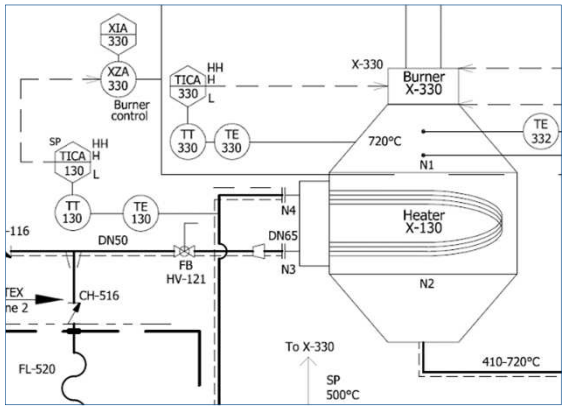


Array Industries

Your Turn key R&D partner!

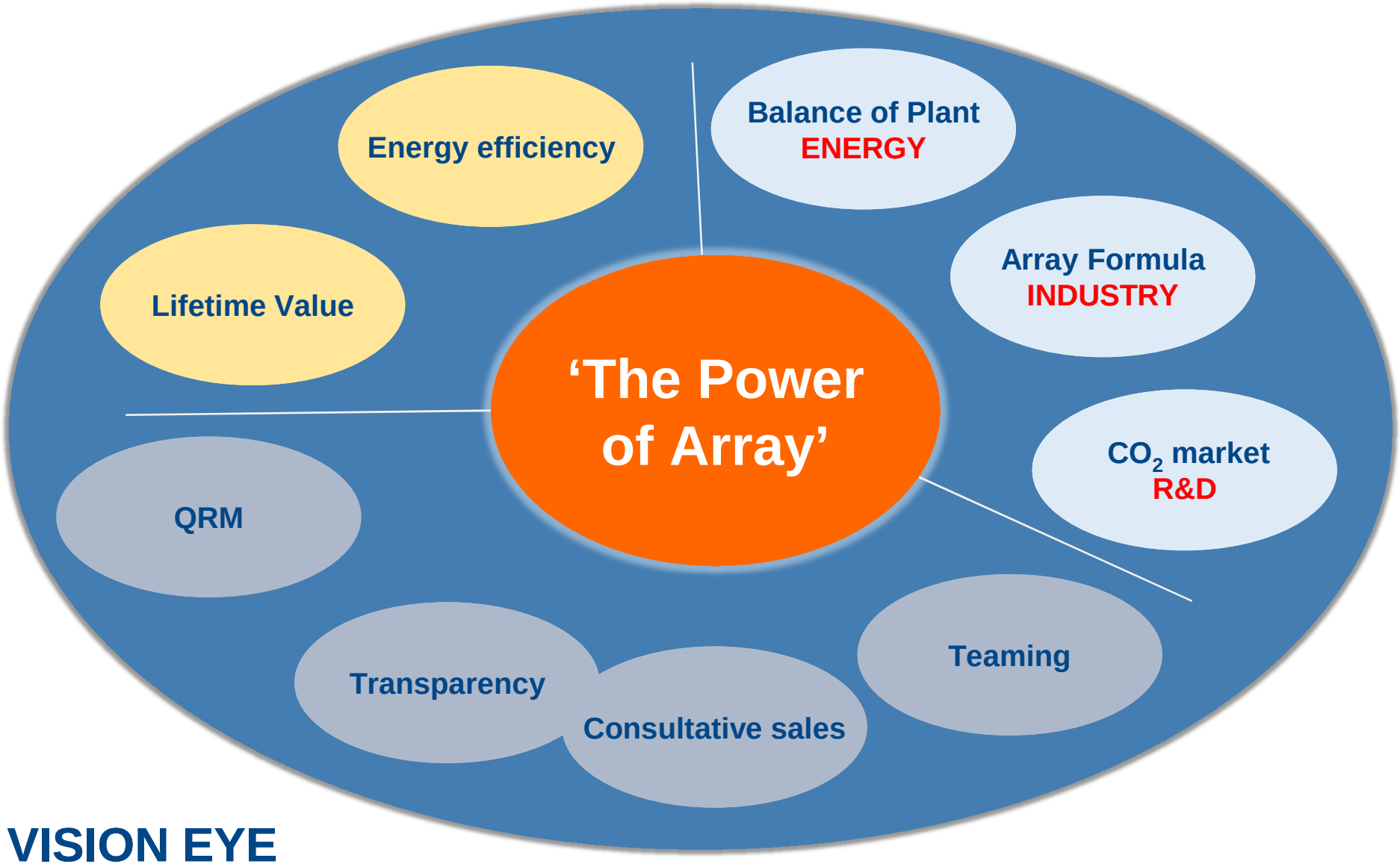
By: Rob Ernst - CEO
Date: April 2017

The Power of Array Industries

Outline presentation

- Strategy & Markets
- Engineering capabilities, our bases
- Balance of Plant
- Array Formula
- CO_2

