DEVELOPMENT OF SUSTAINABLE AVIATION FUEL (SAF) GREENFIELD PLANT DIGITAL TWIN FOR OPERATOR TRAINING PURPOSE

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Priority Topic Area: **Digitalisation, including Cybersecurity**

1 – Digital Twin for a Greenfield Project

- Greenfield plant operators might be **difficult to gain competency** on plant operation, at least to train their first plant startup
- Sustainable Aviation Fuel (SAF) process is still **considered new**, especially in Southeast Asia, which increase the difficulty to train operator
- If there is a way to substitute the **process plant** and **control system** to **digital independent platform** where operator can train freely, it will be **very beneficial**.
- Technology → Operator Training Simulator (OTS): process plant simulation + emulated control system + DCS HMI

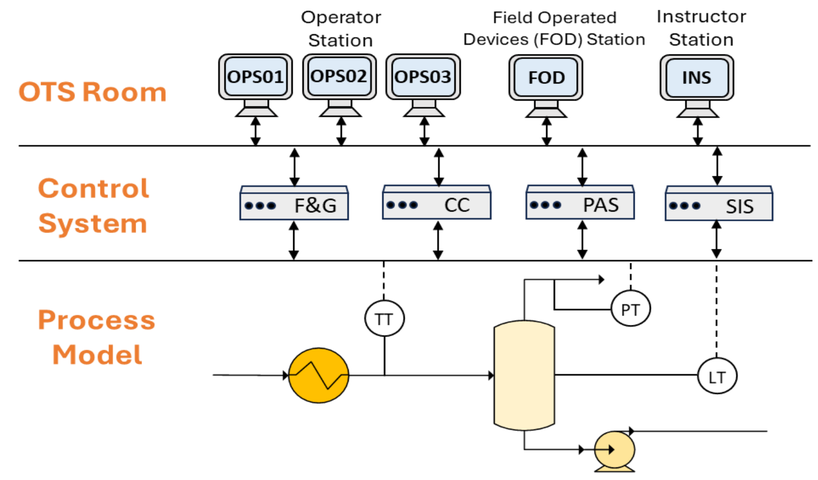

Figure 1. *Simplified process flow diagram of a typical SAF Plant*

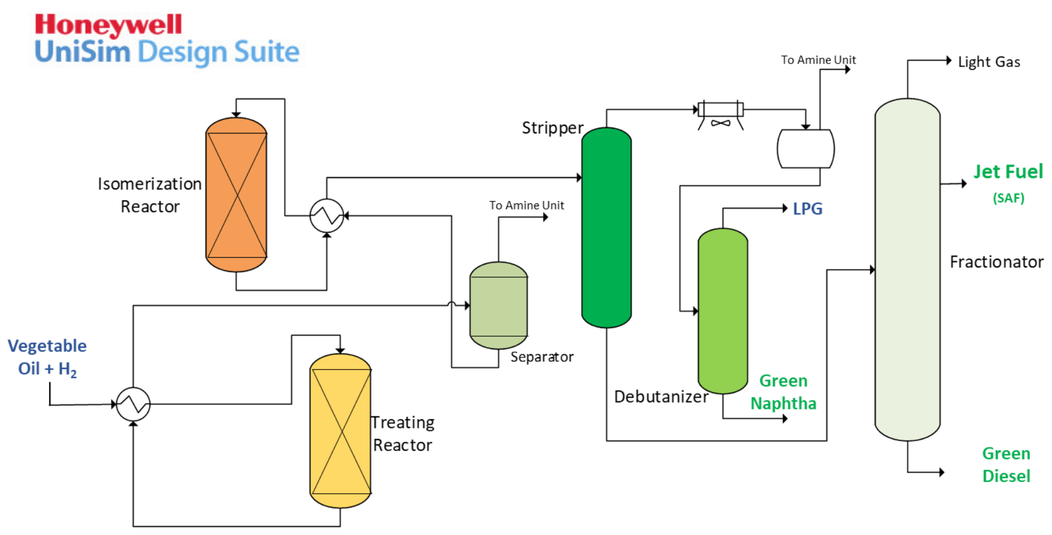

Figure 2. *Simplified process flow diagram of a typical SAF Plant*
(Picture adapted from [1])

2 – Project Execution and Process Modelling Methodology

General info on process model:

a. **Software:** UniSim Design
b. **Model Scope:** Reactor Section, Fractionation Section
c. **Simulation Mode:** Dynamic Simulation
d. **Fluid Packages:** Peng Robinson, Sour PR, NRTL

