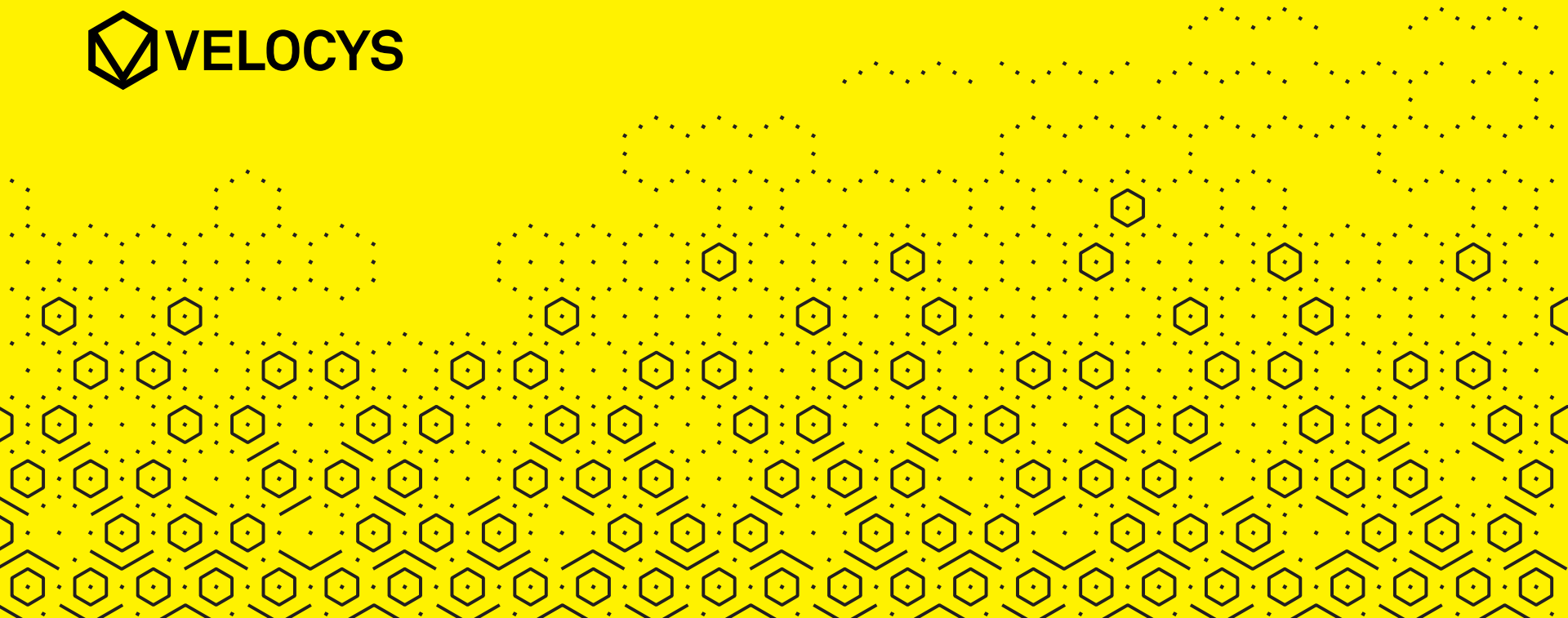


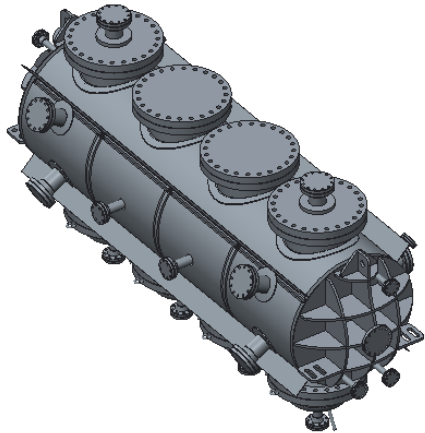
Paul Schubert & Jason Robinson
GTL Technology Forum, August 2016

Enabling larger capacity microchannel reactors



Why make a bigger reactor?

175 bpd vs. 700 bpd?



