

MANITOBA CLEAN ENVIRONMENT COMMISSION

IN THE MATTER OF: BIPOLE III TRANSMISSION PROJECT
ENVIRONMENTAL IMPACT STATEMENT

AND IN THE MATTER OF: Motion to be Brought before the Clean
Environment Commission pursuant to CEC
Process Guideline 2.08 as amended

ARGUMENT

Routing Options

1. In its Environmental Impact Statement (“EIS”), Manitoba Hydro has advocated for a particular routing and locations for the Bipole III Transmission Line (“Line”) and Converter Stations (“Stations”) (in combination referred to as “the Project”).
2. As part of that assessment, the CEC has heard a plethora of evidence as to whether the routing chosen by Manitoba Hydro is appropriate from an environmental impact perspective. Put another way, is there a better way and/or menu of choices to locate and construct the Line such as to minimize and/or ameliorate adverse environmental impacts, which have been demonstrated on the Record?

3. As a prime example, there is already a re-routing proposal set to be filed by Manitoba Hydro to deal with concerns addressed by Manitoba Conservation and Water Stewardship (“CWS”) over the initial routing of the Line. The hearing has been adjourned to March 4, 2013 to deal with that alternative routing.

4. Substantial evidence was led by the Coalition dealing with the concerns over the substantial detrimental impact and cumulative effects that the Line will have on prime agricultural land. Even Manitoba Hydro’s own agricultural expert has admitted as much (T-3663-68).

5. The issue of “other ways to skin the cat” is very much within the scope of the mandate of the CEC for the following reasons:

a. The CEC is reposed with the responsibility to recommend to the Minister whether the Project:

- i. ought to proceed;
- ii. ought not to proceed;
- iii. ought to proceed on conditions.

b. The CEC clearly can recommend changes to the routing on the basis of environmental concerns. Those concerns can include recommendations to:

- i. re-route the Project;
- ii. use different construction methods;

iii. delay the Project until imposed conditions are met.

c. The CEC has already allowed for the introduction of new evidence to examine alternate routing as a result of environmental concerns addressed by CWS;

d. The demonstrated concerns over detrimental effects to agriculture is very much in alignment with that type of assessment and there is no logical distinction between re-routing for concerns over mammals than there is for concerns over the damage to agricultural lands.

6. In fairness to the CEC, it did not have the evidence before it as to adverse agricultural impacts until late in the hearing; and, therefore, could not have appreciated the magnitude of the problem.

7. The options of relocation of the Line to a Station, other than Riel, in order to bypass significant kilometers of agricultural land, is very much a live issue. The germination of that issue was the presentation of Mr. Will Tishinski (T-2985-3002); which took root with the further presentation of Mr. Dave Ennis (T-4255-64); was pollinated with evidence presented by Mr. Jim Collinson (Ex. BPC-005); and lastly, was further pursued in questioning by the CEC at the end of the hearing (Nov. 22, 2012) (T-5799ff).

8. In light of the legitimate concerns raised as to the plight of the agricultural areas impacted by the Project; and, in recognizing there is only partial and antedotal evidence on the Record, it is critical to the process that the CEC hear evidence on the various options in linkage to Riel, Dorsey or La Verendrye.

9. Clearly, since reliability is the genesis of the Project, and cost is a factor in any decision making, both these issues must be fully vetted in the context of re-routing options.

10. As it presently stands, the filing with the CEC of Manitoba Hydro by Mr. Tishinski of a Manitoba Hydro Report at the request of the CEC, dealing with routing options and concerns circa 2005 (T-3001-02); questions posed by panel member Gibbons (T-2999ff); panel member Kaplan (T-5799ff); and the Chair (T-5840ff); and, the letter from the Chair dated December 3, 2012, this issue has been made germane. Thus, a full and complete testing of the evidence is required.

11. *A fortiori*, since Manitoba Hydro is required to provide further evidence on the issue of the relocating of Bipole III, the Record is not complete without the Participants being able to test the answers given by Manitoba Hydro in its evidence and in the anticipated Information Requests; and, to be able to provide evidence in response.

12. Natural justice would dictate that, if an issue is in scope and relevant, all relevant evidence in the form of cross-examination or Participant evidence, or both, must be allowed.

