ENRICH YOUR SRU! HOW TO INCREASE SULPHUR PROCESSING CAPACITY OF AN EXISTING PLANT

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SUMMARY

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INTRODUCTION

- **CASE STUDY**

  Revamping of SRU Unit designed by KT (2 Claus + 1 TGT) and started-up in 2009
- **SCOPE OF WORK**

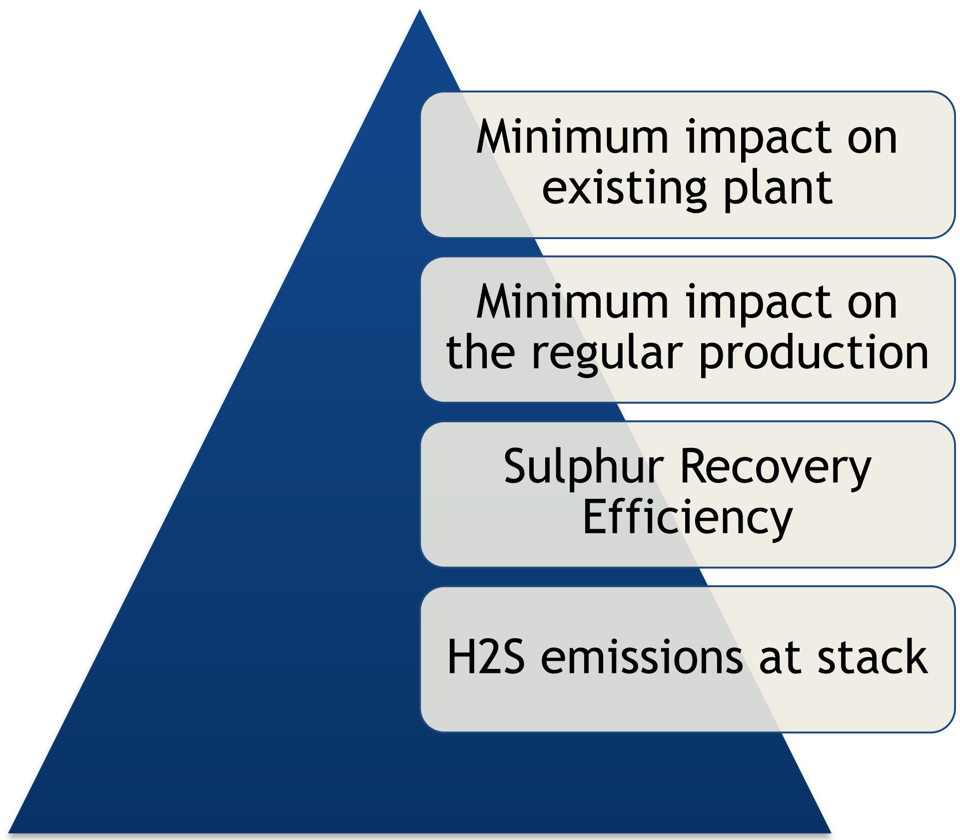
  Perform the best revamping of the plant configuration combined with the best delivery time for a long standing Client in Europe
- **PLANT CAPACITY**

  Current capacity 150 t/d of sulphur production; after revamping 236 t/d.
- **A NEW APPROACH FOR REVAMPING**

  The sequence of activities followed in this project, which involved an actual field trial of the final revamping before the design finalization, represents a very unique and innovative manner of developing such revamping projects.

