STATE OF CONNECTICUT

CONNECTICUT SITING COUNCIL

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February 10, 2005

TO: Parties and Intervenors

FROM: S. Derek Phelps, Executive Director

RE: **DOCKET NO. 272** - The Connecticut Light and Power Company and The United Illuminating Company application for a Certificate of Environmental Compatibility and Public Need for the construction of a new 345-kV electric transmission line and associated facilities between the Scovill Rock Switching Station in Middletown and the Norwalk Substation in Norwalk, Connecticut.

The Connecticut Siting Council (Council) has scheduled a technical meeting on Monday, February 14, 2005, in Room 309. at the Institute of Technology and Business Development, Central Connecticut State University (CCSU), 185 Main Street, in New Britain, from 10:00 a.m. to approximately 1:00 p.m. The technical meeting will be moderated by Derek Phelps, Executive Director of the Council and Robert K. Erling, Senior Siting Analyst.

The Council announces the following participants and discussion topics:

Participants

Council Staff

Derek Phelps, Executive Director

Robert Erling, Senior Siting Analyst

Fred Cunliffe, Docket Analyst

KEMA (Council's Independent Consultant)

Richard A. Wakefield, Vice President, Transmission & Regulatory Services, KEMA, Inc.

Johan Enslin, Principal Consultant, KEMA Inc.

Yi Hu, Principal Consultant, KEMA, Inc. (resume enclosed)

Applicants

Roger Zaklukiewicz – Vice President, Transmission Engineering and Operations, Northeast Utilities Service Company

Brent Oberlin- Project Manager, Transmission Planning, Northeast Utilities Service Company

Reigh Walling, Principal Consultant, Energy Consulting, General Electric Energy

Elizabeth Pratico, Consulting Engineer, Energy Consulting, General Electric Energy

ISO-New England

Stephen G. Whitley, Senior Vice President and Chief Operating Officer, ISO *[or designee]*;

Erich W. Gunther, Chairman and Chief Technology Officer, EnerNex Corporation

Wilsons and S. Main Street Irrevocable Trust (Middletown)

Steven A. Boggs, Director, Engineering and Research, Underground Systems, Inc. (resume enclosed)

Melvyn Hopkins, Engineering and Quality Manager, AZZ/CGIT. (resume enclosed)

Topics

- Final ROC Report contention that additional undergrounding (beyond 24 miles) is not technologically feasible.
- Use of C-Type filters and other types of mitigation.
- Feasibility of alternative underground technologies.

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NOTICE OF SERVICE

I hereby affirm that a photocopy of this document was sent to each Party and Intervenor on the service list dated January 26, 2005.

Dated: February 10, 2005

Lisa Fontaine
Custodian of Docket No. 272

Profession: Power System Protection **Nationality:** Canadian Citizen

Years of Experience: 20

Education: Ph.D. Electric and Computer Engineering, University of Manitoba, Winnipeg, Manitoba, Canada, 1994

M.Sc. Electric Engineering, Nanjing Automation Research Institute, Nanjing, Jiangsu, China, 1984

B.Sc. Electrical Engineering, Southeast University, Nanjing, Jiangsu, China, 1982

Position On team: Principal Consultant

Key Qualifications:

Power system analysis, modeling and simulation
Dr. Hu is the Principal Consultant at KEMA for conducting power system steady-state, dynamic and stability analysis, transient and harmonic system studies, electric network modeling and simulations. He has extensive experience in using power system analytical tools, such as ATP/EMTP, PSCAD/EMTDC, PSS/E, PowerFactory and MATLAB, for conducting complex and demanding system analysis, modeling and simulation projects.

Power system protection and fault location
Dr. Hu is an expert in power system protections. He has an in-depth knowledge in principal, architecture and applications of power system protections for transmission and distribution lines, generators, transformers, shunt reactors and capacitors. He has also developed unique expertise in very challenging power system protection applications, such as parallel line protection, series compensated line protection, short line distance protection, and generator protection. Dr. Hu is also an expert in accurate fault location for power systems. He has developed several new and improved fault location methods/systems for locating faults on transmission/distribution lines with tapped lines/loads, and on series compensated lines.

Protection system testing
Dr. Hu is the Principal Consultant at KEMA for conducting protective relay type testing and for providing on-site test witnessing and certification. He had lead the development of an Advanced Relay Test System, which automated the complete process of testing C/C++ relay functional modules, from test case specification, generation, execution to results analysis. His recent assignment is to witness the compliance of teleprotection equipment to IEC 60834-1 and IEC 60495 standards for various vendors.

