SOUTHERN REGION - BRITISH RAILWAYS

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NEWS STORY No. Date July 1961

B. R. 3400 1/44

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CATCHLINE ELECTRO-DIESEL LOCOMOTIVE

Britain's first electro-diesel locomotive is due for completion by the end of the year. It is one of six authorised two years ago for experimental operation on the Southern Region.

This newcomer to the British Railways traction "stable" represents a bolder and more elegant concept than its rather meaningless name would suggest.

While the principle is not entirely new, the basic design evolved for these Southern Region locomotives is a highly-sophisticated attempt to solve some of the outstanding problems of electrified rail operation.

This particular version of the dual-traction locomotive, capable both of using third rail traction current and of running under its own diesel-electric power, has, in fact, been developed as an answer to a fundamental problem which first loomed on the Southern more than 20 years ago.

The Southern's operational planners, seeking to eliminate steam working completely from their already extensive electrified network, faced heavy expenditure on the electrification of freight yards -- unless some method could be found of working freight trains away from the power supply.

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The many ideas advanced for bringing this about narrowed down eventually to the basic principle of a third rail D.C. electric locomotive equipped with a separate diesel-electric plant capable of providing independent traction power.

But within the terms of this solution there was still enormous room for vastly differing operational concepts: the key question, on which the whole economics and practicability of the enterprise rested, was the balance of power between the two forms of traction which had to be based on a ruthlessly objective appreciation of its proper roles.

One of the early proposals, for instance, was to produce a locomotive capable of approximately the same performance on and off the electrified lines in any conditions: it seemed to promise the apparently incontrovertible advantages of supreme flexibility and universal availability.

But close examination and analysis suggested that the practical day-to-day value of these qualities was not as great as it might appear: and it was decided that it was greatly outweighed by the heavy economic penalties.

An electro-diesel built to these standards of performance offered no reductions in running costs over a straightforward diesel-electric locomotive of equivalent power -- which would be very much lighter and cheaper to build. There would, in fact, be no point in having such electro-diesels, since equivalent diesel-electrics would be just as useful anywhere on the system.

This proposal underlines the basic conflict between ideal performance targets and cost, which has to a large extent determined the design approach to the present vehicles. They represent the result of very hard thinking as to the actual duties and performance likely to be required in practice and of precisely the amount of diesel power necessary.

The design, in the end, has been based on a deliberate limitation of the roles which electro-diesels will be able to carry out.

No attempt has been made to design vehicles able to take over all the haulage in the electrified area which requires non-electric traction: "pure" diesel-electric locomotives with adequate power will still be relied on for some heavy line haul services.

In fact, no-one will know until there has been considerable operational experience to what extent electro-diesels running singly or in multiple will be able to carry out the heavier tasks when they are not able to use traction current. By accepting these limitation, it has been possible to reduce their cost below that of equivalent diesel-electrics. The diesel power chosen, 600 h.p., is rather larger than the optimum theoretically dictated by the considerations described: here, the fact that this engine is already in standard use on the region's multiple-unit diesel-electric trains promises off-setting economies. It provides twice as much as the normal maximum shunting power requirements, but is particularly useful for the type of haulage in demand during the night hours in the third rail electrified area.

The over-riding need to keep the cost of this sort of hybrid locomotive down, similarly led to the choice of the simplest possible electric traction control equipment -- resistance control with motors grouped in series parallel and parallel, and with four stages of field weakening in each grouping.

But as the amount of electric power provided is based on the fact that the first locomotive of this type is intended for general freight and relatively light passenger duties it has been matched more or less to that of the Type 3 diesel-electric locomotive built for similar duties.

The one-hour rating will be 1600 h.p. (a purely electric rating, of course, which cannot be compared with the Type 3's 1550 engine h.p.). The electro-diesel locomotive will be considerably more powerful than the Type 3 up to 40 m.p.h. with a decreasing margin to about 65 m.p.h., above which the diesel-electric locomotive will have more power. It seems likely that for the greater part of its work the electro-diesel locomotive should be superior to the Type 3.

It is fairly obvious that the limited flexibility accepted in the basic design would normally be likely to complicate locomotive rostering. To offset this, the electro-diesel has been made capable: (1) as a diesel, of running in multiple with the Type 3 and a wide range of other B.R. diesel-electric locomotives; and (2) as an electric locomotive, of running in multiple with the modern classes of multiple-unit electric stock.

