



ASIA TURBOMACHINERY & PUMP SYMPOSIUM  
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# Investigation and Resolution of Propane Compressor High Axial Position Alarm - Case Study from Exxon Mobil Singapore

# Authors

	Author	Position	Working Experience	Organization
1	Sridhar Kuppa Padmanabha	Machinery engineer	8-years as Machinery engineer in Refinery	ExxonMobil Singapore
2	Ng, Peck Lui	Instrument ation Engineer	5-years as Instrumentaion in engineer in Oil & Gas industry	ExxonMobil Singapore



# Abstract

Propane compressor in Propane Dewaxing Unit was experiencing intermittent high axial spikes coinciding with the chiller swing. The axial spikes were due to compressor surge caused by sudden drop in flow during chiller swing.

The response and the tuning of the anti-surge controller (ASC) was set in a generic way to suit steady state operation. But this being a semi-batch process, the ASC retuning was required.

ASC retuning was done to suit to the process conditions. By doing so, the compressor surge was avoided and the axial position spikes were also eliminated.



# Agenda

1. Machine Detail
2. Problem Statement
3. Schematic
4. Solution approach
5. Solution
6. Results
7. Lessons learnt



# Machine Details

- Propane recovery compressor
- Steam turbine driven
- Anti-surge controller system
- Suction pressure: 1.5-10 psig
- Discharge pressure: 210-255 psig
- Gov Speed range: 6250-6600 rpm
- Suction temp: -17 to 75 degF
- Chiller Swing cycle period: ~20 mins



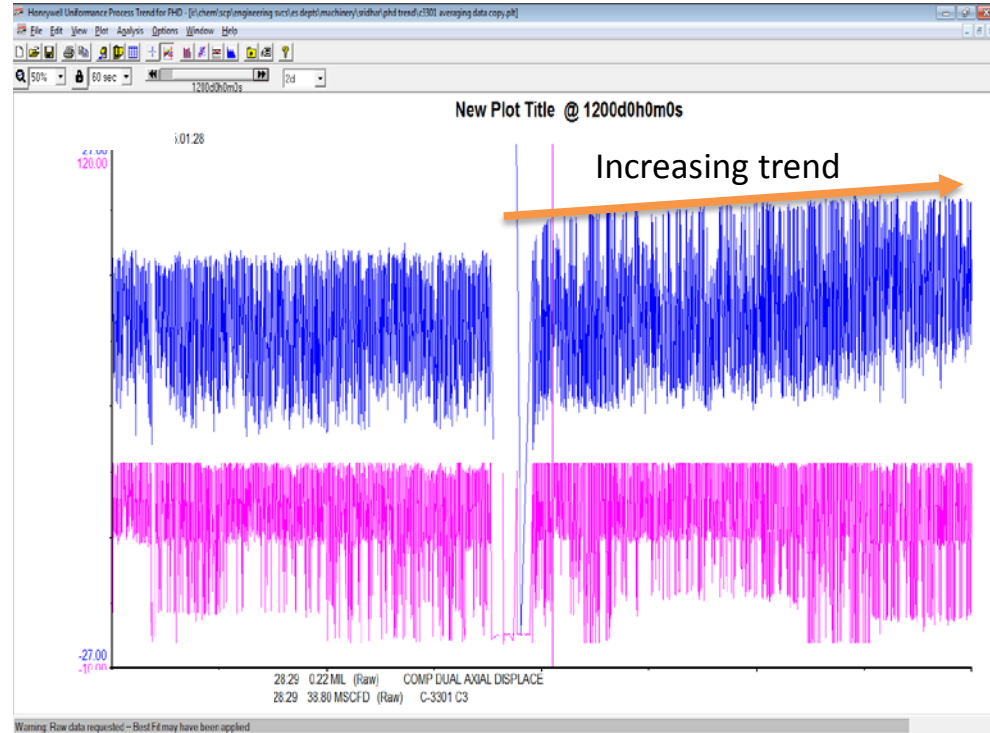
# Problem Statement

- Observed compressor thrust position alarms intermittently.
- The compressor thrust position trends showed rising trend since overhaul of the machine a year before.
- Compressor was also experiencing 'Safety ON' alarm on the anti-surge controller. This is indication of surging in the compressor.
- The thrust spikes and the safety on alarm were coming on approx. every 20 mins and coinciding with the chiller swing cycle.