13. If allowed, Expert Reports would be from Art Derry, Vice-President, Business Development, Manitoba Hydro (retired) (CV attachment 1) and Dennis Woodford, P. Eng., President of Electanix Corporation, an independent power systems consulting firm specializing in HVDC and AC transmission around the world (CV attachment 2). The Report is expected to include discussions as to options, including the various configurations of the Lines to various Station locations; the timing, cost and reliability issues surrounding these options, including, if necessary, any critique of Manitoba Hydro's responses to anticipated Information Requests scheduled to be filed with the CEC on or before January 28, 2013.

Construction Methods – Underground Cable

14. Manitoba Hydro introduced the possibility of the use of underground cable in its EIS (Ch. 2: 17 – 22).

15. The Coalition was allowed to initiate a cross-examination on the efficacy, including costs of underground cable, but the cross-examination was truncated by the Chair in ruling that the matter is out of scope (T-571).

16. Subsequently, however the issue of the potential for the use of underground cable for part of the Line transecting the southern portion of the route was re-visited when the CEC heard evidence from Mr. Collinson (Ex. BPC-005) and followed up with questioning of the Manitoba Hydro panel (T-5840).

17. With respect, that issue is left in limbo and in an unsatisfactory state if the cross-examination process and the ability of the Coalition to bring its own evidence for the benefit of the hearing is not allowed to proceed.

18. If allowed to proceed, the Coalition expects to produce expert evidence in the form of an expert report and oral evidence at the hearing by Graham Lawson of Energy Cable Consultants Inc. (CV attachment 3), an expert in the use of underground cable for hydroelectric projects, to challenge the assertions made by Manitoba Hydro in its EIS, Chapter 2, in its evidence given in cross-examination (T-559-70); and, in answers to questions posed by the Chair (T-5840 – 43).

19. In the submission of the Coalition, it is critical to the process to determine the viability of the use of underground cable for part of the way, given the potential catastrophic economic damage facing the agricultural community. No adequate consideration can be complete without assessing that alternative, including costs as a factor, especially

in light of the evidence that there will be other transmission lines crisscrossing southern agricultural lands in the future.

20. If granted permission, the evidence will demonstrate the status of the use of underground cable today and the rapidly changing technology; and will challenge the costs which Manitoba Hydro has placed on the record.

Rebuttal (Reply) Evidence

21. At the end of the hearing in November, certain Participants requested that Rebuttal evidence, if any, by Manitoba Hydro be prepared in writing in advance of the March 4, 2013 hearing date and that cross-examination be allowed. The Chair indicated that the usual rules of procedure would be followed.

22. There might be some clarification required as to what is contemplated. If Manitoba Hydro's counsel had wished to clarify evidence given by its Panel members, they would have been allowed to ask questions to clear up any inconsistent evidence. No further cross-examination would have been allowed. However, where further evidence is intended by Manitoba Hydro to be introduced in Reply to rebut what the Participants' evidence is, then that evidence is subject to cross-examination; just as if it had been introduced during the initial appearance of Manitoba Hydro's witnesses.

23. Given the fact that there are no specific rules in the CEC Process Guidelines, the Coalition would like to point out that, in the course of regulatory hearings involving Manitoba Hydro before the Public Utility Board (“PUB”), the procedure invariably is that, once intervener evidence has been filed, Manitoba Hydro has the opportunity to file Rebuttal evidence. That Rebuttal evidence in all cases is in the form of written evidence submitted in advance of the hearing, which is then subject to cross-examination by all parties. At the PUB hearings, usually the Rebuttal evidence is before the PUB at the start of the hearing, such that intervener witnesses are able to comment on the Rebuttal evidence at the hearing.

24. In this particular instance, the Participants are at a disadvantage in not being able to have their experts comment on any Rebuttal evidence sought to be introduced. Consequently at the very least, cross-examination should be allowed. In order to have a productive and germane cross-examination, the Rebuttal evidence must be submitted in writing and in advance, in enough time for Participants to be able at least to liaise with their consultants in order properly to prepare for cross-examination.

