RCEA
(SUSSEX)

An Association for Retired Professional Engineers

NEWSLETTER April 2023

President's message

Hello everyone, and a warm welcome to the April Newsletter.

We are coming to the end of a full year of talks and are well prepared for the summer break. The talks have been varied and well attended, averaging 35 for the period January 'till April.

As we now move towards the summer, our thoughts turn to visits and outings, so please look further into this newsletter for any reply slips and keep a close eye on your in boxes as Mike will be sending things through as they crop up.

The Coffee mornings continue each month, with meetings on the 3rd Thursday of the month at the Spotted Cow and the last Thursday of the month at the Swallows Return with partners. There is always room available if you want to give it a go.

The AGM will start off our new season of talks on September 19th and once again the usual cry goes out for new members to join us.

We do value the input of the membership to arrange talks and visits as new / different thoughts bring fresh ideas. So, if you feel this is for you, please talk to me or anyone else on the committee for more information.

As I have said in the past, everyone on the committee works extremely hard to bring you these talks, arranging speakers, writing up the synopsis, arranging their expenses. This all takes effort and I wish to place on record my thanks to my fellow committee members for ALL their hard work and long may it continue.

All that remains is to wish you all a pleasant summer, keep your eye on emails form Mike and look forward to September when we can do it all again.

Take care and stay safe.

George Woollard

President
April 2023

PROGRAMME OF EVENTS May 2023 – September 2023

2nd May	**Tuesday**	**Visit – Virgin Atlantic maintenance hangar, Heathrow**
18th May	**Thursday**	**Coffee – at Spotted Cow, Angmering**
25th May	**Thursday**	**Coffee – with Partners at Swallow's Return**
13th Jun	**Tuesday**	**Outing – Denbies vineyard**
15th Jun	**Thursday**	**Coffee – at Spotted Cow, Angmering**
29th Jun	**Thursday**	**Coffee – with Partners at Swallow's Return**
20th Jul	**Thursday**	**Coffee – at Spotted Cow, Angmering**
27th Jul	**Thursday**	**Coffee – with Partners at Swallow's Return**
17th Aug	**Thursday**	**Coffee – at Spotted Cow, Angmering**
31st Aug	**Thursday**	**Coffee – with Partners at Swallow's Return**
21st Sep	**Thursday**	**Coffee – at Spotted Cow, Angmering**
19th Sep	**Tuesday**	**AGM & Talk – 'How do machines learn?'**
28th Sep	**Thursday**	**Coffee – with Partners at Swallow's Return**

All Talks and Meetings will commence at 2.30 pm and are held in the Pavilion, Field Place, Worthing unless another venue or time is indicated. Timings for visits and outings will be as printed in the detailed description of the activity.

Coffee mornings commence at 10.30 am.

We apologise for only being able to publish a very short list of our forthcoming events. We are increasingly having to inform our members of late changes to our programme by email and suggest that members should rely upon our website at **www.rceasussex.org.uk** for up-to-date details of events.

New Members and Speakers for Talks

The RCEA needs new members and speakers to ensure that we can continue as a thriving organisation. Please think of appropriate people you know and encourage them to come along to our talks and hopefully join the RCEA. All our talks are open to the general public as are our visits and outings, but priority will always be given to members if there is any limit imposed on numbers attending.
We also need more speakers to give talks to us on Tuesday afternoons from September to March/April. We are aware that many members have the knowledge from their working careers to provide interesting talks. If you are willing to give a talk, please let us know. Speakers from outside organisations are increasingly harder to find and often seek payment for their services.

RCEA Insurance

Members need to be aware that the insurance policy that the Association holds is solely for the protection for the assets and liabilities for the Association as an entity. The policy does not provide cover for personal injury or loss to individual members. Members attend the Association's events at their own risk, although under some circumstances there may be some cover from the insurance arrangements of the venue owner.

Newsletter Entries

If you would like to provide an article for inclusion in a future newsletter it would be very welcome as we are always looking for new material in addition to reports on previous talks and visits/outings. From feedback from our members, we know that the newsletter is particularly appreciated by those who are no longer able to get to our meetings and visits, so if you are able to contribute in this way it would be much appreciated. Articles should preferably be Microsoft Word documents, although we can usually convert both text and pictures (even photographs) into a suitable format. Accompanying pictures are best supplied as separate files which will be embedded within the text during editing.

Brief Detail – Talks, Outings and other activities May 2023 – September 2023

Visit
Tuesday, 2nd May 2023

We have arranged a visit to the Virgin Atlantic hangar at Heathrow airport on a day when we have been told that there will be an Airbus A350 in the hangar having an engine change. We believe that the visit is likely to start late morning and last in the order of 2 hours, and that Virgin can accommodate 18 of us.

Currently we have no further details, but members interested in joining the visit who have not already contacted Mike Wooldridge, our Programme Manager, should do so as soon as possible. There is no reply slip for this visit due to the tight timescale.

Outing
Tuesday, 13th June 2023

We have booked a group tour of the vineyard on the outdoor train departing at 12.30. The tour lasts 45 minutes and there are plenty of other things to do on our return. See www.denbies.co.uk
Once we have firmed up the number of participants, we are committed, so regrettably we cannot offer refunds for short notice cancellations. A reply slip is at the end of this newsletter.

Talk
Tuesday, 19th September 2023 - How do machines learn?
David James – member

It is becoming difficult to find industrial, commercial and healthcare products that don't claim to incorporate some form of Artificial Intelligence (AI). Much of it might be marketing hype, but AI techniques are being used to model systems that are difficult to describe analytically. And if governments are concerned about the application and verification of such systems then we perhaps need to take them seriously.

In the same breath as talking about AI, people also mention Machine Learning (ML). Certainly, any AI application needs to learn about the domain to which it is being applied, but how do you get a piece of software to learn about something in the physical world? This talk will look at one type of AI and, without using too much maths, describe some of the simpler approaches to Machine Learning.

Reports

Talk
Tuesday, 13th December 2022 – The design challenges of building modern lifeboats for the RNLI.
Iain Wallbridge BEng (Hons), CEng, MRINA, MSNAME, Senior Naval Architect, RNLI, West Quay Road, Poole, Dorset, BH15 1HZ

Iain has been a staff member of the RNLI since 1997 and began his talk by providing us with some background to the organisation.

The RNLI is entirely funded by donations, with annual running costs of approximately £200m of which £140m comes from legacies – the rest from donations.

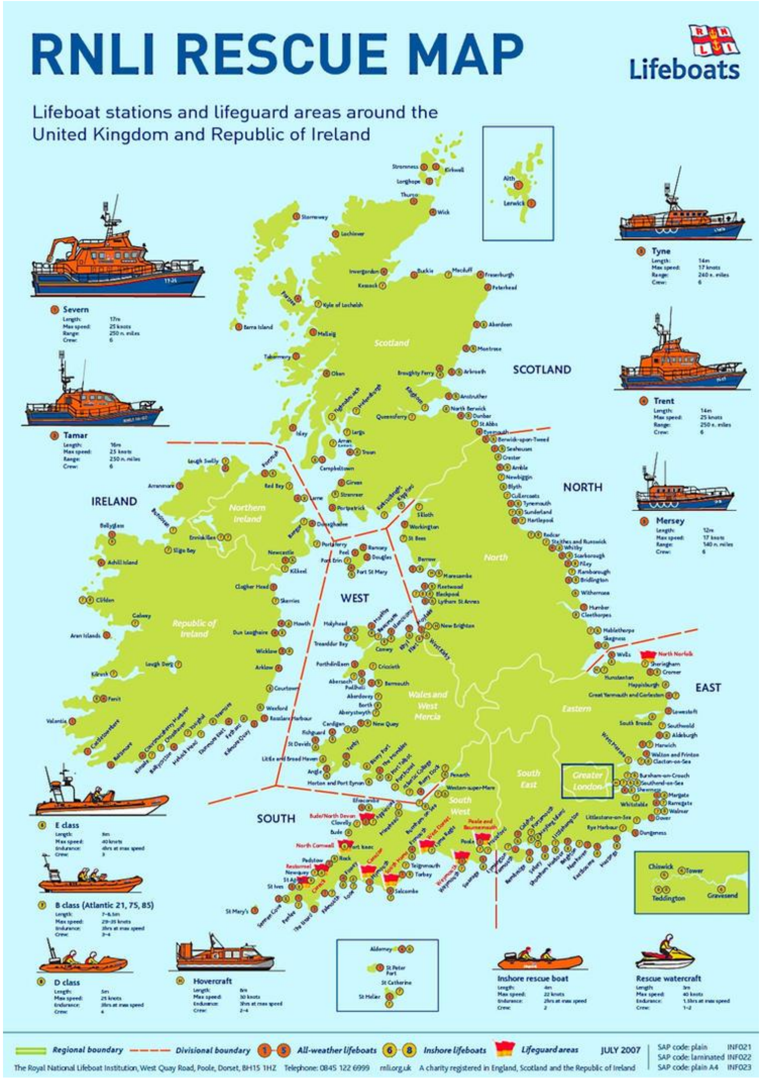
Since their formation in 1824, the RNLI has 'saved' 140,000 lives.

Based in the UK, the RNLI has 238 lifeboat stations, manned by 5,600 volunteer lifeboat crew members. The picture on the right shows the overall structure of the organisation.

In addition, there are 1,646 beach lifeguards, and a further 26,000+ shore-based helpers, all of whom are volunteers.

The RNLI also have paid staff, of whom Engineering & Supply Directorate have approximately 600 staff.

Iain comes from that part which was traditionally called the Engineering Office and consists of 44 engineers (Naval Architects, Marine, Mechanical, Electrical, Electronic, Launch and Recovery, CAD). They are the Design Authority for the whole of the RNLI.



Each station is equipped with craft appropriate to the station's location and expected duties, and includes a total of 160 all-weather lifeboats, 282 inflatables for inshore work, 7 Hovercraft, and a range of sophisticated launch and recovery vehicles.

The picture left shows the current fleet.

All-weather lifeboats (ALBs) have been manufactured in Poole for the last 6 years, whereas inflatables are manufactured in East Cowes.

Iain then went into detail about how the Shannon Class lifeboat, shown in the picture below- the RNLI's most modern ALB which first went into service in 1995 – came into being.

The design challenges.

As there are many conflicting requirements and constraints, some compromises are always necessary, as illustrated in the slide on the right.

For the Shannon, the range must be 250 nautical miles at full power, with 10% reserve fuel.

Speed and range dictate large engines (2 * Scania 650HP chosen) and plenty of fuel (2,700ltrs chosen)– but this adds to weight (50 tonnes max, dictated by launching/retrieval) and size (think of base station accommodation capacity).

The latter also introduces beam width constraints which in turn significantly impact on dynamic stability at sea.

The boat must tolerate 16m high waves and 60 knot wind speeds and be capable of 25 knots in Force 2 winds, reducing to 17 knots in Force 7. The picture below shows some of the sea conditions that the boats must be designed to survive and operate in.

Another obvious requirement is the ability to self-right in the event of a capsize. We were shown a video of a crane being used to capsize a prototype as shown in the picture on the right.

There are implications in terms of water intake, effect on engines, etc. The exhaust system is routed in such a way as to minimise the risk of water intake during a capsize.