Strategy & Markets



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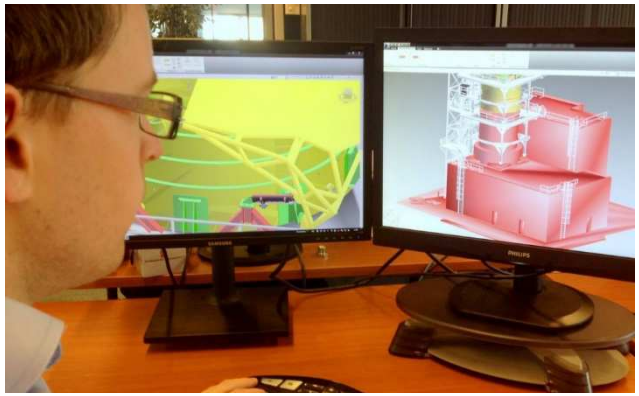
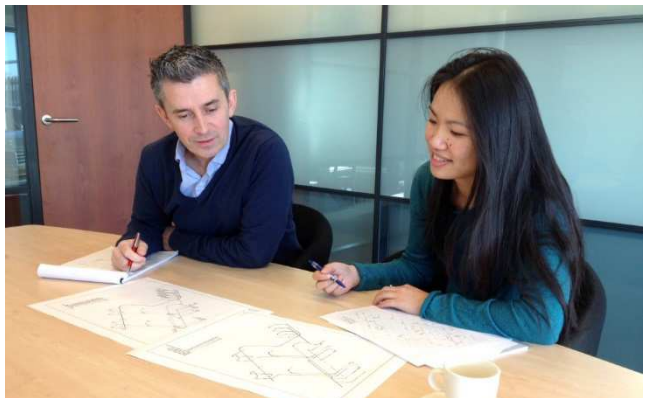




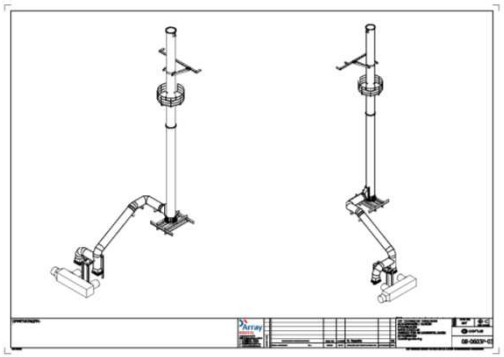
Engineering capabilities

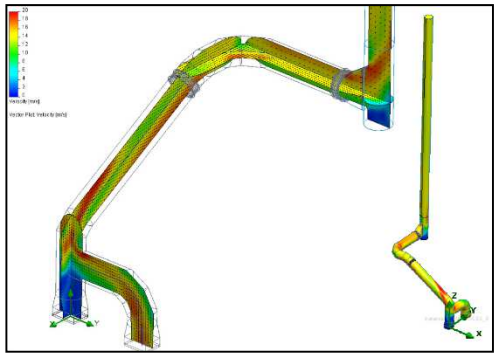
Array industries

The power of Array Industries

Engineering disciplines

- Pipe stress analysis (P10)
- Pressure vessel calculations
- FEM (Finite Elements Method Calculation)
- CFD simulations (Computational Fluid Dynamics)
- SCIA calculations (steel structures)
- Waterhammer calculations
- Foundation load calculations
- Engineering studies
- Feasibility studies
- Electrical integration
- 3D modelling





Balance of Plant - BoP

Array industries

The Power of Array Industries

Balance of Plant

- Array Industries is a turn-key partner for the complete design, supply and installation of the balance of plant around your CHP installation.
- <u>Our scope of works consist of:</u>
  - Engineering
  - Flue gas system design and supply including:
    - Ducting/ compensators/ supports
    - Silencers
    - Coolers/ condenser/ economizer
    - SCR catalyst/ DeNox/ Oxicat
    - Stack
    - Condensate system
  - Oil system (Clean oil tank/ day tank)
  - CV system (Heating water incl pumps, valves)
  - Urea tank + certification (KIWA NL)
  - Sound enclosures
  - Installation on site
  - Electrical integration

Scottow – Balance of plant ORC

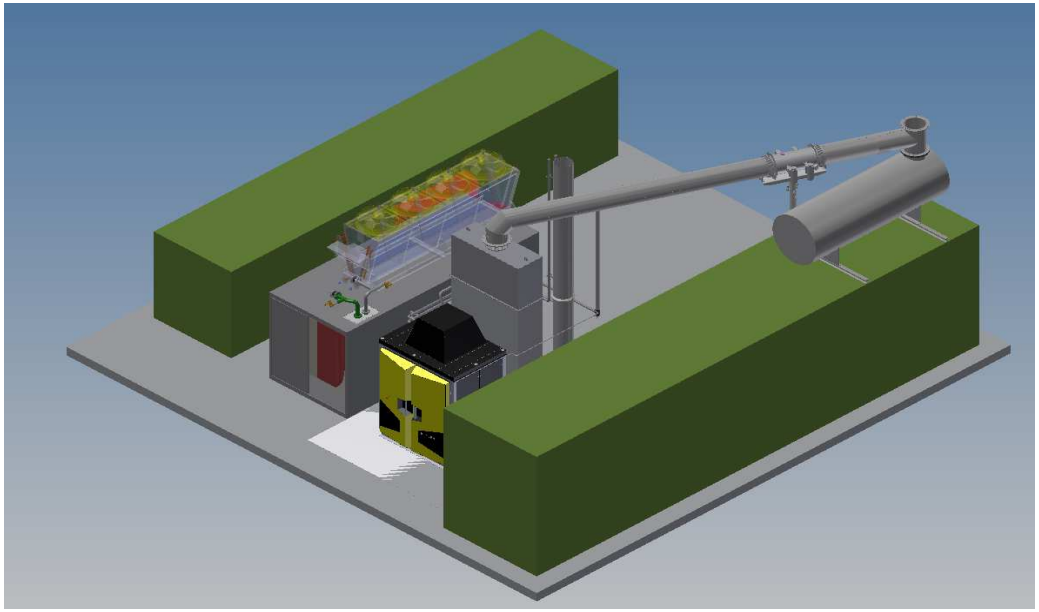
Client : Triogen
End User : Future Biogas
Project : Scottow - UK
Reference : 15-0109P
Year : 2015
Scope : Detailed engineering, fabrication, assembly and installation of BoP and ORC unit

