Hard to win

After a bruising (and unexpected) Bermuda finale Oracle Team USA design co-ordinator Scott Ferguson takes stock…

The America's Cup is as much a design competition as it is a sailing competition; it is the pinnacle of the sport of sailing, requiring the highest level of commitment from an entire team of people over a long period of time. It combines design, engineering and technology together with pure sailing, requiring top-level experts in rigging, machining, composite building, hydraulics, electronics, computer programming, structural design engineering and fluid dynamics in addition to the world's top sailors and coaches.

When you bring all these individuals together to work toward a goal, that is when a team is made. Combine that with good chemistry, having a lot of things go right and firing on all cylinders when the actual racing begins, well, that is when a team sees true success.

The America's Cup is a hard regatta to win and heart wrenching to lose. Anyone on the inside of any America's Cup team has lived through the inevitable ups and downs. Despite this year's loss I'd like to step back and reflect on the overall picture of what has happened since the 70ft monohull America's Cup Class became obsolete 10 years ago.

Journey from 2007

I joined Oracle Racing in 2007 to lead the mast design for a 90ft monohull that never happened. Since then it has been quite the journey.

Over the past decade we have witnessed revolutionary changes in the sport. It feels like just yesterday we were watching the Cup with monohulls slowly duking it out on long courses. Fast forward to today and we have these racing machines on hydrofoils, with hulls never touching the water, that careen around a short racetrack and mesmerise onlookers who will miss them fly by if they blink an eye.

The Deed of Gift Match in Valencia in 2010, with Oracle and Alinghi going head to head on two mammoth multihulls, was just the beginning of what was to be a bumpy road toward change that ultimately resulted in the fast and nimble AC50s.

DANIEL FORSTER

In a nutshell the Deed of Gift is a document that defines the conditions under which the America's Cup will be competed. After each edition the winner of the Cup and the Challenger of Record must come together to agree on the Protocol for the next edition, which adheres to the Deed. In 2010 the guidelines when it came to the design were pretty wide open, with no limits on sail area, mast length, overall length, boom length, sprit length, materials, rudders, daggerboards or engines to drive the sheets; the only rule was each yacht had to have a waterline no greater than 90ft.

To put it into perspective, these yachts were so soaring in height that they could barely clear the Golden Gate Bridge. These 2010 America's Cup yachts were marvels of design and engineering and on the very edge of 'dangerous' given the timeframe of execution and how often we were modifying pretty much everything.

Despite two very cool boats and some

***Left*: at times in Bermuda the situation on the water could appear truly odd; but when you only ease the jib by a few centimetres at the top mark you know a lot has changed. *Above*: Oracle splash down after finishing behind ETNZ yet again. Spithill's upbeat efforts in the press conferences while suffering loss upon loss out on the water were mighty… right until the night before the final race when, like Dean Barker heading out to the last race in San Francisco in 2013, the body language told you that the game was up**

INGRID ABERY

eye-opening developments in the world of yacht design the contested challenge was over and a new class rule with some design limits needed to be introduced. The same questions were being asked back then: would it be a monohull or a multihull?

More countries – reduce costs

The start of the 2010-2013 campaign was marked with an 'event first' philosophy. Our build facilities and work sheds were opened up. There were lots of tours, no shrouding of hulls or components so the public could see everything we were doing. Furthermore, the goal was to level out the playing field and encourage more teams to compete; a goal that was often at odds with many of us who just wanted to win the next America's Cup.

Once the decision was made for the multihull AC72 box rule we were also tasked with designing the AC45 in the summer/autumn of 2010, a one-design package given to all teams entering as a test boat and a stepping stone into the AC72 multihull/wingsail arena. The AC45s were also developed for the inaugural World Series in 2011 and 2012, an offspring of the America's Cup to bridge the gap to the 2013 Cup and boost participation from more countries.

The series did just that, with as many as 11 entries competing from eight countries at different times during these events; most later fell by the wayside as the financial and other demands of competing in the Cup itself took on a stark reality.

The 2013 America's Cup in San Francisco saw an incredible final match between two quite different AC72 designs from Oracle Team USA and Emirates Team New Zealand. However, only four countries competing in the 2013 event were not enough for Larry and Russell and the push was on immediately to improve participation and reduce costs.

For the 2017 campaign lean was the theme, and at Oracle Team USA we were on a limited budget from the start. A small core of us were retained; and there was a push for us to exercise restraint when recruiting more designers and engineers.

Our first task in 2014 was to help draft a new rule introducing the AC62, a yacht 10ft shorter than the previous design to make it more cost effective and also tighten up the design space; for example, the wing surface shapes and jib sizes were limited to tight tolerances.

