Operation Pluto

Chapter Four : Making the Hais cable

In the preceding chapters a brief outline of the early stages of Operation Pluto may possibly have led to the conclusion that given the idea and the authority to proceed with the project, all that was necessary was to set the wheels in motion. In fact, this would be very far from the truth and Mr F.W.H.Shaw, formerly chief engineer of the cables division of Siemens Bros. and later managing director of Submarine Cables Ltd., has described in considerable detail the work involved and the difficulties experienced in perfecting and finally manufacturing the many miles of Hais cable. The following account is taken from a paper on the subject specially written by him for this book. Since the account must necessarily be in chronological order a certain amount of duplication with facts given in other chapters has been inevitable.

Mr Shaw recalled that one Saturday afternoon in April 1942 Mr G.W.Giffen, the general manager of Siemens cable division asked him to be prepared to receive ~~an~~ important visitors next morning. These visitors subsequently proved to be Mr A.C.Hartley, chief engineer of the Anglo-Iranian Oil Company and Mr H.A.Hammick, chief engineer of the Iraq Petroleum Company.

Hartley did most of the talking and he began by emphasising the need for the utmost secrecy in everything to do with the subject to be discussed. He then briefly outlined the requirement which was to determine the possibility of producing long lengths of submarine cable with a hollow core, capable of withstanding internal pressures of 400 to 500psi. After some further discussion both Giffen and Shaw began to grasp the nature of the problem and said that a hollow lead core could be made to stand the pressures suggested providing that adequate reinforcing steel tapes were used to enclose it.

Stella Lab
A.I.

After some further discussion Siemens agreed to put in hand immediately a trial length of cable at the highest priority and stringent rules for internal security were laid down. It was agreed that the code name Hais (from Hartley, Anglo-Iranian, Siemens) should be used to designate the proposed cable.

Next morning at 0900 a military dispatch-rider arrived at Siemens works at Woolwich with a letter giving Cabinet authority for the Hais project to take precedence over all other government work.

At once a quarter of a mile of 2in id lead pipe with a wall thickness of .19in was extruded on the Siemens presses and two days later this was passed through the armouring machines. The protection applied consisted of two layers of compounded paper tape, one layer of bitumenised cotton tape, two layers of mild steel reinforcing strip 1½in x .010in, one serving of gas tarred jute yarn. Then came the armouring of 42 x .192in galvanised steel wires laid up left-handed and covered by two layers of tarred jute yarn applied in the reverse direction. Each layer was coated with bitumen compound as it passed through the armouring machine.

Samples from this original length of Hais cable were cut into 25ft(7.62m) sections and given hydraulic pressure tests. A drum length of about 250 yards (228.6m) was wound over a 3ft (.91m) sheave, rewound onto another drum and then loaded into the Post Office cable ship Ariel which moored off the works. Here the cable was paid out over the bow sheaves of the ship, hauled along the bed of the river to the stern rollers over which it was hauled back into the cable tank. It was then returned to the laboratory for further tests.

A great deal of thought and effort went into the question

of providing suitable caps to seal the ends of the cable as these would have to withstand the stresses resulting from internal water pressure. This pressure inside the cable was necessary to withstand the high external water pressure resulting from the depth in which the cable would have to be laid. Already all sorts of problems were becoming apparent which did not occur with ordinary deep sea cable.

Bursting pressure tests usually produced failures within the range of 800-1300psi. Most of the bursts were near the ends and it was noticed that they were invariably in the longitudinal seam of the lead pipe. This later led to the decision to use a different method of producing the pipe which did not result in a longitudinal seam. While tests were going on, Clifford Hartley took some pieces of the first length of 2in(50.8mm) Hais cable, one of which was shown to the Prime Minister.

