APPENDIX 'D'

HYDRO-VAC

Manitoba Hydro

Corporate Safety & Health Division

GUIDELINES FOR EXCAVATION OF CABLES BY WATER PRESSURE/VACUUM SYSTEMS (HYDRO-VAC)

For further information, please contact:
Safety Policies, Publications and Training Department 204-474-3766

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Forms are available at: http://coil.hydro.mb.ca/esh/ ___N/A____

For any concerns or questions, please contact Safety Policies, Publications and Training Department at 204-474-3766

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EXCAVATION OF CABLES BY WATER PRESSURE/VACUUM SYSTEMS (HYDRO-VAC)

This publication provides the user of the water pressure/vacuum systems with operating limits for excavating within 3.0 m (10 ft.) of energized and de-energized cables.

1.0 BACKGROUND AND EXPLANATION

1.1 Process

An alternative to exposing cables by "hand digging" is to use a water pressure/vacuum system capable of exposing Manitoba Hydro cables without damage. This service is available from a number of companies using the same basic operating concept with variations in the capabilities of each machine.

All of the water pressure/vacuum systems presently available have a combination of water temperature and pressure that have the potential to damage Manitoba Hydro underground cables.

1.2 Legislative Requirements

To comply with Manitoba Regulation 217/2006 (26.6(1)), Manitoba Hydro will provide underground locations when a "Work Clearance Request" has been made and, where possible, de-energize underground cables prior to being exposed. Where de-energizing underground cables is not possible and the excavation is to be within 1 m (3 ft.) of locations, a Safety Watcher may be required during the excavation process. There are limitations to the types of cable and voltages that can be excavated while energized. This information is included in subsections "1.3 Voltages" and "1.4 Cables". In all situations the Work Clearance Request form details any conditions for the excavation of Manitoba Hydro cables within 3.0 m (10 ft.) of the cable. This includes the time frame that the Work Clearance Request is valid and the lead time required if Manitoba Hydro is to provide a Safety Watcher.

Note: A hydro-vac operator previously approved and trained to Manitoba Hydro standards to recognize and mitigate all hazards associated with the excavation of energized or de-energized cables, will be permitted to expose cables using hydro-vac methods, provided they proceed as trained, and in accordance with the directions in this document.

1.3 Voltages

Manitoba Hydro cables energized at voltages above 25 kV must be de-energized and grounded prior to excavation.

Manitoba Hydro cables listed in subsection "1.4 Cables" cannot be excavated using the water/vacuum system while energized at any primary voltage.

1.4 Cables

The cables noted below are subject to damage at extremely low water pressures and **cannot** be exposed while energized. Districts that have these types of cables will find that they are concentrated in older installation areas. Distribution and "as built" prints will assist in identifying cable types prior to water/vacuum excavation commencing. When it is not possible to determine the cable type by the maps, on site visits by qualified staff to verify cable type will be necessary prior to excavation. These cables can be exposed using the water/vacuum system after they have been de-energized and grounded providing complete inspection of the cable is carried out prior to the cable being re-energized. If direct contact of the water stream is applied to these types of cables, damage can be expected.

Reason: **These cables have a high failure rate due to long term moisture migration into the insulation through the jacket and conductor. Exposing this cable by any technique while energized will make these cables very susceptible to failure.**

Cables subject to damage include:

Jacketed 5 kV & 15 kV Rated Cable installed 1970 and earlier

#2, 2/0 or 4/0 Copper 5 kV & 15 kV rated cable having a butyl rubber type insulation and the concentric neutral covered with a neoprene or PVC jacket (red or black in colour). Identified on the distribution maps as follows:

*** RINJ C/N **kV**
*** RI/PVCJ C/N **kV**

Jacketed 25 kV Rated Cable installed 1974 and earlier

All 25 kV rated cables having an XLPE type insulation with a copper taped shield covered with a red PVC jacket. Identified on the distribution maps as follows:

*** AL XLPE 25 kV PVC**
*** CU XLPE 25 kV PVC**

Unjacketed 15 kV Rated Cable installed 1972 and earlier

#2, 4/0, or 350 MCM Copper 15 kV rated cable having an XLPE type insulation, with the concentric neutral unjacketed (bare). Identified on the distribution maps as follows:

*** CU XLPE C/N 15 kV**

*** = any size conductor **= any voltage cable**

1.5 Operating Temperatures and Pressures

The water/vacuum systems tested by Manitoba Hydro varied in operating temperatures and pressures to extremes of 65.5ºC (150ºF) and 3000 psi pressure.

