THIS IS EXHIBIT "O"

REFERRED TO IN THE AFFIDAVIT OF

JANE MUSTAC

SWORN BEFORE ME THIS 24TH DAY

OF JULY, 2020.

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A Commissioner, etc.

Enbridge Pipeline Vehicle Loading Analysis

Proposed NPS 6 Windsor Line along County Road 46, County of Essex Ontario

Introduction:

Enbridge is proposing to replace the existing NPS 10 Windsor Line with a new NPS 6 pipeline. The pipeline will be installed within the road allowance parallel to roads for approximately 64 kms between Chatham-Kent and The County of Essex. There was a concern about the stress of the pipeline in its proposed location as it is likely to be exposed to vehicle loading including but not limited to superloads, particularly on County Road 46 in the County of Essex as the pipelines proposed alignment is within approximately 2m of road edge in some locations. The following analysis will provide results of a load assessment on this new pipeline under vehicle loading conditions to meet the Enbridge's design and operating requirements and those of CSA Z662-15 and to determine the max allowable axle load that can be accepted by the pipeline. Analysis considers the hoop stress due to internal pressure and those imposed on it by the soil and vehicle loading.

Assumptions:

- Basis for axle load will be the Ministry of Transportation Ontario (MTO) legal axle load limit of 9000kgs per axle.
- Superload is considered a vehicle weighing more than 120000kgs, from MTO, A Guide to Oversize/Overweight Vehicles and Loads in Ontario, but is limited to max axle load of 9000kgs per axle.
- Vehicle axle load is to be positioned directly vertical over the pipeline. This arrangement will create the maximum loading for this condition.
- An imbalance factor of 10% which increases the wheel load of the axle to allow for consideration of illegal loads and an impact factor of 1.5 was used to simulate vehicles driving on uneven surface over the pipeline.
- Analysis will consider tired vehicles only, which will simulate the maximum ground pressure over the pipeline. Other vehicles, such as those that ride on tracks generally disperse their weight over a larger area and therefore have a lower ground pressure values than those of tired vehicles.
- Assume the pipeline is backfilled only with the native material found within the road allowance, which is known to be ordinary clay. This is considered a conservative assumption as compacted granular fill over and/or around the pipeline would bear more of the vehicle loading than clay and transfer less to the pipeline.

Pipeline Design Parameters:

Outside Diameter (OD): NPS 6 (168.3mm)
Wall Thickness: 4.8mm
Material: Gr. 359, Cat. I, HFERW seam, CSA Z245.1-18 steel pipe
Specified Minimum Yield Strength: 359 MPa
Cover Depth: 100cm
Max Op Temp: 20C degree
Max Op Pressure: 3450 kPa
Min Install Temp: 0C degree
Content: Sweet Natural Gas
Pipeline design to meet the requirements of Clause 12, of CSA Z661-15
During vehicle loading pipeline shall operate at less than 85% SMYS

Live Loads To Calculate:
1. MTO road legal limit or 9000kgs per axle. See analysis equipment label SHL.
2. 5 x MTO road legal limit or ~45000kgs per axle. See analysis equipment label 5xSHL
3. 10 x MTO road legal limit or ~90000kgs per axle, to simulate a maximum pipeline loading. See analysis equipment label 10xSHL

Results:
In all live load cases the results display that the pipeline operates below allowable stress limits under the proposed design conditions for the pipeline located near or under the travelled portion of the roadway. This includes a superload.
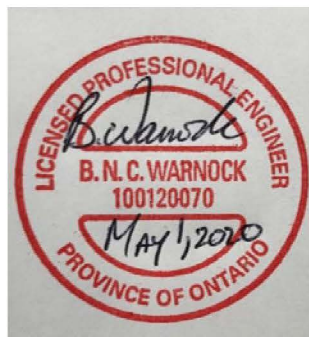
The results of the analysis meet the requirements of the Transportation Association of Canada (TAC) Guidelines For Underground Utilities Crossing Highway Right-Of-Ways.

Results for the 9000kgs and ~45000kgs per axle load considered the impacts of fluctuating hoop stresses or fatigue loading. This can be assumed to represent the case of loads sustained by regular vehicle traffic over the roadway and pipeline.

Results for the ~45000kgs per axle analysis displays an allowable loading factor of safety of 5 over what could be expected the normal vehicle use along the roadway.

Results for the ~90000kgs per axle analysis display a near maximum loading that can be accepted by the pipeline. In this case if a superload were to be overweight or given a permit to operate an axle load at greater than 9000kgs up to ~90000kgs per axle the pipeline is robust enough to carry that extreme load.

Analysis performed by Blair Warnock, P.Eng, Senior Pipeline Design Engineer, Enbridge Inc.