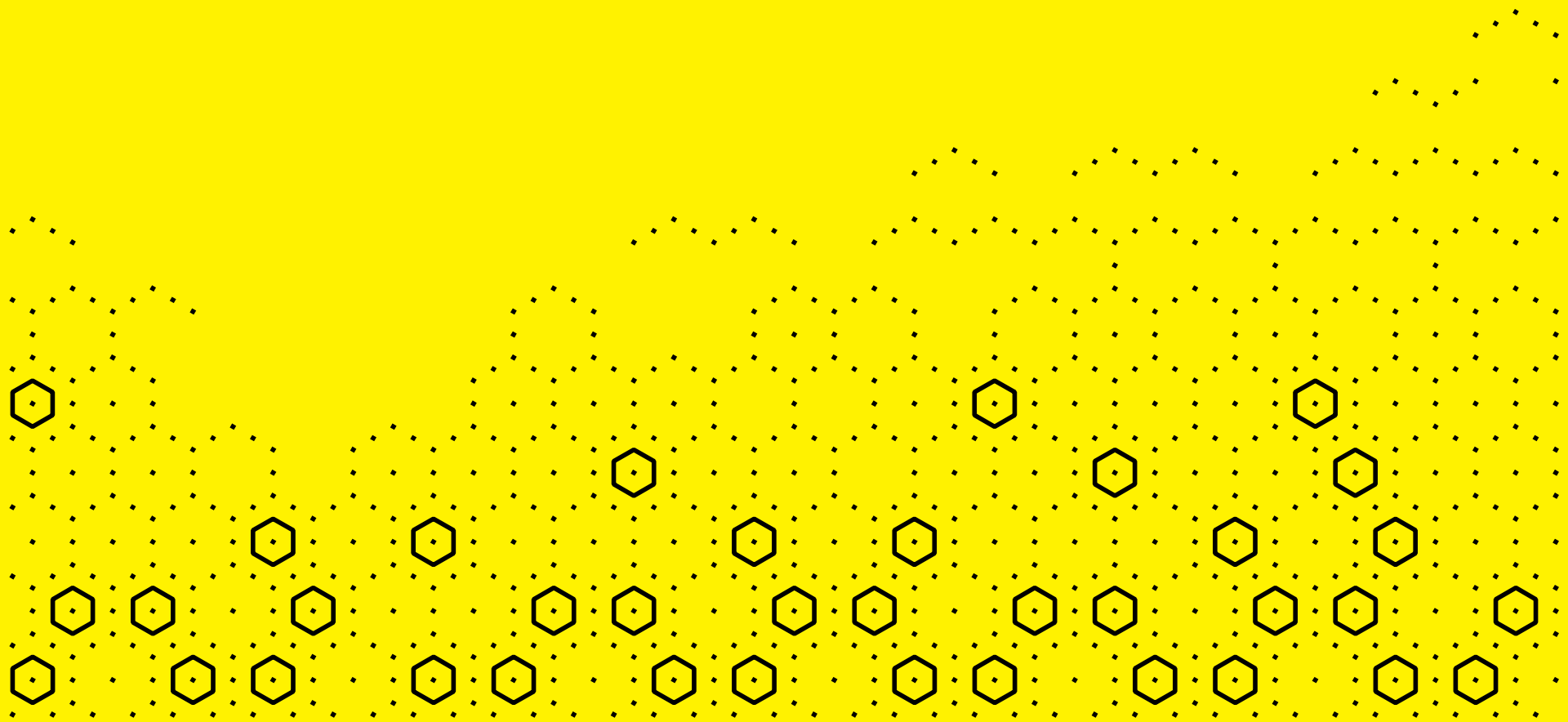
175 bpd reactor



700 bpd reactor

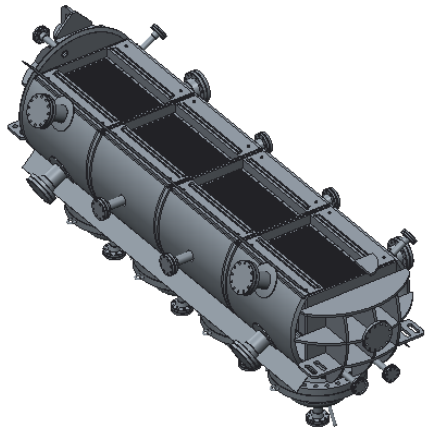
Design concept

4-fold scale-up from current design

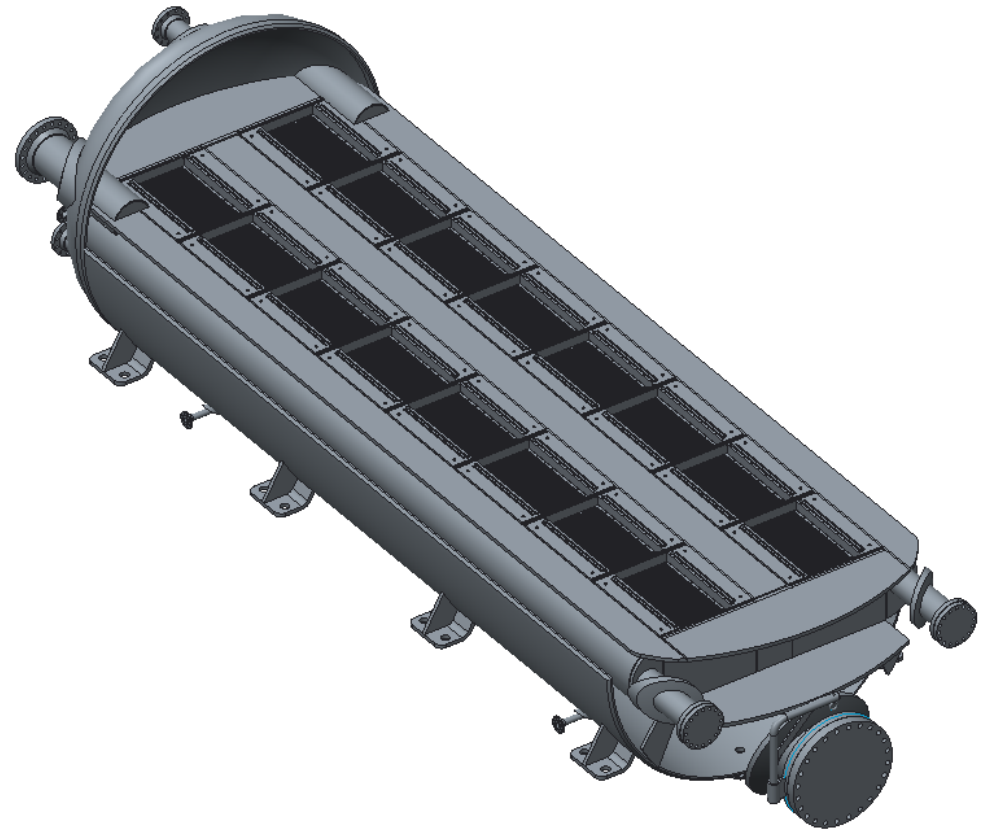


Basic reactor design

Numbering up 4-core commercial design



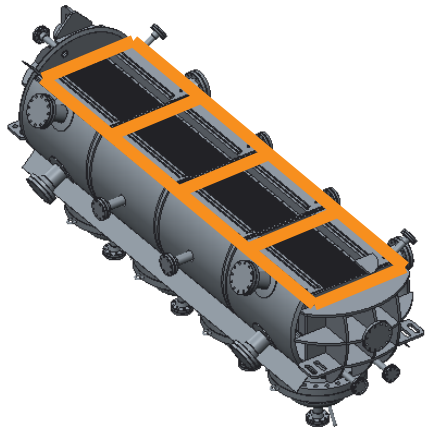
175 bpd reactor



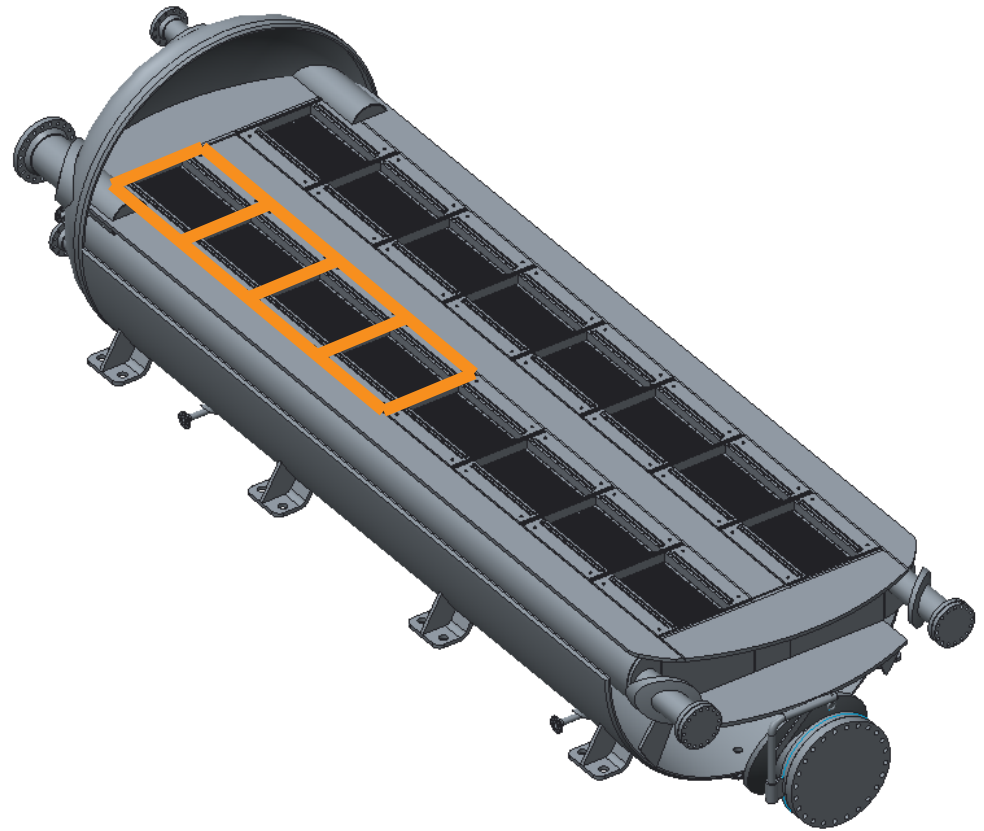
700 bpd reactor

Basic reactor design

Numbering up 4-core commercial design



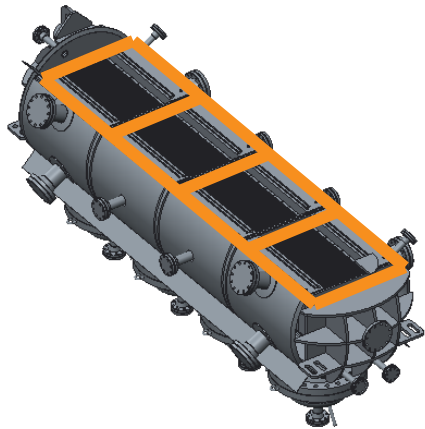
175 bpd reactor



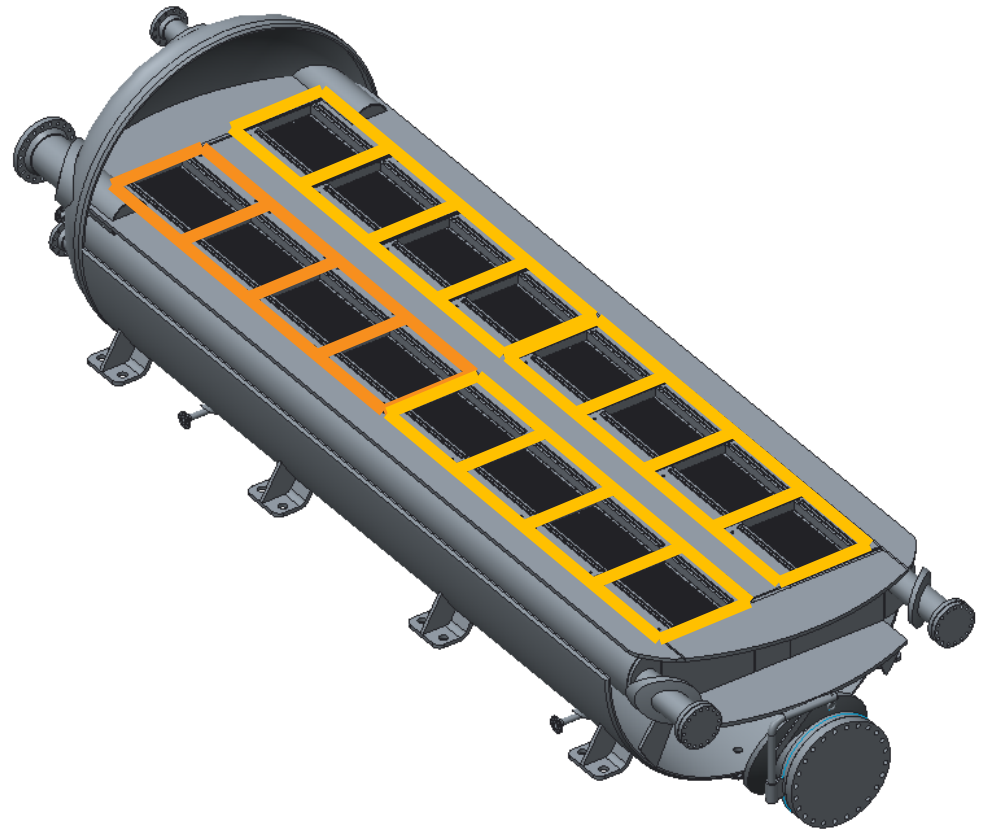
700 bpd reactor

Basic reactor design

Numbering up 4-core commercial design



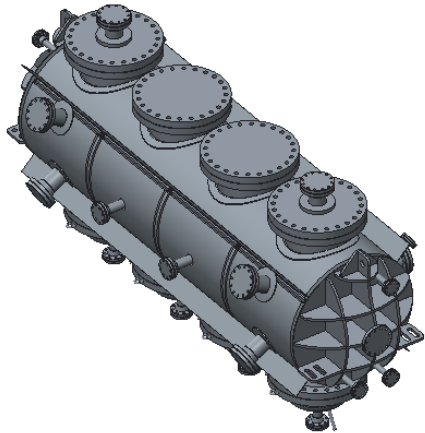
175 bpd reactor



700 bpd reactor

Basic reactor design

The reactor is designed in accordance with ASME “*Boiler and Pressure Vessel Code Section VIII Division 1*”



