools in New Jersey. Faculty did not accomplish what they were supposed to with this money, and it didn't bother them that they were taking it and not achieving the results they had promised; it didn't bother them. A lot of the engineering faculties use research projects as a means to supplement their income and they don't recognize they had an obligation. This money is coming from poor people. The utility collects it and gives to them, and they don't realize they have an obligation to do something useful with this. Faculties in the universities tend to be rooted in their research work, getting their honors, getting their high compensation, and they don't have the societal view that I think is necessary. This carries over to the students.

I don't know if you were there Monday at the IEEE Winter Power Meeting. We had a plenary session. We have a video tape of it which you can get. You might want to look at it, it is three hours. We had Dean Eleanor Baum from Cooper Union, whom I like and know very well. She is the only lady engineering dean in the country, but probably one of the best. She stressed the point that the kids in school these days and the professors are not being oriented to what our society needs if we are going to succeed and survive. Look at the session video, you'll find it interesting.

But our concern about obligations carried over from the war. I am sure that the war triggered it. Also the Depression years. I grew up in the

Depression years. We didn't have too much to eat, and you began to learn that you had to share with brothers, sisters, mother and father, and that attitude permeated society. I think there were a whole generation of people like that. I can give you a dozen names here of people who grew up in the same era who had the same attitude. Charles Rudasill from Vepco was one. I worked with Charlie back in the 1950s; we needed to cooperate and work together to do a good job. The philosophy that we had these societal obligations was strong.

We now have a whole generation with a philosophy based on how to make the most money. I am not saying that we didn't like to make money; don't get us wrong, but there was this overriding code of ethics which has in many ways disappeared from our business world.

It was in the engineering profession that it was the strongest, in the engineering profession where the real builders were. Those who execute our engineering designs and ideas, the people who go out and put up the steel structures are the people who create wealth. The wealth you look around and see, not what we have in the checkbook. Our wealth is our power systems, our manufacturing plants, our buildings, our homes, our transportation system, our roads, and our bridges.

Butler: Do you have any suggestion about how young engineers and engineers in training can get back on track?

Casazza: Yes, as a matter of fact I think one of the things they need to do is to have

some of the builders return to teaching. One of the problem with the universities is that nobody can teach in the university without a Ph.D., and you can't rise in the university unless you do a certain amount of research and write a certain amount of papers. The progression up the ladder of the university is not based on your ability to teach and pass on knowledge. It's absolutely not.

Eleanor Baum and a number of others have been suggesting that we need to give people who have been in their careers five, ten, or fifteen years who would like to go back for a year or two to the university to teach, a chance to go back. Don't make them second-class citizens because they lack PhD's.

You can get to be an adjunct professor, but if you are an adjunct professors, you are dirt. Really, in the overall set-up, you are not very important. Give them a chance to go back and to really play an important role. Bring to the university problems from the real world.

For about three years I helped Lehigh University. I used to be on what they called the "Visiting Committee for the Electrical Engineering Department." We used to go out and rate the department head and the overall department for the president of the university. To rate them and we would talk to students. We spent three days there each year and told the president, "We think that he is doing a good job," or "Everybody we talk to thinks he is not running it well." The suggestions we made in those visits

were valuable because lots of times, if the professor was good, he would ask, "Have you got a practical illustrative problem that I can use in this course?" We don't do that in this country nearly enough.

I work a lot in Europe, Australia, and South America and in almost every country the industry people and the university people are co-mingled much better than they are here. One of my good friends in Denmark used to teach two days a week in the University of Copenhagen, and for three days a week he worked for the power system. He was able to bring new ideas, new ways, new approaches from the university into the business world and he brought practical problems back to the university. This made the kind of things the faculty was working on and the students were learning much more relevant.

In the USA my daughter's got a master's degree in Penn State. She was a graduate student, she had a fellowship, and she was teaching courses for the professors. She was not nearly as well-qualified as the professor; That's typical.

But I think some of these valuable things can be done, Loren, and I think we need to look at some of them. I don't know if this is history, but it is the things that I have seen.

Butler: Speak a little bit more about your experiences in Europe and other foreign countries.

Casazza: Well, I had never been in a foreign country until about 1964. I had a boss

who said that there was an international meeting on engineering that he was supposed to go and asked me, "Will you go for me?" It was the CIGRE meeting in Paris. I went over there and there were about 2,000 engineers talking about things that I was very interested in. I was amazed because up until that time I thought Americans were the best in the world. The Japanese didn't know how to make cars; they didn't know how to do anything. We're great.

I went over seas and I saw some of these people from other countries and it dawned on me that there are an awful lot of bright people over there. They knew a lot that I could learn and I started at that point trying very hard to keep abreast of what was going on in every other country I could. I had special friends in England and France. I followed what was going on in Germany, I did a lot of work of that type. I got to know people all over the world and found that they were smart. In many cases they were smarter than we are.

Many times we in the USA had more resources, but sometimes lacking a resource forces you to be more creative. They were in many ways doing things that we could have well learned from. I enjoyed that and I spent a lot of time in Europe. I made a point every two years to visit some of the companies over there and talked with them. They used to come over to the USA and I got to know an awful lot of them. I got to know the people, their wives, their family, their children. Relationships built up which were

exceedingly valuable because when I want to know something I pick up a phone and call, or now I send a fax.

Then about 1971 or 1972, Mr. Nixon had a debate with Mr. Khrushev the "kitchen debate" in Russia. Out of that came the decision that instead of fighting maybe what we should have is a technology exchange. So they set up technology exchange groups in I think three or four areas; I am not 100% sure. One of them was agriculture. The Russians wanted to learn how we grow all that wheat. The other one was science and technology, and there was another one which was space, I believe.

Under the science and technology area they had one group on electric power systems in which I spent almost six or seven years. I used to head the U.S. electric power system planning delegation that went over and met with them. I got to meet a lot of Russians. They were communist at the time, but they were nice people. I always got along with them. Professionally I found them honest, but politically they kept in line. If you asked them whether something worked or didn't they were generally honest unless the KGB man was watching them and didn't want them to say it. There were certain things they were told not to talk about. They followed those instructions. I found it fascinating, and began to see all the weaknesses in their system.

One of the things we did talk about is how we did everything in the USA versus Russia, and this was an excellent demonstration of democracy versus

their system. In the USA, when we have to decide what to do on electric power system, we project the electricity needs by small towns, by geographic areas, by companies, and we accumulate from down below to the top and get a projection for a whole region, a whole country. Over there somebody in an all-powerful bureau would decide what the national total need was and everyone else subdivided it. It's really the difference between their system and ours. Was it top-down or bottom-up? Ours was bottom up and we had discussions about that. Some of this is in my book. In discussions with them we checked the results. Our results were better than theirs. So we honestly talked, and we sat around the table. "Why are you getting better results than us?" I could remember the words in the answer that we agreed to. It was something called "the diversity of error."

In our system if one area was projected high and another one was projected low, and so on, when we accumulated them there were compensating errors. It was this diversity of error which gave you compensating error, so the total came out better. But if you did it from the top and you made an error, it permeated everything.

This is fundamentally the difference of between a dictatorship and a democracy. We don't elect the right people all the time, we make mistakes, but there is diversity in error so over time it compensates and our system works because of it. In the Communist system when they made a mistake it hurt forever. There was no compensating force. Our system has

compensation.

There is one of the things that came out of the meetings. At a lot of these meetings we tried to understand the political systems and their effects. We talked frankly; we used to talk with some of these Russians and say, "Look. How can you continue to support this kind of system when you know it isn't working? Look at how much better we are doing." We went back and forth with, "We are going to do better" and that kind of thing.

My work in the USSR was very interesting, and I still have friends over there. Some of them even at that time were giving strong indications that they wanted to change things. It was oppressive, and they began to see that by talking with us. There were other groups in many other areas who said we had some advantages that they didn't have. Talking across the table, they began to see it.

Butler: Did you observe a lot of technical and technological differences as well in their power systems?

Casazza: First, their economy was much poorer. For example, they did not have anywhere near the computer facilities we had. Secondly, they didn't have the money to build redundancy into the electric power system. In a power system we have to be prepared for things to fail. A transformer fails or a cable fails, and the lights are supposed to stay on. At home you don't know about it. People say keep the lights on; I want to take my shower, watch my Superbowl game and do my laundry.

They didn't have the redundancy or the money to maintain the same degree of reliability, but in many areas they were very clever in compensating for this lack of money. I think we learned some things about what they did. I think 90% of the time what we did was better than what they did, and about 10% of the time what they did was better than our procedures. They recognized this, and they appreciated the fact that we were giving them 90% for 10%.

This is why some people in the USA began to say, "This is stupid; these people are our enemies. Why are you helping them like this?" My feeling always was that peaceful exchanges, even a knowledge of technology in various areas, was not going to determine the outcome of this Cold War. I think history showed us this. Most of us involved did in this work felt that by being fair and honest with our Russian associates we were doing good for the United States. In the long run they were going to say that we were nice people. We felt that someday some of these people that we were talking to were going to be higher up and were not going to fear us because of their personal experiences. I think some of them did rise to their higher up positions.

Some people would say that they wouldn't want to do much with North Korea or the Somalian government or the Serbs in Yugoslavia, or whomever, but I think the technical people, by working together, really started setting an example or maybe a precedent for the political people.

Engineers have played a large role in this kind of thing.

CIGRE, which is the international organization, has really been a wonderful place to work. I worked with communists there. I worked with Iranians there when they had American hostages. We all worked well together. People may say that you are being disloyal, but I don't think I was. I think we were finding areas where we could work together. Maybe they'll be more of those times and fewer when they'll keep hostages in the embassy.

Engineers are very willing to help others. In the electric power area they are exceedingly willing to help others. Part of the reason is that what I tell someone about how to build a better substation or transmission system can in no way hurt us, and what he tells me can in no way hurt him. There are no direct military implications in any of these things, and over time we are both better off, so it's a win- win situation when engineers cooperate.

I wouldn't give them defense secrets or anything, but in the end both sides recognize that. I think telling someone how to grow wheat or corn better and that kind of thing really wasn't hurting us in the long run. Somebody said, "Well, now they have more food." Yes, they have more food, and maybe they aren't quite as hungry and aren't quite as aggressive to take somebody else's food. Engineers are good at that, looking at the total system picture.

As we moved into the 1980s, a lot of people began to say, "Well, electric

power systems are not efficiently run. They are not efficiently designed because you don't have competition." People only can buy from one supplier. This is a good question: if I can buy shoes from five people and bread from fifty bread companies, why can't I have more than one electric supplier? Part of the reason is that we can't afford to have two different people. It would double the cost for two different companies to be able to run wires in your house. You have to have only one. So the next question is, supposing you've got only one, why don't you just use that as the delivery system? Use that like the United Parcel Service, be able to buy from any store you want, and just have one delivery agency? That is not too far- fetched, but the real problem with that, the thing most people don't realize, is that if all these people who had been cooperating start suddenly competing, it can hurt the public. The cooperation between people is now changing. Engineers won't cooperate with one another as well, they won't tell each other as much, and the exchange of information, and ideas is lessened.

Even here at this IEEE meeting it is lessened. Companies say, "Well, we got this new way of doing things. Don't say anything about it; we can use it to take business from the other fellow." It used to be that sharing information did not harm you because you had customers they couldn't take them away from you. Now we are moving towards a set-up where they can take customers away from you. You don't help competitors.

A good example is when we have major storms, there are power interruptions. Trees are down, wires are down. Ice storms and hurricanes. Typically, if one company had a lot of customers out of service they would call up the other companies in the region and they would send their line crews and workers to help restore the wires and service. Now some are saying, "The next time they have a power outage, send in the salesmen." I am serious. It's a different psychology. "Send in a salesman, get them to sign over with us." In almost every business, service is an important part. We want to show that we'll give better service than they can, and we'll get customers to switch over to us. We are into a new age of electric power, which has an important impact on the engineering for electric power systems. I said, the idea of working together and cooperating, even with Russians, is now not what it used to be. It's changing.

Through the years I have had a sort of sense built in the seat of my pants or at the top of my head or whatever you want to call it that some of the things I was seeing were historically important, so I started to keep records of it for future reference. Some of these records are good, and some of them aren't any better than your pad here. But I have a tremendous collection of material on the history and development of power systems, the things that I was involved in. I've got three file drawers of documents, press releases, an awful lot of stuff which might be used to implement some of your things, and you are free to have it anytime you want it. Do you

ever get into the Washington area?

Butler: Absolutely.

Casazza: Sometime when you are in the Washington area and you have a little time, I'll let you look through my files. One of the reasons I've been able to do a lot of this work is that I have kept things orderly. I have indices of the things in my files. I know where things are and I can find them. I can send you a table of contents of what's in these files.

Butler: That would be excellent.

Casazza: If that would be of any use to you, you are welcome to it. You don't have to credit me or anything, and there is one other thing I wanted to point out to you while we are here. I have here a copy of a very famous book; this is a rare copy and they are exceedingly difficult to get. This is a book that was done by William Spencer Murray as you can see, he was an electric engineer and this work was done at the suggestion of the professional societies, ASME and AIEE. I got this through some other people. The original owner gave it to somebody who gave it to me. It's Superpower: Genesis and Future, published in 1925. This predicted the development of electric power systems in the future. There are an awful lot of things of interest in it, tremendously interesting. For example a Congressional Committee was formed at the suggestion of the professional societies!

Our role is now so downgraded. The professionals prepared this whole book. For example, they show the systems in the northwestern United States

as they were in 1919, and how they were projected to grow. This has material that you cannot get any other place. Out of this came the suggestion that there had to be regulatory commissions. Based on this book the government formed the Federal Energy Regulatory Commission. Then came the state commissions, the public service commissions, e.g., there is a commission in New Jersey, the Public Utilities Commission. Out of this came the whole concept as to how we were to build the electric power industry and how the government was to control it--one book called Superpower. If you would like to borrow it, you are welcome, but I won't give it to you until you are ready to use it because it is a rare volume, and if it's lost it's irreplaceable.

Butler: Right. I am optimistic that we would be able to track it down through interlibrary loans. It is a very sophisticated process.

Casazza: Have you got the name?

Butler: I have got the name down.

Casazza: Superpower is probably one of the best books around. I have another book which I recommend, the Existential Pleasures of Engineering written by Samuel C. Florman whom I've never met but I have been writing to for a year.

Butler: I remember reading this book in my college days, but I may turn back to it now.

Casazza: This is a new one.

Butler: This is new?

Casazza: Yes. He wrote another one in 1968 called Engineering and the Liberal Arts. But this one was written in 1976. Samuel Florman is on the National Research Council, involved in engineering education activities. He should be a good contact for some history. His book is not on electricity per se but it is a fascinating book. If you could write a history as he has done it it would be great. In fact, I read his book before I wrote mine, and the key is mixing people with technology; it's awfully dull if it is straight technology. He deals with people and philosophy, and he points out why engineers have come into disfavor and are mistrusted now as compared to fifty years ago. Dullards and Demigods is a Chapter title. He has titles like that, but they are good. Those two books I would recommend highly.

Butler: Well, thank you. Those are excellent tips.