Timing

25. With respect to Participants’ expert reports, the Coalition would ask that its expert reports be submitted on February 25, 2013, for the following reasons:

- a. It is the same time period within which all other Participant expert reports were submitted (that is to say one week before the commencement of the hearing); and,
- b. Given the fact that the answers to the Information Requests from Manitoba Hydro will not be completed until January 28, 2013, it gives the Coalition only three weeks to have its Reports prepared.

26. The timing for Manitoba Hydro's Rebuttal evidence should be well enough in advance of the re-commencement of the hearing to allow for consultation to take place as between Participants and their consultants. By now, Manitoba Hydro should know the extent to which, if any, it is going to be submitting Rebuttal evidence and should have plenty of time to prepare same.

ALL OF WHICH IS RESPECTFULLY SUBMITTED.

January 11, 2013

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ARGUMENT

BIPOLE III COALITION

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File No. 117719-0001

CV ATTACHMENT 1

Short Form CV of William (ART) Derry

Education:

B.Sc. Electrical Engineer 1958 University of Manitoba

General Electric Power Systems Engineering Course 1960/61

1958 to 1967

Employed by Saskatchewan Power Corporation:

Engineer - in - Charge of Transmission Planning

Engineer - in - Charge of Generation Planning

1967 to 1972

Employed by Atomic Energy of Canada

HVDC Engineer on the Nelson River Bipoles I and II Transmission Project.

1972 to 1989

Employed by Manitoba Hydro:

HVDC Planning Engineer:

Prepared the report recommending the northern Bipole II HVDC terminal be located at Henday.

Manager of Generation Planning:

Responsibilities included the recommendations of the in-service dates for Long Spruce and Limestone, as well as load forecasts during part of this time period.

Negotiated export sales contracts.

Participated in National Energy Board Hearing as an Expert witness on behalf of Manitoba Hydro,

Vice- President Business Development.

Responsibilities included Export Sales contracts and the formation of Export Services later to become Manitoba Hydro International.

1989 to 1992

The Field Project Manager & System Planning Advisor for a Manitoba Hydro International CIDA project in Zimbabwe Africa

Retired from Manitoba Hydro in June of 1992.

1992 to 1998

Employed by Zimbabwe Electricity Supply Authority

System Planning Advisor, consultant to the Zimbabwe Electricity Supply Authority.

2001 & 2002

Contract Specialist, working for Manitoba Hydro International, on a CIDA project called the South China Project.

CV ATTACHMENT 2

CV

DENNIS A. WOODFORD, P.Eng.

President
Electranix Corporation

EDUCATION

1973 MSc. University of Manitoba
1967 B.E. University of Melbourne (Hons.)
1964 Completed Associate Diploma of Electrical Engineering,
Royal Melbourne Institute of Technology

EXPERIENCE

Transmission planning of ac and dc transmission facilities and associated equipment, loadflow, stability, fault and electromagnetic transient studies, insulation coordination, AC, DC and power electronics simulation and study, power system loss analysis, reliability studies, economic assessments and technical specifications. Wind farm interconnection studies.

2001 – Present

As President of Electranix Corporation, have been directly involved in international engineering projects including integration of wind farms into ac networks for Eltra in Denmark, overvoltage, control and protection studies for wind farms for both stall regulated and doubly fed induction generator wind turbines, studies for and assistance in the preparation of the specification of the Lamar dc link in Colorado USA for Xcel Energy as well as studies for integrating the dc link, a wind farm in Colorado, ferroresonance studies for Tenaga Nasional Berhad in Malaysia, assessment of ac and dc transmission expansion options for ESBI (Alberta) Ltd. in Canada. He also participated in the studies to upgrade the David E. Hamil dc link in Nebraska for Tri-State G & T Association and Blackwater dc link in New Mexico for Public Service of New Mexico and participated in the preparation of the Technical Specification for the upgrade of dc controls for Blackwater. He participated in a review of the Eddy County dc link for Xcel Energy. Under contract to the California Energy Commission and the San Francisco Public Utilities Commission, was leader of two studies investigating importing of renewable energy into California through ac and dc transmission, including tapping the Pacific HVDC Intertie. He participated in system studies, preparation of the technical specification, project engineering and commissioning of a +/-25 MVAR SVC for Tri-State in New Mexico. He was involved in studies

CV of D.A.Woodford

pertaining to and commissioning of the Basslink HVDC Project in Australia. He is working on several projects with EPRI and Lionel Barthold of IMod Inc., in the development of ac to dc line conversions, including selection of dc voltage based on tower geometry, conductor, insulators and HVDC field effects and the tripole HVDC converter configuration.