ENGINEERING
FABRICATION
INSTALLATION

The ORC recovers heat from the flue gasses using a condenser. With a separate heat transfer loop this heat is turned into electricity. Array industries has designed, supplied and installed the complete balance of plant of the ORC unit.

Project highlights:
Type engine: JMS620
Duct diameter: 600 mm
EPC scope
Startup assistance

Scope of works:
- Detailed engineering & 3D modelling of ducting/ mechanical calculations
- Installation on site/ field testing



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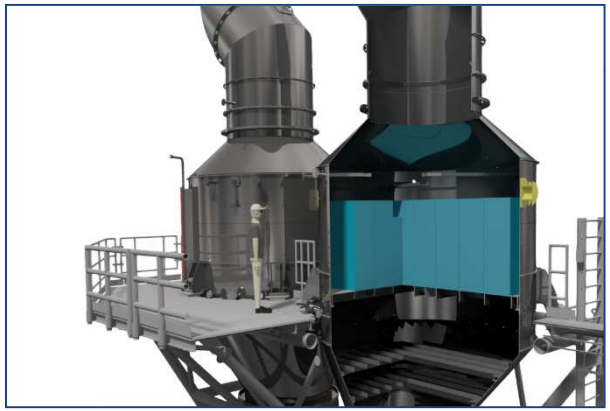
ENGINEERING

FABRICATION

INSTALLATION



Array Formula

Array industries

The Power of Array Industries

Reactor modification – 5pcs

Client : Stahl Europe BV
End User : Stahl Europe BV
Project : various reactor modifications
Reference : 13-070E 13-0169P
Year : 2014 - 2016
Scope : Engineering, fabrication & integration at site

ENGINEERING
FABRICATION
INSTALLATION

Replacement GOP flare package

Client : Escher Process Modules BV
End User : Kuwait Petroleum Europoort B.V.
Project : Replacement GOP flare package
Reference : 13-070E 13-0169P
Year : 2013
Scope : Engineering, fabrication & integration

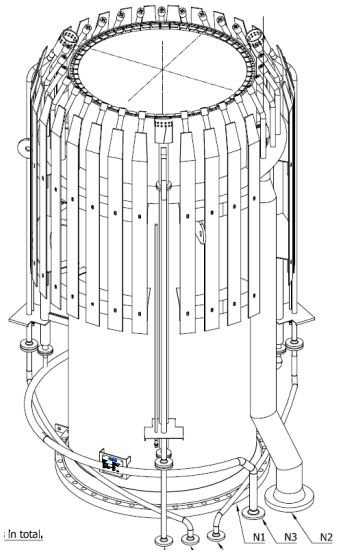
ENGINEERING
FABRICATION
INSPECTION

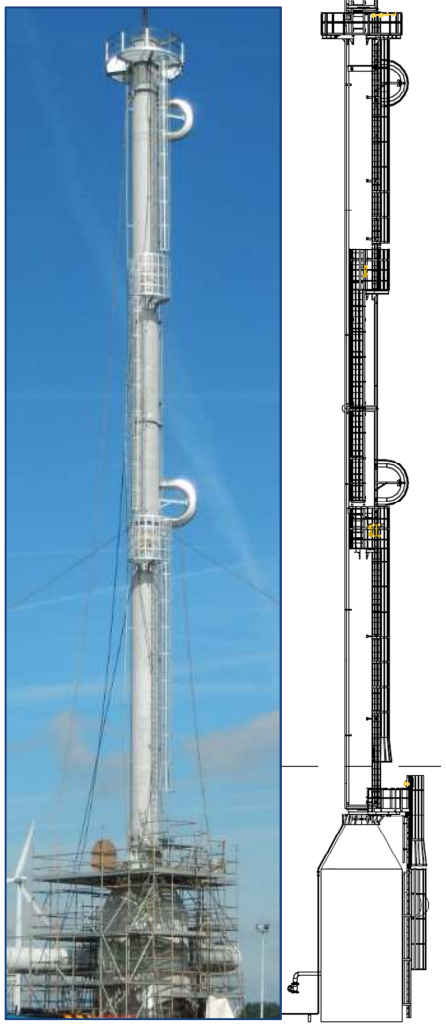
Detailed engineering, fabrication and installation supervision of new flare stack and flare tip. The new 80m stack is installed on the existing seal drum which was modified by Array Industries on site.