Power system control and power electronics devices control
Dr. Hu is experienced in the areas of real-time power system transient stability control and power electronics device control. He developed a dynamic power angle measuring system, a real-time transient stability control sub-system for a

regional power system, control system for Static Transfer Switch and Thyristor Controlled Reactors.

Telecommunication and network expertise
Dr. Hu had worked in telecom industry to develop diagnostic systems for testing new generation wireless/wire-line telecommunication/network equipment, such as SS7, UMTS, GPRS, etc.. He had developed in-depth knowledge in the areas of voice CODECs and objective voice quality assessment techniques.

Real-time control systems and digital signal processing
Dr. Hu has developed a number of real-time protection and control systems, including both hardware and software development. His specialty is in digital signal processing techniques and DSP based system development.

Papers and Patents

Dr. Hu has authored and co-authored a number of technical journal/conference papers in the IEEE and other organizations. He holds thirteen US patents with 37 related international patent filings.

Experience:

2004 – present KEMA
Principal Consultant:
Responsible for business development, project management and support in areas including power system analysis, power system protection and control, system analysis, modeling and simulation.

2003 – 2004 KEMA
Associated Consultant:
Provided consulting services in the areas of project support for power system protection and control.

2000 – 2003 Catapult Communications Corporation
Staff Engineer:
Performed product HW/SW development and support for telecom/ network diagnostic equipment for system tests including SS7, UMTS, GPRS.

2000 – 2002 Tekelec
DSP Engineer 4:
In charge of all DSP HW/SW related product development and support for telecom/network diagnostic equipment for system tests including SS7, UMTS, GPRS.

1994 – 2000 Electric System Technology Institute, ABB Power T&D Company
Fellow Engineer (1997 – 2000)/Senior Engineer (1994 – 1997):

Team Leader: in charge of advanced test system development for a new ABB digital protection system development project. Delivered an EMTP/MATLAB based Advanced Relay Testing System (ARTS). ARTS automated the complete process of specifying, generating and running test cases for verifying C/C++ coded relay functional modules.

Project Manager: in charge of securing project funding, project creation execution, and completion for a number of projects with total funding over one

million US dollars. Major projects include SACE Resonance Protection for IED controlled capacitor, EdF Adaptive Protection Study for parallel and short lines, online CT saturation compensation, Adaptive Transmission line/Transformer Protection, Impact of series compensation capacitor installation on existing relay systems study, etc.

Lead Investigator/Developer: leading the investigation and development efforts in several key development projects including Adaptive Series Compensated Line Protection, Advanced Generator Protection Function Development, Distribution Network Fault Location, Control System Development for Static Transfer Switch (STS) and Thyristor Switched Reactor (TSR), Tapped line fault location, etc.

ABB T&D University Instructor: taught advanced power system protection courses in 1999 and 2000.

1990 – 1994 University of Manitoba
Research Assistant:
Lead Developer: Developed an operational Integrated Generator Protection System (IGPS) prototype based-on NEC 77230 DSP and Motorola 68000 CPU. All standard generator protection functions were implemented in the IGPS prototype. Investigated special protection problems in protecting generators supplying HVDC lines. Developed and implemented new protection functions in IGPS prototype to address the identified special protection problems (e.g. wide system frequency variation, self excitation, etc.)

Developer: Participated in the development of an Adaptive Series Compensated Line Protection scheme. Investigated main difficulties in protecting two series compensated lines linking Manitoba Hydro system to the US system. Co-developed an adaptive distance protection scheme for protecting these two lines.

Teaching Assistant

Provided lab instruction and supervision for power system and electric circuit related courses.

1984 – 1989 Nanjing Automation Research Institute
Project Leader/Engineer
Project Leader: Developed a Dynamic Power Angle Measuring Device for real-time transient stability control. In charge for both hardware and software development of the project and project planning and execution. The device was installed at Xinanjiang Hydro Station in China.

Lead Developer: Real-time Transient Stability Control System (RTSCS): Responsible for developing an entire subsystem for the RTSCS, which consists on master system and four subsystems. The system was installed in Northeast Pool regional system in China.

Languages: English – Fluent, Chinese – Excellent

Professional Affiliations:
IEEE Member, Power Engineering Society (1994 – 2000, 2004)
IEEE Student Member, Power Engineering Society (1992 – 1994)

Publications:

"An Efficient Compensation Algorithm for Current Transformer Saturation Effects", IEEE Transaction on Power Delivery, Vol. PWRD-19, Issue 4, October 2004, pp. 1623 -- 1628

"An Adaptive Scheme for Parallel-Line Distance Protection", IEEE Transaction on Power Delivery, Vol. PWRD-17, Issue 1, January 2002, pp. 105 – 110.

