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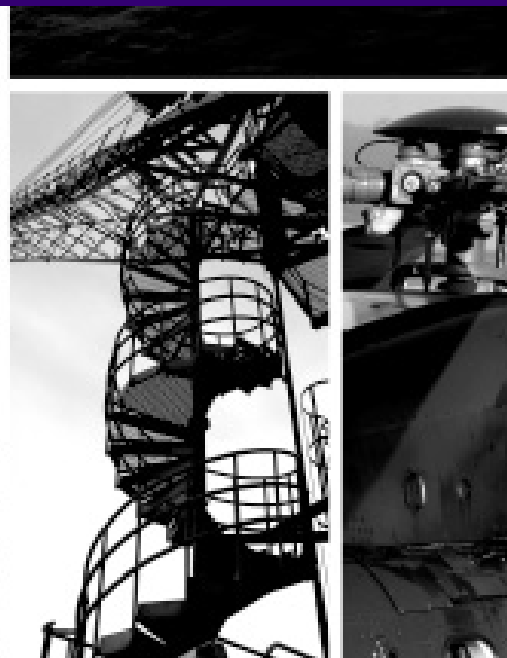
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Innovation in a Mature Market



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Babcock LGE Process

Supply Chain Innovation



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"Innovation in a Mature Market"

15th June 2016

Michael Scott, Technical Sales Manager

Content



- Introduction to Babcock LGE Process
- Innovation - The Vent Gas Cooler (VGC™)
- Benefits of VGC™ to Clients and Babcock
- Conclusions

Babcock LGE Process

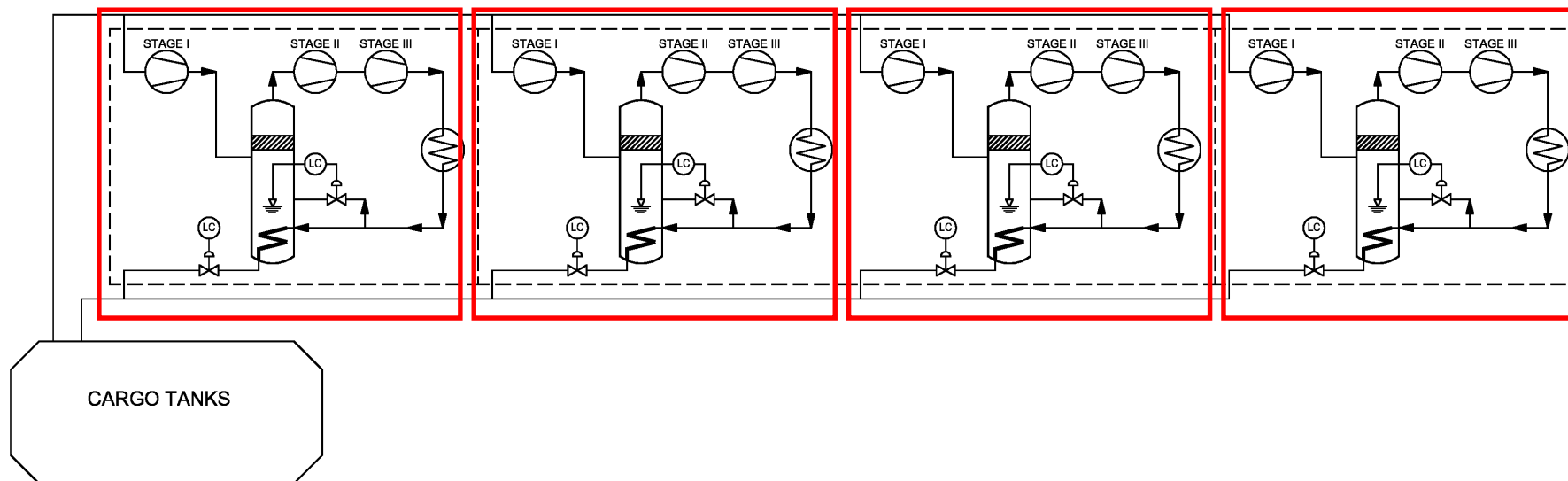
- **Engineering, Procurement and Project Management (EPPM):** Delivery of projects for the transportation and storage of liquefied gases on newbuild ships carrying, Liquefied Petroleum Gas (LPG), Liquefied Ethylene Gas (LEG) and Liquefied Natural Gas (LNG).
- **Location & People:** Established in 1967. Based in Edinburgh, Scotland with 125 people (with 17 in Korea and 2 in China to support outfitting, commissioning and performance tests).



Traditional LPG Reliquefaction

The first purpose-built, fully refrigerated LPG carrier was constructed by a Japanese shipyard, to a United States design, in 1962.

Traditional Reliquefaction - 4 Compressors



Market conditions that led to demand for new technology

The Vent Gas Cooler™ (VGC™) innovation was created in response to the increase in shale gas production coming mainly from the U.S.A.

Ship-owner desire to improve capital and operating costs and at the same time improve the environmental efficiency of gas handling.

Ability to handle higher percentages of “incondensables”. For example, higher ethane content in commercial propane.