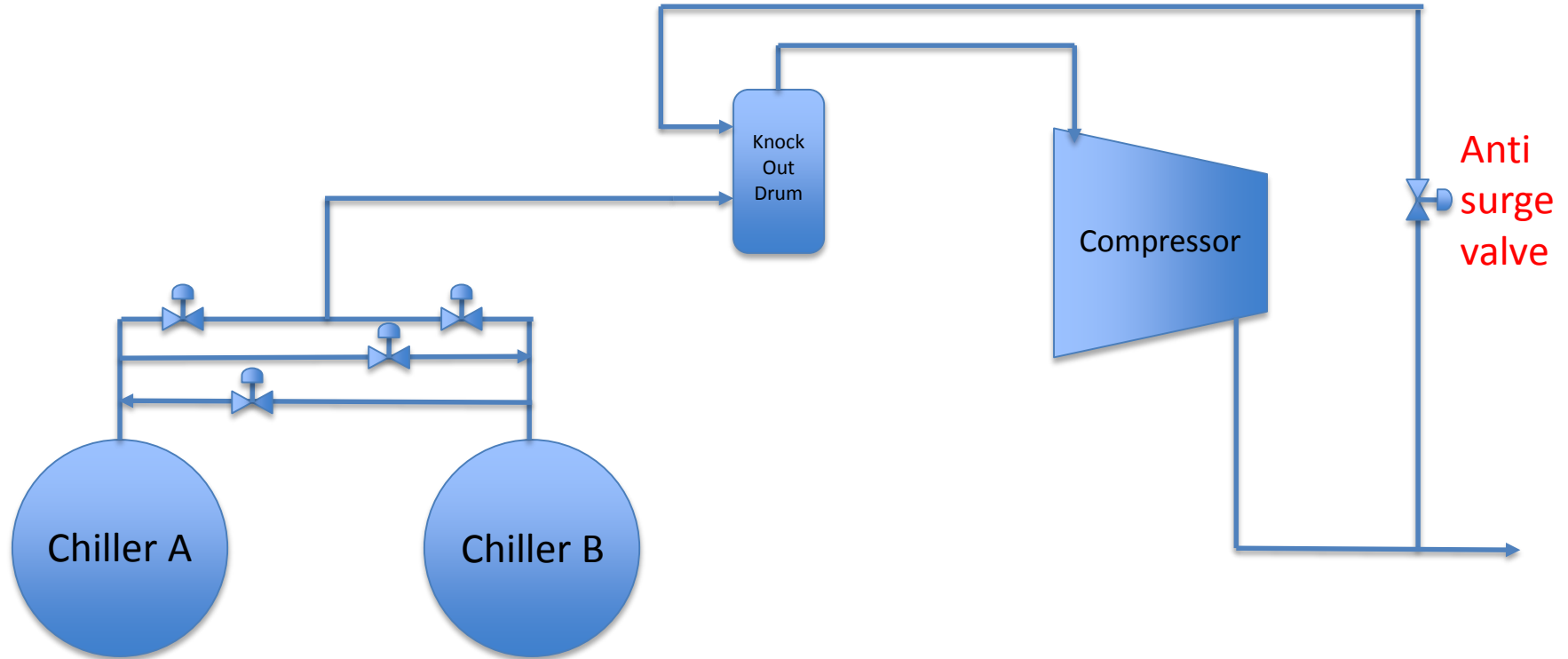


# Problem Statement

- The thrust position alarm was at  $\pm 20$  mils and the trip at  $\pm 27$  mils.
- The thrust position values were hitting +20 mils on both the thrust position probes.
- Based on the trend, the projected timeline of operability was about 1.5 years.



# Schematic





# Solution Approach

- The process trends show us that the machine was clearly surging during the chiller swing which was causing both the thrust spike and the safety on alarm.
- Chiller swing operation review suggested that the chiller swing was optimized, hence, the need is to work on the compressor.
- Though the anti-surge valve opens during the surging (up to 100%), it is not opening in time and not able to prevent surge.
- The anti-surge controller was found to have been tuned in a generic way to suit to stable operations.