Engineering consisting of:

- Pipe stress calculations
- Strength calculations
- FEM calculations
- Wind / foundation load calculation

Project highlights:
Design temp: : 250°C
Size stack : 48” / 80m height
Weight : 12MT
Materials : Inconel 625/ API 5L/ SS310





Replacement GOP flare package

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Project : Replacement GOP flare package
Reference : 13-070E 13-0169P
Year : 2013
Scope : Engineering, fabrication & integration

ENGINEERING
FABRICATION
INSPECTION


Hastelloy 625 flare tip


Hastelloy 625 flare tip – fully assembled


Trial fit Flare tip on riser

Installation supervision

Gasunie – Low NOx – Gas turbine

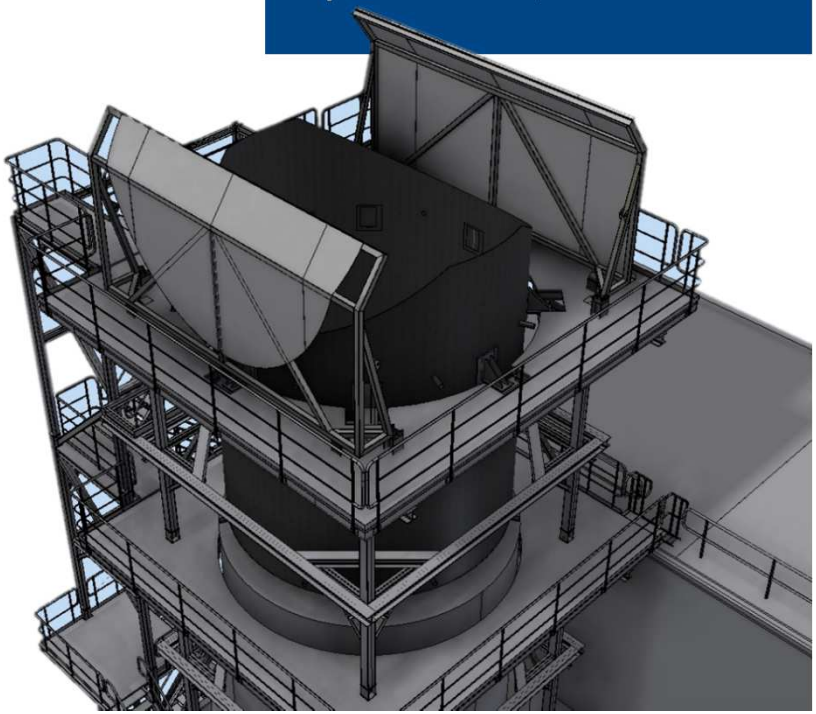
Client : Gasunie N.V
End User : Gasunie N.V
Project : Ravenstein Compressor Station
Reference : 14-0213P
Year : 2015
Scope : Detailed engineering & Fabrication of stack, covers & hydraulic power unit

ENGINEERING
FABRICATION
INSTALLATION

Two existing stacks are extended and equipped with a SCR catalyst bed in order to reduce the NOx content in the flue gas emissions. The catalyst is protected from rain and snow by means of a robust hydraulic driven hood. Availability, reliability and maintenance are the main drivers in the design.

Project highlights:
Robust design – 99,8% availability
Gasturbine: 15MW/e
Stack diameter: 5500mm
Stack height: 7000mm
Total weight: 20MT
Project sum: 1,5 MLN

Scope of works:
- Detailed engineering & 3D modelling/ mechanical calculations
- Transport/ Installation on site/ field testing



Ravenstein Compressor Station – Low NOx

Client	: Gasunie N.V
End User	: Gasunie N.V
Project	: Ravenstein Compressor Station
Reference	: 14-0213P
Year	: 2015
Scope	: Detailed engineering & Fabrication of stack, covers & hydraulic power unit

ENGINEERING

FABRICATION

INSTALLATION

Preparation for Shipment

Road transport

Ravenstein Compressor Station – Low NOx

Client : Gasunie N.V
End User : Gasunie N.V
Project : Ravenstein Compressor Station
Reference : 14-0213P
Year : 2015
Scope : Detailed engineering & Fabrication of stack, covers & hydraulic power unit

