[redacted]

Line: 93 and 3	**Location:** GF
Discipline: Transient	**Operation:** Pipeline (Sidestream Delivery Blockage)
Report Number/Title: L01 Connectivity Side Stream Blockage - Transient Memo v2.1	
Report Revision/Date: v2.1 / February 4th, 2020	
Project Name: Line 1 Connectivity	
Project Consultant: N/A	**Project AFE:** N/A
Relevant EES / EES Revision/Date: D02-109 (2016)	**Software Used:** SPS 10.4

Flowpaths: LO-GF-DN (L93 to L03 and L93 to GF)

Scenarios Analyzed: Side Stream Delivery PCV 100% Closure, CommIn

Worst Case Result: Estimated max surge pressure (psig / % MOP) using the proposed OpLims Pressure Limits.

INITIAL STATE	SCENARIO	Initial P			Max Surge P After Upset GF Del PCV Closure				
		LOCAL STN			FROM-TO	P_{SURGE}	LOCAL MOP	P_{SURGE}/MOP	POSITION
		NAME	P_{DIS}	P_{SUC}	[-]	[psig]	[psig]	[%]	[miles from AP]
LQmax	Side Stream Delivery PCV 100% Closure	GF	320	499	AP-DN	249	402	62%	318
HQmax	Side Stream Delivery PCV 100% Closure	GF	320	499	AP-DN	842	1440	58%	256

Accepted Recommendations

Three effective elements would help protect the lines – the GF Station PCV in control, the pipeline control logic, and the relief on GF discharge side,. The GF delivery PCV closure would not cause overpressures on L93 and L03 with the following conditions, assuming no other blockages happen downstream of GF on L03 at the same time.

1. L93 rate is limited by Qmax = 5370 m3/h.
2. At GF, SRW Restriction = 500 psig and HSSD = 550 psig are implemented as OpLims Pressure Limits.
3. GF station PCV is in control, even though there is no pump running.
4. GF relief on discharge side is set to 380 psig, in case any lower SRW is used.

Comments:

Record of Issues / Acceptance by LP Engineering Services

Rev.	Issue Description	By / Date	Review / Date	Accept / Date
0	As Found	Blake Lu /Feb. 04, 2020	Emma Perez /Feb. 04, 2020	E. Perez 02/05/2020

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Memorandum – Engineering Services

Date: February 4, 2020
To: Kevin Tsang
From: Blake Lu

Re: L01 Connectivity – Transient Study for GF Side Stream Blockage's Impacts on L93 and L03

The L01 Connectivity project is for L93 to have a side stream delivery at GF to L01 while running the balance volume into L03. A concern has been raised in regards to the side stream operation – If the sidestream is blocked, the volume of L93 will be forced into L03 whose design rate is too small to take such an overwhelming volume. It could be a risk for the system. Simulations have be run to see whether the existing safety devices are sufficient to protect the system. Here is the summary of the study.

Assumptions

1. L03 MDR = 2870 m3/h; Terminal MDR = 2500 m3/h, Thus for L93, Qmax = 2500 + 2870 = 5370 m3/h will be used for the transient study.
2. LLV uses UHC and HMV uses OX1.
3. iPETH's previous SPS model for 2870 m3/h study is still valid for this study.
4. The previous transient study for L93 – L03 with MDR = 2870 m3/h showed the worst cases were with Heavy Qmax and Light Qmax. So, it is assumed Heavy Qmax and Light Qmax are still the worst for this study. Two new worst initial states (WIS) - HQmax and LQmax will be created for this purpose.
5. A scenario of the side stream delivery PCV 100% closure (CommIn) was simulated with each WIS, assuming it won't be double jeopardized with any blockage on L03 downstream of GF.

Findings from the Simulations

L93 has high MOPs. For the MDR = 5370 m3/h operations, BMDPs are not limiting factors, but SRWs.

Unlike SRW = 314 psig, SRW = 500 psig would have higher initial pressures for HQmax and LQmax – the GF suction pressures start from 500 psig. Because the L03 GF discharge is set to 320 psig, the previous SRW = 314 psig would have the GF station PCV opening at 100% while the new SRW = 500 psig would have the PCV at about 30% to start a closure scenario.

For both HQmax and LQmax cases, the delivery PCV closure (CommIn) would trigger the following events in a sequence:

- The volume to the terminal is being blocked and pressed onto L03.
- The suction pressure at GF station starts increasing from 500 psig which was the initial pressure (GF SRW = 500 psig, no pump running at GF) and soon triggers HSSD shutting down all upstream stations. (This happens sooner than it's set to SRW = 314 psig)
- No overpressures on mainlines, just Line 93 shutdown.
- The surge pressures from the two scenarios are collected in the following table and plots.