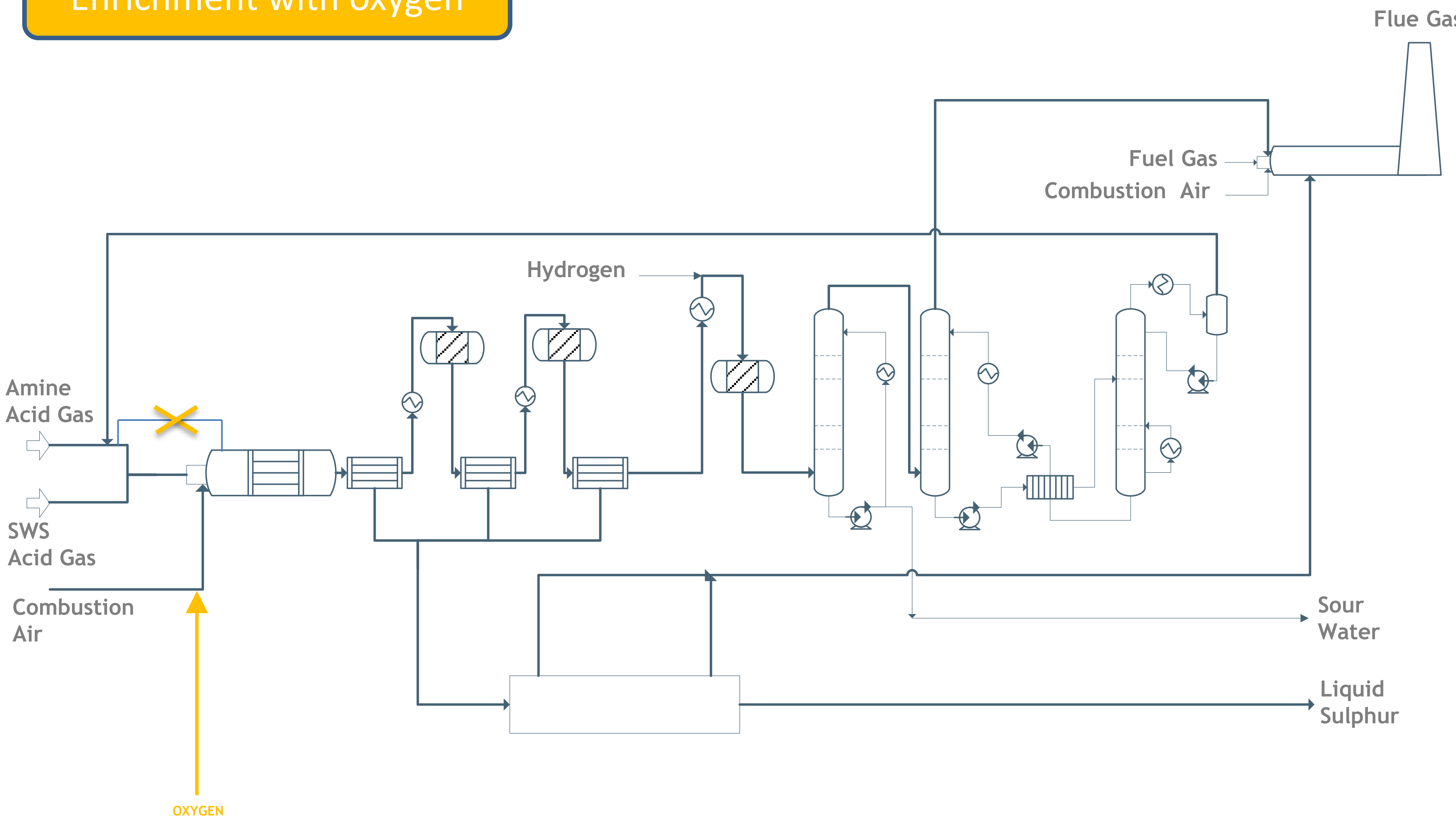
DESIGN REQUIREMENTS

Considering an increase of 150% on Sulphur production, the SRUs Facility shall be in compliance with the following main requirements:



DESIGN REQUIREMENT

Enrichment with oxygen



PROJECT STEPS

New approach to revamp a plant

STEP	ACTIVITIES	KT RESULTS
1. Feasibility Study (2013)	• Assessment on the operation of the SRU in order to reconcile the field data • Investigation on the revamping options	• Finding of the “best” solution for capacity increase • Definition of the maximum capacity for the given SRU
2. In field test (2014)	• Reproduction of the conditions foreseen after revamping • Observation of plant behaviour during test	• Confirmation of the feasibility results • Understanding of the critical issues
3. Design and Engineering (2016)	• Design based on the collected data and observation of plant behaviour	• Intervention on the real bottlenecks

FIRST STEP - FEASIBILITY STUDY

Case studied: 25% more of sulphur production (AAG and SWS increased both)

Parameters confirmed with increased capacity:

- ❑ Hydraulics (5% more of Claus process gas comparing to original case)
- ❑ Ammonia destruction despite the lower residence time in thermal reactor
- ❑ Heating systems
- ❑ Degassing system

Modifications proposed with increased capacity:

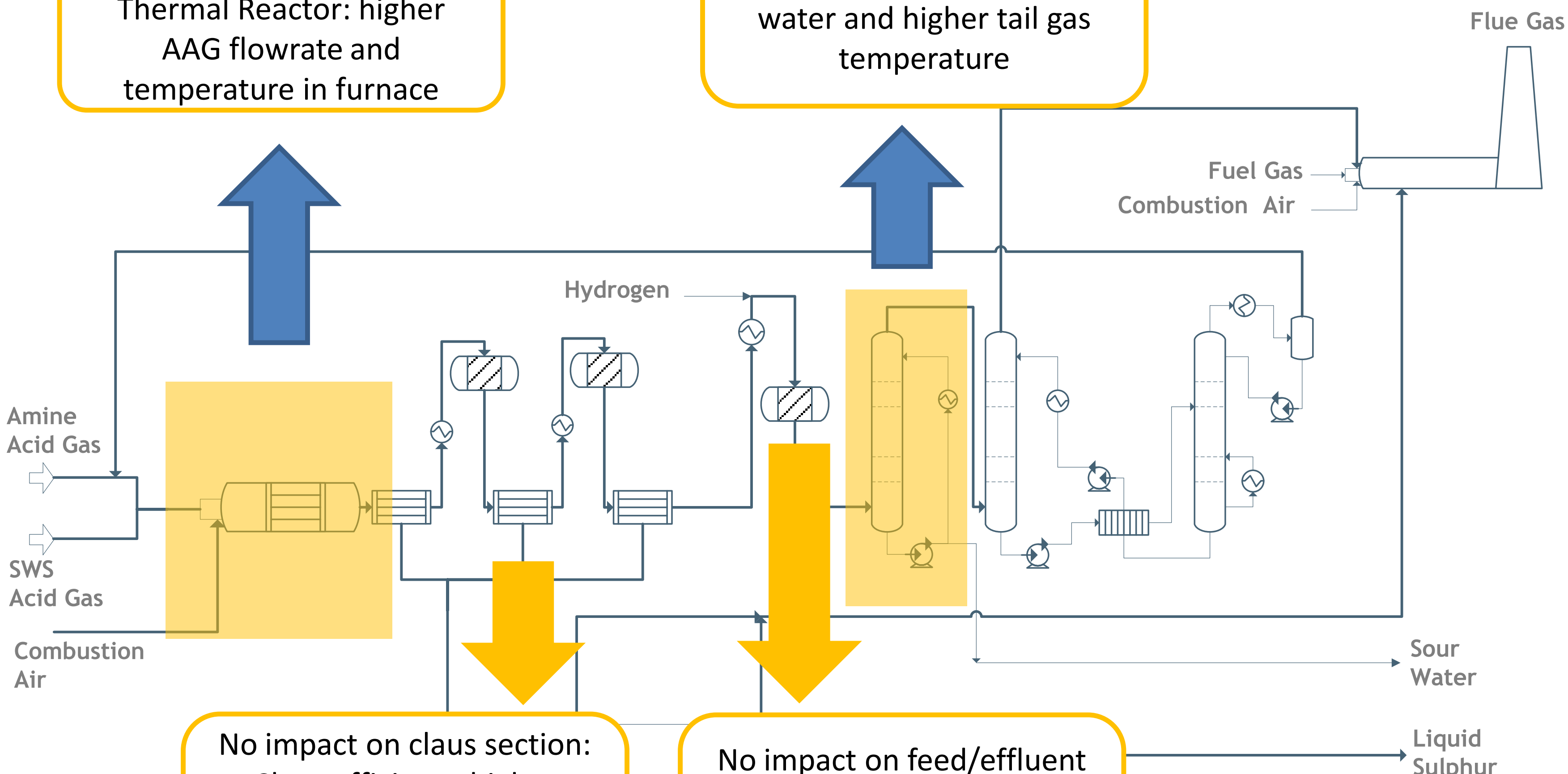
- ❑ Burner (no impact on material)
- ❑ Substitution of pyrometer with a thermocouple on Thermal Reactor
- ❑ WHB tubesheet: new type of ferrules
- ❑ Quench circuit: addition of trim cooler on quench water circuit

