CITY AND COUNTY OF SAN FRANCISCO
MUNICIPAL TRANSPORTATION AGENCY
ONE SOUTH VAN NESS AVE, 7TH FLOOR
SAN FRANCISCO, CA 94103

MODIFICATION NO. 3 TO AGREEMENT BETWEEN SIEMENS INDUSTRY, INC. AND THE CITY AND COUNTY OF SAN FRANCISCO FOR PROCUREMENT OF NEW LIGHT RAIL VEHICLES (LRV4) (SFMTA No. 2013-19)

This Modification No. 3 to Agreement is made and entered into this 16th day of August 2016, by and between Siemens Industry Inc. (Contractor), and the City and County of San Francisco, a municipal corporation (City), acting by and through its Municipal Transportation Agency (SFMTA).

RECITALS

A. On September 30, 2014, the City entered into an agreement with Contractor (Agreement) to provide 175 light rail vehicles (LRVs), together with associated equipment and spare parts, as well as Options for additional LRVs and parts.

B. On March 31, 2015, the City approved Modification No. 1 to the Agreement to exercise Option 1 in accordance with Section 64.1 of the Agreement for 40 additional LRVs to be delivered after the Phase 1 delivery of 24 vehicles, and to exercise Options for additional Spare Parts and Equipment, in accordance with Sections 64.2, 64.3 and 64.4 of the Agreement.

C. On October 30, 2015, the City approved Modification No. 2 to the Agreement to update the list of approved major suppliers listed in Section 29, clarify the purpose of Item 1.1 (Allowance) in Exhibit 2 of Volume I, and specify the payment structure for changes to the LRVs paid under Item 1.1.

D. The SFMTA now wishes to modify the Agreement to update the list of approved major suppliers, modify radio/CAD/AVL systems on the Vehicles, including related price and payment schedules, provide extra time for delivery of the vehicles and

other project submittals, add a new parent guarantee, and make miscellaneous changes to the Technical Specifications.

Now, therefore, the parties agree that the Agreement shall be amended as follows:

1. *Section 29 (**Subcontracting**) is amended in its entirety to read as follows:*

Contractor may subcontract portions of the Work only upon prior written approval of City. Contractor is responsible for its subcontractors throughout the course of the performance of the Work. City's execution of this Agreement constitutes its approval of the major subcontractors/suppliers listed below. Neither party shall, on the basis of this Agreement, contract on behalf of or in the name of the other party. Any agreement made in violation of this provision shall be null and void.

	COMMODITY	SUPPLIER
1	Automatic Passenger Counting System	INIT
2	Automatic Train Control System	Thales
3	CCTV System	Kratos
4	Communications - Radio	Harris
5	Doors	Ultimate Transportation N. America
6	Event Recorder	Hasler Rail
7	Friction Brake System	Tec Tran Brakes (Wabtec)
8	Heating, Ventilation and Air Conditioning	Thermo King Corp.
9	Passenger Information System, Infotainment	Televic
10	CAD/AVL	Xerox
11	Couplers	Voith
12	Lighting (exterior)	TDG
13	Lighting (interior)	TDG
14	Pantograph	Schunk
15	Sanders	Knorr
16	Seats (passenger)	Freedman Seating Company
17	Seats (driver)	Seats Incorporated
18	Steps	Vapor Stone Rail Sys (Wabtec)
19	Train to Wayside Communication System	Vecom

2. *A new Exhibit 1A.A (Schedule of Prices-Modification No. 3 Work) is added to the Agreement and is attached to this Modification.*

3. *A new Exhibit 2.1 (Payment Schedule–Modification No. 3 Work) is added to the Agreement and is attached to this Modification.*

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4. *Exhibit 3 (Project Delivery Schedule) is replaced with a new Exhibit 3 (Delivery Schedule), which is attached to this Modification.*

5. *Exhibit 6 is modified by adding after Exhibit 6.2 a new Exhibit 6.3, which is attached to this Modification.*

6. *Subsection 1 of Section 2.9.2 (Maintenance Plan) of the Technical Specification is modified in its entirety to read as follows.*

    1. The Contractor's maintainability program shall include a detailed plan outlining all schedules and activities for vehicle preventive maintenance. **(CDRL 63)**

7. *Section 6.3.7 (Step System) of the Technical Specification is modified by adding a new subsection 12 to read as follows:*

    12. The front right step shall be capable of being operated in UP and DOWN position independently from the other steps by using a switch on the operator control panel in the cab. This operation shall be available in the leading Vehicle only; the trailing Vehicle shall be unaffected.

