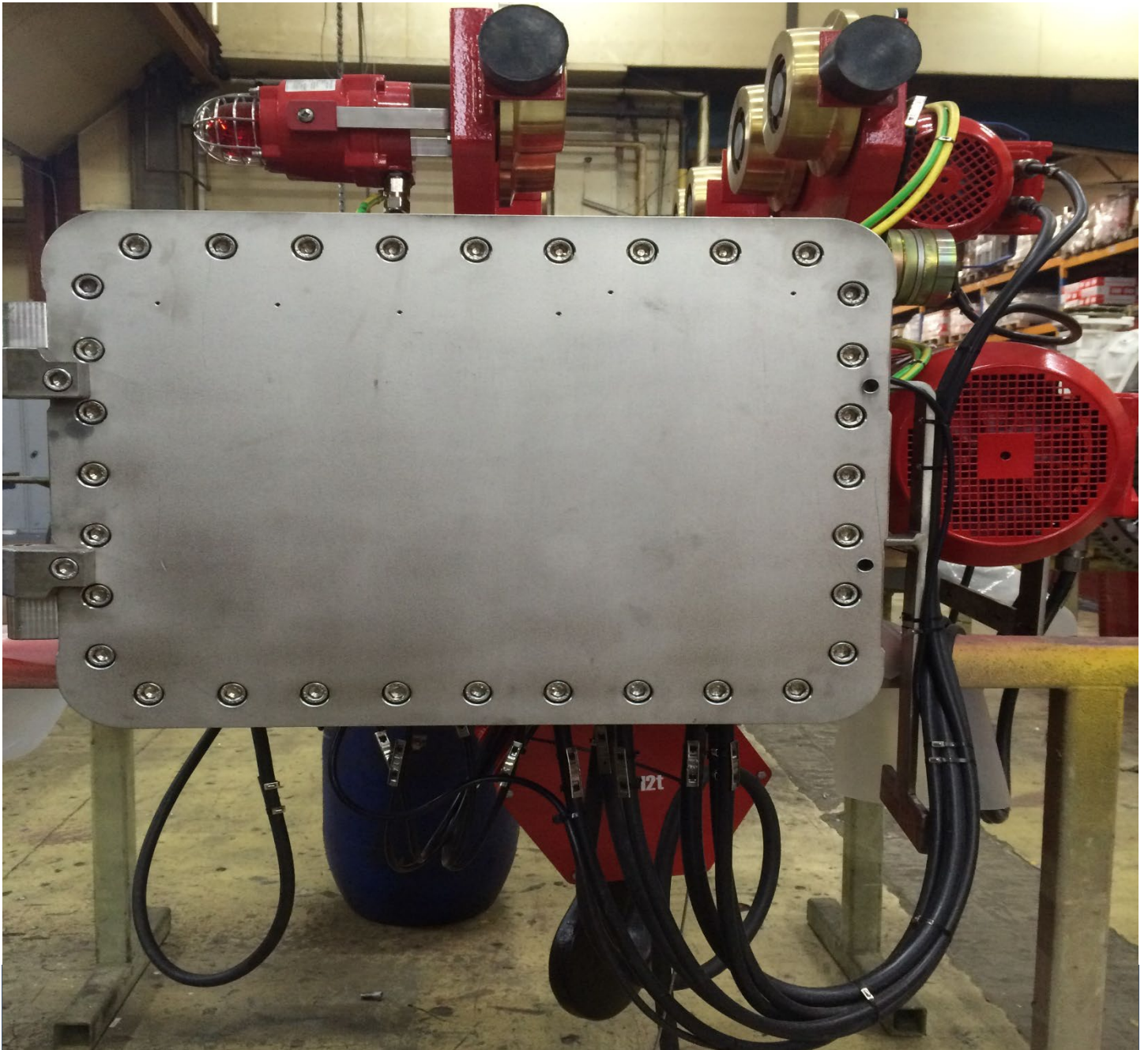




Assessment B

Analysing the innovation involved in developing and producing the Ex-proof Electrical Control Panel Proquip 4530

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Background about the Proquip

PCT Group Sales LTD. is an SME and a manufacturer and supplier of lifting appliances like overhead cranes, chain and wire rope hoists, beam clamps and every other lifting and handling equipment on the market. These pieces of equipment can be manually, pneumatically or electrically driven. The niche of the company is providing equipment suitable to be used in potentially explosive environments, such as oil rigs, chemical plants, refineries.

In the case of electrical hoists, the electrical components like motors, brakes, limit switches, beacons, alarms need to be explosion-proof rated and certified by a 3rd party authority, which maintains overview of the products throughout their life cycle.

The component selected by the company as the product innovation is the Electrical Control Panel. It is considered the brain of the machine as it holds all the switchgear controlling the movements of the hoist and is the place where sparks may take place, making it essential for the panel to be Explosion-proof. Another aspect that must be considered is the material of construction which must be corrosion proof, because it will spend up to 35 years in a harsh saline sea environment. Any corrosion is not acceptable, as it would lead to a reduction in the wall thickness of the box, making it more susceptible to deflection in case of an explosion.

The following report will take a look at the drivers, process, management and success of this project, referring along the way to best practice methods for the various topics.

The innovation drivers

‘The aim of the cost reduction is to differentiate the product from competing products on price or ensure the product remains price competitive’. (Kahn 2018, p. 454)

This product innovation is intricately linked to the company’s marketing strategy. PCT had been operating in the Oil&Gas industry for three decades at the start of this undertaking. According to Kahn’s Product-Market matrix, market penetration (current market, current technology) (Kahn 2018) is the strategy engaged by the company.

