Roland Lebrun
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September 11 2016

Metropolitan Commission
Programming & Allocations Committee 9/14 Meeting
Item 3.B Caltrain Modernization Project Status Update

Dear Chair Wiener and members of the Programming & Allocation Committee,

Thank you for agendizing an update on the Caltrain Modernization Project.
The intent of this letter is to highlight emerging issues not covered by the staff presentation.

Capacity

I would like to thank MTC for providing relief for the so-called "Caltrain capacity crisis".
Six of the eleven Metrolink cars parked behind the CEMOF maintenance facility have been put into service and half of the Caltrain fleet now consists of 6-car (762 seats) trains. This reconfiguration has resulted in a significant reduction in standing-room-only trains during peak.

Unresolved issues:
How could Caltrain's proposed $551M train order possibly handle the current passenger seat demand let alone a doubling when the Downtown Extension (DTX) to the Transbay terminal opens? Specifically, how could six 450-seat trains/ hour possibly carry 6,300 passengers/direction let alone 60,000 passengers/direction in a 24-hour period?
http://mtc.legistar.com/gateway.aspx?M=F&ID=785a8a9b-28bf-41d3-9f74-3413cd5128a9.pdf (slide 9)

Rolling stock Costs

The award to Stadler Rail is approximately $225M (70%) above similar procurements in Europe

Client	Manufacturer/model	Year	Contract ($M)	#units	Unit cost	Reference
SNCF Lux	Stadler KISS	2010	$84	24	3.49	http://www.railway-technology.com/ne
Deutsche Bahn	Bombardier Twindexx	2011	$483	137	3.53	http://www.railway-technology.com/pr
Deutsche Bahn	Bombardier Twindexx	2012	$210	64	3.28	http://www.railway-technology.com/pr
STIF & SNCF	Bombardier Omneo	2015	$442	168	2.63	http://www.railway-technology.com/ne
AeroExpress	Stadler KISS	2016	$205	62	3.31	http://www.railway-technology.com/ne
SNCF	Bombardier Omneo	2016	$38	16	2.38	http://www.railway-technology.com/ne
Caltrain	**Stadler KISS**	**2016**	**$551**	**96**	**5.74**	**http://www.caltrain.com/Assets/__Ag**

Obsolete EMU specification

One of the apparent reasons for the staggering railcar costs (and resulting loss of seating capacity) is a requirement for two sets of doors to accommodate different platform heights for High Speed Rail. It has now become apparent that the FRA will not allow the deployment of Very High Speed EMUs in the United States and will mandate loco-hauled trains (similar to the French TGV) for safety reasons. This train configuration eliminates the requirement for high floors and enables level-boarding platform compatibility @ +/- 22 inches.

Irregularities with the EMU procurement process

The Caltrain EMU RFP was not issued through the SamTrans procurement website: http://procurement.samtrans.com/openbids.aspx (page 2). There is no reasonable explanation for not releasing the RFP through normal procurement channels and this may have resulted in non-competitive bidding (both cost and capacity) culminating with a single proposer.

Impact of CBOSS on electrification costs

The staff presentation does not mention Caltrain's new signaling system which is over one year late and at least $17M over budget. There are strong indications that this system will never work and that there is budget for a complete resignaling imbedded in the actual electrification costs. This is the only plausible explanation for the staggering cost of "electrification" of 51 route miles @ $1,253M (**$24.5M/route mile**)

*"Cost to design and install high speed rail electrification system from Boston, MA to New Haven, CT (primarily two track mainline railroad) was approximately **$2 million per mile** (contract cost) but nearly $4 million per mile (according to the federal auditor's review)."*
http://www.reconnectingamerica.org/assets/Uploads/bestpractice101.pdf (page 4: average costs).

Timing of the electrification project

Similar projects around the World wait for the completion of all capital improvements prior to electrification while Caltrain will make it very difficult to implement large capital projects such as grade separations and reconstruction of stations @ Diridon, South San Francisco and Transbay let alone track improvements required for high speed rail.

Please refer to the appended November 30th 2014 letter to the Caltrain Board for additional details.

Sincerely,

Roland Lebrun.