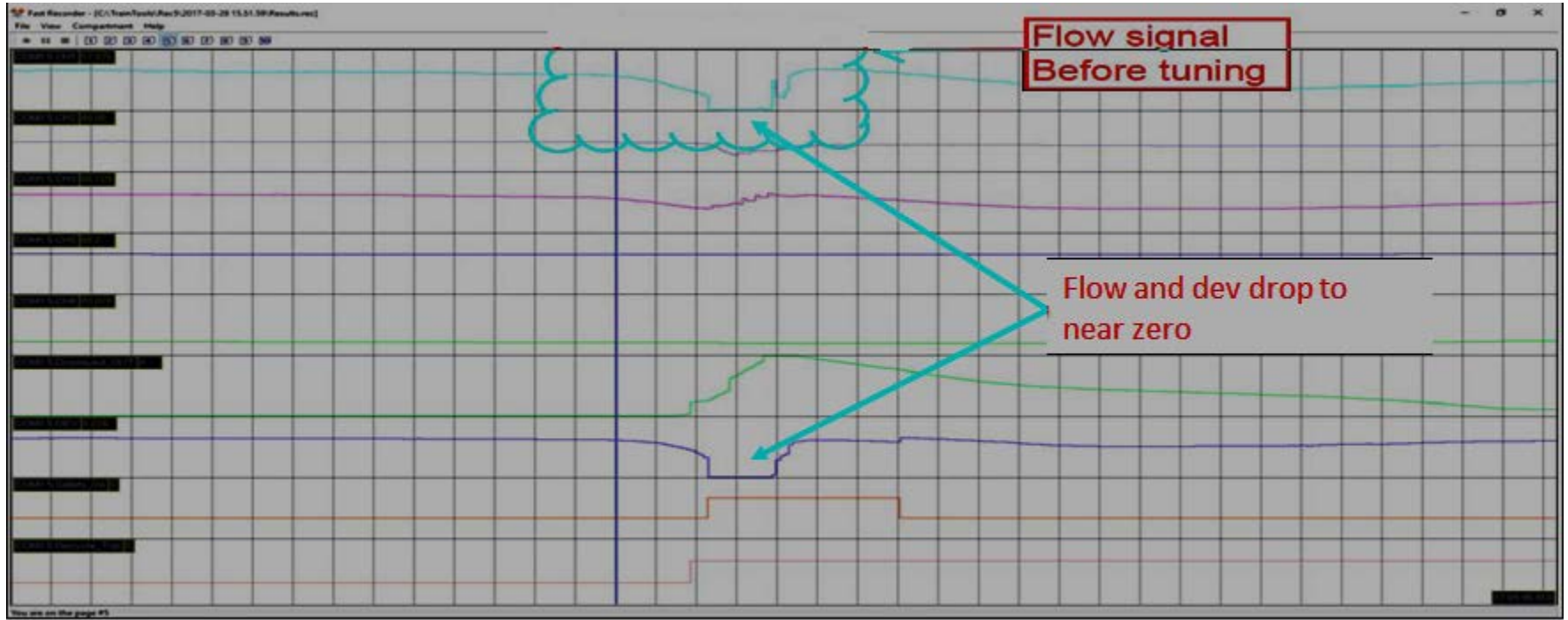


# Solution Approach

- However, this machine is a semi-batch operation and it was concluded that a more customized tuning would be required for this machine.
- If the machine surging can be avoided, the axial spikes can also be avoided.
- If we can avoid the axial spikes, we can continue running with the existing bearing (partially worn off, but not deteriorating further) till the next downtime.



# Solution Approach



# Solution

- 1. The suction pr. low limiting value increased:** Value changed from 0.5 psig to 1.4 psig. By increasing the suction pressure low limiting value, the ASV would open earlier.
- 2. Derivative action enabled:** Derivative action enabled in PID & tuned it according to process, for proactive response to chiller swing. Enabling early opening of ASV based dropping deviation value during the chiller swing.



# Solution

3. **Rate of change of speed made gradual:** During chiller swing, the rate of drop of speed and also the rate of drop of flow was too rapid. This was made more gradual.
4. **Speed lower limit increased:** The lower limit of minimum compressor speed was increased. By increasing the lower limit, the operating point moved further away from SCL.
5. **Surge control line shifted to the right of curve:** The SCL was shifted by 10% to the right of the curve.