FIRST STEP - FEASIBILITY STUDY

Results

Impact on Burner and Thermal Reactor: higher AAG flowrate and temperature in furnace

Impact on quench circuit due to higher amount of water and higher tail gas temperature



No impact on claus section: Claus efficiency higher despite the increase of flowrate and catalyst moderate deactivation.

No impact on feed/effluent exchanger: heating gas from reduction reactor is hotter. Tail gas flowrate is lower.

SECOND STEP - IN FIELD TEST

In field Case: 50% more of sulphur production and 10% more of process gas (AAG increased only)

Critical parameters

Parameters	Enriched air
Claus Furnace system	Single zone
Max. Claus Furnace adiabatic flame temperature , °C	1500
Residence time	>0.9 sec
Claus Furnace WHB mass velocity, kg/m^2s	16.5
Steam produced from WHB, kg/h	13000
1st Converter inlet temperature, °C	220
1st Converter outlet temperature, °C	300
SRE Claus, at EOR conditions, %	>92
Total Sulphur production whole SRU, TPD	236
Hydrog. Reactor inlet, °C	255
Hydrog. Reactor outlet, °C	285
Hydrogen concentration on quench column top, %	5%
Circulating water inlet flow rate, m^3/h	150
Quench top temperature, °C	41
Overall SRE (inclusive of Claus units), %	>99.8

SECOND STEP - IN FIELD TEST

Analysis of test:

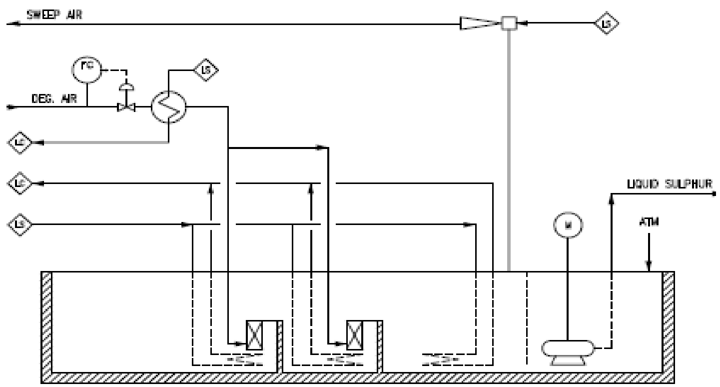
- Confirmation of Feasibility study results and modifications
- Hydrogen consumption can be reduced since the hydrogen concentration on tail gas stream is high
- Steam production has a 35% increase due to higher quantity of heat exchanged in the Claus WHB
  - Because of higher steam flow rate produced, the flue gas quantity to the MP Super heater shall be increased to guarantee the level of superheating

