BIBLIOGRAPHY OF RELAY LITERATURE, 1993 IEEE COMMITTEE REPORT

Members of the Bibliography and Publicity Working Group of the IEEE Power System Relaying Committee are:
M.S. Sachdev, Chairman, A.G. Folkman, D. Finley, M. Kezunovic, R. Ramaswami,
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ABSTRACT - The latest of a series of classified lists of power system relaying references, begun in 1927, is presented. This bibliography is in continuation to the bibliographies of relay literature which were published previously and are contained in the following volumes of the IEEE Transactions:

Bibliography for	Particulars of the Transaction				
	Volume	No.	Year	Page# from	to
1927-1939	60		1941	1435	1447
1940-1943	63		1944	705	709
1944-1946	67	pt. I	1948	24	27
1947-1949	70	pt. I	1951	247	250
1950-1952	74	pt. III	1955	45	48
1953-1954	76	pt. III	1957	126	129
1955-1956	78	pt. III	1959	78	81
1957-1958	79	pt. III	1960	39	42
1959-1960	81	pt. III	1962	109	112
1961-1964	PAS-85	10	1966	1044	1053
1965-1966	PAS-88	3	1969	244	250
1967-1969	PAS-90	5	1971	1982	1988
1970-1971	PAS-92	3	1973	1132	1140
1972-1973	PAS-94	6	1975	2033	2041
1974-1975	PAS-97	3	1978	789	801
1976-1977	PAS-99	1	1980	99	107
1978-1979	PAS-100	5	1981	2407	2415
1980-1981	PAS-102	4	1983	1014	1024
1982-1983	PAS-104	5	1985	1189	1197
1984-1985	PWRD-2	2	1987	349	358
1986-1987	PWRD-4	3	1989	1649	1658
1988-1989	PWRD-6	4	1991	1409	1422
1990	PWRD-7	1	1992	173	181
1991	PWRD-8	3	1993	955	961

1992 - Paper # 93 SM 379-8 to be published in PWRD-9.

94 SM 436-6 PWRD A paper recommended and approved by the IEEE Power System Relaying Committee of the IEEE Power Engineering Society for presentation at the IEEE/PES 1994 Summer Meeting, San Francisco, CA, July 24 - 28, 1994. Manuscript submitted March 13, 1994; made available for printing May 9, 1994.

The papers listed include references to the subjects of service restoration, testing and methods of calculation, as well as to the field of relaying. Only the more readily available foreign publications are included.

Each reference includes the title, author, publication information, and a very brief summary of the subject matter. The listing of the titles is subdivided into ten sections, depending upon the general substance of each article. The section titles are as follows:

3150 **RELAYING ALGORITHMS**
3151 **DISTRIBUTION AND NETWORK PROTECTION**
3151.1 Industrial and Power Station Auxiliaries
3151.2 Primary Distribution Systems
3152 **TRANSMISSION LINE PROTECTION**
3152.1 Distance and Ground Relaying
3152.2 Relay Communications
3152.3 Relay Systems
3153 **RELAY INPUT SOURCES**
3154 **ROTATING MACHINERY PROTECTION**
3155 **OTHER PROTECTION**
3155.1 Transformer and Reactor Protection
3155.2 Capacitor Bank and Static Var Protection
3155.3 Other Protection
3156 **FAULT AND SYSTEM CALCULATIONS**
3157 **MAINTENANCE, TESTING, ANALYSIS AND MODELING**
3158 **STABILITY, OUT OF STEP, RESTORATION**
3159 **SURGE PHENOMENA**

The entries in each section are listed in alphabetical order by the name of the first author. Each title is listed in only one section even if it covers material that belongs to several sections. A list of the periodicals which have been cited and the addresses of their publishers follows the bibliography.

The abstracts of many articles reported in this paper are available in the Science Abstracts - Section B, the Engineering Index, and other digesting and/or indexing periodicals.

ADDITIONAL REFERENCES

Electrical & Electronics Abstracts, are published monthly by the Institution of Electrical Engineers (U.K.) and the Institute of Electrical and Electronics Engineers, Inc. (USA).

Papers and journals published in several countries are covered.

3150 RELAYING ALGORITHMS

Constrained Frequency Domain Algorithms for Determination of Parameters of Fundamental Sinewave of Signals, K. Fr. Eichhorn, T. Lobos, P. Ruczewski, IEE Proceedings - C, Vol. 140, No. 6, 1993, 477-80. The method presented enables the design of FIR digital filters which satisfy a specific frequency response and auxiliary constraints. The procedure for selection of design parameters for particular applications is also described.

Performance of a New High Speed Digital Technique for Measuring Power System Frequency, P.J. Moore, D. Carranza, A.T. Johns, 5th Int. Conf. on Developments in Power System Protection, IEE Pub. No. 368, 1993, p 73-6. This paper describes further development of a previously proposed frequency measurement algorithm.

3151 DISTRIBUTION AND NETWORK PROTECTION

Determination of the Impacts of High Impedance Faults on Protection of Power Distribution Systems Using a Probabilistic Model, J. Barnard, A. Pahwa, Electric Power Systems Research, Vol. 28, 1993, p 11-8. The effects of fault impedance on overcurrent protection of electric power distribution systems are investigated in this paper.

The Application of Satellite Communications Technology to the Protection of the Rural Distribution Networks, P.V.F. Beardow, J.A. Barber, R. Owen, J.C. Bell, 5th Int. Conf. on Developments in Power System Protection, IEE Pub. No. 368, 1993, p 17-20. The use of Inmarsat-C communication system for protecting remote rural distribution networks is presented.

Design of a Digital O/C and G/F Relay for Low Voltage Power Systems, A. Gangopadhyay, Trans. CEA E&O Div., Vol. 32, 1993, Paper No. 93-SP-98. The paper describes the design of microprocessor based overcurrent and ground fault relay. The relay is designed for protection of low voltage power system elements.

Distribution Substation Control and Monitoring Using Numerical Relays, K.A. Hill, M.K. Browne, 5th Int. Conf. on Developments in Power System Protection, IEE Pub. No. 368, 1993, p 34-7. The paper describes a communication system developed specifically for remote monitoring and control of protective relays within the substation environment, particularly at distribution level.

High-Impedance Fault Detection System Using an Adaptive Element Model, C. J. Kim, B. D. Russell, IEE Proceedings - C, Vol. 140, No. 2, 1993, p 153-9. An adaptive-element approach for high impedance fault detection is presented. The system employs multiple detection algorithms using different frequency parameters. The system shows good performance and is secure against false identification.

Voltage Compensated Protection - A New Form of Backup Protection for Use on Distribution Circuits, A.J. Mackrell, H.R. Postlethwaite, W.J.S. Rogers, B.W. Swinnerton, J.V.H. Sanderson, W. An, 5th Int. Conf. on Developments in Power System Protection, IEE Pub. No. 368, 1993, p 91-4. This paper describes the design and testing of a voltage compensated protection which has evolved from overcurrent relay principles and uses sequence voltages to modify an IDMT characteristics.

A Method for Adaptive Coordination of Overcurrent Relays in an Interconnected Power System, N.A. Laway, H.O. Gupta, 5th Int. Conf. on Developments in Power System Protection, IEE Pub. No. 368, 1993, p 240-3. Description and test results of an algorithm for adaptive coordination of directional overcurrent relays in an interconnected system are given.

A Microprocessor-Based Digital Feeder Monitor with High-Impedance Fault Detection, R. Patterson, W. Tyska, B.D. Russell, B.M. Aucoin, 20th Annual Western Protective Relay Conference, Oct. 19-21, 1993. This paper describes a digital feeder monitor that uses a high waveform sampling rate for the ac current and voltage inputs in conjunction with a high-performance microprocessor to obtain the frequency response required for arcing fault detection and power quality measurements.