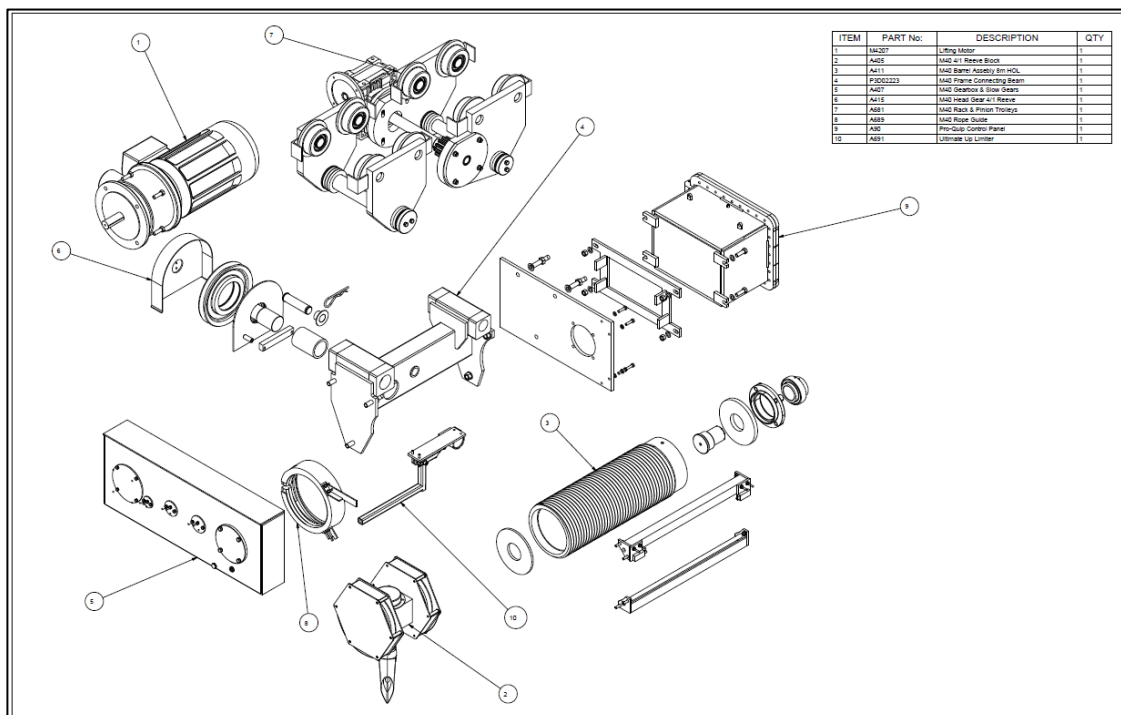


Figure 1. Exploded view of PCT's M40 wire rope hoist with the Proquip 4530 Enclosure (item 9)

The PCT leadership team looked at the typical components of the hoist (see Figure 1) and evaluated which of the bought-in components could be brought into production in-house. The control panel matched the production capabilities of the company and was selected as a prospective candidate for product innovation.

The barriers and risks

Short term thinking was one of the barriers the project faced. The original expectation of the management team was that the newly developed control panel would be used on the electric hoists PCT was contracted to supply by the end of 2014. The entire innovation process, taking it from draft to approved, commercially viable solution took circa 2 years, with the first 4 panels being successfully tested in August of 2016.

Having the leadership team's expectation at odds with the time for completion of the approval process created a paradoxical situation. As Dorst puts it: 'A paradox, a real opposition of views, standpoints, or requirements, thus requires a redefinition of the problematic situation in order to create a solution'. (Dorst 2006, p. 14)

This problem resulted in a narrowing of the scope early the process of innovation and the product range was reduced to a single size, it is made from a single material of construction (stainless steel) and is of singular benefit. (Trott 2016)

Another large obstacle was to decide which standards the company wanted the enclosure certified to. ATEX (for Europe) plus IECEx was chosen, which is reputedly accepted worldwide - except in America. Bear in mind that most Oil & Gas installations are designed, and project managed by American conglomerates, thus some installation specifications are based upon their standards.

It was important to realise that in order to attack the American market, one needs to know their certification standards, which can vary from state to state, and would require auditors from the American organisations to visit PCT's UK premises several times a year, with all expenses paid – adding unnecessary cost and extending the time required to obtain certification for the panel.

One of the biproducts of taking this singular approach was reducing the overall element of risk. Instead of the best practice approach to risk assessed decision making (Trott 2016), the urgency and the limited use of this innovative product had the same effect on lowering the degree of risk associated with the new product development process by limiting the scope of innovation.

Nevertheless, the largest risk with a new project like this, is stepping out of the company's comfort and knowledge zone. The essence of a Exd enclosure is to try and determine the pressure value and the consequence of an internal explosion, of a specified mixture of gas. This is done by an actual explosion test. Any permanent damage or distortion from the test explosion to the enclosure, classifies as a failure.

As evidence to this step outside of the comfort zone, soon after completing an early draft of the panel, two enclosures were commissioned to be built and, after being manufactured, were tested by the certifying authority, Baseefa, and failed.

Failure is an inherent component of innovation (Bessant, Tidd 2015), and its effect on the project was two-fold. On one hand, the management realised that the draft product needed to be taken further, updated and researched systematically. (Bessant, Tidd 2015) On the other hand, it enabled the project owner win over key stakeholders that were involved in the failed attempt, which were now determined to get it right the second time around. Additionally, it paved the way for the formation of a multi-skilled team that was formed by partnering with external resources (Walden, Lie et al. 2018)that brought in the expertise and technology needed to progress and achieve a successful end product.

The key determinants in the process

The multi-skilled team was led by an engineer with vast experience. He works for PCT as a consultant, having been the Director of Projects and Design for circa two decades, prior to his retirement. This is a relevant detail and a key determinant in the process.

It is important to note that his position away from the day-to-day workflow, with the inherent firefighting and deadlines, allowed him the opportunity to be methodical in his approach and dedicate his time to only this project, becoming the product's champion. (Trott 2016)

For example, he engaged with the electrical engineering manager to not only provide the typical electrical components population that would fit in the panel, but also to research the market and get to understand why two of the largest Ex-proof panel manufacturers are in the same region of Italy. He discovered several aluminium producers and an aluminium mine in the vicinity. PCT could not compete with the prices of the aluminium enclosure, and this conventional method of market research contributed to the decision (Bessant, Tidd 2015) to only pursue the stainless-steel variant.

Next, he engaged with the Machine Shop Manager, not only for the part of the project that concerned him – i.e., machining the mating surfaces on the box and lid; but also appealed to his entrepreneurial character as a tool to encourage further innovation (Rigtering, Weitzel 2013). His involvement in the project led to a side product innovation in the development of lid-hinges that would allow them to be re-positioned so that the Proquip panel could open to the left or right, depending on site conditions.

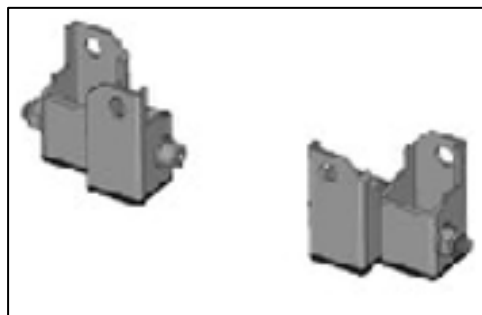


Figure 2: Laser-cut Panel Hinges

In summary, the key determinants were the people buying into the project and the trust they had in the project owner which gave them the freedom to show more entrepreneurial behaviours. (Rigtering, Weitzel 2013)

The processes and technologies

The use of iterative design was paramount for the success of innovation in the context of the fast turn-around expected in order to maximize the benefits of the finished product usage. From developing the early simple prototypes and not being discouraged by their failure (Kahn 2018), the approach dictated the product characteristics and the technologies employed. (Kahn 2018)

As evidence to this thinking, the quickest and most inexpensive way to progress the product to a second attempt at pressure testing was 3D simulation and FE Analysis. A known and reputed consultant that had consulted with the company before was brought on board to that effect.