THIRD STEP – PROJECT EXECUTION

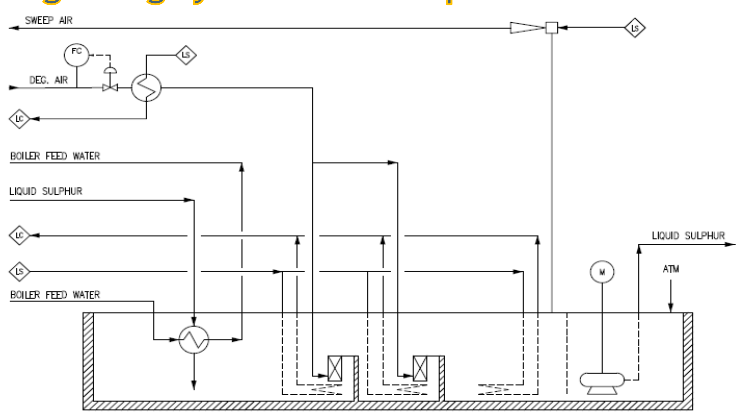
Equipment modification

- ❑ Optimization of degassing system in order to reduce H_2S in liquid sulphur.

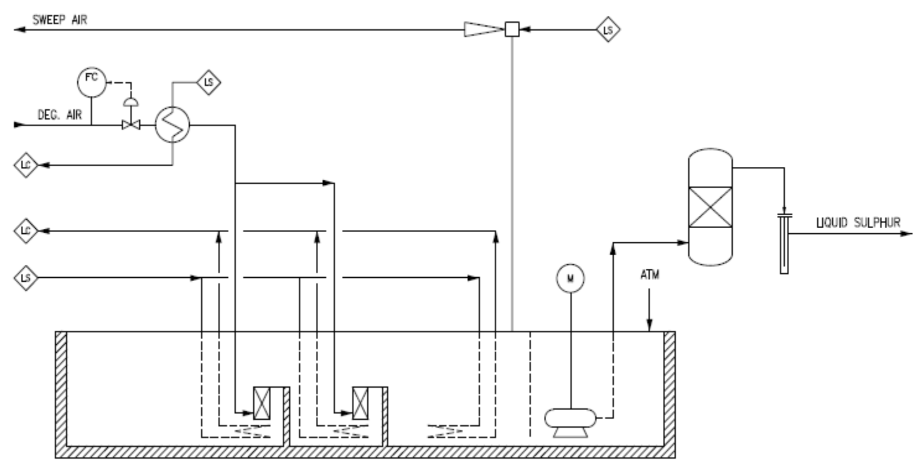
Degassing system installed



Degassing system with sulphur cooler



Degassing system with additional external column



→ Low impact on plant layout and pit

THIRD STEP – PROJECT EXECUTION

Equipment modification

- Installation of two Thermal Reactor Burners
- Two pieces head square ferrules provided on WHB tubesheets
- Oxygen lines up to connection with air line
- Installation of one trim cooler on quench water system: plate heat exchanger

THIRD STEP - PROJECT EXECUTION

Instrument and automation modification

- Oxygen instrumentations and control system
- R thermocouple on thermal reactor furnace instead of pyrometer
- No impact on intruments installed on AAG line (CV and FE Venturi): only recalibration of transmitter
- New valves on steam and BFW connected to Claus WHB

COMMISSIONING AND START-UP

KT attended the test of Burner with oxygen injection

Basic information by KT for oxygen line cleaning

Control system function has been checked after modification

Oxygen injection: November 2017

KT follows the start up of the plant after revamping with atmospheric/oxygen enriched air

Test Run succesfully performed in June 2018

CONCLUSION

The presented Study confirms KT's expertise in proposing innovative and customized solutions to meet Client requirements.

The following challenges have been successfully overcome:

- ❑ Plant capacity increase of 50%
- ❑ Performing SRU
- ❑ Minimum impact on existing plant (two weeks of revamping activities)

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