SEGULA TECHNOLOGIES

GLOBAL ENGINEERING GROUP

FUEL CELL DEVELOPMENT @ SEGULA

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www.segulatechnologies.com

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Fuel Cell Development @ Segula - Content

- Segula at one Glance
- Fuel Cell Capabilities Overview
- Fuel Cell Testing Capabilities
- Fuel Cell High Voltage Development
- Fuel Cell Safety and FMEA
- Fuel Cell Software & Calibration Development
- Fuel Cell Simulation
- Fuel Cell Integration & Design
- Fuel Cell Prototype Build up
- Fuel Cell Certification
- Summary

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SEGULA AT ONE GLANCE

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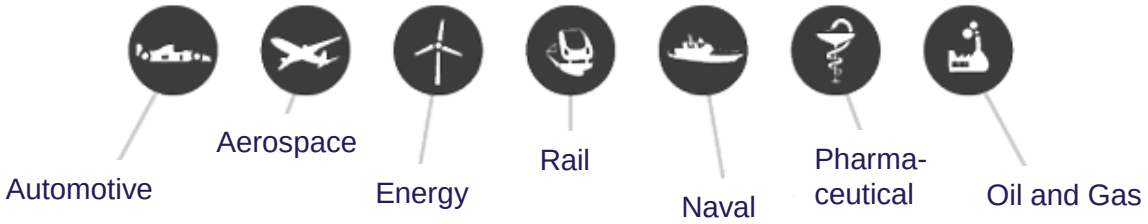
SEGULA TECHNOLOGIES WORLDWIDE

GLOBAL ENGINEERING GROUP

HELPING BOOST COMPETITIVENESS IN ALL MAJOR INDUSTRIAL SECTORS



10 000 EMPLOYEES

MORE THAN 30 COUNTRIES

MORE THAN 140 LOCATIONS

MORE THAN 300 CUSTOMERS

MORE THAN 200 R&I-PROJECTS EVERY YEAR

Our values

RESPONSIVENESS PROXIMITY AMBITION INNOVATION

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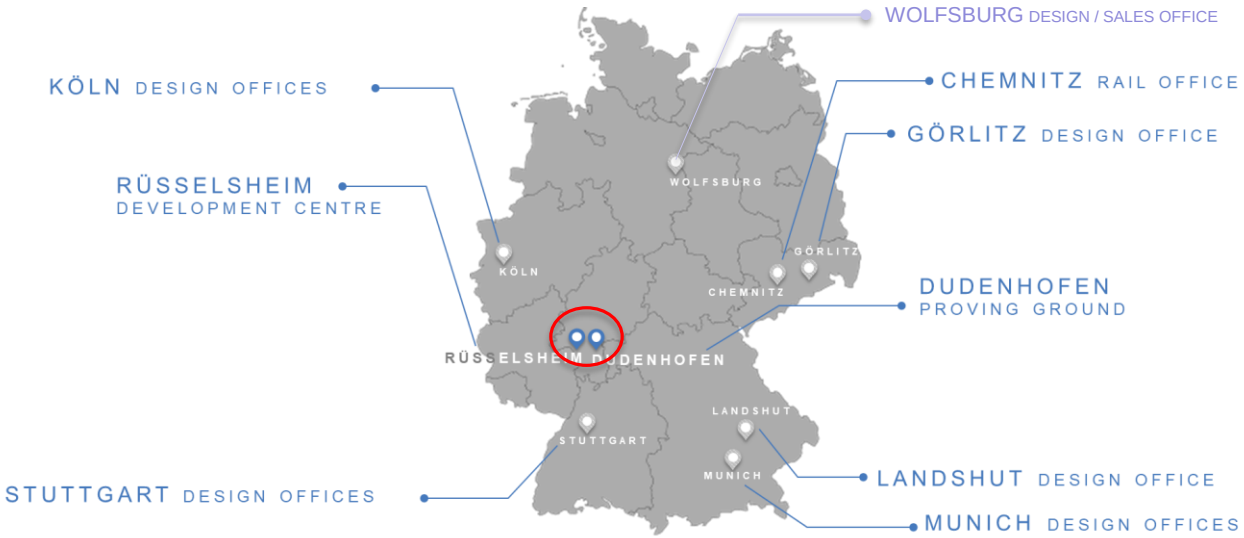
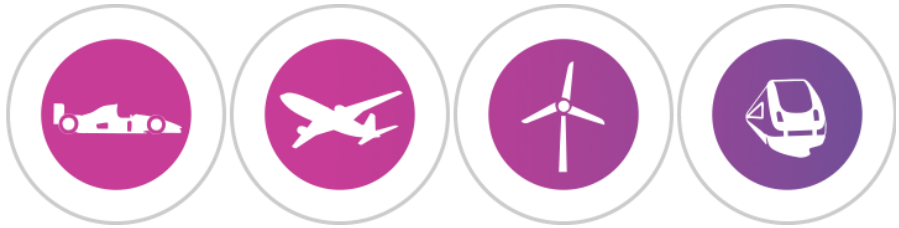
SEGULA Technologies in Germany