8. *Section 13.3.2 (Information Signs) of the Technical Specification is modified by adding new subsection 4 to read as follows:*

    4. The destination signs (front destination and exterior side of the side destination signs) shall have a red green blue (RGB) LED color-block beside the amber LED that shows the destination. The color-block RGB shall visualize the letter designating the line on a background color defined by the Digital Voice Communication System (*DVCS)* automatic announcement and display database.

9. *Section 13.4 (Interface with Radio CAD AVL System) of the Technical Specification is modified in its entirety to read as follows:*

    13.4 INTERFACE WITH RADIO, CAD/AVL SYSTEM

    The following interfaces shall be furnished between the radio, CAD/AVL system and other vehicle systems. All the software shall be installed to SFMTA latest version at the time of delivery:

    1. Farebox - The radio vehicle logic unit and farebox shall exchange the information through SAE J1587 messaging protocol over the SAE J1708 physical connection.

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2. Destination Sign - Destination signs shall be controlled by radio vehicle logic unit through the interface between the Digital Vehicle Communication System (DVCS) and the CAD/AVL System.

3. EA switch (each cab) shall be interfaced with radio vehicle logic unit.

4. GPS signal information shall be provided from the CAD/AVL System to the CCTV System (Surveillance Camera system).

5. Critical Control Point Speakers (CCP Speakers), Destination signs, stop request, doors status shall interface with the Digital Vehicle Communication System (DVCS). The DVCS is connected to the radio vehicle logic unit through cable connection.

6. Speed Sensors - Speed sensor information shall be provided to radio vehicle logic unit.

7. Mobile Access Router - Router shall be connected to radio vehicle logic unit via 4 port Ethernet switch. The Surveillance camera system is connected to the CCTV router.

8. Door Status – Door status signal shall be connected to radio vehicle logic unit.

9. Stop Request - Stop request shall be connected to radio vehicle logic unit.

Details of the required integration are provided in Appendix C.

10. *The Technical Specification is modified by adding a new section 14.1.5 to read as follows:*

14.1.5 Train ID

1. Each train shall have the capability to set the Train ID for each cab in the train consist from the lead cab.

11. *Section 20.10 (CDRL List) of the Technical Specification is modified by adding CDRL Nos. 61 – 63 to Table 20-1 as follows.*

61	Hazard Mitigation Traceability Matrix	21.3.7.6
62	Reliability Demonstration Plan (RDP)	21.3.11
63	Maintenance Plan	2.9.2

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12. *Section 21.3.7.6 (Hazard Mitigation Traceability Matrix) of the Technical Specification is modified in its entirety to read as follows.*

21.3.7.6 Hazard Mitigation Traceability Matrix

The Contractor shall develop and maintain a matrix of all Category I and II hazards. The matrix shall describe each hazard and its ultimate resolution, and identify current status. The resolution of each hazard must be verified by identifying a specific drawing, procedure, analysis, or report. **(CDRL 61)**

13. *Subsection 1 of Section 21.3.11 (Reliability Demonstration) of the Technical Specification is modified to read as follows.*

1. The Contractor shall submit a Reliability Demonstration Plan (RDP) 90 Days before delivery of the first car that defines the following for a demonstration to prove compliance with the specified MDBTD and MDBCF requirements and failure definitions in Section 2.8. **(CDRL 62)**

14. *Subsection 2 of Section 22.1 (General) of the Technical Specification is modified by adding item g. to read as follows:*

g. SIBAS Expert 2 Software.

15. *Section 23.3.3 (Radio [Voice and Data]) of the Technical Specification is modified by adding No. 3-12 to Table 23-3. Radio as follows:*

3-12		Handheld Radio Charger	2	One in each cab

16. *The Technical Specification is modified by adding Appendix C (Radio/CAD/AVL Onboard and Wayside Systems) thereto, which Appendix is attached to this Modification.*

17. ***Release***. Contractor acknowledges and agrees that the amounts agreed for the work described in this Modification No. 3, and/or any extension of time granted herein, with or without cost, shall be full accord and satisfaction for all past, current and prospective costs incurred in connection with Contractor's performance of all work under the contract up to and including the work covered under this Modification No. 3, without limitation. Said costs may include, but are not limited to, costs for labor, materials, equipment, disruption, lost productivity, escalation, delay, extended overhead, administration and extended performance time. Contractor releases the City from all claims for which full accord and satisfaction is hereby made, as set forth above.