INITIAL STATE	SCENARIO	Initial P			Max Surge P After Upset GF Del PCV Closure					P_{SURGE} PLOT
		LOCAL STN			FROM-TO	P_{SURGE}	LOCAL MOP	P_{SURGE}/MOP	POSITION	
		NAME	P_{DS}	P_{SUC}	[-]	[psig]	[psig]	[%]	[miles from AP]	
LQmax	Side Stream Delivery PCV 100% Closure	GF	320	499	AP-DN	249	402	62%	318	Figure 1. LQmax
HQmax	Side Stream Delivery PCV 100% Closure	GF	320	499	AP-DN	842	1440	58%	256	Figure 2. HQmax

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Memorandum – Engineering Services

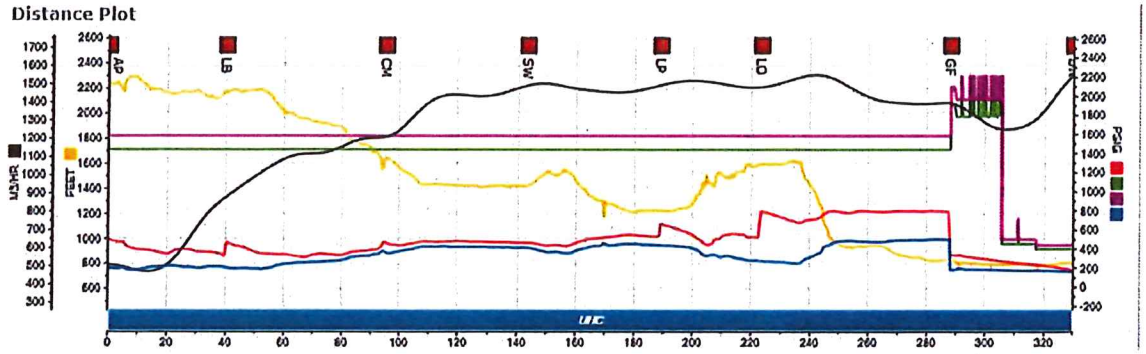

Figure 1. LQmax – Surge Pressures Caused by GF Delivery PCV Closure

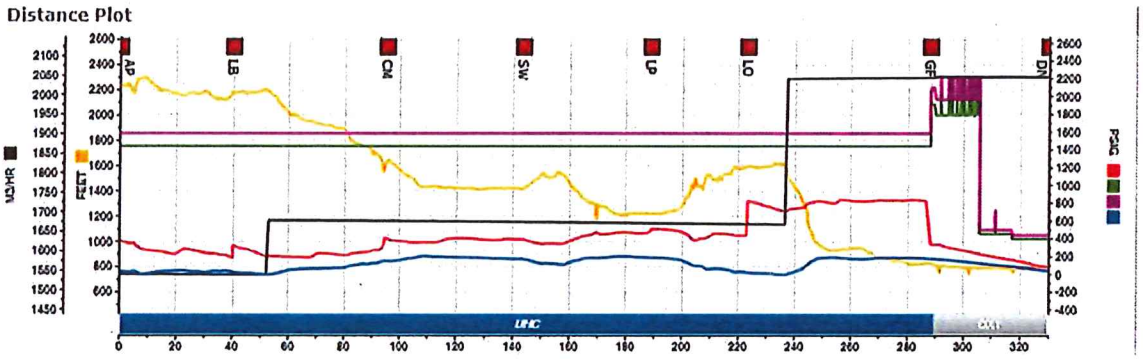

Figure 2. HQmax – Surge Pressures Caused by GF Delivery PCV Closure

Note: MOP – Green, MSP – Pink, Max P – Red, P – Blue, Elevation – Yellow, Q - Black

Conclusion

Three effective elements would help protect the lines – the GF Station PCV in control, the pipeline control logic, and the relief on GF discharge side,. The GF delivery PCV closure would not cause overpressures on L93 and L03 with the following conditions, assuming no other blockages happen downstream of GF on L03 at the same time.

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PERMIT TO PRACTICE
ENBRIDGE LIQUID PIPELINES
Signature
Date Feb 4, 2020
PERMIT NUMBER: P 14256
The Association of Professional Engineers and Geoscientists of Alberta

PROFESSIONAL ENGINEER BLAKE LU

04-Feb-2020

Revision Index				
Rev.	Description	Originator	Checker	Approver
1.0	Issued for Review	Blake Lu / 2019-08-01	Prashanth Parthasarathi	
2.0	Issued for Review	Blake Lu / 2020-01-03	Emma Perez / 2020-02-04	
2.1	Final	Blake Lu / 2020-02-04	Emma Perez / 2020-02-04	Kevin Tsang / 2020-02-05