APC on a Naphtha Splitter column

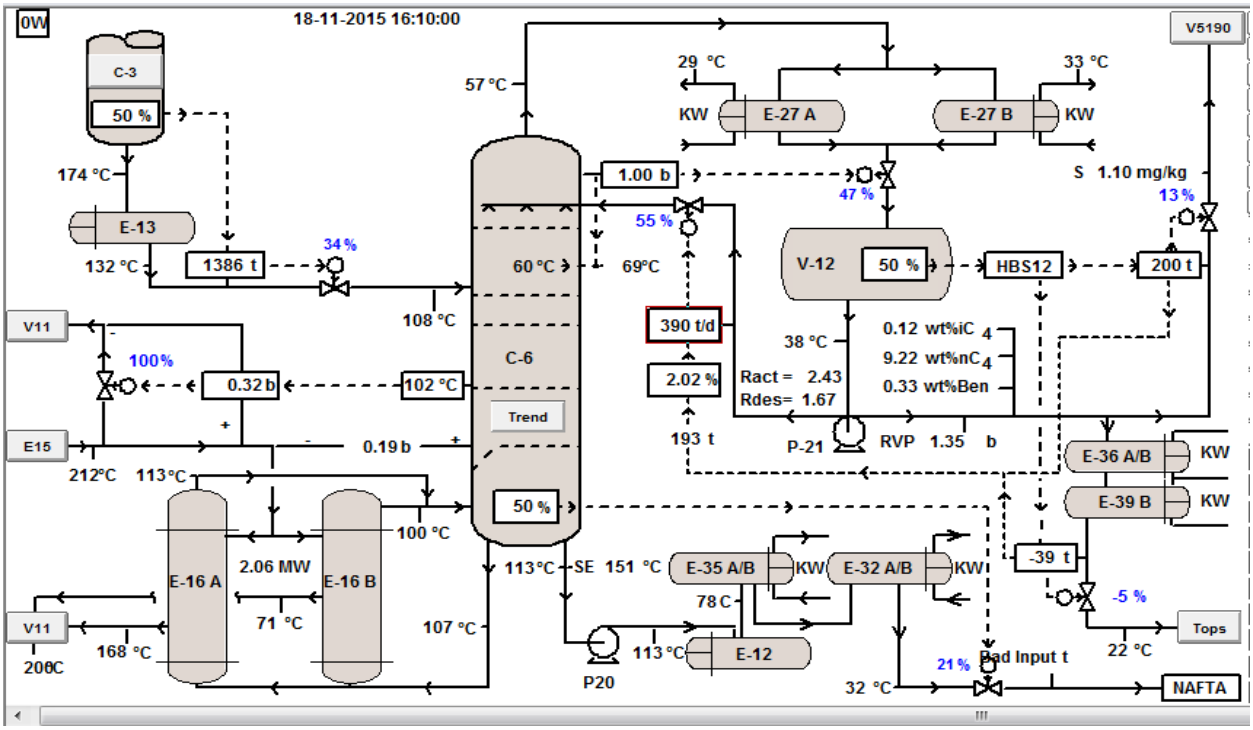
1. APC Scope and Problem definition

Advanced process control was implemented on a Naphtha Splitter Column, as part of a crude distillation unit. This column has to separate Light Naphtha from Heavy Naphtha, using the hot Long Residue, from the bottom of the main distillation column, as re-boiler medium. It uses cooling water as top condensation medium. The APC application uses the following as manipulated variables:

- Reflux to distillate ratio controller, that sets the reflux flow.
- Column top pressure controller.
- By-pass valve of the Long Residue to the re-boilers.

The main controlled variables are the following:

- Benzene % in the top, controlled to a high limit.
- Reflux flow high limit, used as column capacity constraint.