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18. ***Effective Date.*** Each of the amendments set forth above shall be effective on and after all parties have signed the Amendment.

19. ***Legal Effect.*** Except as expressly modified by this Modification No. 3, all other terms and conditions of the Contract remain unchanged and in full force and effect.

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IN WITNESS WHEREOF, the parties hereto have entered into and executed this Modification No. 3 on the date set forth on page 1 above.

CITY

San Francisco Municipal Transportation Agency

Edward D. Reiskin
Director of Transportation

Approved as to Form:

Dennis J. Herrera
City Attorney

By _____
Robin M. Reitzes
Deputy City Attorney

San Francisco Municipal Transportation Agency
Board of Directors

Resolution No. 16-111
Dated: 8/16/16

Attest: R. Boomer
Secretary

CONTRACTOR

Michael Cahill
President
Mobility Division
Siemens Industry, Inc.
7464 French Road
Sacramento, CA 95828

Christopher Halleus
Vice President, FBA
Mobility Division
Siemens Industry, Inc.
7464 French Road
Sacramento, CA 95828

City vendor number: 50009
Federal Taxpayer ID No.13-2762488

Attachments
Exhibit 1A.1 – Schedule of Prices – Modification No. 3 Work
Exhibit 2.1 – Payment Schedule
Exhibit 3 – Project and Vehicle Delivery Schedules
Exhibit 6 - Parent Company Guarantee
Appendix C – Radio/CAD/ Onboard and Wayside Systems

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EXHIBIT 1A.1
Schedule of Prices – Modification No. 3 Work

ITEM	DESCRIPTION	UNIT PRICE	QUANTITY	EXTENDED PRICE
Item 11	Modification No. 3 (Non-Recurring Costs)			
Item 11.1	Engineering	Lump Sum	x 1	$6,128,416
Item 11.2	SIBAS Expert 2 Monitoring and Diagnostic Software	Lump Sum	X1	$71,000
Item 12	Modification No. 3 (Base Recurring Costs)			
Item 12A	Base Phase 1	$62,313	x 24 cars	$1,495,514
Item 12B	Base Phase 2	$62,313*	x 151 cars	$9,409,275
Item 13	Modification No. 3 Option 1 (Recurring Costs)	$62,313	x 40 cars	$2,492,523
TOTAL Items 11-13				**$19,596,728**

Note: *The price does not include escalation. Escalation will be applied in accordance with Section 7.5 of the Agreement.

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Exhibit 2.1
PAYMENT SCHEDULE
(All Item references are to Exhibit 1A.1)

Item 11 - Modification No. 3 Work (Non-Recurring Costs)

Item 11.1 – Engineering

	Milestone	Percent of Bid Item
A	Conceptual Design Review / Preliminary Design Review / Plan	20%
B	Final Design Review	40%
C	First Article Inspection	20%
D	System Acceptance Test	15%
E	Completion and Approval of all Contract Requirements (Retention)	5%
Total for Item 11.1		100%

Item 11.2 – SIBAS Expert 2 Monitoring and Diagnostic Software

	Milestone	Percent of Bid Item
A	Delivery and acceptance of SIBAS Expert Software	62%
B	Completion by SFMTA of two SIBAS Expert Training Sessions	33%
C	Completion and Approval of all Contract Requirements (Retention)	5%
Total for Item 11.2		100%

Item 12 - Modification No. 3 (Base Recurring Costs)

Item 12A – Base Phase 1

	Milestone	Percent of Bid Item
A	Delivery to site of installation of equipment required by Modification No. 3	42%

AB

B	SFMTA Acceptance for shipment from final assembly site to SFMTA property of Vehicle with equipment Installed as required for Phase 1	25%
C	SFMTA Conditional Acceptance of Vehicle with equipment installed as required for Phase 1	30%
D	Completion and Acceptance of all Contract requirements for Phase 1 (Retention)	3%
Total for Item 12A		100%