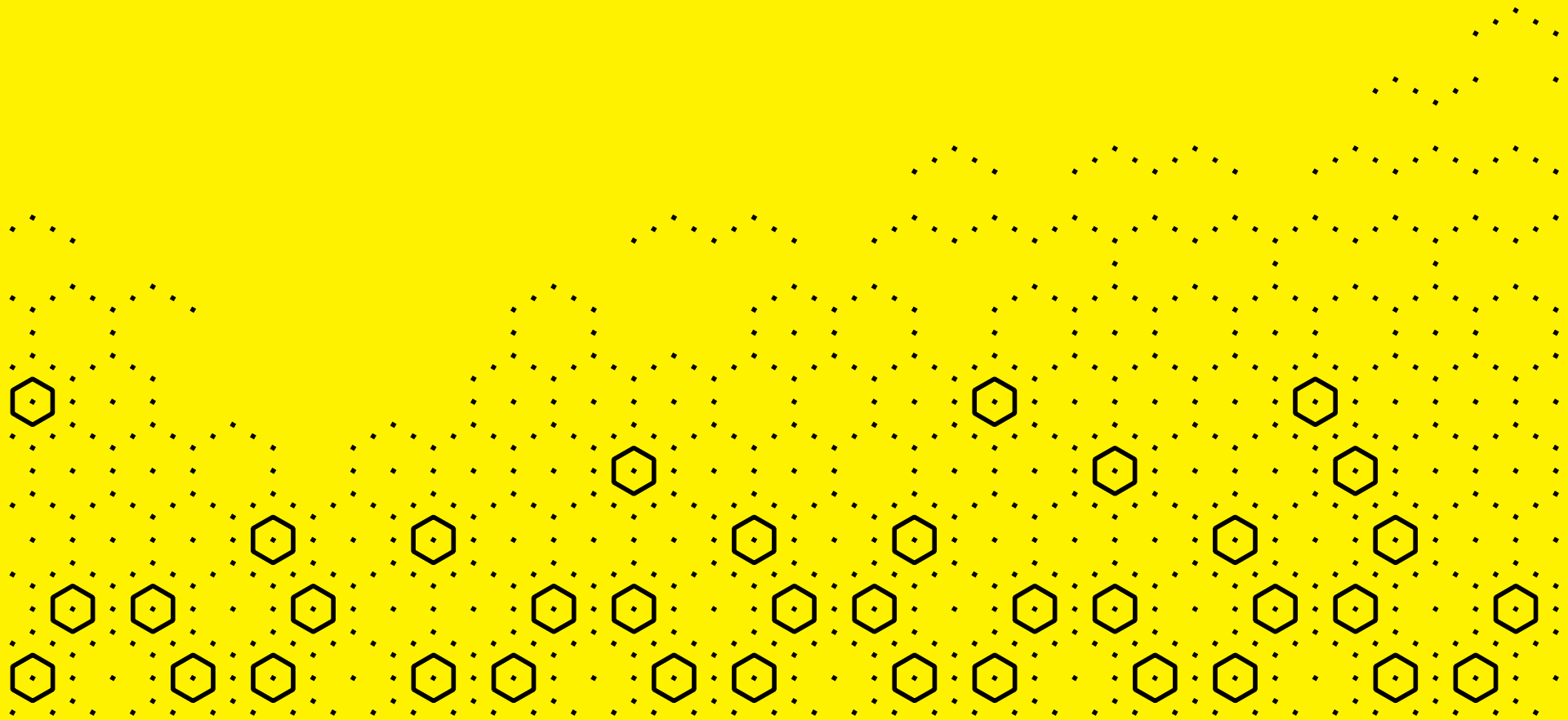
175 bpd reactor



700 bpd reactor

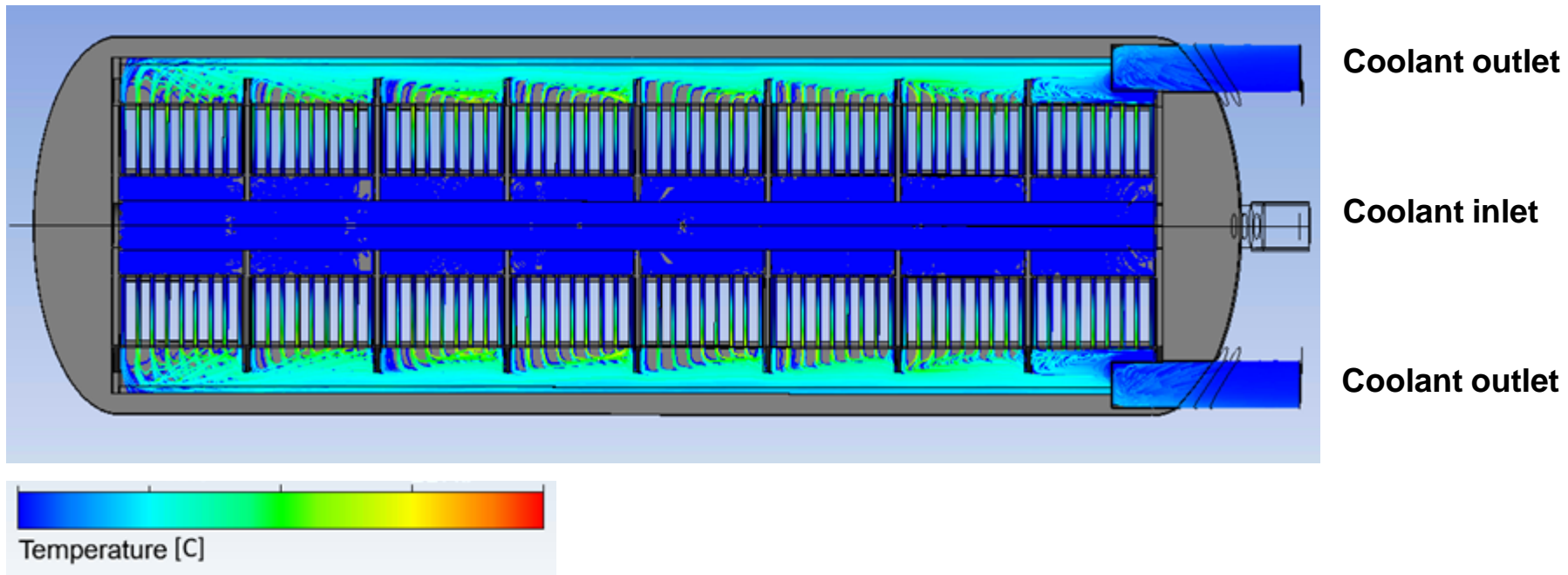
Vessel size = ~11' x 34' / 3.3 m x 10.3 m

Design validation through modeling



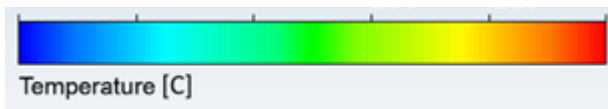
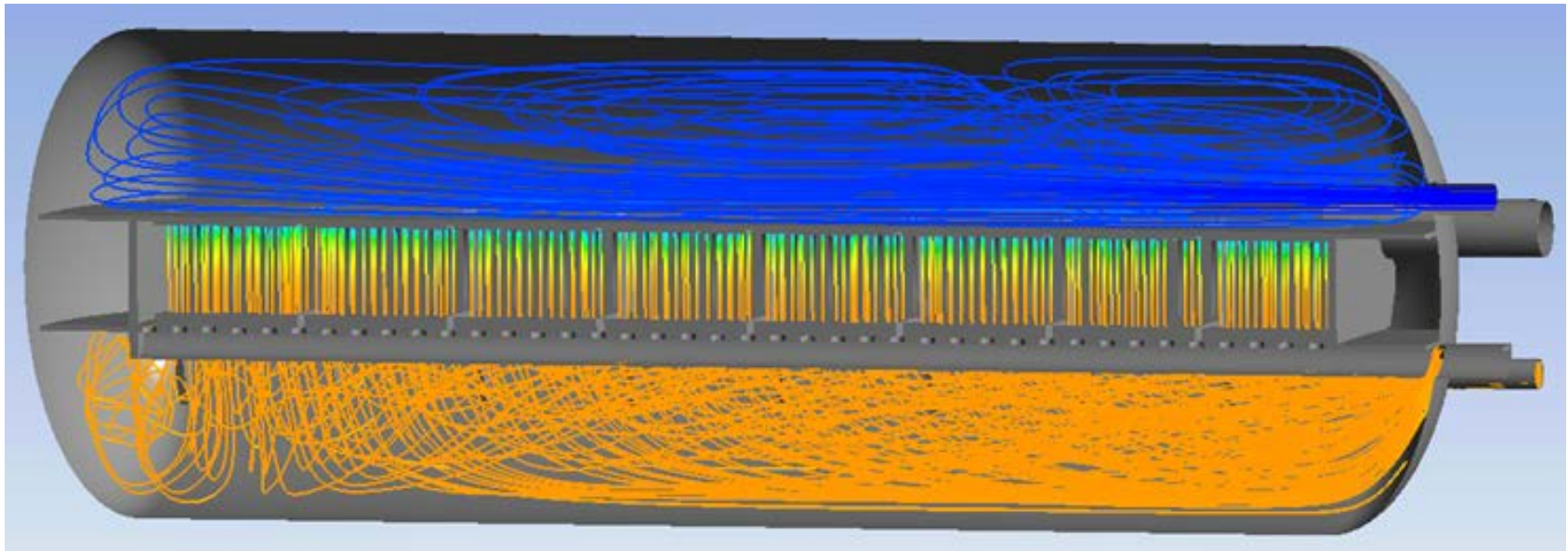
Coolant flow is uniform