The design of openings – needed for fresh air for the crew – must be limited and designed to minimise water intake.

Interestingly, Iain told us that during his 20+ years at RNLI there have been no capsizing events during operations.

Various hull shapes were considered during the initial design phase for the Shanon (see picture on the left) and tested in the Haslar water tank as well as using scale models up to 1.5m long in the sea.

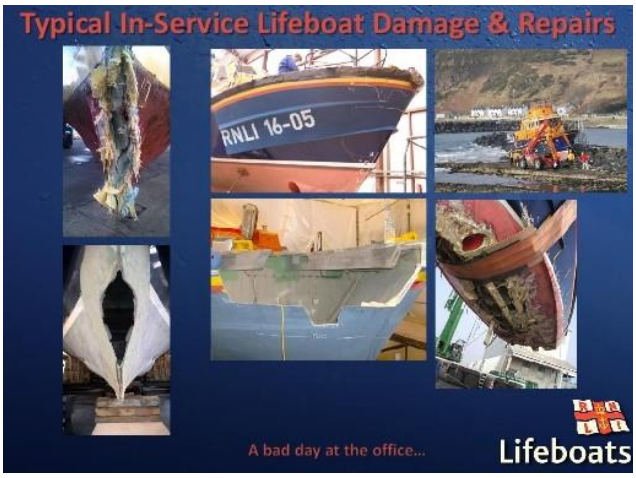
Other constraints include the need to use as many common parts and materials as possible across the RNLI's range of craft, and to design for long life.

Safety and ergonomics now assume an increasing role in the design of modern lifeboats.

For example, much attention is now given to crew seating, especially the skipper's seat, which is equipped with springs and dampers to help smooth out the jolts and G forces encountered in a rough sea.

Similar attention is now also given to seating in inflatables, and an inflatable seat, shown in the picture on the right, has evolved.

Beaching and underwater obstructions are always a challenge. Modern lifeboats, starting with the Shannon class, have minimal underwater protuberances – the most prone to damage being the rear stabilising fins. Rudders and propellers have been replaced by water jets which are far more robust and forgiving than propellers. We were shown a video of a lifeboat tethered with its stern just a few feet from a gravel beach with engine revving, something that would be impossible with traditional propellers and rudders.



Unfortunately, even with all the design features built into modern lifeboats, damage does still occur, bearing in mind that lifeboats must be capable of entering locations that other craft steer clear of. Iain showed some horrendous photos (left) of hulls damaged through hitting underwater obstructions at speed. Apparently, despite employing hulls moulded and then 'oven' cured (80-90 ºC) in a single operation, they can easily be repaired by careful cutting away of the layers of material, applying new GRP, then applying a vacuum bag to remove air, and finally heating the repair with a special external 'electric blanket'. In cases of severe damage, it is sometimes cheaper to write the hull off, but this has only happened some 3 times in the last 20 years.

The ease with which repairs and modifications can be made to the hull has given the RNLI the opportunity to extend the life of Severn class boats rather than replace them, and thus save on capital costs. A new Shannon boat costs £2.3m. Another advantage of using (modern) GRP is that it enables designers to simply apply extra layers in areas of higher stress. Strain gauges are used to measure this, but, in answer to a question, Iain told us that laser scanning is also used to detect the very small dynamic movements away from the at-rest scan readings.

Inflatables

These are extensively used inshore, but it is only recently that more attention has been given to whole body vibration and ergonomics. Research using water tank testing at Hasler has shown that hitherto unstudied longitudinal vibrations do occur, where the bow moves forward whilst the stern moves backwards. Ripples along the underside of the floor membrane have also been studied using vertical straws protruding through a reference plane laid over the floor.
The sponsons (the inflatable side tubes) frequently encounter rocks or other obstructions. RNLI inflatables have more internal walls (and hence water-tight compartments) within the sponsons than a normal commercial inflatable.
Our speaker has never seen an inflatable sink due to sponson damage, although he has seen one sink due to a fire caused by a faulty flare! Luckily the crew were close to shore and could swim/wade to safety.

The talk generated many questions: -

1) What co-operation is there between RNLI and other countries' lifeboat services? Answer - Not as much as one might expect, though Iain did explain that they have links to, and share knowledge with, the Netherlands, Germany, and France. The RNLI are members of the International Maritime Rescue Federation and have often sold boats to other organisations and trialled other organisation's boats to avoid re-inventing the wheel.

2) Are lifeboats sent back to Poole for routine maintenance? Answer - Not really. The RNLI have divided the UK into regions, each of which is staffed with specialist maintenance/repair engineers who travel to the region's lifeboat stations as necessary.

3) What external checks are carried out on RNLI engineering design, regulation compliance, and maintenance? Answer - Virtually none. In some ways the RNLI would welcome such checks, but they feel they already exceed many requirements. The RNLI do work with Lloyds Register and MCA in UK and Irish equivalent in Republic of Ireland to develop codes, etc. We do have links with universities, etc. The RNLI also have a committee structure that oversee the various functions of the RNLI. One of these is a voluntary Technical Committee made up of some very eminent engineers, academics, and operators from marine and other industries. They meet a few times per year and receive reports on work that is ongoing. They may also advise on some subjects if we are asked to do so.

4) Do the engines momentarily stop during a capsize? Answer - No. They automatically throttle back to idle, and various valves etc automatically close. It was worse in the days of carburettors etc.

5) Does the design team find life easier not being government-controlled and potentially subject to changes in requirements? Answer - Maybe, but the RNLI has learnt how to respond to constantly changing requirements, particularly in the areas of health and safety for both the crew and those rescued. Iain felt that the RNLI, being independent of Government control, allows it to do what is necessary to save lives at sea without having to deal with politics.

Our thanks to Iain for a most interesting talk.

Mike Wooldridge

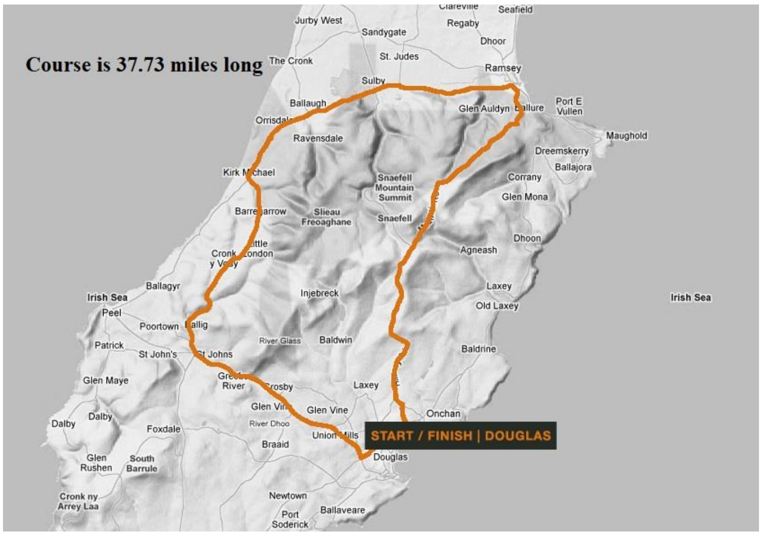
Talk

Tuesday 10th January 2023 – The TT races from an engineering perspective

Malcolm Hind - member

Our speaker, Malcolm, is an engineer with a career in the automotive industry and with a life-long interest in two wheels on which he has extensively toured Europe and has attended the TT races as a spectator.

He began his talk by giving us some background to the origins of the Tourist Trophy races (TT), from the Gordon Bennett Challenge Cup in 1899, originally for cars, later to include motorcycles, up to the creation of the TT in 1907.



The TT is a race for motorcycles (and sidecars) held each year in late May, early June, on the Isle of Man.

The race circuit is shown on the map of the island on the left and is now known as the Snaefell Mountain course of 37.73 miles long.

It differs from most race circuits in two ways – there is no dedicated racetrack, with racing taking place on public roads, and it is a time trial with riders starting off either singly or in pairs at 10 second intervals.

The start and finish are in the capital, Douglas.

In the early days of the TT, the motorcycles were little more than engine-assisted bicycles as can be seen in the picture on the right, which shows Rem Fowler on a Norton. Note the pedals and the single front brake.

The motorcycles of this period were incapable of climbing the mountain course (nor safely descending), so racing took place on a shorter course referred to as the St. John's course of 15 miles. Competitors had to traverse the course 10 times with a compulsory 10-minute stop after 5 laps for refuelling, refreshments and, usually, repairs.

Riders often carried spare inner tubes and spark plugs, such was the fragility of these early machines, and not all starters finished, including one machine that caught fire on the course.

The first two races on the Mountain course were won at average speeds of 41.45 mph and 47.63 mph.

Although these speeds appear very low by today’s standards, we must remember that during these early years the roads were little more than cart tracks as can be appreciated from the picture on the left showing Harry Collier on a Matchless in 1911 kicking up the dust.

There were also gates across the road. It was the duty of the first rider round in the morning to open all the gates, and the last one to close them.

The year 1911 also marked the first fatality at the TT.

Crash helmets came into use in 1914, but crowd safety did not improve however, as can be seen in this picture on the right showing Tommy Spann descending Bray Hill in Douglas on a Jawa in 1933.

The only safety precaution appears to be a rope restricting spectators to the sidewalks.

By this time machines regularly exceeded 100 mph on parts of the course.

MOTORCYCLE MAKES IN THE TT 1907-1939

BRITISH	NORTON	MATCHLESS/JAP	TRIUMPH	DOT	BAT
BRITISH	NUT	HRD (VINCENT)	RUDGE-WHITWORTH	OK-SUPREME	ROYAL ENFIELD
BRITISH	CHASE	McEVOY	FORWARD	SCOTT	COTTON
BRITISH	LEVIS	REX ACME	VELOCETTE	DOUGLAS	BLACKBURNE
BRITISH	SUNBEAM	NEW IMPERIAL	EXCELSIOR	VINDEC	NEW HUDSON
BRITISH	ARIEL	BSA			
ITALIAN	MOTO GUZZI	BENELLI	GARELLI	BIANCHI	
GERMAN	WANDARER (JAWA)	DKW	BMW	NSU	
BELGIAN			FN		
AMERICAN			INDIAN		
SWEDISH			HUSQVARNA		

The years before the outbreak of the second world war marked a golden period for British manufacturers, and in this slide on the left showing makes of TT machines from 1907 to 1939 you can see why.

You may be able to recognise some of these names, the majority having ceased trading many years ago.

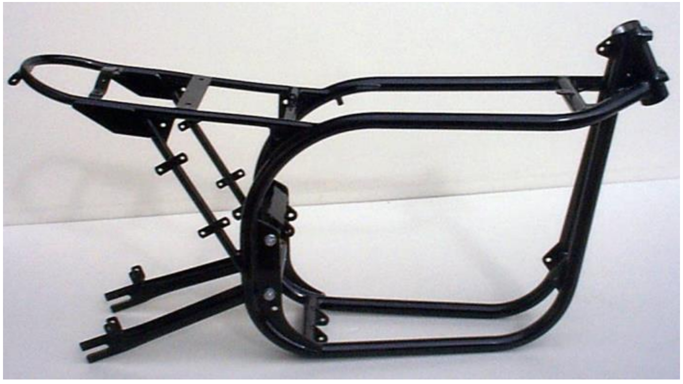
Interestingly although British manufacturers dominated the racing scene and were much envied by overseas companies, the German company DKW was the largest single manufacturer making large numbers of two stroke motorcycles.

