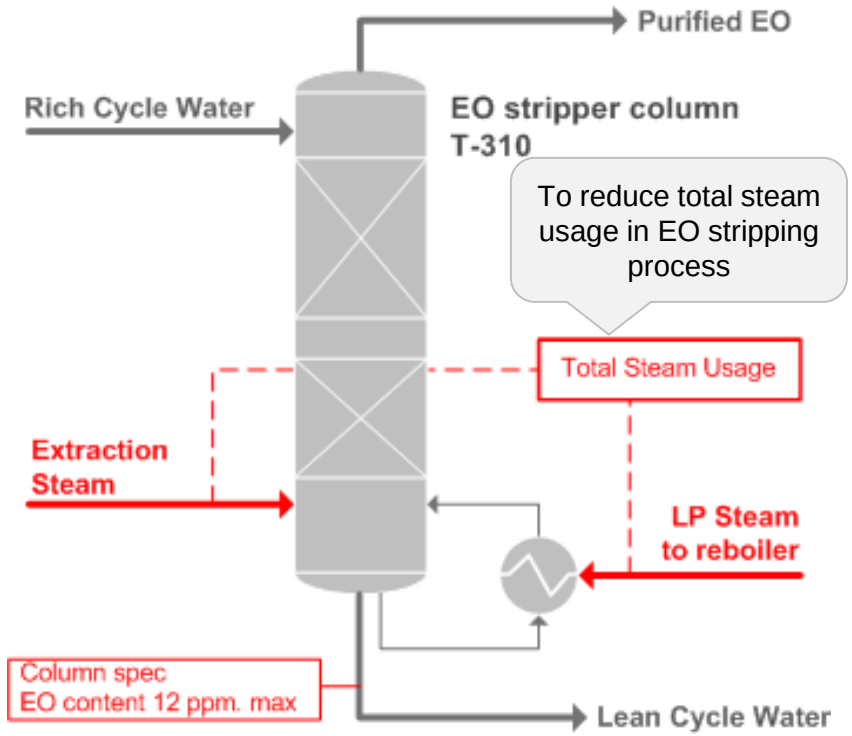
Initiative Overview on T-310 Structure packing replacement #371