Uniform coolant flow distribution for isothermal operation



Syngas and product flow is uniform

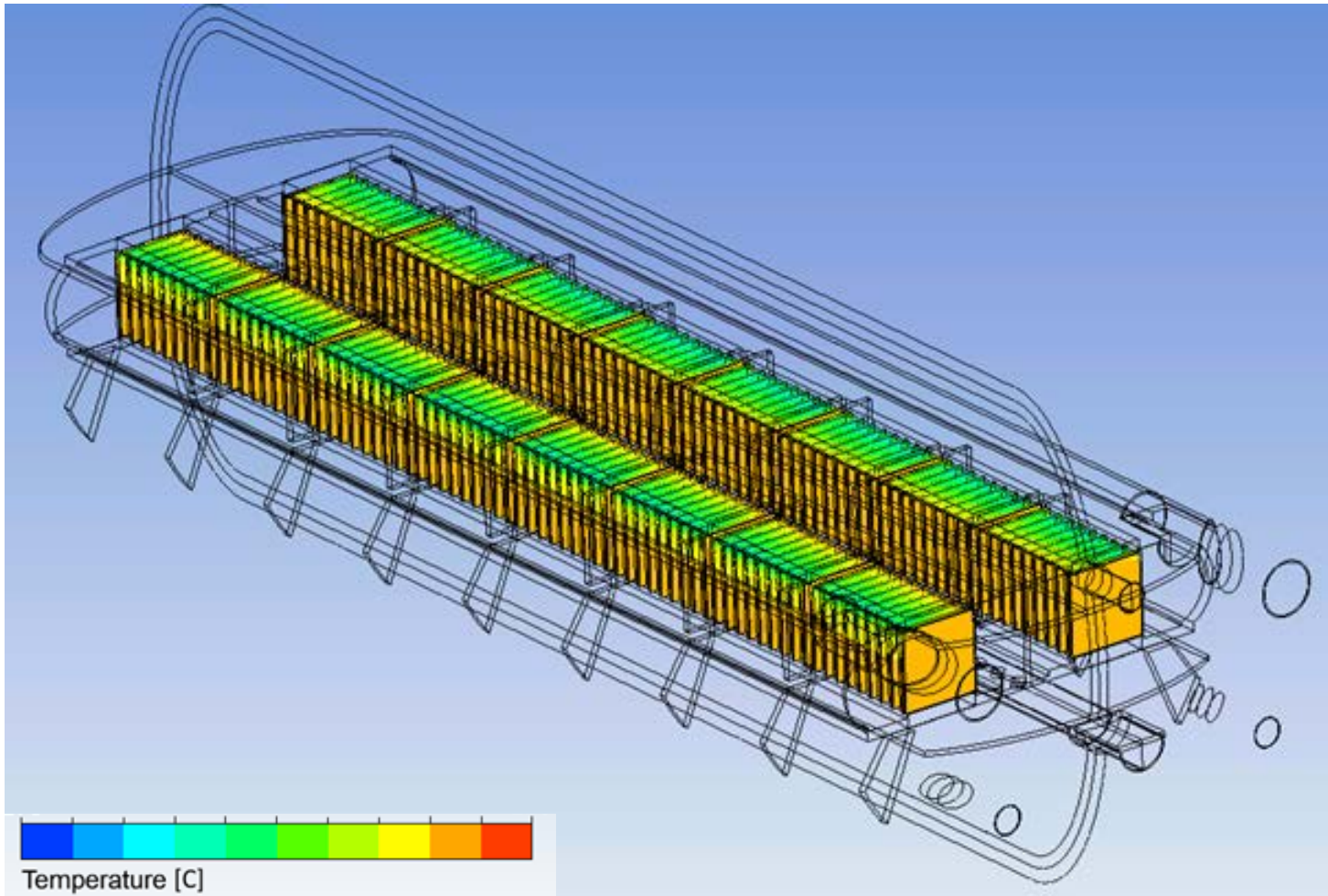
Excellent flow distribution under a wide range of conditions



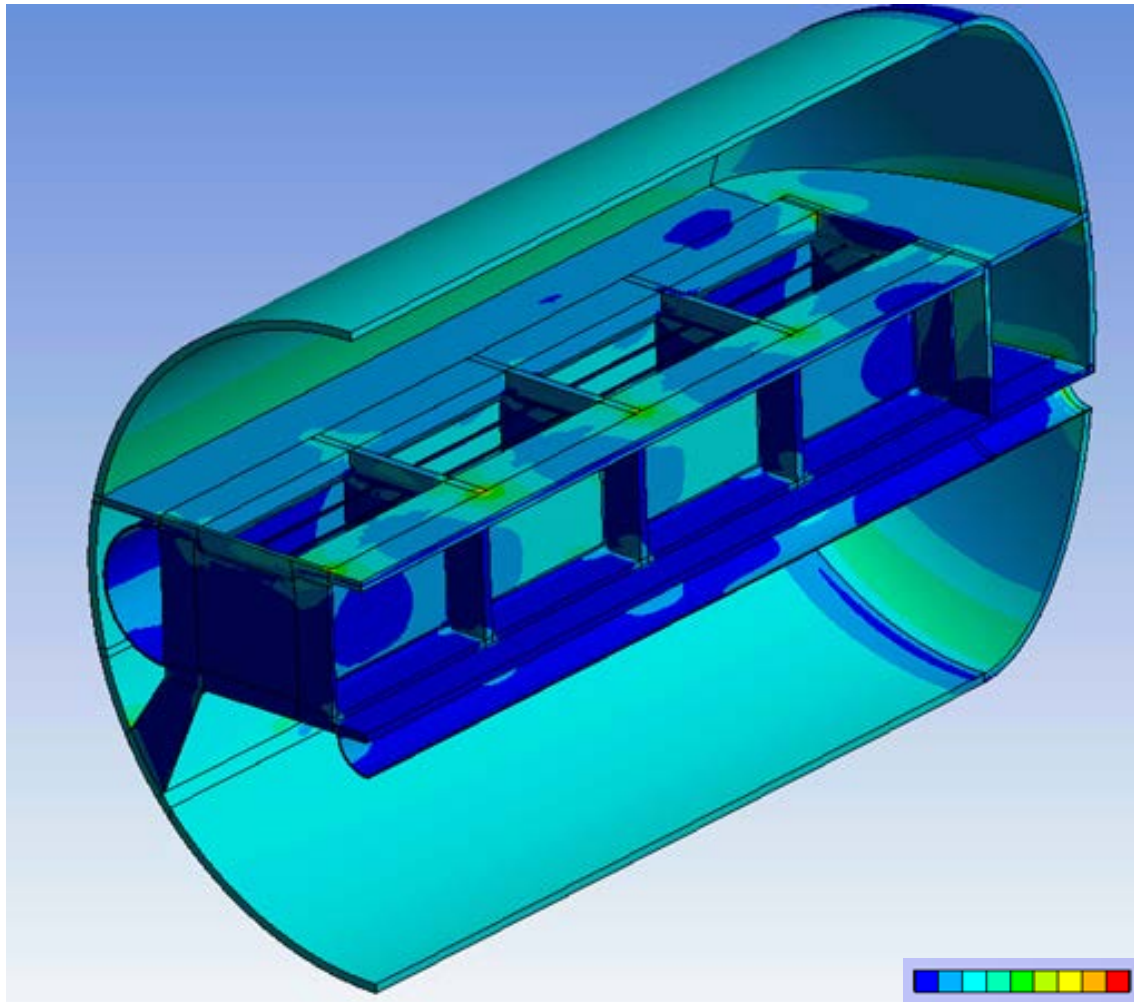
Example of CFD simulation analyzing process feed distribution through internal cores during operation