Next up was an internal task to modify the existing AC45 platform to create a scaled-down version of the AC62, which we launched in February 2015 as the AC45S. After buzzing around San Francisco Bay and setting a speed record of 46kt in 16kt of wind, we were pretty happy with our new test boat as a stepping stone to the AC62. And Larry was impressed that a small boat could achieve similar speeds to the AC72.

At this point there were still only five teams looking to enter, so the push was on to use something similar to the AC45S, with even more one-design components that would further reduce the costs and potentially allow in more teams. The majority of other existing entries agreed and the AC50 was born.

The change lost Italy (who merged some assets with New Zealand) but gained France and Japan. Throughout summer and autumn of 2015 our design team worked with Pete Melvin on an even more constrained AC50 design rule. From there they went on to create the one-design shapes of the hulls, beams, pod, sprit, wing and sails, following up with the structural engineering, laminate detail and rule drawings to accompany the AC50 class rule for all of the teams to build from.

I believe 2010 to 2017 will be considered an unprecedented period where the Defender of the America's Cup was not satisfied with just winning the America's Cup. Instead a considerable amount of money and effort was spent to grow the event and reduce the cost to compete. Equalising the boats was one of the compromises thought helpful to achieving this.

The racing in Bermuda

The first line-up between contenders is always a highly anticipated event, as it is the first time you really know where you stand. When Oracle and Emirates Team New Zealand first lined up on 15 May 2017 we appeared to have a comfortable speed advantage upwind and similar or better speed downwind with both teams on their small daggerboards. This was a very encouraging first test. The other clear observation was NZL's fast turn rates and generally consistent manoeuvres.

The start of the qualifiers, 27 May, was a big day for all of the teams with every point now counting. Before even leaving the dock threats of protest were being hurled about over the highly contested design feature of a loose lower shroud, which had been implemented on Oracle and SoftBank Team Japan to increase the rudder foil angle differential (through greater wracking of the hulls relative to each other) which increases the AC50 righting moment by 'pinning down' the weather transom.

We faced Groupama Team France and Emirates TNZ on day one, emerging with two wins. It was quite a close race with ETNZ, and our reaching speed was reasonably good, which was an area of concern leading up to that day. Our tacking was still not as consistent as the Kiwis', but our upwind speed kept us in the game.

We ended the qualifiers with a second win against ETNZ in TWS 9-11kt. Both teams emerged from the qualifiers holding an 8-2 win/loss record, with New Zealand's only two losses being to ourselves. With the extra point from the World Series (and winning the tie-breaker either way) we had won the qualifier Series and essentially just won our first race in the America's Cup. It was a big moment for Oracle knowing we were in the hunt.

By the end of the qualifiers you could begin to see all the teams adapting their technique a bit. We were speeding up our turns, the New Zealand crew were exiting their tacks at a higher angle. All of the teams were looking to take advantage of anything that the other teams were doing better.

The top four challengers rolled immediately into the semis/finals while we had two weeks to basically sail alone, which is a disadvantage. New Zealand's Peter Burling frequently referred to the steep learning curve his team were still on. They made a number of mistakes leading up to the America's Cup that they corrected, but practice makes perfect and certainly ▷

Burling got much better in the starting box as the Challenger Semis and Finals progressed. In my opinion, the Challenger Final Series between Artemis Racing and ETNZ was particularly interesting and highlighted some of the key difference makers to consider between the top three teams Oracle, ETNZ and Artemis:

Power production The ETNZ bikes produced approximately 20-30 per cent more raw power than arm grinders to control the boat. Additionally, using legs as the power input opened up the use of hands for precise control.

Daggerboard stability vs rake control system The more open 'L' foils on Oracle/ETNZ required more energy to control in exchange for higher performance. The more closed 'L' on Artemis gave them more inherent stability – which may be one of the reasons they performed better with more wind and waves.

Daggerboard wing area/span vs minimum tacking speeds The main difference between the light-air and heavy-air daggerboards was span and area. The larger area on the light-air daggerboards allowed for lower bottom speeds before dropping off the foils but at the expense of straightline speed. Each team had a different TWS where their foils were optimum, but this optimum was changing as the teams got better with their tacking technique and increased their bottom speeds. We discovered perhaps a bit late that our light-air daggerboard was only good in about 8kt and below, whereas ETNZ's was probably still working well up to 11kt.