A New Approach to Distribution System Protection, M.S. Sachdev, B. Chattopadhyay, T.S. Sidhu, 5th Int. Conf. on Developments in Power System Protection, IEE Pub. No. 368, 1993, p 165-8. Important design aspects of an adaptive relaying system for the distribution network of the City of Saskatoon are presented. Some results from laboratory implementation of the proposed technique are included.

Automation of Knowledge Acquisition and Representation for Fault Diagnosis in Power Distribution Networks, C. Y. Teo, Electric Power Systems Research, Vol. 27, 1993, p 183-9. A fault diagnosis system for power distribution networks using machine learning of fault patterns through a network state capturing mechanism is described.

Swedish Distribution Networks - A New Methode for Earthfault Protection in Cable- and Overhead Systems, K.M. Winter, 5th Int. Conf. on Developments in Power System Protection, IEE Pub. No. 368, 1993, p 268-70. This paper describes a measurement method which is used to gain suitable control parameters for the residual current compensation device which is capable of suppressing arcing single-phase faults. The method also provides the distance to earth fault.

3151.1 Industrial and Power Station Auxiliaries

Motor Bus Transfer., IEEE PES Power System Relaying Committee Report, IEEE Trans. on Power Delivery, Vol. 8, No. 4, Oct. 1993, p 1747-58. Industry practices for implementing automatic motor bus transfers in power plant applications are reported. The report summarizes automatic transfer methods (fast, slow, parallel, residual voltage, and in-phase) and the application of supervisory and control relays for these schemes.

3151.2 Primary Distribution Systems

A New Concept for the Detection of Open Conductors, A.H. Ayoub, D.E. Dunn, S. Meliopoulas, A.C. Westrom, 47th Annual Georgia Tech Protective Relaying Conference, Apr. 28-29, 1993. This paper presents a new approach to the problem of downed conductors. The system presented detects a loss of voltage condition to an open conductor and communicates through the circuit neutral conductor with a relay which is located near a breaking device.

Tests of 34.5 kV Expulsion Fuses at Los Angeles Department of Water and Power, F. Calderon, IEEE Trans. on Power Delivery, Vol. 8, No. 1, 1993, p 203-11. DWP operates a 34.5 kV sub transmission system as a distribution system. Load transformers are fused to coordinate with line protective relaying. This paper presents the results of fuse tests to characterize the 34.5kV system parameters necessary for proper operation of the fuses.

High Impedance Fault Detection in Low Voltage Networks, R. D. Christie, H. Zadehgol, M. M. Habib, IEEE Trans. on Power Delivery, Vol. 8, No. 4, 1993, p 1829-36. The results of lab tests of arcing faults at 100 to 600 V are given. A detector of 2-10 kHz components of phase currents made it easy to reliably discriminate between arcing faults, noisy load, and loose connector waveforms.

Microprocessor Based Moulded Case Circuit Breakers, T. Craig, 5th Int. Conf. on Developments in Power System Protection, IEE Pub. No. 368, 1993, p 224-7. The paper explains how traditional moulded case circuit breakers with integral microprocessors meet the requirements for more advanced and flexible protection of distribution systems.

Negative-Sequence Overcurrent Element Application and Coordination in Distribution Protection, A. F. Elneweihi, E. O. Schweitzer III, M. W. Feltis, IEEE Trans. on Power Delivery, Vol. 8, No. 3, 1993, p 915-24. Negative-sequence overcurrent elements operate faster and more sensitively than phase overcurrent elements for phase-to-phase faults. This paper introduces simple setting guidelines to coordinate negative-sequence overcurrent elements with downstream phase overcurrent elements for phase-to-phase faults on a radial distribution system. Coordination for other faults and ground overcurrent elements is achieved with no further analysis. A step-by-step example is included.

Sympathetic Tripping on Distribution Feeders, D. Jackson, 46th Annual Texas A&M Conference for Protective Relay Engineers, Apr. 12-14, 1993. This paper discusses one utility's investigation into sympathetic tripping of distribution feeders, and describes the experiences and thoughts on these operations.

Downed Conductor Detection: Theory and Practice, J.R. Linders, D.I. Jeerings, 46th Annual Texas A&M Conference for Protective Relay Engineers, Apr. 12-14, 1993. Presented is a summary of the work leading up to the development of a downed-conductor relay based on the concept that such events are rich in harmonics and can be detected with suitably designed harmonic current detecting equipment.

Innovations in Distribution Substation Relay Protection at Philadelphia Electric Company, J.A. Schwenk, 20th Annual Western Protective Relay Conference, Oct. 19-21, 1993. This paper describes one utility's use of multi-function microprocessor relays to totally rethink and redesign their protection for distribution buses and circuits.

3152 TRANSMISSION LINE PROTECTION

A.C. Line Protection Operating Conditions in the Near Vicinity of HVDC Installations, F. Andersson, L-E. Juhlin, T. Jones, 5th Int. Conf. on Developments in Power System Protection, IEE Pub. No. 368, 1993, p 119-22. Two risk factors for improper ac line protection operation due to the influence of HVDC transmission are defined in this paper. The influence on different protection systems on an ac line in the vicinity of HVDC transmission is also discussed.

Travelling-Wave Based Protection of Double-Circuit Lines, M.H.J. Bollen, IEE Proceedings - C, Vol. 140, No. 1, 1993, p 37-47. The protection scheme presented in this paper includes a travelling-wave based double-circuit current comparison protection and differential protection. The scheme also contains fast reclosure, breaker failure detection, and adaptive setting for back-up relays. The setting of relay parameters and the relay's performance are discussed.

Current Differential and Phase Comparison Relaying Schemes, F. Calero, W.A. Elmore, Trans. CEA E&O Div., Vol. 32, 1993, Paper No. 93-SP-96. Contrasts between current differential and phase comparison relaying systems are described. The difficulties imposed by outfeed are reviewed and methods to overcome them are examined. Shortcomings and strengths of various "current-only" schemes are discussed.

Three Terminal Line Protection Based on a Superimposed Component Impedance Relay, J. S. Daniels, R. K. Aggarwal, A. T. Johns, IEE Proceedings-C, Vol. 140, No. 6, 1993, p.

447-54. Application of impedance relaying principle to a teed feeder is presented. The proposed relay design is immune to false tripping due to power swings or prefault load conditions. This has been achieved by using prefault and superimposed components of relaying voltages and currents. Some results are also included.

A New Digital Transmission Line Current Differential Relay System - Concepts and Test Results, L.J. Ernst, W.C. Fleck, W.L. Hinman, Trans. CEA E&O Div., Vol. 32, 1993, Paper No. 93-SP-97. The paper describes a new technique, called "charge comparison", for current differential protection of transmission lines. The technique resolves problems associated with the telecommunication requirements of current differential schemes.

Numerical Protection for Power Transmission Systems, T. Gudmundsson and P. Szabo, ABB Review, July/Aug. 1992, p 3-8. This paper reports on the upgrading of Iceland's 220/132 kV line protection systems using modern numeric relays to enhance the reliability of power supply. It is also reported that the REL100 series of relays applied on this system have already performed reliably under various fault conditions.

An Enhanced Transmission Line Protection Concept for Multi-Circuit Lines, H. Hupfauer, G. Koch, 5th Int. Conf. on Developments in Power System Protection, IEE Pub. No. 368, 1993, p 149-52. This paper discusses the requirements and operating features of a transmission line protection system for multi-circuit lines.