1000
EMPLOYEES

SEGULA Technologies Germany
is part of the Global SEGULA Network





AUTOMOTIVE AEROSPACE ENERGY RAIL

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RUESSELSHEIM SITE

INSIGHTS INTO THE ENGINEERING CAMPUS

NVH (Noise, Vibration, Harshness) Tests

NVH (Noise, Vibration, Harshness) Tests

Antenna Lab

EMC (Electromagnetic Compatibility) Tests

Crash Tests

Sled test facility

Dummy Lab

Prototyping, small series, logistics

Whole vehicle structure test bench

Kinematics & Compliance test bench

Soak chambers

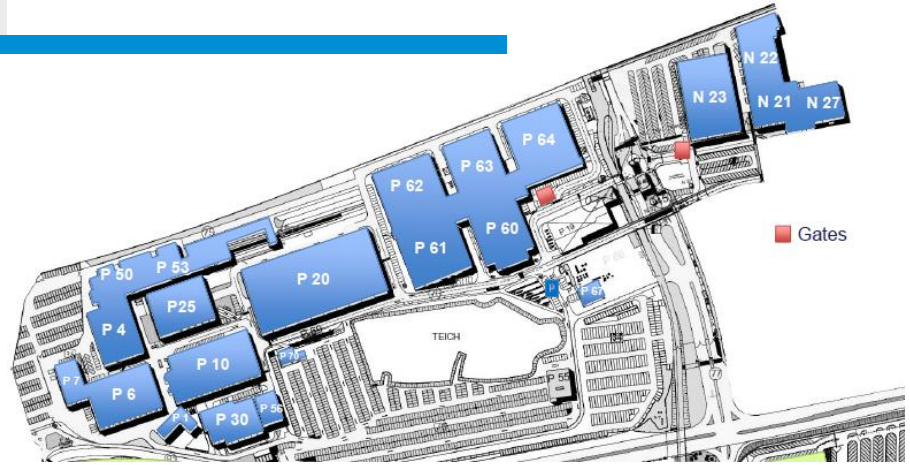
Dyno climate test cell

Shed test

PEMS (Portable emissions measurement system)

Rental Workshops

Main building



HIGHLIGHTS

>700
Employees for complete vehicle development, powertrain & testing

54
Engine test benches, PWT (Powertrain), and fuel cell test benches

8
Crash & vehicle safety test facilities, including sled test facility

14
FWD/AWD (Front-and All-wheel drive) chassis dynamometers CO_2 /range calibration + certification of which 5 special test cells - hot/cold/altitude/sun