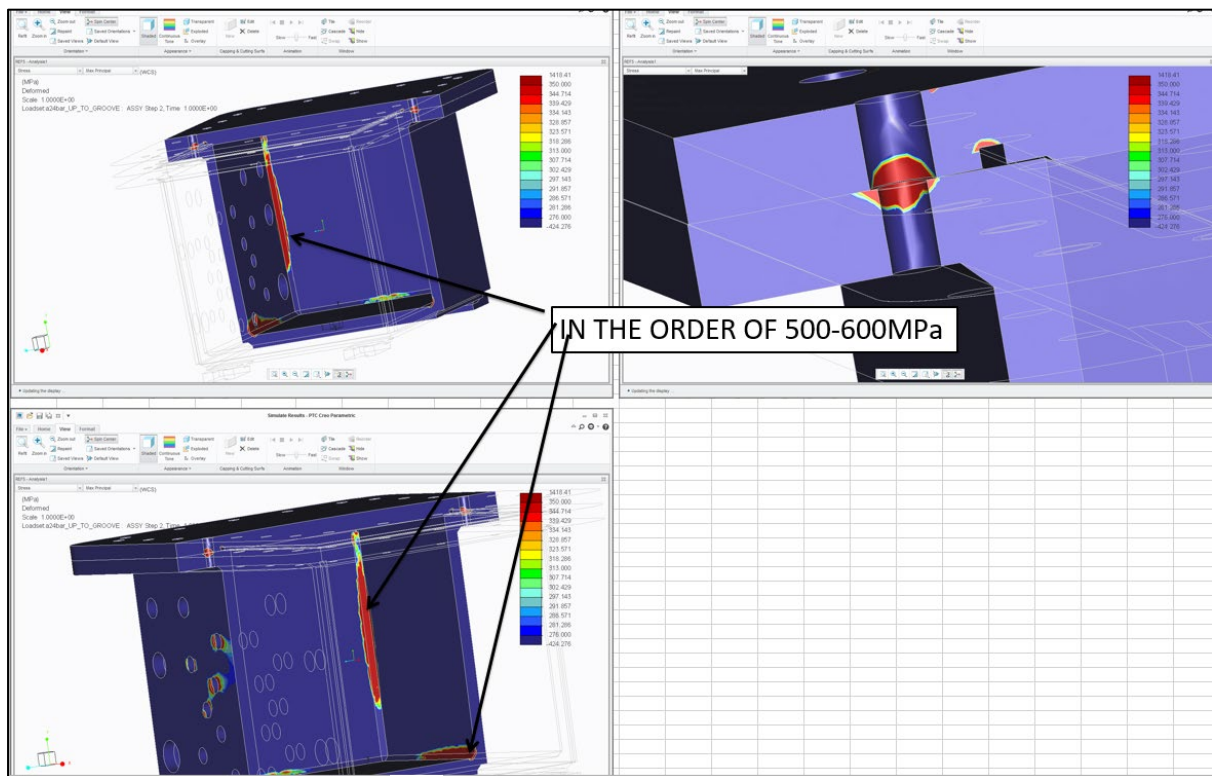


Figure 3. FEA results simulating pressure testing of the panel

By this point in the project, the team had researched the market to learn from the current players; they had familiarised themselves with the stringent specifications and regulations for the acceptance criteria and were contribute to the design of the 3D model of what would become an explosion-proof panel to be used in hazardous environments such as oil rigs and refineries.

To enumerate some of the aspects considered:

- The lid and the panel lips (surfaces that clamp together) had to be of a specific length to ensure that, in case of an explosion, the flame would not escape but die out due to the lack of fuel (oxygen) over the distance.
- The bolts holding the panel lid together had to be able to expand to a certain degree to allow the gas to evacuate the enclosure, but not too much letting the flame out.
- The thickness of the walls and lid of the Proquip enclosure was selected based on the simulated pressure. Due to the welded construction and the straight edges inside, excessive pockets of pressure would form in the corners.

As Trott says: ‘A product is multi-dimensional ‘. (Trott 2016, p. 492) All aspects of NPD had to be considered: the quality specifications, the features, price and time invested, the technologies employed, branding.

As a result of this extensive and focused research and development, the company, and specifically the project team, gained what Nonaka and Teece identify as integral knowledge as a driver of integral innovation in their book. (Nonaka, Teece 2001, chapter 11)

The external resources and their management

To continue the discussion on the integral knowledge required to develop and complete the project, the external resources that were engaged in the NPD process must be mentioned.

The procurement of external expertise was paramount in coordinating the different technological processes necessary during the project. Through trial, error and continuous improvement, the team came to understand the different technological elements (Nonaka, Teece 2001) involved in completing the tasks at hand and gain the full knowledge of the product by engaging with external resources.

One of the characteristics of SME's is the relatively small internal pool of expertise. This fact leads firms to engage in what Reay (2016,228) cited in (Walden, Lie et al. 2018) describes as ‘the blending of many different forms of knowledge’ and constitutive participation from a range of stakeholders. (Walden, Lie et al. 2018)

In detail, there were three major external stakeholders that were integral to the project.

Firstly, the consultant that was brought in to lead the innovation and become the project owner. As mentioned before, having an external resource drive the process that has an intimate and lengthy working history with the company meant that he was given the time and space to focus on this design, which can be seen as a luxury for day-to-day production duties of a manufacturing SME like PCT. Furthermore, as a collaborative leader (Nonaka, Teece 2001, chapter 8), he earned and maintained the interest and buy-in of all the stakeholders. His knowledge and experience influenced the decisions that were made, rather than having a place in the company hierarchy – he is an outside consultant.

Secondly, hiring the 3D and FEA simulation expert meant that the time and physical resources, i.e., prototypes, were greatly reduced. This also reduced the risk of another failure, evidenced by the fact that the next test was successful and PCT received full accreditation to build and commercialise the panels as part of our hoists. It is worth mentioning that this expert also has a long-standing collaboration with the firm, with his consultancy being called upon from time to time for bespoke projects.

Lastly, one of the important parts of the approval process was creating the procedures for mass producing the control panels. At this time, PCT contracted a SMAS (Scottish Manufacturing Advisory Service) Practitioner for Business Process improvements. He drafted the process maps and processes that are followed to produce each of the panels to date. An excerpt of the current process map is in Appendix 3.