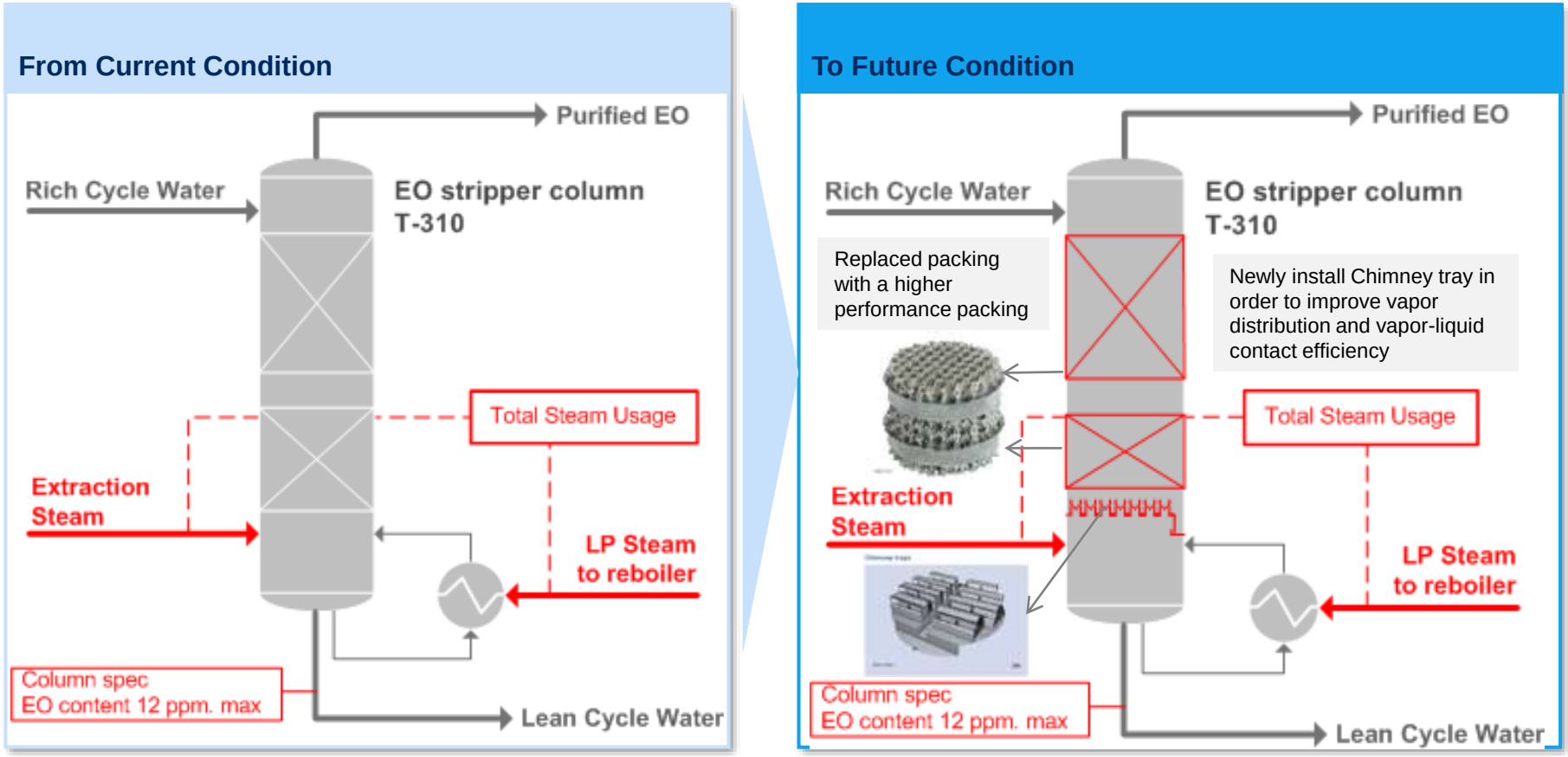
Initiative description	▪ To reduce steam usage in EO stripping process by applying higher structure packing performance and chimney tray.
Estimated annual benefit (MTHB)	▪ Actual steam usage per ton EOE after modification is 1.31 ton steam/ton EOE (ref.) ▪ Basis → Steam usage per ton EOE of previous catalyst cycle = 1.55 Ton steam/Ton EOE (ref.) ▪ Estimated annual benefit uplift is 100.8 MTHB (ref.)
Current Status	▪ Mechanical completion on April 10th, 2017 ▪ Commissioning and performance test on during April 13th – 21th, 2017 ▪ Delivers benefit uplift since April 21th, 2017

Illustrative Sketch



SOURCE: PTTGC

Schematic Description on T-310 Structure packing replacement #371



- Major modification is replacing structure packing and installing new chimney tray in order to improve separation efficiency and subsequence to reduce total steam usage (extraction + LP steam) in EO stripping process.

