



**Caltrain Bicycle Advisory Committee  
Subcommittee on Understanding EMU Design Constraints**

***Q1. The BAC would like to better understand the factors that went into the decision to order trainsets where the individual cars are not identical.***

**A1.** In July 2015, the JPB Board took action on a number of items that were instrumental in determining the design of the EMU trainsets. A two year outreach effort and discussion with the riders and community regarding the tradeoffs among the seats, standing space, bikes, restrooms (the fixed space in the vehicle) and upper level doors was conducted prior to their decision. Outreach activities included surveys; top 10 station outreach during both morning and evening commutes; and 20 public meetings. Traditional and social media were used, and over 10,000 comments were collected from the different venues. A JPB Board special workshop was also held. What resulted were the following Board decisions:

- 8:1 bike to seat ratio (staff originally proposed 9:1)
- 1 ADA accessible restroom per train (staff originally proposed no restrooms)
- Upper level dual doors “not to preclude” future High Speed Rail boarding decisions (the vehicle would be customized and seats could be placed in front of the doors)

Other factors also impacted the train design, including the train builder contract and funding. In May 2014, the JPB put out a Request for Information and six electric train car builders participated. After the Board decisions regarding the bikes, bathroom, and upper level doors were made, the JPB then put out a request for proposals in August 2015. One proposal was received and Stadler was awarded the contract in July 2016.

On May 2017, after the tireless work and effort of riders, leaders, and the greater Caltrain community, the project’s federal funding grant (FFGA) was approved, requiring a minimum 10% increase in seated capacity.

These requirements (FFGA seat capacity, bike/seat ratio, ADA restroom, and upper level doors) largely defined the Stadler design, which includes four different car types in a six-car trainset:

- Cab car (2): To allow for a driver/engineer and control equipment. There is a cab car on either end of the trainset to allow for the train to go either north or south without turning around.
- ADA restroom car (1)
- Bike car (2)
- Coach-only car (1): Contains only seats

With this configuration, Stadler proposed a design that met an 11% seat increase. However, after working with the bike coalitions to refine the bike car design, three seats per bike car were removed to replace bike storage lost when the vertical hooks were removed. The current design now meets a 10.3% capacity increase.

**Q2. Please explain how the electrical equipment is spread among the cars and how that was determined in relation to bikes.**

A2. The EMUs differ greatly from the current diesel trains in how they are powered. One of the most important distinctions is that with an EMU the power is distributed throughout a trainset; whereas in the current diesel trains, the power resides in the locomotive, which pulls or pushes the rest of the cars. Because of this, the locomotive is not counted in the number of train cars when the diesels are referred to as 5-car or 6-car trains. In contrast, the power for the EMUs is distributed throughout the trainset.

Power for an EMU is drawn from the overhead catenary system via two pantographs, one on top of each of the bike cars. Some power equipment is also distributed along the roof of the trainset.

Within a train, 50% of the axles should be powered to achieve performance requirements. This means that half the trucks have motors and there is propulsion equipment within those cars. Two cars do not have any powered trucks, so they are inherently lighter and therefore could be made longer. By using the non-powered trucks on the bike cars, these cars could remain slightly longer, maximizing the number of bicycles which can be carried on board.

It is undesirable to have two unpowered cars adjacent to one another, as it is preferred to have uniformly distributed weight and power. If there were powered axles on the bike cars, then those cars would need accompanying traction power equipment. As mentioned above, the equipment is heavy and would require changing the length of the vehicle due to axle loading requirements.

**Q3. What constraints determine what can go into the passenger space of the EMU cars as it relates to seats, bikes, and how these items are spread out?**

A3. Below are some of the constraints that helped determine the electric train design:

- Aisle width: 32"
- 2 ADA wheelchair spaces per car
- ADA accessible bathroom
- Wheelchair lifts
- Seat space requirements
- Standee space
- Bike space
- Work tables
- \*Maximum vehicle weight
- \*Max wheel loading
- Side door placement
- Pantographs
- Distributed power
- Evacuation requirements
- Emergency windows and access (No permanent fixtures blocking window access. Bicycles do not constitute a permanent fixture as they can be removed without the use of a tool or other implement. See Question #10.)
- Cabs

\*The various aerial structures and the strength of the rails & ties themselves limit how much a train can weigh.