As shown above, these three important people were not unknown to the company, as they engaged in similar activities with PCT beforehand. Professor Doctor Cees van Beers of TU Delft mentions in an online lecture about the importance and advantages of technology clusters, like Silicon Valley software firms, Swiss Watch Makers, Fashion Designers in Milano. (van Beers 2021) One can take this idea and further develop it into knowledge clusters. Knowledge clusters (networks) are formed by companies, particularly firms like SME's, who time and again need to access external resources to either supplement their own staff or provide know-how that the SME doesn't have covered. They are not geographically based but rather, grow throughout the history of the company.

To sum up this section of the report, Trott describes outside engagements as network models of NPD where the external resources garner the accumulation of knowledge over time (Trott 2016), but in the case of SME's where there are limitations of resources, the only accumulation of knowledge is knowing where to go and the right person to call to assist. Of course, this is where these valuable external resources need to be managed well; they must be treated with respect, paid on time and given a voice within the project when it's their area of expertise.

The management overview during the development

About the management and how this innovation sits against Satell's innovation typology, it is straight forward: the problem is well defined – cost and the market is well defined – explosion proof panels (Satell 2017). This identifies the new Proquip panel as a sustaining innovation (Satell 2017). Adding a third dimension to his matrix would allow an in depth look at whether this product development was indeed an element of the company strategy or simply a short-term fix that happens to fall into one of Satell's categories of innovation.

In order to better understand the corporate foresight (Vishnevskiy, Karasev et al. 2015) demonstrated by PCT's top management, the reader must first know that typically the contracts PCT has with the first-tier contractors of the oil & gas industry, where these units would be used, have an average duration of up to one year from contract signature to equipment delivery. Being faced with an R&D project that was going to take twice as long as

the current order book, they had to resort to identifying and predicting the future demand (Vishnevskiy, Karasev et al. 2015) for the product.

Forecasting innovation, as Tidd and Bessant put it, is an essential part of business planning (Bessant, Tidd 2015). The method used by the management in the process of forecasting was road mapping (Vishnevskiy, Karasev et al. 2015) (Bessant, Tidd 2015). Road mapping products and technology has a medium-term use but cannot account for future trends in the market.

The driver of innovation was cost-cutting, so a large emphasis was put on reducing all the costs in time, effort, resource, finance.

As evidence of this the approximated costs of the entire innovation process are summed up in Table 1. For most of the proceedings, only one person, the project owner, was actively involved. He had the ability to pull in the expertise when it was needed and to limit the duration of their interventions – the longest individual process being the 3D analysis at 2 months.

Activity	Duration	Rounded Costings	OBS
Project management	24 months	£ 48,000.00	Averaged at £2000 per month, includes all design time
First prototypes	1 month	£ 7,500.00	This costing includes manufacturing and test failure
3D analysis	2 months	£ 4,000.00	
Review of Drawings by Baseefa	2 months	£ 9,000.00	
Proquip 4530 Electric Panel prototype	1 month	£ 5,000.00	Manufacturing costs for the two panels that were to be tested
Baseefa testing and certification	1 month	£ 11,000.00	Pressure testing and testing to destruction
Totals	circa 24 months	£ 84,500.00	

Table 1: Rounded costing during the process of product development of the Proquip 4530 panel

Following this product being developed and produced, the knock-on effect was the prototyping of three other control panels:

- A half-height control panel that got to the stage of having fabrication drawings submitted to Baseefa for review
- An isolator box with only a concept 3D model
- A Junction Box with only a concept 3D model



Figure 4. Half-height Control Panel

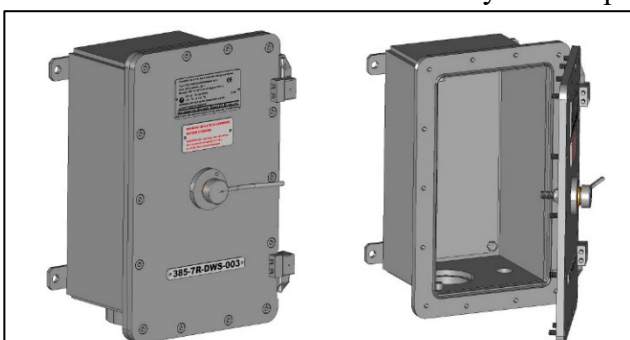


Figure 5(left). Isolator and Junction Box

By and large, the Proquip 4530 Panel was a good fix for the short to medium time frame because it satisfied the initial premise of cost reduction, but the full scope of the other products that could have been developed as a knock-on effect was never realised.

The best practice in the innovation process?

The question asked at this stage is: Does the innovation process represent best practice? In order to arrive to a relevant answer, the parameters of this process must be set.

- What this an innovation?

Freeman (1982) quoted in Mumby's lecture (Mumby 2022, pg. 10) states that 'Innovation includes the technical, design, manufacturing, management and commercial activities involved in the marketing of a new (or improved) product or the first commercial use of a new (or improved) process or equipment.'

The Control Panel fits this definition and is indeed a product innovation that is new to the company, developed using all the above activities.

- What process of innovation can be used to measure against?

Considering that we are referring to a product innovation we can look at a few authors and their definitions/ milestones of the innovation process.

For instance, Trott considered activities-staged model and concurrent engineering (Trott 2016) when he was listing models of new product development. The process of developing the enclosure fits the bill when it comes to the stages it went through, starting with the planning, then prototyping, to developing the model all the way to commercialisation (Trott 2016). An important technology employed was the 3D analysis which satisfied the concept of concurrent engineering while spending very little physical materials.

Another example of innovation as a process is raised by Kahn when he looks at the innovation cycle as a model for organizing and managing the activities to reach a fruitful outcome (Kahn 2018) Once again, the process of developing the panel goes through all these three stages in the same way. Identifying the right component to manufacture rather than buy in was done at the discovery phase. Developing the product utilising all the technologies in house and acquiring the external resources to fill in the missing steps in the process, and lastly delivering the finished product. To date, PCT has manufactured 102 panels, having had 2 failures at the start of the process and having 3 remaining in stock. This information can be found in Appendix 4.

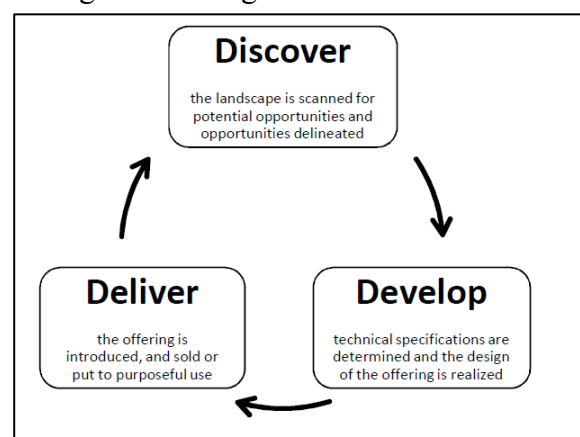


Figure 6. The innovation cycle (Kahn 2018)

All in all, 97 panels were commercialised, and became part of the Explosion Proof Hoists that are operating at present in various parts of the world like Nigeria, Brazil, Saudi Arabia, Kazakhstan.