5
Vehicle test halls
+1 EMC component hall
+1 EMC test bench

6
NVH test benches

7500 m²
Prototyping, small series & logistics

PLUS
Rental workshops and offices

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RODGAU-DUDENHOFEN SITE

INSIGHTS INTO THE TESTCENTER

High-speed circular track

Mountain track, circuit

Handling circuit, waterable

Long straight

Skid-Pads

Comfort & noise

Pass-by noise

Airbag Misuse

Climate chambers

Endurance test

Mud bath

Salt & water bath

Performance Area, irrigable

Grit line

Dust tunnel

Calibration path

Torture track

Traction roller

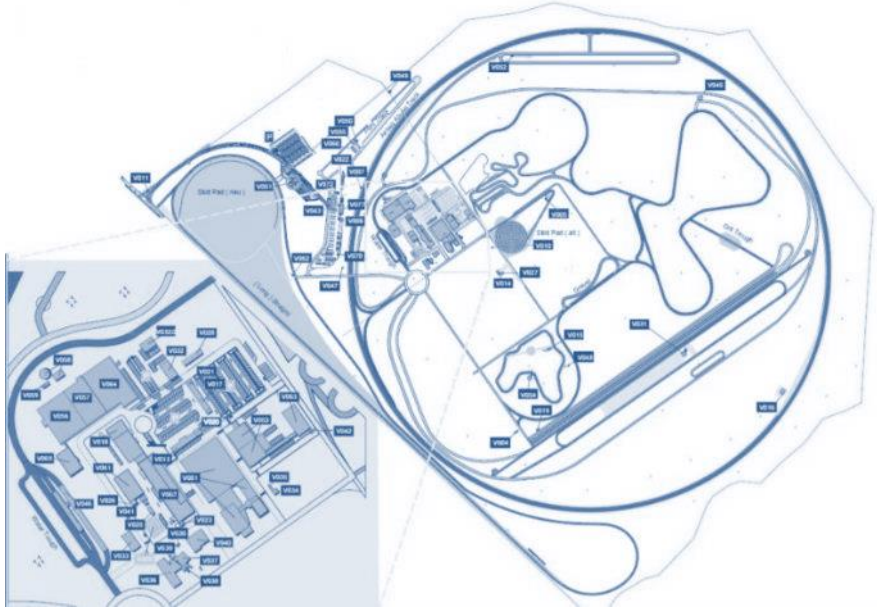
Emission laboratory

Office and conference rooms

Standard & special fuels
Car wash stations

Set up workshops

ADAS



HIGHLIGHTS

> 120 Engineers & Test Drivers	**80 km** Test track	**3 km** Long straight with skid pad
23 Different test tracks for the entire range of testing	**4,8 km** High-speed circular railroad	**PLUS** Various test benches (roller, PHE, and exhaust roller test benches, soak areas)

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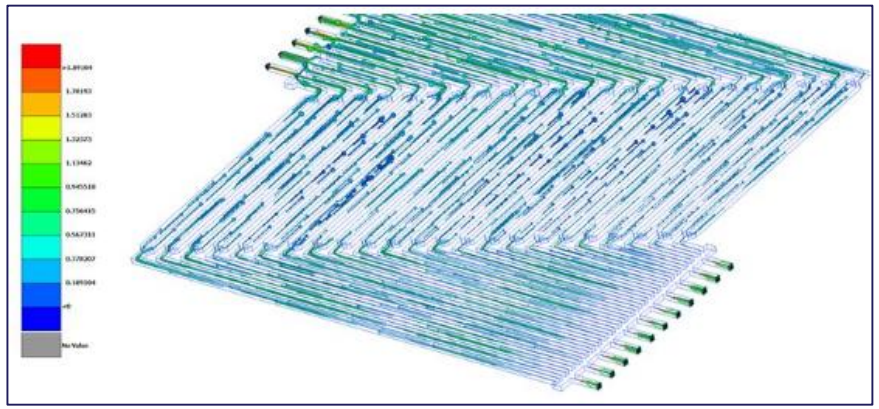
Fuel Cell engineering