SOURCE: PTTGC

Realized benefit uplift on T-310 Structure packing replacement #371

Baseline Steam Consumption Index

Steam Consumption Index Baseline 2015 vs Actual 2017

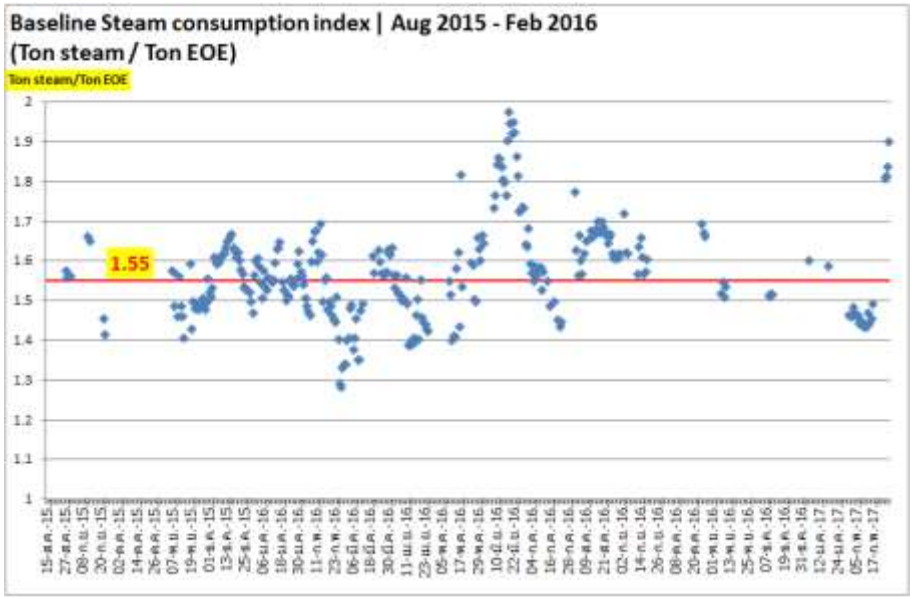


FIGURE I

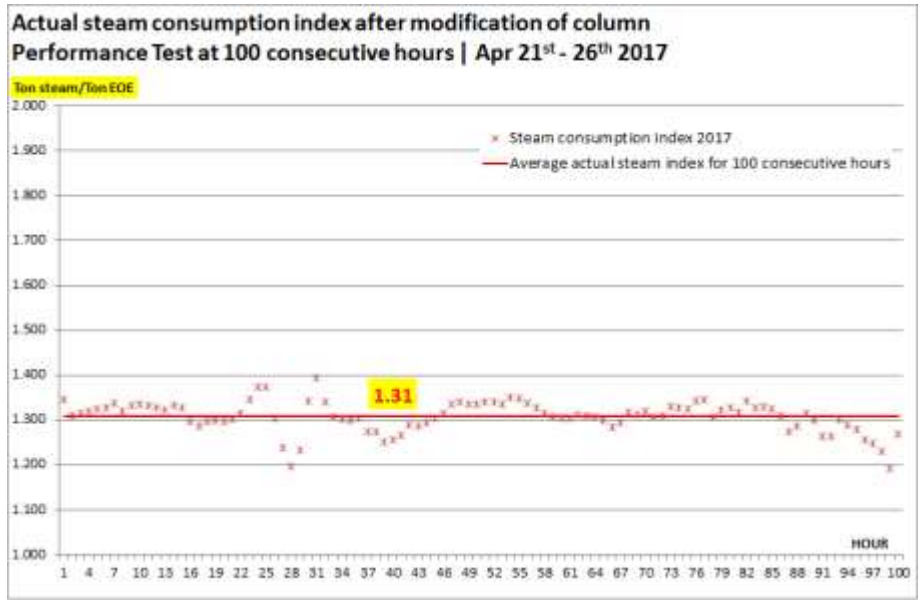


FIGURE II

- Baseline of steam consumption index (Ton steam/Tone EOE) of previous cycle (Aug 2015 – Feb 2016) was **1.55 ton steam/ton EOE** as illustrated in Figure I
- Actual steam consumption index after improvement is **1.31 ton steam/ton EOE** as illustrated in Figure II (Data was collected for 100 consecutive hours on during April 21st – 26th , 2017)

SOURCE: PTTGC

Realized benefit uplift on T-310 Structure packing replacement #371

Forecasted Annual Recurrent Saving Cost of Steam

Calculation and Assumption are demonstrated in below

Baseline of steam consumption index		1.55	ton steam/ton EOE
Actual steam consumption index during PTR		1.31	ton steam/ton EOE
Decrease of steam consumption index		0.24	ton steam/ton EOE
Average EOE production in 2017 (referred to business plan 2017 of April – Dec 2017)		49.34	ton EOE/h
Average hourly actual steam reduction (Committed 5 T/H at IL2)	49.34 x 0.24 =	11.84	ton steam/h
Number of Day in operation per annual		330	days
Total annual EOE production	49.34 x 24 x 330 =	390,772.8	ton EOE
Total annual steam saving	390,772.8 x 0.24 =	94,785.5	ton steam
Steam price unit		1074.6	THB/ton steam

Forecasted Annual Recurrent Saving Cost of steam

94,785.5 x 1074.64 / 10^6 = **100.78** **MTHB**

Explanation of impact validation methodology and results (including assumptions and key calculation drivers)

5-8% of steam saving are expected after improvement. In this case, steam saving would be 5 t/h (6.25% reduction). Hence, yearly steam saving are 330 day x 1074.62 THB/t x 5 t/h x 24 = 42.55 MTHB.