Pipelines Crossed by Equipment on Tires

Location:						
Description & Purpose	NPS 6 Windsor LIne - Oversize Vehicle Load Analysis					
Province	ON	Permanent crossing?	Yes	Type	3rd Party	
Equipment:			Tire or ground bearing pressure, psi | kPa		110 | 758	
Label	SHL		Distance between axles in set, in | cm		48 | 122	
Description	MTO limit of 9000kgs/axle under Fatigue/Cyclic loading		Axle gauge, ft | m		6.0 | 1.83	
Axle Load, lb | kg	19,841 | 8,998		Impact Factor		1.5	
# axles in set	3		Imbalance Factor		10%	
Line(s) to be crossed:						
Line Name	6WL					
OD, in | cm	6.625 | 16.8					
Wall thickness, in | mm	0.189 | 4.8					
Pipe grade, ksi | MPa	52 | 359					
Pressure, psi | kPa	500 | 3447					
Long seam type	ERW					
Installation:						
Depth of cover, in | cm	39 | 100					
Installation type	Settled					
Bottom Reaction Angle, deg	60					
Trench or bore width, in | cm	7 | 17					
Soil Unit Weight, pcf | kg/m^3	120 | 1922					
Soil Type	4					
Modulus of soil reaction E', psi | kPa	250 | 1724					
Slab or Matting:	no slab					
Slab thickness, in | cm						
Impact Factor on slab or mat						
Slab material						
Slab width across pipe, ft | m						
Slab length along pipe, ft | m						
odulus of subgrade reaction k, pci | MPa/m						
Maximum Hoop Stress, % SMYS:						
Calculated	26.3%					
Allowable	85%					
Fluctuating Hoop Stress, psi | MPa:						
Calculated	4.2 | 28.7					
Allowable	20 | 138					
Requirements / Notes:	Axle load for analysis of ~9000 kgs or MTO Road Legal Axle limit. Results show pipeline still remains below maximum allowable hoop stress limit and max allowable fluctuating hoop stress limit, which considers fatigue or cyclic loading which can be assumed to be representative of continuous vehicle traffic over the pipeline/roadway.					
Analyzed by:	BNW 4/17/2020					

Pipelines Crossed by Equipment on Tires

Location:

Description & Purpose	NPS 6 Windsor LIne - Oversize Vehicle Load Analysis				
Province	ON	Permanent crossing? Yes		Type	3rd Party

Equipment:

		Tire or ground bearing pressure, psi | kPa		110 | 758
Label	SHLx5	Distance between axles in set, in | cm		48 | 122
Description	5 x MTO limit of 9000kgs/axle under Fatigue/Cyclic loading	Axle gauge, ft | m		6.0 | 1.83
Axle Load, lb | kg	99,000 | 44,898	Impact Factor		1.5
# axles in set	1	Imbalance Factor		10%

Line(s) to be crossed:

Line Name	6WL				
OD, in | cm	6.625 | 16.8				
Wall thickness, in | mm	0.189 | 4.8				
Pipe grade, ksi | MPa	52 | 359				
Pressure, psi | kPa	500 | 3447				
Long seam type	ERW				

Installation:

Depth of cover, in | cm	39 | 100				
Installation type	Settled				
Bottom Reaction Angle, deg	60				
Trench or bore width, in | cm	7 | 17				
Soil Unit Weight, pcf | kg/m^3	120 | 1922				
Soil Type	4				
Modulus of soil reaction E', psi | kPa	250 | 1724				

Slab or Matting:

	no slab				
Slab thickness, in | cm					
Impact Factor on slab or mat					
Slab material					
Slab width across pipe, ft | m					
Slab length along pipe, ft | m					
odulus of subgrade reaction k, pci | MPa/m					

Maximum Hoop Stress, % SMYS:

Calculated	50.5%				
Allowable	85%				

Fluctuating Hoop Stress, psi \| MPa:

Calculated	19.4 | 133.7				
Allowable	20 | 138				

Requirements / Notes: Axle load for analysis of ~45000kgs or ~5 x MTO Road Legal Axle limit of 9000kgs. Results show pipeline still remains below maximum allowable hoop stress limit and max allowable fluctuating hoop stress limit, which considers fatigue or cyclic loading which can be assumed to be representative of continuous vehicle traffic over the pipeline/roadway.

Analyzed by: BNW 4/17/2020

Pipelines Crossed by Equipment on Tires

Location:								
Description & Purpose	NPS 6 Windsor LIne - Oversize Vehicle Load Analysis							
Province	ON		Permanent crossing?	No		Type	3rd Party	
Equipment:			Tire or ground bearing pressure, psi | kPa			110 | 758		
Label	SHLx10		Distance between axles in set, in | cm			157 | 400		
Description	10 x MTO limit of 9000kgs/axle assumed Super Load			Axle gauge, ft | m		19.7 | 6.00		
Axle Load, lb | kg	198,000 | 89,796			Impact Factor		1.5		
# axles in set	1			Imbalance Factor		10%		
Line(s) to be crossed:								
Line Name	6WL							
OD, in | cm	6.625 | 16.8							
Wall thickness, in | mm	0.189 | 4.8							
Pipe grade, ksi | MPa	52 | 359							
Pressure, psi | kPa	500 | 3447							
Long seam type	ERW							
Installation:								
Depth of cover, in | cm	39 | 100							
Installation type	Settled							
Bottom Reaction Angle, deg	60							
Trench or bore width, in | cm	7 | 17							
Soil Unit Weight, pcf | kg/m^3	120 | 1922							
Soil Type	4							
Modulus of soil reaction E', psi | kPa	250 | 1724							
Slab or Matting:	no slab							
Slab thickness, in | cm								
Impact Factor on slab or mat								
Slab material								
Slab width across pipe, ft | m								
Slab length along pipe, ft | m								
Modulus of subgrade reaction k, pci | MPa/m								
Maximum Hoop Stress, % SMYS:								
Calculated	77.1%							
Allowable	85%							
Fluctuating Hoop Stress, psi | MPa:								
Calculated	N/A | N/A							
Allowable	20 | 138							
Requirements / Notes:	Axle load for analysis of ~90000kgs or ~10 x MTO Road Legal Axle limit of 9000kgs. Results show pipeline still remains below maximum allowable hoop stress limit. This load is considered to represent a superload or over weight vehicle permitted load.							
Analyzed by:	BNW 4/17/2020							