Amtrak's View of Railroad Electrification

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Because not much has been done with electrification is this country, the original Northeast Corridor, completed in 1933, is the only real example of an operating electrified railroad in the United States. Early reasons for electrification were to cut down on the smoke produced by steam engines and, before the advent of diesel locomotives, to increase tractive effort. The GG-1 locomotive, which was built 40 years ago, is still being used in the Northeast Corridor. One reason for its long life is that some speeds that were expected in the Northeast Corridor were not attained.

Why did electrification stop here? There were many reasons, of course. The depression was one, and World War II followed on its heels. After that, the railroad industry saw most of its passengers take to the automobile, with first-class passengers going to aircraft. Also, the improvement in the nationwide highway network financed with government funds made it possible for the motor carriers, hauling freight by truck, to take over a lot of the freight business. The big changes from railroad to motor carriers took place in the northeastern United States, where distances were shorter and the railways were laid out in a rather primitive alignment. We have simply not been able to compete; trucks can travel anywhere.

I would like to tell briefly why I am so interested in electrification. At the Illinois Central Gulf Railroad Company I had my first real brush with this side of the business. The commuter line was electrified, and one of my tasks was to obtain federal funding, which had never been received in Chicago before, for a portion of the cost of the new commuter cars. We actually went through a study at that time, in the late 1960s, to determine whether we should keep the electrification. Of course, we had the alternative of a diesel-electric push-pull operation if we wanted to tear down the wires. It was determined that, in spite of the age of the electrified installation and some of the shortcomings of the 1500-V direct current system, we would retain the electrified system, and the bilevel electric-motorized unit car was designed, tested, and built. Not too long after that, I was asked to chair the in-house feasibility study on electrification for the freight lines, specifically on the line from Chicago to Memphis, which is a route with heavy traffic. The decision in this case was not to proceed with electrification.

WHERE WILL ELECTRIFICATION BEGIN?

There are about 13 000 km (8200 miles) of rail line in this country that could justify electrification, extending what now exists. Those are the lines that carry 36 Tg/year (40 million gross tons/year). There are those who believe we might even electrify as many as 32 000 km (20 000 miles), but I think we ought to walk a little before we try to sprint. The Federal Highway Administration has directed the states to build highway overpasses and railroad underpasses 0.61 m (2 ft) higher than standard to ensure that there is clearance for the pantograph collector above electric locomotives. That would be for lines that carry 27 Tg/year (30 million gross tons/year). There are some 27 000 km (17 000 miles) of track that fit into that category in this country. I think it is very gratifying to see that kind of advance planning and coordination between the highway people and the railroad people in the U.S. Department of Transportation, so that we do not build bridges that would interfere with progress in rail electrification on high-density lines.

The National Railroad Passenger Corporation (Amtrak) appears to be the leading edge of this move toward electrification because of the Northeast Corridor Improvement Project, which includes the electrified line we are now operating and the extension of that line that will go on from New Haven to Boston. We will be the operating test-bed for a lot of the experience that will be invaluable to others. Some mistakes will be made but, on the technical side, there can be a great deal of assistance to other interested parties as the project moves forward and we actually gain some operating experience.

There are some complexities. Our power is currently 11 kV, 25 Hz; the power in the New York Metropolitan Transportation Authority and Connecticut Transportation Authority sectors will be 12.5 kV, 60 Hz; the Northeast Corridor Improvement Project is pursuing a higher voltage—25 kV—in its own sector. I believe we ought to build everything we need toward that ultimate level. Depending on the market projections for demand in the future, we should install the proper equipment from the start.

The real question, however, is not technical but financial. The financial constraint on electrification, even with federal assistance, as in the case of Amtrak, is the overwhelming issue. I can only think of a couple of technical issues that trouble me at this time. One is the problem of phase breaks; we will have to have three separate phases as we go from section to section. And this really has not previously been done at high speeds, at least to my knowledge. Our trains now travel at 190 km/h (120 mph), and we are trying to build up to 240 km/h (150 mph). At those speeds, the phase-break problem has not been solved yet. The other issue is the costs of adapting the signal system to electrification. I do not think that is a very serious problem technically—it is largely a matter of dollars. And that is a big problem.

It appears that everybody is in the race to be second in the railroad industry, but where are the dollars coming from? I do not think any more track will actually be electrified for operation until we determine where the capital is coming from. Looking for a moment at what this does to the income statement and balance sheet, some of the risks involved show why we have not seen progress in the recent past.