Roland Lebrun
ccss@msn.com
30 November 2014

Dear Chair Nolan and Honorable members of the Caltrain Board of Directors,

The intent of this letter is to substantiate and elaborate on the comment I made at the November Board meeting that the time has come to revisit the entire approach to the Caltrain modernization program.

Background:

In April 2012, the 9 funding partners co-signed the High Speed Rail Early Investment Strategy MOU that should have resulted in Caltrain electrification at a cost of $785M and new rolling stock (EMUs) for $440M (total cost $1.225B) by 2019.
http://www.caltrain.com/Assets/Caltrain+Modernization+Program/Documents/Executed+9+Party+MOU.pdf

In April 2014, the Caltrain Board approved a $122.4M set of consultant contracts:
- Project Delivery Director: $4.3M
- Systems Safety Specialist: $4.0M
- Project Management: $23.5M
- EMU Vehicle Consultant: $42.4M
- Electrification consultant: $48.2M

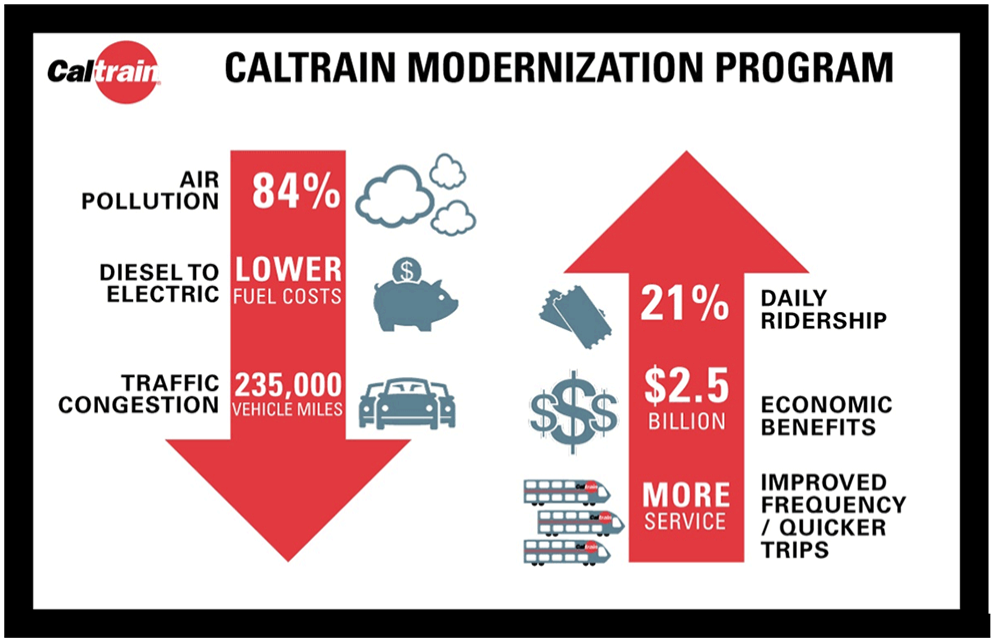
http://www.caltrain.com/Assets/Caltrain+Modernization+Program/Documents/CalMod+Procure.Fact+Sheet+3.11.14.pdf.

On November 6th 2014, SamTrans staff and consultants presented the Caltrain Board with the following update:
- New cost estimate of $958M for 150 track miles (**$6.4M/mile vs. $1.6M in the UK**)
- 90-minute off-peak headway during construction (vs. 30-minute headway requirement)
- **6 years of construction (1 year longer than 2,000 miles of electrification in the UK)**
- No revenue service until 2021 (new rolling stock was due in 2015-2018 timeframe)
- No increase in capacity until after electrification (projected 21% increase in ridership will occur 5 years before electrification)
- No improvement in San Jose to San Francisco travel times (**exposure to litigation**)
- No electrification of Main Track 1 (MT-1) between Santa Clara and Tamien, making it impossible to run service to Tamien during peak or emergencies (signal/switch failures)
- Additional "Management Reserve": $28M
- "Vehicle Management Oversight": $65M (**50+% over April consultant contract**)
- "Defer purchase of one 6-car EMU train set offset by need to purchase 3 used electric locomotives": $20M
- "~75% diesel vehicle conversion to EMUs", making it impossible to operate a high-capacity electrified blended system

http://www.caltrain.com/Assets/__Agendas+and+Minutes/JPB/Board+of+Directors/Presentations/2014/11-6-14+JPB+BOD+CalMod+Cost+and+Schedule+Update.pdf