Performance Testing of Relays for Intersystem Faults in Combined 380 KV/110 KV Lines, C.G.A. Koreman, G. W.F.J. Kersten, 5th Int. Conf. on Developments in Power System Protection, IEE Pub. No. 368, 1993, p 145-8. This paper discusses the performance of relays for intersystem faults on 380 kV/ 110kV lines simulated using the EMTP. Measures to limit overvoltages on the 110 kV system and changes in the protection philosophy at the 380 kV level are described.

New, Intelligent Line Terminals, C. Ohlen, ABB Review, July/Aug. 1992, p 9-18. This paper describes many relay schemes in the PYRAMID family of microprocessor-based numerical relays which employ fiber optic and personal computer technologies for inter-relay communications. In addition to the standard relaying functions, these "intelligent workstation" systems also support setting and calculation, disturbance evaluation and recording, and analog simulation of disturbance recorders and line protection systems.

Improved Directional Comparison Based Algorithm for Protection of Multi-Terminal Transmission Lines, J.V.H. Sanderson, R.G.R. Santana, B. Al-Fakri, 5th Int. Conf. on Developments in Power System Protection, IEE Pub. No. 368, 1993, p 153-6. The algorithm described in this paper discriminates between internal and external faults based on current direction at the terminal with the largest voltage change.

Optical Fibre Pilot Differential Relaying for a 138 kV Eletrosul Short Transmission Line, A.J. Soares de Oliveira, 5th Int. Conf. on Developments in Power System Protection, IEE Pub. No. 368, 1993, p 248-51. The paper presents a summary of the technical report on the design of optical fibre pilot differential relaying applied to a short transmission line in Brazil.

A Travelling Wave Relay for the Protection of EHV Transmission Lines with Teed Feeders, D.W.P. Thomas, F.R.F. de Lima, C. Christopoulos, 5th Int. Conf. on Developments in Power System Protection, IEE Pub. No. 368, 1993, p 232-5. This paper describes the principle and test results of a travelling-wave based relaying algorithm for protecting teed feeders.

3152.1 Distance and Ground Relaying

Combined use of Definite and Inverse Time Overcurrent Elements Assist in Transmission Line Ground Relay Coordination, C. F. Henville, IEEE Trans. on Power Delivery, Vol. 8, No. 3, 1993, p 925-32. This paper describes the use of definite time overcurrent elements combined with inverse time relays to obtain faster relaying at both the low and high current ends of the settings. This permits faster operation of backup devices. Digital relays can incorporate the hybrid characteristic with little extra cost.

Combined Use of Definite and Inverse Time Overcurrent Elements Assists in Transmission Line Ground Relay Coordination, C.F. Henville, 20th Annual Western Protective Relay Conference, Oct. 19-21, 1993. This paper discusses the background and application of different types of overcurrent characteristics including the particular strengths of each type. Modern multifunction digital relays may include both characteristics, and benefits of combined uses are explored.

A Novel Non-Unit Protection Scheme Based on Fault Generated High Frequency Noise on Transmission Lines, A.T. Johns, Z. Bo, R.K. Aggarwal, 5th Int. Conf. on Developments in Power System Protection, IEE Pub. No. 368, 1993, p 65-8. A non-unit protection scheme which uses fault generated noise for deciding if the fault is inside or outside the transmission line protection zone is described. Results from simulation studies are also included.

Adaptive Distance Protection of a Double-Circuit Line Using Artificial Neural Nets, A.G. Jongepier, L. van der Sluis, 5th Int. Conf. on Developments in Power System Protection, IEE Pub. No. 368, 1993, p 157-60. This paper proposes a correction factor to adapt the settings of distance relays protecting a double-circuit line. Use of neural networks is

suggested for computing the correction factor.

Variable Digital Filter Response Time in a Digital Distance Relay, J.M. Kennedy, G.E. Alexander, J.S. Thorp, 20th Annual Western Protective Relay Conference, Oct. 19-21, 1993. Investigated in this paper is the effect of digital filtering on the operating time of a generic digital distance relay.

An Enhanced Transmission Line Protection Concept for Multi-Circuit Lines, G. Koch, H. Hupfauer, K. Friedrich, 46th Annual Texas A&M Conference for Protective Relay Engineers, Apr. 12-14, 1993. As utilities are required to maximize their use of existing rights-of-way, the concept of multi-circuit lines becomes more common. The protection of multi-circuit lines requires additional considerations for mutual coupling effects and, cross country and inter-circuit faults. This paper presents a system to enhance the security and reliability of the relaying systems.

A Transputer Based Distance Protection Scheme, P.D. Minns, R. Niven, 5th Int. Conf. on Developments in Power System Protection, IEE Pub. No. 368, 1993, p 86-90. Hardware and software of a distance protection scheme based on a transputer is described. Performance results are also included.

Discriminative Response Indices for Numeric Distance Protection, T. T. Nguyen, W. Derek Humpage, Electric Power Systems Research, Vol. 28, 1993, p 149-63. This paper investigates the discriminative properties which numeric distance protection can achieve.

Z=V/I Does Not Make a Distance Relay, J. Roberts, A. Guzman, E.O. Schweitzer, 20th Annual Western Protective Relay Conference, Oct. 19-21, 1993. This paper examines the Z=V/I approach to distance relay design, and shows the degradation due to load flow and fault resistance.

Development of an Amplitude Comparator for Distance Protection, M.S. Sachdev, I. Uttamchandani, T.S. Sidhu, W.O. Kennedy, Trans. CEA E&O Div., Vol. 32, 1993, Paper No. 93-SP-101. The development of a polyphase amplitude comparator suitable for use in microprocessor based distance relays is described. The performance of the comparator is similar to that of the selected phase comparator including the benefits of polarization.

A Microprocessor-Based Measuring Unit for High-Speed Distance Protection, T. S. Sidhu, Canadian Journal of Electrical and Computer Engineering, Vol. 18, No. 3, 1993, p 117-26. This paper describes a measuring unit which provides accurate estimates of apparent parameters of a line. The unit uses an algorithm which is not affected by distortion of input signals and by the system frequency drift from its nominal value. Test results indicate that the estimates converge to true values within 10 ms.

Symmetrical Component Based Improved Fault Impedance Estimation Method for Digital Distance Protection, Part I. Design Aspects, D. L. Waikar, S. Elangovan, A. C. Liew, Electric Power System Research, Vol. 26, 1993, p 143-7. In this paper, an improved fault impedance estimation method for digital distance protection that leads to a computational advantage over previously suggested symmetrical component based methods is proposed.

Symmetrical Component Based Improved Fault Impedance Estimation Method for Digital Distance Protection, Part II. Computational Aspects and Validation, D. L. Waikar, A.C. Liew, S. Elangovan, Electric Power System Research, Vol. 26, 1993, p 149-54. This paper deals with the computational aspects and performance testing of the fault impedance estimation method proposed in Part I.

First-Zone Performance Assessment of a Symmetrical Component Based Improved Fault Impedance Estimation Method, D. L. Waikar, A. C. Liew, S. Elangovan, Electric Power Systems Research, Vol. 27, 1993, p 161-8. This paper describes the first-zone performance assessment of a symmetrical component based fault impedance estimation method that was previously proposed by the authors.

Comparing Ground Directional Element Performance Using Field Data, K. Zimmerman, J. Mooney, 20th Annual Western Protective Relay Conference, Oct. 19-21, 1993. This paper presents differences between negative-sequence and zero-sequence polarization techniques, with emphasis on selecting the correct polarizing method.

3152.2 Relay Communications

Interfacing between SCADA Systems and Substation Communications Networks, R. Ball, D.R. Berresford, E. Crook, R. Squires, 5th Int. Conf. on Developments in Power System Protection, IEE Pub. No. 368, 1993, p 9-12. This paper describes the requirements, implementation and testing of a protocol converter for providing interface between SCADA systems and substation communications networks.