Saving assumption in IL2

Realized benefit uplift on T-310 Structure packing replacement #371

Monthly Steam Saving Calculation (Actual Tracking)

Start to deliver benefit uplift on April 21st, 2017 onwards

Annual Steam Saving Cost

T-310 Structure packing replacement #371

Baseline steam consumption			1.55	ton steam/ton EOE (Baseline is derived from average steam usage per ton EOE since Aug 2015 - Feb 2016)									
Steam price			1074.62	THB/ton steam (refered to steam price submitted in IL2)									
				Actual	Plan	Plan	Plan	Plan	Plan	Plan	Plan	Plan	
	Jan-17	**Feb-17**	**Mar-17**	**Apr-17**	**May-17**	**Jun-17**	**Jul-17**	**Aug-17**	**Sep-17**	**Oct-17**	**Nov-17**	**Dec-17**	
Days in operaion	31	28	31	9	31	30	31	31	30	31	30	31	
Production rate (Ton EOE/h)				50.60	49.10	49.20	49.40	49.40	49.50	49.40	49.50	49.40	
Steam price (THB/ton steam)				1074.62	1074.62	1074.62	1074.62	1074.62	1074.62	1074.62	1074.62	1074.62	
Baseline steam usage index (ton steam/ton EOE)	1.55	1.55	1.55	1.55	1.55	1.55	1.55	1.55	1.55	1.55	1.55	1.55	
Actual steam usage index (ton steam/ton EOE)				1.33	1.31	1.31	1.31	1.31	1.31	1.31	1.31	1.31	
Actual steam saving index (ton steam/ton EOE)				-0.224	-0.240	-0.240	-0.240	-0.240	-0.240	-0.240	-0.240	-0.240	
Actual hourly steam saving cost (THB/h)				-12,188.56	-12,663.32	-12,689.11	-12,740.69	-12,740.69	-12,766.49	-12,740.69	-12,766.49	-12,740.69	
Actual Monthly steam saving cost (MTHB)	n/a	n/a	n/a	**- 2.63**	**- 9.42**	**- 9.14**	**- 9.48**	**- 9.48**	**- 9.19**	**- 9.48**	**- 9.19**	**- 9.48**	
Accumulated saving cost (MTHB)	n/a	n/a	n/a	**- 2.63**	**- 12.05**	**- 21.19**	**- 30.67**	**- 40.15**	**- 49.34**	**- 58.82**	**- 68.01**	**- 77.49**	

SOURCE: PTTGC

Realized benefit uplift on T-310 Structure packing replacement #371

Benefit Uplift review

Hourly steam saving (T/H) and Accumulated steam saving cost (THB)