When excavating within 1 m (3 ft.) of Manitoba Hydro cable locations for energized or de-energized cables, the water temperature shall be limited to 38ºC (100ºF) and 1500 psi pressure. Systems must be capable of constant monitoring of temperature and pressure to ensure these limits are not exceeded.

1.6 Wand Tips and Vacuum Tube Ends

Wand tips shall be the oscillating type to prevent a concentrated water stream. This type of tip can be identified by the circular pattern of the water stream evident as pressure is first applied to the wand.

Tests conducted by Manitoba Hydro resulted in cable damage when a single stream nozzle end was directed toward a specific location on the cable. Damage was also observed when the single stream nozzle end was used in a sweeping motion. Single stream nozzle ends must not be used to excavate Manitoba Hydro cables.

The vacuum end is capable of making direct contact with the cable as the excavation progresses and must have a neoprene or equivalent lip to eliminate any occurrence of mechanical damage to the cable.

1.7 Damage

Cable damaged by excessive water pressure will appear as a slice into the cable of unknown depth or as though the outer surface has been torn and pulled outward. Before backfilling an inspection of all exposed cables for damage must be completed by qualified Manitoba Hydro staff.

1.8 Cable Failure

Cable damaged by excessive water pressure can fail immediately or any time thereafter.

2.0 MANITOBA HYDRO RESPONSIBILITIES

2.1 Manitoba Hydro Responsibilities - All Situations

2.1.1 Ensure cable(s) are not energized if over 25 kV and ensure cable(s) listed below are excavated using water pressure/vacuum systems only when de-energized. Complete inspection of the cables listed below is required prior to re-energizing the cables. (See 1.4 Cables for additional information.)

*** RINJ C/N **kV**
*** RI/PVCJ C/N **kV**
*** AL XLPE 25 kV PVC**
*** CU XLPE 25 kV PVC**
*** CU XLPE C/N 15 kV**

*** = any size conductor ** = any voltage cable**

2.1.2 Provide automatic circuit reclose blocking for any lines over 750 V prior to an excavation commencing.

2.1.3 Ensure protective barriers are installed by qualified Manitoba Hydro personnel prior to workers entering the excavation. At a minimum, the barrier selected will prevent worker contact with the cables.

2.1.4 Inspect all exposed cable before the excavation is backfilled.

2.2 Manitoba Hydro Responsibilities - When Manitoba Hydro Safety Watcher Is Required

In addition to the requirements stated in 2.0 the Manitoba Hydro shall:

2.2.1 Provide a qualified Safety Watcher for water/vacuum excavations within 1 m (3 ft.) of energized high voltage cables when required.

Manitoba Hydro Corporate Employee Safety and Health Rule Book - Rule 402 b states:

> "If in the opinion of the person in charge of the job, the high voltage work to be undertaken requires special precautions, a qualified Safety Watcher shall be appointed. The person in charge may elect to serve as the Safety Watcher providing his/her undivided attention is given to this duty. The Safety Watcher shall:
>
> 1. Be at the immediate work location.
> 2. Be clearly identified to all workers at the site.
> 3. Be in clear sight and communication with the workers performing work and;
> 4. Have full authority to immediately stop the work at any time."

2.2.2 Participate in a pre-job meeting to identify hazards prior to work commencing and ensure an underground location has been completed and is current.

2.2.3 Ensure that the water/vacuum system is capable of constant monitoring of pressure and temperature and is equipped with an oscillating tip. The Safety Watcher will ensure settings of 1500 psi water pressure and 38ºC (100ºF) water temperature are not exceeded when the excavation is 1 m (3 ft.) from energized cable.

2.2.4 Inspect all exposed cable. A visual inspection may lead to cable testing prior to any non Manitoba Hydro personnel entering the excavation.

2.2.5 Stop excavation if any damaged cable is sighted and notify the appropriate supervisor.

2.2.6 Stop excavation as soon as a splice is visibly located. All splices must be inspected by qualified staff prior to hydro-vac excavation resuming.

2.3. Manitoba Hydro Responsibilities - When the Contractors Supplies a Manitoba Hydro Trained Safety Watcher or Hydro-Vac Operator For Excavations Within 1M of Energized Cable

In addition to the requirements stated in 2.1 Manitoba Hydro shall:

2.3.1 Ensure that the contractor provided safety watcher or hydro-vac operator has been trained by and to Manitoba Hydro standards.

3.0 CONTRACTOR RESPONSIBILITIES

3.1 Contractor Responsibilities - Energized Cables

3.1.1 Ensure a Work Clearance Request is obtained and current.

3.1.2 No contractor safety watching shall be performed unless/until a Hot Dig Request has been issued by Manitoba Hydro by fax to the contractors fax number **and** the contractor has contacted the applicable Manitoba Hydro representative to request line blocking.