Basic Communications For The Relay Engineer, G. Clough, A. T. Giuliante, J. Gosalia, 20th Annual Western Protective Relay Conference, Oct. 19-21, 1993. This paper is a tutorial on communications language for the relay engineer.

Power Line Carrier Tuner Problems Caused by Customer Generated Noise, M.A. Crowley, J.R. Parker, 47th Annual Georgia Tech Protective Relaying Conference, Apr. 28-29,1993. The intent of this paper is to bring to the readers attention the problems introduced by customer generated noise in placing a power line carrier signal on high voltage conductors. Also, some solutions to these problems are introduced.

Performance Assessment of Digital Teleprotection Systems, I.J. Hall, 5th Int. Conf. on Developments in Power System Protection, IEE Pub. No. 368, 1993, p 1-4. This paper outlines methods of assessing the performance of wideband teleprotection systems.

Fiber Optic Communications for Utility Subsystems, R.E. Ray, 46th Annual Texas A&M Conference for Protective Relay Engineers, Apr. 12-14, 1993. This paper outlines some of the fundamentals associated with fiber optic communications and provides an insight into operation of digital channels. Also described is a new generation of digital fiber optic equipment.

Coding Techniques to Enhance Digital Data Communications for Unit Protection During Power System Fault Conditions, M.A. Redfern, D.P. McGuinness, R.F. Ormondroyd, Z.Q. Bo, 5th Int. Conf. on Developments in Power System Protection, IEE Pub. No. 368, 1993, p 21-4. The performance of error detecting and correcting techniques during random errors and burst errors are studied. Burst detecting techniques are also discussed.

Application and Field Experience of a New Digital Substation Switch at Savannah Electric and Power Company, R. Spain, G. Hoffman, K. Fodero, 47th Annual Georgia Tech Protective Relaying Conference, Apr. 28-29,1993. This paper discusses one utility's experience with using a digital substation communications switch to communicate with several devices located in the substation.

Standardization of Serial Interfaces of Digital Protection Equipment, R.M. Speh, R. Dinges, B. Gortz, 5th Int. Conf. on Developments in Power System Protection, IEE Pub. No. 368, 1993, p 5-8. Results of the coordination of standardization of serial communication interface of digital relays in Germany are described. The basic structures of the substation control systems as well as the standard interfaces are given.

Investigation of Time Transfer Accuracies Over Utility Microwave Communications Channel, R. E. Wilson, IEEE Trans. on Power Delivery, Vol. 8, No. 3, 1993, p 993-9. The paper describes the tests of time-keeping accuracy over a microwave channel for fault recording time synchronization. Estimates of channel propagation delay were calculated and compared with measurements. Accuracies of one millisecond were maintained.

3152.3 Relay Systems

The Intelligent Protection, Control and Monitoring Terminal, L.G. Anderson, C. Ohlen, W. Wimmer, I. Mesmaeker, T. Jones, 5th Int. Conf. on Developments in Power System Protection, IEE Pub. No. 368, 1993, p 29-33. This paper describes an intelligent transmission line terminal which can communicate with the substation control system, substation monitoring system, and relay testing and simulation system.

Hierarchical Protection of Transmission Systems, P.J. Moore, B. Stedall, A.T. Johns, J. Goody, 5th Int. Conf. on Developments in Power System Protection, IEE Pub. No. 368, 1993, p 123-6. Structure of an adaptive protection system for protecting transmission lines is outlined. Techniques for coordinating the protection are also reviewed.

ETL, A New Family of PLC Equipment, K. Morf, ABB Review, July/Aug. 1992, p 23-30. This paper describes the ETL family of Power Line Carrier equipment which are microprocessor-based and fully programmable. This system offers a range of interfaces with which data, speech, and teleprotection signals can be reliably transmitted in any combination.

3153 RELAY INPUT SOURCES

Current Measurement Device Based on the Faraday Effect, A. Cruden, J.R. McDonald, I. Andonovic, D. Uttamchandani, R. Porrelli, K. Allan, 5th Int. Conf. on Developments in Power System Protection, IEE Pub. No. 368, 1993, p 69-72. An optical current measurement device based on the Faraday effect is described. The performance of the sensor is also discussed.

Relay Performance Considerations with Low Ratio CTs and High Fault Currents, IEEE Power System Relaying Committee Report, IEEE Trans. on Power Delivery, Vol. 8, No. 3, 1993, p 884-97. Low ratio cts, commonly used in metal-enclosed switchgear for metering and relaying, usually have very low voltage capability. They may be subjected to saturation during high fault currents, resulting in delayed operation or inoperation of the relay. Emphasis is placed on the need for providing correct ct application for both overload and short circuit protection. Recommendations for modifying existing switchgear are presented.

Primary Sources for Fast and Efficient Checking of VT's and CT's Secondary Circuits, A.E. de Paula, A.J. Soares de Oliveira, 5th Int. Conf. on Developments in Power System Protection, IEE Pub. No. 368, 1993, p 211-5. This paper provides the details of a primary injection technique developed and practiced by a Brazilian utility for checking CT and VT secondaries at the time of comissioning substations and power plants.

3154 ROTATING MACHINERY PROTECTION

New Proposed Adaptive Frequency Load Shedding Scheme for Cogeneration Plants, M.M. Elkateb, M.F. Dias, 5th Int. Conf. on Developments in Power System Protection, IEE Pub. No. 368, 1993, p 236-9. This paper demonstrates the dependence of the rate-of-change-of-frequency load

shedding technique on the power system configuration and proposes an adaptive load shedding technique which uses information regarding the operating status of the power system.

Coordinating Protection and Control of Dispersed Generation, M.M. Elkateb, G. Fielding, 5th Int. Conf. on Developments in Power System Protection, IEE Pub. No. 368, 1993, p 131-5. The paper discusses the use of voltage controlled overcurrent relays and rate of change of frequency relays for protection and control of dispersed generation.

Impact of HV and EHV Transmission on Generator Protection, IEEE Power System Relaying Committee Report, IEEE Trans. on Power Delivery, Vol. 8, No. 3, 1993, p 962-74. The hazards to generators connected to HV and EHV transmission lines are more severe than the hazards to generators connected to lower voltage transmission lines. This paper focuses on seven major types of hazards and, the techniques and relaying solutions used to minimize their effects on generators.

Protection Planning Considerations of an Independent Power Producer (IPP) Connected to a Distribution Feeder, F.P. Plumptre, 20th Annual Western Protective Relay Conference, Oct. 19-21, 1993. This paper discusses the protection aspects of a generator connected to a distribution feeder from the perspective of an Independent Power Producer (IPP) .

Protection Against Loss of Utility Grid Supply for Dispersed Storage and Generation Unit, M. A. Redfern, O. Usta, G. Fielding, IEEE Trans. on Power Delivery, Vol. 8, No. 3, 1993, p 948-54. This paper discusses an algorithm which monitors changes in power output of the generator. Tripping occurs when the integrated signal exceeds the trip setting. Tripping can occur when separation causes a load change of 1% of generator rating. While tied to the grid, the algorithm is stable for switching causing doubling or total loss of local load.

A New Digital Relay for Loss of Grid to Protect Embedded Generation, M.A. Redfern, O. Usta, J.I. Barrett, G. Fielding, 5th Int. Conf. on Developments in Power System Protection, IEE Pub. No. 368, 1993, p 127-30. A digital algorithm for detecting loss of grid for a small or medium sized embedded generator operating in parallel with a utility supply is described. Microprocessor-based implementation of the algorithm and performance results are also given.