Casazza: I think I have given you a copy of my book on "The Development of Electric Power Transmission" published in 1993 in the IEEE Case Histories of Achievement in Science and Technology. I thought I brought it with me. I have a good executive assistant. Here is the table of contents of my book on transmission. I think if you look at references in the book, there are some sixty or seventy references, you'll find that they are awfully complete. Here is my home file reference. These are what I have got in the file numbers. I have got about five book drafts that I may someday want to publish. What I have done from time to time is to write down what I am

thinking and why and draft a summary paper. So I have got all these drafts for use in a book. I always pick a sexy book title like E Pluribus Unum and so on. The IEEE book was to be called Anatomy of Electric Power Transmission in the Twentieth Century. The conservative IEEE changed it to "Development of Electric Power Transmission." But there are book drafts here which have a lot of material in them, which I don't remember all of because a lot of this I wrote years back. Here's other journal reference material. A lot of the utilities have had histories published of them. Public Service Electric and Gas of New Jersey where I worked had an author do a history of the company. He was a friend of the chairman of the board and they paid him $25,000 to write this and it was absolutely terrible. It wasn't good but some of the utility histories are good. These may not be listed in a lot of the libraries.

Butler: We have a small collection at the History Center. Just a selection of the utility histories.

Casazza: Utilities have histories. I have in my files awfully interesting historical stuff. For example, I have some material from 1915 or 1916, a letter from Edison to the utility of New Jersey saying, "I think your service is excellent, and your price is reasonable." Nice letter, you get a compliment. I have also had dinner with one of Edison's sons. In fact, it was down in near Piscataway or New Brunswick someplace. He was ninety-four at the time. One of Edison's sons became governor of New Jersey, but this was the son

who didn't. This must have been 1955 or 1960, and it was fascinating to talk to him about his father.

Butler: You should have jotted down those thoughts.

Casazza: I should have typed them. Perhaps what I have seen is everything from Edison because one of my bosses did some work with Edison. Edison died in 1931. But some of these people I worked with were working for the company in 1915. I started in 1945, and that was only thirty years later. If they started at twenty they were only fifty. They had met Edison and worked with him, so there was a lot of transition. I went from the people who knew Edison through to the atomic age. That was interesting.

Well I'll leave you these lists, if any of these are valuable. I have a lot of historical material on a lot of things--the USA-Canada electricity interchanges, the inter-regional transmission grid. This is mentioned in my book, a particularly important study. This study I'll mention to you here: Some of us had the idea that we had to build some high voltage lines in the coal mines into the East here because oil prices were so high in the East that we would get electricity cheaper here. "Coal by wire" was the term. We looked at building some additional lines and we found that certain lines were economically justified. They were good, they were in the public interest, and we couldn't get the financial support to build them. We could not get the financial support because all the companies that would benefit wouldn't contribute their share of the needed capital and the others said, "I

am not going to pay for him." You get into that kind of problem in the real world.

Butler: And this was in the 1970s?

Casazza: This was 1971. In 1973 we had the oil embargo and because we didn't have this line, we paid a fantastic extra cost, perhaps billions of dollars extra for the added cost of the oil compared to the cheap coal we had in the West which we could not convert into electricity and bring to the East. Here's a case where the engineer saw the need but perhaps the engineers (and I was one of them) weren't smart enough to put together the financial package to execute it. Maybe we weren't smart enough, maybe the people we were trying to sell the idea to weren't smart enough to listen to us, but either way there was a failure.

These failures from time to time have hurt society, and engineers need to recognize that they have hurt society. It's not electric, but a very good example is the bridges in New York. Engineers have known for years that these bridges are decaying and getting close to falling down, but they let the city stop doing any maintenance on them. You get to the point where the bridges have to be closed because they are unsafe to use. The bridges across the river are too precious to let that happen. The engineers have not spoken out. They have kept their mouths shut. That is a failure of engineering: not to speak out when the public interest is at heart. It may cost you your job but somebody has got to do it.

Butler: I wonder if you could talk a little bit more about the case of the aftermath of the oil embargo and engineers' responses?

Casazza: Well, in about 1970 a number of companies, American Electric Power, Public Service Electric and Gas, General Public Utilities, Niagara Mohawk, Con Ed, Philadelphia Electric, and a number of other companies said, "We need to take a look at whether a new transmission line from the West, maybe out in Ohio or Indiana someplace, coming to the East to deliver this low cost coal energy is economically justified." So we arranged a task force and they studied it, and it came out with a report and the project was justified. Then the next step was to try and put together a critical mass of institutions that would do this. We invited a lot of people to come down and take a look at the report and we met in Philadelphia and spent about a whole day going over the report. At about 2:00 in the afternoon, we said, "Now we are going to talk about who's going to participate and to what degree in this project." The net result was that our company had talked and I had the power to commit Public Service. Others committed, but the people at Con Ed and the people at Niagara Mohawk said, "Well, that line has to be built in Pennsylvania and New Jersey. That's not our territory. We don't want to put up any money." They were going to get a lot of these benefits. They had to put up some more money because we wouldn't put it all up. They refused and we did not go forward with the project, but it was mainly the eastern companies. When the oil embargo came, they were deadly sorry

that they had made that mistake. It was very difficult at that time to build it because when you build transmission lines you have to build them pretty much over virgin territory. People don't like transmission lines; if their house is in the way, they like them even less. So the problem became one of getting right-of-way and being able to build it. Within a few years it had gotten to the point that it was impossible and that line cannot be built now.

There are certain times in the history of all kinds of developments, particularly when you are using land and there are societal consequences when you are able to do things. Later on it is too late to do them. You can't do it. You have to take the opportunity when it's there, particularly in electric power projects. Once everybody has got their homes along the route, you are not doing anything there.

This part of the engineering is looking at the societal questions: what harm are you doing, what good are you doing? Is this the right time to do it, or is it better to do it later? These are questions which are not amendable to solving with equations but are still engineering problems. The engineer is best skilled to do them, I believe.

Butler: So was PSE&G able to do anything constructive in response to the oil embargo and the high cost of energy in the early 1970s?

Casazza: Well, yes. We did everything that we could, but we didn't have this line to deliver low cost energy. We brought in as much as low cost energy as we could.

I would like to talk a little bit more about the oil embargo. You might find it interesting because again, suddenly, like Pearl Harbor, the oil embargo came right out of the blue. We were rolling along, doing our work, the lights were on, the power plants were running, and all of a sudden OPEC said, "No more oil," just like that. Well, we had a couple of tankers en route delivering oil and we had three days' oil storage in our tanks. All of a sudden we got no more oil and the federal government that afternoon asked for representatives from all the key companies in the area to go down to Washington. I went down representing the PJM pool, in which Public Service is a member. We came to Washington, and sat down in the room. They said, "We've got to make a program to help us survive." I can remember until this day the basis for the program. They said, "Look. Not everybody is going to get all the electricity they need. How do we allocate?" After some discussion which only took about an hour, the decision was that we give the electricity first to industry, to keep industry running. This keeps our production up, keeps people with jobs, keeps getting them salary checks. Industry first. Some of the sacrifices have to be taken in other places: residences.

What came out of this was that the governor of New Jersey, Brandon Byrne, a nice man, but who issued an order, "Thou shalt keep your thermostat at sixty degrees." He issued an order and everybody said, "Nuts. You are not coming into my house to check it either. This is my home, my

home is my castle." Well, if he had asked for cooperation, he would have done a lot better than issuing an order. But out of this campaign we started to not run our generation as much. We began to buy generation from the surrounding systems. They produced the electricity and sent it over the transmission lines instead of us using up our very short oil supply.

There were some systems that had thirty days of oil in storage, but we had only three days. What we did, and the utilities did this cooperatively, was say, "We are all going to help one another." The philosophy at that time was what I call the three musketeers'. That was the term we used--"one for all, all for one." We helped one another and we minimized the societal impacts by cooperating with one another. Maybe one company had to ask its customers to take some sacrificial steps, but was the impact less from the viewpoint of health and other things than if other customers curtailed? What we should do is average this out and do the best we can with what we have got on a regional basis, not worrying what's good for this town or this state. Let's do the job so that the people of the whole Northeast are in the best possible position.

Now we have departed from this three musketeers approach, and it's in the literature. They've gone to what is now the "lone ranger" approach, which is that you take care of yourself and I'll take care of myself. Societally, I don't like that nearly as much. Maybe the other approach of you take care of yourself and I take care of myself is better for competition and maybe

competition will force people to do better, but I believe it isn't as good as the cooperative approach that I have seen almost all of my life. The cooperative approach with the Russians, and everyone else, is good for society, good for mankind. It's the right thing to do and in the long run it leads to benefits that you don't get by being cut-throat. Cut-throat capitalism is bad, but cooperative capitalism is good.

Butler: Did any of the procedures that you implemented during the emergency period around the embargo continue on? People went back to the old ways?

Casazza: They used some of them. During the past cold spell, some of these procedures were put into place. What we also have now is procedures for reducing consumption. In Washington D.C. they shut down the federal government. Everybody decided things were better without it. The traffic problems were gone. Maybe we don't need them. That was interesting. I have been involved in a number of these blackout investigations. I am going to tell you about that one because that's an interesting one. This is a little historical thing. Consolidated Edison, back in the good old days, was a giant--a callous ruthless giant in its dealing with other companies. They thought that they were all-powerful, the biggest company in the United States; they had money. Very frankly, they were hard to work with, very hard to cooperate with. It was the attitude of everybody who worked for them. They finally got to the point that their inability to get along with their neighbors was hurting them, and they brought in a man named Charles

Luce, who had been in Washington as Secretary of Interior or something similar.

Charles Luce's first step was to tell everyone in that company, "Look, you'd better learn to get along with your neighbors. We need them and they need us. This bickering and fighting all the time is bad." So we started to work together with Con Ed and things were going reasonably well. In fact, I had done some joint work with Con Ed agreeing on a new interconnection with Con Ed across Staten Island. We had started to put in the new interconnection, had signed contracts, and all of a sudden we heard Con Ed was going to put in a huge generator called "Big Alice."

I don't know if you have ever heard of big Alice? It was a 1,000 megawatt generator. They did this because their reputation was going down. Wall Street was saying they weren't progressive, they were stuck in the mud, and it was affecting their stock values. So they decided to build the biggest generator in the world and bought this generator and were going to put it in. When we found out that they were going to put it in, we began to check. Before we had agreed on the new interconnection, the officers in Public Service said, "Be sure you can trust those people." That's the question I got from the chairman of the board and I said, "Yes, I am sure we can trust them." Then about two weeks later we read in the newspaper about something I didn't know about which would cause us harm.

We made studies and found out that if they put in that generator it could

cause transmission lines to burn down in New Jersey and maybe as far out as Pennsylvania and Ohio. So we had a meeting with Con Ed and a lot of the top people came and told them that they could not operate that generator. They said, "We're building it, and you can't stop us." Then we had to try to find ways to protect ourselves and not harm them any more than we had to. Basically, we found what I would like to call a technical and institutional solution. First, they agreed that they would not operate the generator with more than 600 MW being produced, and then we put certain relays on so that if they didn't keep their word the lines would trip and we wouldn't get hurt but they would.

Power pooling is coordination, this coordination thing is a lot like mountain climbing. People tie ropes around their waists, three, four, five, six of them when they go climbing. In case one falls, the others hold them up. That's what this cooperation is like and in that sense it is very beneficial. On this new generating unit they put in, we weren't quite sure they could do what they said they would, so we put a special relay on the line to Staten Island and everybody said, "Are you sure that's right? Suppose that thing operates improperly, it could cause a lot of problems." Yes, it could. We put this special relay in service.

On November fifth or something in 1965, I am riding home in the car listening to the radio and I hear that Consolidated Edison and all of New York City is black--no electricity. I said, "Oh, my God. That relay we put

on didn't work right. It failed to operate properly." I thought it had misoperated and caused the blackout--it was a funny feeling. When I got home, I called some people at our dispatch center and I found out that we had not caused it, but for about twenty minutes, you couldn't imagine how low I was, thinking that I had done something that shut down New York City, and all those poor people stuck in subway trains.

It turned out frankly if that the relay hadn't been there, the blackout might have spread into New Jersey and other places. It served its function and it operated properly, but sometimes you make decisions in engineering and you begin to ask afterwards: Is it right? Did I make a mistake? Did I hurt somebody? This is part of what power engineering and electrical engineering covers. It's not just the technical calculations, but again the societal impacts. The good engineer is looking at what it is going to mean to other people; that's the key.

A year and a half later we had a blackout in New Jersey. Right after the Consolidated Edison blackout, I was asked by our corporate officers if the same thing could happen in New Jersey. So we made a lot of studies and had undertaken a lot of corrective actions. You learn from the other guys' mistakes if you are smart. We were making some changes in New Jersey, but we hadn't finished them.

One of the changes we're making was putting in a new computerized total system control system, the first one to be installed in the whole United

States. Incidentally, the whole concept of this control system I got from Europe. The British were doing it in 1962 and there are some companies that have not done as much in 1993 in the U.S.A. They had a computer which would continually check the network and see where bad things could happen, if something tripped out. They called it a "security assessor." We were putting in the same thing in New Jersey. It hadn't been completed when we had a blackout in New Jersey caused by a problem down near Philadelphia.

With electric power systems, if you lose a generator in New York City they see the effects in Miami, in North Dakota, in New Orleans. It's all one network, and with electric power networks the electricity flows around the speed of light at around 180,000 miles a second, so that when things happen here, they happen very fast in other places, and the controls and sophistication of the system make a very complex system. I know the people with electronic backgrounds don't understand it. I don't understand everything about computers, but I think I know a lot more about communications, telephones, and computers than they know about power systems and how they work. The fact is that this is an instantaneous system; it's the only system in which you produce the product the absolute split second it's needed. When you flip on a light switch a generator has to respond with the speed of light and provide this electricity. There is no time delay; you can't route it. It goes in accordance to the law of science. Well,

people don't realize this.

With this blackout we had in New Jersey, our company officials were called down to the governor's office. I think the governor was Thomas Hughes, but I may be wrong. The governor said, "I don't want to tell you your business, but don't ever let this happen again. It hurts the state. We can't attract business, we can't attract industry, it costs us jobs, it costs us tax revenue. This is bad. Don't let it happen anymore." So we went away and I got the assignment of chairing a committee for about three months to take all the necessary steps, and I would never say that it won't happen again. I said we will do everything to minimize the probabilities of it happening again. This is the way you have to handle some of these problems, because in technical areas no one, absolutely no one, can give 100% assurance that certain things won't happen. There was always a possible combination of events, and I have always felt this way about nuclear power.

I am a strong supporter of nuclear power. People say, "Well, aren't there some combination of events that can cause problems at the plant?" The answer is yes, if you are honest. There is a combination of human mistakes, technical mistakes and so on which can cause a problem. None of these would lead to an atomic bomb. That's not possible because the right combinations of materials isn't there, but you could have some kind of problem with the plant which could be important. But then you have to ask,

"What's the probability of that? What are the chances of that? What are the consequences if that happens?" The probabilities and consequences, you look at both: how many people are going to be hurt; how seriously are they going to be hurt? Then you have to ask, "Well, suppose we don't build a nuclear plant--what are the consequences?" If you look at the consequences without the nuclear plants, the air pollution, the global warming, CO_2, they are very severe. Again, my approach is that you should look at it from a societal viewpoint. You look at what happens if we do it, what happens if we don't do it.