Analysis:

In October 2008, a similar set of issues were raised during a UK Railway Engineers forum entitled "Making Electrification Happen"
Forum proceedings are appended to this letter. Here are sample extracts in *italic*:
- ***"Just declaring the electrified railway as a good thing to have is not in itself sufficient."***

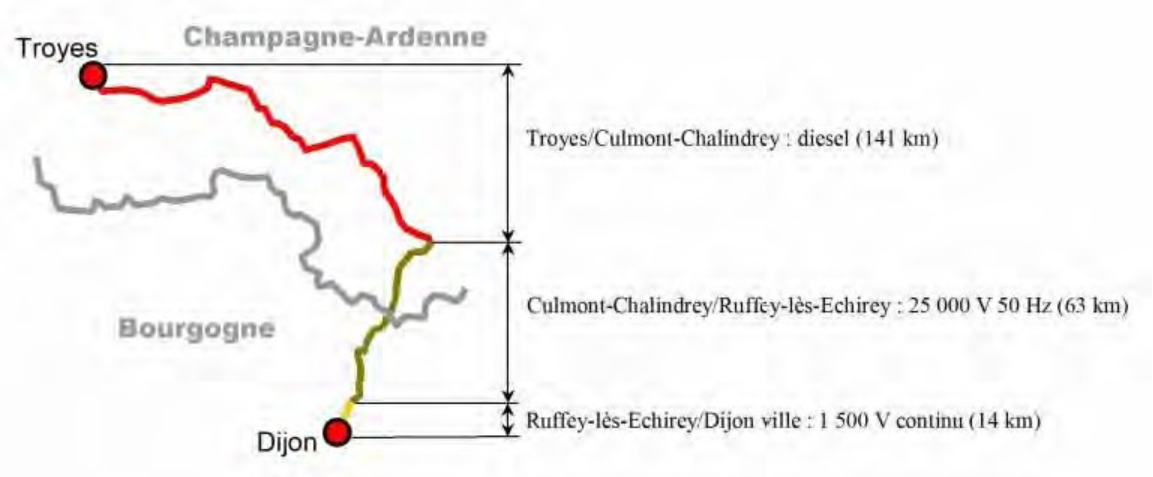


- "*The reduction in carbon emissions is useful but not a deciding factor.*"
- "*Electricity and diesel fuel prices are not that much different.*"
- "*The business case is heavily dependent on traffic density*."
- "*The rollout of electrification can be done more quickly and at reduced cost*."
- "*The current RSSB figure for electrification of $1.4-1.6M per track mile needs to reduce to $1.1-1.25M"*
- "***A 1-mile section needs to be achievable in an 8 hour week night possession***."
- "*Ways of reducing costs, particularly for possession management, must be found*."
- "*Project management must be sized to scope."*
- "***Track must be in its final design position so as to avoid later adjustment***."
- *"To be successful, a set of competence standards must be built up*."
- "***The Bi-mode IEP*** (Hybrid InterCity Express) ***may be a key factor in maintaining through services.***"

Discussion:

- Caltrain is experiencing a significant capacity crunch that needs to be addressed urgently through an improved signaling system and enhanced infrastructure (one or more passing stations at Palo Alto, Redwood City and/or Hillsdale).
- 75% of the existing rolling stock is due for replacement in the next couple of years.
- The current approach to Caltrain modernization will not be able to cope with the expected increase in ridership.

- France (AGC BiBi hybrid trains), the UK (InterCity Express bi-modes) and Spain (Alvia S-730) all faced similar challenges which were addressed through the introduction of hybrid trains capable of operating on the existing infrastructure regardless of the type of electrification (if any). Example: Troyes to Dijon:



Recommendations:

- Immediate moratorium on electrification and vehicle consultant activities ($110M saving)
- Postponement of electrification RFP until cost and schedule issues have been resolved
- Engage ACE and Capitol Corridor on joint EMU procurement (economies of scale)
- Issue RFP for bi-level bi-mode (hybrid) EMUs with a maximum speed of 125 MPH
- Issue RFP for an entity with demonstrable railway modernization expertise, specifically:
    - Substantial network capacity improvements (minimum 100% over 20 years)
    - Increased operating speeds (minimum100 MPH)
    - Experience installing 1 mile of electrification in an 8-hour weekday night possession
    - Successful implementation of high-speed blended systems including freight

I hope that you will find this information useful.