"Improving Parallel Line Distance Protection with Adaptive Techniques", Power Engineering Society 2000 Winter Meeting Proceedings, Volume: 3, pp. 1973 – 1978.

"Power Factor Controller – An Integrated Power Quality Device", 1999 IEEE Transmission and Distribution Conference Proceedings, Vol. 2, pp. 572 – 578.

"A New Frequency Tracking and Phasor Estimation Algorithm for Generator Protection", IEEE Transactions on Power Delivery, Vol. PWRD-12, No. 3, July 1997, pp. 1064 – 1073.

"Algorithms for Locating Faults on Series Compensated Lines Using Neural Network and Deterministic Methods", IEEE Transactions on Power Delivery, Vol. PWRD-11, No. 4 October 1996, pp. 1728 – 1736.

"Application of Artificial Neural Networks for Series Compensated Line Protection", Intelligent Systems Applications to Power Systems, 1996. Proceedings, ISAP 1996, pp. 68 – 73.

""Self-Excitation Operating Constraint for Generators Connected to DC Lines", presented on 1996 IEEE Winter Meeting, Baltimore, February 1996, Published on IEEE Transaction on Power Delivery, Vol. PWRD-14, Issue 3, August 1999, pp. 1003 – 1009.

"Efficient FFT/DFT Implementation Techniques for a TMS320C30 based Numerical Relay for Power System Protection", ICSPAT International Conference on Signal Processing Applications and Techniques, Boston, USA, 24th-26th October, 1995.

"Self Excitation Protection for Generators Connected to DC Lines", Proceedings of International Conference on Power System Engineering, Beijing, China, 1994.

"A Microprocessor Platform for A Generic Protection System", CEA Engineering and Operating Transactions, Vol. 31, 1991/1992.

"Three New Control Algorithms for Out-of-Step Generator Resynchronization Control", Proceedings of 4th National Conference on Developments in Power System Protection, Yantai, China, 1986.

"A New Power Swing Detecting Unit", Proceedings of National Protection Academic Annual Meeting, 1985, Qindao, China.

Patents:

US 6,747,373, EP1468345, BR0207589, SE0302283, NO20033787, FI20031193, WO03058653, "System and method for coordinated control of a switched power capacitor with an integrated resonance protection system"

US 6,584,417, "Method and directional element for fault direction determination in a capacitance-compensated line"

GB2373935, "Locating faults on a transmission line with multiple tapped loads"

US 6,466,031, SE519953, US2002149375, JP2002243790, SE0104168, NO20016193, AU9743301, FR2819052, "Systems and methods for locating faults on a transmission line with multiple tapped loads".

GB2373586, "Locating a fault on a transmission line with a tapped load".

US 6,466,030, SE519964, US2002121903, JP2002243789, SE0104169, NO20016195, AU9743401, FR2819053, "Systems and methods for locating faults on a transmission line with single tapped load".

DE10163405, "Improved fault location in a power transmission network with multiple load tapping points by use of synchronized or unsynchronized measurement data from two ends of a power transmission line".

DE10163408, "Improved fault location in a power transmission network with a single load tapping point by use of synchronized or unsynchronized measurement data from two ends of a power transmission line".

US 6,397,156, EP1142076, AU1237700, WO0030233, "Impedance Measurement System for Power Transmission Lines".

EP1159627, AU1134100, WO0029861, "Reach-measurement method for power transmission lines"

US 6,336,059, "Reach-Measurement Method for Distance Relays and Fault Locators on Series-Compensated Transmission Lines using Local Information".

US 6,181,113, "Harmonic Resonance Control and Protection System for Switched Power Factor Control Capacitor Devices".

US 6,081,768, "Digital Peak Detector"

US 5,956,220, CA2319479, EP1060551, AU2338799, WO9940662, "Adaptive Distance Protection System".

US 5,839,093, ZA9711639, TW437138, DE19782226T, GB2334635, AU5324498, WO9829752, "System for locating faults and estimate fault resistance in distribution networks with tapped load".

US 5,805,395, "Half-cycle summation V/Hz relay for generator and transformer over-excitation protection".

US 5,721,689, "System and Method for Phasor Estimation and Frequency Tracking in Digital Protection Systems".

US 5,671,112, "Digital Integrator V/Hz Relay for Generator and Transformer Over-excitation Protection".

Melvyn Hopkins

CGIT Westboro, Inc.
30 Oak Street
Westboro, MA 01581
(508) 836-4000 (Telephone)
(508) 366-6113 (Facsimile)
www.azz.com

Education:

BSEE, Wayne State University, Detroit, Michigan

Experience:

Thirty five years experience in the design, construction and installation of SF6 apparatus.