Butler: Were you involved in the planning or building of any nuclear plants besides these planned floating plants?

Casazza: Yes. I was involved with planning Hope Creek, Salem, and Peach Bottom. I think they were good. There are some things I have been involved with planning, which were executed, and ten years later I knew we had made a mistake. Anybody who does any amount of work will know that sometimes he made a mistake because no one can foretell the future. It is sort of like the quarterback; sometimes you are going to throw an interception. But you keep them to a minimum and you learn from your interceptions and your mistakes. But the nuclear plants were not mistakes.

There were other good plants, some of them mine-mouth plants that we built out in Western Pennsylvania. If you look at what the cost in electricity in New Jersey would have been if we hadn't built them. . .

People say nuclear is more expensive, and that's not true. Look at those plants and what it would have cost if we hadn't built them. They have saved the people of New Jersey money, and they haven't been spewing out carbon dioxide and other things. They have been safe. I will not promise you that they'll be safe in the next hundred years, but all I will tell you is that the risks are less than the risks of not having them, and that is all you can do. With a lot of power projects, that's basically the approach.

Butler: You have talked about several big historical moments in power over the past couple of decades. You have mentioned a lot of peoples names in passing, I wonder if there are really any important points you feel that you have missed, that you would like to return to?

Casazza: One of the reasons I wrote this book on transmission, is that what each of us does affects other people. Whether you are a teacher or an engineer or so on, we're influenced by the examples: our mothers and fathers, our families, our friends. One of the things I have been very happy about is that my children in school made good friends. They are not the kind of people whose example they are going to follow and get into trouble; they are good citizens, at least most of the time. I was influenced very importantly by a number of people in my life and their example impressed me. It wasn't what they said as much as what they did. Some of them are in the book.

Joseph Swidler is one of the people who influenced me very much and

you must interview him. He is eighty-seven years old. At the age of thirty-two in about 1930, he became the number two man in forming TVA. He's a lawyer, but at heart he is an engineer. I don't like most lawyers, but he thinks like an engineer. His philosophy is part of his reasoning. He was appointed originally by John Kennedy, he was a friend of Eleanor Roosevelt, and was also appointed by Rockefeller. He has a tremendous collection of letters from presidents and people like that, and it's all in the area of electric power and electric power policy. I think if you are in Washington sometime, visit Joe Swidler. If you need his phone number, call my office and you tell him you are doing this history of the IEEE. Mention my book; he has a copy, and he encouraged me to write it. He was talking about doing a history himself.

One who impressed me the most is Bob Hooke, who has now been dead about fifteen years. Bob was a Unitarian, a very religious man, and he believed very strongly in this obligation to people. I can always remember when I was a young engineer of about twenty-seven. I did all this wonderful calculation and everything else and I gave him the report. He read it and I went back in a day later. He said, "Let's discuss the report." He went over it and he asked me about this number and that number. After about ten minutes he looked out the window--this was in Newark, and you could see all the slums--and Bob said, "Jack, you have all the numbers down here, and it looks like you are right. Can I ask you one question: what's best for

those people out there?" Engineers don't ask themselves that question as much as they should, and he did this a lot with a lot of his younger people. That is a philosophy you don't see in government. You don't see it anywhere anymore, or at least not as much as you should. The engineers I worked with had this concept: we are here to do a job better than anyone else can from the public viewpoint. We used to call it the public interest concept. If we do our work right, the public is better off. They get more reliable electricity, cheaper, with less environmental impact. If we do it properly, then we deserve the maximum salary we can get. That's the way it ought to be. That's the way we saw capitalism in electric power engineering and the people who set the example.

I have tried to set similar examples from time to time, but I don't always do it. Some things I have done I wish I hadn't, but I'll tell you this. I haven't taken much salary for the past two years. I keep working and a lot of the money I am making I am contributing to causes of various types. I don't need the money. My wife and I live quite comfortably, we can travel where we want. What do I need with 2,000 pairs of shoes like Emelda Marcos? What do I need with a big fancy car? I am quite comfortable the other way. I have had luxuries as a high official and I found that they didn't make me happy, so I have gone to other things.

One of them was writing this book. and I have set up at Cooper Union this fund for improving government technical competence. I think our

government technical competence is terrible. An example is the Department of Energy. Hazel O'Leary whom I know, (in fact I have done a TV interview with her), the Secretary of Energy, is a nice lady who's technically ignorant. She thinks politically; all of her thinking is: "Where I can get the most political support? She has never asked herself: "What's right for this country? What's right for our grandchildren." That's what I am concerned about. Why do I buy life insurance? Because I want to provide for the people who live after me, my descendants. Why do I try to accumulate some kind of estate and have a will. Because I want to provide for them. Yet in government policy we don't provide for them. It is an absolute contradiction.

The people I worked with did set this example; they felt that you need to take a twenty-five or thirty year look. Look at what's right in the long term and move in that direction. Many people say that the United States is becoming a second-rate nation in international competition because our view is for profits now. I like to call it the "me now" generation. "Right now, me now, my rights, my profits and the hell with everybody else for the next fifty years." That's the psychology governing America right now.

The people I worked with were probably the most important single thing in my career. Probably the most important single event is the fact that I was fortunate enough to work for these people. There are other people who have not worked for such people, and they get very negative. I was lucky and I

enjoy what I do and I enjoy working with the people I work with. When I didn't enjoy it, I left. I was fortunate my children were through college. I had enough money and I could be independent. I am now, and as I said I run my own business, I am the principal owner and I say and do anything I want and if I lose my money, I lose it. Nobody else does. So is that a good summary?

Butler: Very good. Thank you.

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"The Bribing of the 'Me Now' Generation"

By J. A. Casazza

During the past year there has been increasing attention by the American Public concerning the use of business and government power to generate wealth or funds for personal purposes. Much of this has been focused on the raising of campaign funds and the many evils involved in the way this has been done from the sale of a night in the white house bedroom, coffees with the President, and special favors through the Department of Agriculture. This is merely the tip of the iceberg that may sink our way of life, our talents. We need to look much deeper to avoid the national disaster of which we face.

I have limited knowledge, having been heavily involved in the activities related to the restructuring of the electric power industry. These activities have clearly shown that those involved are not concerned about the overall welfare to the American public, but merely their own financial welfare. They are involved in a massive effort to shift wealth, shift cost, shift economic benefits from one group to another with themselves, of course, receiving the economic benefits while others pay the extra cost.

Why does the American public not only accept, but sometimes support, such activities? In fact, they hardly even notice or care about them. It is because they have been bribed. They have been told that these changes will lower your cost of electricity and that they will make a lot of money by investing in the company; buy these bonds, you will make a good interest rate and they make no cash. They are not interested and are not being told the source of the money they are making. Stockholders and investors really don't care about the source of the money they aquire. They close their eyes and look at

stock is paying a good dividend. They close their eyes and look at stock's earnings, how fast its market price is increasing and then decide what stock to buy.

We live in a "me now" generation. Most want economic benefits now and are, willing to accept an immoral precedent, regardless of the long term effects on the country. They are not concerned about the future generation of our society and culture that will suffer. While this is evident in many areas of our society, I will limit my comments to developments in the electric power business. In connection with the restructuring of electric power systems, support has been garnered from a large number of groups who will receive, these include: the companies that make and sell meters not needed with the exception of retail wheeling. The accountants who will be employed and receive additional fees as a result of the large number of additional transaction costs that will take place. The lawyers who will have to write the many, many new contracts required and revise many of the existing ones will achieve huge economic benefits. The engineers who will have the knowledge by the financial interest required for their financial marketing, who will gain from the increase in engineering jobs not otherwise needed and higher salaries that will result in.

Are these financial rewards really not bribes? Are those accepting these rewards really concerned with the additional cost to the public that will accrue as a result of all these benefits they obtain? Those investing in the stock of the many companies who are now involved in the restructured industry, the power marketers, the independent power producers, etc., are being told they will make far greater earnings on their investment than if they had been put into a traditional utility. This may be true, but it involves extra cost to

the general public. All cost increases must be paid by the users of electricity the stockholders and taxpayers.

In California, the power system has been restructured to give all consumers a choice of power supplies. A rate reduction to consumers of 10% was promised and given. However, a competition transition charge (CTC) of about 17% was added. This resulted in a net increase of 7% to most residential customers. In addition, the total costs to set up (not operate in the future) the new ISO, the power exchange, and other associated changes has been estimated to be $1.5 billion . Who has provided these funds? The rate payers? The stockholder? The tax payer? Attempts to find out are met with stony silence. The end result? Every one pays more to allow 0.69% of consumers to switch suppliers.

The engineers who assisted in some of the work involved in this change had to sign statements agreeing meet to comment adversely or criticize the potential effects of these changes before being hired. They were bribed with a job to silence them. The same thing happened with the California blackouts-no real review of the contributors of new unstructured structures to the blackout was made. Too many have to be politically correct to hold a job.

Many power plants are being sold. Most sales are for more than "book value," "Book value" is used to determine an important component in presence regulated charge for electricity. The new owners will have to charge more, again causing electricity charges to increase. It is pure fantasy, a kind of perpetual motion to know that constitutional charges will increase costs and still promise stockholders higher profits and consumers lower costs. Many perpetuating this myth are being bribed by high salaries and bonuses.

Last, but not least, are the bribes being taken my beloved engineering profession, my lifetime training taught me that the engineers role was to do it better and cheaper than others could. I believed (and I still do, that is why I write this article) that my professional obligation was to provide a reliable system or project while minimizing costs. I just returned from an international meeting in Paris attended by over 200 countries. Most discussions of new methods focused on how to insure reliability of service. This new generation of engineers is from the "me now" generation. Their professional goals and activities are based on the profits they can produce. A whole generation of engineers is subject to the rush.

In all of this there is the question of the proper functioning of capitalism. I am a capitalist and believe in capitalism. I do not believe, however, that capitalism should have as its sole goal the maximizing of profits. That capitalism should not allow "robber barons" to reap off the top at public expense huge profits without contributing additional benefits to the public. Capitalism needs to reward those who contribute better ways of doing things. Better equipment. Better methods. Better technologies that will enable us to produce goods and services at a lower cost. These are where the rewards should go. Under many of the new procedures the rewards are going to those who are skilled in financial maneuvering. Skilled in playing financial games.

Our government does not seem concerned with this. In fact, this is where the contribution comes in the campaign financing. Those who can make many of these huge gains from legislations and regulation changes are quite willing to contribute some of them back to the political groups who are making them possible their huge gains.

At the core of all of this is our banking and investment system. This system is required in the capitalist structure to pay and reward those who are involved in helping the American public make wise investments with its surplus funds. These investments should go to the areas where they will help produce better products, lower costs, and generally benefit the American public. For this service those making the investments should obviously be well rewarded, and those who are helping them make the investments should also be fairly compensated.

What we have now, however, is a banking and investment system where those who make bad decisions in advising the public in investing the public's money are saved by our government and by the international institutions. And an outstanding and specific examples are given by the recent decisions of the International Monetary Fund (IMF). It is obvious that those who mouth the mantra "free trade" expect the rest of us to save them from the disastrous results in the free market of some of their decisions. They have asked Mr. Rubin to devise a plan to save them from the consequences of their bad investments and loans. At this time we have a situation where Citicorp has $60 billion in Asian loans, many of which are very risky loans in the first place. Chase Manhattan Bank has $32 billion. J.P. Morgan has $23 billion. And Bank of America has $16 billion. These bankers have made these loans without adequate security. They have taken risks with the public's money and now require governmental and international bail outs. Isn't this a key reason why investors show little concern over the actions of those to whom they aive their money, why investors accept the "bribe" they receive to tolerate us excessive ----? Is it fair that a large bank makes an inappropriate or poor decision concerning investments and looses a lot of money, that the American public should bail them out? I doubt it very

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much. It is not fair that if a small businessman, or even a medium sized businessman, makes an investment decision which has excessive risk and as a result looses money, they are not bailed out by any of these federal or international institutions. The key to success apparently in America, is to take huge risks. The government will view the consequences of the bad results from these risks as so large is that the overall country will suffer, so they will bail you out. This is obviously not the way capitalism is supposed to work. If the government wishes directly to mitigate the effects of very large unwise investments, it should not provide funds to those who have made these poor decisions. Rather it should provide whatever funding it wishes to those who have been affected by such decisions.

Worldwide our government, the World Bank, and many others, have focused on the importance of the application of market forces. The importance of unrestrained or pure capitalism. This view permeates a great many decisions concerning financing and aid to developed and poor countries. These countries are being forced to do something that in their hearts they know is wrong for them. This focus on immediate profits as the only parameter for judging what is wise to do and not wise to do is very damaging. The market should not be the only arbiter of human life today. Capitalism as part of the decision of investments also looks at what is good for human beings. Unrestrained capitalism can be just as ruthless disregard for human welfare. If it is to survive, capitalism must strike a balance between the pursuit of profits and social welfare. The striking of this balance is vital to the future of the world. It should be done in the Board Room and not with government legislators.

What can one conclude from this? One can conclude that the core of our problems in the USA, whether it is in campaign financing, restructuring the electric power industry,

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helping poor nations, is the excessive power. The dominant power that is given to those who control our funds. The investment bankers, those who are employed by such banks as the World Bank, the IMF are our new royalty, they are dominating our society while at the same time promoting unbelievable wealth and privilege for themselves. They are skilled at "bribing" the general public, they investors and the tax payers. They claim they earn the huge sums they receive. This new royalty needs to be examined carefully and their powers restrained.

Our society is, now dominated with an obsession with our rights, our entitlements> What is in it for me? is the slogan of the "me now" generation. We have a "Bill of Rights" which has provided us with our freedom. It was understood by prior generations that this requires all to meet their obligations to keep freedoms. Many have given their lives as a part of these obligations. I propose a "Bill of Rights" to guide us in the future. A good model to start with is the "Ten Commandments."

JAC
1999

Our Schools Promote the "Zero Religion."

By John A. Casazza

When I grew up, I was taught that our constitution prohibited any official religion in the U.S.A. No religion was to be favored by government policy. Sadly, this is no longer the case. While we prohibit activities based on the Christian, Jewish, Moslem, Buddhist, Hindu, and other organized religions in our schools, we have given full official support and aid to the "Zero Religion."

If one looks back in history we see societies that were hamstrung and limited in their development by lack of one simple piece of knowledge. Our Roman predecessors developed a civilization which was able to conquer and rule a large part of the world around the Mediterranean, their "mare nostrum". Then progress was hampered and ultimately limited by an important factor, their number system. They did not realize there should be a number for nothing!

Around the tenth century another competing number system began to be used, the arabic system we now use. This had a tremendous advantage. It recognized that there should be something to represent nothing, the number zero! With this breakthrough, our modern number system was able to evolve. It was the keystone in the development of scientific knowledge and our ability to calculate. This leap forward in man's knowledge, the recognition that zero was something, set free man's mind in science and in many other areas. It helped trigger the Renaissance.