The conclusion

In final analysis, I can safely say that the innovation process was well managed, achieving the result and completing the cycle of innovation. When it comes to product innovation all the processes come to a make-or-break point – have they led to creating a viable product?

Whether you look at Kahn's innovation cycle where it ends with delivery (Kahn 2018), or you look at Trott's activity model finishing with commercialisation (Trott 2016), or the stage-gates a product must pass through according to Tidd and Bessant (Bessant, Tidd 2015), it all comes to the last step which is creating the cost-effective product that was set out at the start of the process. The Porquip 4530 panel is exactly that product, in addition to generating circa £240,000 in savings over 2 years of production (see Appendix 2 for the cost comparison), it also enabled the company to have the option to bring in house an expensive and long-lead component. All in all, the innovation was a success, albeit limited in scope.

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Appendix 1: Baseefa Examination certificate – front page

Certificate Number
Baseefa15ATEX0020U



Issued 20th July 2016
Page 1 of 3

1 EU - TYPE EXAMINATION CERTIFICATE

2 Component Intended for use on/in an Equipment or Protective System
Intended for use in Potentially Explosive Atmospheres
Directive 2014/34/EU

3 EU - Type Examination Certificate Number: Baseefa15ATEX0020U

4 Product: Electrical Control Panel (Empty Enclosure PCT 4530)

5 Manufacturer: PCT Group Limited

6 Address: Dalsetter House, 37 Dalsetter Avenue, Glasgow, G15 8TE

7 This product and any acceptable variation thereto is specified in the schedule to this certificate and the documents therein referred to.

8 SGS Baseefa, Notified Body number 1180, in accordance with Article 17 of Directive 2014/34/EU of the European Parliament and of the Council, dated 26 February 2014, certifies that this product has been found to comply with the Essential Health and Safety Requirements relating to the design and construction of products intended for use in potentially explosive atmospheres given in Annex II to the Directive.

The examination and test results are recorded in confidential Report No. GB/BAS-ExTR15.0012/00

9 Compliance with the Essential Health and Safety Requirements has been assured by compliance with:

EN 60079-0:2012+A11:2013 EN 60079-1:2014

except in respect of those requirements listed at item 18 of the Schedule.

10 The sign "U" is placed after the certificate number. It indicates that this certificate must not be mistaken for a certificate intended for an equipment or protective system. This partial certification may be used as a basis for certification of an equipment or protective system.

11 This EU - TYPE EXAMINATION CERTIFICATE relates only to the design and construction of the specified product. Further requirements of the Directive apply to the manufacturing process and supply of this product. These are not covered by this certificate.

12 The marking of the product shall include the following :

Ⓔ II 2 G Ex db IIB Gb

SGS Baseefa Customer Reference No. 7315

Project File No. 15/0024

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A handwritten signature in black ink, appearing to read 'R S Sinclair'.

R S SINCLAIR

TECHNICAL MANAGER

On behalf of SGS Baseefa Limited

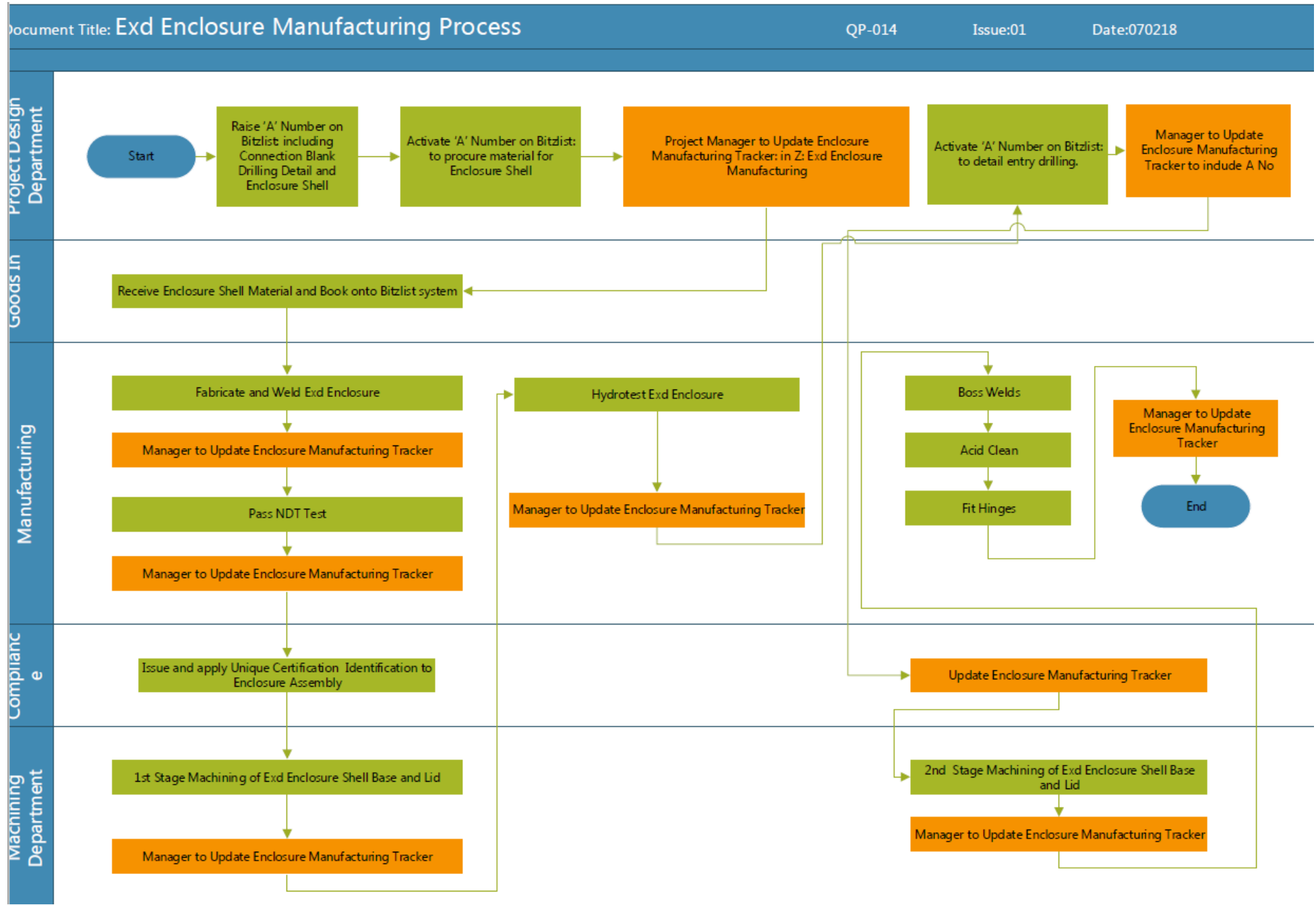
Appendix 2: A summary evaluation of the cost savings generated by the innovation

