

THE INTRODUCTION OF DIESEL TRACTION: KEY TO PORTUGUESE RAILWAYS MODERNIZATION AND PIONEER ELEMENT IN EUROPE

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The purpose of this lecture is to characterize the dieselisation of the Portuguese Railways, seen as a process of replacement and later on total substitution of the steam engine locomotives by Diesel engine locomotives in the non-electrified lines. This operation began in 1948 for the broad gauge lines and ended in the mid 70's. In the narrow gauge lines, the substitution began in the same year but was only concluded in the late 80's when finally, any trace of steam locomotives in regular service disappeared in our country.

Nevertheless, the long way towards Diesel does not end with the disappearing of the steam traction. Long after this event, the purchase of Diesel traction material continued, but this time it was not destined to replace steam locomotives: the motive was now the enbroadment of the stock or the progressive replacement of older material. Therefore, this later period is not an object of this study.

The first Diesel locomotives were built in the early XXth century. Nevertheless, whether a big success or not, these locomotives were mere experiments and were never used for commercial service on a big scale.

As a matter a fact, until the World War II the Diesel solution for railways was limited to the manufacture of shunters and railcars. This situation was the result of two main facts: the first Diesel engines had little power and there were some problems with the transmission. The mechanic transmissions revealed to be very fragile and little flexible for the demands of the railways services. The construction of hydraulic or electric transmission was still underdeveloped¹. The new traction solution was not left out but its application was destined mainly to the low power vehicles. In the case of shunters and railcars they have only few hundreds horse power.

Diesel traction was no real alternative for steam and electric traction of traditional trains, composed by a locomotive, cars or goods wagons. The dawns of Diesel as an alternative solution to steam engine and a traction solution for non-electrified lines were bound to be in the USA in the 40's.

In Portugal, except for the Cascais line, electrified in the 20's the entire railway network was run with the aid of steam traction. The difficulties met by the country between the two World Wars, both political and economical, did not make possible a constant update of the railways system. The new competition of the automobile was beginning to question some technical obsolescence as well as a running system far too rigid and inadequate

¹ As a matter of fact, the first Diesel locomotives had mechanic transmissions as automobiles have. This solution is still used today for certain shunters and railcars but it is limited to low power vehicles. The definitive solution appears with the development of hydraulic and electric transmissions. In the first case the engine movements are transmitted to a pump, which, by compressing a fluid actions a turbine, and so make the wheels move. This solution was mainly used by German locomotives or locomotives manufactured under German influence. The other solution, the electric transmission, consists in using the engine movements to action a generator which provides power to the electric traction engines. This system is more widely spread.

conceived in the XIXth century in a time when the railways detained the monopole of the terrestrial transportation.

The traffic loss in favour of the road transportation was converting into a growing problem for the Boards of the Railways Companies all over the world after the I WW.

The concern is visible in the increased importance of the subject at successive congresses of the International Railways Association from that date further. Pressed by the road competition, most of the European Railways Administrations launched a counter attack on 2 main fronts: on one hand, at an institutional level, seeking to influence the political power to regulate the competition in the transports sector; on the other hand by trying to make more flexible both the infrastructure and the rolling stock in order to provide the public with a better service and stop the traffic decrease.

As to the update of the rolling stock the idea of fighting the automobile with its own weapon by applying the automobile technique to a railway vehicle came early. A result of this concept is the railcar, in essence a vehicle put in motion by an explosion engine (not necessarily a Diesel one) whose movements are transmitted to the wheels by a transmission, initially a mechanic one, similar to a bus or a truck.

In 1933, the railcars have already overcome the experimental stage and were widely used by the European Administrations.

The advantages of its application did not pass unnoticed in Portugal, and therefore, on May 9th 1934, a Government Decree ordered a committee of engineers to study the possibility to introduce these vehicles in the Portuguese Railways system. The committee was formed by elements of the Government and from the Railways Companies. The study referred to various countries, which were already using the Diesel traction, and detailed the types of services they were used for, their functioning and maintenance, building solutions etc. Chief of the Committee was the General Director of the Railways himself, the engineer Rogerio Vasco Ramalho. His conclusions were extensively published by the magazine “Associação dos Engenheiros Civis” latter on “Boletim da Ordem dos Engenheiros”.