Following the end of the second world war, the TT started up again in 1947 and in 1949 was given official World Championship status, becoming the British round and the most prestigious round of the world series. This resulted in many overseas riders and motorcycles coming over to the Island with makes such as Benelli, BMW, Moto Guzzi, Mondial, MV Augusta and Gilera.

The number of races also increased to cover the 125, 250, 350 500cc and sidecar classes.

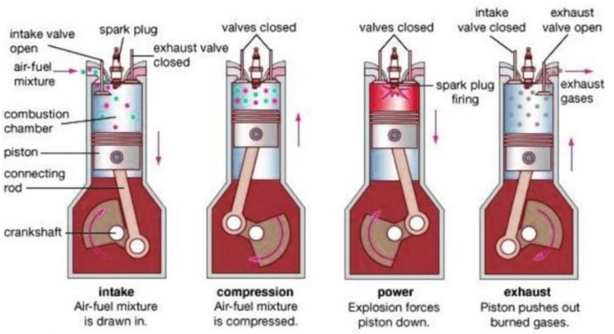
Norton introduced what was to become known as the Featherbed frame in 1950, shown in the picture on the right. This frame had full suspension front and rear with the engine cradled in between.

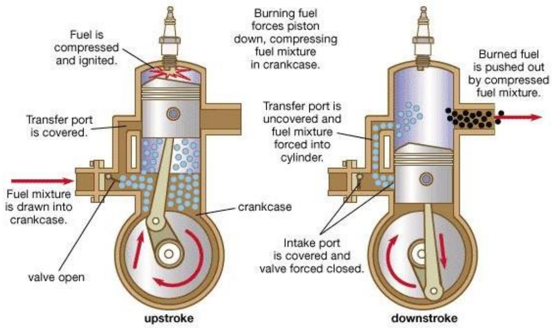
This layout was quickly adopted by other manufacturers and remains in use today, albeit with light alloy castings often replacing the steel tubes.



The early 125cc class, often known as the lightweights, were won by 4 stroke machines, sometimes revving to 10,000 rpm. In fact, most of the motorcycles racing at the TT up to this time were 4 strokes, although those manufactured by Scott, Levis and DKW were actually 2 strokes.

However, all was about to change with some significant developments of the 2-stroke engine. In the diagrams below we can see the basic principles of operation of 4 stroke and 2 stroke engines.





In the diagram above we see the 4-stroke cycle where the engine provides 1 power stroke every 4 cycles, or every 2 revolutions.

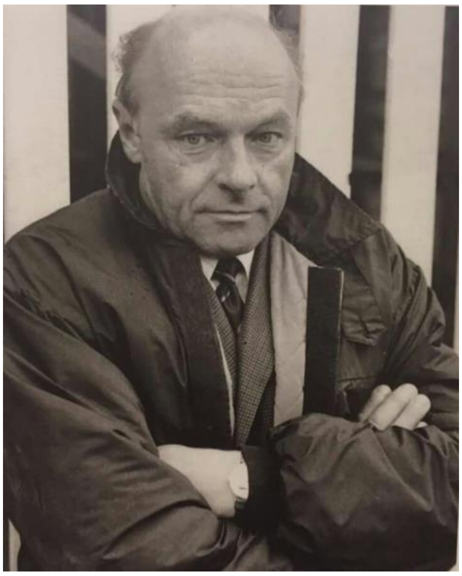
The well-known sequence is Suck, Squeeze, Bang, Blow.

By contrast the 2-stroke (above) provides 1 power stroke every 2 cycles or every revolution. This would seem to be a major advantage over the 4-stroke cycle, particularly considering the absence of valves and their associated drive gear.

Unfortunately, the 2-stroke has several problems, starting with the difficulties of providing lubrication to the bearings which are in a pressurized crankcase subject to regular ‘washing’ with fuel/air mixture. This is usually overcome by mixing a small amount of oil into the fuel, but this implies a total loss lubrication system which in turn often results in spark plug fouling. It also results in two stroke exhausts having a bluish haze, and in the case of racing engines, leaving the familiar aroma of burnt Castrol R in the air.

An even more significant problem is that during part of the 2-stroke cycle, both the transfer and exhaust ports are open at the same time, resulting in the carrying over of some unburnt fuel straight into the exhaust. This not only affects fuel consumption, which is relatively poor compared to the 4-stroke engine, but exhaust emissions are high making it very difficult to meet emission regulations. Note the shaped piston top to try and minimize the mixing of incoming and exhaust gases.

Development of the 2-stroke engine after the second world war owes much to two East German engineers, Walter Kaaden shown in the picture overpage on the left, and Ernst Degner in the picture overpage on the right.

During the war, Walter Kaaden (on the left) worked at the Peenemünde Army Research Centre, and at the end of the war was captured by the Americans before returning home to build his first motorcycle based upon the DKW RT125, which design was later taken by the allies as part of wartime reparations and ultimately became the basis for the design of the BSA Bantam which sold in large numbers and was used extensively by the UK post office for telegram delivery.

Kaaden was a brilliant engineer, and in 1955 used an oscilloscope to study resonances in the exhausts of his two-stroke engine resulting in the development of the expansion chamber or resonator which improved the performance of the two stroke substantially, but only over a very limited range of engine speeds, making power delivery rather ‘peaky’.

Both Walter Kaaden and Ernst Degner worked for MZ, an East German company, Kaaden being the Chief Engineer and Degner the factory rider. By the early 60s the MZ 125 and 250cc machines were formidable on the racetrack forcing other motorcycle manufacturers to develop their own two stroke engines to compete.

During the Swedish Grand Prix in 1961, Degner defected to the West taking all MZ’s secrets with him and ultimately re-emerged working for a Japanese manufacturer, Suzuki. In 2021, a film entitled ‘Missile from the East’ was released about Degner’s defection.

MZ did not have the financial resources to invest to compete with the Japanese, so the balance of power started to move to the far east.

In addition to the use of an expansion chamber, several manufacturers added valves to their two stroke engines such as the disk and reed valves to increase power output.

Some manufacturers were also moderately successful in developing alternative crankcase lubrication systems to avoid the need to add lubricating oil to the fuel.

Two stroke engines were extremely successful, even up to 500cc machines, but their thirst (some could only manage 11mpg) and the development of four stroke engines contributed to their demise. You could always tell when a two-stroke racer went by as it sounded like an angry wasp, usually also leaving the rather pleasant aroma of burnt Castrol R in the air. The last year that two strokes raced at the TT was 2004.

The period from the late 50s to the early 60s is often called the golden era of the TT, with riders such as Geoff Duke, John Surtees, Mike Hailwood, Giacomo Agostini, Phil Read and Jim Redman competing.

In the golden jubilee year of 1957, Bob McIntyre on an Italian Gilera became the first rider ever to lap the Mountain circuit at an average speed of over 100 mph.

T T wins by make

Honda	255 wins
Yamaha	232 wins
Suzuki	107 wins
Norton	94 wins
Kawasaki	42 wins
BMW	36 wins
MV Agusta	34 wins
Triumph	21 wins
AJS	19 wins
Aermacchi	18 wins

Moving further into 1960s, the TT saw a period of tremendous innovation largely driven by the Japanese manufacturers who were intent upon dominating the manufacture of mass transport, something which they did extremely well with their mix of engineering competence and dogged persistence.

It is a sad fact that despite British companies being involved in the TT from the very beginning, if we look at the number of wins by make (picture on left), Japanese manufacturers are way out front, even though they were very late entrants to the racing scene.

Honda, the most successful of the TT manufacturers, was responsible for a large number of developments in racing motorcycles, many of which were later incorporated into their range of road bikes and later influenced their development of cars.

The company was founded after the war in 1948 by Soichiro Honda who was by then already 48 years old. Although his first product was a 50cc two stroke, it was said that Mr. Honda did not like two strokes, and as we will see later, was a very talented engineer capable of producing complex four stroke machines which eventually became the envy of the world.
He first came over to the Isle of Man in 1954 and was apparently impressed by the speeds of the racing bikes and their reliability. He publicly stated that he intended to participate in the TT as he saw it as the pinnacle of racing success.

It wasn't until 1958 that Honda began to race at the TT but didn't do too well initially. The next year they entered 5 machines in the 125cc class, all with Japanese riders, and finished in sixth, seventh, eighth and eleventh places. One rider fell off. In 1960 they entered both 125cc and 250cc classes and gained a fourth, fifth and sixth place.

However, 1961 marked the breakthrough for Honda now that they had signed up Mike Hailwood to ride their machines and Hondas took the first 5 places in both classes to the astonishment of their competitors who started to take Honda seriously at last.

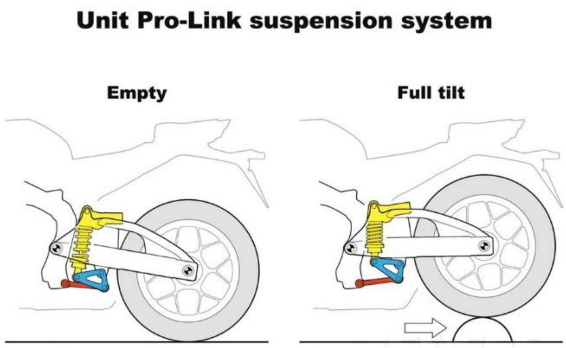
Over the next few years Honda began to dominate the racing world with their incredible engineering skills as this slide on the right shows. To further illustrate how good these engines were, at 20,000 rpm the valves have to open and close 167 times every second. With the exception of the 500cc engine, all the rest develop more than 200bhp/litre. These are naturally aspirated engines which would be completely stripped down and rebuilt after each race, but still have to be sufficiently durable to last a race – in racing, a popular saying is in order to finish first, you first have to finish.

Honda's range of four stroke racing engines

50cc twin-cylinder	14 bhp at 21,500 rpm
125cc five-cylinder	34 bhp at 20,500 rpm
250cc six-cylinder	60 bhp at 18,000 rpm
297cc six-cylinder	65 bhp at 17,000 rpm
500cc four-cylinder	85 bhp at 12,000 rpm

Not content with showing the world that Honda engineers were supreme, in 1979 they announced the NR500 racer (pictured on the next page) with carbon brakes, upside down forks, a rising rate rear suspension and slipper clutch – all common features now on MotoGP bikes and on many road bikes.

Some of these features are explained in the pictures on the next page beneath a picture of the NR500 itself.