A Digital Algorithm for Detecting Internal Faults in Synchronous Generators, T.S. Sidhu, B.R. Sunga, M.S. Sachdev, Trans. CEA E&O Div., Vol. 32, 1993, Paper No. 93-SP-103. The paper describes a digital algorithm for detecting faults in synchronous generators. The algorithm is based on positive- and negative-sequence models of the generator. Some test results are also included.

Optimum Settings for the 100% Ground Stator Protection in the Tucurui, Balbina and Samuel Hydro Power Plants - Electronorte - Brazil, A.J. Soares de Oliveira, C.A. de Miranda Aviz, 5th Int. Conf. on Developments in Power System Protection, IEE Pub. No. 368, 1993, p 186-90. Settings of the third harmonic based relays for 100% ground fault protection of stator windings of hydro generators in Electronorte, Brazil are discussed. Third harmonic measurement techniques are also described. A brief comparison of techniques used for 100% ground fault protection of stator windings is also given.

Protection of Utility/Cogeneration Interconnections, F. Soudi, P.B. Tapia, E.A. Taylor, D. Tziouvaras, 20th Annual Western Protective Relay Conference, Oct. 19-21, 1993. Presented is one utility's basic relay requirements for interconnection of cogeneration facilities, descriptions of some protective schemes, and their operating experiences.

Developments in Generator Protection - Design and Application Aspects of a New Numerical Relay Range, G. Ziegler, 5th Int. Conf. on Developments in Power System Protection, IEE Pub. No. 368, 1993, p 111-4. This paper discusses the design aspects of a numerical relay for generator protection. System structure, relay architecture and upgrading of protection functions are described.

3155 OTHER PROTECTION

Microprocessor-Based Busbar Protection Relay, F. Andow, N. Suga, Y. Murakami, K. Inamura, 5th Int. Conf. on Developments in Power System Protection, IEE Pub. No. 368, 1993, p 103-6. This paper describes the architecture and functions of a microprocessor-based busbar differential protection system. Principle and operation of a ct-saturation-countermeasure element is also given.

Protecting the Channel Tunnel, J.S. Finn, P.J. Hindle, 5th Int. Conf. on Developments in Power System Protection, IEE Pub. No. 368, 1993, p 107-110. This paper discusses the protection requirements for the channel tunnel electric distribution system and how these have been met by utilizing existing principles of protection and relay technology.

Numerical Protection Systems for Generators and Generator Transformer Units, M. Ilar and G. Stranne, ABB Review, Jan. 1993, p 27-38. This paper provides an overview of the advantages of numerical protection systems and details the REG series of numerical relays for generator and generator transformer protection applications. In addition to providing adaptive protection, these relays also allow for communication with station control and monitoring systems.

Digital Bus-Zone Protection, A. Kumar and P. Hansen, IEEE Computer Applications in Power, Vol. 6, No. 4, 1993, p 29-34. This paper describes a numerical bus protection relay which employs the low impedance measuring

principle. This one-cycle relay integrates many protection functions, such as breaker failure and overcurrent controlled line trip. Good operating experience has been reported during the last five years of installation at voltage levels ranging from 20 kV to 200 kV.

Development of Digital Relay for 275 kV AC Filters at the Shin-Shinano Frequency Converter Station, Y. Ohura, N. Ohashi, T. Maeda, K. Murotani, Y. Jikihara, T. Emura, T. Harada, 5th Int. Conf. on Developments in Power System Protection, IEE Pub. No. 368, 1993, p 81-5. Design and testing of a digital relay for protecting ac filters at the Shin-Shinano frequency converter station are presented.

A New Numerical Busbar Protection System with Bay Oriented Structure, D.M. Peck, B. Nygaard, K. Wadelius, 5th Int. Conf. on Developments in Power System Protection, IEE Pub. No. 368, 1993, p 228-31. Design, functions and application of a numerical busbar protection system are discussed in this paper.

3155.1 Transformer and Reactor Protection

PC Based IIR Filter Algorithm for Power Transformer Relaying, A. M. Basha, K. Anantha Raman, Electric Power Systems Research, Vol. 28, 1993, p 123-7. The development of an IIR filter algorithm coupled with a unidirectional current check for the differential protection of power transformers is presented.

Flux-Based Current-Differential Relay for Power Transformer Protection, J. Haydeman, L. van der Sluis, 5th Int. Conf. on Developments in Power System Protection, IEE Pub. No. 368, 1993, p 77-80. A current differential relay for a power transformer based on the flux-current relationship of the transformer is presented. Results from laboratory testing of the relay are included.

Experimental Testing of a Stand-Alone Digital Relay for Power Transformers, B. So, M.A. Rahman, Trans. CEA E&O Div., Vol. 32, 1993, Paper No. 93-SP-104. This paper presents the experimental results from testing of five algorithms for protection of power transformers.

Cost Effective "Protection Module" Designs for Power Transformer Protection & Control Schemes, J.M. Theunissen, 5th Int. Conf. on Developments in Power System Protection, IEE Pub. No. 368, 1993, p 244-7. Described are the specifications and implementation of a "protection module" approach to the design of future transformer protection and control schemes adapted by a South African utility.

Fuzzy Set Approach to Transformer Differential Relay, A. Wiszniewski, B. Kasztenny, 5th Int. Conf. on Developments in Power System Protection, IEE Pub. No. 368, 1993, p 169-72. Application of fuzzy set theory for differential protection of transformers is proposed in this paper.

Whole Transformer Station Protection and Automation - A Local Area Network Approach, Q. Yang, Y. Zhao, R. Watson, 5th Int. Conf. on Developments in Power System Protection, IEE Pub. No. 368, 1993, p 13-6. This paper describes a local area network which permits interconnection of protection systems, fault recorders and the host computer to provide protection and automation of a transformer station.

3155.2 Capacitor Bank and Static Var Protection

New Algorithm for Protection of Capacitor Banks Exposed to Harmonic Overvoltages, G. Benmouyal, H. Bilodeau, S. Chano, G. Sybille, IEEE Trans. on Power Delivery, Vol. 8, No. 3, 1993, p 898-904. Conventional capacitor bank overvoltage relays based on voltage peak detection exhibit overprotection when harmonics are present due to GIC conditions. This paper considers the concept of a distortion index (DI)-the ratio of the actual peak voltage to that of a sine wave of the same RMS value. Overprotection can be reduced by adaptive overvoltage protection using a compensation factor based on the value of DI.

Digital Protection of Advanced Series Compensators, M. Pereira, K. Renz, F. Unterlaβ, 5th Int. Conf. on Developments in Power System Protection, IEE Pub. No. 368, 1993, p 140-4. Various protection functions of schemes protecting Advanced Series Compensators (ASC) are described. The hardware for digital realization of ASC schemes is outlined. Impact on line protection is discussed.

3155.3 Other Protection

B.C. Hydro Experience with Integrated Monitoring and Control of a Large Hydroelectric Generating Station, D. Apps, Trans. CEA E&O Div., Vol. 32, 1993, Paper No. 93-SP-86. The paper describes the rationale for using the PLC based Data Acquisition and Control System for the B.C. Hydro's 2400 MW G.M. Shrum hydroelectric generating station. The features, architecture, hardware, software and implementation of the system are also described.

Coordinated Control and Protection: Functionality Enhancements via Information Technology, C. Booth, J.R. McDonald, R.W. Stewart, W.J. Laycock, A. Bennett, 5th Int. Conf. on Developments in Power System Protection, IEE Pub. No. 368, 1993, p 25-8. A possible architecture for a future substation control and protection system utilizing advanced information technology, and having a conventional coordinated control and protection system as a 'base' is presented. Reliability and advantages of the proposed system are discussed.

The Integration of Protection, Control, and Monitoring in a High Voltage Substation, J. Burger, J. Schnegg, M.