Fundamentally they were the following:

- the cost of a railcar in circulation was approximately half of a train headed by a steam locomotive.
- The utilization of the Diesel engine was dominant comparing to other fuels such as gasoline or “poor gases”
- Its commercial speed was normally much higher due to its facility to start, accelerate and stop.
- These characteristics allowed to reduce to half the cost of running lines with low traffic, or duplicate the daily number of circulations without any increase in the costs, offering this way a service competitive to the one provided by road transportation.
- In the lines with a medium or high traffic, it allowed the increase of the frequency and the commercial speed of the services without any increase of the costs
- There were three basic types of railcars corresponding to three types of needs: the ones destined to the branch lines normally of 2 axles with up to 200 HP; the ones destined to cross country services in complementary

or main lines, normally of 4 axles and 200 up to 400HP; finally, the ones destined to prestige long distance services, intended mainly to compete the automobile and airplane. They were usually DMU with a variable number of cars and power from 500 to 1000HP:

- Whenever the normal traffic was exceeding the railcar capacity, the solution of the steam engine locomotive was more advantageous.

As a consequence of these studies, CP Board assembled on September 30th 1936, had to respond to a letter from the General Direction of the Railways inquiring on the following items:

- whether the possibility of using railcars in its network has been studied
- in case of an affirmative answer, what types of vehicles they were interested, how many and how much did it cost;
- whether they pretended to purchase them in the near future;
- in case of not having the intention of purchasing them in the near future but have no doubt on their advantages what was the reason for not acquiring them;
- in case the reason was a financial one, which was the aid the company needed in order to be able to purchase the railcars.

In its answer, the Board indicated the matter was of its interest since 1929, having demanded some of its technicians to study the cases already existing abroad: in 1934 had sent two of its engineers to make a detailed study of various European countries; recognized that the railcars allowed to run more efficiently the branch lines and that most of its lines belonged to that category; that they made possible to offer a better service in the main lines, recovering some of the traffic lost in favour of the road transportation.

Next, it presented a full programme referring to the implementation of an experimental railcars service, which required 12 2 axles units for branch lines and 8 4 axles units for cross country service in main lines.

The investment needed, including vehicles, tractors, tools and the start up for a maintenance unit for the new material, rounded 16 900 to 18 000 *contos*. Depending on the results obtained was going to be decided an increase of the stock fleet. For the time being, they informed that the financial difficulties have forced the company to reduce the experimental programme to 3 units, which were to be ordered still. The answer letter was concluded with a hypothetical financial plan implying State aid, which would allow the Company to put in practice the experimental railcars service.

From all these we may draw the conclusion that, by the end of the 30s, the experience of Diesel traction introduction was well known and the studies needed for its application in Portugal existed already.

Following the history we see that the railways were seeking modernisation for in August 1939, had already began the negotiation for the purchase of 12 GE shunters, 10 big Essling Railcars, purchased through Otto Wolf company in Köln, 4 of them Diesel electrical and 5 Diesel mechanical. Tentative was made to order another 10 small Diesel mechanical railcars. As we mentioned before, the railcars and shunter were at the time the main application of the Diesel traction for railways. The CP Board didn't know that its plans were to be frustrated by external events: in September the 2nd World War broke out and the price of the railcars provided by Otto Wolf

became much higher with no delivery deadline in sight. An alternative was seek out at the Italian company Breda but it raised the price up to 65% more than its original bid in the auction and therefore was considered the opportunity of consulting neutral countries.

As to the American shunters, it was difficult to reach an agreement with the constructor regarding financial condition and finally the General Manager of Railways expresses its dislike towards the transmission system and asked for a consult with European Companies. The attention turned then to England and Switzerland but directly or indirectly the war ended by affecting the normal commercial functioning of all Europe. The order for 12 shunters to the English company Drewry Car Company was approved but due to the circumstances the projects for the introduction of the railcars and shunters have to be postponed for better days.