What has this to do with religion and our schools? Is it not true that if zero is a number, then no religion is really a form of religion? Is not atheism the "Zero Religion"? Should we not recognize that we are fostering in our schools and in our society this "Zero Religion" when we refuse to allow the mention of God or religious holidays in our classroom? Are we not violating our Constitution when we promote the "Zero Religion"?

We live in a society where the rights of criminals are considered more important than the rights of victims. We live in a society where rights of individuals and minority groups are more important than their obligations to society. We ignore the rights of majority groups. Our School administrators claim their role is to educate, not celebrate. They forbid the mention of God or religious holidays, the saying of a prayer acceptable to all religious denominations, and Christmas or other religious decorations in the classroom. They forget that our morality is founded in our religious beliefs. Don't we, every day, hear or read about the results of the "zero moral values" that have been taught because of the "Zero Religion"?

Are we not a society that is as badly hurt by these policies that fail to recognize the "Zero Religion" is a form of religion as the Romans were by their number system? Our founding forefathers, clearly forbidding government advocacy of any specific religion, did frequently mention God. They were wise enough to realize that we would survive only if we were "one nation under God." They would be horrified with the way their words are being interpreted. Our judicial system, through its decisions, is depriving us of rights to which we are entitled under the constitution. Our courts need to be reminded that the "Zero Religion" is a religion.

JAC/dbb

June 28, 1994

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RIOTS AND PEOPLE:

Robert and What I Learned from Him

John A. Casazza

Robert was a young black man that I got to know when he was 18 years old and a senior at Central High School in Newark. I got to know Robert, his problems, and his aims in life because I went to work for about one week with Army troops with loaded machine guns posted at the corner of our office building. Everett was a brilliant young man who worked for me at the time. He also was a key link in my getting to know Robert.

In the riots of the 1960s, a part of Newark was burned and 16 people died. During these riots, we went to work with horror and fear, thinking on one hand that perhaps the armed troops stationed at the corner of our building could not protect us, and on the other that they might shoot and kill some innocent people in the streets below us.

After the riots were over, Everett decided to do something to help. He talked to a number of us and asked if we would work with him. All agreed we did not want to ever again see such a riot. We agreed to help him in any reasonable preventive steps that could be taken.

Everett went to the Central High School in Newark, which was at the core of the riot area. The student body was almost entirely black. He talked to the school officials and asked if there were students in the school who were ambitious, wanted to get into college, and could use some tutoring to help improve their qualifications. The administrators responded eagerly, "Yes - there were some." As a result, a program was set up with about 12 students involved, each of whom were to be given special tutoring.

We agreed to tutor these individuals one-on-one in our company offices. The arrangement was that each student was to come to meet their tutor one afternoon a week at about 4:00 PM and the tutoring lesson was to last until 5:00 PM. Since quitting time was normally 4:30 PM, the individual tutor gave up about one-half hour of his time and the company gave about 1/2 hour from the normal work period. I was assigned Robert because he wanted tutoring in biology and plane geometry, — subjects with which I was helping my own 16-year old son.

The first time Robert came into the office, he was not dressed well. He was not particularly clean. He was obviously worried and frightened. He did not know how to act. He had no experience in a large office building. He was in a foreign society. During our weekly meetings Robert and I got to know each other. I learned that Robert had no father. His mother worked hard and tried to instill in Robert the desire to be a good person and to succeed in life. It was because of her that he was coming for these tutoring lessons. I stressed that he could become a part of this kind of working force, if he wanted to, and I would help him.

As we worked together, I found Robert had a good mind but was perhaps three or four years behind my own son in the level of his education. We talked weekly about biology. One day we discussed reasons why if his finger was cut off it would not grow back. Yet, if we took a newt or salamander and cut off its tail, it would grow back. I could see his mind begin to open, — his curiosity mount. I explained to him that there were many phenomena of this type which we did not understand and there was a need for young people to do research in biology and medicine. Perhaps if we could learn how the salamander grew replacement limbs, we could do the same to help people who are badly injured. Robert's interest in biology intensified throughout our work together. Why things grow the way they do and why our bodies function the way they do became questions to ponder. He obviously had never been exposed to any sort of teaching that would encourage him to ask "why."

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One day I asked him what he learned in school. He said, "I don't learn anything. I just don't make any problems." The situation at Central High School was one where the prime concern of the faculty was to maintain discipline, keeping violence to a minimum, not teaching students. It was not to get them to start asking "why" and teaching them that reading and pursuing answers to questions on their own could be fun.

One day we were going over one of our geometry lessons and I asked Robert a question about the angle bisector of Angle B. He pointed to angle C in the triangle. I asked Robert why he was pointing to Angle C. He said, "Oh, I don't see so good." I said to him, "Look at some of this material and read it to me." He could read it, but only with a great struggle. It was then that I found that Robert needed a pair of glasses and did not have any. No one had taken the time or trouble throughout the 17 years of his life or through the 12 or so years of school to discover that he needed glasses. On inquiry, I found an agency in Newark which would give Robert an eye exam and a pair of glasses for the nominal sum of five dollars. I told him that he should go and get them. His response was that he did not have the five dollars. I asked, "Doesn't your mother have five dollars?" He answered that she worked but there were other children and money was a very scarce commodity. I said to Robert, "I will give you five dollars but I want you to repay me. You can pay me a dollar a week for the next five weeks. Find yourself some work, even if it is just delivering packages or unloading trucks." I gave Robert the five dollars and he got the glasses and his work improved considerably. He also repaid me the five dollars, one dollar at a time.

I asked Robert if he knew why I wanted him to return the five dollars. He said no. I asked, "Do you think it was because I couldn't afford to give it to you?" He said, "Well, I'm not sure." I said, "I could afford to give you that five dollars. But I want you to learn to stand on your own feet, to be able to earn what you get. Don't be dependent on me or anyone else. In life, you must earn your own way and you should take pride in earning your own way." I could see Robert's understanding grow.

One afternoon at 4:00 PM, Robert didn't show up. He didn't show up at 4:30 or at 5:00. He didn't show up at all. The next week when he came at the appointed time, he had a bandage on his head. I let him know I was unhappy with him and I let him have it. I said, "Robert, you know I sat here and waited for you for an hour last week and you didn't come. Why didn't you call me if you couldn't make it?" I was astounded with his answer. He simply did not know that if one could not make an appointment, they should call and explain that they would not be there. It was something he had never been taught or learned!

We talked further and I asked him why he hadn't shown up. He explained to me that there had been some trouble in his neighborhood and that there had been some knife fights. He had been hurt in one of the scuffles and had a cut on his head that had to be stitched. After the incident, his mother had told him to go to stay with his aunt for a week or so in Morristown until the whole situation had cooled down. He had done so. This helped me to understand that Robert lived in a jungle where his own safety was at stake daily. Under these conditions, I should not expect him to know all of the rules of my culture. He had grown up and survived by learning the essentials of his culture.

Robert and I proceeded with his lessons and he progressed rapidly. He was an intelligent person. Here was a good mind going to waste unless someone was willing to help him. I was quite pleased when Robert informed me that he had taken his exams and had been accepted by the Hampton Institute.

I will always remember our last meeting. I talked to Robert a little about what he had learned from me. He didn't say much but before he left, we shook hands and he said, "One thing I want to tell you. If I ever have a son, I will try to do for him what you have done for me." That made my day.

That is not the end of what Robert helped teach me. The program was also successful with the other individual students and tutors. It was so successful that some in the Federal government heard about it. The end result was an appropriation of Federal funds to increase the program significantly the next year and allow the high school to take over its administration. The net result was failure. The mere appropriation of funds cannot solve the problems of our inner cities and the problems of our young people like Robert, who do want to learn, who do want to progress in our society, and can become valuable contributors.

The Federal program was conducted in the high school. That meant that young people like Robert completely lost the experience of coming into a large office building and learning that they could be accepted as equals. This growth in confidence that Robert gained from participating in an activity outside of the ghetto area was extremely valuable. Most importantly, Robert knew, as did the others in Everett's program, that we were helping them not because we were being paid but because we wanted to help them. That created a bond money can never buy.

Robert's lesson for us is that our urban problems can only be solved if they are tackled by people one-on-one. Without this, an appropriation of funds to be administered by bureaucrats, many of whom really don't know or really care about the individuals with whom they are dealing, is doomed to failure.

3/1/92

Lauren Fram
March 20, 2007
American Experience – Heath

Interview with John Casazza on the Racial Tensions during the 1960's

My grandfather, John Casazza, was a white middle-class Executive engineer working at Public Service Electric and Gas Company, living in Hasbrouck Heights, New Jersey. He has led an event-filled life, traveling all over the world speaking about energy, and has written numerous books, as well as articles online, both on energy and electricity as well as on the past experiences of his life. He had both positive and negative experiences with racial tension and the Black Power movement during the 1960's, which we discussed in our interview, below.

Me: Let me just start out with some basic questions. How old were you in 1960?

Grandpa: I was 36 years old.

M: So in 1970 you were 46.

G: Correct.

M: And where were you living during this time?

G: I was living in Hasbrouck Heights, New Jersey.

M: What were you doing during this time of your life? What was your occupation?

G: I was an executive for an electric power company, living with my wife, my son, and my daughter, who were children.

M: What was your impression of or feeling toward President Kennedy?

G: I thought Kennedy was a pretty good man who was trying to do the right things. Later on, I learned that my opinion of him was probably too high, but back then I thought Kennedy was very good for the country.

M: What about towards President Johnson?

G: Johnson was trying to do the right things also, in some ways, although he seemed to be less articulate than Kennedy in making speeches and expressing his goals for the country.

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M: What was your impression of or opinion towards Nixon?

G: Nixon I never quite liked. I thought he was kind of a nasty man. He didn't really like people. Kennedy seemed more to like people, as did Johnson to a lesser extent, but I found Nixon to be a really stern, strict politician who was primarily concerned with how to maintain his power.

M: What were your feelings about the Anti-War movement?

G: You mean the Vietnam War?

M: Yes.

G: Well I thought that the people in our government who felt that we had to go to war in Vietnam in order to keep the Chinese Communists from taking over all of Southeast Asia may have been exaggerating; on the other hand, I didn't know enough about what was going on to have a firm opinion. I thought that since the French had been involved and so were we currently, there might be some good results from our involvement.

M: What is the main concept or event that comes to mind when I mention the 1960's to you?

G: The main things I can think of were the racial tensions, the problems that came about from the differences in the way races were treated, and the problems of our country that were coming about because of racial tensions.

M: Did you have any experience with the Civil Rights movement during the 60's?

G: Yes, in quite a number of ways. Most of us were aware of the fact that the black people in lots of places in the country did not have equal rights, for instance, voting. We read about it in the paper. We read about how certain governors and schools and universities wouldn't admit black people, like the University of Alabama and other places, and we were aware of these

things. We didn't get personally involved, but we'd hear about it on the television news and read about it in the paper. That was where it all started for me.

M: So you mentioned that you were aware of the racial tensions in our country from reading about it in the newspapers, but was there anything in which you were personally involved?

G: Yes, the first thing that I can recall was something that happened at a school which I went to. I was an alumnus of Cooper Union, which was a fine and famous school in New York. It has a wonderful Great Hall, and at one time it was the largest auditorium in New York City. It was the place in which Lincoln made his first speech running for president, where the first movement started for Women's suffrage, and so on. It had been built in 1858, and in 1965 they decided they had to refurbish the Hall because it was getting old, so they asked all the alumni for money. I gave them $5000 for this fund, because I had gotten a completely free education so I felt that I had obligations to the school. They had rebuilt the whole Hall and decided to have an opening ceremony. I was invited with my wife to go there. We went there on the night of the ceremony, and the program said that Governor Rockefeller of New York was supposed to be there. He was going to make a speech to thank all the donors. When we got there we saw a lot of policemen, but we went in and sat down anyway. When it was time for the program to begin, all of a sudden in one corner of the hall somebody jumped up with a black glove on his hand and yelled "Now!" and all of these people jumped up and started yelling "Black Power!" All of the dignitaries were sitting on the stage, such as the Dean and President of the university, etc., and these people jumped on the stage and started throwing others off the stage, which was five feet off the ground. They threw the Dean of the English department, who was 65 years old, right off the stage! There was general turmoil and we were all frightened. All of a sudden the police broke in and locked us all in to try to catch these people. A lot of them got away, but the whole ceremony got called

off. This was the first time I had personal contact with some of the people who were creating disturbances and involved with Black Power and so on. It wasn't until later that I found out that these people had been disturbed by the riot at the prison at Attica, New York. Rockefeller had sent in troops to put down the riots, in which a lot of the rioters were black, and were fired on by troops and killed. This had triggered the whole thing at Cooper Union. We were able to get out and went home right away. We asked ourselves, "Is this the way to solve problems in America? Are the rioters doing any good by taking over an old Hall that was fixed up for public good and used for public speeches, hurting people and creating a hazard to public safety?" It began to dawn on me that this was not a good way to solve the problem of black voting rights.

M: Do you know what the reason was for Black Power leaders to come to this particular ceremony at Cooper Union? Was there anything Cooper Union itself supported that they were protesting, for example?

G: No, they took over this particular ceremony because Governor Rockefeller was supposed to be there, and they were protesting the killings at Attica, which he had kind of been a cause of. Apparently, Rockefeller found out somehow that they were going to be doing this on that evening, and he never showed up!

M: Did you have any other personal experiences?

G: Yes, the second one happened to also involve Rockefeller. I used to be involved with working with the Regional Plan Association, which was a Tri-state agency (NJ, NY, CT) that was trying to develop plans to solve a lot of the problems of the New York metropolitan area.

M: What kind of problems?

G: Housing, transportation, water supply, sewage, etc. We were trying to find answers to a lot of the problems in the area, because a lot of the areas were getting old. This Association, which

my company supported, hired people to make these plans. We made arrangements to have these plans presented at a luncheon at the Hilton Hotel in New York City. All the people who had contributed came to a big luncheon with about 50 tables of 10 people each. We went in, and at the head table were the governors of New York, New Jersey and Connecticut, as well as all the top officials of these states. We sat down and all of a sudden there was a shout and the back doors opened, and a bunch of black people with black gloves came rushing in, followed by TV camera reporters and flood lights. These people came in and took pitchers of water and pieces of bread and threw them at people. Then they got up on the head table and started running back and forth on it. One of the people I was with was the Director of Communications, Publicity and Public Relations for our company, and he grabbed one of the TV reporters and asked why he was doing this. The man replied, "It's newsworthy, isn't it?" It was obvious that this was an organized effort, in that the TV station had been working with these Black Power members to get some action to report on. I learned that the media sometimes helped arrange these problems, because it made stories to make the media stations more popular.

M: Again, what was the reason that Black Power leaders chose to take over this particular luncheon?

G: Because of governors that were there. Black Power constantly and consistently protested Rockefeller and other governors; they wanted to embarrass them, and wanted to obtain publicity.

M: Did these protests always involve just a few members, of the Black Power associations, for example?