Adamiak, E. Weintruab, 46th Annual Texas A&M Conference for Protective Relay Engineers, Apr. 12-14, 1993. The "Digitization" of the utility substation has been both a boon and a bother for the average utility engineer. This paper examines the drivers and objectives of integrating digital devices in a high voltage substation as well as presenting a strategy to achieve these objectives.

EHV System Protection Upgrade, J.E. Cox, 46th Annual Texas A&M Conference for Protective Relay Engineers, Apr. 12-14, 1993. This paper presents one utility's approach to analyzing the need for relaying upgrades to the EHV system and presents the results.

Integrated Protection, Control and Data Acquisition, J. C. Fong, J.C. McGough,, 20th Annual Western Protective Relay Conference, Oct. 19-21, 1993. Described is an application and technology enabler software package utilized together with a Programmable Logic Controller to provide the basis for building a wide range of real-time supervisory monitoring and logging, control, and information management systems, including the integration of data from protective relays.

Power System Monitoring and Control Facilities on Protective Relays, S.M. Haden, Trans. CEA E&O Div., Vol. 32, 1993, Paper No. 93-SP-84. A solution which addresses many of the problems associated with integration of protection, monitoring and control functions is presented. An example of how it might be applied in a typical substation is also given.

Modal Saturation Detector for Digital Differential Protection, G. Hosemann, H. M. Steigerwald, IEEE Trans. on Power Delivery, Vol. 8, No. 3, 1993, p 933-40. Differential relay settings may be compromised to allow for ct saturation without false operation. The paper describes a digital procedure to detect the inception of ct saturation within 3 ms to permit adjusting the differential characteristic to compensate for the impending ct saturation. Ct magnetic properties need not be known.

Feasibility of Adaptive Protection and Control, IEEE Power System Relaying Committee Report, IEEE Trans. on Power Delivery, Vol. 8, No. 3, 1993, p 975-83. The paper presents some background on the concept of adaptive protection, summarizes a questionnaire, and gives an analysis of the responses. Sixteen possible adaptive protective functions are evaluated.

Advanced Substation Protection and Control - Design and Introduction of the Second Generation, A. Inan, G. Ziegler, 5th Int. Conf. on Developments in Power System Protection, IEE Pub. No. 368, 1993, p 38-41. The characteristics, design and application aspects of an advanced substation protection and control system are covered in this paper.

Pyramid Concept, L.R. Johnson, Trans. CEA E&O Div., Vol. 32, 1993, Paper No. 93-SP-82. The paper describes the architecture and design of the co-ordinated substation control system, summarizes its benefits, lists the functions it performs, and addresses issues which users confront as they move to substation control based on modern technology.

Open Relaying Systems - A New Philosophy, P.G. McLaren, G.W. Swift, E. Dirks, A. Neufeld, Z. Zhang, R.W. Haywood, 5th Int. Conf. on Developments in Power System Protection, IEE Pub. No. 368, 1993, p 95-8. A new development in relaying hardware and philosophy is described. Details of a prototype design capable of being assembled and configured by a utility are given. Results of tests on the prototype are also included.

Applications of Digital Differential Protection, J.N. McMurdo, G.C. Weller, 5th Int. Conf. on Developments in Power System Protection, IEE Pub. No. 368, 1993, p 115-8. This paper describes developments in differential protection relays which have made these relays suitable for more diverse applications.

Application of Fault Location System in Power Substations, Y. Mukaiyama, K. Mizuno, A. Horide, T. Sakakibara, S. Maruyama, I. Kamata, A. Shinoda, IEEE Trans. on Power Delivery, Vol. 8, No. 1, 1993, p 48-55. The paper describes tests used in developing sensors for detecting pressure waves, pressure rises, arc lights, tank vibrations, and ground currents caused by fault current arcs in GIS systems. Methods of applying the sensors are discussed.

Synchronized Phasor Measurements in Power Systems, A.G. Phadke, IEEE Computer Applications in Power, Vol. 6, No. 2, 1993, p 10-5. A summary of the fundamental concepts and a variety of potential applications of satellite-synchronized phasor measurements in the power system area are covered in this paper. The applications include frequency measurement, static and dynamic state estimation, adaptive relaying, instability prediction and improved control schemes for excitor, HVDC, and SVCs.

Detecting, Locating and Identifying the Type of Faults on the Interfacing Link Between an Industrial Link and a Utility, S.K. Salman, A.R. Mollah, 5th Int. Conf. on Developments in Power System Protection, IEE Pub. No. 368, 1993, p 136-40. A microprocessor based technique for detecting, locating and identifying the type of faults on the interfacing circuit is described. Results obtained from the application of the technique to a simulated system are presented.

Study on Complex Grounding Fault Protection with High Impedance for at Feeding Traction System, G. Shi-bin, H. Wei-jun, C. Xiao-chuan, 5th Int. Conf. on Developments in Power System Protection, IEE Pub. No. 368, 1993, p 264-7. Principles and structure of relays for ground fault protection

of autotransformer fed circuits of electric railways are described.

Applications of Thermal Replica Relays to Optimize Intertie Emergency Capability, E.R. Terlau, S.L. Hayes, M.Y. Vaziri, J. Campbell, 20th Annual Western Protective Relay Conference, Oct. 19-21, 1993. This paper describes the application of thermal replica relays to protect transmission lines from exceeding their thermal capacity.

Microprocessor Controlled Standard System for Power Substation Control, Monitoring, Automation and Protection, S. Wolf, Trans. CEA E&O Div., Vol. 32, 1993, Paper No. 93-SP-83. The paper describes the application of the microprocessor controlled LSA 678 substation control and protection system and discusses its advantages.

A Multi-Function Protection and Control Relay Designed Using Multiple Micro-Controllers, Q. Yang, Z. Zhang, X. Zhao, J. Cunningham, M. McCleery, P.A. Crossley, 5th Int. Conf. on Developments in Power System Protection, IEE Pub. No. 368, 1993, p 99-102. A multifunction protection and control relay designed using micro controllers is described. The relay incorporates self monitoring, event recording and a man machine interface.

3156 FAULT AND SYSTEM CALCULATIONS

Practical Approach to Accurate Fault Location on Extra High Voltage Teed Feeders, R. K. Aggarwal, D. V. Coury, A. T. Johns, A. Kalam, IEEE Trans. on Power Delivery, Vol. 8, No. 3, 1993, p 874-83. This paper describes the basis of an alternative approach to impedance measurement utilizing voltage and current waveforms recorded at all three ends of a teed circuit. The voltage at the teed point is calculated from terminal data. It disagrees for the faulted leg. The distance to the fault is then evaluated from the teed point and faulted leg terminal phasors.

Computer-Aided Design and Testing of an Accurate Fault Locator for EHV Teed Feeders, R.K. Aggarwal, D.V. Coury, A.T. Johns, A. Kalam, 5th Int. Conf. on Developments in Power System Protection, IEE Pub. No. 368, 1993, p 60-4. A fault location technique which utilizes voltages and currents recorded at three ends of a teed feeder is described. Procedure for synchronizing data from the three ends and some test results are given.

Analysis of the Faults Involving Adjacent Conductors of a Six-Phase Transmission Line Together with a Modelling of the Phase Conversion Transformer, S. S. Ahmed, M. Tawrit, Electric Power Systems Research, Vol. 27, 1993, p 99-105. This paper illustrates the way a phase conversion transformer can be incorporated in the six-phase line fault modeling and presents the application of the loop current method to determine the currents and fault MVA for faults on a 132 kV six-phase line.

PC-Based Fault Finder, N.N. Bengiamin, C.A. Jensen, and H. McMahon, IEEE Computer Applications in Power, Vol. 6, No. 3, 1993, p 22-6. A pc-based fault locator for application on transmission/distribution lines developed for Otter Tail Power is described in this article. Balanced and unbalanced faults are identified and located taking into account changes in conductor sizes and network configurations.