Nevertheless, it will be a small company, Companhia Nacional de Caminhos de Ferro, owner of the running rights for the Tua and Dão lines, the one to run in 1938 the first Diesel engine locomotive. It was the n.º 31 “Lydyia”, manufactured in Germany by Deutz. Its short life was spent on the Tua line, where it seemed to have past almost unnoticed. It is possible that the inexperience and lack of duly qualified for a new technology so different from the steam might have discouraged being used. It is also possible that the war might have made difficult the shipment of spare parts and the maintenance services of the manufacturer. The truth is that this episode can only be seen as a precedent for the introduction of the new traction system and that the true start up will still have to wait a while.

It will be the administration of another narrow gauge line the star of the second episode in the Diesel history in Portugal: this time Companhia para a Construção e Exploração de Caminhos de Ferro no Estrangeiro, a French owned Company concessionary of the Vouga line and Aveiro branch. In 1940, the supply problems resulting of the war have almost paralysed the road traffic. The railways had to face a considerable increase of demand although they too have a lot of trouble due to high price and low quantities of the fuel and other material. All rolling stock, even the shunting locomotives were intensively used to put up with the increased traffic. Needing to enlarge its stock but unable to do it due to the circumstances, the Vouga Valley line had realised the advantages of using railcars mainly in a branch line such as itself. The solutions studied and implemented was then to build its own railcars.; the first model was build in 1940 using the chassis of a Panhard truck property of the Company. A bogie replaced the front axle, in order to negotiate sharp curves. The body was build in the Company’s own shops as well as the front bogie. It was equipped with an original Panhard truck gasoline engine. The tremendous success led to the manufacture of another 4 unites form a total of 5 later on, when integrated in the CP numbered as ME51 to 55. There was a 6th locomotive destined to fish transportation between Aveiro and Viseu which became in the CP number scheme ME 21. As they were built out of scrapes normally they used 2nd hand chassis and engines. Two of them used for a time Disel engines but most of the time they run on gasoline. Nevertheless, the must be seen as pioneers in the application of explosion engine for railways being the first railcars ever to circulate in the national network.

Even during the war and once frustrated its attempts to order abroad, Cp would build its own stock of railcars by using the same technique. They used 2nd hand truck chassis building the bodies in the Santa Apolonia workshops. The engines were new gasoline Chevrolet. Seven of these vehicles were destined to normal gauge being numbered from M1 to 7, 8 were destined to narrow gauge, the series ME1 to 8.

Later on, the M01, “Andorinha” (“The Sparrow”) manufactured by the Figueira da Foz workshop joined in.

Nevertheless, the real start up for the Diesel in Portugal occurred after the 2nd World War. Once the conflict ended the stock already revealed to be worn out by a intensive using as well as a high average age. This was preoccupying for the General Direction of Railways who, on December 2nd 1946 sent a letter to the President of the Board describing the general bad condition and recommended the purchase of new material.

According to this document, the stock at the time included about 400 units from which only 12% had less than 20 years, 24% were between 20 to 30; 19% had more between 30 and 40 years, 12% had between 40 and 50 and 17% had between 50 and 60 years of service. The new Mikado 850 steam locomotives bought from the American company Alco in 1945 could not disguise the existence of an aging overworked stock that accumulated malfunctioning and out of service material. To cope with the situation the General Director of Railways recommended the purchase of 10 more steam locomotives with serial number 070: another 10 units of the newly bought Mikado 850; finally the acquisition of a experimental range of 5 Diesel electrical locomotives of 1.500HP.

CP response, after the elaboration of a study by the Stock and Traction Department was a bold one as defended the following: as to buying more steam locomotives the common sense required to invest in the serial numbers already existing as 070 and 850. Nevertheless, they would not allow great improvements of the service. It is true that new locomotives would compensate the lack of reliability of the stock but they could not improve the commercial speed or the cargo capacity of the trains. They could only maintain the service as it was, without any real advantage.

Then, the Company proposed not to buy any more steam locomotive and buy instead 15 to 20 Diesel electrical locomotive of 1 000 HP.

«The first reaction of Vasco Ramalho, General Director of the Railways was of fear. As a matter of fact, Diesel electrical locomotives have been used for some time now in the USA proving their efficiency and effectiveness. In spite of all this, no European Administration used them on broad scale. According to him, the investment in an innovating traction system in a country of poor resources was a risky one especially without an experimental period for the try up of the material and preparation of conduction and maintenance personnel. In his letter dated January 15th 1947 we may read:

From the facts presented by the document n° 16/47-A of this Board we are led to believe that the technical services recommend the immediate adoption of Diesel traction on broad scale without any accommodation period (...) before the system could run at its maximum capacity and efficiency.