Mr. Hopkins has over 35 years experience in the design, construction and installation of SF6 apparatus. After graduating with a BSEE from Wayne State University in Detroit, he started in the Westinghouse Circuit Breaker division in 1968 working on the design of Gas Insulated Substations (GIS) and Gas Insulated Lines (GIL). In 1978, he moved to the CGIT SF6 bus facility in Westboro, Massachusetts. He holds 6 patents in the areas of SF6 technology and is active in the IEEE substations committee, NEMA SG15 and the NEMA SF6 task force. In the past, he has participated in CIGRE joint working groups to define the principles of operation, performance and reliability of Gas Insulated Lines (GIL).

Mr. Hopkins is currently the Engineering and Quality Manager for AZZ/CGIT.

Mr. Hopkins can provide information to the Siting Council on the following topics:

- Reliability of Gas Insulated Lines.

CGIT bus has an excellent reliability record. The first installation was a 242 kV direct buried GIL in 1977. Since then CGIT has accumulated over a million meter years of service experience. The Mean Time to Failure (MTTF) for a 1 kilometer (3300 ft) circuit of CGIT is 71 years.

- CGIT has flexibility in design and installation.

The GIL can be installed above ground, in open or covered trenches or direct buried. Systems as large as 20,000 ft have been installed. The GIL is flexible and can often follow the contour of the land. For more abrupt changes in elevation mitered elbows are used to change direction. No matter what the terrain the GIL can be installed.

- CGIT has high current carrying capacity often twice the capacity of conventional cable technology.

A single 362 kV circuit of GIL can carry over 3000 amps. The addition of a spare phase would reduce the outage time should there ever be a problem.

With losses of only about 50 Watts/phase foot the GIL can have much lower operating costs that conventional cable.

- CGIT has much lower capacitance than conventional cable, typically about 16 pF/ft.

This means that the GIL has a much longer critical length than conventional cable.

- Public Access.

All high voltage equipment should be installed to limit public access. Overhead lines are mounted to poles. Conventional cable is buried underground. Access to the GIL can be achieved by a fence or placed in a covered trench either above or below grade.

Some of the safe operating principles of GIL include:

- External magnetic fields are extremely low. Typical values for a 400 kV GIL are 10 μT at 1 meter and 5 μT at two meters distance.
- The GIL is completely dead front and grounded.
- Operating pressures are low. Typically less than 60 psig.
- CGIT has never had an internal fault, which has punctured the enclosure. Typical gas compartments are large which limits the pressure rise due to an internal fault to a very safe level without the need of a rupture disk.

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Dr. Steven A. Boggs

Position: Director, Electrical Insulation Research Center and Research Professor of Electrical Engineering, Physics, and Materials Science, University of Connecticut

Education: MBA, University of Toronto, 1987

Ph.D. (physics), University of Toronto, 1972

M.Sc. (physics), University of Toronto, 1969

B.A. (physics), Reed College, Portland, Oregon, 1968

Positions Held: Director, Engineering and Research
Underground Systems, Inc.
February 1987 - October 1993

Senior Physicist, Ontario Hydro
January 1983 - February, 1987

Research Engineer/Physicist, Ontario Hydro
January 1975 to January, 1983

Experience: During his 12 years with the Research Division of Ontario Hydro, Steve conducted research in the areas of solid dielectrics, thermal design of underground cable, and SF_6-insulated systems including SF_6-insulated transmission lines. He was project leader of the team which developed the EPRI Thermal Property Analyzer (TPA) for measurement of soil thermal properties relevant to underground power transmission, the first instrument to be licensed by EPRI. In the area of SF_6-insulated systems, he pioneered the study of fast transient phenomena in gas-insulated substations (GIS) and trasmission lines (GITL), including transient groundrise, disconnector-induced transients, and statistical modeling of disconnector operation. Much of this work was carried out in cooperation with the major manufacturers including Alsthom, ASEA, Brown-Boveri (later ABB), and Siemens, all of which were subcontractors under his direction during an EPRI-sponsored project to improve the reliability of solid dielectric spacers for SF_6-insulated substations and transmission line. Steve was elected a Fellow of the IEEE for his contributions to the understanding of SF_6 insulated power apparatus. At Underground Systems, Inc., Steve patented the high temperature superconducting power cable design which was developed by Pirelli and American Superconductor with EPRI participation. He also invented a new transmission class cable termination design which has been fully qualified. Steve is author of nearly 200 technical publications, a Contributing Editor to Electrical Insulation Magazine, and an active participant of the IEEE Insulated Conductors Committee which deals with power cable. Steve has consulted for the ITAIPU Hydro Electric Project in Brazil, FURNAS (Rio de Janeiro), S&C Electric, ABB, and numerous US utilities.