ENGINEERING

FABRICATION

INSTALLATION

Installation on site

Stack and cover assembled

Supervisors during lifting

NUON – BMC Lelystad – Low NOx

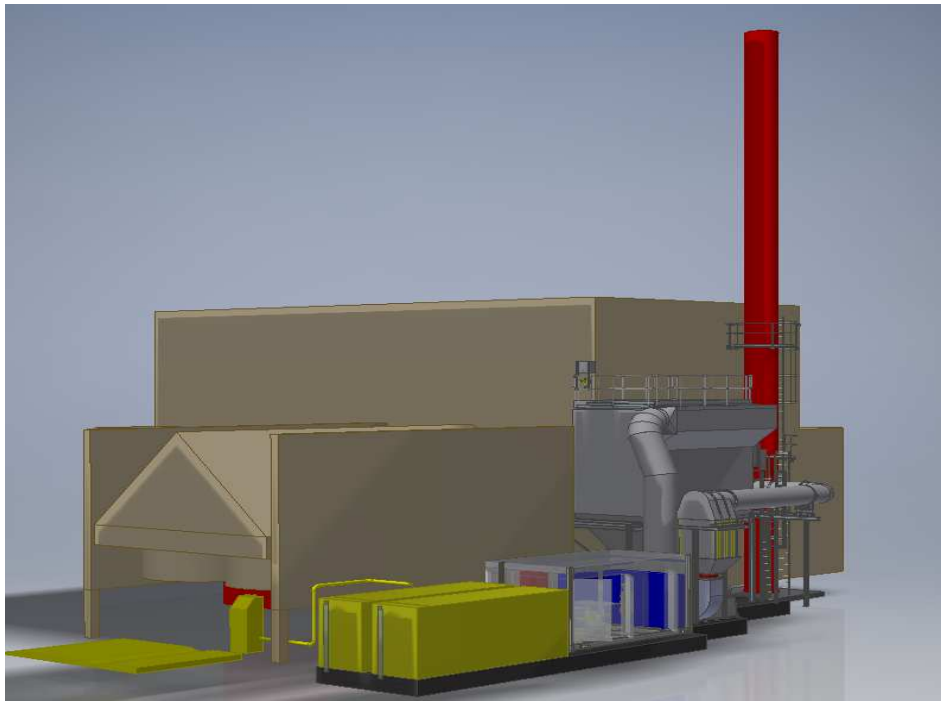
Client : Nuon
End User : Nuon
Project : BMC Lelystad
Reference : 16-0164P
Year : 2016
Scope : Detailed engineering & Fabrication of SNCR and dustfilter system

ENGINEERING
FABRICATION
INSTALLATION

Integration of SNCR system and Dust filter installation in order to meet the stringent emission restriction requirements.
Complete EPC scope executed by Array Industries.

Scope of works:
- Detailed engineering & 3D modelling/ mechanical calculations
- Transport/ Installation on site/ field testing

Project highlights:
SNCR system
Urea offloading and storage system
Dust Filter installation
Stack modification
Project sum: 1,6 MLN



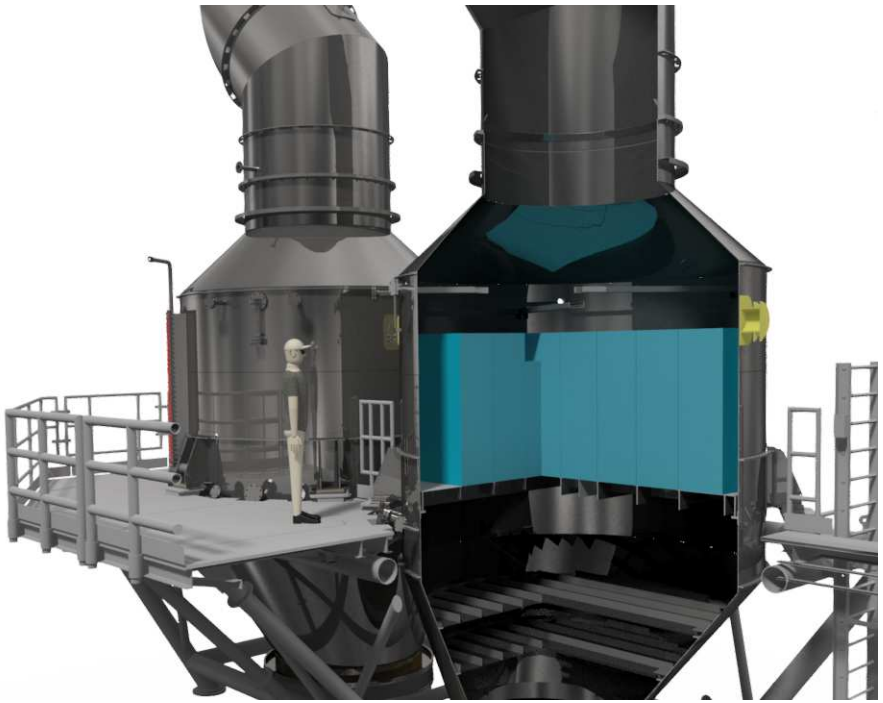
J6A – SCR system offshore – Low NOx

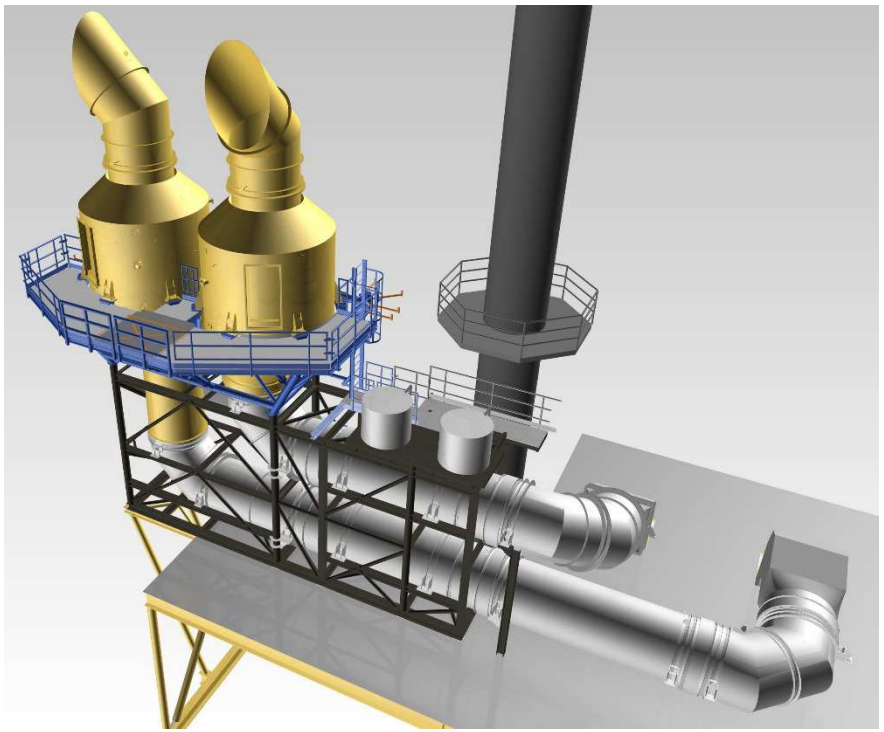
Client : Centrica
End User : Centrica
Project : J6A – Low NOx emission project
Reference : 16-0290P
Year : 2017
Scope : Design & supply of exhaust system and steel structure