It is the understanding of this General Direction that might be prudent to perform a gradual replacement of steam by Diesel traction and, by consequence, allow a larger or smaller period of transition in order to prepare the conducting vigilance and maintenance personnel and convert the personnel formed for the steam traction avoiding thus the failure occurred under the same circumstances on other railways, better prepared technically and with better start up conditions than ourselves. (...)»²

The Board answered back, pointing out that Diesel locomotives had already past the experimental stage, that the fuel cost was about half of the steam engine locomotives, that a Diesel locomotive did not consumed while still, did not required firing up or washing and was already ready for service, in addition to being easier to conduct and requiring no great adjustment for the conduction personnel. The major problem would possibly be the adjustments needed for the workshops destined to the repairing and maintenance of this type of material. Nevertheless this would never be a real problem since the preparation of a workshop for the railcars was planned! Finally, Vasco Ramalho would give in and was decided that the State would purchase 6 Diesel electrical units and Cp another 6. This is the real beginning of the Diesel traction not only in Portugal but in Europe as well.

² «Letter of the General Director of Railways to the President of CP Board; Direcção Geral de Caminhos de Ferro», Lisbon, CP Historical Archives, Green Books, 1947, p. 39-41.

Finally in 1947, the Drewry shunters negotiated in the beginning of the 2 World War arrived and began to function. It was not a range of 12 units as initially planned but of 6 units purchased by the State and later on numbered by Cp from 1001 to 1006.

The arrival of the railcars have been also delayed by the war and in the end the order was not placed near any of the Companies initially consulted. The Swedish Company Nohab was the chosen one and the delivery began in 1948. The order consisted of 6 units of 2 axles serial number My 51 to 56, 15 units of 4 axles, serial number My 101 to 115 and 3 units destined to narrow gauge, serial number MEy 101 to 103. Some cars accompanied them.

Even more spectacular was the introduction of American Diesel electrical locomotives, the serial number 1501 to 1512 manufactured by Alco, which arrived in 1948. Using this kind of material for regular service was a novelty in Europe. In 1949 began the delivery of the 12 GE Diesel electrical shunters, also American.

The different maintenance technique of this material and the comprehension that a new era in railways traction have begun led to the opening of a workshop in Campolide for the Diesel locomotives autonomous from the warehouse and the general traction service. Later on, these facilities were enlarged by the tests bench in Barreiro.

Proving since the beginning to be of excellent quality, the Alco locomotives were soon confronted with the faults of a deficient infrastructure of the national railways network. Meant to circulate at 120km/h, their weight by axle provoked enlargement of the lines that limited the speed to a maximum of 80km/h. This problem did not permitted at the beginning to improve the commercial speed of the fastest trains but made possible an increase of the cargo keeping the previous time tables when the lines where operated by steam locomotives. The problem would be solved only latter on by replacing the original bogies by another more convenient ones. The possibility to function with multiple traction, which means that one conductor could drive more than one locomotive when coupled could not be used as the railways stations were too short. In addition to this, most of the cars were old models and the couplers could not bear the weight of the trains, which the new locomotives were able to form.

Up to this point the dieselisation effort was sustained both by the State and CP, in 1956 Portugal will enter the Marshall Plan, after first have rejected it.

As a consequence, more Diesel electric locomotives were ordered. At the end of 1951, 5 new Alco arrived similar to the first ones but slightly more powerful (an increase from 1500 to 1600 HP), with serial number from 1521 to 1525. At this time we may say that was already formed a full stock of shunters, railcars for passengers service and heavy line locomotives for services in the main lines as The North Line, West Line and Vendas Novas branch. Nevertheless, were needed more Diesel locomotives able to serves the weaker lines such as Beira Baixa among others. In the Beira Alta line, the Alco could not run due to the fact that the bridges were not able to sustain their weight per axle. The solution for this problem came from NATO considering the line as strategic point in case of an invasion from the east and therefore offered to finance the modernisation of the infrastructure.