An interesting incident occurred a few days later when a all was ready at Siemens works for the night shift to commence extrusion of a mile length of the 2in lead pipe. Arrangements had been made for Siemens to receive a delivery of 'E' alloy lead from the refinery which was situated on the Thames at Swanscombe in Kent. This type of lead was used extensively for submarine power and telephone cables' sheathing as it had better mechanical characteristics than commercially pure lead, that is, higher creep and fatigue resistance. The five ton load of lead was due to arrive by barge on the high tide at 1700 but at 1800 there was no sign of the barge and the tide was ebbing. A telephone call elicited the information that the tug engaged to tow the barge had not turned up, so delivery could not be made until next day.

At this time Siemens had their own Home Guard unit and

on the evening in question the man in charge happened to be the member of the purchasing staff who had ordered and arranged for the delivery of the lead. As he was aware of the urgency of the work he called for volunteers from the platoon to go and collect the lead by lorry. This was perhaps not quite so easy as it sounds as at this time the whole of Kent was a prohibited area and the lorry was held up at a barrier at Crayford with a request for a permit to proceed.. However the officer in charge of the platoon used his persuasive powers and that and the uniforms did the trick and they were allowed through.

When they arrived at Swanscombe it was already getting dark and the works were closed for the night. The night watchman refused to admit them and it needed telephone calls to A.C.Hartley and the works manager before the determined little band was able to proceed.

The lead was still in the barge alongside the wharf and on the ebbing tide some twenty feet below, with only a vertical iron ladder as the only means of reaching it. Undismayed, the gallant Home Guard managed to hoist the 112lb ingots of lead and carry them to the lorry. It is nice to be able to record that they all got back to Woolwich before ten o'clock and were able to have a well-earned pint at the local before commencing work on extruding the lead pipe. Next day a one mile length of the pipe was ready for the armouring process which was cOmmenced immediately.

In May 1942, 1200 yards (1097m) from this length were loaded into the Post Office cable ship Alert and laid in a loop in the Medway estuary where it was connected to a pump for pressure and flow tests at 600psi.

When pumping started it was soon clear that the pressure was not being held and a train of bubbles was visible on the surface of the water. The cable was recovered and on examination it was found that as a result of handling and laying the reinforcing steel tapes had moved so that one strip was riding over the next, leaving a gap through which the lead pipe had been forced, causing it to develop cracks.

Following discussions after the trials it was decided that in future the lead pipe should be made on presses developed by Henley's cable works at Gravesend under the direction of their works manager Mr Judge. These presses produced lead pipe without ~~a~~ the longitudinal seam which had obvious drawbacks. It was also decided to use four steel reinforcing tapes instead of two as formerly, for operation at pressures of 750psi. Meanwhile Siemens engineers had redesigned the heads of the armouring machine in order to ensure uniformity of tension and registration of the tapes.

In June 1942 one mile lengths of 2in Hais cable were manufactured by both Siemens and Henley's and subsequently despatched to the Post Office depot at Dunoon on the Clyde. Here the two one mile lengths were loaded aboard the Post Office cable ship Iris. A few days later A.C.Hartley, Hammick and Shaw joined the ship which proceeded to a spot south of the Isle of Arran where the Siemens cable was laid in deep water.

This first length was laid over the bow sheaves with the ship going ahead and the pipe was empty - that is, filled with air at atmospheric pressure,-so that conditions were exceptionally severe. The Siemens cable was then recovered and at first sight it appeared that it was leaking but close examination proved that the lead pipe had been squeezed into a kidney shape (see diagram) and on test pressure being applied the pipe began to resume its original

shape, forcing water which had been trapped by the distortion out through the armouring. This gave the impression that the pipe had been fractured but in fact it was unharmed.

A few days later the Henley's length of Hais cable was also laid in deep water but this time the pipe was filled with water at 100psi pessure. It was again laid over the bow sheaves of the Iris but with the ship going astern in order to simulate the easier conditions normally experienced when laying over the stern rollers. When eventually recovered the cable appeared to be in perfect condition. It was clear that considerable progress had been made.