G: No. For instance, something else happened during the riots in Newark. There had been some riots in Watts, CA, and rioters had been killed by the police. Then in Newark, apparently a policeman had arrested a black man and had been thought to beat this man up. These two events

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started a riot involving tens of thousands of people in Newark in which a large part of the city was burned. The rioters were coming toward my building in Newark, where we worked maintaining electric power supply for most of New Jersey. The government sent the National Guard and army troops in, and they were there on the half tracks, like the small tanks, with loaded guns, at the corner of our building, and right across the square were all these rioters yelling and screaming. Those of us in the building were very worried because we didn't know if the troops could stop these rioters, or if a lot of innocent people would be killed if the troops started firing into the rioters. So here was a confrontation where there could be a lot more disaster than there was. There were 16 rioters killed by the police in this particular riot, because they were breaking into stores and stealing. The rioters were crazed and resentful and caused a lot of damage to the city. As a result, all of the big companies moved out of Newark, which used to be the main headquarters for the Prudential Insurance Company. All the big department stores moved out. Basically, the riots caused real damage to the commercial activity in Newark, which used to be a fine city where people used to go shopping at big stores. Instead downtown Newark became a bad place to go, and everyone was afraid to go there. I was living in Hasbrouck Heights, which was about 10 miles away, and a lot of the people in surrounding towns began to worry about if they should be getting guns and arming themselves, because they thought the rioters would come and try to destroy their property. The net result of all of this was exceedingly harmful to Newark, the rioters, as well as to the surrounding areas. It all had been triggered by a policeman and what he did or didn't do; no one really cared whether he beat the black man up or not. Once the rumor started to spread that a white policeman beat up a black man the mob went crazy and there were tens of thousands of people.

M: Was there anything particular these people were protesting in your company, which was why they were right outside your building? What was their reasoning?

G: No, the riots moved all around the city. I just happened to be in a building somewhat near a square in which they were stopped by the police, and could see out my window.

M: Were you ever motivated to "fix" any of the problems you saw around you, or to participate in change?

G: Oh yes. Some of the people in my company were very concerned. They decided that we should do something so a riot like this never happened again. One of the people was a very bright and brilliant young man named Everett, and he went and talked to the people at a local all-black high school, in this area were the rioting was. He asked what he could do for the young people to help stop this from happening. He was told that the students wanted to get into college, but they didn't have the training to get in, and that maybe he could help with their education. Everett came back to the company and said that we ought to organize some kind of educational program for the students who wanted to learn more than they did in school, in order to get them into college. We talked it over and agreed we'd organize a training program, which was to be one hour a week. The normal quitting time at the company was 4:30pm, and we decided we'd let the employees work on training these students from 4 to 5pm, so they'd get a half an hour off, and stay a half an hour late. We got about 12 students from Central High School to participate in this program. I taught one of them; his name was Robert. I'll always remember him because I learned a lot from him about the nature of the problem and what needed to be done to solve it. He was about 18 years old and a senior; and he didn't have a father, but was raised by his mother. His mother wanted Robert to be a decent young man. He came to the office one day, about 4pm in the afternoon, for the first time,; he was unclean and frightened. He didn't know

how to act in an office building, because it was different from his culture; he didn't even know how to act. He wasn't dressed well. To him it was a foreign society. I think he was very frightened to come into the building, and I don't think he was going to come again. I tried very hard to work with him. I found that he had a good mind and was bright. He needed training in biology and plane geometry, and I found that he hadn't learned much in school. I asked him what he learned in Central High, and he said "Just not to make any trouble, that's all they teach me. I don't want to cause any problems." I tried to get him to think. For example, in biology, I could give him some examples to make his mind alert. I said to him, "Do you know about salamanders? Well if you cut their tails off they will grow back, but if I cut my finger off it won't. Why do you think that is?" He began to look at me and began to think about cause and effect. No one had ever made him think about things and find explanations, so Robert began to want to know why. One day we were doing geometry and I asked him about the bisector for angle B, and he pointed to angle C. I said "You're pointing to the wrong angle, Robert," and he said "Well I can't see so good." I asked if he had ever had an eye exam; he was 18. I told him to go to get an eye exam and some glasses, but he said he didn't have any money. I found a place in Newark where a charitable organization would give an eye exam and glasses for $5, but he said he didn't have the money for it. I asked if his mother had any money, but he said no, there were four or five other kids in the house. I asked if he'd go if I gave him $5, and he said yes. I told him he had to pay me back. He looked at me like I was cheap, but I told him I wanted him to pay me back because I wanted him to learn to pay his own way and never rely on anyone. I gave him the money and he went and got glasses and he could see a lot better and his work improved a lot. He paid me back the money. He learned a lot of other things. One afternoon he was supposed to show up but he never did. The next week he came in, and he had a bandage on

his head. I asked why he didn't call the week before if he couldn't make it. He said "You're supposed to call if you can't come?" He did not know that if you could not keep an appointment you were supposed to call, because were he grew up they didn't do that, they just didn't show up. Well anyway, I asked what happened and he said there was a riot among the students at Central and there were knife fights and he got cut, and his mother made him go to Morristown to stay there, and then he came back after a week. It began to dawn on me that he grew up in a completely different culture in the slums of Newark than one did in the suburbs only 10 miles away, and that was one of the big problems. I found he was intelligent, and he was able to get into the Hampton Institute in Virginia. I lost contact with him and never heard from him again. The thing that I learned was that there were a lot of people who could be very good citizens but were not being given a chance the way they've grown up, and part of the cause of the problem was that their fathers took no responsibility for them, and their mothers had to do everything. Part of it was they never got a chance to get a good education. I became convinced that the answer to the problems with voting rights, etc., was not riots; riots were hurting the black people. The answer was to educate these people. If the school didn't do it, individuals had to do it, like this fellow Everett who came up with the program in our company. The 12 students who took our program all got into college. The federal government heard about the success of this program, so the next year the government gave money to Central High to hire people to do the training in the high school, and it failed. One of the reasons the program worked with Robert and Everett was because Robert knew that those of us who were trying to help him, like me and the other teachers, were doing it because we wanted to help them, not because we were being paid, so we were very successful. The federal government program failed, and the one thing I learned was that you have to have educators who care about these people who are substandard in

our society but need a chance to get ahead. I learned a lot about educational programs, and became very interested in educational programs for minorities as a result.

M: So you've spoken about the racial riots and Black Power issues so far. What do you think the catalysts of these problems were, particularly for the things you experienced?

G: The treatment of blacks had been quite unfair in our society. But there were some in the Black Power movement who saw this as a chance to gain power and influence, and they did things to create their position of power, rather than solving the issues of black people themselves. In other words, there were some people in the Black movement whose sole goal was their own personal political power. There are still some today whose goal is not the welfare of the black person, the black student, or the black poor person. They've been driven by the desire for personal power. And that's one thing we all have to be careful about. I'll be very frank, I think Jesse Jackson, Al Sharpton, and some of these people are more concerned with their personal power and wealth and influence than they are with what is really good for the black people and this country. The overall country is better off when the black people become significant contributors to our society.

M: Do you think that racial riots caused a sense of doubt in white people who used to support black rights to vote and such, and changed their minds?

G: Yes it did do that harm. I think that in that meeting I mentioned at Cooper Union in which black people came in and threw officials off a platform, that didn't help white people accept black people as equals. But if you thought about it, you realized that these people who did these things weren't really concerned with the welfare of black people. Martin Luther King really was.

M: Do you think that though, on the other hand, these riots and events were good for instilling racial pride in African Americans?

G: I don't think so. I think that getting an education, a good job, making a good income, and being able to make money to support your family are the things that instill pride in people. When they began to see that they could do all the things that white people could, and just as well, they would realize that rioting does not instill pride. It instills hate.

M: So do you think that even though it might have been the goal of the Black Power movement to inspire pride in African Americans as a culture or race, it actually had the negative affect?

G: I don't think it was the goal for a lot of them. I think, as I said, a lot of them wanted to be dictators, and were only concerned with their own welfare. For example, Robert's mother wanted him to be a good citizen, to get an education and a good job. She didn't want him to be rioting. She was smart enough to know that this was not going to help her family.

M: Do you know what specific groups of the Black Power movement participated in these riots you experienced?

G: The Black Panthers, and some of Louis Farican's groups. While these groups tried to organize the average good black citizen, they did not have the same influence over these people that King did, who influenced millions of blacks.

M: How did the Martin Luther King, Jr. movement compare with the Black Power movement, according to your experiences?

G: Martin Luther King was a tremendous force for good in solving problems because he believed that the best way for the black people to solve these problems was not through violence, not going into meetings and throwing things around, not knocking people off stages. Violence was not the answer. Instead the answer was through peaceful approaches. King had that belief,

and unfortunately someone assassinated him in 1968. Even though he was killed, his ideas that education and nonviolence were they ways to solve the problems became more generally accepted. If you look now, almost 40 years later, that really worked, because most black people are getting better educations than were generally accepted then. Some of the problems of the urban areas have been solved because of King. My personal experience indicated to me that King was right and we had to all follow his advice.

M: Any last thoughts?

G: I think that one good thing that has come out of all of the racial tension, and everything that has happened, is that the acceptance of blacks as equals has become almost universally adopted in the US. Like when I go to the South in Georgia in Alabama, I see blacks and white all working together and interacting. They get along well, and I think the key matter of importance is that all American learn to acceptance other Americans for their ability, their integrity, their honesty, etc., and not for their color.

PSE&G

R&D Quarterly

SEPTEMBER 1975

WHY R&D?

By J. A. Casazza
Vice President — Planning and Research

The basic philosophy and precepts on which our PSE&G R&D program is founded are:

- Our Nation, New Jersey, and PSE&G have problems which require the maximum use of new technology for their solution. The oil crisis, rapidly rising costs, shortage of capital, and high unemployment are current manifestations of our long-term problems. Never has the need for developing new energy concepts been greater than it is today.
- Our R&D program must help develop the new technologies needed to solve our long-term problems. It must also produce some results which will have short-term usefulness.
- We recognize that the funds available for R&D are limited and that we need to concentrate on items of major importance to New Jersey.
- To assure maximum return on R&D funds provided by our stockholders and customers, we need to generate revenue through royalties and licensing of patent rights.
- We believe that those who have the greatest motivation for solving a problem will produce the best solution. We want to do as much as possible to solve our own problems.
- To assist in solving our problems, outside funding should be obtained. We should also coordinate our R&D program with others whenever possible.
- We need to provide guidance and direction to the R&D efforts of the Federal Government, equipment manufacturers, and other major agencies such as the Electric Power Research Institute, the American Gas Association, and the Institute of Gas Technology to insure full consideration of our needs. Participation in advisory committees and the maintenance of personal contacts is therefore essential.
- An intimate and balanced knowledge of potential technological developments must be made available by R&D and put to use in our planning, engineering, and corporate decision-making. We must not make the great mistake of failing to anticipate technological changes of the future.
- We must recognize that our energy systems and their future needs are intimately related to mankind's other problems including adequate food, water, and a healthy environment.

We have therefore established the following top priority areas for research:

- Convert energy in the atom for useful purposes of mankind, emphasizing development of floating nuclear plants and fusion.
- Develop means for storing energy on a large scale so it can be available when needed.
- Use rejected heat from our power plants, particularly for aquaculture and agriculture.
- Develop future role of hydrogen for complementing our electric and gas systems, including full consideration of hydrogen's usefulness in producing fertilizer, synthetic fuels, steel, and other chemicals.
- Use refuse as a source of fuel in producing both electricity and gas.
- Develop means for insuring that emissions from PSE&G facilities are environmentally acceptable.

Currently, the PSE&G R&D program includes 60 projects. Estimated expenditures over the next five years amount to $70 million and represent 0.8% of our total revenue. We are continuously comparing the results being achieved versus expenditures for these projects, accelerating efforts or discontinuing projects as warranted. Presently we are applying for outside funding for 22 R&D projects totalling $13 million which could significantly reduce our expenditures.

We believe we have an outstanding staff to administer our R&D program based on the above precepts and priorities. It consists of 28 full time employees headed by Ray Huse — Manager — Research and Development. There are 14 professional members, ~~four~~ SIX with PhD's and ~~six~~ SEVEN with Master degrees, in various fields of science and engineering. With the help and cooperation of the Energy Laboratory and many others inside and outside the Company, our R&D program has made good progress. Our goal is to continually increase the value of our R&D efforts.

For additional information contact:
Research and Development Department, Room 12329, PSE&G Company, 80 Park Place, Newark, N.J. 07101

EPRI TO FUND STUDY OF GAS TURBINE EMISSIONS AT KEARNY

PSE&G and the Electric Power Research Institute (EPRI) have agreed on a program of research on stack emissions from the use of fuel additives in gas turbines. The research will be funded by EPRI and carried out at Kearny Generating Station by KVB Incorporated, Scarsdale, New York. The initial EPRI funds of $30,000, of a requested $75,000, will carry the project into November.

The EPRI was founded in 1972 to conduct cooperative research and development programs for the electric utility industry. The Fossil Fuel Department, one of the divisions of EPRI, is involved in the development and improvement of processes to generate power from fossil fuels in an environmentally acceptable manner. This division will fund the work at PSE&G.

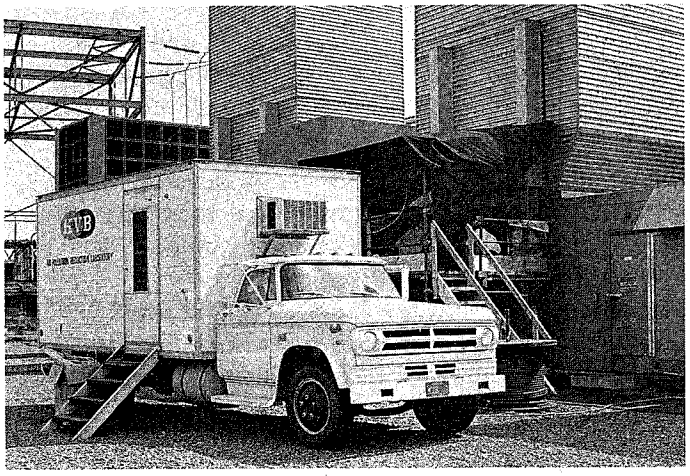
The joint EPRI — PSE&G study of emissions from gas turbine fuel additives originated in 1974 when EPRI was informed of a study of Trace Emissions in Stack Gases from Fossil Stations being conducted for PSE&G by Exxon Research. Whereas the EPRI study is directed to the assessment of emissions from the use of fuel additives in gas turbines, the PSE&G trace emissions project is directed to assessing the principal compounds which occur in trace concentrations in stack gases from fossil units including coal and oil fired boilers.

A PSE&G interdepartmental task force on air quality consisting of J. E. Billings, Manager of Methods, Electric Production; W. E. Somers, Senior Engineer, Engineering Department; J. Tomshaw, Chemical Division Chief, Energy Laboratory; D. Campbell, Mechanical Division Chief, Energy Laboratory; S. Siebert, Staff Assistant, Environmental Affairs; H. B. Barron, Principal Staff Engineer, Environmental Affairs; and chaired by C. R. Guerra, Research Program Director Chemical and Environmental, Research and Development Department, evaluates research projects of this type.