Consider a project to electrify about 800 km (500 miles) on a railroad with heavy traffic that runs through relatively flat country. This railroad probably has about 9500 km (6000 miles) of total trackage, so we are dealing with less than 10 percent of the entire operation. Such a railroad is probably capitalized at about $1 billion to $1.2 billion, so this would represent a tremendous increase in the capitalization of that property—probably 20 to 25 percent, depending on what signal system is in use on that sector of line. This is not bad, considering the rate of return, particularly with appropriate financial maneuverings, such as leverage leasings. This is

one way to see what actually happens both to the bottom line of the financial report and to the total capital invested in this business. The other needs for capital must be taken into account and, on a railroad this size, that could amount to another $100 000 000/year.

One of the risky issues in any analysis of electrification is what to do with the diesel fleet that is released. Generally, a railroad like the one we have been considering will have a fairly good locomotive fleet. A lot of assumptions about disposition are possible, even such extreme optimism as being able to lease out 100 locomotives at $300/d, but it really depends on how many companies electrify. And although such leasing opportunities may be available to the railroad that gets there first, in the railroad business, as I have seen it in my 20 years, everyone will try to move at once.

The issue of the diesel locomotives and how they might be used is tied in with traffic projections. How much business will there be? How many trains will be run 10 years from now, and how many of these could be diesels? There is a very high risk in making erroneous judgments. In the past few years everybody was projecting ever-increasing traffic. Then came the energy crunch in 1973, and with it came shortages of materials; the bottom dropped out so fast that we wound up trying to find out every day how far the traffic was going to drop.

EQUIPMENT USED WITH ELECTRIFICATION

I would also like to mention some of my feelings about the equipment that should be used under electrification, particularly as it applies to the passenger business. In the Northeast Corridor today we have a mixture of electrified multiple-unit (EMU) equipment and locomotive-hauled equipment. My prejudice is toward EMU equipment, as you might guess, because of my experience at Illinois Central Gulf and because of the success of the Metroliners. The 61 Metroliner cars, even with the difficulties we have keeping them maintained, are producing about 16 percent of Amtrak's revenue. They have never had a heavy overhaul yet, although they have had about 10 years of service running back and forth, many of them 1100 km/d (700 miles/d).

As a practical matter, we are going to see a mix of EMU equipment. It may begin with an overhauled Metroliner, since something has to be done about overhaul if we are going to continue to run them. Then we shall also need locomotive-hauled trains because of the tremendous fluctuations of volume that we have. At Thanksgiving, everybody in the United States goes somewhere; nobody wants to eat alone. The highways are bumper to bumper, and the airways are all filled up, so everybody comes running to the trains. I do not see any way, especially in the Northeast Corridor, to handle such a surge with only EMU equipment. There must be the flexibility that additional locomotive-hauled trains provide of lengthening trains and at least getting people where they want to go. That is what we are in business for.

The next step will occur when we achieve speeds above 190 km/h (120 mph). Then, EMU equipment will have the edge because of the power-to-weight ratio and the reliability required. It is possible to lose a car (or even two, in the case of a Metroliner) and still get there, but if a locomotive is without power or the pantograph drops for any reason, that is the end of the game.

I would like to address another issue. In the Northeast Corridor we have both passenger and freight trains, and some of the freight operations between Washington and New Jersey involve very heavy loads. A short time ago one of those freight trains broke what I call the first commandment of railroading—"Thou shalt not run into each other." One freight train ran into the rear of another at a point where there are four tracks. Just think what would have happened if there had been passenger trains on either side of them at that time. Amtrak assumes a considerable degree of risk, particularly when striving to maintain speeds above 190 km/h (120 mph), in trying to operate a reliable, high-speed, intercity passenger operation in coexistence with the freight operations, especially in view of the heavy axle loads associated with freight cars in this country. The British, French, and Japanese have expressed considerable concern in this regard since the axle loads in this country run approximately 9 Mg (10 tons) higher than they do on railroads in other countries. It is very difficult to maintain the necessary track tolerances with such high axle loading.

I would like to conclude by making a few predictions that may come back to haunt me.

1. I think electrification will take place, and I mean electrification beyond what is going on at Amtrak between New Haven and Boston.
2. I think electrification is a nice, graceful way toward rationalization of the railroads, something we need because we do have excess railway plant and inefficiencies. I hope that electrification will tend to draw the freight to the more efficient lines and that rationalization will foster the joint use of track. Many of the things intended under the provisions of the Railroad Revitalization and Regulatory Reform Act actually support such endeavors.
3. Except for the relatively minor technical problems that I mentioned earlier, electrification does not present major technical problems.
4. The major issue is the financing of this effort. I do not believe the private railroads can do it by themselves.