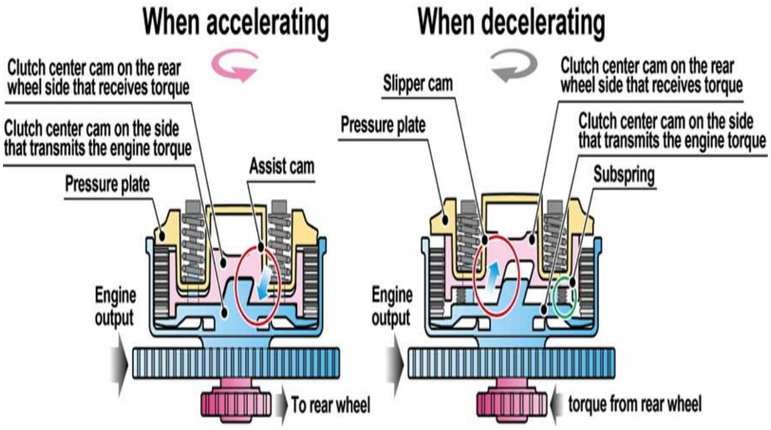
The picture above shows upside-down front forks, so called because the heavier outer tubes were at bottom in older designs of fork. This upside-down arrangement reduces unsprung weight but gives the fork oil seals a harder life as most of the internal parts of the fork are filled with oil for both lubrication and damping.

The picture above shows a typical rising rate rear suspension where the effective spring rate increases as the suspension deflects due to the geometry of the links, which do require periodic maintenance to remain fully effective.

The picture on the right shows a typical slipper clutch which largely prevents rear wheel lock-up should the rider change down in gear too quickly.

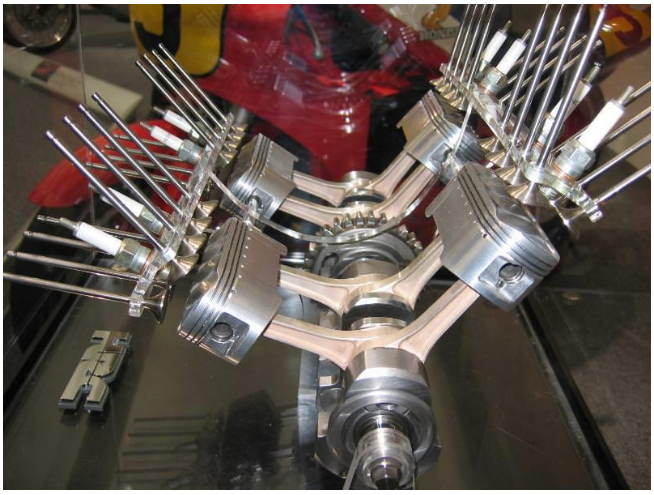
Modern high compression engines generate a lot of braking torque when the throttle is closed and should this exceed the level at which the clutch is set, it effectively disengages the drive between the engine and rear wheel.

This is again a feature found in many of today's motorcycles.



However, the feature for which the Honda NR500 will be forever remembered concerns its V4 engine, pictured right, which had 'oval' pistons, 8 valves per cylinder, twin spark plugs and a rev limit of 20,000 rpm, previously unheard of in such a large capacity engine.

Regrettably the NR500 did not achieve the ambitious targets that Honda had hoped for, and development was quietly dropped a few years later.



Even though the NR500 was considered by some to be a failure, many of its features were incorporated into Honda's next generation of winning race bikes such as the RC30 and RC45 with conventional pistons in a V4 configuration, both of which ultimately became big sellers in road going form.

In 1976 the British Grand Prix was held on the mountain circuit for the last time, and many people thought this would be the end of the TT as manufacturer's support was withdrawn. The TT has however survived, and 1977 saw the start of a remarkable series of victories by a little Irish man called Joey Dunlop who went on to win 26 TTs, a record that still stands today and will probably never be beaten.

In 2009 a new race series named the TTXGP was introduced for electric motorcycles (shown in the picture on the left) which was limited to 1 lap of the TT course due to the limitations of the batteries.

One of the early sponsors was the IET, with whom our speaker travelled to the race.

The race series was renamed TT Zero the following year, and although the machines achieved lap speeds of over 80 mph, the concept of near silent motorcycles racing at the TT was never a crowd puller and the series was abandoned a few years later.

So why do so many people still come over to the island each year to watch the TT although it no longer enjoys manufacturer support nor is it part of any world race series?

Malcolm offered some suggestions from his own experience of visiting the TT. Unlike any other racing event, you can watch 2 weeks of practice and racing for free. You can stand anywhere along the 37.73-mile course, including in some well used public houses. The accent is on informality. You can mix with the competitors and their machines in the paddocks. You can sit at the side of the road and have the racers pass by within feet of you, sometimes doing more than 100 mph.

Our speaker concluded his talk by inviting the audience to experience riding the TT via an on-bike video taken in 2019 when the lap record was 134 mph.

Following the break for refreshments, there was a lively question session revealing that many of our members have ridden motorcycles previously, with several admitting to still having some in their garages!

Malcolm Hind

Talk
Tuesday, 14th February 2023 – Target Acquisition and Surveillance

Eddie Bridges BSc (Hons) Environmental Management – member

Eddie began his career instructing in the Royal Artillery as a Staff Officer, and has served in the UK, Germany, Sarawak and Oman. Later he became responsible for Environmental Protection within the MOD.

He began his talk by comparing his subject with the skills required to drive a car on a public road, relying upon some necessary skills to control the vehicle, keen observation of potential hazards, and the ability to react to unexpected events such as finding another vehicle travelling towards you on your side of the road! The same skills are required of artillery officers.

In the very early days of warfare, opposing forces would have little more than stones to throw at each other, but the Romans soon introduced catapults which had more effect, even though it was largely the fear of the 'weapon' on the enemy rather than the accuracy of the projectile.

Gunpowder, also commonly known as black powder to distinguish it from modern smokeless powder, is the earliest known chemical explosive, much used as a propellant in early cannons as shown on the right. It consists of a mixture of sulphur, carbon (in the form of charcoal) and potassium nitrate (saltpetre). Compared with more modern explosives it burns relatively slowly, perhaps just as well considering the relatively low strength of cannon barrels of the period.
It was originally discovered by the Chinese and came to western notice through the writings of Roger Bacon in 1267.
Cannons of this era could project a cannon ball about 200m and were used mainly to break down defensive walls.

The picture on the left shows one of the largest cannons made, named Mons Meg (after the Belgium town of Mons) and had a barrel of 20” in diameter.

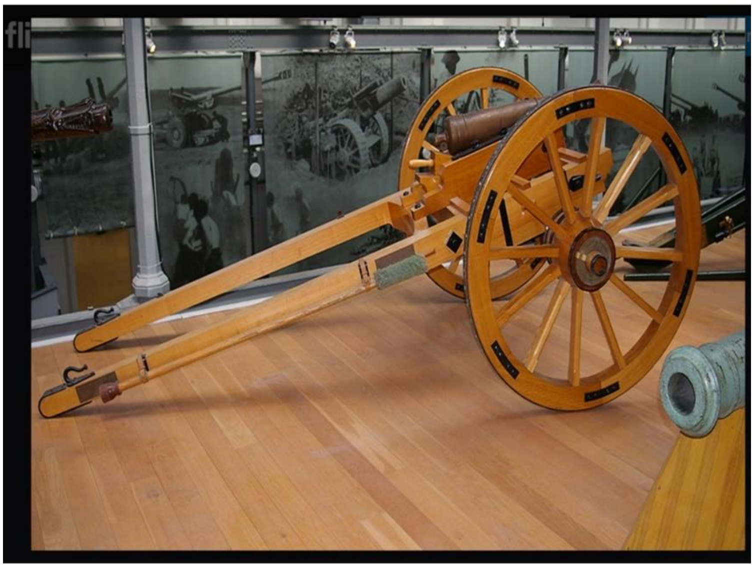
Mons Meg was built in 1449 on the orders of the Duke of Burgundy and gifted to the king of Scotland in 1454, where it still resides at Edinburgh Castle.

It could project a ball about 1480 yds but took some 20 minutes to reload limiting its fire rate to some 3 shots per hour.

As cannons became a favoured means of breaking down castle walls, so called Star Forts such as the one shown on the right in India became popular, particularly in Italy during the French invasion from 1494 to 1559.

Even the great Michelangelo himself designed the defences of Florence using this principle.

Star Forts were much more difficult to penetrate with cannon shot, and even when part of the wall had been broken, defenders could stand atop the walls and direct fire down on the intruders from two sides.



The battle of Blenheim in 1704 demonstrated the benefits of mobile artillery, and the picture on the right shows a Galloper, which was essentially a cannon mounted on a wheeled carriage that could be pulled by one horse between the shafts.

It had 1½, 2, 3, 4 and rarely 6 pound shell variants. The gun and carriage weighed around 600 pounds.

Although the Galloper itself was relatively mobile, it had no provision for ammunition storage: consequently, the time to fire from a different location was not significantly reduced as the gun crew had to follow behind bringing these essential stores with them.

Following the Jacobite rebellion in circa1715, the British government established 2 companies of artillery at Woolwich in 1716, and in 1866 the first breach-loading, rifled barrel gun was introduced.

This is shown on the right, and although an improvement over the Galloper, still had no provision for ammunition storage nor protection for the gun crew.

It was however more accurate and capable of a faster turnaround between firings.

By the time of the Boer War in 1899, it was becoming obvious to the artillery officers that they needed to develop means of spotting the enemy (targets) when beyond the range of normal sight, and by 1902 ‘spotters’ in balloons were introduced, communicating back to the ground using either semaphore or via a trailing cable from the balloon. The ‘spotters’ themselves were obviously in an extremely precarious position.

In 1909 Louis Bleriot won the £1,000 prize for flying over the English Channel, and the military were quick to see the advantages of using aircraft to spot targets which were ‘over the horizon’.

By the start of the First World War in 1914, the first anti-aircraft guns appeared on the scene.

The use of artillery became a major feature of the First World War. There was still a siege mentality with opposing forces dug in using bombardment to wear down the enemy, destroy his facilities, cause casualties, crush morale and subsequently destroy his ability to fight the war.

This war also marked the start of trench warfare, the creeping barrage and the tank as the ultimate mobile gun which was self-contained in that it carried its own ammunition and crew.

Sound Ranging was also introduced during this war with microphones positioned at approximately 2 km intervals across the battlefield.

These microphones were tuned to very low frequencies of between 2 – 20 hz and connected back to a central point where the resulting sound waves were usually recorded on a chart recorder so that the time delays between individual microphones could be measured and the position of the enemy’s guns calculated.

Sound ranging is still in use today, along with other means, requiring gun batteries to move quickly from their positions once they have fired.

Target acquisition technology remained fairly static until the early 1960's when radar was introduced to locate enemy mortars, and drones first came into service.

By 1979, jet-assisted take off drones with pre-planned flight paths were introduced into the battle zone as shown in this picture on the left.

They had a maximum endurance in the air of approximately 2 hours, after which they would return to their launch points and descend gracefully by inbuilt parachutes, with their landings cushioned by inflatable balloons so that they could be reused.