Recently, has been involved in preparing technical specifications for several HVDC transmission projects, including conventional thyristor converters and the more recent developments of voltage sourced converters.

He has studied modern wind turbine generator wind turbines and their applications with series compensated AC feeders and off-shore HVDC voltage sourced converter feeders and grids.

1986 - 2001

MANITOBA HVDC RESEARCH CENTRE
Winnipeg, Manitoba

Executive Director. He directed the Manitoba HVDC Research Centre for 15 years. Significant research included investigation of dc transmission environmental effects, dc wall bushing flashover analysis and prevention as well as testing of new ideas and concepts using power electronics and controls for dc and ac power systems. He directed the development of digital simulation technology of ac and dc power systems (PSCAD and RTDS) and taught various courses on digital simulation of ac and dc power systems around the world.

1975 - Aug. 1986

MANITOBA HYDRO
Transmission Planning Department
Winnipeg, Manitoba

Special Studies Engineer, Transmission Planning Department

He was responsible for all studies involving the planning of EHV interconnections into Manitoba from neighboring utilities. Areas of planning studies and research included load flow, stability, fault, loss, reliability studies, insulation coordination and switching surges, multi-terminal dc, forced commutation, ac and dc simulation, original developer of the PSCAD/EMTDC simulation program, solar induced currents, electromagnetic pulse, static and series compensation, single pole switching and all planning studies for the series compensated Winnipeg-Twin Cities 500 kV ac interconnection. He was involved in studies for the Nelson River Dc Transmission system.

1972 - 1975

Engineer, DC Planning

He undertook studies for the planning and operation of the Nelson River HVDC transmission system.

CV of D.A.Woodford

1966 - 1970 ENGLISH ELECTRIC CO.

Engineer

Commencing in Australia after completing B.E., joined English Electric as a sales engineer. In 1967, transferred to the U.K. and worked on variable speed drives and DC Transmission.

MEMBERSHIPS AND AFFILIATIONS, PAST AND PRESENT

Member, Association of Professional Engineers and Geoscientists for the Province of Manitoba.

Life Fellow, Institute of Electrical and Electronics Engineers.

Individual Member, CIGRE. Former Canadian representative of Study Committee 14, DC Links.

Former Chairman, IEEE Subcommittee on HVDC and FACTS.

Former secretary to the International Electrotechnical Commissions' Sub Committee 22F "Converters For High Voltage DC Power Transmission".

Adjunct Professor, University of Manitoba.

Member of the American Wind Energy Association

AWARDS/PATENTS

Holder of 3 patents (registered in the U.S. and Canada), and is the recipient of the Tesla Award from the Westinghouse Corporation in 1981 for contributions to the electric power industry. In 1985, he received the Merit Award from the Association of Professional Engineers of the Province of Manitoba for technical contributions.

In 2004 received the IEEE Uno Lamm HVDC Award.

PUBLICATIONS

Author or co-author of over 80 papers.

CONTACT

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CV ATTACHMENT 3

**EXPERIENCE SUMMARY OF
Dr. W. GRAHAM LAWSON**

B.Sc., Ph.D., C.Eng., Fellow I.E.T., Sen. Mem. I.E.E.E.

Energy Cables Consulting Engineer with:

- **20 Years RD&E Experience in the Energy Cable Industry**

Plus:

- **15 Years International Experience as a Consulting Engineer in the Field of Underground and Submarine Cables**

Date: January, 2012

KEY QUALIFICATIONS:

Dr. Lawson's career in Research, Development and Engineering (RD&E) with Pirelli (now Prysmian) involved extended periods in Italy, Brazil, U.K. and in North America where he held the position of Vice President RD&E. In 1992 he joined Power Technologies, Inc. (now Siemens PTI, Inc.) of Schenectady, New York as Manager of the Underground/Submarine Cables Group. In 1997 he founded Energy Cable Consultants, Inc. a Type "S" Corporation registered in New York State. Since 1992 Dr. Lawson has provided consulting services in the field of underground and submarine cables to a worldwide client base. Among his most recent U.S. activities Dr. Lawson has provided consulting services for the Neptune^{RTS} Project, the 500 kVDC, 660 MW submarine cable link between New Jersey and Long Island, NY and the 3-core 138 kV, 300 MVA Connecticut to Long Island submarine cable link which replaced the 1969 SCFF submarine cable circuits.