Sincerely,

Roland Lebrun

Cc:

California High Speed Rail Authority
Metropolitan Transportation Commission
San Francisco County Transportation Authority
Santa Clara Valley Transportation Authority
City of San Jose
City and County of San Francisco
Transbay Joint Powers Authority

Making Electrification Happen

Electrification has become fashionable, so said one of the speakers at the recent Railway Engineers Forum seminar on Making Electrification Happen. With virtually no electrification schemes being undertaken in the UK over recent years (CTRL excepted), the change in attitude has come about because of concerns on climate change and the realisation that oil prices will continue to increase as supplies dwindle. Even the DfT has done a U turn in the past 12 months. **The proponents of electrification all point to the benefits but much needs to be done before electric trains begin running over new routes**. The seminar looked at what needs to happen in terms of finance, engineering and resources. The downsides of electrification must not be overlooked and ways of minimising the impact of these are important.

The Mobile Factory

An inspired key note speech by Steve Yianni, the Network Rail Director of M&E Engineering set the scene and demonstrated that much thought has gone into how **the roll out of electrification can be done more quickly and at reduced cost**. Two factors have to be in place before work can start:

- **The Business Case**, which will be developed as a partnership between funders, customers and suppliers, and which becomes part of the NR Route Utilisation Strategy (RUS).
- **The Operational Plan, to achieve a roll out with sufficient capacity to deliver at the right cost and timescale**.

Key to both of these will be the Mobile Factory – **a means of installing electrification infrastructure within existing possession patterns and without significant disruption to train services**. In effect, **a 1.5km tension length section** based on masts at 50-60 metre spacing, **needs to be achievable in an 8 hour week night possession**, inclusive of take up and give back time. To do this the 'factory' will consist of:

- 3 x Piling and Mast Trains
- 1 x Feeder and Return Wire Train
- 1 x Cantilever and Registration Assembly Train
- 1 x Catenary and Contact Wire Train
- 1 x Inspection and Measurement Train including Earthing assurance

Normally **the 'factory' will operate on a single track with other tracks kept open for traffic**. The use of bi-directional signalling will be key to this. The 'factory' will be capable of reaching both lines of a 2 track railway if a complete possession is obtained. Designed primarily for plain line sections, adaptation for junctions, bridges, tunnels, etc needs to happen when work will be done during weekend possessions.

Later speakers confirmed the concept of a mobile factory as workable. Keith Warburton, the Head of Electrification Design in Balfour Beatty Rail gave an insight on the costs for both a blockade and possession type approach

	Blockade	**Blockade**	**Possession**	**Possession**
Description	Proportion	Typical Cost per Single Track km	Proportion	Typical Cost per Single Track km
Survey & Design	3%	£11k	3%	£14k
Materials	44%	£157k	38%	£189k
Construction	45%	£158k	40%	£200k
Project Mgmt	**8%**	**£29k**	**19%**	**£94k**
Total	**100%**	**£355k**	**100%**	**£497k**

Unsurprisingly, the blockade approach is cheaper as the engineer has unrestricted access to the railway. However, **criticism of blockades is increasingly vehement because of the disruptive impact. Ways of reducing costs, particularly for possession management, must be found**. Planning, design and engineering principles are too often forgotten.

- Do a survey well ahead of design, in a single pass and collect data electronically including 3D modelling linked to material supply and signal siting
- Design work to promote a single installation activity with minimal or no stage work
- Use standard spans and tension lengths, and employ new technology / methodology but only when proven

- Maximise use of like parts by a 'one size fits all' design with a standardised geometry and easy calculation of balance weights and droppers
- **Ensure track is in its final design position so as to avoid later adjustment**
- Construction activities to have no unknowns as to access availability, plant utilisation and resource deployment
- **Project management to be sized to scope**

Mark Simmons from Plasser demonstrated by video sequence a 'mobile factory' in use on Austrian Railways (OBB). Particularly impressive was the installation of masts by a rotating 'central gripper' mounted on a wagon and inserted into the ground by piling. Machine and trains have a jolt free control to enable catenary and wire to be installed at final tension and stagger. **All this is achieved in 5 hour work blocks in 2 possessions**. A reminder was given that mechanised piling and erection had been trialled on the ECML in the 1980s, when 6 piles per hour had been achieved.