Cost sheet for 1 A612 104194_D 104193_C - Proquip 4530 Electrical Panel (26/05/2022)			
Sales Price	£4269.30	Unit Sales Price	£4269.30
Markup(s)	100%	Gross Margin	50.00%
Cost Total	£2134.65	Unit Cost Total	£2134.65
Labour	£1037.79	Unit Labour Cost	£1037.79
Energy	£19.59	Unit Energy Cost	£19.59
Overhead	£313.90	Unit Overhead	£313.90
Material	£763.37	Unit Material	£763.37

Profile (rounded costings)						
Qty	Relative Cost	Unit Price	Unit Cost	Labour	Energy	Overhead
1	100%	4269.30	2134.65	1037.79	19.59	313.90
2	84%	3615.48	1807.74	794.50	14.87	235.00
5	75%	3223.18	1611.59	648.52	12.04	187.65
10	72%	3092.40	1546.20	599.86	11.10	171.87
20	70%	3027.02	1513.51	575.53	10.62	163.98
50	69%	2987.80	1493.90	560.94	10.34	159.25
100	69%	2974.72	1487.36	556.07	10.25	157.67
200	69%	2968.18	1484.09	553.64	10.20	156.88
500	69%	2964.26	1482.13	552.18	10.17	156.41
1000	69%	2962.94	1481.47	551.69	10.16	156.25

Proquip Cost (batches of 5)	£	1,650.00	Average cost over the period (2016-2017)			
Sub-Contractor Selling Price	£	5,000.00	Average selling price over the period (2016-2017)			
Difference	£	3,350.00				
Money saved for 97 panels	£	324,950.00				
One off R&D costs	£	84,500.00				
Cost savings	£	240,450.00				
R&D costs ammortised after		25	panels			