**Q4. How flexible are the interior of the cars? For example, we know that the bombardier cars can be changed (+/- seats and bikes) with some work. Is there a similar ability with the EMUs after Caltrain has received them from Stadler?**

A4. It is possible to move bikes into the seating area, although this could reduce overall seating capacity. A redesign would need to consider the constraints/criteria listed in #3 and would be a costly change order with time impacts.

**Q5. What's involved in changing the configuration and the interior of the cars? What is the time and cost impact?**

Q6. Without knowing exactly what would be changed, it's hard to offer an estimate. A change such as removing the lower level of seats in the coach car and replacing them with bikes would involve the JPB Board and the project's Change Management Board (comprised of the project's funding partners) since it would be considered a fundamental change to the train builder's contract.

The redesign in this example would involve different departments such as the technical engineering team, the contractor, rail operations, safety, outreach, finance, contracts, document control, and risk analysis. The criteria in #3 would need to be considered and a justification memo, independent estimate, and change order would need to be developed and signed off on. If approved, production on the vehicles would stop until the redesign process was complete and could be implemented. There would also be material and labor costs to consider. The change in this example would cost the project millions of dollars and months of time, and as the project moves closer to delivery the costs would increase accordingly.

If the interior of the cars were to be changed after the vehicles were delivered, a similar process to what's outlined above may have to occur depending on the scale of the change requested and whether the vehicles were in revenue service.

**Q6. Can you share more detailed engineering drawings of the proposed bike car layouts?**

A6. Please see below. The top image is the coach car's lower level. The bottom image is the bike car's lower level. Detailed engineering drawings are proprietary to the train builder.



Note: Based on discussions with the bike coalitions, there are no vertical hanging hooks in the bike cars; the flip seats in the circled area have been removed; and bikes may be stored in this location. This is intended to clarify the deletion of the flip-up seats and added associated bike storage.

**Q7. Can you share a capacity spreadsheet?**

A7. Please see below.

SEATS					
Today		Mixed Service 2022 (*no hooks)			
217	Diesel (6)	774	305	Diesel (7)	910
319	Diesel (6)	770	113	EMU (6)	567
221	Diesel (5)	615	115	EMU (6)	567
323	Diesel (6)	757	307	Diesel (7)	910
225	Diesel (6)	789	117	EMU (6)	567
			119	EMU (6)	567
<b>Total Seats</b>		3705	4088		
<b>Delta</b>			10.3%		

  

BIKES					
Today		Mixed Service 2022 (*no hooks)			
217	Diesel (6)	72	305	Diesel (7)	72
319	Diesel (6)	72	113	EMU (6)	72
221	Diesel (5)	80	115	EMU (6)	72
323	Diesel (6)	72	307	Diesel (7)	72
225	Diesel (6)	72	117	EMU (6)	72
			119	EMU (6)	72
<b>Total Bikes</b>		368	432		
<b>Delta</b>			17.4%		

  

6-car EMU Seat Counts	
Total (w/o vertical bike hooks)	567 Fixed + Flip-up

  

7-car Diesel Seat Count	
Bom	910

  

Today Bike Numbers	
Four 6-car Bi-level trains plus one 5-car Gallery train (4 x 72) + (1 x 80) = 368	

  

Mixed Use Bike Numbers (no hooks)	
Four EMUs plus two 7-car bi-level diesels (4 x 72) + (2 x 72) = 432	

  

\*After working with the bike coalitions, three seats and the vertical bike hook storage were removed from each bike car

**Q8. (1) The BAC would like a better understanding of why three EMU bike cars need three conductors. From a rider perspective, the current system of three bombardier bike cars with two conductors works well. (2) The BAC would like to hear an explanation from conductor and operations perspectives, and would like to see supporting data on if the addition of a third bombardier bike car (with only 2 conductors) has had a positive or negative impact, including on dwell times or specific incidents or duties.**

A8(1). The number of conductors depends on the length of the train. A six-car trainset requires two conductors and more resources would be needed to increase this amount. A third conductor would be required on a train longer than six cars per contractual agreement.

Active conductor support in the bicycle cars has been encouraged by the bicycle community, as cyclists have noted it allows for a more efficient boarding/deboarding process and better overall experience. When two conductors are spread among three bike cars while still attempting to fulfill other duties (such as helping passengers in need of assistance), resources can be strained.