Likely Routes for the Passenger Railway and the Business Case

Studies on various routes have looked at fuel/energy costs, train reliability and passenger capacity in analysing whether electrification would be beneficial. Jim Morgan, the Director of Passenger Development in First Group, suggested the criteria necessary for electrification to show advantages over diesel were:

- Capital costs – rolling stock provision linked in with energy costs and carbon emission, also bridge and clearance works
- Variable track access costs – these must allow for OLE maintenance including performance and reliability expectations
- Staff costs – any train crew implications
- Revenue impact – is the 'sparks' effect on passenger growth still valid

There will be pluses and minuses here. Electric trains should be cheaper and lighter, thus causing less track wear. **The current RSSB figure for electrification of £550-650k per track km needs to reduce to £450-500k**. On board energy costs need to be accurately metered and regenerative braking must help. System losses have to be addressed with better driving techniques and lower train idle time costs. The availability of rolling stock and where to cascade displaced stock to, will be a major factor. Taking all these considerations into account, the likely routes for electrification are:

- GWML from Airport Junction to Bristol, Cardiff and Oxford
- MML from Bedford to Sheffield via Derby plus Nottingham
- Cross Country to link up existing and proposed electrified routes
- North Trans Pennine from Liverpool and Manchester to York

There will be an impact on through services that exist today and it is acknowledged that this is a difficult problem. **The hybrid version of the new IEP may be one answer but diesel haulage off the wires and slick cross connections may have to suffice**.

Richard Davies, the Head of Strategic Planning in ATOC added that **the business case was heavily dependent on traffic density**, where rail has typically doubled its usage in 20 years. **Electricity and diesel fuel prices are not that much different** but the delta may be the deciding factor. **The reduction in carbon emissions is useful by not a deciding factor**. In addition to the main line routes, there was a good case for suburban routes around Manchester, Liverpool, Leeds and Cardiff. **Inclusion of diversionary routes is unlikely as the business case is weak**.

The Freight Situation and the case for In-Fill

A totally different view comes across from the Freight Sector. Graham Smith, the EWS Planning Director, whilst supporting electrification, stated that gauge enhancement was the top priority. At present, the gaps between electrified lines were too numerous and **having to do frequent locomotive changes made operation expensive and time consuming**. Hence, the freight companies have invested heavily in diesel traction, with electric locomotives being only a small percentage of the fleet. Increasing electric freight usage would need the gaps to be filled and 31 schemes were tabled, many of them being very short distances. Doing some of these in the CP4 period

would be advantageous as it would allow the engineering and implementation skills to be built up in non sensitive areas. It would also be necessary to acquire a fleet of electric locomotives, which need to be less complicated (and expensive) than the Cl 92, with all the different voltage and signalling systems that these embrace. **The 'last mile' problem on how to access sidings and loading facilities without having a resident diesel shunter on site is another challenge.**

Maintenance and Reliability

If electrification is to be expanded, then some of the present maintenance problems have to be overcome, so says Kevin Lydford, NR's Head of Electrification. **Electrified infrastructure should have a 90 year life, with contact wire renewal between 40-50 years and piece part renewal every 30 and 60 years**. New designs should minimise routine maintenance and not need regular adjustment. Booster transformers should be eliminated in favour of 50kV auto transformer systems, and Sub Stations and Track Sectioning Cabins must be made simpler and cheaper. **Inspection trains to check height and stagger, dynamic force measurement and wire wear are vital** with MENTOR and the NMT fulfilling this role currently. Combating theft and vandalism is another challenge, with designs needing to be more capable of withstanding the interests of less desirable elements within society. Pantographs have to be compatible with the electrification infrastructure and be regularly and reliably maintained

Establishing whole life costs is important and buying cheap equipment initially will lead to significant problems. The balance between Capex and Opex must be right for equipment with such a long life. **Too many entanglements and de-wirements happen and the ensuing poor reliability undermines the business case**. If the wires are down, the chances are you will not get home that night!