Appendix 3: EXd Enclosure Manufacturing Process Map



Appendix 4: EXd Enclosure Manufacturing Master Tracker

1	Exd Enclosures												
2	Manufacturing Data									Certification Data			Box Material
3	Project	Project Number	Finished Machined Tag No	Machining Complete 1=Y, 0=N	TYPE	Assembly Number	Due From Machine Shop	Priority Machining order	Status	Manufacturing Job No Certificate No	Test Date	Pass/Fail	
4	Kaombo 2	124139	N-13JH7804	1	M20	A612	Complete	N/A	Complete	J1147.5/A612 1/26	????	Pass	Stainless Steel
5	Kaombo 2	124139	N-13JH7805	1	HPRE050	A612	Complete	N/A	Complete	J1147.5/A612 2/26	????	Pass	Stainless Steel
6	Kaombo 2	124139	S-13JH7804	1	M20	A612	Complete	N/A	Complete	J1147.5/A612 3/26	????	Pass	Stainless Steel
7	Kaombo 2	124139	S-13JH7805	1	HPRE050	A612	Complete	N/A	Complete	J1147.5/A612 4/26	????	Pass	Stainless Steel
8		1		1		A612				J1147.5/A612 5/26	????	Fail	Stainless Steel
9		1		1		A612				J1147.5/A612 6/26	????	Fail	Stainless Steel
10	Kaombo 1	124136	N-14JH7801-A	1	M40	A612	Complete	N/A	Complete	J1147.5/A612 7/26	20/08/2016	Pass	Stainless Steel
11	Kaombo 1	124136	N-14JH7801-B	1	M40	A612	Complete	N/A	Complete	J1147.5/A612 8/26	20/08/2016	Pass	Stainless Steel
12	Kaombo 1	124136	N-14JH7801-C	1	M40	A612	Complete	N/A	Complete	J1147.5/A612 9/26	20/08/2016	Pass	Stainless Steel
13	Kaombo 1	124136	N-14JH7801-D	1	M40	A612	Complete	N/A	Complete	J1147.5/A612 10/26	20/08/2016	Pass	Stainless Steel
14	Kaombo 1	124136	N-14JH7801-E	1	M40	A612	Complete	N/A	Complete	J1147.5/A612 11/26	21/08/2016	Pass	Stainless Steel
15	Kaombo 1	124136	N-14JH7801-F	1	M40	A612	Complete	N/A	Complete	J1147.5/A612 12/26	21/08/2016	Pass	Stainless Steel
16	Kaombo 1	124136	N-14JH7801-G	1	M40	A612	Complete	N/A	Complete	J1147.5/A612 13/26	22/08/2016	Pass	Stainless Steel
17	Kaombo 1	124044	N-12JH7825	1	HPRE050	A612	Complete	N/A	Complete	J1147.5/A612 22/26	04/10/2016	Pass	Stainless Steel
18	Kaombo 1	124043	N-12JH7801	1	HPRE050	A612	Complete	N/A	Complete	J1147.5/A612 21/26	04/10/2016	Pass	Stainless Steel
19	Kaombo 1	124045	N-12JH7803	1	HPRE250	A612	Complete	N/A	Complete	J1147.5/A612 23/26	04/10/2016	Pass	Stainless Steel
20	Egina	123910	TO-JE-7807	1	PETH02	A1227	Complete	N/A	Complete	J1146.29/A612 9/17	28/01/2017	Pass	Stainless Steel
21	Egina	123910	TO-JE-7808	1	PETH02	A1227	Complete	N/A	Complete	J1146.29/A612 10/17	28/01/2017	Pass	Stainless Steel
22	Kaombo 1	124044	S-12JH7825	1	HPRE050	A612	Complete	N/A	Complete	J1147.5/A612 25/26	04/10/2016	Pass	Stainless Steel
23	Kaombo 1	124043	S-12JH7801	1	HPRE050	A612	Complete	N/A	Complete	J1147.5/A612 24/26	04/10/2016	Pass	Stainless Steel
24	Kaombo 1	124045	S-12JH7803	1	HPRE250	A612	Complete	N/A	Complete	J1147.5/A612 26/26	04/10/2016	Pass	Stainless Steel
25	Kaombo 1	124136	S-14JH7801-A	1	M40	A612	Complete	N/A	Complete	J1147.5/A612 14/26	22/08/2016	Pass	Stainless Steel
26	Kaombo 1	124136	S-14JH7801-B	1	M40	A612	Complete	N/A	Complete	J1147.5/A612 15/26	22/08/2016	Pass	Stainless Steel
27	Kaombo 1	124136	S-14JH7801-C	1	M40	A612	Complete	N/A	Complete	J1147.5/A612 16/26	22/08/2016	Pass	Stainless Steel
28	Kaombo 1	124136	S-14JH7801-D	1	M40	A612	Complete	N/A	Complete	J1147.5/A612 17/26	22/08/2016	Pass	Stainless Steel
29	Kaombo 1	124136	S-14JH7801-E	1	M40	A612	Complete	N/A	Complete	J1147.5/A612 18/26	22/08/2016	Pass	Stainless Steel
30	Kaombo 1	124136	S-14JH7801-F	1	M40	A612	Complete	N/A	Complete	J1147.5/A612 19/26	04/10/2016	Pass	Stainless Steel
31	Kaombo 1	124136	S-14JH7801-G	1	M40	A612	Complete	N/A	Complete	J1147.5/A612 20/26	04/10/2016	Pass	Stainless Steel
32	Kaombo 1	124040	N-14JH7802-A (1)	1	M100	A1240	Complete	N/A	Complete	J1146.29/A612 11/17	29/01/2017	Pass	Stainless Steel
33	Kaombo 1	124040	N-14JH7802-A (2)	1	M100	A1239	Complete	N/A	Complete	J1146.29/A612 12/17	29/01/2017	Pass	Stainless Steel
34	Kaombo 1	124040	N-14JH7802-B (1)	1	M100	A1240	Complete	N/A	Complete	J1146.29/A612 13/17	29/01/2017	Pass	Stainless Steel
35	Kaombo 1	124040	N-14JH7802-B (2)	1	M100	A1239	Complete	N/A	Complete	J1146.29/A612 14/17	29/01/2017	Pass	Stainless Steel
36	Kaombo 1 Rev 1 Additions	42671	N-12JH7805	1	Goliath 25t (20t)	A1241	Complete	N/A	Complete	J1937.1/A612 3/5	09/04/2017	Pass	Stainless Steel
37	Kaombo 1 Rev 1 Additions	42671	S-12JH7805	1	Goliath 25t (20t)	A1241	Complete	N/A	Complete	J1147.5/A612 5/26	09/04/2017	Pass	Stainless Steel
38	Egina Topsides	123910	TO-JH-7805	1	HPLE120	A1241	Complete	N/A	Complete	J1768.1/A612 16/27	09/04/2017	Pass	Stainless Steel
39	Egina Topsides	123910	TO-JH-7806	1	EKPV050	A1241	Complete	N/A	Complete	J1768.1/A612 18/27	09/04/2017	Pass	Stainless Steel
40	Egina Topsides	123910	TO-JH-7808	1	HPLE120	A1241	Complete	N/A	Complete	J1768.1/A612 14/27	09/04/2017	Pass	Stainless Steel
41	Egina Topsides	123910	TO-JH-7809	1	HPLE120	A1241	Complete	N/A	Complete	J1768.1/A612 9/27	06/04/2017	Pass	Stainless Steel
42	Egina Topsides	123910	TO-JH-7810	1	EKPV050	A1241	Complete	N/A	Complete	J1768.1/A612 23/27	16/04/2017	Pass	Stainless Steel
43	Egina Topsides	123910	TO-JH-7811	1	HPLE120A	A1241	Complete	N/A	Complete	J1768.1/A612 13/27	09/04/2017	Pass	Stainless Steel
44	Egina Topsides	123910	TO-JH-7812	1	HPLE150	A1241	Complete	N/A	Complete	J1768.1/A612 17/27	09/04/2017	Pass	Stainless Steel
45	Egina Topsides	123910	TO-JH-7813	1	HPLE120	A1241	Complete	N/A	Complete	J1768.1/A612 15/27	09/04/2017	Pass	Stainless Steel
46	Egina Topsides	123910	TO-JH-7814	1	HPLE120	A1241	Complete	N/A	Complete	J1768.1/A612 11/27	06/04/2017	Pass	Stainless Steel
47	Egina Topsides	123910	TO-JH-7815	1	HPLE120A	A1241	Complete	N/A	Complete	J1768.1/A612 20/27	09/04/2017	Pass	Stainless Steel