Segula Fuel Cell Team

- Cross-functional team of experts with a long history in Fuel Cell development (former GM Fuel Cell development center in Mainz Kastel)
  - Simulation
  - Engineering
  - Testing
- Advanced development centers in France and Germany



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Fuel Cell Market

Fuel Cell Propulsion Application

- High average power demands (e.g. commercial vehicles and trains)
- Short charging time requirements (e.g. distribution traffic)
- Continuous operation demand (e.g. pallet transporter)
- Payload critical applications (e.g. commercial vehicles)
- Weight critical applications (e.g. light plane / drone)

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SEGULA TECHNOLOGIES

FUEL CELL CAPABILITIES OVERVIEW

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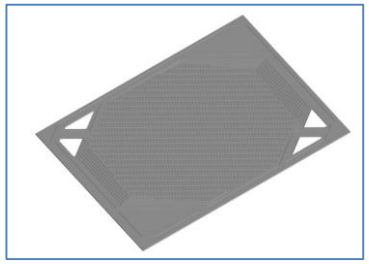
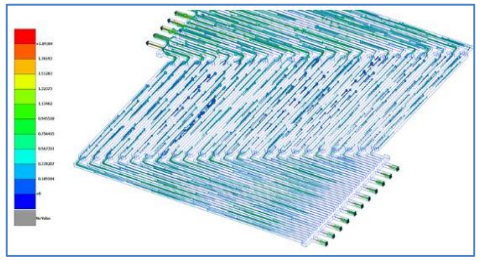
Fuel Cell Engineering & Testing

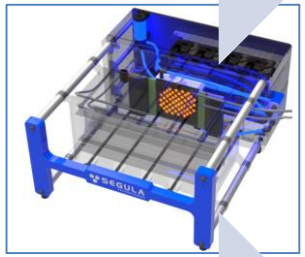
OVERVIEW

Fuel Cell Single Cell

Design → Development & Simulation → Testing

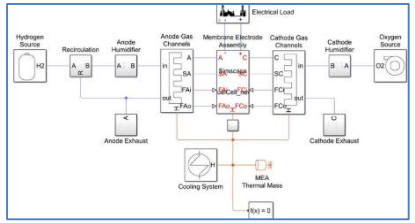


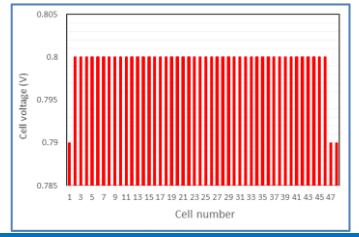


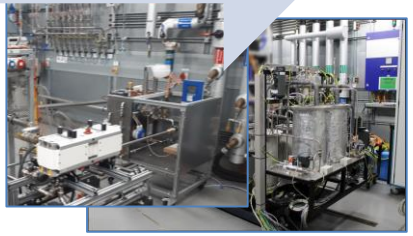


Fuel Cell Stack

Design → Development&Simulation → Testing







KEY COMPETENCES

- Turn-key Fuel Cell vehicle development from scratch to certification
- Turn-key fuel cell system development from scratch to certification

SIGNIFICANT REFERENCES

European OEM – Series LCV - FCEV – Controls & Testing & Release &FMEA
Clean Logistics Fuel Cell Truck – Thermal Management & Operating strategy
German Tier 1 – Turn Key Fuel Cell System development

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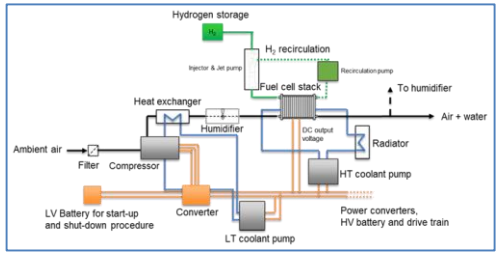
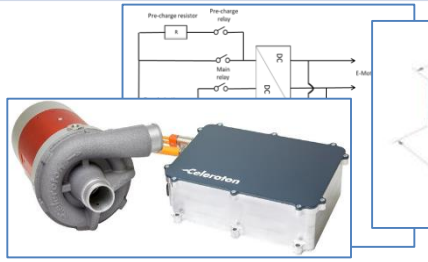
Fuel Cell Engineering & Testing