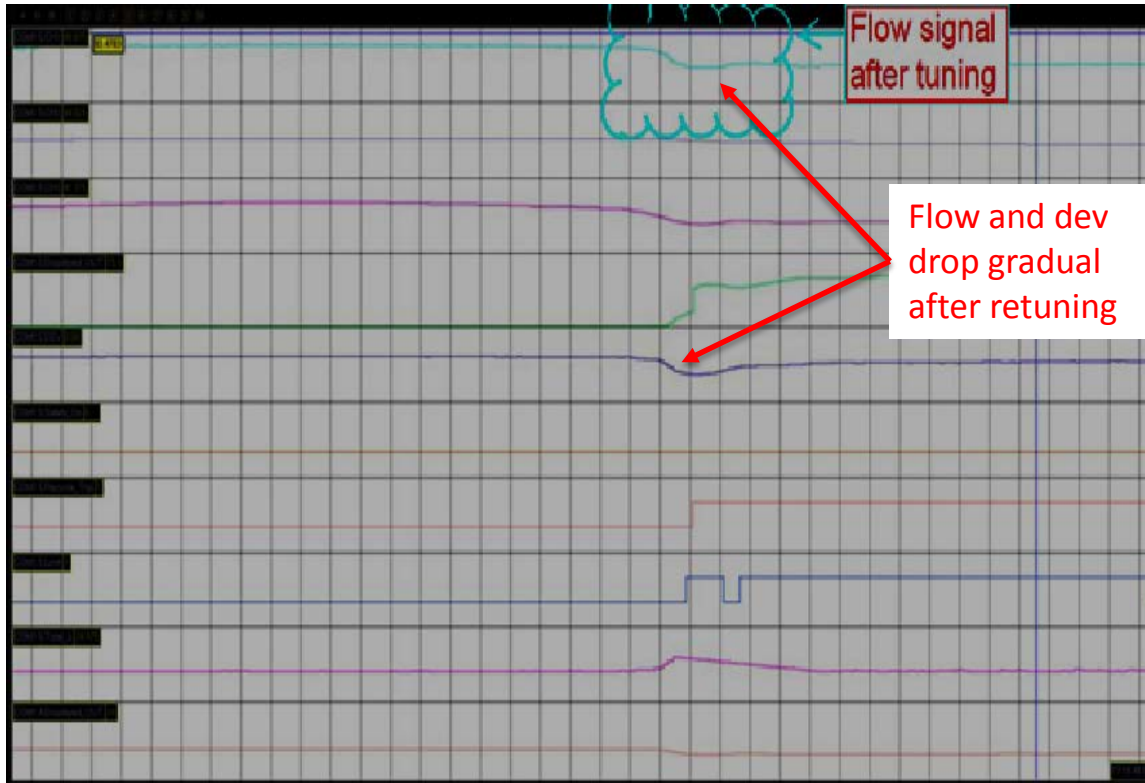


# Results

- CCC anti-surge controller retuning from a generic tuning to customized tuning to suit to this process.
- Anti surge controller retuning achieved without any impact to process.
- After retuning, the Safety on alarm no longer comes on.
- After retuning, the axial position spikes also have stopped coming along.