EDUCATION:

Dr. Lawson graduated with a B.Sc. (Hons. Physics) from Edinburgh University (UK) and a Ph.D. (Electrical Engineering) from the University of Southampton ,(UK).

EXPERIENCE RECORD:

Since founding Energy Cable Consultants, Inc. Dr. Lawson has provided consulting services for the following clients:

ABB High Voltage Cables AB - Karlskrona, Sweden.
Advanced Power Solutions, Sdn. Bhd. Shah Alam, Selangor, Malaysia.
Atlantic Energy Partners LLC, Pittsfield, Maine, United States
Baltimore Gas & Electric Company - Baltimore Maryland.
Black & Veatch Corporation, Overland Park, KS.
Consolidated Edison Company of New York - New York City NY.
Electric Power Research Institute (EPRI) - Palo Alto CA.
Energy Initiatives Group, LLC, Sutton, MA.
Fichtner Consulting Engineers International - Stuttgart, Germany.
Harza Engineering Co., Bellevue, WA.
Lahmeyer International, Bad Videl (Frankfurt), Germany.
Nexant, Inc., Second Street, San Francisco CA 94105.
Northern Ireland Electricity plc - Belfast, Northern Ireland.
Northeastern Utilities Service Company (NUSCO), Berlin, CT.
Siemens-PTI, Schenectady, NY.
Southern California Edison - Oakland CA.
Stantec Consulting Ltd. 10160-112 St. Edmonton AB T5K 2L6, Canada.
Tasmania Hydro, Australia.
Teshmont Consultants LP, Winnipeg, Manitoba R3T 0P4, Canada.
Underground Systems, Inc. USA.
Vector Electricity, Newmarket, Auckland, New Zealand.

Brief details of Dr. Lawson's more recent submarine and underground cable consulting activities are summarized in the following Sections A and B, respectively:

A: SUBMARINE CABLE ACTIVITIES

- **San Francisco Bay Project (2011):** Assisted Black & Veatch in planning a short 230 kV, 400 MVA submarine cable link between PG&E's Potrero and Embarcadero Substations.
- **PREPA- VIWAPA Project (2010 – 2011):** Dr. Lawson worked with Siemens PTI on the Feasibility of Interconnecting the Caribbean Islands of Puerto Rico and the USVI / BVI by means of HVDC Light/Plus and HVAC submarine power cable types.
- **NORGER Project (2009 – 2011):** Dr. Lawson worked as a Subcontractor to Fichtner (Stuttgart) on this \pm 500 kVDC, 1400 MW Interconnection between Norway and Germany, a distance of ~ 600 km, which was due to be commissioned in 2014. Consulting activities included HVDC submarine cable technology review, selection of cable type, detailed cable design and budgetary pricing, and review of marine survey data.
- **SEATRAC Project (2009-2010):** Dr. Lawson carried out studies and prepared budgetary costs and technical specifications for the supply and installation of a 500 kVdc, 1600 MW submarine cable link between East and West Malaysia, a distance on 670 km across the South China Sea (the new Bakun project now called SEATRAC). The submarine cable component of the project will cost on the region of EURO 2 billion (2.8 billion USD). The lead consultant for the Project is Fichtner (Stuttgart, Germany). The Project is currently on-hold.
- **CRESS Project - Caribbean Regional Energy Strategy Study (2009- 2010):** Dr. Lawson worked with Nexant of San Francisco in this World Bank financed study, being responsible for furnishing advice on submarine transmission cable technologies and assessing viable interconnections among the islands to minimize generation and transmission investments to meet future power demand.
- **San Francisco Bay Submarine Cable Feasibility Study (2009):** Dr. Lawson worked as a subcontractor to Power Delivery Consultants, Inc. and was responsible for developing technically feasible and economic HVAC and HVDC submarine cable designs for the proposed 400 MW submarine power cable link between Newark Substation at the southern end of San Francisco Bay and San Francisco City at the northern end, a distance of some 30 miles (50 km). The lead consultant was MHW (San Francisco) and the client was San Francisco Public Utilities Commission.
- **British Columbia / California Renewable Power Transmission Study (2007):** Dr. Lawson was retained by EIG, LLC to participate as the submarine cable expert in a feasibility study concerned with all aspects of a proposed HVDC submarine cable interconnection between British Columbia (Canada) and Northern California (USA).
- **West Bay Project: Doha Qatar (2007- 2009):** Dr. Lawson worked with Lahmeyer International (Frankfurt, Germany) on KahraMaa's 220 kV, 1030 MW XLPE submarine cable connection across the West Bay, Doha. Consulting services include provisional assessment of the cable route, provisional cable design, power transmission capacity,