A8(2). As seen in the November 16, 2017 BAC presentation “On-Time Performance and Delay Mitigation,” when bikes and other passengers mix while boarding/alighting there are delay impacts. In an effort to make improvements, the Bikes Board First Pilot will start in April 2018.

**Q9. The BAC would like to understand the reasons why Caltrain would not run 7-car EMUs—both from a technical and operational standpoint.**

A9. As part of the base order, Caltrain could only afford 96 vehicles, configured as sixteen 6-car trainsets. Sixteen trainsets are the minimum necessary to run Caltrain’s new 6 train per hour schedule and still provide adequate spares for maintenance and a protect train. Stadler’s EMU design does allow

trains to be lengthened--for instance, Caltrain plans on adding vehicles to the fleet to make 8-car trains in the future.

Unlike bi-levels or gallery cars, these EMU trainsets are built as “semi-permanently coupled” 6-car trainsets, so removing a single car from an EMU trainset is a three-hour long process, which is not practical. For example, a train that comes in from the morning commute rush at 10:00 a.m. would not be ready until 1:00 p.m. However, it would then need to be back to be readied for the evening rush hour by 2:30 p.m., making even one trip difficult.

Also, because of the distributed power, any resulting trainset that isn’t configured in the as-designed 6-car set may not perform adequately.

So while a 7-car EMU maybe feasible, it is not part of the current design. If additional funding was available, whether JPB would run a 7-car EMU (rather than an 8-car EMU) would need to be determined at that time.

**Q10. What is staff’s FRA interpretation regarding the placement of bike racks in front of emergency exit windows?**

A10. On November 28 and 29, 2018, JPB met with the FRA, presented the EMU design and discussed the bike car layout. The FRA took no exceptions, allowing JPB to move forward with the design.

Below is the FRA language specific to this question.

Information on the FRA Regulation

- Access at <https://www.ecfr.gov/>
- Where it says General Provisions, click on the drop down menu and select “49 Transportation”, and “Go”.
- In the table, in the row browse parts select “200-299”,
- On the next page scroll down and click on “238.1 to 238.603”
- Scroll down and click on “§238.113”

FRA Regulation Language:

**§238.113 Emergency window exits.**

**(a) Number and location.** *Except as provided in paragraph (a)(3) of this section, the following requirements in this paragraph (a) apply on or after April 1, 2008—*

*(1) Single-level passenger cars. Each single-level passenger car shall have a minimum of four emergency window exits. At least one emergency window exit shall be located in each side of each end (half) of the car, in a staggered configuration where practical. (See Figure 1 to this subpart; see also Figures 1b and 1c to this subpart.)*

*(2) Multi-level passenger cars—main levels. Each main level in a multi-level passenger car is subject to the same requirements specified for single-level passenger cars in paragraph (a)(1) of this section.*

*(3) Multi-level passenger cars—levels with seating areas other than main levels.*

*(i) Except as provided in paragraphs (a)(3)(ii) and (iii) of this section, on or after August 1, 2009, any level other than a main level used for passenger seating in a multi-level passenger car, such as an intermediate level, shall have a minimum of two emergency window exits in each seating area. The emergency window exits shall be accessible to passengers in the seating area without requiring movement through an interior door or to another level of the car. At least one*

*emergency window exit shall be located in each side of the seating area. An emergency window exit may be located within an exterior side door in the passenger compartment if it is not practical to place the window exit in the side of the seating area. (See Figures 2 and 2a to this subpart.)*

*(ii) Only one emergency window exit is required in a seating area in a passenger compartment if:*

*(A) It is not practical to place an emergency window exit in a side of the passenger compartment due to the need to provide accessible accommodations under the Americans with Disabilities Act of 1990;*

*(B) There are no more than four seats in the seating area; and*

*(C) A suitable, alternate arrangement for emergency egress is provided.*

*(iii) For passenger cars ordered prior to April 1, 2009, and placed in service prior to April 1, 2011, only one emergency window exit is required in a seating area in a passenger compartment if—*

*(A) It is not practicable to place a window exit in a side of the passenger compartment (due to the presence of a structure such as a bathroom, electrical locker, or kitchen); and*