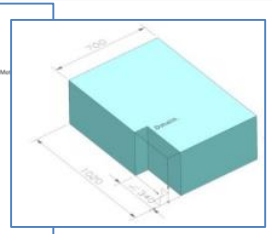
OVERVIEW

Fuel Cell System

FC-System Concept → Development & Integration → Testing, Valdiation & Calibration, Certification

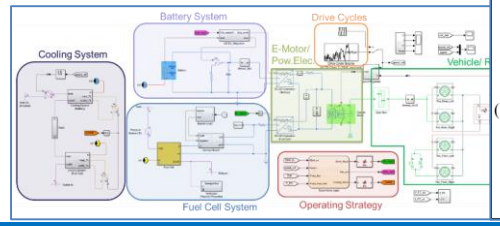


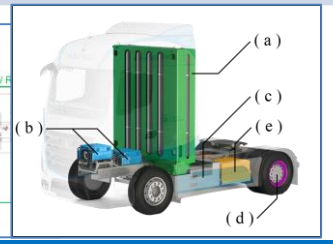


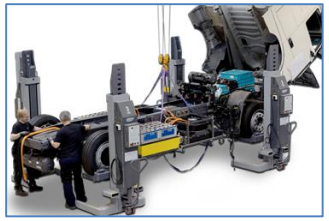


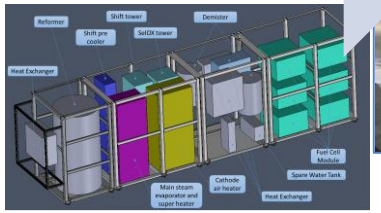
Fuel Cell application

Application concept → Development & Integration → Testing, Valdiation & Calibration, Certification









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Fuel Cell Development

OVERVIEW

MECHANICAL INTEGRATION AND SPECIFICATION

- Tools and Technique
- **System and vehicle design & package**

SIMULATION

- **Stack, system and vehicle simulation** – validated models in Simscape
- Model In the Loop environment capability – coupling with control unit software

FUEL CELL SOFTWARE & CALIBRATION DEVELOPMENT

- Matlab Simulink based
- **Fuel cell system control** (system and vehicle)

TESTING

- Stack testing
- **System (up to 250 kW) and vehicle testing**

FUEL CELL SAFETY AND FUNCTIONAL SAFETY

- **Compatibility to existing standards**
- Crash and hydrogen safety

PROTOTYPE BUILD UP

- **Fuel Cell System & vehicle build up capacity**
- General assembly for up to 400 vehicles per year and system assembly

CERTIFICATION

- Based on relevant specifications
- **Cooperation with certification provider**

Key Competences

- Specification, design and packaging of BoP components
- Simulation, software and testing capability from stack to vehicle
- Turn Key support up to series

Significant References

System supplier: Fuel Cell system development & testing (100 kW peak)
System supplier: Fuel Cell system small series build up
European OEM – Flying engineers for captured test-fleet

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Fuel Cell Engineering & Testing

TOOLS & TECHNIQUE

Development process

Jira

- From requirements to validation
- A-Spice
- Interface management

Design

Packaging
E&E
HV components

SIEMENS NX
CATIA
SOLIDWORKS

Software development

MATLAB SIMULINK
GitHub
Arttest

- Simulink toolchain incl. requirements
- Software testing
- FCCU & FCPS definition