3.1.3 Ensure that the hydro-vac operator, (previously approved and trained to Manitoba Hydro standards to recognize and mitigate all hazards associated with the excavation of energized or de-energized, cables) exposes the cables using hydro-vac equipment.

Where a hydro-vac operator trained as noted is not available, ensure that an employee previously approved and trained to Manitoba Hydro standards to recognize and mitigate all hazards associated with the excavation of energized or de-energized, is provided to act as a safety watcher for the hydro-vac operator.

If staff (previously approved and trained to Manitoba Hydro standards) is not available ensure that a Manitoba Hydro Safety Watcher is provided.

3.1.4 Have the Hydro-Vac operator or Safety Watcher (previously approved and trained to Manitoba Hydro standards) attend a pre-job meeting with own staff, prior to commencing excavation work, to recognize and mitigate all hazards associated with the excavation of energized or de-energized, cables. If staff trained as noted are not available ensure that a Manitoba Hydro representative attends the pre-job meeting.

3.1.5 Ensure that the Hydro-Vac Operator or the Safety Watchers undivided attention is given to this duty as follows:

1. Be at the immediate work location.
2. Be clearly identified to all workers at the site.
3. Be in clear sight and communication with the workers performing work and;
4. Have full authority to immediately stop the work at any time."

3.1.6 Ensure personal protective equipment including dielectric footwear, rubber gloves, hard hats, appropriate safety eye wear, and hearing protection is worn.

3.1.7 Have a water pressure/vacuum system equipped with an oscillating tip on the wand.

3.1.8 Have a neoprene end or equivalent attached to the end of the vacuum tube.

3.1.9 Have a water pressure/vacuum system equipped with gauges to indicate water temperature and wand pressure settings. Maximum settings when excavating within 1 m (3 ft.) of cable locations will be 38ºC (100ºF) temperature and 1500 psi pressure.

3.1.10 Ensure the excavation vehicle is grounded with a minimum 2/0 copper temporary protective ground attached to a portable ground rod. Consult with the Manitoba Hydro representative completing the "Work Clearance Request" for an appropriate location to install the portable ground rod. If installation of a portable ground rod is not possible due to the type of surface (e.g. cement) consult with the Manitoba Hydro representative for alternatives.

3.1.11 Ensure the excavation truck is visibly barricaded at a distance great enough to prevent physical contact from outside the barricaded area to the truck prior to an excavation commencing. If required, emergency shutdown of the excavation equipment must be accomplished from outside the barricaded area.

3.1.12 Ensure the excavation area is barricaded prior to commencing work.

3.1.13 Ensure that personnel operating the wand and vacuum are wearing the appropriate classification of electrical rubber gloves for the voltage of cable being exposed. Body contact of the vacuum tube above the rubber gloves must be avoided.

3.1.14 Complete excavation of the cable by a sweeping motion until the cable is sighted. After the cable has been sighted, the cable shall not be contacted by spray or vacuum.

3.1.15 Stop excavation as soon as a splice is visibly located. All splices must be inspected by qualified Manitoba Hydro staff prior to hydro-vac excavation resuming.

3.1.16 Prevent the operators of excavation equipment from entering the excavation until barriers are installed by Manitoba Hydro.

3.1.17 Ensure protective barriers are installed by qualified Manitoba Hydro personnel prior to workers entering the excavation.

3.1.18 Prior to backfilling have Manitoba Hydro staff inspect all exposed cable. All exposed splices must be identified to the Manitoba Hydro representative.

3.2 Contractor Responsibilities - De-Energized And Grounded Cables:

3.2.1 Ensure that the Work Clearance Request submitted to and completed by Manitoba Hydro is complete and current.

3.2.2 Ensure personal protective equipment including dielectric footwear, hard hats, appropriate safety eye wear, and hearing protection is worn.

3.2.3 Have a water pressure/vacuum system equipped with an oscillating tip on the wand.

3.2.4 Have a neoprene end or equivalent attached to the end of the vacuum tube.

3.2.5 Have a water pressure/vacuum system equipped with gauges to indicate water temperature and wand pressure settings. Maximum settings when excavating within 1 m (3 ft.) of cable locations will be 38ºC (100ºF) temperature and 1500 psi pressure.

3.2.6 Complete excavation of the cable by a sweeping motion until the cable is sighted. After the cable has been sighted, the cable shall not be contacted by spray or vacuum.

3.2.7 Prior to backfilling have Manitoba Hydro staff inspect all exposed cable. All exposed splices must be identified to the Manitoba Hydro representative.