Heel control and flying high Staying on the knife-edge of flying as high as possible without slipping sideways and heeling to windward, with the windward bow just touching, translates directly into boatspeed. ETNZ were the only team that dedicated one person to the board-rake control which sets the ride height, whereas Oracle and Artemis had the helmsman doing both, an extra role that increased the burden on the helmsman. Heel control is a combination of wing twist and wing rotation. ETNZ used hydraulics to do both, while Oracle and Artemis used hydraulics for twist and a winch for wing rotation.

Not a big difference between the three teams in straight-flight control, but I had the impression that ETNZ were capable of quicker catches. More available power affords these faster movements, likely to be most relevant during transitions like tacking, accelerating, mark roundings… and so on. Do it better than your opponent and valuable metres are on offer.

Mistake-free sailing The starts, rounding mark 1 ahead and executing the first gybe were a critical part of the race. Tactics and picking the correct gate mark to round were often what made the difference in the puffy, shifty Bermuda Great Sound. And consistency in all manoeuvres only became more important as the top teams began to execute perfect 100 per cent fly times.

The Louis Vuitton Challenger play-offs had Artemis and Team New Zealand going head to head in what was a very close series sailed with an average true wind speed of 13.2kt with no race sailed in under 10kt. New Zealand were up 2-1 going into day two, but had selected the light-air daggerboards – seemingly the wrong choice for the day. Artemis won Race 4 to even the series. Artemis were ahead again in Race 5 and looked to be in command if not for a few errors. I could easily have seen this day ending with the Swedish team up 4-2 and on match point. Instead ETNZ sailed brilliantly to lead 4-2 then went on to win the last start and extend around a lopsided racecourse with few passing lanes.

It was becoming evident that the ETNZ light-air daggerboards were well positioned in terms of moding and excelling in 8-11kt of wind, without too big a penalty up range. These were the daggerboards that the team used in the last 13 races… which took them to the end of the America's Cup.

The America's Cup Match between Oracle and Emirates Team New Zealand was not nearly as close a series as most of us anticipated. The average wind speed of 9.5kt and a range of 8-11kt may have been part of the reason. I think the first race weekend showed two weeks of rust on our side of the garage while ETNZ were pressed hard and continued to improve. Additionally, the Kiwis had time to modify their wingsail structure to accept the loose lower shroud set-up they copied from Oracle. This was clearly a boost to their performance (roughly 10m/minute).

After a dominating four wins in a row we were on our back foot and in need of some more speed. We learned through the racing that our light-air daggerboards were no good above 8kt, but looked as if they'd be better than ETNZ below 8kt had there been a chance to see that. Given the long-range forecast we decided to extend the span on our high-speed daggerboards to fill the gap down to 8kt, where New Zealand were so strong.

We closed the gap considerably on the second weekend and looked to have some new life after a win in Race 6 and had made a pass upwind after coming back in Race 5, only to cop a penalty during a routine dial-down. It just was not enough, the hole was too deep and the Kiwis were sailing flawlessly. The final race we picked our light-air daggerboards and they were clearly out of range – the result was pretty much determined before the race was started.

Deceptively smooth – but deadly. A calm-looking Glenn Ashby works the Gameboy, the cyclors pumping away steadily and nicely tucked in to minimise aero-drag. A look that compared dramatically with the flailing arms pressuring the hydraulics onboard Oracle

INGRID ABERY

The future

I was a fan of going back to a monohull after the 2010 Cup, but since then I've bought and learnt to sail both an A-Cat and a Moth. I have thoroughly enjoyed both. Going back to a design rule that requires heavy metal in bulb keels for righting moment would, I think, be a mistake.

Seeing the foiling tack already at a high level, I see more classic match racing – but now in catamarans – coming back. Even with the tight boundaries in Bermuda we were beginning to see more mid-course tacks, dial-downs, 'no-look' tacks… and so on. We have come a long way from the stigma of those painfully slow tacks and gybes on cats.

The America's Cup is the pinnacle of our sport and it should reflect the very best in sailing and technology. The technology is what differentiates it from the many successful one-design classes that have numerous countries represented at their world championships.

The America's Cup is hard to win and a lot has to go right to get the win. Congratulations to Emirates Team New Zealand as the new holder of the America's Cup. They proved to be the very best in all facets of their campaign.

I agree with Grant Dalton's comment that the America's Cup is not meant to be a 'beach cat regatta'. I am hopeful that Team New Zealand as the new trustees of the Cup will take the positives of what Oracle Team USA injected into the America's Cup over the last seven years. We may not agree on everything, but I think staying on the leading edge of design and allowing continued innovation should remain high on the list as they agree a new class rule with the Challenger of Record, Italy's Circolo della Vela Sicilia. Interesting days ahead. ▷