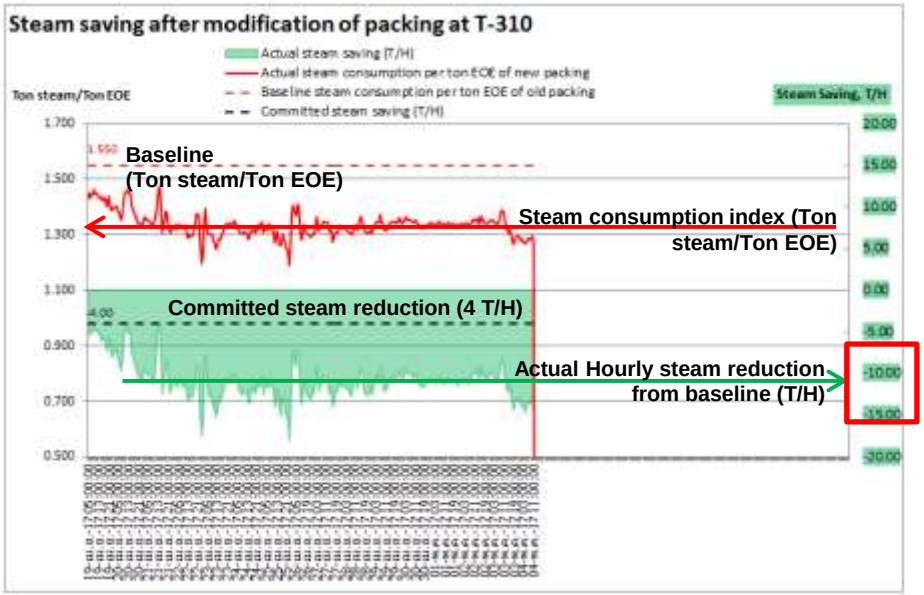


FIGURE I

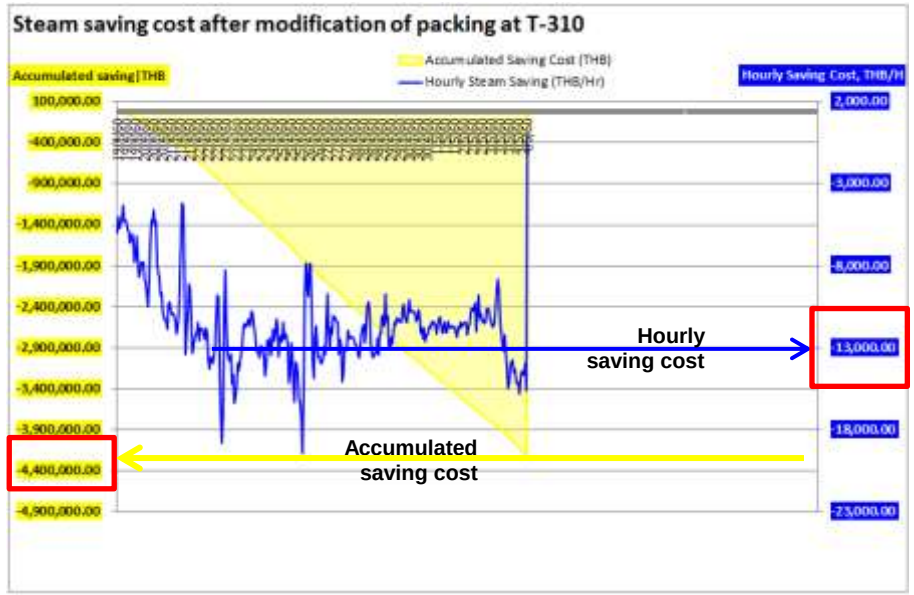


FIGURE II

SUMMARY

- ✓ Baseline steam consumption index for EO stripper column 2015 is **1.55** ton steam/ton EOE.
- ✓ After modification, steam index is presented at **1.31** ton steam/ton EOE. (see in Figure I)
- ✓ Apparently, actual hourly steam saving is presented about **12.5-13** T/H. (see in Figure I)
- ✓ Actual hourly steam saving cost is about 13 – 14 kTHB/h. (see in Figure II)
- ✓ Accumulative steam saving cost since April 19th – 27th is 2.48 MTHB. (8 days) (see in Figure II)