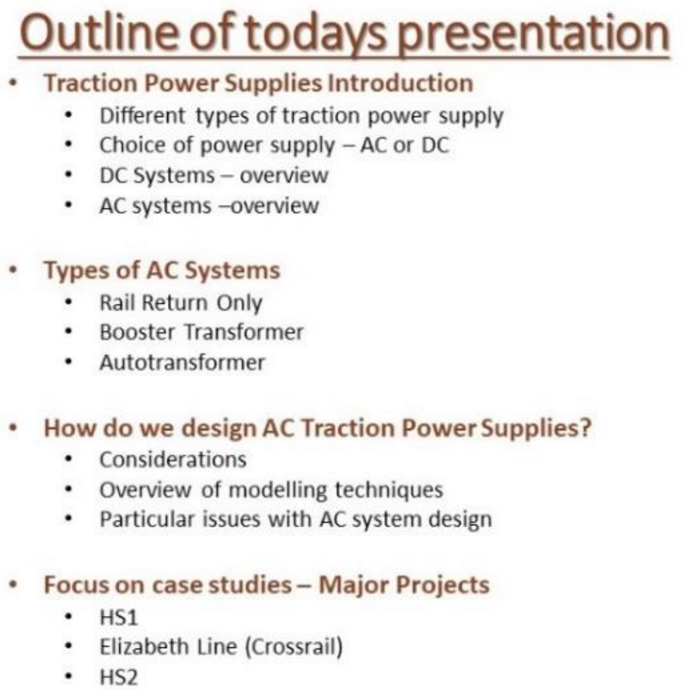
During a busy question time our speaker discussed the marked improvements now made in the accuracy of 'first fire' rounds, and the difference between effective and maximum range of a gun. (Effective range is the range that the gun can be continuously used without significant reduction in the life of the barrel, whereas if used repeatedly at maximum range the barrel would require frequent replacement, as each firing wears some material from the barrel).

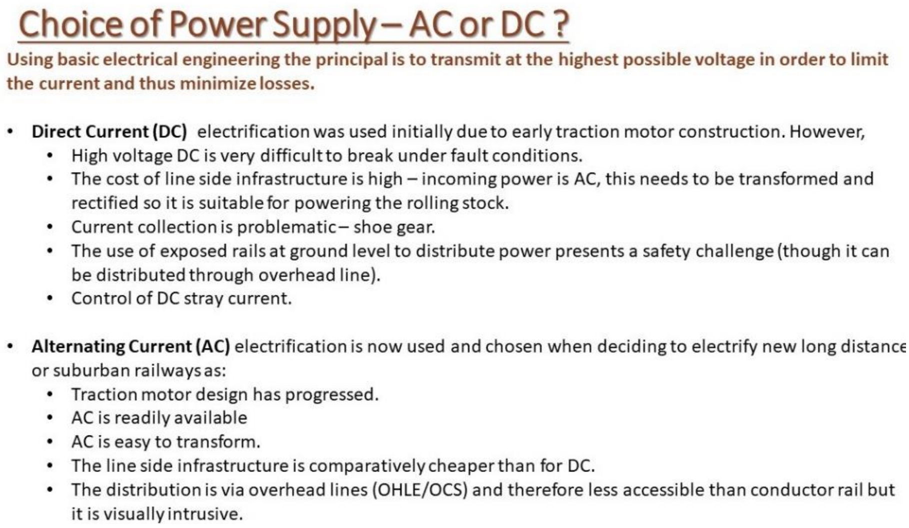
Our thanks to Eddie for an interesting talk.

Malcolm Hind

Talk
Tuesday, 14th March 2023 – Traction Power Systems
Louise Moore CEng, FIET
Dr. Davor Vujatovic CEng, FIET, SMIEEE

This talk was given by two speakers, Louise Moore who is head of HV Systems Engineering for HS2, and Dr. Davor Vujatovic who is an independent Power Systems Engineering Consultant at VandA Engineering.
They began by giving us a list of the topics that they wanted to cover (see list below)– a very ambitious program which they were only just able to cover within the allotted time.

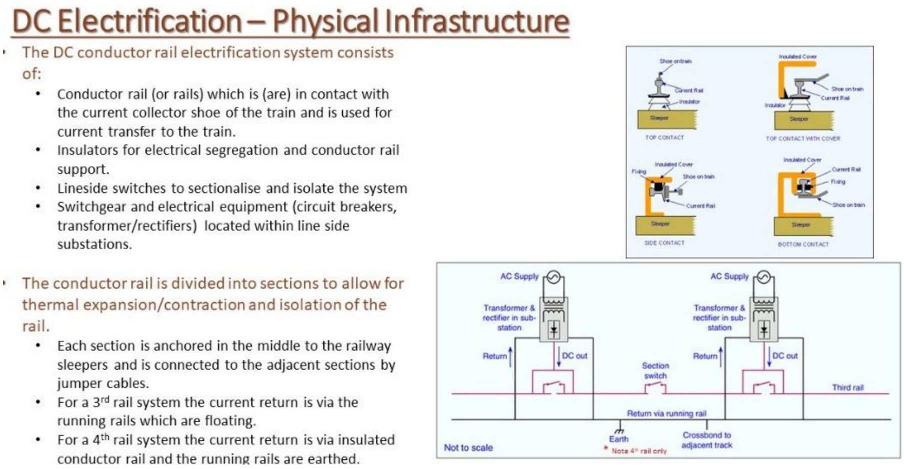




They explained that in the UK there are two systems for supplying power to the railways – DC at below 1kV, and single-phase AC at 25kV. DC is predominantly used in the southeast of the UK and a small amount in the northwest, this being largely historic. The attributes of both systems are shown in the slide on the left.

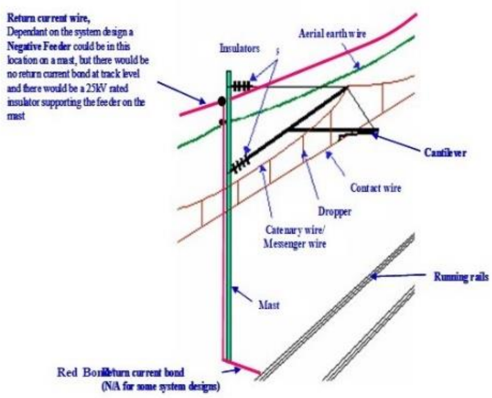
DC Systems

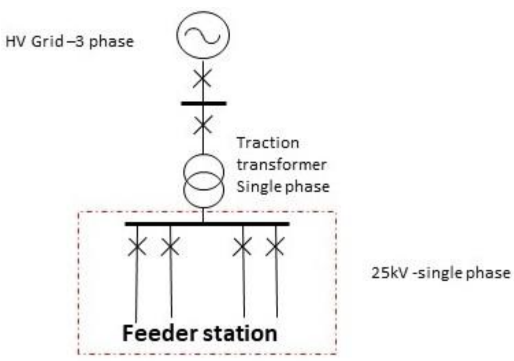
Electrical power on DC systems can be distributed either via overhead lines using a pantograph, or at track level using a third or fourth rail such as London underground. Track level distribution tends to be limited to 750V, but overhead line systems may be at 750V for light metro/trams, 1.5kV as on the Tyne & Wear Metro and in Holland, or even 3kV for suburban and mainline services such as in Poland. The slide right gives more information.

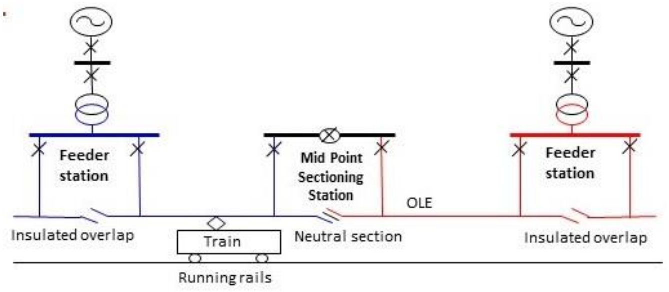


AC Systems

AC distribution is invariably via overhead lines as shown in the left slide below. The overhead line itself can be either a catenary or a rigid conductor such as in the channel tunnel where there is limited height.
Three phase power at 400kV, 275kV or 132kV is transformed down to 25kV by a single-phase transformer connected across two phases of the high voltage supply as shown on the right slide below. The resulting 25kV single phase supply is distributed along the railway via line side substations know as feeder stations.







Insulated overlaps enable segregation for isolation purposes of feeding sections fed by the same feeder station as shown on the diagram above.

These insulated overlaps can be temporarily bridged by a passing train pantograph since both sections are fed off the same phase pairs.

As the single-phase supply to the train comes from only two phases of the HV grid, it causes unbalance on the grid (resulting in negative phase sequence currents). This problem is reduced by connecting different phase pairs at each feeder station in order to equalise, as far as possible, loading across all three phases.

Neutral sections are located at the mid-point between feeder stations to prevent paralleling of the single-phase supplies, which are not of course in phase as they are fed from different phase pairs of the HV grid. The neutral sections can be bridged if one of the feeder stations is out of service, but the feeding section of an adjacent feeder must then be extended to feed the section to continue train operations, albeit at a reduced service level.

Mid-point sectioning stations are used for this purpose.

Types of AC Electrification

The design of the overhead line equipment depends upon which system is used to feed power to the train. Within the UK we have 3 different systems: -

- Rail return only (may have supplementary return conductors)
- Booster transformer
- Auto transformer

In the Rail return only system, return current passes via the train through the running rails back to the substation, although there may be supplementary current return conductors. All the return paths are solidly earthed, as is the transformer secondary.

The main problem with the Rail return only system is Electromagnetic Interference (EMI), which is an issue on all systems, but particularly so on this system which electrically acts like one very large 1-turn coil free to radiate in all directions.

EMI arises from the train's internal traction system which draws non-sinusoidal current from the supply, introducing large, harmonic-rich currents into the power supply.

These harmonic currents cause interference with the railway systems and with surrounding non-railway systems along the railway route.

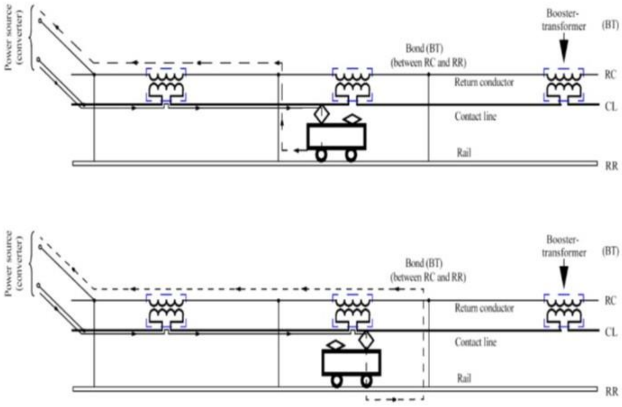
In addition, the magnetic fields produced by the harmonic currents flowing through the running rails can cause problems with track side signalling equipment.

The 'Rail return only' system has little, or no EMI mitigation factored into the design, and as a consequence the Booster transformer and Autotransformer system are more widely used in the UK, as both are designed to force traction current from the rails into other (additional) overhead conductors to minimise the impact of EMI.

The booster transformer system uses relatively small 1:1 booster transformers through which the return current is forced to flow into an additional overhead return conductor to minimise the effects of electromagnetic fields on surrounding systems, in particular the railway signalling system.

EMI is much reduced and is restricted to a very small section between two booster transformers as the return current flowing through the rails is only present in the section where the train is located as shown in the slide on the right, showing the train in two positions.