ENGINEERING
FABRICATION
INSPECTION

Detailed engineering and fabrication of two Exhaust gas Systems for existing gas Turbines. The project involves major modifications to the exhaust gas system and steel structure. Array Industries suppies the exhaust gas system, steel structure, catalyst support structure, flow distribution plates, permanent NOx measurement tubes and a trial fit of the complete system.

Design temp.:	520°C
Diameter:	3600mm
Gas turbine:	LM1600 13,7 MW/e
Equipment weight:	33 MT
Materials:	SS316L/ S355





Eneco – SCR integration 4 WKC's

Client	: Eneco Solar, Bio & Hydro B.V.
End User	: Eneco
Project	: WKC Vijfwal, WKC Vaanpark, WKC Wateringseveld, WKC Ypenburg
Reference	: 16-0011P
Year	: 2016
Scope	: Detailed engineering, fabrication, assembly and installation 12 new exhaust gas systems

ENGINEERING

FABRICATION

INSTALLATION

The CHP produces electricity and heat to supply to the surrounding households. Due to new legislation for emission of flue gasses a DeNOx/ SCR catalyst is to be integrated In the flue gas system. Eneco has awarded Array Industries the contract for Turn-key modification of the complete flue gas system for 12 engines (1,6 – 1,9 MWe each)

Project scope:
- Detailed engineering of flue gas system (process & mechanical)
- Fabrication of ducting; frame, lifting frame & stack
- Installation of silencers/ 'pre' coolers, Urea injection system, SCR
- Installation of Urea system

Engineering consisting of:
3D modelling/ process & mechanical design/ Pipe stress analysis/ Pressure drop calculations/ silencer design/ cooler design/ thermal design of complete system