The order for lighter locomotives (16 t per axle), meant to fully cover the deficient railways network, was also undertaken by the Marshal Plan and placed to Withcomb, a Baldwin subsidiary. These will be locomotives with serial number 1301 to 1312, which deserve special highlights as they were specially designed for the needs of the Portuguese railways without resulting from any modified pre existing model. They arrived in 1952.

Once overcame the initial faze, the dieselisation could not be stopped and in 1953 we could witness the beginnings of the rolling stock with more impact on the public: 3 Fiat railcars destined for rapid service for long

distance which initiated the “Foguete” (“Rocket”) service, during many years the fastest train between Lisbon and Oporto, needing 4 hours to cover the distance, a record that remained unbeaten for more than 15 years.

In addition to this, they were the first railway vehicles to offer air conditioning as well as the possibility for the passenger to have a meal at his own seat, similar to the services offered by the airplane. Its commercial success helped disguising some reliability problems only solved little by little. Each of the 3 trains was composed by 2 motor units on each side of a trailer having serial numbers from My 501 to 506.

After the railcars destined to rapid service, some more acquisitions were required for the frequent stops service in main or secondary lines.

The vehicles destined to this type of service would start running in 1954 and were the Dutch Alan railcars. Contrary to the Nohab, which were Diesel hydraulic or the Fiat, Diesel mechanic the Allan were the first Diesel electric railcars in Portugal. 25 of these units were destined to broad gauge (My 301 to 325) and 10 to narrow gauge (MEy 301 to 310). After some initial problems, they proved to be extremely reliable and some of them are still running in a remodelled form.

In 1955 we are at the dawn of electrification but the progress made possible by the Diesel was very much visible and a reason of satisfaction for the Board of the CP: between 1947 and 1954 the steam locomotives service was down from 97.6% to 60.4% and the services offered by locomotives with explosion engine was up from 2.4% to 39.6% and the forecast was to reach 50% the same year. It was widely believed that by electrifying the line Lisbon Oporto Sintra and some more acquisition the steam would be gone for good.

The same year the stock of shunters will be added more 18 Moyse with serial numbers from 1051 to 1068.

This was the first time Diesel was used in Europe in a grand scale and could not but deeply influence towards its use on the entire continent: in 1954 the IRC decided to assembly its Committee in Campolide in order to study the new traction system. At the 3rd CIMAC Congress, in 1955, the information regarding the Diesel was required from the CP technicians present in the act.

As a sequence of this meeting, several European railways Administrations asked for the permission to visit the Workshop in Campolide.

Early in the 60s a credit from Eurofima and the 2^a development Plan allowed the enlargement of the diesel stock: this time the order referred several locomotives for heavy shunting or light line services. These locomotives, of French design, produced by Brissonneau & Lotz, were the first assembled in Portugal by Sorefame, between 1961 and 1964, with serial numbers from 1201 to 1215. The involvement of the Portuguese industry into the process will increase in the following years: with the help of another Eurofima credit, an order will be placed for 19 railcars built by Sorefame with Rolls-Royce engines. These railcars will be DMU with serial number 401 to 419. The same financing company and the same building partners, Sorefame and Rolls Royce, will allow the existence of the broadst range of shunters of the Portuguese Railways, “The Sentinel”, 36 units numbered from 1151 to 1186.

Once the Diesel traction and electrification gained a certain importance, the steam as traction system declined but the last stroke soon came: The help from The Special Fund for Terrestrial Transportation allowed an order for light medium power locomotives (1300HP) to be placed to the English Company English- Electric. These locomotives were destined to light service lines, which constituted the biggest part of the Portuguese railways system. It was agreed that the first 10 would be manufactured English Electric in England and the remaining 40

by Sorefame, and all the elements needed for the assembly were to be sent by the English Company. This way the national industry assured an important contract but also, for the first time, the final price of the locomotives was lower than it would have been in case of imported locomotives. These locomotives with serial number 1400 are today omnipresent in the Portuguese railways system. The first 50, delivered starting in 1966, were followed by another order of 17 and numbered from 1401 to 1467. In 1969, English electric delivered another English manufactured 10 units, this time heavy ones, at that moment, the most powerful existing in Portugal numbered from 1801 to 1810.