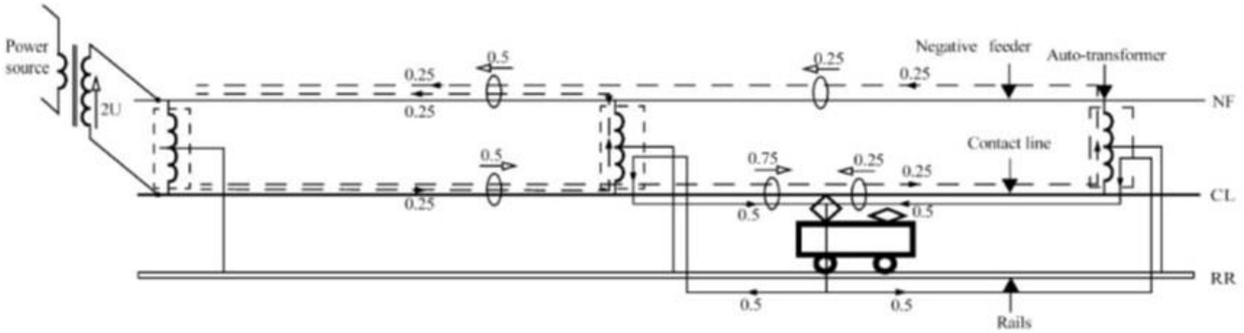
The booster transformers do however add impedance into the electrical supply system and safety can be compromised if the transformers are not adequately bonded.

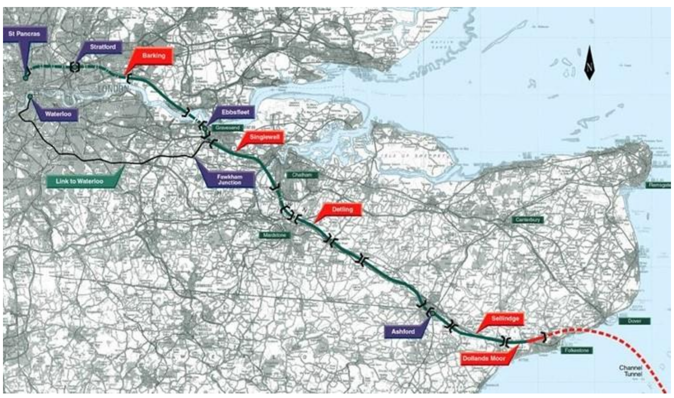


The Auto transformer system, shown in the slide below, uses two power conductors charged at +25kV and -25kV coupled via autotransformers. (The designation + and – is purely for illustrative purposes). It was developed by SNCF for the specific purpose of electrifying high-speed lines where power demand and distance between feeder stations is a problem. The system uses 50kV to supply 25kV traction loads. Autotransformers are used to split the supply and balance the current in the 50kV system. Distributing power at a higher voltage means that feeder stations can be situated further apart.

The auto transformers act as intermediate transformers transforming the 50kV supply to 25kV for use by the trains. Through this action, they largely remove the return current from the rails and force it into the 2x25kV system conductors placed as to minimise EMI.

The downsides are additional costs for the second overhead line, which require larger supporting structures and additional electrical clearance due to the higher voltage, and the additional cost of the autotransformer substations and switchgear. Protection coordination and management can be challenging.





Our speakers then discussed the many design considerations inherent in the design of large AC systems, with particular reference to HS1 (the cross-channel link), which route is illustrated in the slide on the left.

The design considerations included compliance with technical standards, the power demand which is affected by the type of trains and timetables, the available grid connections, and the space requirements along the route.

Power system modelling is now an essential element of all such projects, and this was discussed in detail before summarising the main issues with all AC systems: -

- Unbalanced load can be an issue for large intake points.
- The single-phase supply is derived from different phase pairs, so only radial feeding is possible.
- Due to radial feeding, maintaining voltage along the line is challenging.
- Large dynamic loads may cause unacceptable voltage fluctuations.
- Traction units generate harmonics which can be troublesome.
- Some traction current returns through the earth.

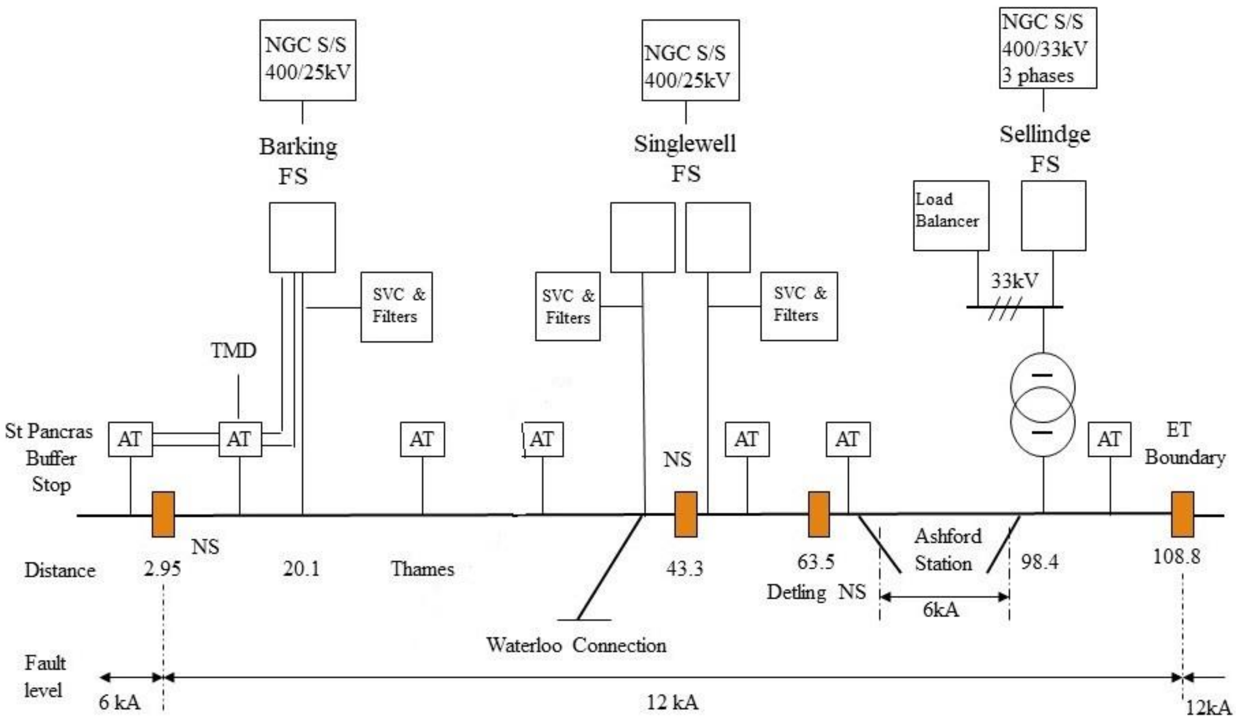
The speakers concluded by introducing us to the three major electrification projects that they had worked on, HS1, Cross Rail (now the Elizabeth Line) and HS2.

HS1

HS1(the cross-channel rail link) is approximately 109 km long from the channel tunnel to London St. Pancras station.

Initially there were to be 4 power intake points along the route at Kings Cross, Barking, Singlewell and Sellindge, but the number was later reduced to 3 which resulted in the system voltage drops becoming too great. It was also known that the Eurostar trains would cause unacceptable levels of harmonic distortion in the supply.

The design solutions involved adding Static VAR Compensators (SVCs) and harmonic filters at both Barking and Singlewell as shown in the diagram below. (A VAR, which stands for Volt Ampere Reactive, is a measure of reactive power. VARs are created when AC electric current and voltage are not in phase, and if excessive, can result in problems at the supply).



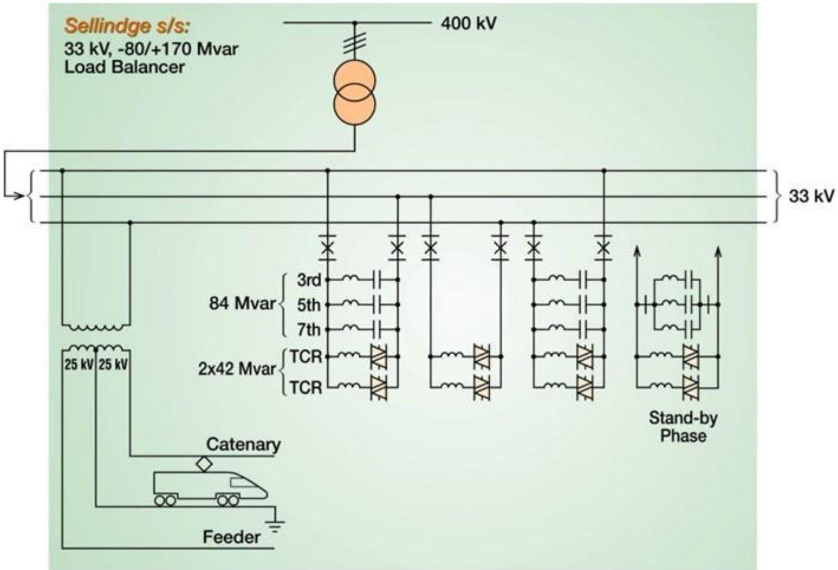
SVCs regulate the grid voltage. If the power system's reactive load is capacitive (current leading voltage), the SVC will use thyristor-controlled reactors to consume VARs from the system, lowering the system voltage.

Under inductive (lagging) conditions, capacitor banks are automatically switched in, thus providing a higher system voltage.

In the previous diagram it can be seen that at Sellindge, which is at the far end of the UK's grid supply, a load balancer was also required.

The circuit diagram on the right shows it being connected at the intermediate 33kV interface. It is delta connected, and each branch comprises an SVC rated 84MVAr (140MVA, cosφ=0.8) with two TCRs (Thyristor Controlled Reactors).

The load current does not have to be in phase with voltage (offers positive sequence voltage support).