Item 12B – Base Phase 2

	Milestone	Percent of Bid Item
A	Delivery to site of installation of equipment required by Modification No. 3	42%
B	SFMTA Acceptance for shipment from final assembly site to SFMTA property of Vehicle with equipment installed as required for Phase 2	25%
C	SFMTA Conditional Acceptance of Vehicle with equipment installed as required for Phase 2	30%
D	Completion and Acceptance of all Contract requirements for Phase 2 (Retention)	3%
Total for Item 12B		100%

Item 13 – Option 1 (Recurring Costs)

	Milestone	Percent of Bid Item
A	Delivery to site of installation of equipment required for Option 1	42%
B	SFMTA Acceptance for shipment from final assembly site to SFMTA property of Vehicle with equipment installed as required for Option 1	25%
C	SFMTA Conditional Acceptance of Vehicle with equipment installed as required for Option 1	30%
D	Completion and Acceptance of all Contract requirements for Option 1 (Retention)	3%
Total for Item 13		100%

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EXHIBIT 3
PROJECT AND VEHICLE DELIVERY SCHEDULES

A. Project Delivery Schedule

Item	Date
Notice To Proceed	9/30/2014
Project Plan	11/29/2014
Training Start	4/17/2017
Training Complete	8/15/2017
Special Tools / Diagnostic Test Equipment	4/17/2017
Delivery of Publications (Manuals, Parts Book, Drawings) - Prelim	2/16/2017
Delivery of Publications (Manuals, Parts Book, Drawings) - Final	11/13/2017
Delivery of Spare Parts (Phase 1)	8/15/2017
Delivery of Spare Parts (35% of Phase 2 Quantity)	5/15/2021
Delivery of Spare Parts (35% of Phase 2 Quantity)	With Delivery of 50th Vehicle (Phase 2)
Delivery of Spare Parts (30% of Phase 2 Quantity)	With Delivery of 100th Vehicle (Phase 2)
Acceptance of Training Simulator 1	4/17/2017
Delivery of Additional Spare Parts (Exhibit 1 C)	TBD
Delivery of Spare Parts for Option Vehicles	TBD
Delivery of Training Simulator 2	TBD

Note: See Exhibit 3.B for Vehicle Delivery Schedule.

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B. Vehicle Delivery Schedule

Item	Vehicle Delivery Date	Completion of Acceptance Testing
Notice To Proceed	9/30/2014	
Delivery of 1st Vehicle (Phase 1) to SFMTA (LRV 2001)	12/13/2016	8/15/2017
LRV 2002	2/28/2017	9/21/2017
LRV 2003	5/2/2017	9/28/2017
LRV 2004	8/17/2017	10/27/2017
LRV 2005	8/31/2017	11/3/2017
LRV 2006	9/15/2017	11/13/2017
LRV 2007	10/3/2017	11/30/2017
LRV 2008	10/13/2017	12/12/2017
LRV 2009	10/27/2017	12/27/2017
LRV 2010	11/7/2017	1/5/2018
LRV 2011	11/16/2017	1/22/2018
LRV 2012	12/4/2017	1/31/2018
LRV 2013	12/13/2017	2/9/2018
LRV 2014	12/22/2017	2/27/2018
LRV 2015	1/10/2018	3/7/2018
LRV 2016	1/19/2018	3/16/2018
LRV 2017	1/30/2018	3/27/2018
LRV 2018	2/8/2018	4/5/2018
LRV 2019	2/20/2018	4/13/2018
LRV 2020	2/27/2018	4/23/2018
LRV 2021	3/6/2018	4/30/2018
LRV 2022	3/13/2018	5/7/2018
LRV 2023	3/20/2018	5/14/2018
LRV 2024	3/27/2018	5/21/2018
Delivery of 1st Option 1 Vehicle to SFMTA (LRV 2025)	4/10/2018	6/4/2018
LRV 2026	4/24/2018	6/18/2018
LRV 2027	5/8/2018	7/2/2018
LRV 2028	5/22/2018	7/16/2018
LRV 2029	6/5/2018	7/30/2018
LRV 2030	6/19/2018	8/13/2018
LRV 2031	7/3/2018	8/27/2018
LRV 2032	7/17/2018	9/10/2018
LRV 2033	7/31/2018	9/24/2018