During this period, Callenders Cable and Construction Co. Ltd., were using Pirelli type presses to produce seamless lead pipe at their Belvedere works at Erith, Kent. Tests carried out on pipe produced by this method and on the Henley 'Judge' presses led to the decision to use these processes exclusively, the armouring being undertaken by Siemens at Woolwich and also by Callenders who possessed no less than four armouring machines. Other cable manufacturers with suitable presses but without waterside facilities for loading the completed cable were able to to produce lead pipe which was then transported to Woolwich and Erith on drums.

The next problem which arose was the joining of successive drum lengths of lead pipe to form one continuous length. This vital work was carried out by the two Stone brothers of Deptford, who were well known for their skill in making burnt lead joints. These men had often been employed by Siemens to make joints in the lead sheathing of power and telephone cables and had a splendid reputation for the quality of their work. It was necessary that the

joint should be made in such a way as not to increase the overall diameter of the pipe as this would have affected the accurate application of the steel reinforcing tapes.

The process involved swaging down the ends of the pipes to be joined by ½in (12.7mm) and bringing them together. With an oxy-acetylene torch the lead at the point of contact was lightly brushed, forming a small pool of molten metal. Almost instantaneously a thin strip of lead was melted and blown on to the spot previously liquified. This process continued right round the pipe unti the cavity formed by the swaging operation was completely filled. To make these joints required great skill and subsequent bursting tests proved that the joints were stronger then the pipe itself. On the inside of the joints there was no perceptible effect on the flow of liquid through the pipe. It is pleasing to be able to record the fact that the brothers firm, W.P.Stone and Co. Ltd. of Brockley, London, is still flourishing. Without their ability to make satisfactory joints in the lead piping the Hais cable might well have failed to function with the reliability it later exhibited.

During July 1942 drum lengths of 1500-1600 yards (1371m-1463m) of 2in ID lead pipe from Henleys, Callenders, Johnson and Phillips and Enfield Cables arrived at Siemens and were coiled down behind the armouring and protecting machine. These lengths, to a total of 30 miles were jointed by the Stone brothers and filled with water at a pressure of 251bs psi. Armouring commenced on 14 August 1942 and was completed by the end of October 1942.

During October the cable ship Holdfast arrived off Siemens works at Woolwich and loading of the 30 mile length into her tanks commenced as soon as the armouring was completed.

Captain of Holdfast was Commander Treby Heale RNR who was formerly master of Siemens cable ship Faraday which was lost by enemy action in 1941. He was of course fully experienced in laying submarine communication cables and had operated all over the world. At Siemens works at Woolwich it was not known to what use this first long length of Hais cable was to be put and it was a considerable time later before it became known that it had been laid across the Bristol channel.

The success of the Bristol channel operation and a review of the ultimate requirements for this method of transporting fuel led to the conclusion that a 3in ID (76mm) Hais cable was a feasible proposition and one which would reduce the number of lines to be laid. Since the 3in Hais would have nearly three times the output of the 2in its advantages were considerable but the very much increased weight and overall size meant new and greater handling problems. The 2" Hais weighed approximately 25 tons per mile and the 3" Hais 63 tons.

At about this time, as it became clear to those involved at Siemens just what the final objective of the Hais cable was to be, grave doubts were entertained as to whether the laying operation was a practical proposition. From experience of the hazards involved under normal peacetime conditions it was known that the most difficult part of the work involved was the landing of the shore end of the cable at the end of the lay. In this case it was realised that the end of the cable on the far shore would have to be landed on a coast near enemy held territory. The lack of Manoeuvrability of a ship secured to a cable weighing over 60 tons to the mile and liable to attack from air and surface craft, if not from artillery, left no doubt as to the dangers involved.

The decision to manufacture the 3in cable immediately

imposed storage problems. It was realised that existing facilities were inadequate for the storage of the much heavier cable which had an outside diameter of 4.48in(114mm) and a new building to house forty mile lengths was put in hand. Later dockside storage sites were provided on the Thames at the East India, Surrey Commercial and King George V docks. Covered storage was also constructed at Callenders Erith works which enabled work to be carried on during the black-out.