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WATER PRESSURE/VACUUM EXCAVATION CHECKLIST

Excavation location		
Excavation contractor		Excavation for
EXCAVATION DATE	yyyy mm dd	Feeder number

CHECKLIST	YES	NO
Work Clearance Request form current		
Hazards identified		
Excavation within 1 m (3 ft.) of location		
Line cannot be de-energized		
Line recloser blocked		
Line is 25 kV or below if excavating while energized		
Cable must be de-energized All cables listed below must be de-energized prior to water pressure/vacuum excavation - check Distribution and As Built Prints). *RINJ C/N **kV *R1/PVCJ C/N **kV *AL XLPE 25 kV PVC *CU XLPE 25 kV PVC *CU XLPE C/N 25 kV Any cable energized over 25 kV *any size conductor **any voltage cable		

CHECKLIST	YES	NO
Safety Watcher identified		
Pre-job safety orientation meeting completed		
Appropriate personal protective equipment worn		
Operator is wearing the appropriate class rubber gloves		
Oscillating tip is on wand		
Neoprene or equivalent end is on vacuum tube		
Pressure set to maximum 1500 psi		
Temperature set to maximum 38°C (100°F)		
Vehicle grounded if excavating within 1 m (3 ft.) of underground locations		
Vehicle barricaded if working within 1 m (3 ft.) of underground locations		
Excavation area barricaded		
Cable visually inspected after excavation completed		
Cables barricaded after inspection		

Comments

In the event of an emergency requiring medical assistance contact the System Control Centre by radio at 040 or by phone at 477-7268.

Contractor Signature	yyyy mm dd	Safety Worker / Person in Charge Signature	yyyy mm dd

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APPENDIX "D"
HOT DIG REQUEST

INSTRUCTIONS TO CONTRACTOR:

1. **Line Location and Work Clearance Request forms must be filled out prior to any excavation. Prepare, Discuss, and Review the job plan with the excavator.**
2. **Complete all applicable fields and provide all required information.**
3. **Fax this completed form to the applicable Manitoba Hydro Office.**
   IMPORTANT: No Contractor Safety Watching shall be performed unless/until an Authorized Hot Dig Request has been issued by Manitoba Hydro by fax to the Contractor's fax no. listed below and Contractor has contacted the applicable Manitoba Hydro Representative to request line blocking.

TO BE COMPLETED BY CONTRACTOR:

Contractor's name	Phone no.	Fax no.
Work site location		Map no.
Safety Watcher's name	Phone no. at hot dig site	yyyy mm dd
Excavation being performed ☐ Install ☐ Remove ☐ Repair Specify _____		
Location of work site identification on Work Clearance Request		Work Clearance Request no.
Comments		

EMERGENCY PLAN: call 911

Identify exact location and directions for emergency response

SCHEDULED START DATE AND TIME	yyyy mm dd	hh mm	**SCHEDULED COMPLETION DATE AND TIME**	yyyy mm dd	hh mm

Contractor Information	Yes	No	Contractor Information	Yes	No
Safety watcher identified/person in charge			Underground locating equipment on site		
Line Location and Work Clearance Request current			Underground distribution print available		
Excavation within 1 m (3 feet) of location			Proper excavating procedures reviewed with excavator		
Will cables be exposed by soft dig (if Yes, form 303 Water Pressure/Vacuum Excavation Checklist required)			Barrier in place to protect exposed cables		
Hazards identified: Traffic			Public safety reviewed		
Barricade Excavation			Other Utilities located		

INSTRUCTIONS TO MANITOBA HYDRO:

1. **Complete all applicable fields and provide all required information.**
2. **If Authorized, fax completed form to Contractor at fax no. above.**

TO BE COMPLETED BY MANITOBA HYDRO:

Manitoba Hydro contact name	Phone no.		Fax no.
Work site location			Map no.
Feeder no.'s	Blocked ☐ Yes ☐ No	Removed ☐ Yes ☐ No	Voltage
Comments			

Manitoba Hydro Information	Yes	No	Manitoba Hydro Information	Yes	No
Line is 25 kV or below if excavating while energized			Exposed cables will be visually inspected after excavation is complete		
De-energize and ground underground plant					

DATE AND TIME FOR REQUESTED LINE BLOCKING	yyyy mm dd	hh mm	**DATE AND TIME FOR REQUESTED REMOVAL OF LINE BLOCKING**	yyyy mm dd	hh mm

Authorized Hot Dig Request - To be signed by Manitoba Hydro Representative if authorized	yyyy mm dd

Note: See Reverse for District Contacts for Safety Watch.