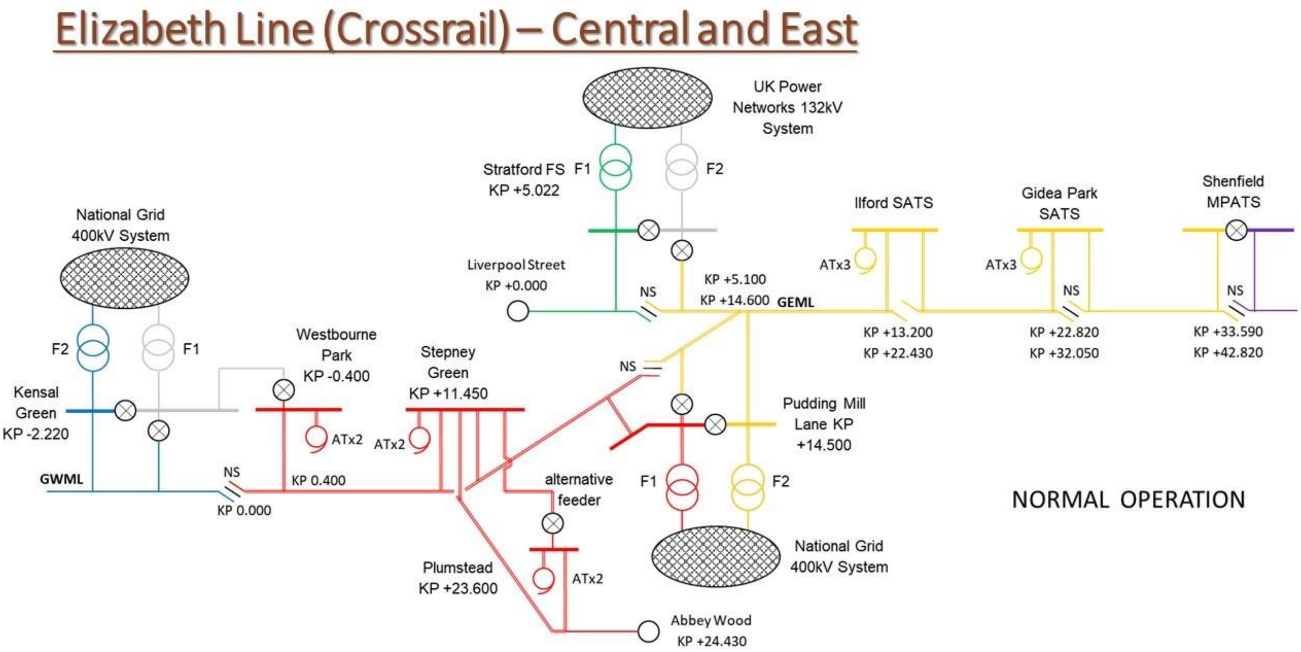


Cross Rail (Elizabeth Line)

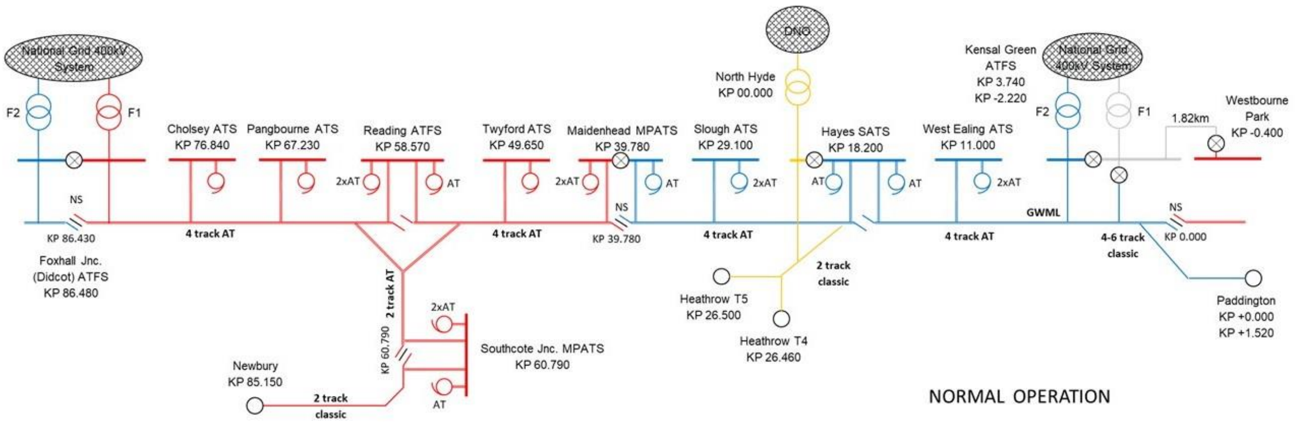
The Elizabeth line runs from Reading in the west through London and out to Shenfield in the east.

The project has three parts – a Central section in the capital approximately 24km long, Central East to Shenfield approximately 29km and a Central West to Reading approximately 58km long.

The diagrams below show the electrical supply points for Central and East, and West respectively.



Elizabeth Line (Crossrail) – West (also shows elements of GWEP)



Electrically the project had several challenges, which included: -

- Small tunnels – necessitating the use of rigid beams instead of contact wire and cabled negative feeder.
- Originally it was assumed that the traction system would utilize autotransformers, but due to cost constraints, the autotransformer system was reduced to the section between Pudding Mill Lane and Gidea Park. The rest to Springfield remains a classic booster transformer system – resulting in the retention of the existing 132kV connections.
- It was assumed that due to the 'new' connections being from a 'stronger' National Grid 400kV connection, performance would be superior to the existing 132kV connections at Bow and Springfield, however this turned out not to be the case and the new connections required a significant amount of harmonic mitigation (not required at the 132kV sites) due to the rolling stock and onerous National Grid requirements.

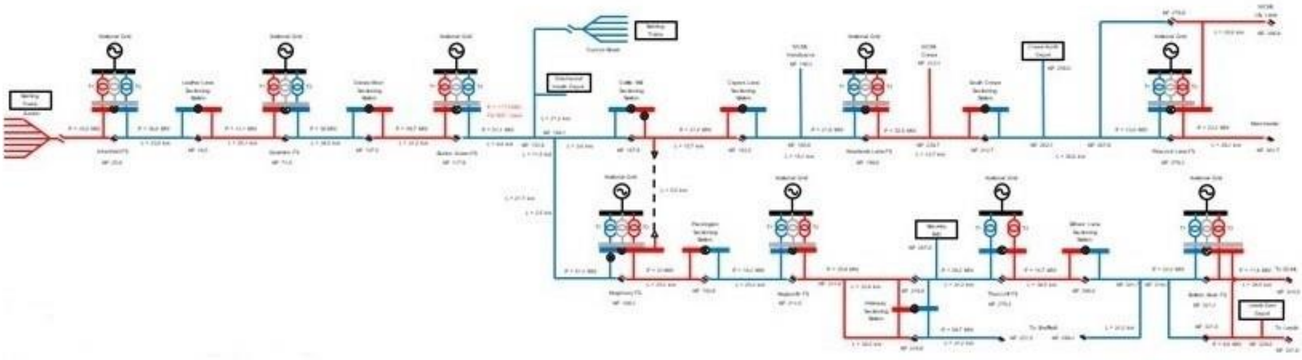
Our speakers then discussed in detail the harmonic studies carried out and the results.

HS2

The HS2 project has a number of phases:
Phase 1 – London Euston to Curzon St in Birmingham
Phase 2a – Birmingham to Crewe
Phase 2b West- Crew to Manchester
Phase 2b East – Birmingham to East Midlands

When fully operational, the timetable calls for a maximum of 18 trains per hour per day running at 360kph - 400kph), a high-speed metro service and compliance with TSI (NTSN)

This project is ongoing, and our speakers showed in detail how the initial electrical system design has been optimised to reduce cost whilst maintaining performance, often using lessons learnt from HS1 and Cross Rail. Currently the proposed electrical power supply system looks as per the diagram below.



They showed how it was possible to remove all the additional 132kV intermediate voltage and express feeders from the initial system design and how the predicted system voltage profile could be brought up to acceptable limits using SVCs.

In this short report we have been able to include only a selection of the detailed material presented and would always encourage members to attend our talks whenever possible to hear the speaker(s) and participate in the question-and-answer sessions afterwards.

Our thanks to the speakers for such a detailed and interesting talk on this current subject matter.

Malcolm Hind and Derek Webb

Talk
Tuesday, 11th April 2023 – My life in Defence Engineering
Perry Eastaugh – member

Members may recall that in December 2015, Perry gave us a talk on the early part of his career as an engineer in Defence Engineering. There is a copy of the talk in the newsletter for March 2016 on the RCEA archive.

In this talk he moves on to discuss his time running the Admiralty Test House at the National Gas Turbine Establishment, Pyestock, and introduced the oddities of Civil Service jargon and practice in the job he took on promotion to AD/XR(P).

His working life spanned the period when the Ministry of Defence (MoD) grouped its R&D establishments together into an Agency in preparation for radical changes in the way they operated, culminating in his role as PPP Director when MoD privatised the bulk of the Agency.

After leaving Canford School in Dorset, he started a University Apprenticeship with Rolls-Royce Aero Engine Division, spending a year in Derby before going to Leicester University to read Engineering.

His final year at Rolls-Royce was cut short abruptly when the company went into receivership, resulting in his starting work for the MoD at the Admiralty Oil Laboratory in Cobham, where he was in charge of the Mechanical Evaluation of Lubricants laboratory, working on the performance of gear oils and hydraulic fluids of interest to the Royal Navy (RN).

This was a very different sort of establishment from the industrial complex at Derby.

After 12 years at the Admiralty Oil Laboratory, he was transferred to run the Machinery Controls Section at the Admiralty Engineering Laboratory.

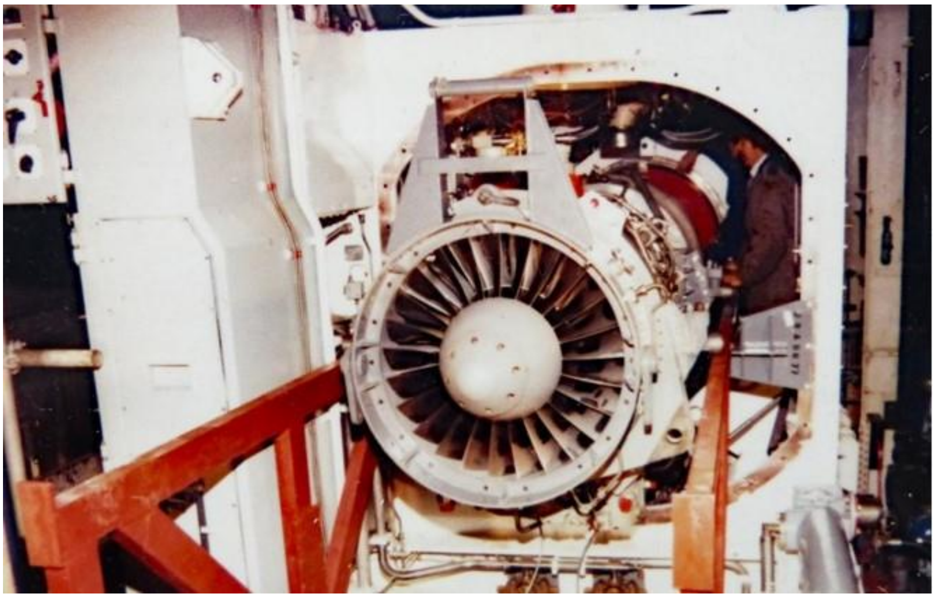
One of the projects involved the evaluation of a new design of mine hunter. After 4 years at West Drayton, he transferred to run the Admiralty Test House at Pyestock, which was used for long term testing of Marine Gas Turbines.

Running gas turbines in a marine environment posed several challenges, the main ones being that they run in a salt-laden atmosphere and burn diesel fuel rather than kerosene.

Diesel fuel contains Sulphur, which corrodes the hot components of the gas turbine, as does salt.

To make matters worse, to maintain warships' stability, their fuel tanks are topped up with sea water! The RN uses coalescer filters to remove water from the fuel, air filters to remove salt spray from the air intakes, and (relatively) low sulphur diesel fuel – but the engines still suffer, and our job was to determine the impact on engine life and reliability.

The engine that we were testing was a marine version of the Spey that I had worked on in my first year at Rolls-Royce. The picture on the right shows the SM1C module that housed the engine and a power turbine which, on board ship, would drive through a gearbox to the propeller. The picture was taken in the Admiralty Test House where the power was absorbed by a dynamometer.



One of the problems that affected the life of the engine was sulphidation corrosion of the combustors.