Evolution of the VGC™

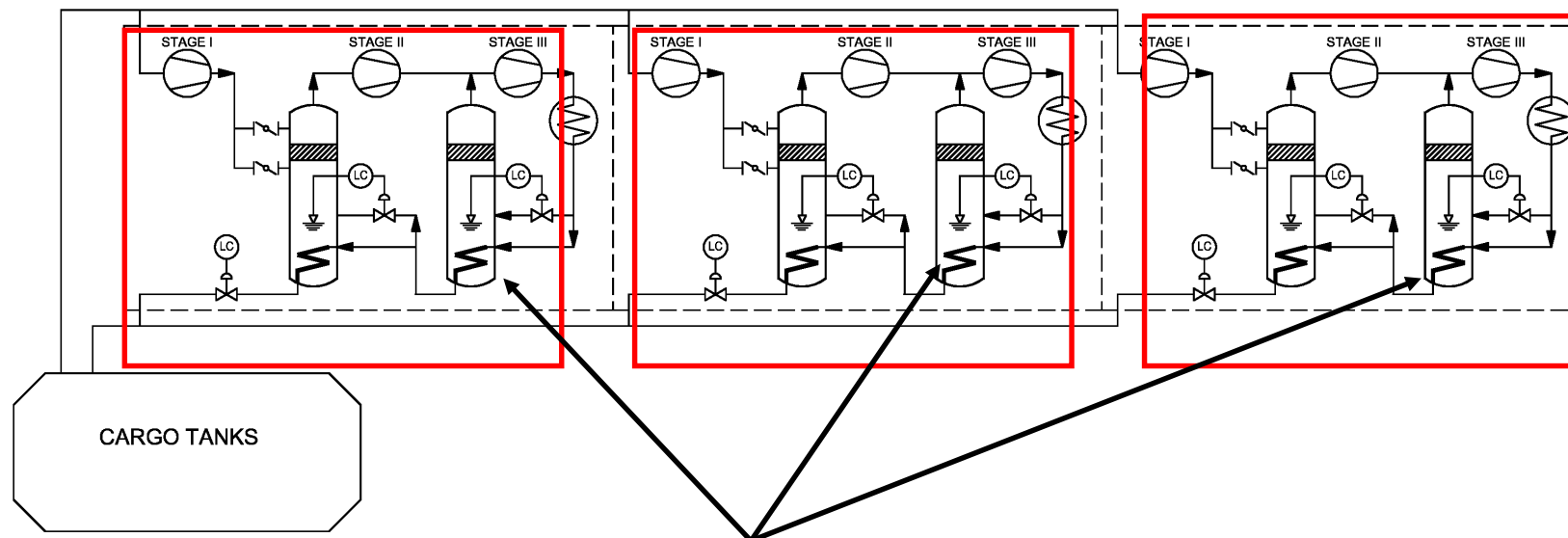
An alternative to the current compression based systems would be a “game changer” but unlikely (?)

If invention is unlikely, focus efforts on innovation and novel applications of the known technologies.

In-house innovation team focused on leveraging knowledge and experience, not blue sky ideas, to develop and grow the business.

LGE LPG Reliquefaction

3 - Compressors



Vent Gas Cooler - VGC™

Difficulties in selling concept

“ What I currently have works, why should I change it? ”

“ The crew understand the current solution, I’ll have to re-train them? ”

We had to come up with a comprehensive list of client benefits in order to encourage uptake of VGC™.

Client Benefits of the VGC

Improved Coefficient of Performance (CoP)

- Typically, the increase in CoP gained is in the range of 8-12% and can rise as high as 15% when the VGC™ is installed

Reductions in CAPEX and OPEX

- Overall system cost is approximately 30% less when compared with the standard four compressor systems

Significantly reduced through life operating costs

- Reduction in fuel consumption in providing electrical power to drive the reliquefaction compressors

No specialist training requirement for the crew

- The technology of the VGC™ is known, just applied innovatively, all a gas carrier crew require is simple basic instruction on the benefits it can bring and when it should be applied.

How the VGC™ has benefited LGE



Increased Turnover

- The VentGasCooler™ system has generated sales in excess of £350m to date.

Healthy Orderbook

- In our current order book, we will deliver 26 projects with the VGC™ this year (12 still to deliver), 16 delivering in 2017 and 1 delivering in 2018.

Investment in Future Innovation

- Implemented Strategic Projects Team

Awarded two Queen's Awards for Enterprise (Innovation and International Trade). Part of an elite group of only six UK companies receiving a double accolade in this year's awards.



Current Innovations

In-house Strategic Projects team in place and focused on development of non-core products.

Strategic projects team was developed to address the future market requirements and is driven by client demands.

Currently working on projects including:

- Ethane/Ethylene Reliquefaction
- LNG Reliquefaction/Regasification
- Crude Oil transport

In Conclusion

- The LGE approach to innovation has provided a range of benefits to both clients and Babcock.
- We have shown that innovation doesn't have to lead to increased CAPEX and OPEX.
- We continue to successfully adopt the same approach to innovation across other product lines.



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