As Siemens new storage building neared completion, 700yd lengths of the 3in pipe were being assembled for armouring to ensure that there would be no delay in moving completed cable when the site was ready to receive it. All this time stoppages were frequent due to air raids and consequent damage tO the works and delays due to materials not being available because suppliers had suffered similarly.

In the summer of 1943 all was ready to commence the armouring of the first long length of/Hais cable. In the new building the coil of finished cable was 65ft 6in (19.8m) in diameter with a number of lengths of up to forty miles coiled down to a height of 10ft 6in (3.2m) and a total weight of 2200 tons. By the middle of 1944 over 170 statute miles of 3in Hais cable were completed at Woolwich by Siemens.

/3in

During this period considerable progress had been made with the design of the terminations or end caps for the cable. These were required because of the necessity for the cable to be filled with water under pressure. This not only helped to avoid distortion of the cable in handling but also was essential to overcome the external pressure when the Hais was laid in deep water. From this work on the terminators the couplings for joining the main cable to the shore ends ~~was~~ were eventually evolved. This was once more a combined

effort in which a number of organisations and individuals assisted, the work being concentrated at Siemens. There were many problems to overcome owing to the high pressures the couplings had to withstand and the fact that the armouring of the cable tended to twist when pumping commenced. The final design was highly ingenious and, together with a split muff for joining two couplings together allowed two lengths of Hais cable to be connected to one another in twenty minutes.

Drawings of coupling & split muff

The essential feature of the coupling was that it could be fitted to the cable end and provided with a swivel and shackle by which it could be hauled. When necessary to join two length of cable together the swivel and shackle were removed and the faces of the couplings brought together, then the split muff and two steel rings completed the joint. The importance of ease and speed in this operation was fully realised as it might have to be done in close proximity to the enemy, if not actually under fire.

The couplings also included bursting discs made of thin copper sheet, in order to retain the water in the cable until all connections were made and pumping commenced. These discs blew out at a pressure of 400psi. Tests on 3in Hais fitted with couplings produced bursting pressures of 3,500 to 4,250 psi.

As it was clear that in order to achieve the throughput of petrol required at the maximum build up in the final stages of the campaign (planned as 7,000 tons a day for the British forces) more pipelines would be necessary than could be produced in Britain in the time available. So Clifford Hartley visited America in February 1944 (periously close to the date fixed for the invasion, it may be thought) and arranged for four manufacturers to produce lengths of Hais cable. The firms concerned were Phelps-Dodge, General Electric,

Okonite-Callenders and General Cables Corporation. A total of 140 miles of Hais cable was produced in America and delivered to England in merchant ships specially fitted with cable tanks. Unfortunately the compound used to cover the final jute serving was not flexible at low temperatures and when attempts were made to unload the cable in Britain all the coils were stuck together. The outer jute covering came adrift from the cable and hung in shreds, jamming the bell-mouth through which the cable was led from the coils in the tanks. As a result a spar carrying a sheave collapsed and it is thought that a man was fatally injured. If this were so it is the only known fatality in the history of 'Operation Pluto', although men were injured, some seriously it is believed. Eventually it was decided that the only way to get the cable out of the ship was to cut it into short lengths. This misfortune cannot have happened to all the consignments of cable as there were two lengths which were laid across the channel, but only one successfully. As the American Hais cable was said to have cost twice as much as that made in Britain it must have proved a very expensive error.

In view of the fact that Hais cable was full of water when laid it was frequently asked to what extent this contaminated the petrol. Clifford Hartley said that the contamination was negligible and that when pumping commenced the waterwwas allowed to run to waste until petrol reached the other side. It was easy to tell precisely when this occurred and the spirit was at once switched to storage tanks. In fact in some cases water was pumped for some time in order to ascertain whether the pressure was maintained since a drop in pressure would indicate that there was a leakage somewhere in the line. To test the speed of the flow, coloured globules were entered into a line. At a pumping pressure of 750psi it took about four hours for oneof

these to pass from Dungeness to Boulogne.