Simulation

Simulink,
Simscape,
3D CFD

MATLAB SIMULINK
GAMMA TECHNOLOGIES
ABAQUS
ALTAIR

Safety & FMEA

ISO 26262
PLATO SOLUTIONS BY SOFTWARE

HARA, Item definition
Certified Safety Manager

Testing&Calibration

ETAS
VECTOR

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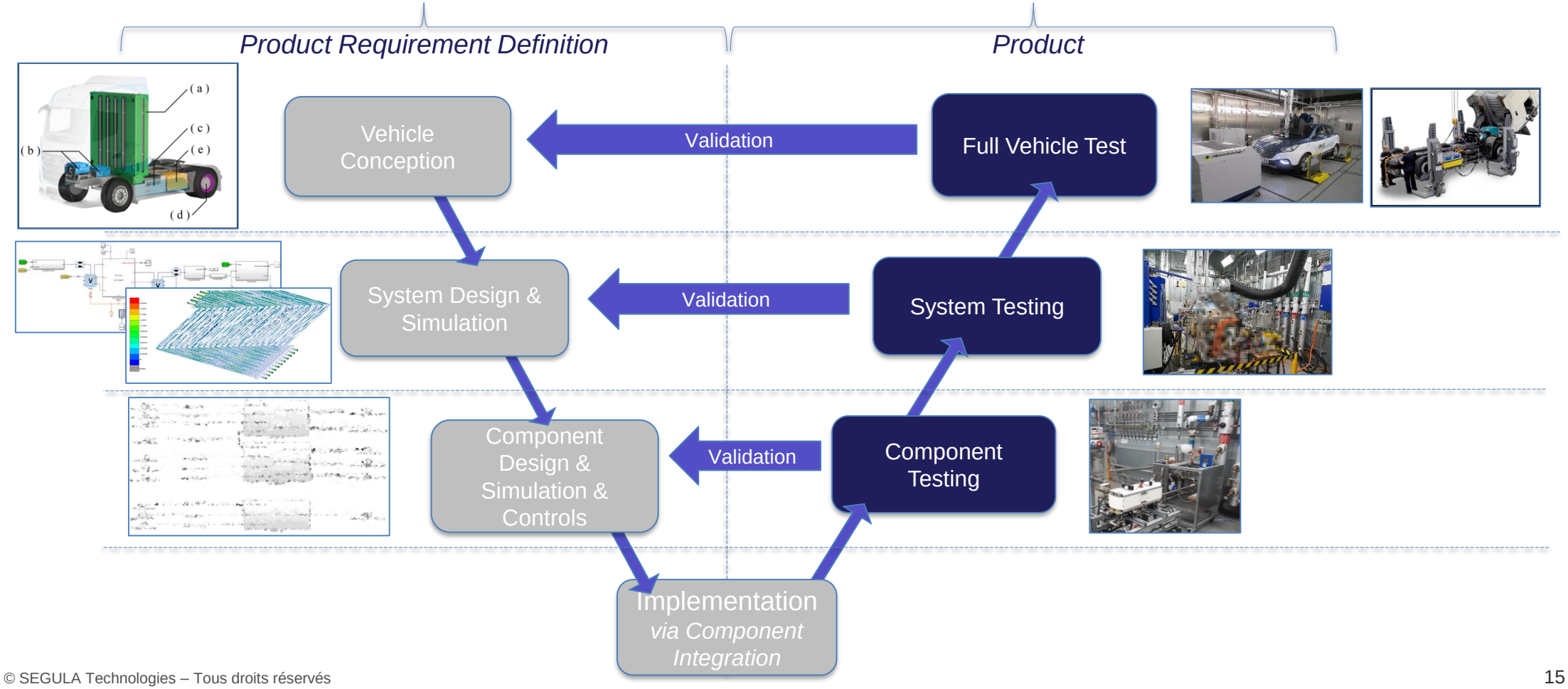
Fuel Cell Engineering & Testing

Fuel Cell System & Vehicle Development Process



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