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Item	Vehicle Delivery Date	Completion of Acceptance Testing
LRV 2034	8/14/2018	10/8/2018
LRV 2035	8/28/2018	10/22/2018
LRV 2036	9/11/2018	11/5/2018
LRV 2037	9/25/2018	11/19/2018
LRV 2038	10/9/2018	12/3/2018
LRV 2039	10/23/2018	12/17/2018
LRV 2040	11/6/2018	12/31/2018
LRV 2041	11/20/2018	1/14/2019
LRV 2042	12/4/2018	1/28/2019
LRV 2043	12/18/2018	2/11/2019
LRV 2044	1/1/2019	2/25/2019
LRV 2045	1/15/2019	3/11/2019
LRV 2046	1/29/2019	3/25/2019
LRV 2047	2/12/2019	4/8/2019
LRV 2048	2/26/2019	4/22/2019
LRV 2049	3/12/2019	5/6/2019
LRV 2050	3/26/2019	5/20/2019
LRV 2051	4/9/2019	6/3/2019
LRV 2052	4/23/2019	6/17/2019
LRV 2053	5/7/2019	7/1/2019
LRV 2054	5/21/2019	7/15/2019
LRV 2055	6/4/2019	7/29/2019
LRV 2056	6/18/2019	8/12/2019
LRV 2057	7/2/2019	8/26/2019
LRV 2058	7/16/2019	9/9/2019
LRV 2059	7/30/2019	9/23/2019
LRV 2060	8/13/2019	10/7/2019
LRV 2061	8/27/2019	10/21/2019
LRV 2062	9/10/2019	11/4/2019
LRV 2063	9/24/2019	11/18/2019
LRV 2064	10/8/2019	12/2/2019
Delivery of 1st vehicle (Phase 2) to SFMTA	5/15/2021	TBD
Delivery Rate of Phase 2 Vehicles	1 car / 2 weeks	
Delivery of 151th vehicle (Phase 2) to SFMTA	2/27/2027	TBD
Delivery of 1st Option 2 Vehicle to SFMTA	TBD	TBD
Delivery Rate of Option 2 Vehicles	TBD	TBD
Delivery of the last Option 2 Vehicle	TBD	TBD

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Exhibit 6.3

MODIFICATION TO PARENT COMPANY GUARANTEE
G-ID 466742

THIS AGREEMENT is entered into as of August 26, 2016 by and among **Siemens Corporation**, a corporation of the State of Delaware ("Guarantor"), **Siemens** Industry, Inc., a corporation of the State of Delaware ("Obligor"), and the City and County of San Francisco ("City'), through its Municipal Transportation Agency ("Beneficiary").

RECITALS

A. Obligor and the Beneficiary entered into an agreement for the supply of up to 260 S200SF light rail vehicles plus spare parts, special tools, training and manuals, Contract No. SFMTA-2013-19, dated as of September 29, 2014 (the "Contract"), and Guarantor issued a Guarantee dated as of September 8, 2014, to secure the performance of Obligor under the Contract (as same has been, is being, and may further be amended, modified and/or restated from time to time) (the "Guarantee").

B. Guarantor, Obligor, and the Beneficiary each desire and have agreed to modify the terms of the Guarantee as set forth in this Modification To Guarantee ("Agreement").

Now, therefore, in consideration of the mutual promises contained herein and of other good and valuable consideration, the sufficiency of which is acknowledged, the parties agree as follows:

AGREEMENT

1. **MODIFICATION.** Notwithstanding anything contained in the Guarantee to the contrary, the Guarantee is modified as follows:

   (A) The fifth paragraph of the Guarantee is deleted and replaced with the following paragraph:

   Notwithstanding anything contained in this Guarantee to the contrary, Guarantor's liability under this Guarantee shall not exceed the value of (1) $76,956,090.96 (Seventy-Six Million, Nine Hundred Fifty-Six Thousand, Ninety and 96/100 United States Dollars) (the "Stated Amount"), plus (2) $52,079,710 (Fifty-Two Million, Seventy-Nine Thousand Seven Hundred Ten and 00/100 United States Dollars) (the "Additional Amount"), which covers providing additional security for progress payments made by the Beneficiary for such phase (as referenced in Section 7.3 of the Contract). Together, the Stated Amount and the Additional Amount covers all Phase 1 obligations. Once 80 percent of the Phase 1 Vehicles have been Accepted or Conditionally Accepted (as these terms are defined in the Contract), the Additional Amount may be released from the Guarantee for Phase 1. Upon Acceptance or Conditional Acceptance of all Phase 1 Vehicles, the Stated Amount will be reduced to 12.5 percent of the total price for Phase1, in accordance with Section 15.2.2(a)(ii) of the Contract.