Core temperatures nearly isothermal

Uniform core temperature profile for 16 cores

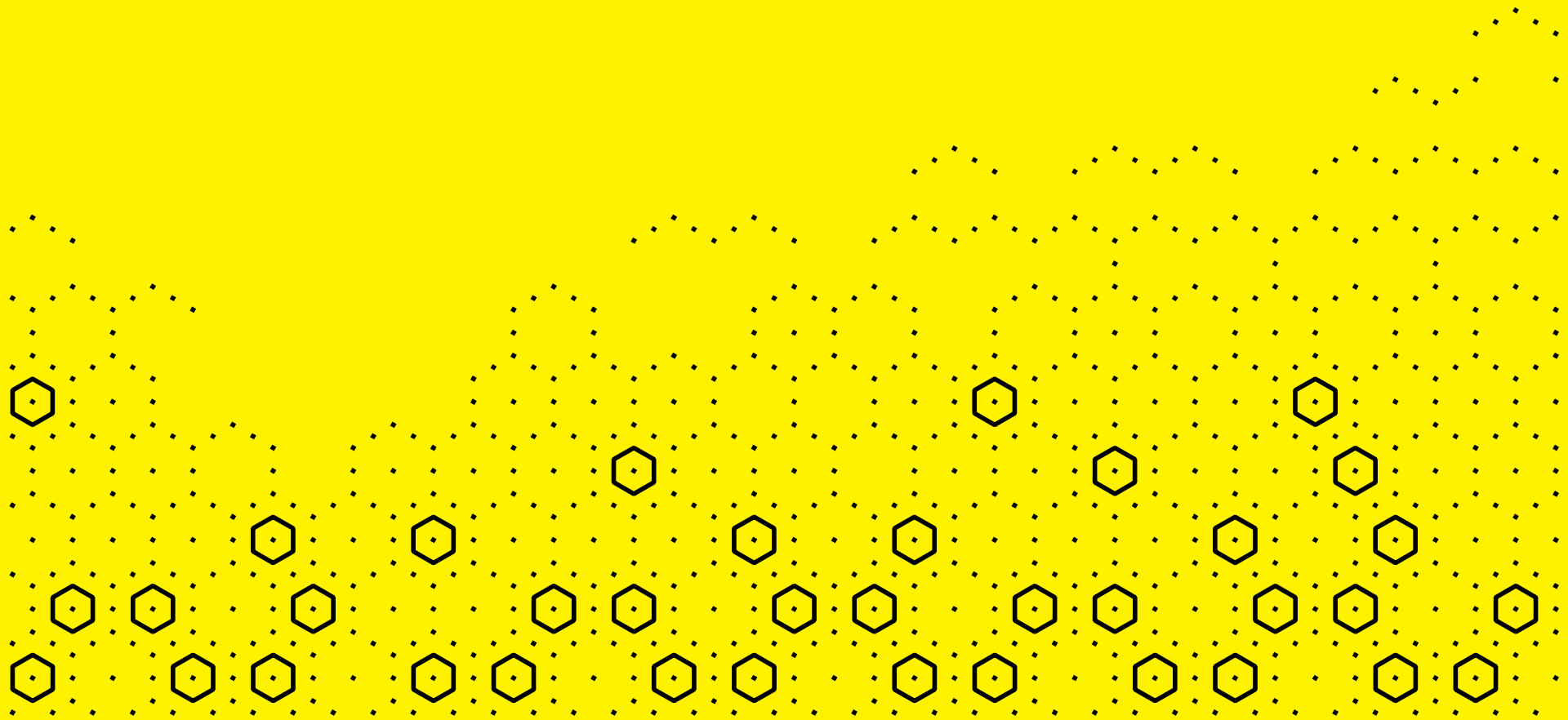


Low thermal mechanical stress for 20+ year field life



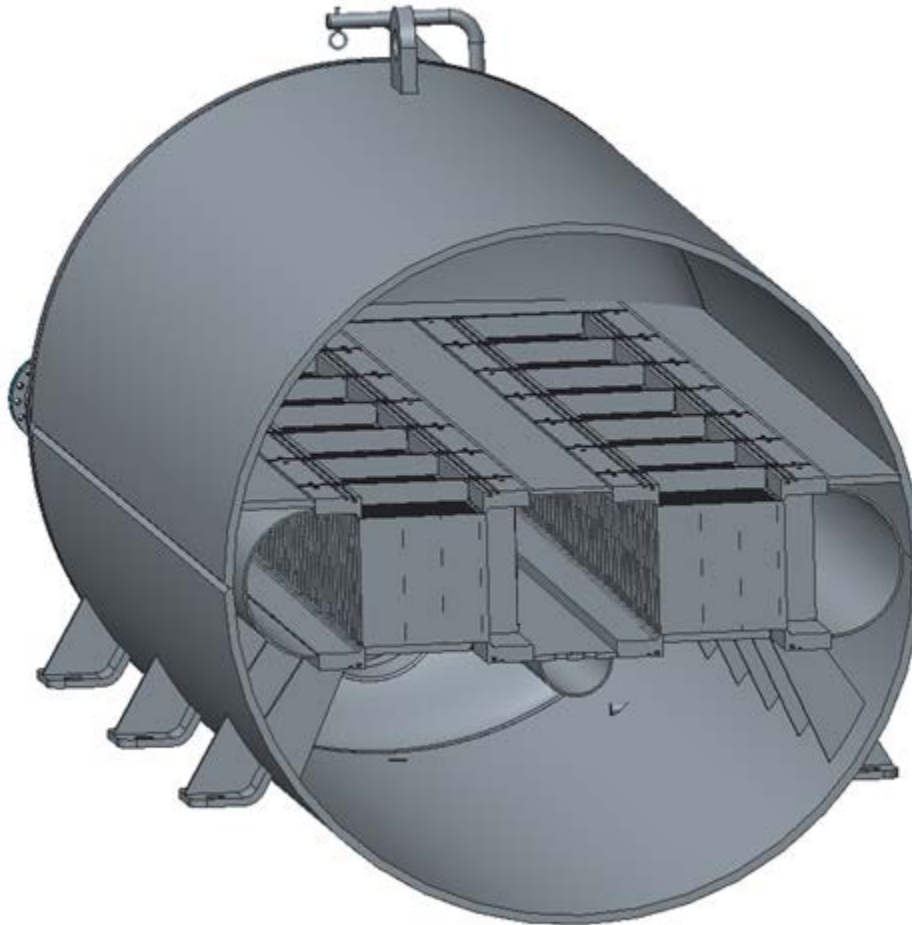
Stress (psi)