SOURCE: PTTGC

Realized benefit uplift on T-310 Structure packing replacement #371

Performance review

EO content at EO stripper bottom vs Steam consumption | 2015 vs 2017

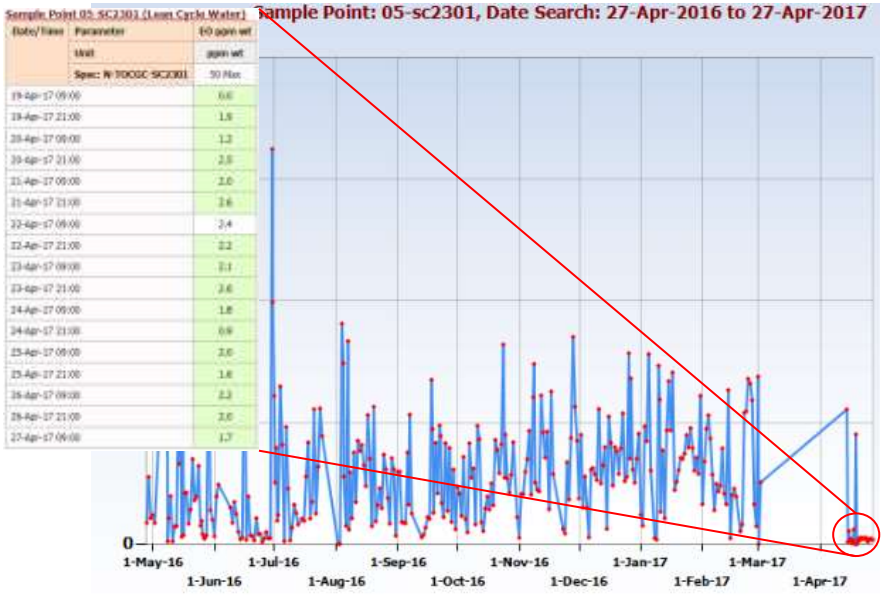


FIGURE I

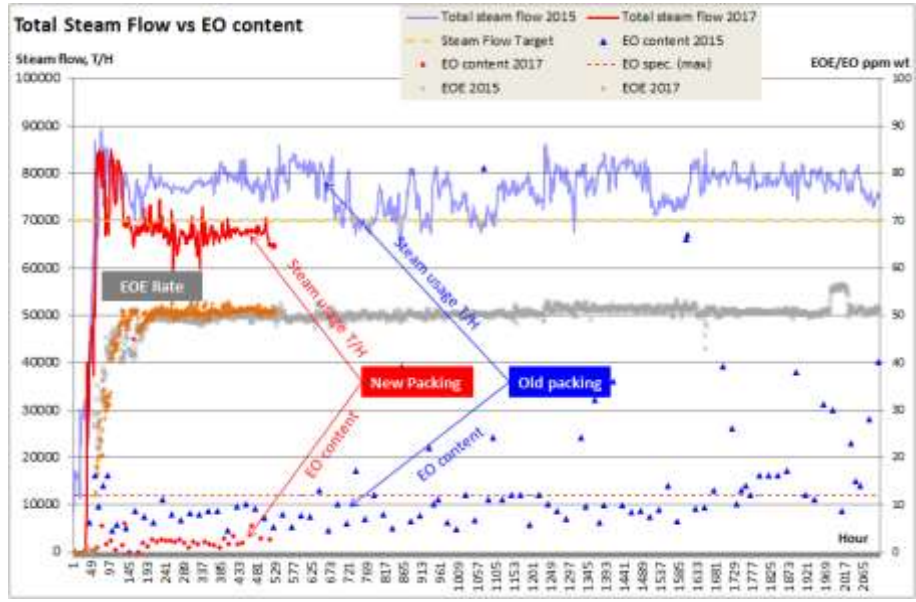


FIGURE II

SUMMARY:

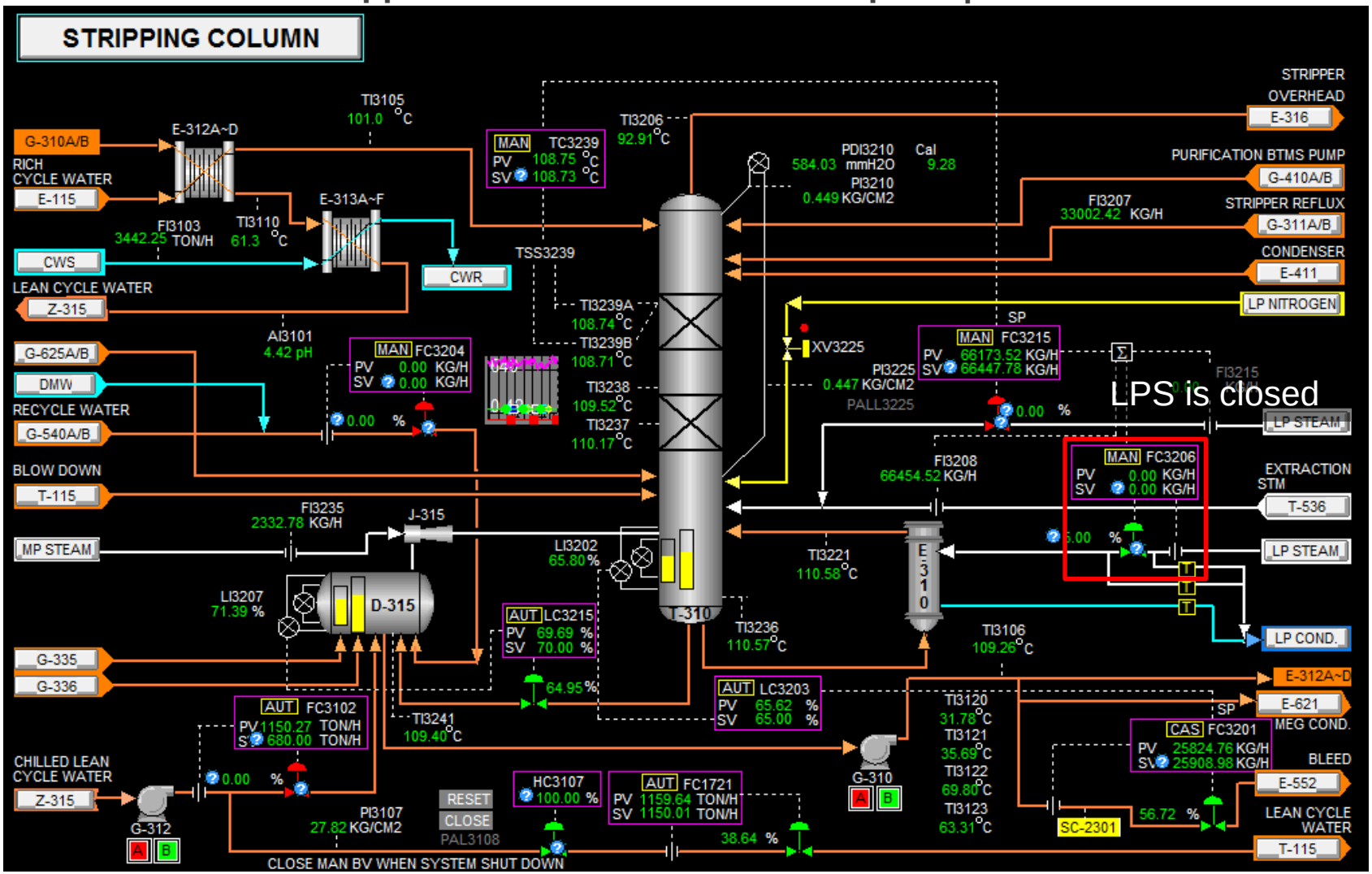
- ✓ After modification, EO stripper performance is significantly improved as indicated **that the column is able to satisfied dissolved EO at much lower steam consumption** (see comparable in Figure II).
- ✓ Dissolved EO at EO stripper bottom is **2.5 ppm** in average whereas dissolved EO before revamping was presented about 30 ppm. in average. (see comparable in Figure I).
- ✓ **LP steam supply** to EO stripping column **has been fully closed since April 19th**. Only extraction steam supplied from evaporator system is able to satisfy column specification. (see screen capture in next slide)