*(B) There are no more than eight seats in the seating area.*

*(4) Cars with a sleeping compartment or similar private compartment. Each level of a passenger car with a sleeping compartment or a similar private compartment intended to be occupied by a passenger or train crewmember shall have at least one emergency window exit in each such compartment. For purposes of this paragraph (a)(4), a bathroom, kitchen, or locomotive cab is not considered a “compartment.”*

***(b) Ease of operability.*** *On or after November 8, 1999, each emergency window exit shall be designed to permit rapid and easy removal from the inside of the car during an emergency situation without requiring the use of a tool or other implement.*

***(c) Dimensions.*** *Except as provided in paragraphs (c)(1) and (c)(2) of this section, each emergency window exit in a passenger car, including a sleeping car, ordered on or after September 8, 2000, or placed in service for the first time on or after September 9, 2002, shall have an unobstructed opening with minimum dimensions of 26 inches horizontally by 24 inches vertically. A seatback is not an obstruction if it can be moved away from the window opening without using a tool or other implement.*

*(1) Emergency window exits in exterior side doors. An emergency window exit located within an exterior side door, in accordance with the requirements of paragraph (a)(3)(i) of this section, may have an unobstructed opening with minimum dimensions of 24 inches horizontally by 26 inches vertically.*

*(2) Additional emergency window exits. Any emergency window exit in addition to the minimum number required by paragraph (a) of this section that has been designated for use by the railroad need not comply with the minimum dimension requirements in paragraph (c) of this section, but must otherwise comply with all requirements in this part applicable to emergency window exits.*

***(d) Marking and instructions.*** *(1) Prior to January 28, 2015, each emergency window exit shall be conspicuously and legibly marked with luminescent material on the inside of each car to facilitate egress. Legible and understandable operating instructions, including instructions for removing the window, shall be posted at or near each such window exit.*

*(2) On or after January 28, 2015, each emergency window exit shall be marked, and instructions provided for its use, as specified in §238.125.*

*(3) If window removal may be hindered by the presence of a seatback, headrest, luggage rack, or other fixture, the instructions shall state the method for allowing rapid and easy removal of the window, taking into account the fixture(s), and this portion of the instructions may be in written or*

*pictorial format. This paragraph (d)(3) applies to each emergency window exit subject to paragraph (d)(1) or (2) of this section.*

**(e) Periodic testing.** *At an interval not to exceed 184 days, as part of the periodic mechanical inspection, each railroad shall test a representative sample of emergency window exits on its cars to determine that they operate as intended. The sampling method must conform with a formalized statistical test method.*

*[73 FR 6401, Feb. 1, 2008, as amended at 78 FR 71813, Nov. 29, 2013]*

**Q11. Regarding the EMU bike car layout, theft and security is a concern. Staff stated that there was only one reported theft from the train in 2016.**

- **Could staff share 2017 data?**
- **The safety and security report data differentiates substantially from incidents noted on social media. What can staff do to determine the reason for this discrepancy? This is critical information to the BAC as the current security standards provides some basis for the design of the EMUs.**

A11. The Transit Police presented 2017 data to the BAC at the January 2018 meeting. The presentation can be found here:

[http://www.caltrain.com/about/advisorycommittees/Bicycle\\_Advisory\\_Committee/Bicycle\\_Advisory\\_Committee\\_Meeting\\_Calendar.html](http://www.caltrain.com/about/advisorycommittees/Bicycle_Advisory_Committee/Bicycle_Advisory_Committee_Meeting_Calendar.html)

They reported the following for 2017

- Approximately 6,000 bikes onboard daily
- 101 reported bike thefts in 2017
- Average bike thefts in 2017 = 8 per month
- Of the 101 reports, \*4 were determined to be onboard
- 2 Arrests were made

\*Note this number has been updated since the last BAC meeting due to the Transit Police obtaining more information since that time.

The number of posts about thefts on social media in 2017 was 25.

The Bike Security Outreach effort that's being launched will work across departments—Operations, Planning, Outreach, Marketing, Social Media, Customer Service, and the Transit Police—to collect and examine data; develop and implement a process to adequately examine and consider the bike community's concerns over theft; and explore potential solutions to improve bike security at stations and onboard.