Operational enhancements



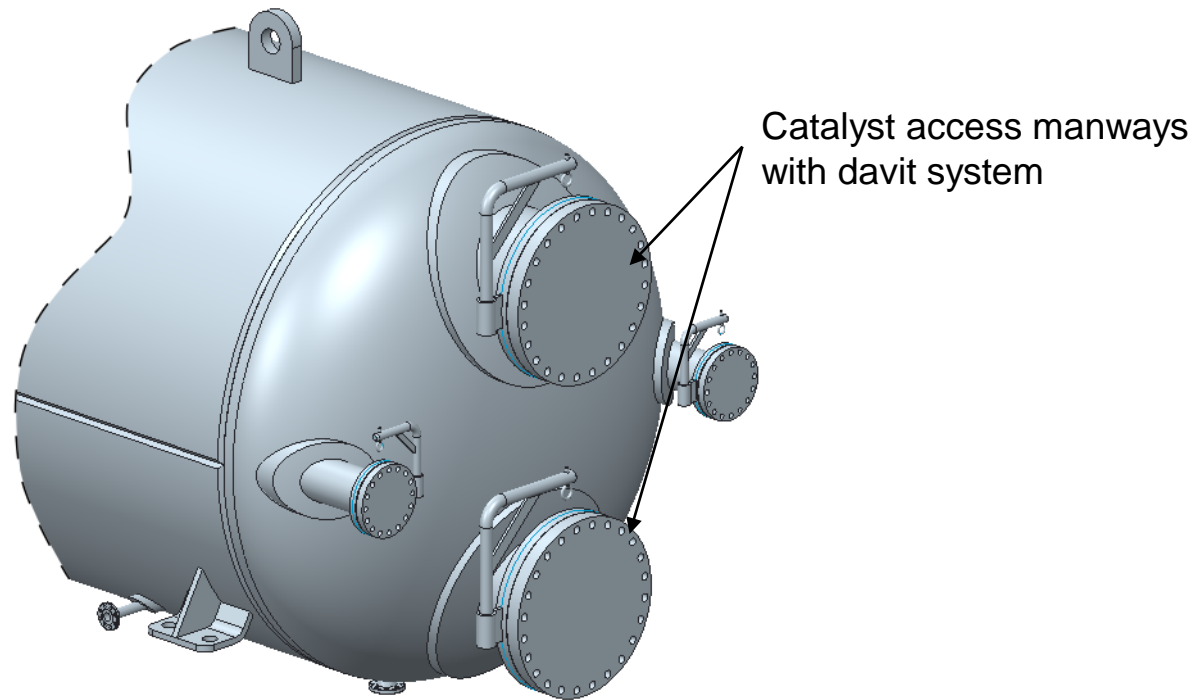
Enhanced access for catalyst change-out

Top and bottom of reactor cores accessible to people



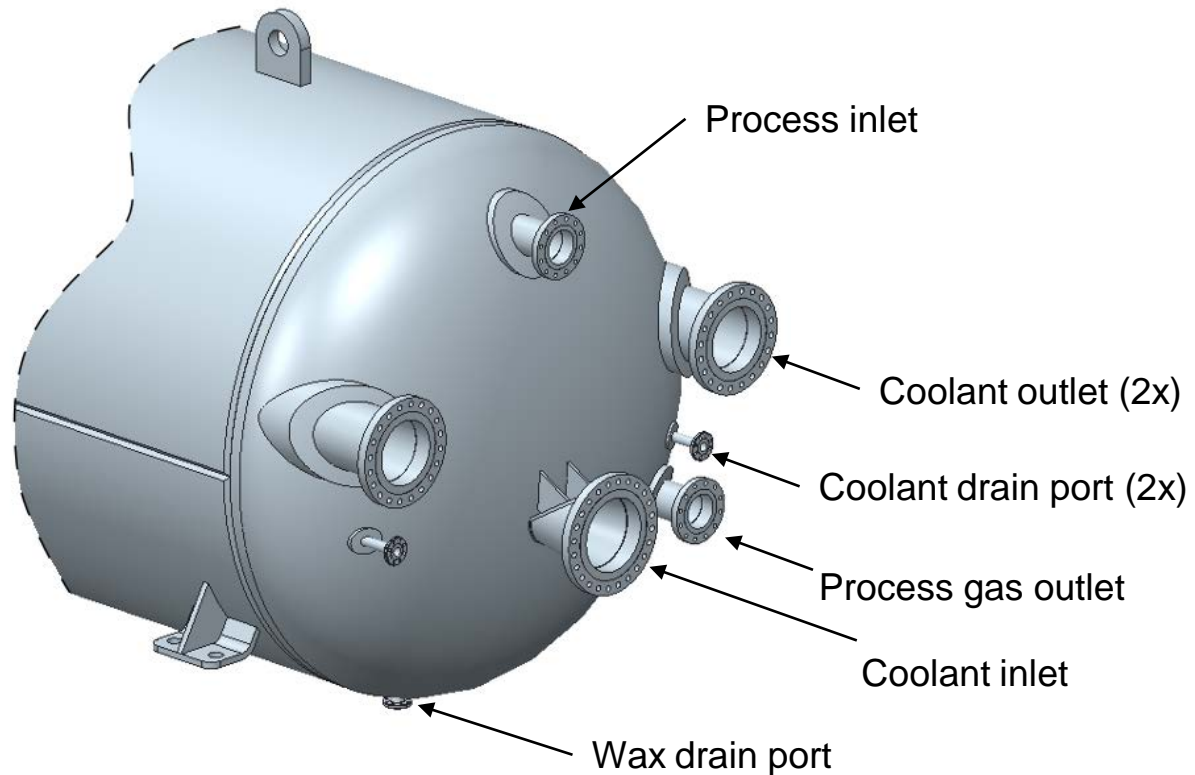
Enhanced access for catalyst change-out

Single manways access top and bottom of the cores

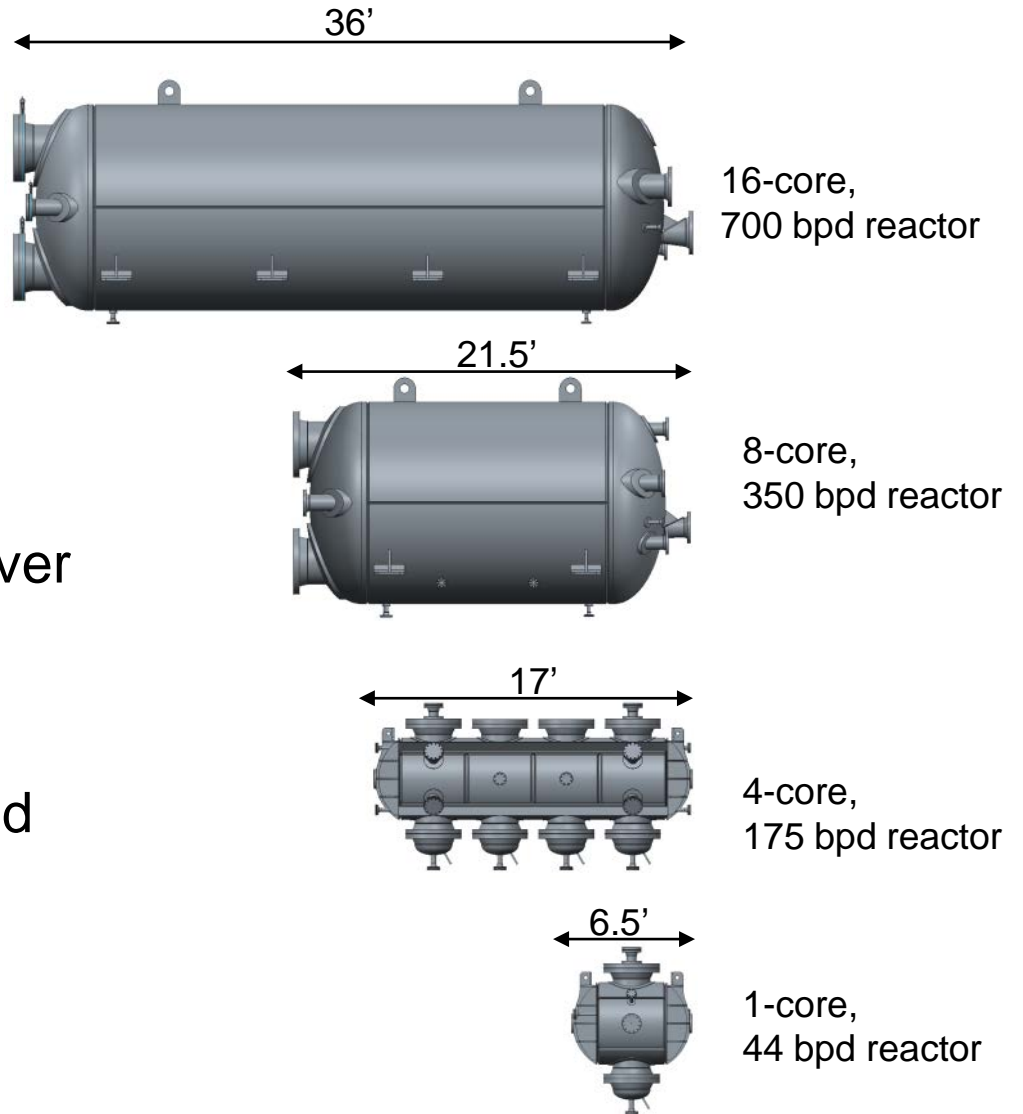


All inlets and outlets from a single end

Simplified piping layout

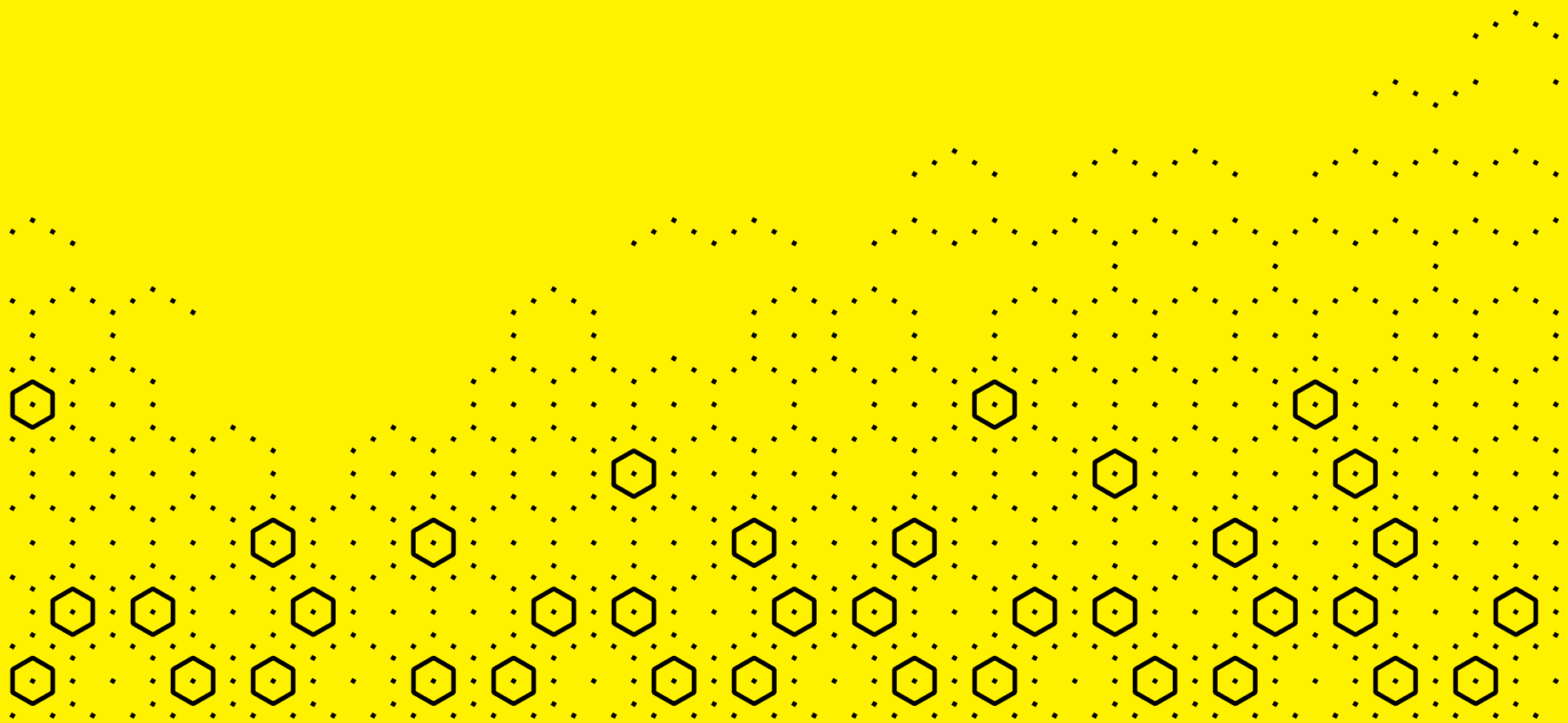


Reactor family



- Easy to scale design to cover a wide range of capacities and applications
- Focusing on use of 175 bpd and 700 bpd reactors for deployment in commercial plants

