Nalcor Energy – Lower Churchill Project

nalcor energy
LOWER CHURCHILL PROJECT

Design Philosophy for Emergency Repair of Overhead Transmission

LCP-PT-ED-0000-EN-PH-0026-01

Comments:	Total # of Pages (Including Cover): 9

A1		**Issued for Review/ Comment**	J. Walsh				
Status/ Revision	Date	Reason For Issue	Prepared By	Checked By	Project Controls Lead	Recommended for Approval	Dept. Manager Approval

Additional Signatures (where required)

Status/ Revision	Date	Reason For Issue	Prepared By	Checked By	IMS Lead	Dept. Manager Approval	Project Manager Approval

Professional Engineers Stamp:
(where required)

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1.0 Purpose

The intent of this design philosophy is to provide information on Nalcor Energy's specific requirements for the emergency repair of overhead transmission lines. It shall be the responsibility of the EPCM Consultant to develop a plan and outline the requirements to ensure adequate repair of the transmission system in the case of emergency. This document shall be used along with reference to feasibility reports and other design philosophies. (See Section 5)

2.0 Scope

Due to the vast expanse of operating territory for all NE-LCP transmission lines and the variety of climatic conditions that the transmission lines are subjected to, the system will occasionally fail due to unforeseen events. These events could be the result of heavy ice, wind, floods, mudslides, etc. In addition, vandalism or sabotage can also cause line failures.

This philosophy addresses the emergency repair needs for all transmission lines as part the Lower Churchill Project. These lines are required for:

1. HVDC Transmission of power from the Muskrat Falls Converter Station in Labrador to the Soldiers Pond Converter Station, located on the Avalon Peninsula.
2. For market supply to support the *Maritime Link*, an HVdc overhead transmission line is needed for transmission of power to the southwest shoreline of the Island.
3. For electrode operation, Overhead Electrode Lines are required.
4. HVac transmission lines from the Muskrat Falls Switchyard to the Muskrat Falls HVdc Converter Station.
5. HVac transmission lines from the Muskrat Falls Switchyard to the Gull Island and Churchill Falls Switchyard.
6. HVac transmission lines put in place in the islands grid to support the *Maritime Link*.

The EPCM Consultant's emergency repair design is to outline the requirements necessary to repair system connections in the face of emergencies only. Operations and general maintenance requirements for the life of the transmission lines are outside the scope of this design.

3.0 Definitions

Note: Throughout this document, the following defined words are italicized.

Corridor	A pathway or linear study area from within which a transmission line routing and right of way are eventually selected.

Counterpoise	Steel wire installed along the length of the overhead transmission line and bonded (connected) to each tower. Used to reduce resistivity between the transmission line structures and the ground for lightning protection.
Maritime Link	A transmission system comprising of both overhead and sub-sea transmission lines, required to interconnect the Island of Newfoundland to the province of Nova Scotia.
Overhead Ground Wire	Provides lightning protection for the power conductors. When used, direct lightning strikes are minimized, and potential disturbances due to lightning are reduced.
Optical Ground Wire	Performs the same function as Overhead Ground Wire; however, it also carries a fibre optic communication system within the wire strands.

4.0 Abbreviations and Acronyms

EPCM	Engineering Procurement Construction Management
NE – LCP	Nalcor Energy – Lower Churchill Project
kV	Kilovolt (Thousand Volts)
OPGW	*Optical Ground Wire*
CSA	Canadian Standards Association
ROW	Right of Way
T&DI	Technical and Design Integrity

5.0 Reference Documents and/or Associated Forms

a) LCP-PT-ED-0000-EN-RP-0001-01 – Lower Churchill Project – Basis of Design
b) LCP-PT-ED-0000-EN-PH-0007-01 – Design Philosophy for LCP Environmental Mitigation
c) LCP-PT-ED-0000-EN-PH-0018-01 – Design Philosophy for LCP Communication Systems
d) AC1020 – Tower Type Selection, 735 kV, Hatch, June 2008
e) AC1030 – Field Investigation and Construction Requirements, 735 kV Transmission Line Gull Island to Churchill Falls, SNC-Lavalin Inc, February 2008
f) AC1050 – Tower Type Selection, 230 kV, Hatch, July 2008
g) AC1060 – Field Investigation and Construction Requirements, 230 kV Transmission Line Gull Island to Muskrat Falls, SNC-Lavalin Inc, February 2008

h) AC1130 – *Corridor* Selection and Construction Infrastructure, 735kV Transmission Line Gull Island to Quebec Border, Hatch, June 2008
i) AC1080 – Load Control and Failure Containment, Hatch, August 2008
j) Development of EHV Transmission Lines in Labrador – RSW Inc. And EDM (joint venture), February 1999
k) Lower Churchill Hydroelectric Generation Project – Environmental Impact Statement, Nalcor Energy – Lower Churchill Project, February 2009
l) LCP-PT-ED-0000-EN-PH-0031-01 – Design Philosophy for LCP Environmental Rehabilitation
m) DC1050 – *Corridor* Section and Construction Infrastructure – Gull Island to Soldier Pond, Hatch, June 2008
n) DC1051 – Field Investigations – HVdc TL – Gull Island to Soldier Pond, AMEC Earth and Environmental, June 2009
o) DC1060 – *Corridor* Selection and Construction Infrastructure – Taylor's Brook to Cape Ray, Hatch, July 2008
p) DC1070 – Preliminary Meteorological Loads, Hatch, August 2008
q) DC1080 – Preliminary Tower Type Selection, Hatch, January 2009
r) DC1010 – Voltage and Conductor Optimization, Hatch, April 2008
s) Gull Island to Soldiers Pond HVdc Interconnection, Teshmont Consultants Inc., June 1998