Computing Overhead Line Parameters, S.M. Chan, IEEE Computer Applications in Power, Vol. 6, No.1, 1993, p 43-5. This article describes the ASPEN Line Constants program that uses interactive graphics for specifying transmission line geometry and computes the self and mutual impedances in both phase and sequence domains.

Modeling MOV Protected Series Capacitors for Short Circuit Studies, M. Coursol, C. T. Nguyen, R. Lord, X-D Do, IEEE Trans. on Power Delivery, Vol. 8, No. 1, 1993, p 448-53. The paper proposes a procedure to model the non-linear characteristics of the MOVs which is combined with a compensation technique to represent the intersequence couplings during unbalanced faults. The effectiveness is demonstrated by comparing the results with those obtained from EMTP simulations.

Fault Location Based on Travelling Waves, P.F. Gale, P.A. Crossley, X. Bingyin, G. Yaozhong, B.J. Cory, J.R.G. Barker, 5th Int. Conf. on Developments in Power System Protection, IEE Pub. No. 368, 1993, p 54-9. Various methods which use travelling waves for fault location are evaluated and a hybrid type unit is proposed.

Development of an Accurate Traveling Wave Fault Locator Using the Global Positioning System Satellites, H. Lee, 20th Annual Western Protective Relay Conference, Oct. 19-21, 1993. This paper describes a fault locator system that consists of traveling wave detectors located at key substations which detect and time tag the leading edge of the fault-generated traveling wave as it passes through.

Development of an Accurate Traveling Wave Fault Locator Using the Global Positioning System Satellites, H. Lee, Trans. CEA E&O Div., Vol. 32, 1993, Paper No. 93-SP-102. This paper describes a fault locator system which consists of traveling wave detectors located at key substations which detect and time tag the leading edge of the fault-generated traveling wave as it passes through. A master station gathers the time-tagged information and determine fault location.

3157 MAINTENANCE, TESTING, ANALYSIS AND MODELING

Use of a Digital Simulator to Test Relays Under Critical Operating Conditions, L.Barretta, B. Ceresolt, E. de Berardinis, C. Pincella, 5th Int. Conf. on Developments in Power System Protection, IEE Pub. No. 368, 1993, p 252-5.

This paper briefly describes a computerized test system developed by ENEL (the Italian National Electricity Board) for defining the behavior of relays under possible network or fault conditions. Results from two cases are given.

Testing Dynamic Characteristics of Overcurrent Relays, G. Benmouyal, S.E. Zocholl, 47th Annual Georgia Tech Protective Relaying Conference, Apr. 28-29, 1993. This paper discusses test methods for determining the characteristics of an overcurrent relay when subjected to currents of varying magnitudes.

Trends in Power System Simulation for Relay Testing, N. Brooks, A.J. Perks, S.J. Rose, A. Williams, 5th Int. Conf. on Developments in Power System Protection, IEE Pub. No. 368, 1993, p 256-9. The paper discusses the trends in relay testing since 1950.

Computer Aided Evaluation and Application of Distance Relays, L.P. Cavero, 5th Int. Conf. on Developments in Power System Protection, IEE Pub. No. 368, 1993, p 199-202. This paper describes a computer program which can be used as a tool by a protection engineer to evaluate distance relays under varying conditions.

Verification of ANSI C37.90.1 SWC Test Generator Outputs, D. M. Cooper, R. D. Pettigrew, IEEE Trans. on Power Delivery, Vol. 8, No. 3, 1993, p 905-14. This paper addresses three topics: (1) design, construction, and testing of high voltage test dividers for checking the test generator output, (2) testing and analysis of output waveform of a C37.90.1 Electrical Fast Transient (EFT) test generator, and (3) recommendations on the ANSI C37.90.1 specifications. Many problems in measuring and using EFT waveforms have resulted from neglect of RF considerations in the test divider design and EFT test setup.

Relay Specific Computer Aided Testing for Protective Relays, K.C.A. Dierks, 5th Int. Conf. on Developments in Power System Protection, IEE Pub. No. 368, 1993, p 207-10. This paper introduces the concept of relay specific computer aided testing software packages. Examples of packages developed and used in Eskom (a South African Utility) are given.

Linear Programming for Directional Overcurrent Relay Coordination in Interconnected Power Systems with Constraint Relaxation, H. B. Elrafie, M. R. Irving, Electric Power Systems Research, Vol. 27, 1993, p 209-16. A complete algorithm for calculating the time dial settings corresponding to given pickup currents is introduced to make this method suitable for computer implementation.

Monitoring of Protection System Behavior Using an Expert System which Analyses Substation Sequential Events Recordings - Field Experience at Electricite De France, P. Fauquembergue, A. Maizener, J.M. Parant, L. Perrot, H. Bertrand, 5th Int. Conf. on Developments in Power System Protection, IEE Pub. No. 368, 1993, p 42-5. A brief description of an expert system, which automatically performs protection system diagnosis using the sequential event recordings at substations, is given. Field experience gained from the use of this system is also described.

Management Experiences from Digital Relay Information and Its Treatment in the Protection Analysis Center, G. Gomez, J.M. Gallastegui, J. Cardenas, 5th Int. Conf. on Developments in Power System Protection, IEE Pub. No. 368, 1993, p 46-9. The results of experience obtained from relays in the field are presented. Basic features and structure of a system for management of the information collected from relays and recorders are described.

Predictive Maintenance by Detection of Incipient Fault Conditions, R.P. Heller, L. Sexton, B.A. Pickett, K.J. Rodrigue, 47th Annual Georgia Tech Protective Relaying Conference, Apr. 28-29, 1993. This paper reviews the operation of a research platform designed to monitor arcing activity and detect incipient faults. Measured activity is correlated to system events to eliminate false indications.

An Expert System for Supporting Protective Relay Settings for Transmission Lines, K. Kawahara, H. Sasaki, J. Kubokawa, H. Sugihara, M. Kitigawa, 5th Int. Conf. on Developments in Power System Protection, IEE Pub. No. 368, 1993, p 203-6. The use of an expert system for coordination and setting of directional overcurrent and distance relays is described. The proposed expert system is developed on a personal computer and an application example is included.

Criteria for the Implementation and Life Cycle Management of a Major 330 kV Protection System Upgrade, D.J. Kerr, 5th Int. Conf. on Developments in Power System Protection, IEE Pub. No. 368, 1993, p 180-5. This paper documents the development of a six year project to upgrade 330 kV protection system. Maintenance and management of the protection system is also discussed.

Expert System for Transmission Substation Event Analysis, M. Kezunovic, P. Spasojevic, C. W. Fromen, D. R. Sevick, IEEE Trans. on Power Delivery, Vol. 8, No. 4, 1993, p 1942-9. Analyzing digital fault recorder data can be a problem due to the large number of disturbances and fault records captured. An expert system makes this process efficient by extracting the fault events and by analyzing the events and protection system operations.

Philosophies for Testing Protective Relays, J.L. Kumm, M.S. Weber, E.O. Schweitzer, D. Hou, 20th Annual Western Protective Relay Conference, Oct. 19-21, 1993. This paper evaluates traditional testing philosophies to determine the effectiveness when applied to new relay designs.

Central Testing and Site Commissioning for a New, User Programmed, 33 kV Feeder Protection, A.J. Mackrell, H.R. Postlethwaite, W.J.S. Rogers, J.V.H. Sanderson, W. An, 5th Int. Conf. on Developments in Power System Protection, IEE Pub. No. 368, 1993, p 220-3. This paper discusses the installation and commissioning of microprocessor protection relays on a 33 kV feeder by district engineers with the help of automatic test equipment. Main methods used and the experience gained are described.