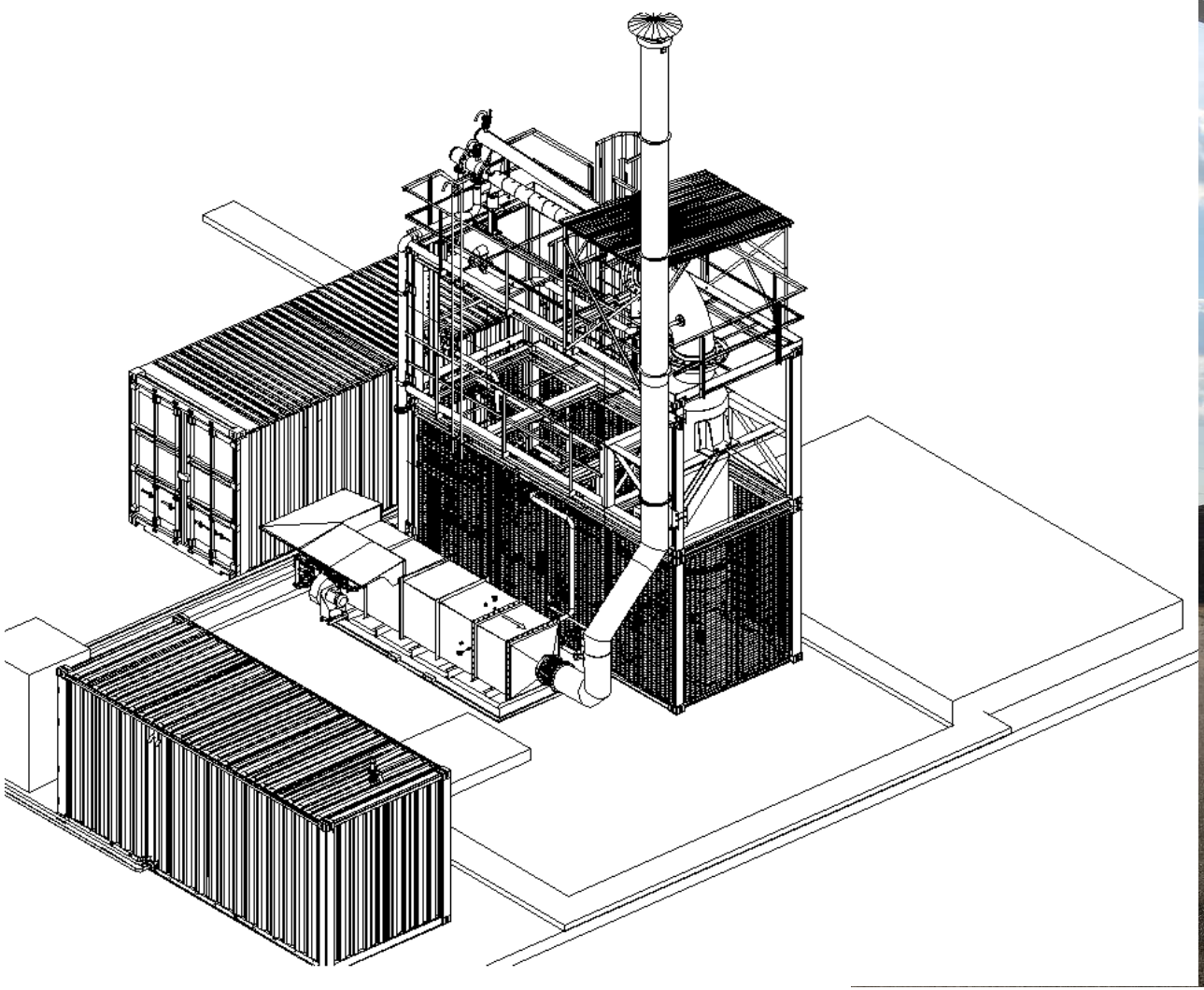
R&D projects

Array industries

The Power of Array Industries

Research and Development

DemoClock 2011 - 2017

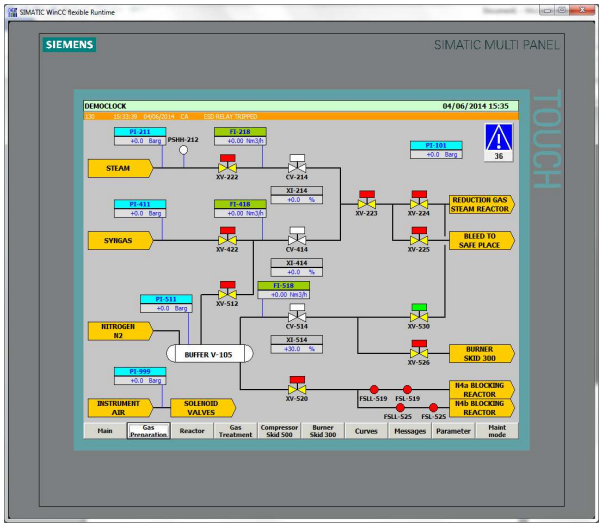


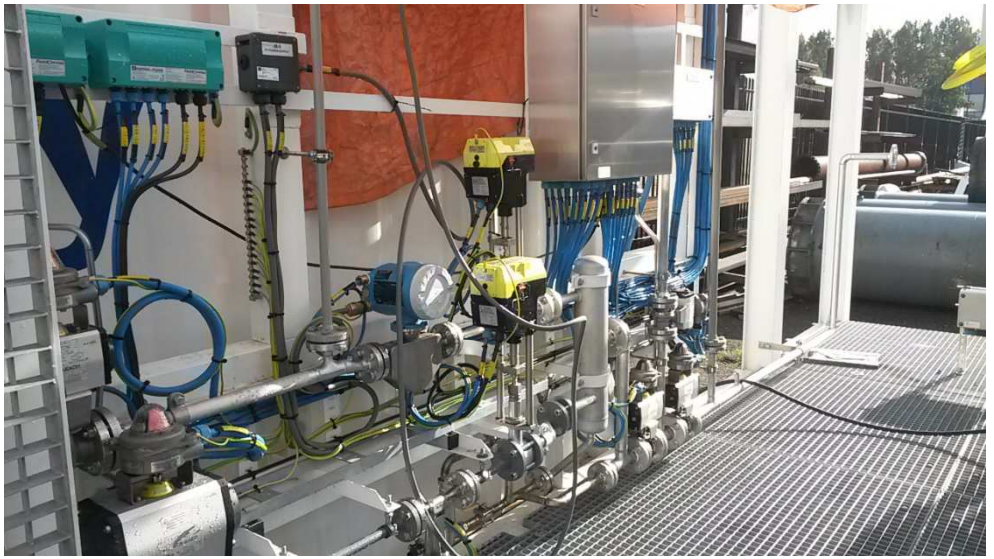
Research and Development

DemoClock 2011 - 2017

FP7 project

The main objective of DemoCLOCK is to demonstrate the technical, economic and environmental feasibility of implementing packed bed Chemical Looping Combustion (CLC) in large-scale power plants.