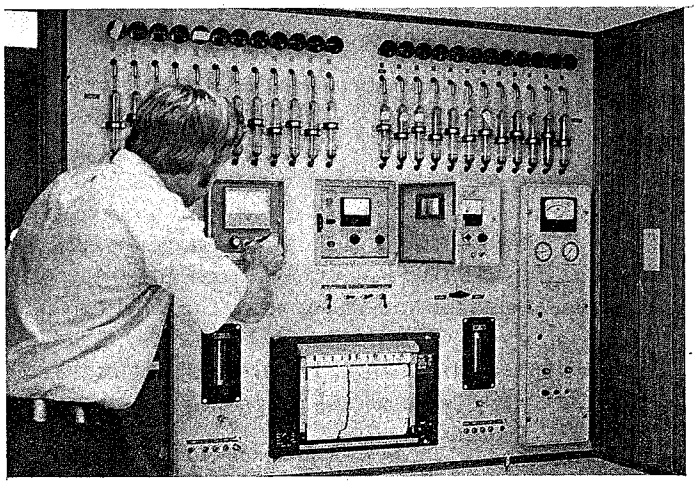
The EPRI will evaluate whether gas turbine fuel additives increase, reduce, alter or create air pollutant emissions. Particular attention will be given to the fate of the metallic part of metal-based fuel additives, since past studies with small scale model combustors have pointed out negative effects of certain fuel additives.

Specifically, whereas certain additives can be effective in smoke plume reduction and improved fuel system performance because of their physicochemical characteristics, the side effects of environmental intrusion might be undesirable, or the plume improvement might be of a cosmetic nature rather than an actual decrease in emissions. Since utilities are interested in fundamentally sound solutions to environmental problems, EPRI and PSE&G will undertake this program to fully characterize several commercial fuel additives using a full scale gas turbine generator.

The program of research will last about six months including about 10 weeks of field tests at Kearny Station. A Turbo·Power and Marine (TP&M) 25 MW gas turbine, Model FT4C-1LF Twin Pak, will be used for the tests and it will be operated under normal



Monitoring van being used at Kearny to measure trace emissions from gas turbine fuel additives.



Instrument panel in monitoring van being used to measure trace emissions from gas turbine fuel additives.

load conditions using various smoke and corrosion suppressant fuel additives. KVB Inc. will evaluate the flow of emissions at selected locations in the gas turbine exhaust train, using an air emissions van.

Representative exhaust samples from the gas turbine will be analyzed for total mass of particulates, size distribution and composition of particulates, chemical state of trace metals derived from the additive and fuel, amount and composition of polycyclic organic matter (benzo-alpha-pyrene), and emission levels of exhaust gases (0_2, CO, CO_2, NO, NO_2, SO_2, SO_3, and unburned hydrocarbons). Correlation of the exhaust composition with fuel and additive analyses prior to combustion will be used to complete a mass balance of all components under study.

The two fuels used in the tests will be No. 2 fuel oil and kerosene. The fuel additives currently scheduled for testing are Ethyl CI-2 and Apollo DGT-2 used for smoke suppression and TP&M's Turbogard™ used for sulfidation prevention. Other additives to be included in the tests are being evaluated. Particulate matter in the gas turbine exhausts will be collected by filtration and wet impingement in accordance with U. S. EPA Method No. 5 under isokinetic flow rates. All gases, except SO_2 and SO_3 will be measured continuously via electronic instrumentation. Oxides of sulfur will be measured by an absorption/titration method to separate SO_2 from SO_3.

Particulate matter analyses will be done by an array of analytical techniques including electron microscopy (particle size and shape), atomic absorption (particle elemental composition), X-ray fluorescence analysis/scanning electron microscopy (elemental analysis including that of segregated individual particles), neutron activation analysis (subtrace elemental analysis of difficult to collect samples), carbon analysis, X-ray/electron diffraction (molecular or crystalline structure of particles) and chromatography/spectroscopy (polyorganic matter analysis). Calspan Corp. (formerly Cornell Aeronautical Labs) and Schwartzkopf Analytical Lab will carry out the particulate and fuel analyses.

The coordination of testing work by KVB with the plant is being done by Messrs. C. Sengupta — Lead Research Engineer, Research and Development Department, and A. Prestifilippo, Gas Turbine Engineer, Electric Production. Mr. A. Silakoski, Superintendent, Kearny Station has assigned plant personnel to the preparation of the gas turbine for the testing and to lend assistance as required.

ENERGY EFFICIENCY IN HOUSEHOLD APPLIANCES — THE ELECTRIC HEAT PUMP

PSE&G Research and Development Department has initiated a project at the Princeton University Center for Environmental Studies to investigate electric heat pump performance under both field and laboratory conditions. Heat pumps are the home owners' answer to the "something for nothing" philosophy in that more heat is generated than electrical energy supplied. Heat pump units consist of a heat exchanger device capable of transferring energy from one environment to another. In winter, energy is extracted from the colder outside environment and, through a compression-evaporation cycle, heat is supplied to the home. In the summer, the cycle is reversed and the unit operates as a conventional home air conditioner.

The idea of extracting heat from low temperature environments is an attractive concept and the effectiveness with which the heat pump accomplishes this task is known as its coefficient of performance (COP). For any COP greater than one, more heat is produced than the heat equivalent of the work input and real savings occur. All commercially available heat pumps have COP's greater than one throughout the range of normal ambient temperatures encountered in the PSE&G area. However, before considering the device as a panacea for solving energy crises, several factors must be kept in mind. First of all, currently available heat pumps are initially more expensive and tend to have a shorter lifetime than other commercial heating and cooling devices. In addition, they have limited capacities at temperatures below 40°F. (4.5°C.). So, for our geographical area, this reduced capacity at low temperatures necessitates supplemental resistance heating. It may be generalized that the effective COP of heat pumps is highly temperature variant with a sharp transition in the 20° to 40°F. (-6.7° to 4.5°C.) range.

Our objective at Princeton University is to obtain firsthand information under actual operating conditions on heat pumps installed in residential developments with similarly constructed houses. From this study we expect to determine what the effective COP for a heat pump will be during a typical heating season in which both the cycle variation of ambient temperature and supplemental resistance heating are evaluated. Under these test conditions we will be able to measure the influence of adverse weather, such as rain or snow, on heat pump performance, while simultaneously analysing the effective COP based on temperature and weather data available

from the climatological survey department of the Federal Government. The influence of family size and user performance with temperature (thermostat) settings on individual COP's will be measured.

In addition, PSE&G is participating in a "Load and Use Characteristics of Electric Heat Pumps in Single Residential Housing Units" study jointly sponsored by the Load Research Committee of the Association of Electric Illuminating Companies (AEIC) and the Electric Power Research Institute (EPRI). Seven of the ten units that Princeton University is analyzing will become a part of the AEIC/EPRI study. This overlap will provide verification by two independent investigators of the conclusions drawn from the data collected. The AEIC/EPRI study will be supervised by Mr. Paul Platt, Manager — Load Research, who will be assisted by Mr. Louis Rizzi, Manager — Residential Marketing, and Mr. James Griffith, Research and Development. This study program is a cooperative effort of 12 electric utilities representing various geographic areas of the United States and will continue until October, 1976. Westinghouse Power Systems Planning Group will supervise the acquisition and analysis of the data collected. At the conclusion of the study, the AEIC Load Research Committee will publish the results of this study in their Annual Report.

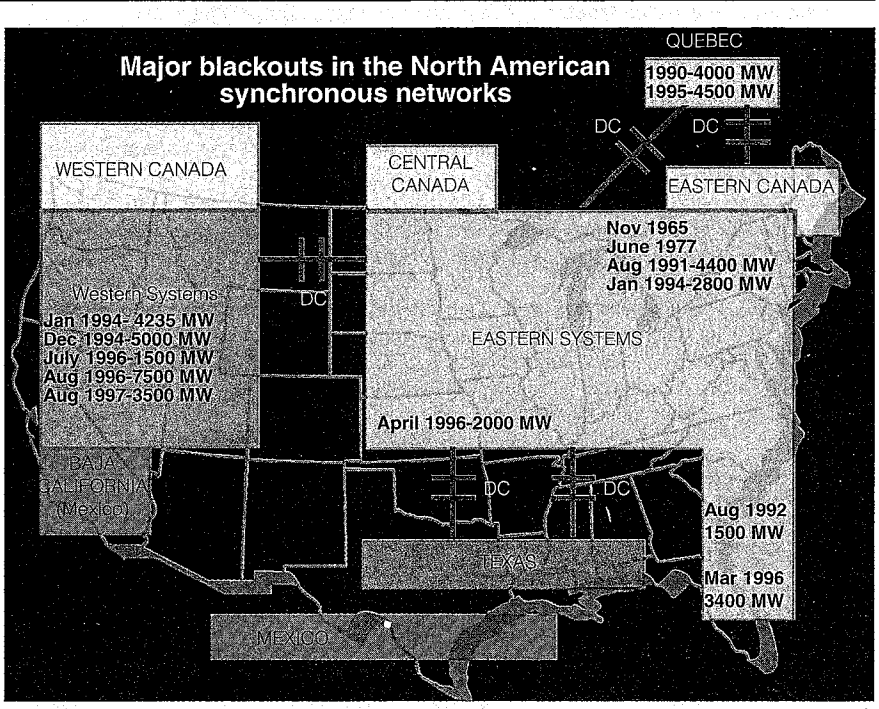
These two studies will assist PSE&G management in formulating future electric heat pump policy.

BLACKOUTS: Is the risk increasing?

By John Casazza, PE

No one can say for sure whether blackouts will or will not occur. Blackouts are rare events with a low probability of occurrence, but with a very high societal cost. As the US electric power industry restructures, both the North American Electric Reliability Council (NERC), Princeton, NJ, and the Federal Energy Regulatory Commission (FERC) are reviewing their roles and organizations to ensure reliability in the future. It is essential that the effects of new policies and procedures on the risk of blackouts be carefully examined. At the same time, the physical capabilities of the electric power network must be recognized. Much can be learned from the history of past blackouts.

Major blackouts of the past have been attributed to many causes, including unusual combinations of events, human failures, use of a system in ways for which it was not intended, and failure to comply with reliability criteria. But in all cases, the real underlying cause has been a failure to comprehend the fundamental nature of the huge synchronous ac systems in North America.



1. Five synchronous networks covering North America provide enormous economies of scale, but also carry the risk of widespread blackouts. Dates and extent of major blackouts are noted

Why systems are interconnected

The electrical network in North America consists of five huge synchronous areas (Fig 1). These areas are the western system, eastern system, Quebec, Texas, and Mexico. Four are interconnected by direct-current links. Only Mexico is isolated. Several economic benefits result from the ac ties within these areas:

- Reduced investment in installed generating capacity because of sharing of installed generation reserves; load diversity and equipment outage diversity; optimum use of available generation sites; coordination of generator maintenance schedules; long-term firm capacity purchases.
- Reduced operating costs resulting from economic energy exchanges; use of regional economic dispatch and unit commitment; optimum use of hydro and pumped-hydro facilities; coordination of maintenance schedules; short-term capacity purchases and sales; and reduced spinning reserves.
- Reduced transmission investment resulting from regional transmission planning; supply to other systems' loads; and backup to other systems' substations.

It has been estimated that the ties between regions, coupled with regional coordination procedures, produced annual saving of over $20-billion in the recent past. All of the benefits cited must be recognized.

But history has shown that these huge economic benefits carry with them the need for careful coordination procedures to avoid serious reliability problems. While ac ties between systems are the mechanism for achieving big savings, they are also the mechanism through which major disturbances can be transferred and spread to other regions. In their greatest strength lies their greatest weakness.

It follows that current proposals to control reliability on an individual state basis—such as the California Independent Systems Operator (ISO)—could increase the risk of blackouts.

The system is a single machine

When electrical systems are interconnected and all generators operate in synchronism, the result is a single large machine that can extend over thousands of miles. One of the characteristics of this machine is that changes in any one portion of it instantly affect the operation of all other portions.

For example, if a large generating unit is lost in New York City, the synchronous power system (the machine) suddenly has less power input than output and—like any other machine—the electric power system begins to slow down. As the rotors of every generator in the system slow down, each gives up a certain amount of its rotating energy to compensate for the

lost input from the unit that has tripped. There is an instantaneous inrush of power to the region that has lost generation. While the amounts of power flowing from individual distant generating units may not be large, they accumulate and build up like water flowing from creeks into a river and approach the deficient system as a flood.

By having the various generators throughout the region assist with the loss of a large generator unit in a specific system, the total amount of reserve generating capacity required is reduced. This situation is similar to the insurance business. The larger the number of policy holders, the better the insurance company is able to cope with a major disaster and the fewer reserves it needs. The great strength of an integrated system is the ability of one part to be helped by others. Its greatest weakness, however, is that the inrush of power into any one area can cause transmission system overloads.

New policies and business decisions under consideration today don't recognize the single-machine characteristic of the electric power network. Transmission that was formerly reserved to handle emergency power deliveries and power inrushes is increasingly being used for profit-making sales. As a result, blackout risks increase.

ow ac power flows

In ac systems, electric power does not follow a specified path but divides among the various transmission routes based on Kirchhoff's Laws and network conditions at the time. This pattern results in a phenomenon called circulating power, of which there are two types: loop flow and parallel-path flow. In the 1960s, when a transmission loop had been established around Lake Erie, system operators began to notice what appeared to be very large circulating power flows around the lake. These power flows occasionally reached 1000 MW—sometimes clockwise and sometimes counterclockwise. Similar circulating flows were also experienced around the periphery of the Rocky Mountains. These circulating flows around mountain and lake areas extended over thousands of miles.

Loop flow is the power that flows completely around any closed transmission path when each system connected to the path is supplying its own loads from its own power sources (Fig 2).

Parallel-path flow is the power that flows over transmission paths in various systems as a part of a power shipment from one system to another. For example, Fig 3 shows that when power is shipped from Ontario Hydro to New York State, some of it flows as far west as Ohio and as far south as Virginia.

In the case of a power shipment from the Pacific Northwest to Utah, 33% of the shipment flows through Southern California and 30% flows through Arizona—far from any conceivable contract path.

In order to operate a power system in a reliable manner, the operators must know the sources and destinations of the transaction causing the various power flows. Each source and destination must be tagged to enable operators to use network analysis techniques—based on Kirchhoff's Laws—to determine the reliability risks.

System operators need data at all times for every transmission circuit, giving the causes of the loading on the system by various functions. For example:

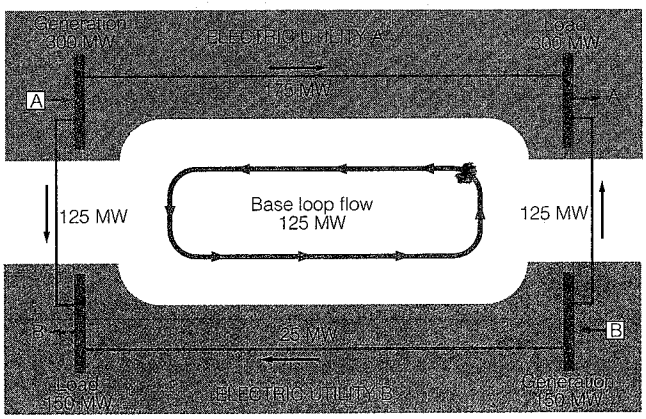
- Native load supplied by native generation.
- Loop flow caused by network characteristics.
- Parallel-path flow caused by transfers between other systems.