In the first role the electro-diesel will be able to play its part in the double-heading of trains heavy enough to require more than one Type 3 locomotive, but not double Type 3 power.

The second capability will open up the possibility of using these locomotives, together with specially equipped trailer coaches, to supplement electric multiple units during the peak: and also perhaps to run mixed multiple unit passenger and van, mail, or newspaper trains.

The result of these various requirements and decisions on performance have produced a design for a Bo-Bo locomotive of about 73 tons.

The diesel engine has been placed at one end mainly so as to keep the electrical equipment together at the other end, but this has also reduced the frame stresses. The body width has been kept within the 8-ft. wide Hastings gauge in order to permit working on diesel power on the Hastings line.

The driving position closely follows the layout of that of the Type 3 diesel-electric locomotives, but two main power handles are required on the master controller, one for diesel operation and the other for electric operation.

Each of these has in addition to its normal "off" position a "lock off" position from which it can only be released by pressing a button at the end of the handle: the locking is such that only one of these two handles can be away from the "lock off" position at one time. The change-over from one form of power to the other is then made quite simply by returning one handle to the "lock off" position and releasing the other from it.

The diesel engine may be started at any time, and would normally be running in readiness for a change-over to diesel power. When the locomotive is running on diesel power the collector shoes are automatically retracted within the loading gauge: there is a button by means of which the driver can lower the shoes when over a conductor rail to check whether it is alive or not.

The diesel main power handle controls the output in exactly the same way as that of a diesel-electric locomotive, largely by adjusting engine speed, and therefore output, through varying control air pressure. The electric main power handle, however, works similarly to those on the recent a.c. and d.c. electric locomotives of British Railways, having in addition to its two off positions, "run back", "hold", "notch up", "run up series", "run up parallel", and "run up weak field" positions. The last three positions are primarily for operation with multiple unit electric stock, although useful also when the vehicle is working as a locomotive. The traction motor fields can be weakened in the series connection by advancing the reverser handle as required beyond the normal forward position, but when one of these weak field positions is in use resistance notching is not available.

The bogies have oil immersed pillar axlebox guides with coil primary and secondary springing. The traction motors are simple axle-hung machines with four poles and lap wound armatures. Roller suspension bearings, as well as roller axle bearings, are used. The bogie frame structure is a simple tubular form composed basically of rolled steel joints with a minimum of forming.

The diesel engine is, of course, the same 4SRKT turbo-blown engine as is fitted to the Hampshire diesel-electric trains, but the generator, although inter-changeable as a unit with that of the multiple unit trains, has different windings. Apart from this the only significant departures from the multiple unit train installations are the abandonment of mechanical radiator fan driver for an electrical one and the use of a much larger and more effective silencer.

The main resistances are naturally-cooled edge-wound strip, continuously rated: resistance notching contactors as well as the group contactors are driven by electrically operated camshafts. Electro-pneumatic contactors are provided as line switches, and for some other functions.

All auxiliaries, except traction motor blowers, are fed at 110v: this supply is derived from a motor generator set when the line feed is available, and from the auxiliary generator on the diesel set when it is not. A 110V. engine starting and control battery is, of course, also fitted; and is charged from whichever of these sources is available. The two traction motor blowers are connected in series across the line when on electric power, and in parallel across the diesel main generator when diesel power is in use.

Provision is made for taking a supply of current from the conductor rail for train heating. Preheating of trains is also possible when no third rail supply is available by taking a supply from the diesel generator; but this generator is not expected to provide heating current when hauling a train.

The braking system is a slightly more elaborate form of the compressed air installations already in use on S.R. diesel and electric locomotives. The driver's main brake valve acts on the compressed air train pipe which in turn controls the vacuum in the vacuum train pipe when vacuum fitted stock is being hauled. The complication in this case arises from the need, when working in multiple with multiple unit electric stock, to control also the electro-pneumatic brake.

When completed it is expected that these locomotives will be tested all over the Southern electrified system, but probably for the most part in the South Eastern Division.

The specifications and designs have been worked out under the supervision of Mr. W.J.A. Sykes, Chief Mechanical & Electrical Engineer, Southern Region, by his staff at London Bridge and Brighton, to the general requirements of Messrs. J.F. Harrison, Chief Mechanical Engineer and S.B. Warder, Chief Electrical Engineer, of the British Transport Commission.

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