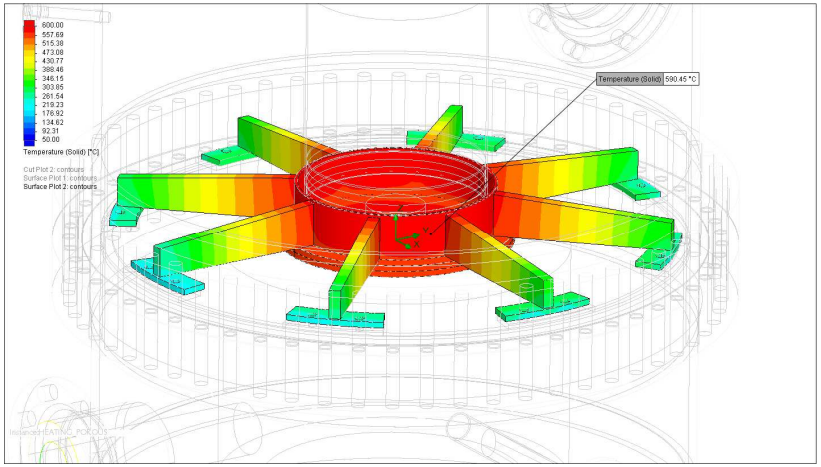




Research and Development

The Democlock consortium consists of the following members:

- SINTEF
- TU/e
- VITO
- ECN
- CTI
- Foster Wheeler
- Politecnico di Milano
- Elcogas
- IEIA
- Array Industries



Research and Development

Participants : Consortium
Funding : FP7 ENERGY
Project : BDF E-Compression Project
Total Budget : over € 9.000.000
Year : 2014-2018

CARBON CAPTURE

ASCENT will provide a robust proof-of-concept of three related high temperature processes; each will lead to a step-change in efficiency of carbon removal in three types of pre-combustion capture, producing the hydrogen needed for highly efficient low-carbon power production. The project brings together five small and medium enterprises preparing to launch these concepts with the support of leading research institutes, universities and industrial partners.

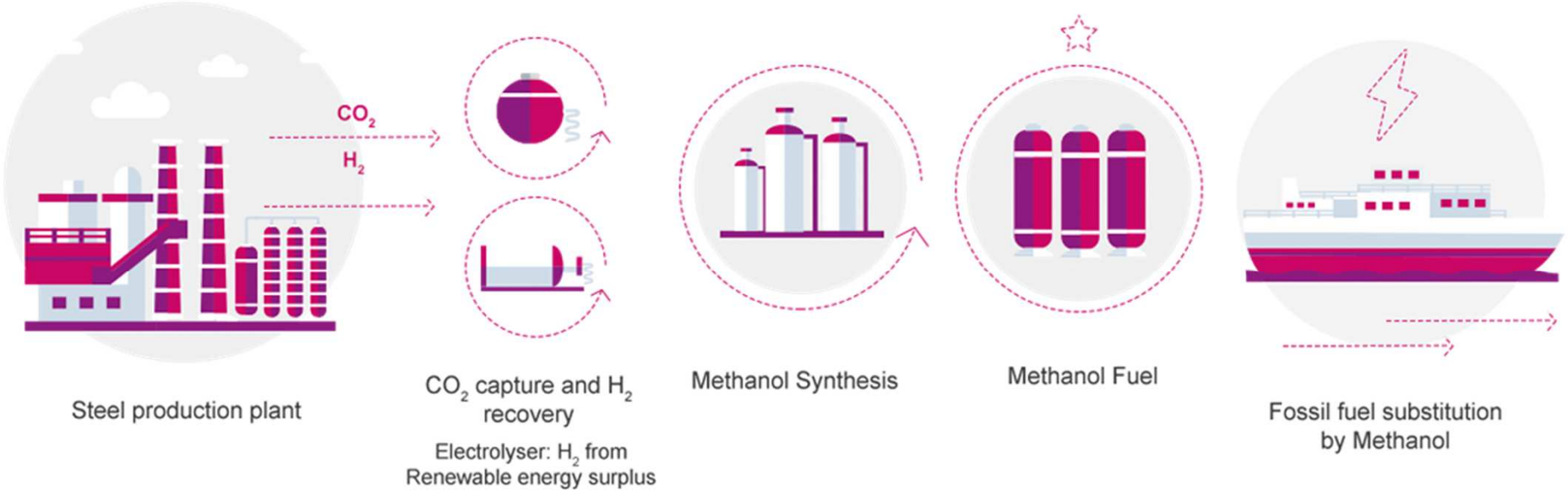
Project sections:

1 - Performance criteria and benchmarking
2 - Combined Ca-Cu Chemical Loop
3 - Fast sorbent mediated water-gas shift
4 - Sorption enhanced reforming looping cycle
5 - Safety and sustainability impact assessment
6 – Dissemination
7 - Exploitation of the developed sorbent technologies
8 - Management

advanced solid cycles with efficient novel technologies

Research and Development

FRESME



Research and Development

DemIdea 2016

- Developed by Array Industries
- Partly funded by WBSO

Demiwater **I**ntegrated **D**estillation under barom**E**tric v**A**cuum (DemIdea) is a distillation column, that has been designed with multiple features to operate with low temperatures, small temperature differences and a small footprint. The driving force for distillation can therefore be for instance industrial low grade waste heat, low grade waste heat from a power plant, or solar heat, or a heat pump, or a combination.

Research and Development

DemIdea 2016

This unit is very suitable for the following situations:

- Concentration of wastewater and demi water production (boiler feed water) in industrial areas where waste heat is abundant.
- Desalinated, potable, basis for drinking water production in dry areas where power plants or refineries are generating waste heat or solar heat is abundant
- Concentration of bioethanol from digester to fuel (under vacuum no azeotrope, high purity ethanol).
- When driving force is a heat pump, also distilleries may be interested for same reason as above.
- Multiple other distillative separation processes may benefit as well from the advantages mentioned above.

Array Industries, the chain between
RESEARCH and MARKET

Thank you for your attention

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