The British locomotives were joined in 1968 by more 5 Moyses shunters numbered 1021 to 1025.

After the acquisition and running of the English Electric locomotives in the late 60s and early 70s, notice on the steam locomotives being retired from service appears frequently in the Acts of the CP Boards meetings.

In 1973 the last Diesel electric locomotives were purchased with the main scope of once and for all substitute the steam traction. The serial number of these locomotives was 1550 and were manufactured in Canada by MLW, a Company which now was entrusted by Alco to manufacture its railways product line.

The 20 units were numbered from 1551 to 1570 and were an updated version of the initial Alco locomotives from 1948 and 1951. Soon after that, in the mid 70s the steam traction would finally disappear from the regular service on the broad gauge. The issue of the narrow gauge still remained open...

If it is true that, in the beginnings of the dieselisation process, the narrow gauge benefited from the acquisition of some new material as the Nohab and Allan railcars, later on, no significant investment was made. As a matter of fact, for the metric gauge system was spent only the minimum necessary to its function without jeopardise safety.

In CP opinion, the narrow gauge was still functioning only for social purposes and while was still not possible to replace it by alternative road transportation. This is why buying new material was out of the question with exception of the metrical system of Oporto formed by the lines between Oporto- Povoas do Varzim- Famalicão and Oporto- Guimarães which, as suburban railways were lines of heavy traffic.

In fact, since late 60s these lines have got the attention of the company Board that studied the possibility to run them with new Diesel locomotives.

Little before April 25th 1974, the close up of part of the Vale do Vouga line seemed to announce the end for the most of the narrow gauge system, but the following events led to the reopening of some of the closed lines. It was then obvious that due to Communities lobby the metric lines were to run for a few more years. Under those circumstances, appeared the problem of replacing steam locomotives, obsolete, with high running costs, difficult maintenance due to lack of spare parts and personnel qualified to handle an almost extinct traction system. It was common knowledge that in case of buying new material this would be destined to the Oporto zone and the other lines should be reinforced with 2nd hand material. Following this strategy, 6 Diesel electric narrow gauge locomotives were bought from the Spanish railway of Tajuña. The locomotives, manufactured by Alstom were numbered from 9001 to 9006. Another 11 units similar to the first but more powerful were also bought 2nd hand from Alstom itself and numbered from 9021 to 9031. The close up of narrow gauge in Yugoslavia allowed the purchase of 10 Diesel mechanic DMU, locally manufactured by Duro Dakovič. The Oporto lines got indeed 22 new Diesel electric Alstom railcars, numbered from 9601 to 9622. Nevertheless, steam traction will only

disappear from regular service in the mid 80s, affected mainly by Diesel competition but also by the traffic loss and the close up of several lines.

In conclusion, Portugal was a true pioneer of the introduction of Diesel system in Europe but would end up the last of the Western European countries to abandon steam traction. It is above questioning that Diesel traction as well as electrification, improved the service, increased productivity, lowered the running costs and allowed the Portuguese railways to survive. Nevertheless, the new traction system could not be taken advantage of at their outmost: the new units began running in an infrastructure dating back in the 30s. Layouts too short in the stations, cars with couplers which would not allow forming longer trains, bridges which couldn't support them, all this limited their technological advantages.

On the other hand, the implementation of the new traction system led to the introduction into the Portuguese Railways system of new and advanced technology: maintenance techniques using ultrasounds, magnetoscopy, spectroscopic analysis of the lubricants, tear and wear by metallic projection, were out of reach for many Portuguese entities.

The same applies to the technology used by the locomotives themselves, since the turbo charge, intercooling, torque converters, 4 valves per cylinder, correspond to techniques used by the automobile industry only nowadays, half a century later on.

Certainly, the Portuguese Railways system would not have survived without the Diesel and electric system, In spite of this, by not updating the infrastructure to the new material the railways loss of market share could not be avoided and nowadays, the railways comes only second compared to road transportation. Its hegemony still holds for services such as suburban passenger service and goods transportation and a future might arise for long distance rapid passengers services.

Most certainly, even a more balanced railways strategy, thought to combine the updating of the infrastructure with new rolling material, could not have prevented the automobile from gaining primacy but would have prevented the public in general to cease seeing the railways as a viable alternative.