In fact, the combustion research group at Pyestock had designed a new type of combustor which was much better at resisting this type of corrosion. Sadly, Rolls-Royce never adopted it.

The picture on the left shows the engine being extracted from the module.

On board ship it would then be turned through 90 degrees and hoisted up through the funnel. An engine could be changed in less than a day.

In 1988 the Admiralty Test House was merged with the Diesel Section to form the Marine Engines Section with Perry in charge of the new organization.

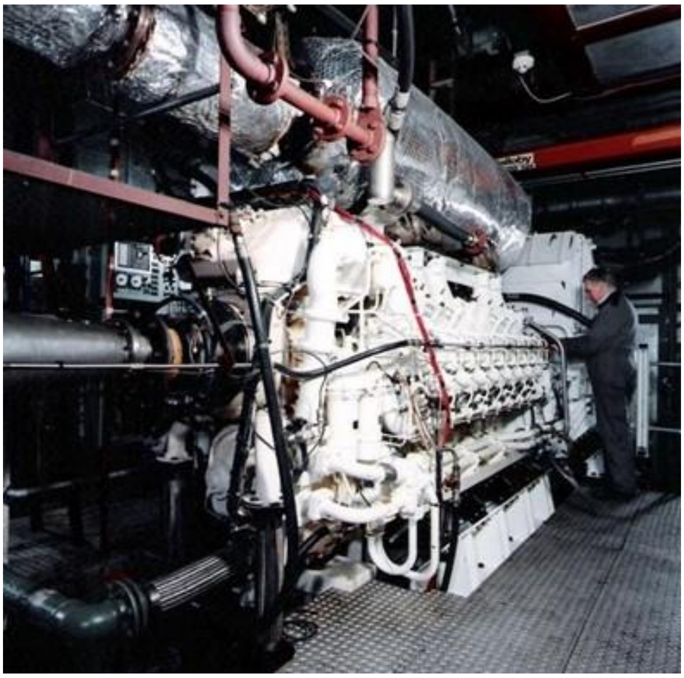
The diesel side did a mix of endurance testing, type testing of new designs for the RN, and research.

The Paxman Valenta (shown in the picture on the right) was in widespread use by the RN – essentially the same engine that powered the Intercity 125 high speed trains.

However, while it had been designed for high power operation (1.4 MW), in RN use it tended to spend most of its time at part load because the Navy wanted to make sure that, if an engine failed, another could pick up the load immediately.

The result was that, in the early days, we did have quite a few failures!

We also had some research programmes, including one (I think with Ricardo using a Ruston engine) on variable geometry turbochargers. They were very much in their infancy in those days, and it is amazing to see that they are now relatively commonplace.



Our speaker then went on to talk about some interesting encounters on the many training course he attended, culminating in his promotion to AD/XRP (Assistant Director, Extramural Research (Propulsion)). This involved managing the MoD and Department of Trade and Industry (DTI) budgets for propulsion research, which amounted to some £30m/year. The DTI became involved when the research was likely to be relevant to both military and civil applications, known as dual use technology.

In 1991 there was a major change. The main non-nuclear research establishments (the Royal Aerospace Establishment, the Admiralty Research Establishment, the Royal Armament Research and Development Establishment and the Royal Signals and Radar Establishment) were combined into the Defence Research Agency (DRA), and our speaker became the Aircraft Sector Business Development Manager.

In his new role, Perry became involved in the Farnborough Air Show which was an obvious opportunity for business development. DRA had a significant presence at Farnborough, both via a large stand in the exhibition area and an experimental air fleet of some 60 aircraft.

One such exhibit was the JOUST Beyond Visual Range combat simulator shown in the picture on the left. This was a state-of-the-art capability, using Sun workstations to represent opposing aircraft.

Up to 3 displays a day were given, with the workstations manned by RAF pilots in full flying gear.

At the head of DRA was a gentleman named John Chisholm, under whose leadership their methods of working were changed under an initiative known as The Trading Fund such that survival depended on being able to convince customers that DRA could supply what they wanted.

DRA had to compete with industry for work, and if they couldn't convince them that they could supply what they wanted, and at a competitive price, they would go under. This required them to mount a formal sales pitch to potential customers, something that had not previously been needed.

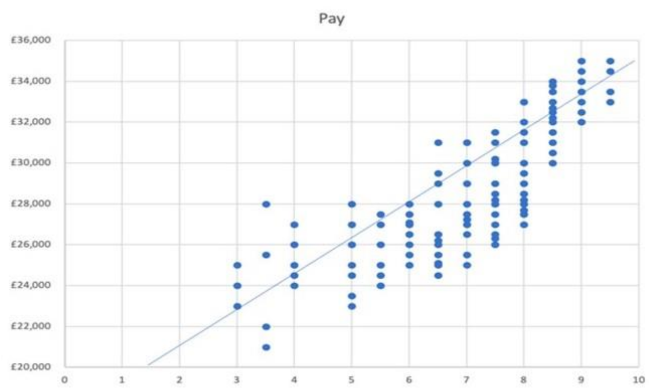
Fortunately, DRA managed to survive the transition to this new way of working and even to thrive. John Chisholm's reward for this was to have yet more MoD organisations added to his portfolio – the Chemical and Biological Defence Establishment (Porton Down), the Defence Operational Analysis Centre, the Centre for Human Sciences, the British Underwater Test and Evaluation Centre, the Armament and Aircraft Experimental Establishment (Boscombe Down) and the Proof and Experimental Establishment.

As a result of these additions, DRA became DERA which stood for Defence Evaluation and Research Agency. Some of the new sections of DERA were to prove quite a headache to operate profitably under commercial rules. About the only thing excluded was the Atomic Weapons Establishment (AWE) – which by this time was a Public Private Partnership. Interestingly, there was an announcement in late 2020 that AWE was likely to return to government management in 2021, which did happen.

Another task that Perry had was managing the Sector pay process. John Chisholm was very keen to ditch the civil service approach where everyone received an annual increase and worked their way up the pay scale for their grade more on the basis of time served rather than performance. Although the introduction of such a scheme inevitably faced opposition, nevertheless Perry succeeded, and the HR team introduced a system where you were paid according to your worth.

Assessing someone's worth proved an interesting exercise. Once the managers had produced their worth scores, we ended up with a plot something like the illustration on the right for each level (levels replaced the civil service grades). In an ideal world, one could draw a line showing the desired relationship between pay and worth and move everyone onto it.

In real life, of course, things were a bit more complicated. Firstly, one couldn't cut the pay of people who were overpaid for their worth – the most we could do was not to give them an increase. Equally, the sectors had a pay budget – say 3% of the current pay bill – and that limited the amount we could award to the underpaid. Perry then went on to describe how he overcame some of these issues and how he took part in bringing the trade unions along with it.



Returning to his days as Business Development Manager, Perry once picked up a call from Richard Branson, asking if DERA would sponsor his record bid. The Executive Committee initially decided it was too risky – but later changed their mind and they did quite a lot to help. Not least, Andy Green, the driver, was an RAF Officer working at DERA at the time (see picture on the left). In the event, it was a good decision, as the team broke the Land Speed Record (and the sound barrier) with a speed of 763mph in October 1997. Incidentally, the car was powered by two Phantom Spey engines which Perry had worked on during his days at Rolls-Royce.

John Chisholm had been brought in with the intention of managing the move of the defence research establishments into the private sector, a decision actually made under a Labour government. Not all of DERA was to be included in this privatization programme for a number of reasons, so the organization was split into a to be privatized part (NewDERA), while RetainedDERA (RDERA) would hold only those activities which could not be done in the private sector. This proved to be a complex process, and the whole process took well over a year.

Perry ended up in NewDERA, the bit that was headed for privatisation. The new organisation needed a new name and web address that hadn't already been registered.

The name finally chosen was QinetiQ, a combination of Qi (life force) + net(working) + IQ (intelligence). The name is pronounced like Kinetic signifying movement.

The new company was very keen for us to project the right image, including the exact shade of blue used in the logo and on QinetiQ products, which is shown in the top picture on the right.

The logo has recently been updated (bottom picture on the right).

Perry then went on to discuss in detail various roles that he held in QinetiQ, including a few more years as Ops Manager, and a period in the central HR team with responsibility for the top team and putting in place a succession planning process, including identifying highflyers.

During this time the process for finding a buyer for QinetiQ was well under way, and Perry soon found himself in yet another post as Public-Private Partnership (PPP) Director involved with project managing the privatization of QinetiQ.

One problem facing potential buyers was that there was no other organization like QinetiQ operating as a commercial company. They were all either much smaller and/ or Government owned. Facilities such as the ranges for testing missiles, submarines, and aircraft had large capital costs and, without a long-term plan, were becoming unaffordable. Consequently, a key element was the Long Term Partnering Agreement - a 25 year plan governing the operation and funding of these facilities.

The first step was to invite tenders, but because QinetiQ were such an unusual beast, there were relatively few organisations interested in tendering – eventually, it came down to 10 bids which might be considered credible, which was further reduced down to a short list of 4 organisations.

These were Candover, Permira, Goldman Sachs and a combined bid from Carlyle and WS Atkins (W S Atkins was the sole remaining Trade organization – the rest were Private Equity companies).

This was eventually further narrowed down to 2 main bidders – Permira (a UK based private equity company) and Carlyle (a US equivalent), W S Atkins having dropped out. Carlyle ended up as the successful bidder, and finally, on 28 February 2003, almost 5 years after the idea of a DERA PPP was approved, the process was complete.

From 1 March 2003, the ordinary shares in QinetiQ were held as follows: MoD 56.25%; Carlyle 33.75%; QinetiQ staff 10%, with Carlyle assuming control. MoD held a 'golden share' allowing them to intervene in matters of national security. To celebrate the event, the principal organizations involved in the process gave commemorative plaques (irreverently known as 'tombstones' in the industry) to key players. Perry's set is shown in the picture on the left.

Perry continued in his role, and on 10 February 2006 QinetiQ was floated on the London Stock Exchange. That made the free staff share option of £40 become worth nearly £3,000, and those who had risked investing some of their savings got even more. Consequently, some staff became very rich. Perry retired in 2008.

After a welcome tea break, there followed a question-and-answer session at which a number of interesting matters were raised.

Our thanks to Perry for stepping in at very short notice to give us a fascinating insight into his career in defence engineering.

Malcolm Hind

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<u>REPLY SLIP - Outing to Denbies Wine Estate</u>

To: Derek Webb, 6 Loxwood Ave, Worthing West Sussex BN14 7QZ

Tel: 07867 572722 E Mail: derek.webb2@ntlworld.com

Would you please reserve me …. places for the outing to the Denbies Wine Estate on Tuesday 13th June.

We have booked a tour of the vineyard on their outdoor train departing at 12.30. The tour lasts 45 minutes and costs £8.50. There are plenty of things to do on our return. See www.denbies.co.uk

Once we have firmed up the number of participants, we are committed, so no refunds for short notice cancellations will be made.

Name: ……………………………………………………… (Block capitals)

Address……………………………………………………………

…………………………………………………………

…………………………………………………………

Name of guest/s …………………………………….

E mail address …………..…………………………

I enclose a cheque made payable to RCEA for **£…………. (£8.50) per person**

Applications by- Monday 5th June please.

End of Newsletter