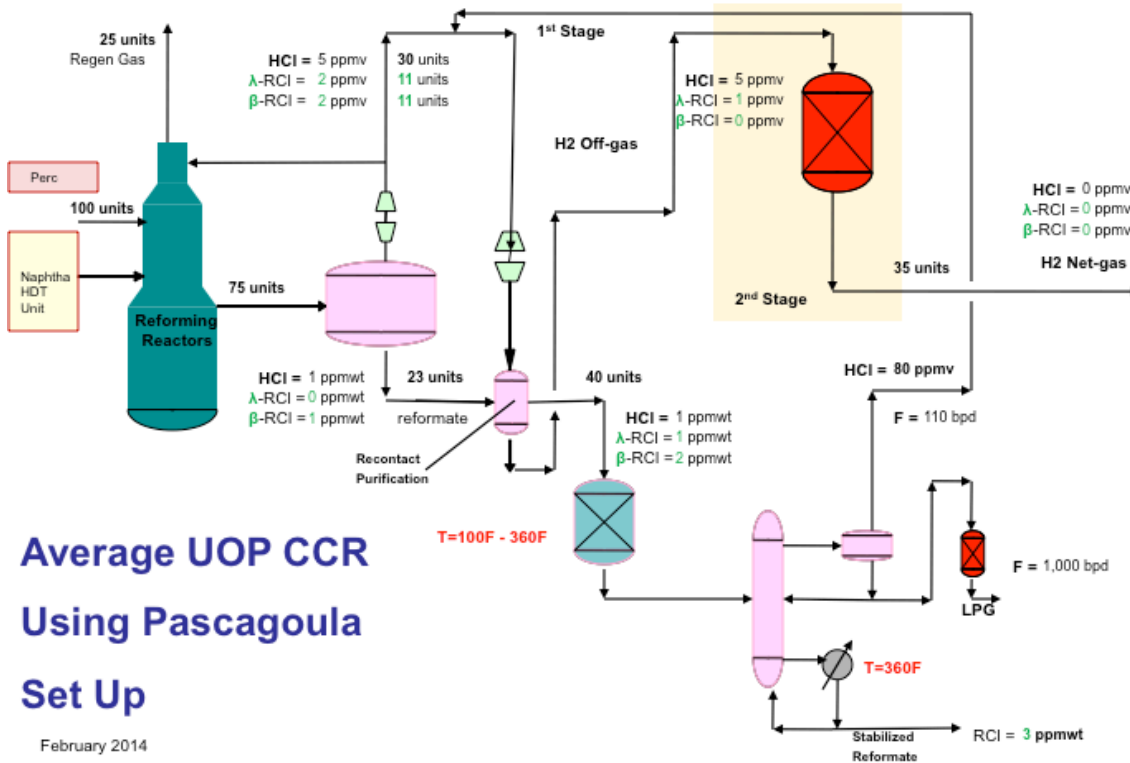




**CASE STUDY**  
**Recent UOP CCR Gulf Coast Refinery**  
**Vari Zeo Replacing Pro Alumina Charge**

This is a US Gulf Coast Refinery with a recently commissioned 60,000 bpd UOP design CCR. The general layout of the reformer circuit is shown in **Figure 1 below**

**Figure 1**  
**CLS – Reformer Circuit Cl Balance**



All chloride concentrations shown are typical average values found in UOP designed CCRs for reformat product going to MOGAS.

This particular CCR has two net gas (2<sup>nd</sup> stage) treaters of 3,315 ft<sup>3</sup> each treating 4.3 mmscfh of reformer hydrogen at 613 psig and 95 F. The hydrogen gas composition was as follows:

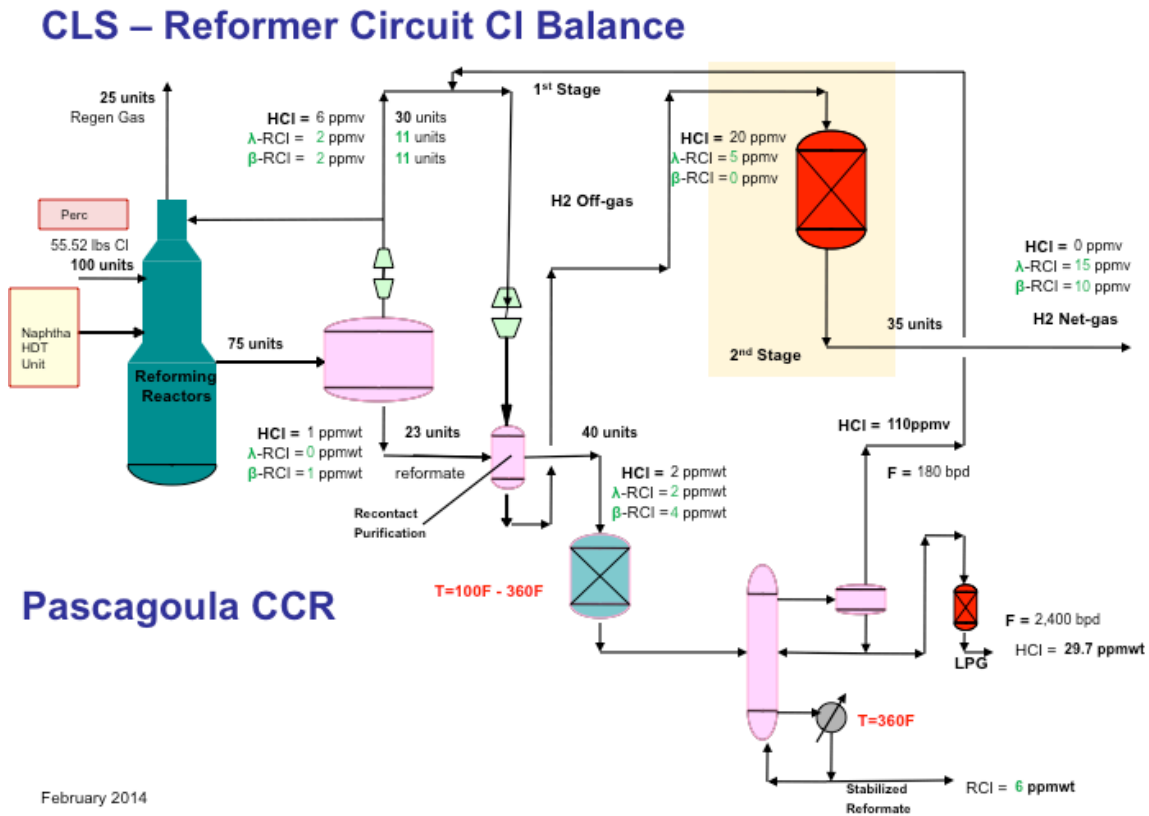
- H2 = 86 vol%
- C1 = 2.5 vol%
- C2 = 3.4 vol%

- C3 = 1.9 vol%
- C4 = 0.4 vol%
- iC4 = 0.5 vol%
- C5 = 0.2 vol%
- C5+ = 0.2 vol%
- H2O = 20 ppmv

The two net gas treaters were loaded with promoted alumina during original commissioning. The lead bed was changed out once after 2 years on line, charged with fresh promoted alumina and placed in lag position. No HCl slip was ever recorded exit from either treaters by operations.

Six months after the change out an onsite CI survey was performed by CLS resulting in the CI balance exhibited in Figure 2 below:

Figure 2

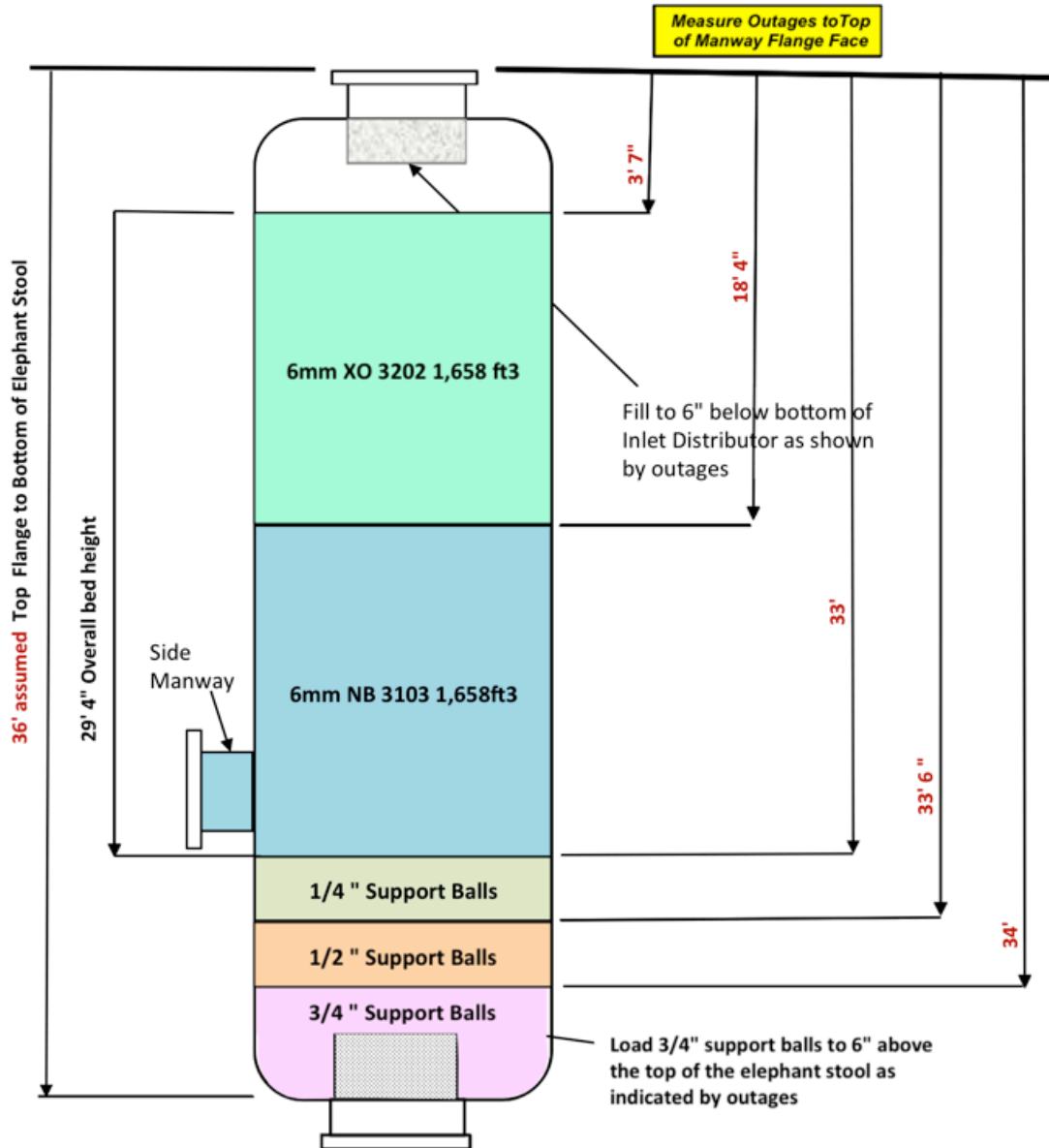


Abundant **green oil** formation was observed together with the **RCI** slip recorded above.

Kinetic modeling of the beds revealed that the promoted alumina lead bed had a cycle length expectation of 8 months with the first 2 months being free of RCI formation.

The refiner decided to replace both lead and lag beds with CLS Vari Zeo material as shown in the loading diagram in figure 3 overleaf:

Figure 3



**VESSEL**

Diameter	12 ft ID
Height	29.31 ft TT
Heads	2:1 elliptical
Volume	3316.0 ft <sup>3</sup>

The features/benefits of the CLS Vari Zeo system are as follows:

- No RCI formation
- No green oil formation
- Total CI removal both HCl and RCI during 8 month cycle length
- Cost of fill for each bed = **\$275,000.00**
- Vari Zeo can be **steamed** for 24 hours prior to discharge to achieve LEL. Cost of steaming is negligible.
- Unloading can be done by dumping via bottom schute within 2 days with catalyst handling cost of **\$40,000.00**.
- Spent Vari Zeo after steaming is designated as **non hazardous** and can be landfilled as Class II industrial waste with a cost of < \$0.05/lb = **\$11,000.00**

**Total cost** of fill plus discharge, purging and disposal = **\$326,000.00**.

The comparative experience with the promoted alumina system was as follows:

- RCI and green oil formation after 2 months online.
- Cost of fill for each bed = **\$215,000.00**
- Pro alumina cannot be steamed. The lead bed was purged with hot nitrogen for 7 days at a cost of **\$30,000.00**. LEL was not achieved.
- Bed was immersed with water for 15 days to achieve LEL. Water was sent to oily sewer for treatment. Cost of treatment = **\$20,000.00**.
- Unloading was done by vacuum discharge from the top manway within 3 days with catalyst handling cost of **\$100,000.00**.
- Spent Pro alumina after is designated as **hazardous for benzene** and had to be landfilled at a cost of \$0.35/lb = **\$73,000.00**

**Total cost** of fill plus discharge, purging and disposal = **\$438,000.00**.

All the best,

Christian Ahrens