Project Execution:

1. **Model Building:** dynamic model development from steady state model
2. **Model Acceptance Test:** 1st startup test, process dynamic response validation, steady state parameter test
3. **ICSS Integration:** process model integration with DCS and ESD database
4. **Factory Acceptance Test:** 2nd startup test, DCS logic test, ESD logic test, upset scenario test
5. **Commissioning:** OTS installation at site, functionality test

3 – Implementation Benefits and Key Results

- I have succeeded to build simulation with **minimum accuracy** of **95%** compared to Heat & Mass Balance document.
- The client utilize OTS to write and **validate all operating procedures**. Typically, procedures are developed by technical writers based on P&IDs, control narratives, and operations manuals. However, this can be a challenging task, especially when the final design and behavior of the ICSS are still unknown [2].
- Several **findings** on **DCS HMI** and **ESD logic** has been captured during OTS testing, reported to ICSS team, and implemented before the first startup
- Display of **laboratory results** that helps operator and engineer to know the process better, such as: flash point, freeze point, oxygenates content
- All the savings were estimated to have saved the project around **10 days** of **startup time**.

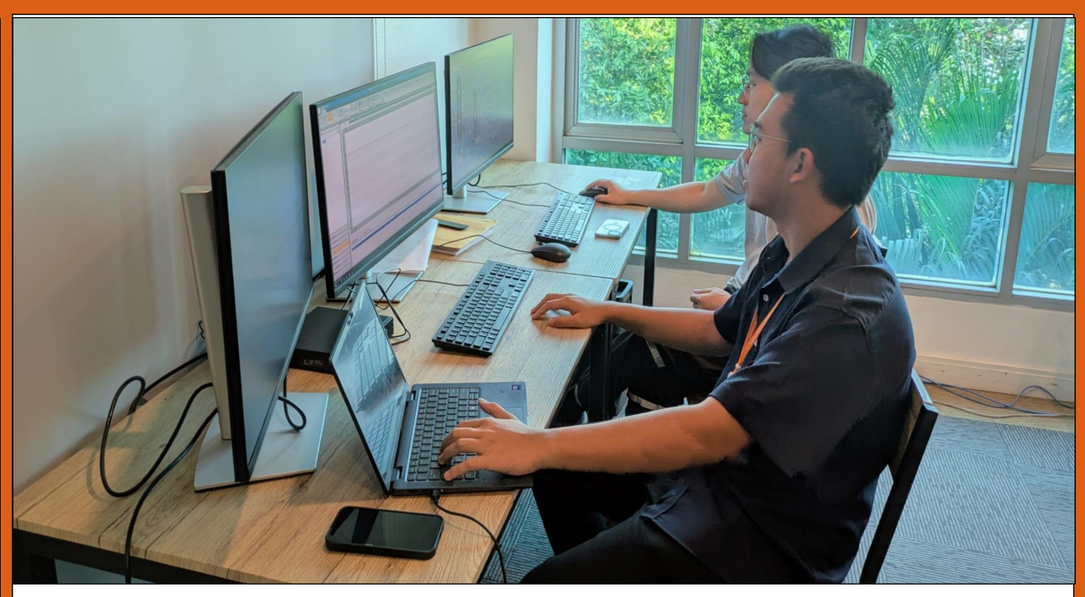

Figure 3. *Honeywell Team during OTS Commissioning*

4 – Benefit to Society

- Facilitate **operator competency curriculum**, where young operator can learn in a **proper** & **formal** method. Operator regeneration process will be easier.
- Increased in operator competency → having a better **career growth**, chance for **getting better position** → better wealth
- Operator competency will increase the potential of a safe startup and safe operation. Hence, it will indirectly **minimize the risk** of harm to society that is caused by process incident
- Generic OTS model can be **used by undergraduate students** and **lecturers** to introduce plant operation and troubleshooting

5 – Next steps

Currently, this OTS was developed based on theoretical heat and mass balance (H&MB). After the first plant start-up, actual condition **might not be the same** with H&MB document. Therefore, OTS model will be **tuned** to match the plant actual condition after the first startup.

Further, **training curriculum** will be prepared in order to have a clear and formal method to train or assess operators and engineers.

References/Acknowledgements

[1] Tao, Ling & Milbrandt, Anelia & Zhang, Yanan & Wang, Wei-Cheng. (2017). Techno-economic and resource analysis of hydroprocessed renewable jet fuel. Biotechnology for Biofuels.
[2] Philip, Joseph. Operator Training Simulator Handbook. (2022). Packt Publishing Ltd.

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