48	Egina Topsides	123910	TO-JH-7816	1	EKPV050	A1241	Complete	N/A	Complete	J1768.1/A612 21/27	16/04/2017	Pass	Stainless Steel
49	Egina Topsides	123910	TO-JH-7817	1	EKPV050	A1241	Complete	N/A	Complete	J1768.1/A612 19/27	09/04/2017	Pass	Stainless Steel
50	Egina Topsides	123910	TO-JH-7818	1	HPLE150	A1241	Complete	N/A	Complete	J1768.1/A612 22/27	16/04/2017	Pass	Stainless Steel
51	Egina Topsides	123910	TO-JH-7819	1	HPLE120	A1241	Complete	N/A	Complete	J1768.1/A612 10/27	06/04/2017	Pass	Stainless Steel
52	Egina Topsides	123910	TO-JH-7820	1	HPLE120	A1241	Complete	N/A	Complete	J1768.1/A612 12/27	09/04/2017	Pass	Stainless Steel
53	Kaombo 1 Rev 1 Additions	124030	S-12JH7804	1	HPRE050 (5t)	A1228	Complete	N/A	Complete	J1071.1/A612 2/6	16/04/2017	Pass	Stainless Steel
54	Kaombo 1 Rev 1 Additions	124030	S-12JH7807	1	HPRE050 (2t)	A1228	Complete	N/A	Complete	J2044.1/A612 5/5	06/09/2017	Pass	Stainless Steel
55	Kaombo 1 Rev 1 Additions	124030	S-12JH7809	1	HPRE050 (5t)	A1228	Complete	N/A	Complete	J1071.1/A612 4/6	16/04/2017	Pass	Stainless Steel
56	Kaombo 1 Rev 1 Additions	124030	S-12JH7812	1	HPRE050 (3t)	A1228	Complete	N/A	Complete	J2044.1/A612 1/5	06/09/2017	Pass	Stainless Steel
57	Kaombo 1 Rev 2 Additions	124030	S-12JH7813	1	HPRE050 (5t)	A1228	Complete	N/A	Complete	J2044.1/A612 1/13	06/09/2017	Pass	Stainless Steel
58	Kaombo 1 Rev 2 Additions	124030	S-12JH7814	1	HPRE050 (2t)	A1228	Complete	N/A	Complete	J2044.1/A612 2/5	06/09/2017	Pass	Stainless Steel
59	Kaombo 1 Rev 1 Additions	124030	S-11JH7801	1	HPRE150A (12t)	A1228	Complete	N/A	Complete	J2045.1/A612 2/13	06/09/2017	Pass	Stainless Steel
60	Kaombo 1 Rev 1 Additions	124030	S-11JH7802	1	HPRE150 (15t)	A1228	Complete	N/A	Complete	J2045.1/A612 3/13	06/09/2017	Pass	Stainless Steel
61	Kaombo 1 Rev 1 Additions	124040	N-13JH7803	1	M40A (12t)	A1288	Complete	N/A	Complete	J1146.29/A612 15/17	29/01/2017	Pass	Stainless Steel
62	Kaombo 1 Rev 1 Additions	124040	N-11JH7801	1	HPLE150A (12t)	A1228	Complete	N/A	Complete	J1768.1/A612 2/27	18/03/2017	Pass	Stainless Steel
63	Kaombo 1 Rev 1 Additions	124040	N-11JH7802	1	HPRE150 (15t)	A1228	Complete	N/A	Complete	J1768.1/A612 1/27	18/03/2017	Pass	Stainless Steel
64	Kaombo 1 Rev 1 Additions	124030	S-12JH7802	1	HPRE150 (10t)	A1228	Complete	N/A	Complete	J2045.1/A612 7/13	06/09/2017	Pass	Stainless Steel
65	Kaombo 1 Rev 1 Additions	124040	N-12JH7802	1	HPRE150 (10t)	A1228	Complete	N/A	Complete	J1146.29/A612 17/17	29/01/2017	Pass	Stainless Steel
66	Kaombo 1 Rev 1 Additions	124030	N-12JH7804	1	HPRE050 (5t)	A1228	Complete	N/A	Complete	J1146.29/A612 3/17	27/01/2017	Pass	Stainless Steel
67	Kaombo 1	124040	S-14JH7802-A (1)	1	M100	A1240	Complete	N/A	Complete	J1937.1/A612 4/5	06/09/2017	Pass	Stainless Steel
68	Kaombo 1 Rev 1 Additions	124030	N-12JH7806	1	HPRE050 (2t)	A1228	Complete	N/A	Complete	J1146.29/A612 5/17	28/01/2017	Pass	Stainless Steel
69	Kaombo 1 Rev 1 Additions	124030	N-12JH7807	1	HPRE050 (2t)	A1228	Complete	N/A	Complete	J1146.29/A612 6/17	28/01/2017	Pass	Stainless Steel
70	Kaombo 1 Rev 1 Additions	124030	N-12JH7808	1	HPRE050 (5t)	A1228	Complete	N/A	Complete	J1146.29/A612 4/17	27/01/2017	Pass	Stainless Steel
71	Kaombo 1 Rev 1 Additions	124030	N-12JH7809	1	HPRE050 (5t)	A1228	Complete	N/A	Complete	J1146.29/A612 8/17	28/01/2017	Pass	Stainless Steel
72	Kaombo 1 Rev 1 Additions	124030	N-12JH7810	1	HPRE050 (3t)	A1228	Complete	N/A	Complete	J1146.29/A612 1/17	26/01/2017	Pass	Stainless Steel
73	Kaombo 1 Rev 1 Additions	124030	N-12JH7811	1	HPRE050 (5t)	A1228	Complete	N/A	Complete	J1146.29/A612 2/17	26/01/2017	Pass	Stainless Steel
74	Kaombo 1 Rev 1 Additions	124030	N-12JH7812	1	HPRE050 (3t)	A1228	Complete	N/A	Complete	J1146.29/A612 7/17	28/01/2017	Pass	Stainless Steel
75	Kaombo 1 Rev 1 Additions	124040	S-13JH7803	1	M40A (12t)	A1288	Complete	N/A	Complete	J1146.29/A612 16/17	29/01/2017	Pass	Stainless Steel
76	Kaombo 1	124040	S-14JH7802-A (2)	1	M100	A1239	Complete	N/A	Complete	J2045.1/A612 4/13	06/09/2017	Pass	Stainless Steel
77	Kaombo 1	124040	S-14JH7802-B (1)	1	M100	A1240	Complete	N/A	Complete	J2045.1/A612 6/13	06/09/2017	Pass	Stainless Steel
78	Kaombo 1	124040	S-14JH7802-B (2)	1	M100	A1239	Complete	N/A	Complete	J2045.1/A612 5/13	06/09/2017	Pass	Stainless Steel
79	Egina Hullsides	124110	HU-JH-7801-C001	1	PETH010	A1241	Complete	N/A	Complete	J1113.152/A612 5/8	16/06/2019	Pass	Stainless Steel
80	Egina Hullsides	124110	HU-JH-7801-C002	1	PETH010	A1241	Complete	N/A	Complete	J1113.152/A612 6/8	16/06/2019	Pass	Stainless Steel
81	Egina Hullsides	124110	HU-JH-7801-C003	1	PETH010	A1241	Complete	N/A	Complete	J1113.152/A612 7/8	16/06/2019	Pass	Stainless Steel
82	Kaombo 1 Rev 1 Additions	124030	S-12JH7806	1	HPRE050 (2t)	A1228	Complete	N/A	Complete	J1071.1/A612 3/6	16/06/2019	Pass	Stainless Steel
83	Egina Hullsides	124110	HU-JH-7801-D001	1	PETH020	A1241	Complete	N/A	Complete	J1113.152/A612 8/8	16/06/2019	Pass	Stainless Steel
84	Kaombo 1 Rev 1 Additions	124030	S-12JH7808	1	HPRE050 (5t)	A1228	Complete	N/A	Complete	J1937.1/A612 5/5	16/06/2019	Pass	Stainless Steel
85	Egina Hullsides	124110	HU-JH-7801-E001	1	PETH030	A1241	Complete	N/A	Complete	J1937.1/A612 1/5	16/06/2019	Pass	Stainless Steel
86	Kaombo 1 Rev 2 Additions	124030	S-12JH7810	1	HPRE050 (3t)	A1228	Complete	N/A	Complete	J1071.1/A612 5/6	16/06/2019	Pass	Stainless Steel
87	Kaombo 1 Rev 2 Additions	124030	S-12JH7811	1	HPRE050 (5t)	A1228	Complete	N/A	Complete	J1071.1/A612 6/6	16/06/2019	Pass	Stainless Steel
88	Egina Hullsides	124110	HU-JH-7801-D002	1	PETH050	A1241	Complete	N/A	Complete	J1937.1/A612 2/5	16/06/2019	Pass	Stainless Steel
89	Kaombo 1 Rev 2 Additions	124030	N-12JH7813	1	HPRE050 (5t)	A1228	Complete	N/A	Complete	J1768.1/A612 3/27			