developing budgetary costs and the preparation of Technical Specifications and Bid Evaluation.

- **Bakun HVDC Project: (2007).** Dr. Lawson teamed with Advanced Power Solutions and Syme Darby on the proposed 700 km long 500 kVdc, 1000 MW submarine cable interconnection across the South China Sea between East and West Malaysia. Consulting services included technical and commercial evaluation of Submarine Cable Options.
- **The Neptune Project (2003-2007):** Dr. Lawson provided consulting services to the Neptune Team/Energy Initiatives Group for the 500 kVDC, 660 MW Neptune RTS™ HVDC submarine cable link between New Jersey and Long Island, New York. Involvement in design studies on HVdc and HVac cables and witnessing of Type Test in 2005 and Factory Acceptance Testing of the HVDC MI and MVDC-XLPE submarine and underground cables, and 345 kVAC and 230 kVAC XLPE insulated underground cables.
- **Long Island Cable Replacement Project (2003-2007):** Dr. Lawson Assisted Northeast Utilities with provisional design studies, preparation of Technical Specifications and review of the Tenders received by NUSCO/LIPA for the supply and installation of a double circuit 138 kV, 300 MVA 3-core XLPE submarine cable link between Connecticut and Long Island, USA. Work also included witnessing of Factory Acceptance Tests in Nexans submarine cable plant in Norway.
- **Java-Sumatra Interconnection Project (2005-2006):** Dr. Lawson performed a pre-feasibility study at the request of Black & Veatch, which concerned the proposed 2,000 MW submarine-cable interconnection between Sumatra and Java. The interconnection will form part of an approximately 500 km long transmission line which will bring electrical power from a large scale thermal power plant to be constructed near to the Sumatran coal mine region to the 500 kVAC grid in Java. The pre-feasibility study involved the development of optimum HVdc submarine cable designs and the preparation of budgetary costs.

B: UNDERGROUND CABLE ACTIVITIES

- **500 kV 600 MW HVDC Land Cable Interconnection: (2003)** Dr. Lawson carried out a feasibility study for a 60 km long Interconnection between Switzerland and Italy making use of a disused oil pipeline and existing tunnels in the Alps as a way leave. The Interconnection was never implemented due to permitting difficulties.
- **The Auckland Blackout: (1998)** Dr. Lawson was one of the cable experts selected by Mercury Energy Ltd. (now Vector Ltd.) to carry out investigations into the multiple failures of their 110 kV underground cable feeders which led to the 3 week blackout of Auckland's Central Business District in March 1998. Dr. Lawson worked as Power Technologies Inc. Associate in collaboration with the local consulting firm Worley International Ltd. of Auckland.
- **230 kV 1200 MVA XLPE Cable Project in Bangkok, Thailand:** A feasibility study was carried out on behalf of the Metropolitan Electricity Authority of Bangkok, Thailand. The

study concerned the technical feasibility as well as the costs involved and the timeframe for implementation of a 230 kV, 1200 MVA link between two substations. The preferred solution was a deep cable tunnel installation with forced air cooling. Cable ratings studies were performed and cooling air velocity and fan power requirements were determined.