A Knowledge-Based System for Automatic Evaluation of Disturbance Recordings, S. Mahrs, L. Cederblad, P.O. Gjerde, 20th Annual Western Protective Relay Conference, Oct. 19-21, 1993. This paper describes a system that is intended to be used to get a better knowledge of power system disturbances, to reduce the information flow created in the disturbance recorders, to reduce the manual work which is required for the analysis and to provide means of altering the maintenance procedures.

A Software-Based EMTP Real-Time Simulator, J.R. Marti, L.R. Linares, H.W. Dommel, Trans. CEA E&O Div., Vol. 32, 1993, Paper No. 93-SP-105. The paper describes a real-time, software-based, fast transients simulator which is suitable for testing protective relays.

Fault Line Analysis on Electromechanical and Microprocessor Protective Relays, J.L. McElray, 47th Annual Georgia Tech Protective Relaying Conference, Apr. 28-29, 1993. Discussed are the simulations of line-to-ground, line-to-line, double line-to-ground, three-phase and three-phase-to-ground faults on impedance protective relays. The analysis shows the operational characteristics of electromechanical and microprocessor impedance relays and their responses to the faults.

Automated Protection Grading and Performance Analysis System, F.D. McHenry, J.R. McDonald, B. Smillie, J. Spiller, S. Lanham, 5th Int. Conf. on Developments in Power System Protection, IEE Pub. No. 368, 1993, p 260-3. The paper presents the major modules of a protection grading package which enables calculation of relay settings as a first pass. Two protection grading case studies are also included.

Developments in Digital TNA's for Relay Testing, P.G. McLaren, R. Kuffel, R. Wierckx, J. Giesbrecht, L. Arendt, 5th Int. Conf. on Developments in Power System Protection, IEE Pub. No. 368, 1993, p 216-9. This paper describes the design and performance of a real time digital simulator for testing relays. Examples of tests done on distance relays are included.

Computer-Based Relay Models Simplify Relay-Application Studies, J.B. Mooney, D. Hou, C.F. Henville, F.P. Plumptre, 20th Annual Western Protective Relay Conference, Oct. 19-21, 1993. This paper describes some of the benefits of using a computer simulation of a relay. Such computer simulations can aid in pursuing difficult application questions.

Experience of Disturbance Recorders in an Island Power System, T. Simpson, T.G. Hagan, 5th Int. Conf. on Developments in Power System Protection, IEE Pub. No. 368, 1993, p 50-3. This paper discusses the application and experience gained from the use of microcomputer based power system disturbance recorder in the Northern Ireland Electricity system.

Use of Computers in Lifetime Management of Protection, Present Applications Within East Midlands Electricity and Possible Future Developments, R.K. Smith, A. Watts, I.E. Burton, 5th Int. Conf. on Developments in Power System Protection, IEE Pub. No. 368, 1993, p 195-8. This paper identifies some of the approaches taken by East Midlands Electricity for the lifetime management of protection systems. Possible future developments are also discussed.

Automatic Testing and Lifetime Management of Protection Relays - An R.E.C. Experience, G.D. Tout, I.S. Sokhey, A.C. Webb, 5th Int. Conf. on Developments in Power System Protection, IEE Pub. No. 368, 1993, p 173-9. This paper discusses one company's experience in the use of automatic relay testing equipment and how this will affect the management of protective relays.

Short-Circuit Tests on Current-Limiting Fuses: Modelling of the Test Circuit, R. Wilkins, T. Saengsuwan, L. O'Shields, IEE Proceedings - C, Vol. 140, No. 1, 1993, p 30-6. This paper describes the modeling of the circuit used for testing current-limiting fuses. The frequency dependence of R and L is investigated. Frequency dependence of R must be taken into account for accurate modeling of the operation of current limiting fuses.

EMPT Transient Modeling of Distance Relay and Comparison with EMTP Laboratory Testing, R. E. Wilson, J. M. Nordstrom, IEEE Trans. on Power Delivery, Vol. 8, No. 3, 1993, p 984-92. This paper reports on a method to test the transient performance of a sampled-data relay. Faults simulated on a transmission line were applied both to the digital model of the relay and to the actual relay.

3158 STABILITY, OUT OF STEP, RESTORATION

Adaptive Out-of-Step Relaying using Phasor Measurement Techniques, V. Centeno, J.D. La Ree, A.G. Phadke, G. Michel, J. Murphy, and R. Burnett, IEEE Computer Applications in Power, Vol. 6, No. 4, 1993, p 12-7. This paper describes an adaptive out-of-step relaying scheme developed under EPRI sponsorship for a Georgia-Florida 500-kV interconnection. The relaying scheme tracks the changing power system conditions using satellite-synchronized phasor measurements and employs a modified system impedance matrix to change relay settings adaptively.

Adaptive Out-of-Step Relaying Using Phasor Measurement Techniques , V. Centeno, J. De La Ree, A.G. Phadke, G. Michel, J. Murphy, R. Burnett, 46th Annual Texas A&M Conference for Protective Relay Engineers, Apr. 12-14, 1993. This paper discusses a practical implementation of one of the most promising adaptive relaying concepts- that of adaptive out-of-step relaying. This is accomplished by the use of two or more Phasor Measurement Units which provide synchronized real-time information regarding the state of the system.

Fast and Exact Line Reclosing Analysis Technique, P. B. Dutta Gupta, S. R. Karnilc, Electric Power Systems Research, Vol. 28, 1993, p 35-40. This paper introduces a fast and exact method for line reclosing analysis.

The Application of Neural Network Techniques to Adaptive Autoreclosure in Protection Equipment, D.S. Fitton, R.W. Dunn, R.K. Aggarwal, A.T. Johns, Y.H. Song, 5th Int. Conf. on Developments in Power System Protection, IEE Pub. No. 368, 1993, p 161-4. This paper discusses the application of artificial neural networks to achieve autoreclosing function. Some simulation results from a 400 kV line are presented.

A Knowledge Based Approach for Setting Protective Relays in Transmission Networks, M. A. Madkour, M. A. H. El-Sayed, Electric Power Systems Research, Vol. 27, 1993, p 107-15. The developed expert system can be used to set protective distance relays in transmission networks having arbitrary complex interconnections.

System Separation Equipment to Minimize Power System Instability Using Generator's Angular Velocity Measurements, Y. Morioka, K. Tomiyama, H. Arima, K. Sawai, T. Matsushima, K. Takagi, A. Ishibashi, H. Saito, IEEE Trans. on Power Delivery, Vol. 8, No. 3, 1993, p 941-7. The out-of-step prediction method of Kansai Electric Power Co. is described. Generators are fitted with electro-magnetic sensors to measure angular velocity. When a disturbance occurs, phase angle difference between generators is calculated and predicted for 200-300 ms in advance. Out-of-step is predicted and appropriate tie point tripping is initiated.

Voltage Collapse Control through SCADA-LTC Voltage Reduction, N.B. Tweed, Jr., 47th Annual Georgia Tech Protective Relaying Conference, Apr. 28-29, 1993. This paper describes one utility's testing done to verify the MW and Mvar changes obtained by LTC voltage reductions. The use of these reductions as a tool to enhance system security is also discussed.

3159 SURGE PHENOMENA

How to Protect Protection Systems, Theory and Demonstration, A.P.J. Van Deursen, P.C.T. Van der Laan, 5th Int. Conf. on Developments in Power System Protection, IEE Pub. No. 368, 1993, p 191-4. A theoretical basis for protection of protective relays against induced voltages is presented. A practical application of the method to a digital equipment is illustrated.

LIST OF PERIODICALS

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