With this information, operators can determine what changes can be made to reduce reliability risks at minimum economic penalty. Without this information, reliability risks increase significantly. But many organizations involved in power trading do not wish to see such information made available, claiming that it discloses important competitive information. The inherent conflict between commercial and reliability concerns was a dominant factor at recent NERC and FERC workshops.

In some cases, loop flows are the intentional result of network design, reducing the need for additional transmission facilities. In other cases, loop flow or parallel-path flows, or both, adversely affect the reliability of systems. The reduction of circulating power is not easy. In some cases, economic penalties have been used. In others, various control devices, such as phase shifters, have been employed. The circulating power problem still exists today. The only absolute solution is technology that directly controls the division of power in the network's circuits—if it ever can be economically achieved. It will require extensive research and much additional high-cost equipment.

Some of the competitors in the new industry structure are fully aware of the nature of power flow in ac systems. They are looking at the possibilities of deliberately operating their resources so as to cause transmission constraints for their competitors. Reliability can be affected not only by actions that are taken by a company, but also by actions that it fails to take.

Policies and procedures that are now being enacted to open the network to competition must recognize the problem of circulating power; they must provide for tagging each source and destination; and they must include methods to prevent competitors from deliberately causing transmission constraints and jeopardizing reliability or electricity costs.



2. Loop flows may occur whenever a complete transmission path is established around mountain or lake areas and can extend over thousands of miles

When is an ac system too big?

Worldwide, the question is often asked "What is the maximum practical size of a synchronous ac system?" In the US today, a more critical question is: How large an ac system is possible with the new institutional structures? Problems that may be manageable in one system are transfered and multiplied when systems are interconnected by factors such as:

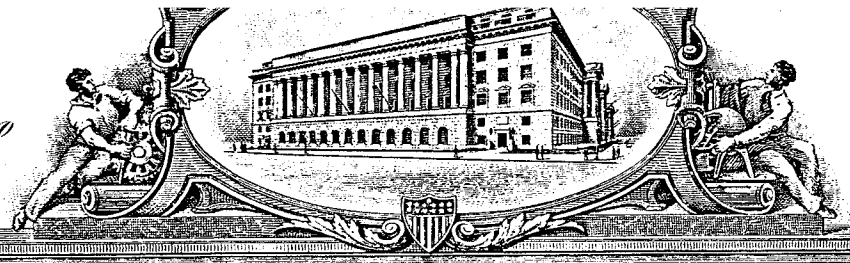
- Differences in reliability standards and constraints.
- The effects of the loss of large units in the networks.
- The complexity of managing networks.
- Computer and communications needs.
- Differences in technical regulation and control.
- Differences in institutional regulations among states and nations.

Dc ties among synchronous ac systems maintain some economic benefits of interconnection while avoiding most technical problems.

Under new competitive procedures, continued operation of the large synchronous ac systems in North America may no longer be feasible. It may become necessary to split the synchronous systems into smaller networks, tied together with dc ties. This question merits additional study, though such study is not being undertaken at this time.

Future role of control areas

Control areas were formed to help manage the huge synchronous systems in North America. Today, there are about 170 con-



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A PETITION PRAYING FOR THE GRANT OF LETTERS PATENT FOR AN ALLEGED NEW AND USEFUL INVENTION THE TITLE AND DESCRIPTION OF WHICH ARE CONTAINED IN THE SPECIFICATIONS OF WHICH A COPY IS HEREUNTO ANNEXED AND MADE A PART HEREOF, AND THE VARIOUS REQUIREMENTS OF LAW IN SUCH CASES MADE AND PROVIDED HAVE BEEN COMPLIED WITH, AND THE TITLE THERETO IS, FROM THE RECORDS OF THE PATENT AND TRADEMARK OFFICE IN THE CLAIMANT(S) INDICATED IN THE SAID COPY, AND WHEREAS, UPON DUE EXAMINATION MADE, THE SAID CLAIMANT(S) IS (ARE) ADJUDGED TO BE ENTITLED TO A PATENT UNDER THE LAW.

NOW, THEREFORE, THESE Letters Patent ARE TO GRANT UNTO THE SAID CLAIMANT(S) AND THE SUCCESSORS, HEIRS OR ASSIGNS OF THE SAID CLAIMANT(S) FOR THE TERM OF SEVENTEEN YEARS FROM THE DATE OF THIS GRANT, SUBJECT TO THE PAYMENT OF ISSUE FEES AS PROVIDED BY LAW, THE RIGHT TO EXCLUDE OTHERS FROM MAKING, USING OR SELLING THE SAID INVENTION THROUGHOUT THE UNITED STATES.

In testimony whereof *I have hereunto set my hand and caused the seal of the* **Patent and Trademark Office** *to be affixed at the City of Washington this* second *day of* March *in the year of our Lord one thousand nine hundred and* seventy-sixth, *and of the Independence of the United States of America the two hundredth*

Attest: Tracy M. Gibson, Jr.
Attesting Officer.

C. Marshall Dann
Commissioner of Patents and Trademarks.

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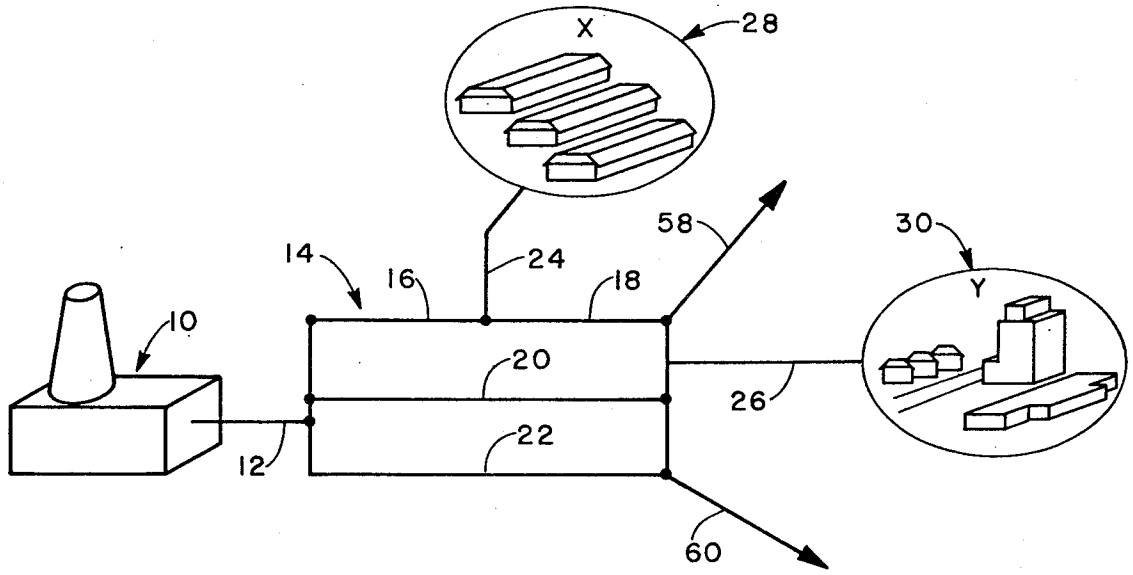
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FIG. 1

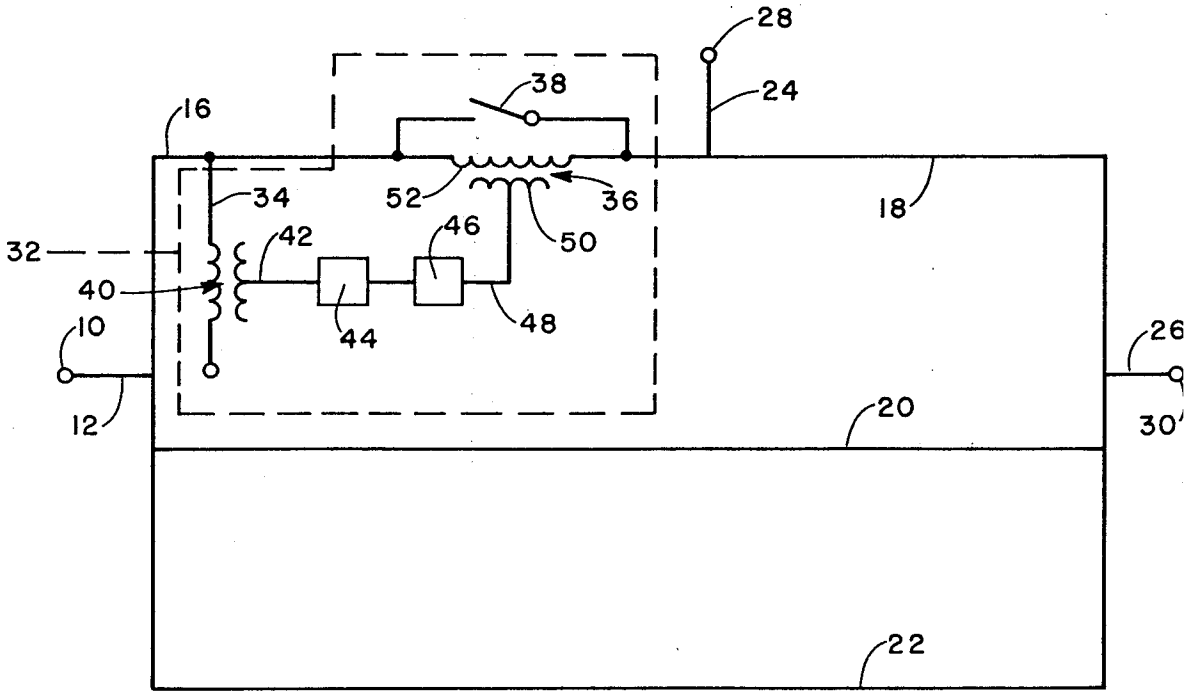
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FIG. 2

United States Patent [19]

Casazza

[11] **3,942,032**

[45] **Mar. 2, 1976**

[54] **POWER INJECTOR CONTROL MEANS FOR TRANSMISSION NETWORKS**

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[22] Filed: **Feb. 15, 1974**

[21] Appl. No.: **442,779**

[52] **U.S. Cl.** **307/148;** 307/3

[51] **Int. Cl.²** **H02J 3/00**

[58] **Field of Search** 235/151.21; 307/31, 32, 307/33, 34, 11, 20, 19, 148, 147, 12, 17, 19, 24, 44, 50, 51, 52, 69, 77, 87, 3; 323/114, 111, 112; 317/103

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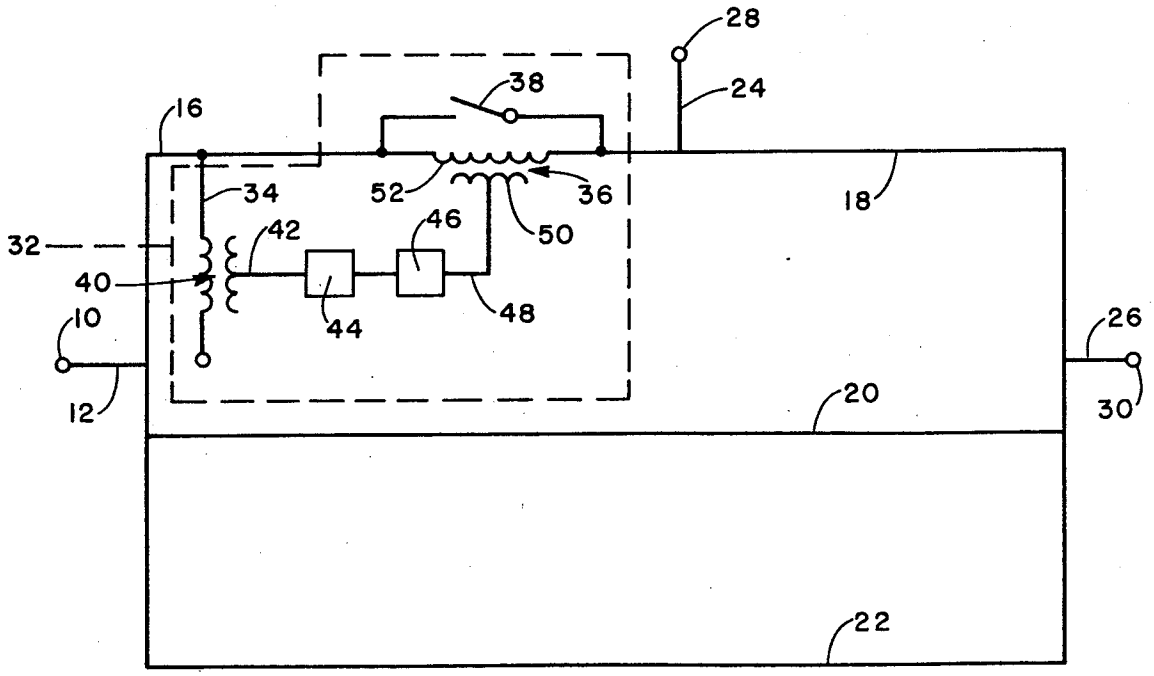
Primary Examiner—Robert K. Schaffer
Assistant Examiner—M. Ginsburg

[57] **ABSTRACT**

Means for better balancing and controlling of circuit loadings in electric power transmission networks to significantly reduce the number and/or cost of the transmission lines and facilities required to make a specific power transfer by significantly increasing the transmission capability of a given network by superimposing controlled circulating alternating currents for redistribution of power and current flows in the network.

15 Claims, 2 Drawing Figures



POWER INJECTOR CONTROL MEANS FOR TRANSMISSION NETWORKS

BACKGROUND

Present AC transmission lines, transformers, circuit breakers, and other devices, are connected in networks or grids. Such integrated networks, and their components, interconnect generating stations which supply electric power and substations which deliver electric power for distribution to consumers.

Presently these transmission facilities are used very ineffectively. Power transfers to or from one area or region to another are limited by loading conditions on a specific circuit(s) even though many other circuits having the capacity to deliver power are loaded below their ratings or capability. The resultant average loadings of transmission lines and equipment are significantly below their carrying capacities or ratings. In fact, studies show average loadings of about 30 percent of ratings on an annual basis and under 40 percent of ratings even during heavy loading periods. The improvement of the utilization of transmission facilities can produce benefits in two ways:

a. Make possible increased power transfers over facilities that have previously been installed.

b. Reduce the need for transmission system additions required to meet future needs.

The present poor utilization of transmission results from a number of factors:

a. The major reason under steady state conditions is that the division of loadings on transmission lines and facilities in AC networks is in accordance with Kirchoff's Laws holding that the impedances of various network branches determine the loadings of the various branches. This results in a division of loadings which is not in proportion to the capacities or ratings. Also, electric power flow patterns are continually changing in transmission networks because of consumption changes and because the transmission and generation facilities in operation change from time to time.