6.0 Responsibilities (Nalcor Energy)

Project Manager - The Project Manager is ultimately responsible for the allocation and expenditure of the project budget to support the emergency repair of overhead transmission lines.

Project Engineering Manager - The Project Engineering Manager is responsible for approval of the Design Philosophy for Emergency Repair of Overhead Transmission.

Engineering Deliverables Manager - The Engineering Deliverables Manager is responsible to check the Design Philosophy for Emergency Repair of Overhead Transmission to ensure technical consistency with other documents to be provided to the EPCM Consultant.

Engineering Leads - The Engineering Transmission Lead is responsible for preparation of the Design Philosophy for Emergency Repair of Overhead Transmission.

Project Controls Lead – The Project Controls Lead is responsible to check the Design Philosophy for Emergency Repair of Overhead Transmission to ensure references to plan and schedule are consistent with other documents to be provided to the EPCM Consultant.

7.0 Philosophy

7.1 Safety and the Environment

Safety with respect to the public, operating crews and the environment shall be the primary focus throughout all planning and design. A desired security level for all equipment used and infrastructure installed shall be determined in conjunction with NE-LCP. The EPCM's emergency repair plan shall ensure the safety of employees, responders and the public while reducing the magnitude of environmental impacts.

7.2 Standard Compliance

With respect to all designs, the EPCM Consultant shall observe, follow and check the correct CSA and NE-LCP approved standard for all components overhead transmission lines. Should there be no applicable code or standard, assumptions shall be stated and accepted by NE-LCP.

7.3 Transmission Line Location and Description

Refer to the NE-LCP Basis of Design (LCP-PT-ED-0000-EN-RP-0001-01) for a description of the overhead transmission system for the Lower Churchill Project.

7.4 Emergency Repair Plan

The EPCM Consultant is required to prepare a detailed and logical emergency repair plan. In the event of unforeseen failures of the overhead transmission, this emergency repair plan will ensure safe, timely and adequate line restoration.

The following are several, but not all requirements to be considered when developing the emergency repair plan.

7.4.1 Access Procedure and Monitoring

The emergency plan shall consider access to all sections of NE-LCP's transmission lines. The EPCM Consultant shall identify the routes and equipment needed to access specific locations in the transmission system.

Several sections of NE-LCP's transmission lines are located in difficult to access, as well as remote locations. The EPCM Consultant is to select the optimal repair requirements and procedures.

The EPCM is to conduct detailed cost and risk comparisons in order to determine the requirement for monitoring. This analysis shall consider high risk areas over the transmission lines that are known to be subject to loading or conditions that could lead to failure.

7.4.2 Sparing Philosophy

The emergency repair plan shall also outline the requirements for material spares. This includes, but is not limited to the quantity of spare:

- Conductor for overhead and underground transmission systems;
- OHGW, OPGW, *counterpoise* wire, guy wire;
- Conductor and guying hardware;

- Insulators and insulator hardware;
- Tower steel and foundation steel. For varying tower types (see section 7.5.3); and
- Wooden transmission poles for electrode line.

An adequate storage and inventory plan must also be developed. As with the access plan, a detailed cost and risk comparisons shall be preformed in order to determine the amount of spare material required.

7.4.3 Repair Solutions

In the event of an emergency outage on overhead transmission lines, there is a requirement for immediate action to take place. Certain components, as part of NE-LCP's transmission lines, are considered essential to the power supply to the province. Repair solution must therefore, be adequate to ensure, safe and timely installation.

The EPCM Consultant is to evaluate and justify the different approaches to facilitate repair. These may include semi-permanent or permanent repair methods. The cost, risk and system analysis will then justify the amount of permanent equipment and material required as spares.

As is stated in Section 7.2 any repair solutions that are deemed to be of a temporary or semi-permanent nature must still comply within transmission line design standards.

7.4.4 Repair Crews

Operation and maintenance crews, required throughout the life of the transmission system, shall also be required to perform emergency repairs. The EPCM Consultant shall delineate the requirement for the size and quantity of crews available for emergency repair. With various equipment needed to access and repair separate locations, the required skill set of each crew shall be outlined.

The requirements for training for each crew shall also be summarized. The training should include actual field training and mock situations, imparting first hand knowledge about, but not limited to;

- Assembly of the modular structures.
- Fixing of foundation plates.
- Erecting of structures on the foundation.
- Guying the tower with anchoring arrangement.
- Stringing of wires and conductors.

A.0 Activity Flowchart (Excel Format)

Not Applicable.

B.0 Attachments/Appendices

Not Applicable.