Resources, Expertise and Contracts

Jeremy Candfield, the Director General of RIA, set out the resource challenge to make all this happen. With no electrification having been undertaken in England and Wales in recent years, the skill base has dispersed and a recruitment and training initiative is essential. Competent people will be in great demand and NR will have to compete for engineers having heavy current expertise needed for the LUL renewal programme, the National Grid refurbishment and overseas rail projects. **To be successful, a set of competence standards must be built up and supplier confidence must be gained by having continuity of work in a programme visible for all to see**. In addition to the electrical engineering aspects which the RIA ELECTIG group are studying, **expertise will be needed in**:

- **Possessions and uninterrupted working**
- **Single line working**
- **Depot provision and management**
- Planning paths to site
- Materials and engineering train management
- Testing

The proposal for a Rail Skills Academy is being driven forward by RIA members but ultimately the companies involved must be the dominant driver in getting trained people in place.

Getting the right contract conditions in place can make a difference according to Ross Hayes an engineer working in the legal sector, and obeying EU rules is another complication. Two options exist:

- **Framework contracts**, whereby contractors enter into an agreement based on work requirements and price. **Broad order quantities are defined and work packages can be awarded under the framework**. These are normally time limited to 4 years but utilities (including railways) can get this waived providing competition rules are not misused
- **Term contracts, where work is committed in relatively simple repetitive work packages**

Contractors generally prefer the latter as these are less open ended. Choosing the right terms and conditions is equally important – ICE, IMechE, NEC, etc – and using a standard that is recognised by industry is always the best bet.

The CTRL and Scottish Experience

Recent electrification projects have only been the CTRL and the Airdrie – Bathgate link. Both have yielded or are yielding valuable lessons. Dominic Kelsey and Mark Howard from Bechtel emphasised the importance of getting power supply points right. These cost around £200k for every km of route energised and are thus an expensive item. The CTRL has three – Barking, Sellindge and Singlewell – and all 3 have compensation devices to eliminate variations to the catenary voltage under different current conditions. Much design and planning effort went into these but cost-saving opportunities are there to be had. The CTRL had also to contend with the interface between 50kV and 3rd rail 750v and this continues to be a maintenance challenge. Difficulties with Notified Body acceptance were an unwanted inconvenience and the required paperwork was massive, out of all proportion to the desired end result.

Bill Reeve, the Director Rail Delivery in Transport Scotland, gave a positive message in that an additional 350 single track kms of electrification has been approved by the Scottish Parliament beyond Airdrie – Bathgate. This will include the main E&G line plus extending to Dunblane. However, **present costs are in the order of £1M per single track km, <u>about double the desired amount</u>**. Some of this is due to having to rebuild the resource and manufacturing capability but interestingly, construction and wiring is less than all the other activities. **There is an urgent need to revise standards** and this must be done in partnership with Network Rail before any further schemes are authorised.

The DfT View and the Day in Retrospect

David Clarke, the DfT's Deputy Director of Rail Services endorsed most of what had gone before but showed a simplified matrix on how electrification might proceed.

High	Suburban Route Extensions plus short In Fills √	Main Line Electrification √ ?
	Single Line Branches √ ?	Long Secondary & Diversionary Routes X
	Low	High

Cost of Construction

Clearly the big question mark is on the future viability of main line projects but single line feeder routes like those existing at St Albans Abbey, Braintree, Southminster, North Berwick are not ruled out. **The optimum timing is to electrify when rolling stock replacement is due and <u>getting rid of diesel traction from under the wires is also important</u>**. New ideas for energy storage to cover gaps in the wires will be welcome. **<u>The Bi-mode IEP may be a key factor in maintaining through services</u>**. The implementation of ERTMS and associated signal siting issues needs to be better understood. **The ultimate challenge is to reduce the cost of running the railway**.

Altogether a fascinating day and those in attendance should be better informed on the challenges that an ongoing electrification programme will present. **<u>Just declaring the electrified railway as a good thing to have is not in itself sufficient</u>.** The promoters must understand the downsides and come up with solutions to overcome these.