In a simple example, if two electric power transmission lines of differing capacity and/or impedance connect two areas in a system, the steady state power transfer limit between the two areas with all facilities available is reached when the first line becomes loaded to its carrying capacity or rating. Since the second line is not loaded to capacity under this condition, additional power can be transferred over the two lines through the injection of of controlled circulating current using the means described herein to reduce the loading of the first line and increase the loading of the second line so that both lines can be loaded to their ratings.

b. When a transmission line or generator becomes unavailable for service due to a sudden failure and automatic disconnection by action of relays and circuit breakers, power flows are automatically redistributed in the networks in accordance with Kirchoff's Laws resulting in a new division of power flows which, in most cases, does not result in the loading of transmission lines and facilities in accordance with ratings. The rapid injection of a controlled circulating current(s) in one or more circuits of the network by the means described herein will redistribute the power flows as described in (a) above so that larger total power transfers can be safely made.

c. The schedules for electric power production among the generating stations in the network so as to meet total electric power requirements are varied as total power usage varies so as to optimize total incremental costs for generation considering the availability and cost of fuel. Such changes in schedules cause changes in loadings on the transmission systems resulting in transmission facilities not being loaded in proportion to ratings thus reducing transmission capability from one area to another. The rapid injection of a controlled circulating current(s) by the means described herein located in an appropriate circuit(s) will redistribute the power flows so that larger total power transfers can be made.

d. Sudden transient disturbances resulting from short-circuits or other failures in the transmission system produce oscillations in the instantaneous speed of generators with respect to the rest of the network which can cause them to lose synchronism requiring that they be automatically disconnected from service. Extra transmission facilities are sometimes provided to reduce such oscillations. Such oscillations result from an imbalance between mechanical power input to the generators and their electrical power output. The very high-speed injection of properly controlled circulating currents using the means described herein will change the pattern of transmission circuit loadings in the vicinity of such a generator so as to dampen such oscillations thus increasing safe generator loading limits for a given transmission system or reducing transmission requirements for future generator installations.

Dynamic oscillations can occur between areas or regions when interconnected with AC transmission which considerably reduce that amount of electric power that can be transferred. When the two areas that are to be interconnected are previously isolated from each other the oscillations may be of sufficient magnitude as to prevent an AC transmission tie and require the installation of a higher cost DC transmission tie. By properly controlled use of the means described herein in the transmission circuits interconnecting the two areas these oscillations can be dampened so that transmission capability is increased and the need for high-cost DC transmission avoided.

e. AC transmission networks have circuit breakers installed at various points so that facilities on which short circuits occur are automatically disconnected. The circuit breakers, and associated bus equipment, must be able to withstand and interrupt the maximum short circuit current that may occur. As AC transmission networks grow and generating stations and substations are added, the magnitude of the short circuit currents can exceed the capability of the associated buses and circuit breakers to withstand and interrupt them, required a replacement of these circuit breakers and/or a physical replacement of the buses involved. By use of the means described herein, current may be injected at a sufficiently fast speed to reduce the resulting short circuit currents within the capability of the circuit breakers and buses, thus eliminating the need for expensive reinforcements and replacements.

By judiciously locating the device described herein in a circuit or number of circuits in the transmission network, a combination of the benefits described above can be obtained resulting in multiple benefits from each device.

In fact, to date a number of such methods exist for achieving some of the above improvements in the transmission of electrical power in AC networks. These have included:

1. Use of phase angle regulators or quadrature boosters. These are large, massive devices that are expensive. They have experienced frequent failures and cannot be changed in settings rapidly. However, such devices are being increasingly used in the U.S.A. and in other nations. They do not however have the ability to achieve the fast changes of the device described herein.

2. Use of DC transmission lines operating in parallel with the AC network. This, too, presents an expensive and complex solution. The DC lines require full capacity rectification and inversion equipment as well as a large amount of reactive correction capacity. The need to design the DC circuit and equipment for full circuit capacity, voltage, and insulation level results in higher costs compared to achieving the same results with an AC circuit equipped with the device described herein. Also, the reliability of such DC circuits to date has been lower than the reliability which has been achieved with AC circuits of similar capacity.

3. Use of operating personnel directly or through supervisory controls to adjust generation schedules at the generating stations or the electrical arrangement of a transmission network by closing or opening circuit breakers when this can improve the utilization of facilities under specific loading conditions. Such changes are usually achieved at a penalty in fuel costs and fuel consumption required to meet overall system energy requirements. Use of the device described herein will not require such fuel penalties.

SUMMARY OF THE INVENTION

It is, with the recognition of the foregoing background, the object of this invention to provide a control means for AC transmission networks that will improve not only the effective use of transmission lines and facilities in integrated networks but do it for a lesser cost than any method presently available using a means that is readily adaptable to existing networks and future additions thereto. In fact, this invention demonstrably provides a unique and low cost method for controlling the steady state and transient loadings of AC transmission circuits and equipment which is applicable in integrated AC networks and for AC lines connecting isolated AC networks.

The objective is to increase the usefulness of transmission facilities and reduce the need for future facility additions in integrated AC networks or grids.

A further object of this invention is to provide a unique means for control of an energy system having a fast response provided by electrical means operable automatically. The fast response is achieved since the moving of large physical masses, as with phase angle regulators, will not be required.

Still another object of this invention is to provide such a means which if inoperative will not remove from the AC transmission system an important transmission line for an extended period of time.

In summary, the unique means provided by the power injector system of this invention can significantly reduce the additions and investments needed in AC transmission networks or grids. It can and does provide the AC transmission systems existing throughout the U.S.A. and the world with the controllability of DC transmission at a fraction of the cost. Furthermore, the fast response characteristic of this invention can be utilized to help improve stability conditions and provide the needed control when connecting isolated AC systems. The power injection system of this invention also can function to limit short-circuit duties; and, because it can be installed on an insulated platform or base, the power injection system can have a significantly reduced insulation level compared to insulation levels needed by conventional DC applications aforedescribed providing substantial cost savings.

DRAWING DESCRIPTION

FIG. **1** is a schematic simplified illustration of an AC transmission network or grid to which this invention is applicable; and

FIG. **2** is a one-line diagram (one phase of a three-phase system) of the transmission grid or network of FIG. **1** with a power injection system according to this invention connected thereto.

DETAILED DESCRIPTION

With particular reference to FIG. **1** there is shown in one-line diagram form electrical generating station **10** generating three-phase alternating current connected by a step-up transformer station **12** to a transmission network **14** comprising lines **16, 18, 20,** and **22.** The transmission network or grid **14** is connected to substations **24** and **26** to supply the electrical requirements of areas **28** and **30,** respectively, being, for example, industrial complex X and town Y. This network **14** might be connected to other networks by transmission lines **58** and **60.** These load stations **24** and **26** could require, for example, 500 MW and 1000 MW, respectively, that in turn is provided by the generation of 1500 MW at generating station **10.** By reason of Kirchoff's Laws, this power could be normally divided in this sample network such that line **16** carries 700 MW to deliver 500 MW to station **28** and 200 MW for line **18** with lines **20** and **22** having normally 400 MW transmitted equally thereby that combines with the 200 MW of line **18** to provide 1000 MW to substation **26** and with lines **58** and **60** normally not delivering or receiving any power. If, for example, these transmission lines are rated normally for 600 MVA and in emergencies for 800 MVA a loading in excess of normal capacity would exist on line **16** and a loading below normal capacity would exist on lines **20** and **22.** Also, if line **22,** for example, trips out of service then line **16** could be carrying 900 MW and line **20 600** MW because of Kirchoff's Laws, resulting in a loading in excess of emergency capacity on line **16** while line **20** would be loaded less than emergency capacity.

Now with reference to FIG. **2** a power injection system **32** is connected to line **16.** This system will inject a small amount of power by means of introducing in each phase controlled voltages having quadrature components in relation to the line phase to ground voltages of the same frequency which will cause circulating currents to flow to balance the loadings on the circuits. In the simple example referred to above, and in FIG. **1,** the voltage and power injected in line **16** would be controlled in the normal transmission network arrangement to circulate 200 MW to reduce the loading on line **16** by 200 MW to 500 MW and increase the loading on lines **20** and **22** by 100 MW each to 500 MW so that all circuits are within their normal ratings. Also, in the simple example described above and in FIG. **2,** the voltage and power injected in line **16** would be rapidly changed if line **22** trips out of service to circulate 150 MW to reduce the loading on line **16** to 750 MW and increase the loading on line **20** to 750 MW so that the two remaining circuits would be loaded within their

emergency ratings.

The voltage injected into line **16** could be varied rapidly and continuously as required by changing system conditions and by the availability of transmission facilities. The amount of power required to be injected would be equal to the net change in losses created in the network, and in some cases this could even be negative. While the injection of predominantly quadrature voltages are required for control of real power flows (MW), in-phase voltage components can also be injected when required to control voltages and reactive power flows (Mvar) or short circuit duties.

The power injection device **32** consists of the following major components:

A suppply transformer(s) **40.**

AC to DC rectification equipment, including suitable reactive compensation and filtering and smoothing equipment as necessary **44.**

DC to AC inversion equipment including suitable reactive and harmonic compensation as necessary **46.**

A power injector transformer **36.**

Suitable controls based on present practice.

A high-speed by-pass switch **38** may be provided on the injection transformer.

Connections between the above components having adequate insulation for the voltages used and adequate capacity for the currents involved, **34, 42, 48.**

The supply transformer **40** is shown connected **34** to line **16** but may alternatively be supplied by any other convenient and adequate AC source available. A three-phase to three-phase transformation, or a three-phase to six-phase transformation, or a three-phase to 12-phase transformation may be used; and the supply transformation may be provided in a single piece of equipment or in physically separate transformers; and transformer voltage ratios may be changed by use of no-load taps or taps which may be changed under load. All of the above characteristics are details of design that will depend on the specific application and involve only the use of conventionally available equipment readily understood by those skilled in the art and do not, therefore, require detailed description.

The output from the supply transformer flows via lead **42** to a power rectification system **44** to provide controlled DC source that is filtered and smoothed. The output of the rectifier flows directly to the invertor **46** which provides a controlled AC output with acceptable harmonic content by connector **48** to the primary winding **50** of power injector transformer **36.** The rectification and inversion equipment, including associated controls, aforedescribed are conventional devices readily understood by those skilled in the art and do not, therefore, require detailed description.

As can be seen in FIG. **2** the secondary windings **52** of the power injector transformer are connected in series in the line **16** whose power flow is to be controlled. The secondary winding **52** current rating required is the maximum current expected to be carried by the line **16,** whereas the secondary winding **52** voltage rating required will be a small fraction of the phase-to-ground voltage of the line **16** being regulated.

Depending on the specific application, the power injector transformer **36** may provide a three-phase to three-phase transformation, or a six-phase to three-phase transformation, or a 12-phase to three-phase transformation, using one or several separate pieces of equipment, having no-load or load tap changing equipment, and involves only the use of conventionally available equipment readily understood by those skilled in the art and does not, therefore, require a detailed description.

The key element in this invention is the use of a rectification to DC and an inversion back to AC in order to obtain an AC voltage source rapidly controllable in magnitude and phase angle for the creation of circulating currents in AC networks to obtain the benefits described heretofore. The DC voltage used is optimized to minimize overall power injection system costs for each type of application, as may be realized from solid-state and other technology for the equipment. Low overall system costs are possible to a large extent because the overall MVA rating of the power injection system of this invention will be a small fraction of the power carrying capability of the transmission line or equipment whose loading is being regulated. This attribute also enables the accomplishment of the installation of the system on an insulated platform or base as mentioned above in the objects of the invention.

The control of the power injection voltage and current will be accomplished through control of the timing of the firing angles in the rectifier system **44** and invertor **46.** Variation of quadrature voltage injected will control real power flows, and variation of in-phase voltage will control reactive flow and short-circuit currents.

The high-speed by-pass **38,** will be provided when required by the specific application and will be operable automatically or manually, as will be understood by those skilled in the art, to leave the line **16** available to continue limited operation during outages of the power injection system **32.**

Having set forth the objects, advantages, and embodiments which this invention has thus far been visualized to have and comprise, the protection sought by these Letters Patent is seen by reference to the appended claims:

What is claimed is:

1. In an AC transmission network for supplying power, a power injection system for controlling current and power flow in separate portions of the network, said power injection system comprising:

a source of AC power;

a means to provide a DC source from said source of AC power;

a means to provide a rapidly controlled AC source from said DC source; and

a means to employ said controlled AC source at the most advantageous locations in the network to control the magnitude and distribution of AC current and power.

2. The structure of claim **1** and further characterized by comprising supply transformer tapping AC from the portion of the network, to provide the AC supply.

3. The structure of claim **2** and further characterized by said means to provide a DC source being a rectifier system including reactive compensation and a filtering and smoothing means.

4. The structure of claim **3** wherein said means to provide a rapidly controlled AC source is an invertor including reactive and harmonic compensation.

5. The structure of claim **4** wherein said means to employ said controlled AC source is a power injector transformer having its primary winding connected to said invertor and its secondary winding in series con-

nection with a portion of the network.

6. The structure of claim 1 having means in the portion of the network to by-pass the power injection system whereby it may be removed from affecting the transmission network.

7. An AC electrical grid comprising:

a power generating system;

means connected to said power generating system to distribute AC power to a transmission network;

at least one load station for using the power from said transmission network; and

injection means in series connection with said transmission network, said means comprising a power injector transformer in at least one line controlling the current and power flow in that line and thereby controlling power flows in other lines of said transmission network.

8. An AC electrical grid according to claim 7 wherein said injection means is operative by AC in one or more lines to provide a DC signal inverted to an AC signal to, by said power injector transformer, provide a quadrature voltage for controlling real power flow in the line, and also provide an in-phase voltage that is variable to control reactive flow and shortcircuit currents.

9. An AC electrical grid according to claim 7 wherein said injection means is operative by any source of electrical power to vary quadrature voltage for control of real power flow and in-phase voltage to control reactive flow and short-circuit currents in said network.

10. The structure of claim 7 and further including means to by-pass the injector means control of the network.

11. A means to control AC transmission lines of a network comprising:

a power injector transformer in series connection in a line; and

a means to provide a controlled AC source controllable in magnitude and phase angle to said power injector transformer to control real power flow, reactive flow, and short-circuit currents in lines of said network, said means operable by a power rating of a small fraction of that flowing in the line.

12. The structure of claim 11 and further characterized in that said power injection transformer includes a secondary winding in series connection with said line having a current rating equivalent to said line and a voltage rating that is a fraction of the voltage of the line being regulated.

13. The structure of claim 12 wherein said means includes a supply transformer providing an AC source with rectifying, filtering, and smoothing means providing a DC source from the AC supply transformer and an invertor means receiving said DC source to provide a rapidly controlled AC source to the primary winding of said power injector transformer.

14. The structure of claim 13 and further comprising a high-speed by-pass in said line about the series connection of said secondary winding with the line.

15. The structure of claim 13 wherein the rectifying means and the invertor are controllable valves for control of the voltage and power to the primary winding.

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