Validation

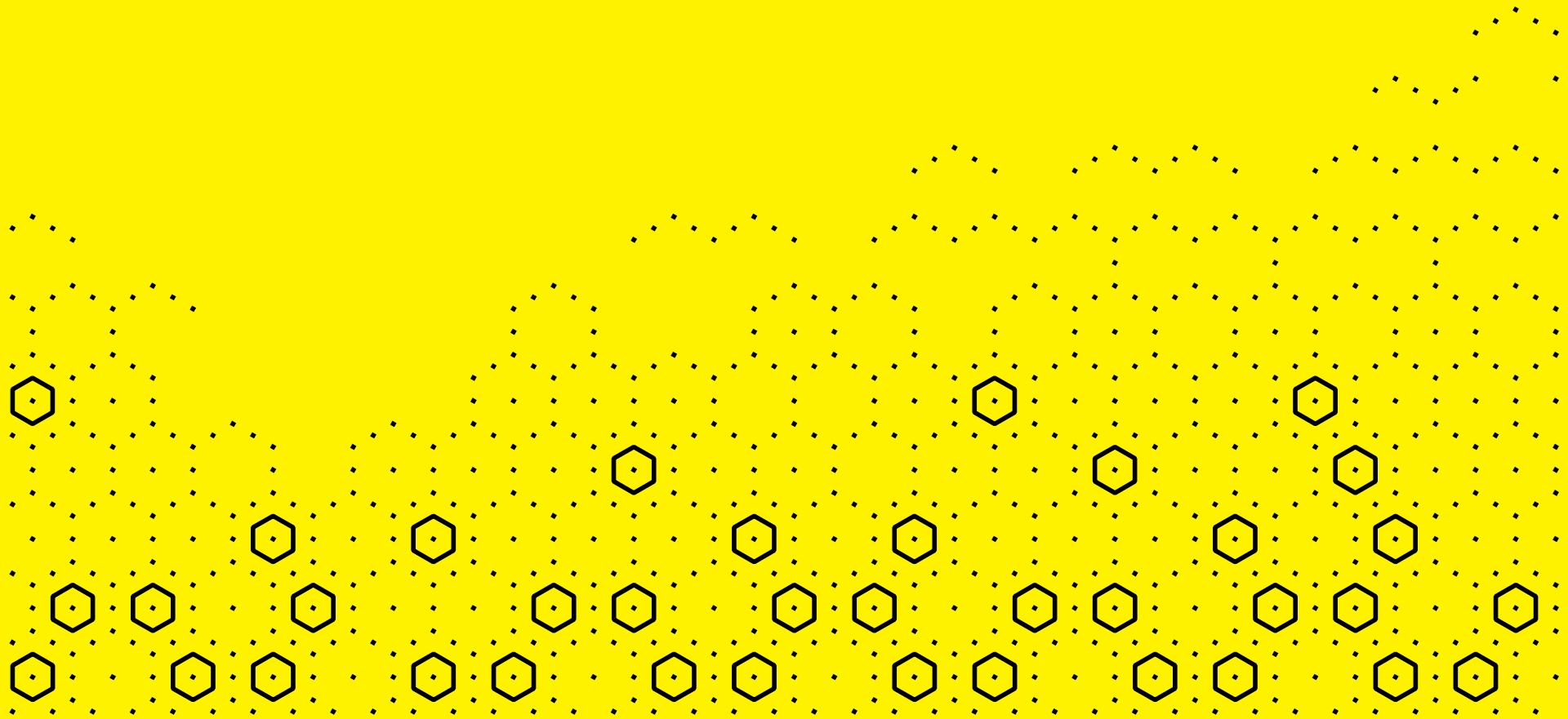


Third party validation

16 core reactor design

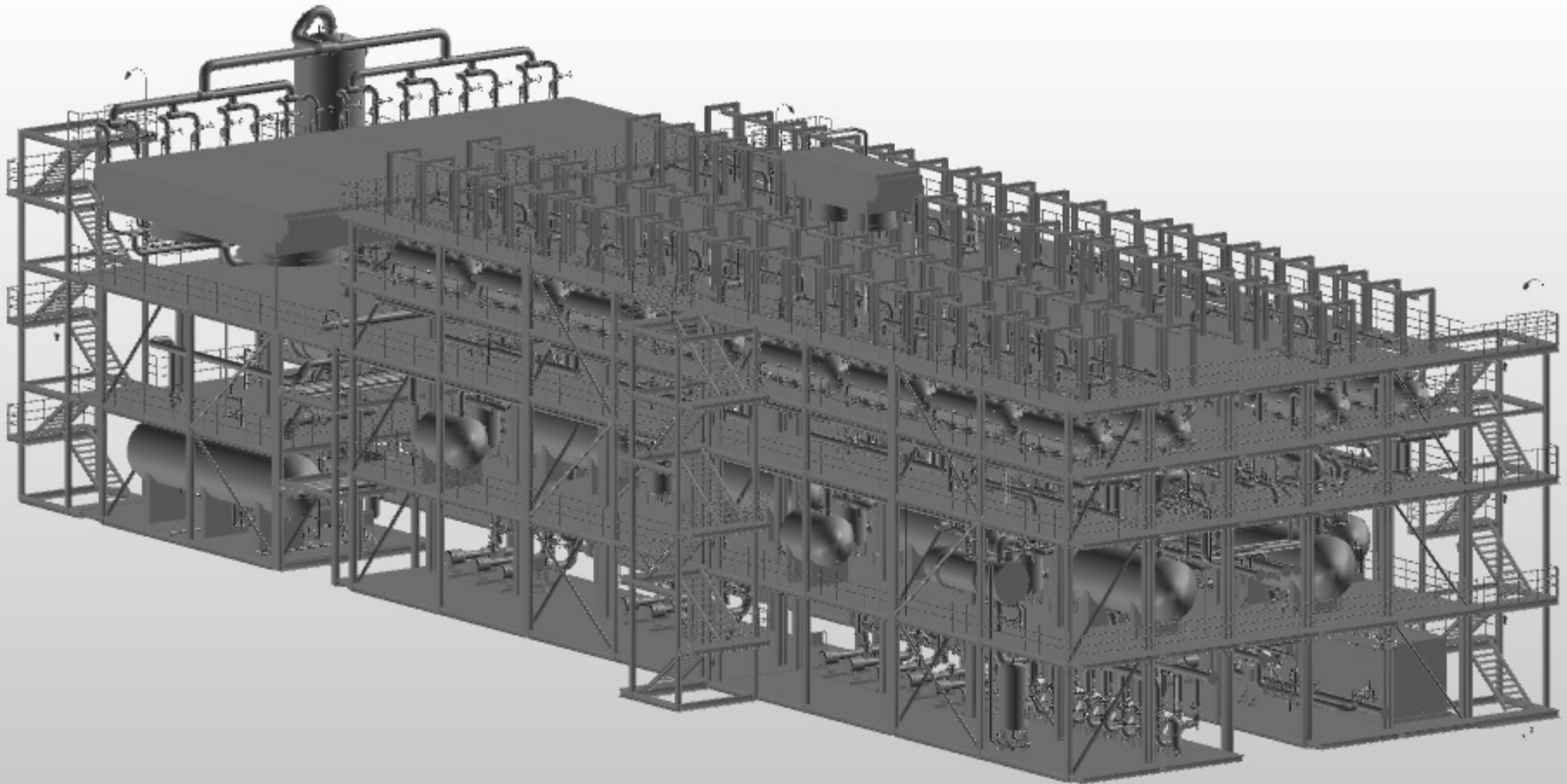
“Based on our review of the 16 core reactor design, and provided that the system is designed, operated, and maintained in accordance of Velocys’ stated recommendations and procedures, and good industry practice, we are of the opinion that the 16 core reactor is a sound method to provide syngas to the individual cores in a uniform manner, that the pressure vessel and associated cube structural support systems can maintain the integrity of the system ...Furthermore, the scale up from the 4 core design to the 16 core reactor design is reasonable.”

Impact on plant design



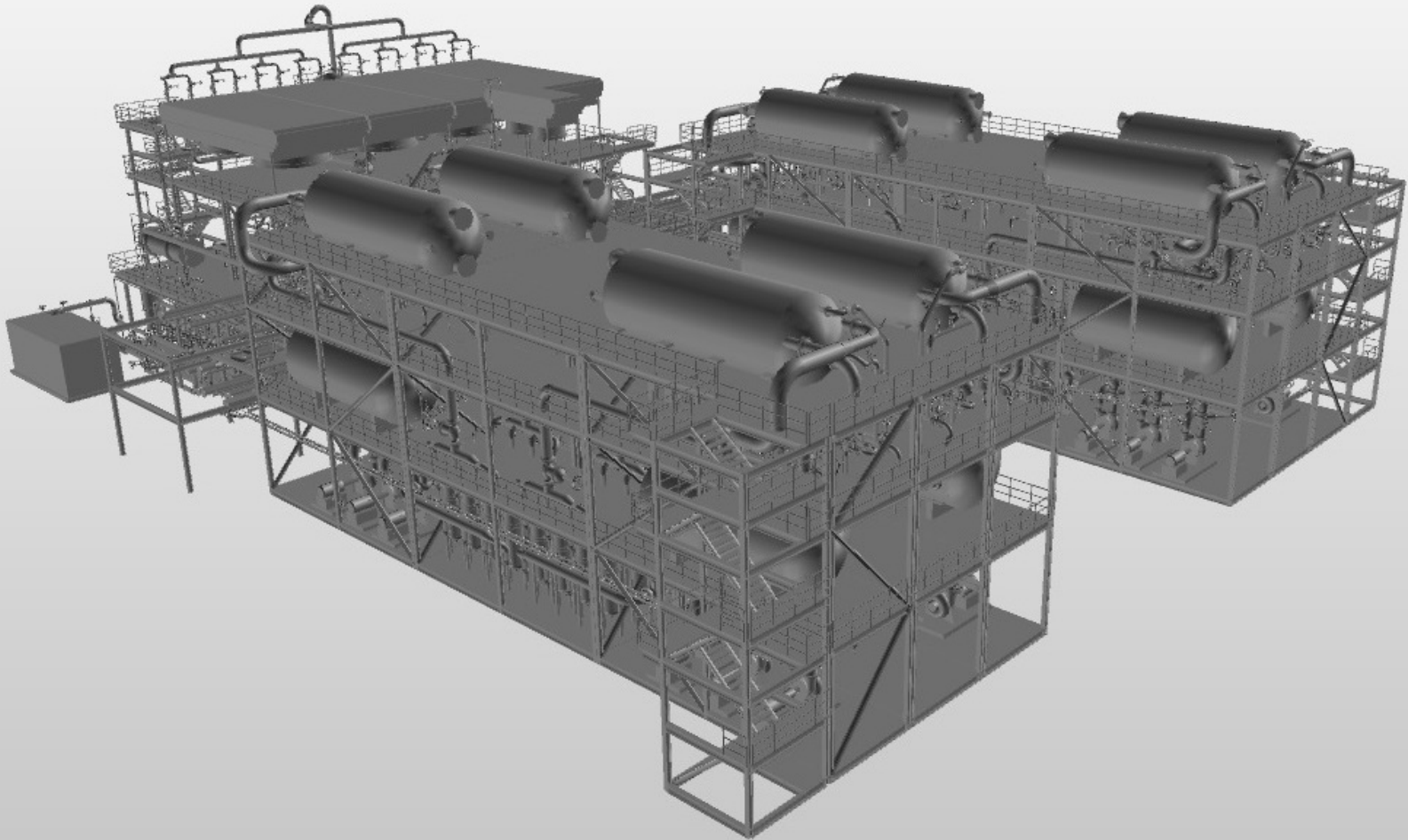
FT island modular plant design for a 5,000 bpd plant