SOURCE: PTTGC

Realized benefit uplift on T-310 Structure packing replacement #371

Performance review

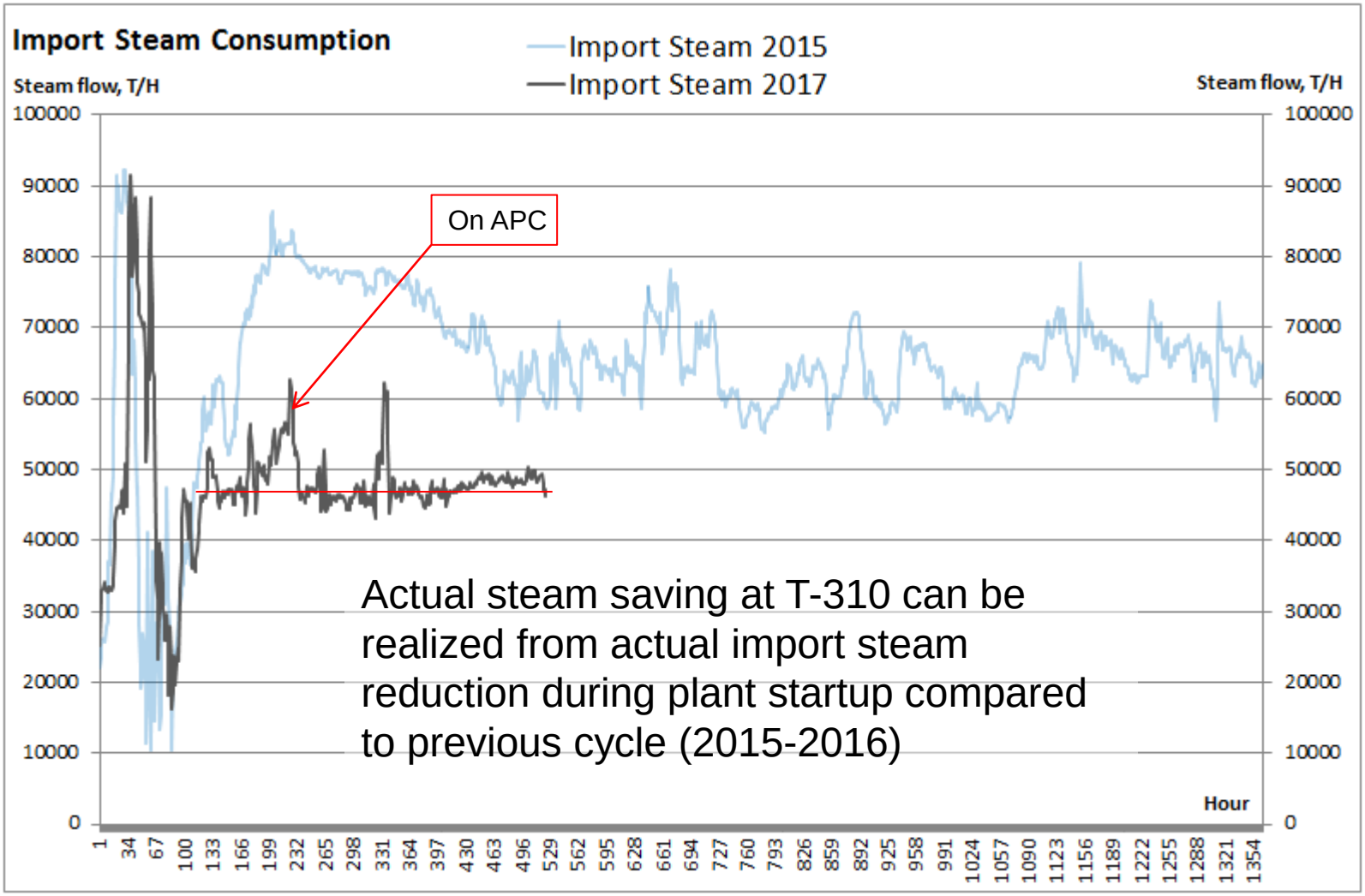
EO content at EO stripper bottom vs Steam consumption | 2015 vs 2017



Realized benefit uplift on T-310 Structure packing replacement #371

Imported Steam Overview compared to previous cycle

Hourly steam import (T/h) since 1st hour of start-up



SOURCE: PTTGC