- **Pacific Gas & Electric, San Francisco, CA. 115 kV, 30 MVA XLPE Cable (2000):** Harza Engineering Co. prepared a conceptual study for PG&E involving two 115 kV, 30 MVA XLPE underground cable circuits between the Flynn and Pier Substations in San Francisco. These two circuits were to run parallel to a 12 kV distribution cable 6 x 3 horizontal duct bank for a distance of approximately 8,000 feet along 3rd Street, San Francisco. Harza carried out the sub-station work and retained Dr. Lawson as their power transmission cable expert. The Project Workslope was as follows:
 - Ampacity evaluation for the 12 kV cable duct bank installation- 18, 3/c cables in a 6 x 3 horizontal duct bank.
 - Development of a suitable 115 kV XLPE cable design based on AEIC CS7 - 93 Specifications.
 - Recommendations concerning suitable pulling lengths and splicing manhole dimensions for a 2 x 3 vertical duct bank installation.
 - Development of budgetary price for the supply of 48,000 ft. of the selected 115 kV XLPE cable size together with the required numbers of pre-molded splices and outdoor terminations.
- **Ceylon Electricity Board, Colombo, Sri Lanka 132 kV, 250 MVA XLPE Cable (2001):** Fichtner Consultants International carried out a design study for the Greater Colombo Grid Substation Project. This Project involved the system design of 30 circuit km of 132 kV, 250 MVA XLPE underground cable to loop in three new 33kV / 132kV substations to the existing grid. This part of the study was subcontracted to Dr. Lawson. The work involved Route Selection, System Design, Steady State and Emergency Load Carrying Capability, Magnetic Field Calculations, Development of Budgetary Costs and Project Scheduling.
- **Northeast Utilities, Berlin, CT. Bethel-Norwalk and Middletown-Norwalk 345 kV Projects (2002, 2005-2006).** Dr. Lawson provided consulting services to Northeast Utilities during the planning stages of these two projects. Among the activities carried out are the following:
 - Advice on the underground cable alternative solutions for a 345 kV, 70 mile long transmission line. Prequalification of potential vendors. Development of a Qualification Test Specification. (2002).
 - Bethel-Norwalk Project. This 21 mile long 345 kV, 600 MW double-circuit transmission line included 9.7 miles of HPPF cable plus 2.1 miles of XLPE cable – the longest and first installation of 345 kV XLPE cable to be installed in the USA with splices. Dr. Lawson participated in the development of Technical Specifications for this Project and in the review of Bidders Proposals. He also wrote a Position Paper on the technology, testing and world-wide service experience of XLPE cables at 345 kV and above. (2005). Project completed 2006.

- Middletown – Norwalk Project. This 69 mile long double circuit transmission line included 24 miles of 345 kV, 600 MW XLPE cables and required the construction of 116 cable vaults and the installation of 372 splices. Dr. Lawson wrote white papers on various technical issues including, thermo-mechanical effects, thermal transients during emergency operation, and a review of worldwide long-length underground cable projects. He also participated in vendor pre-qualification and in the evaluation of Bidders Technical Proposals. (2006). Project completed 2008.
- **Abu Dhabi 400 kV XLPE Underground Cable Projects (2008).** Dr. Lawson supported Lahmeyer International with the design of a new 400 kV double circuit installation in Abu Dhabi by providing current rating analyses for 400 kV, 2500 mm² XLPE underground cables installed in a variety of configurations including direct burial in concrete troughs and deep burial in ducts installed by horizontal directional drilling in both flat and close triangular formations.
- **Hudson Transmission Project 345 kV XLPE Underground Cable Sections (2011).** During October Dr. Lawson visited Prysmian’s new vertical continuous vulcanization plant in Abbeville, SC on behalf of Hudson Transmission Partners / Powerbridge, LLC., the developers on this Project. During the visit Dr. Lawson inspected the new line, witnessing cable manufacture in progress and witnessed factory inspection testing of ~ 10,000 ft. of finished cable. Electrical Testing was carried out to IEC 62067 / ICEA S-108-720 and material testing to ICEA S-108-720. This is the first 345 kV XLPE cable to be manufactured in the USA.

LANGUAGES:

	Speaking	Reading	Writing
English	Native	Native	Native
Italian	Good	Excellent	Good
Portuguese	Good	Excellent	Good

REFERENCES

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West Bay Submarine Cable Project (refer to CV)

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Neptune HVDC Submarine Cable Project (refer to CV)
British Columbia / California Renewable Power Transmission Study (refer to CV)

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Bakun/Seatrak HVDC Submarine Cable Link from East to West Malaysia (refer to CV)