Globally optimized plant, 32 x 175 bpd reactors

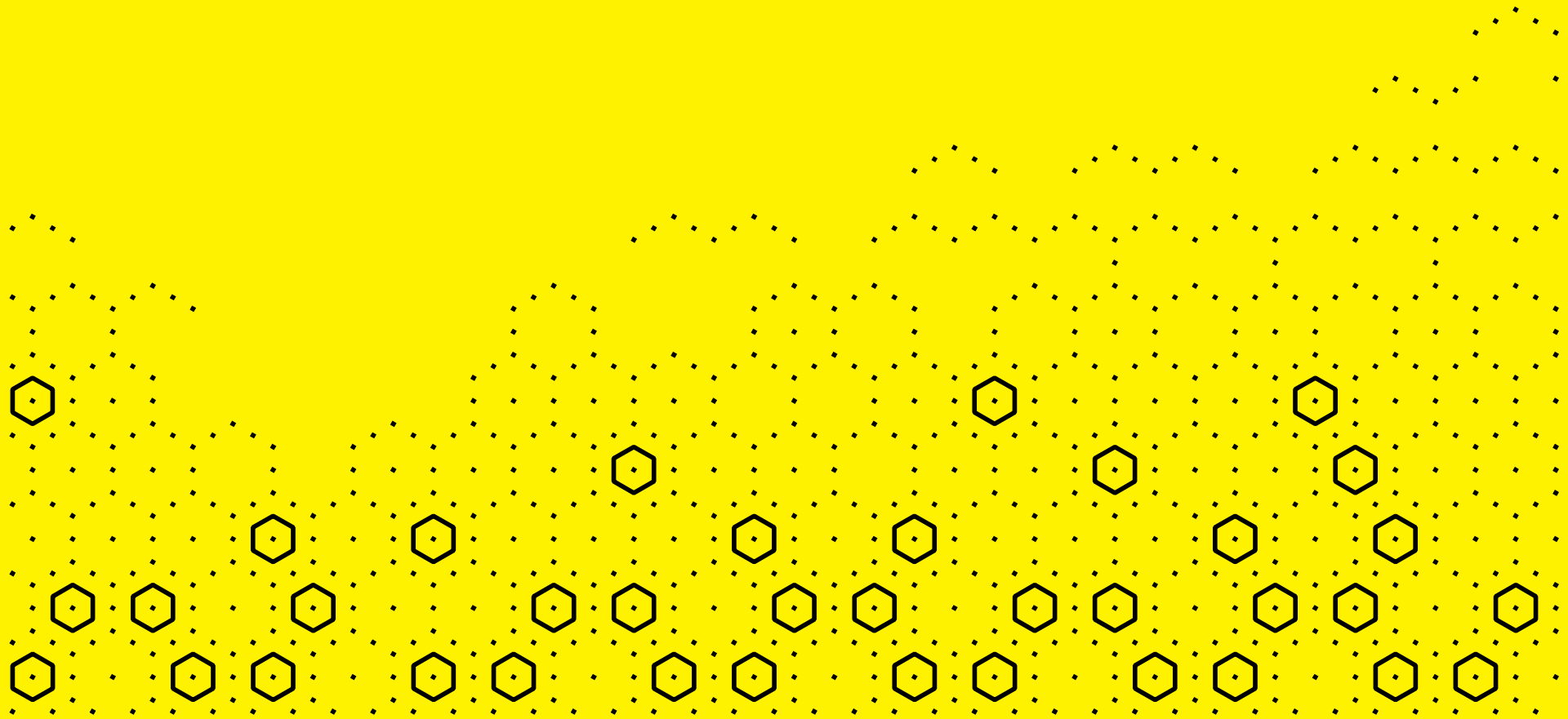


FT island modular plant design for a 5,000 bpd plant

Globally optimized plant, 8 x 700 bpd reactors, 0.8 acres footprint



ENVIA Energy plant progress



Commercial reference plant under construction

By Ventech and its subcontractors in Oklahoma City



**Some of the FT
modules**



ENVIA Energy's Oklahoma City GTL plant

All modules & all other major packaged equipment skids set in place on site



View of GTL plant from landfill site



Steam methane reformer



LFTL and HFTL columns



Landfill gas inlet



Syngas compression



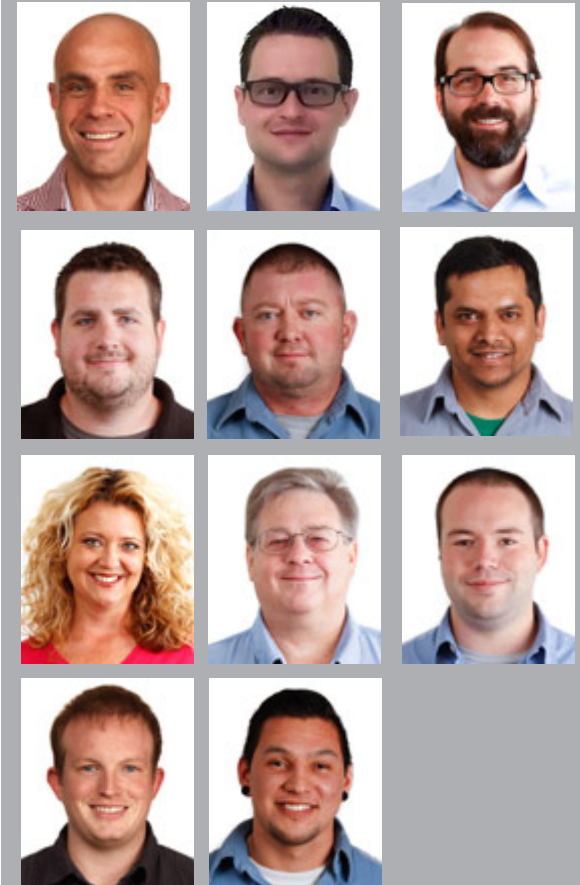
CO₂ wash column

ENVIA Energy – a greater influence for Velocys

Start-up and commissioning

- In Feb 2016 Velocys gained greater influence in commissioning, start-up & operations of the plant
- Since then, Velocys further engaged to provide an operability review, commissioning planning, operating manuals and training for the project
 - Velocys will be supporting the EPC contractor, Ventech, in leading the commissioning and start-up of the plant
- Secondment agreement signed for a team of experienced Velocys operators and engineers to be on-site serving under the ENVIA Plant Manager during commissioning and start-up
- **Velocys commissioning team deployed on-site**

Velocys' on-site commissioning, start-up and operations team



Thank you

Paul Schubert

Chief Operating Officer

paul.schubert@velocys.com

Plain City, Ohio office

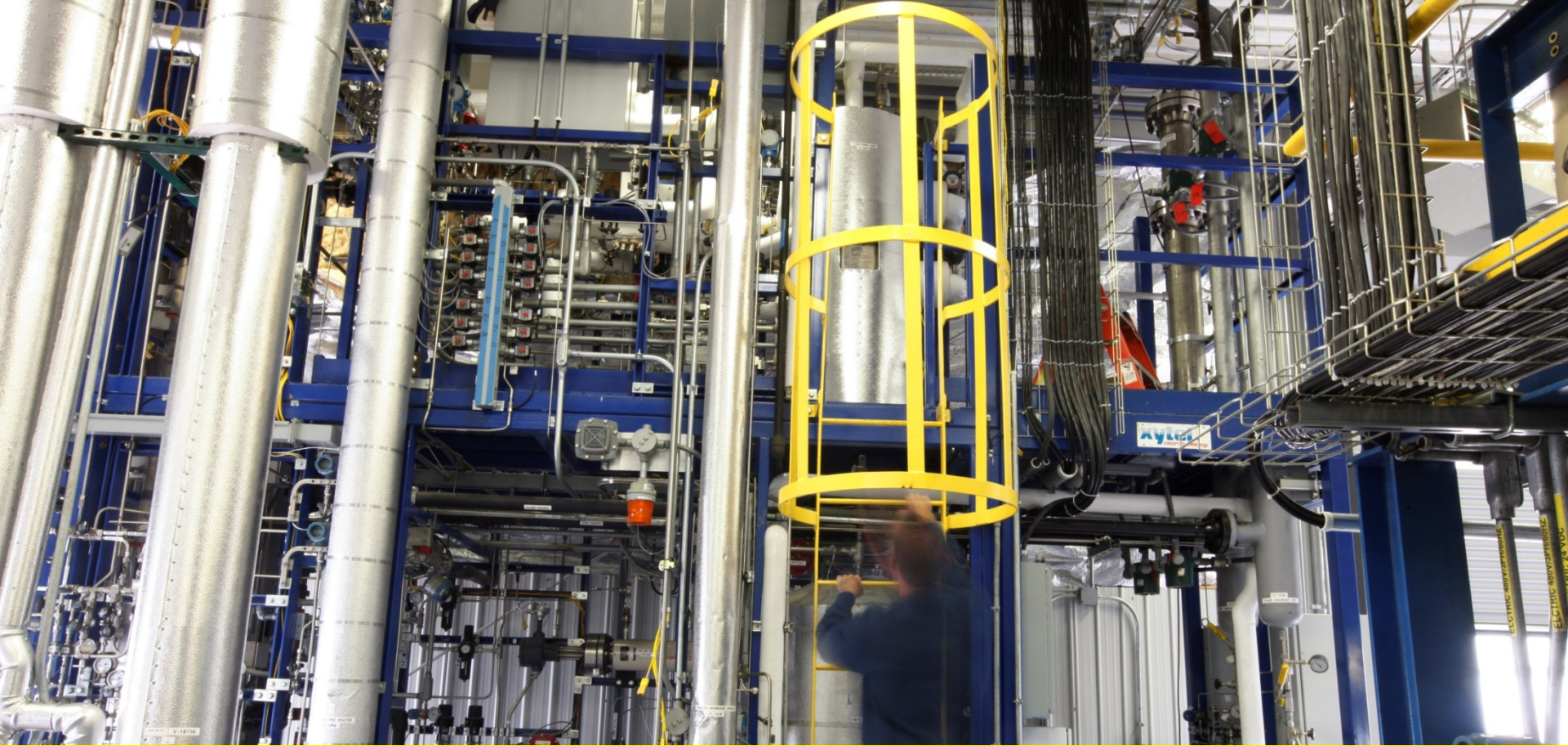
+1 614 733 3300

Houston office

+1 713 275 5840

www.velocys.com





Think Smaller