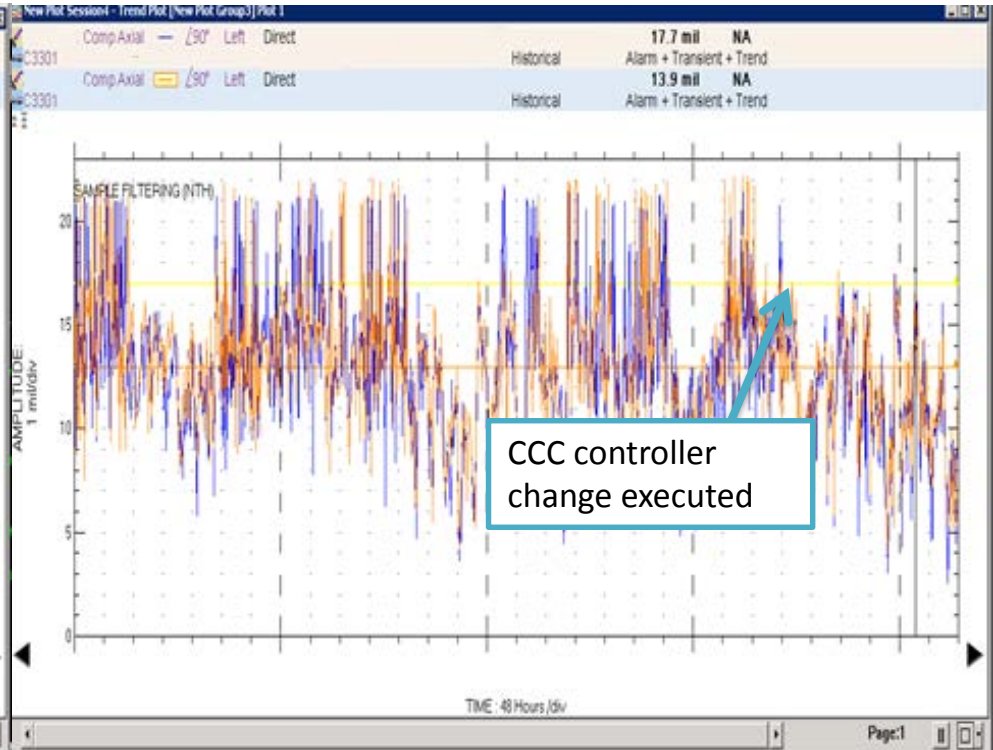
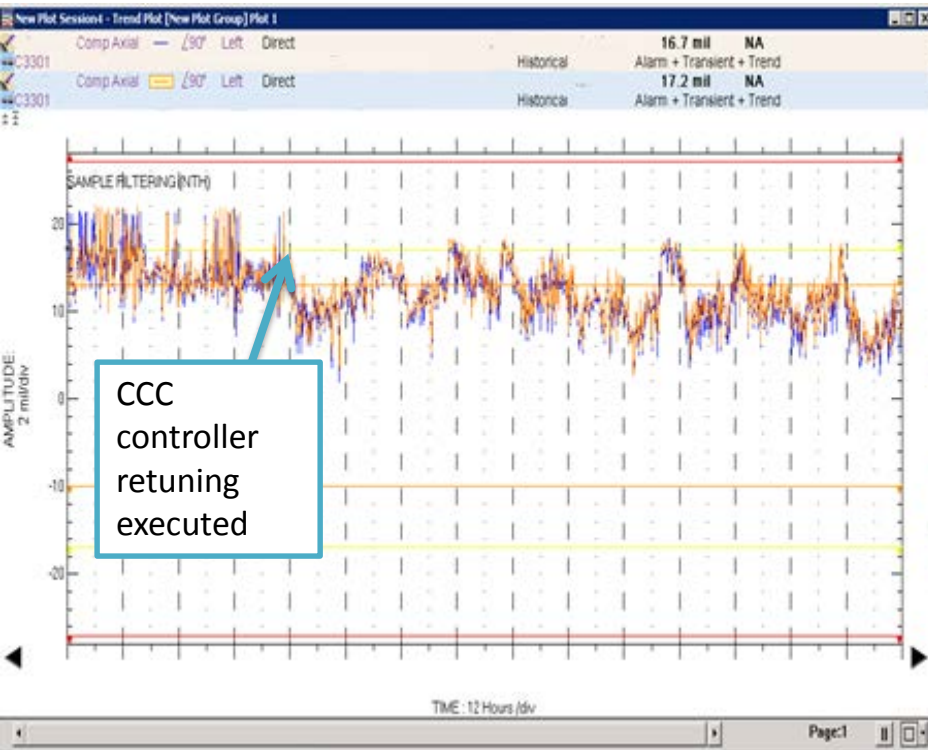


# Results



- The drop in flow is much more smooth during chiller swing after CCC retuning.
- The deviation of controller also smoothed out.

# Results





# Lessons Learnt

- Anti-surge controller tuning very crucial for machines especially in semi operations like in Propane Dewaxing Unit.
- Anti-surge tuning to be assessed in case of any process changes.
- Anti-surge retuning required after overhaul of machine.



Thank You