2. Challenges

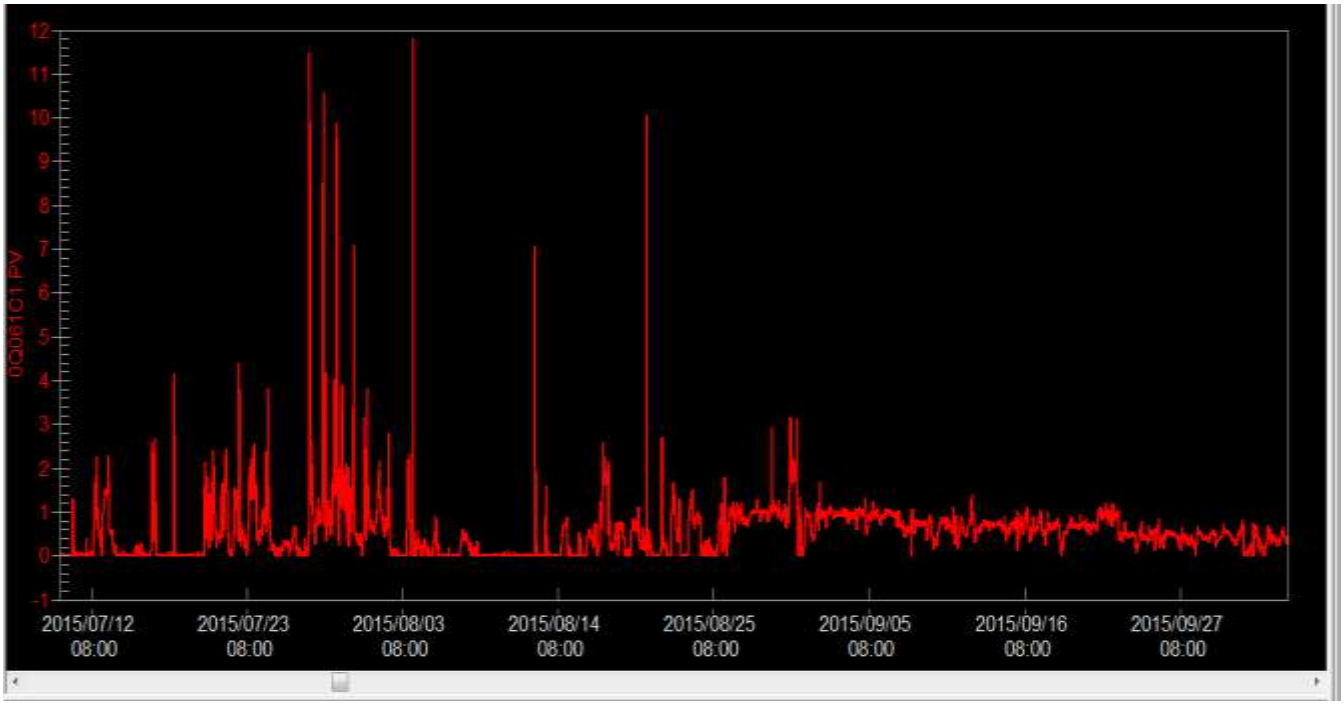
The optimization objective is to maximize the Light Naphtha yield, by pushing against the high limit of the Benzene quality in the distillate. This is achieved by minimization of the reflux-to-distillate ratio

controller every minute. At the same time we minimize the pressure to get better separation, against a reflux flow high limit. The re-boilers are oversized and deliver too much duty under normal operating conditions, so the by-pass valve tend to be fully open all the time.

By better control of the Benzene quality in the top with APC, we can reduce the standard deviation, thereby running closer to the limit. This way we push more benzene into the Light Naphtha and end up maximizing the yield.

3. Results

The following data plot shows the benzene quality in %. Commissioning took place between 24 and 28 August, more or less in the middle of the data plot, so the difference in control is very obvious when comparing before and after.



With the following flow of logic we can calculate this benefit in Euro terms.

Average %BZ:

Before 0.4717; After 0.5121

Standard deviation %BZ:

Before 0.7898; After 0.3223

Difference in standard deviation: 0.4675. This is the amount we can operate closer to the limit without increasing the number of transgressions with APC.

Average flow of Light Naphtha distillate: 196.29 t/d

Increase in flow due to higher % BZ: 0.4675% * 196.29 t/d = 0.9176 t/d

Price difference Light and Heavy Naphtha: assume $50/t

Benefit/d: $50 * 0.9176 t/d = 45.88 $/d

Benefit/a: $16 746/a assuming 100% availability.

4. Conclusion

A benefit of $16 746 per year can be delivered by APC on a Naphtha Splitter refinery column. This is achieved by improved control of the % benzene in the top Light Naphtha distillate, and therefore being able to maximize the yield of Light Naphtha as opposed to the bottoms Heavy Naphtha.