2. **ACKNOWLEDGMENTS.** The parties hereto acknowledge and agree that:

   (A) the Guarantee, as amended and modified hereby, is in full force and effect and incorporated herein;

   (B) no default by Obligor in the performance of its duties under the Contract has occurred;

   (C) no default by Guarantor under the Guarantee has occurred;

Exhibit 6.3

MODIFICATION TO PARENT COMPANY GUARANTEE
G-ID 484678

THIS AGREEMENT is entered into as of August 29, 2016 by and among **Siemens Corporation**, a corporation of the State of Delaware ("Guarantor"),**Siemens** Industry, Inc., a corporation of the State of Delaware ("Obligor"), and City and County of San Francisco ("City"), through its Municipal Transportation Agency ("Beneficiary").

RECITALS

A. Obligor and the Beneficiary entered into an agreement for the supply of up to 260 S200SF light rail vehicles ("LRVs") plus spare parts, special tools, training and manuals, Contract No. SFMTA-2013-19, dated as of September 29, 2014 (the "Contract"). The Contract included an option for 40 additional LRVs, which was exercised as of March 31, 2015 (the "Option"). Guarantor issued a Guarantee dated as of March 25, 2015, to secure the performance of Obligor under the Option (as same has been, is being, and may further be amended, modified and/or restated from time to time, the "Guarantee").

B. Guarantor, Obligor, and the Beneficiary each desire and have agreed to modify the terms of the Guarantee as set forth in this Modification To Guarantee ("Agreement").

Now, therefore, in consideration of the mutual promises contained herein and of other good and valuable consideration, the sufficiency of which is acknowledged, the parties agree as follows:

AGREEMENT

1. **MODIFICATION.** Notwithstanding anything contained in the Guarantee to the contrary, the Guarantee is modified as follows:

   A. The fifth paragraph of the Guarantee is deleted and replaced with the following paragraph:

   "Notwithstanding anything contained in this Guarantee to the contrary, Guarantor's liability under this Guarantee shall not exceed the sum of (1) Eighty-Four Million, Eight Hundred Ninety-Eight Thousand, One Hundred Sixty Six Thousand United States Dollars and 10 United States Cents ($84,898,166.10 US) (the "Stated Amount") plus (2) the Additional Amount, which covers providing additional security for progress payments made by the Beneficiary for such Option 1 (as referenced in Section 7.3 of the Contract) and which on each Date of Change reflected on Table A shall be automatically adjusted to the adjacent Additional Amount as set forth in Table A of this Guarantee. Together, the Stated Amount and the Additional Amount covers all Option 1 obligations. Once 80 percent of the Option 1 Vehicles have been Accepted (as those terms are defined in the Contract), the Additional Amount may be released from the Guarantee for Option 1. Upon Acceptance or Conditional Acceptance of all Option 1 Vehicles, the Stated Amount will be reduced to five percent of the total price for Option 1, in accordance with Section 15.2.2(c) of the Contract."

2. **ACKNOWLEDGMENTS.** The parties hereto acknowledge and represent that:

   A. the Guarantee, as amended and modified hereby, is in full force and effect and incorporated herein;

   B. no default by Obligor in the performance of its duties under the Contract has occurred;

APPENDIX C - RADIO/CAD/AVL ONBOARD AND WAYSIDE SYSTEMS

C.1 GENERAL

The work described in this section shall apply to the LRV4 Radio/CAD/AVL onboard and wayside systems, and shall be in addition to the work required by the original Contract No. SFMTA-2013-19.

C.2 SCOPE OF WORK

The scope of work is to provide a reliable and fully functional revenue service ready radio/CAD/AVL system with all supporting interfaces. This includes integration of the LRV4 on-board digital vehicle communication system (DVCS) equipment with SFMTA's wayside components and radio/CAD/AVL infrastructure. This also includes providing fully functional solutions and equipment to fulfill all of the functionalities in the operational needs (Table C-1). The scope of work also includes fitting of SFMTA defined Operator's Cab communications equipment, compliant with the ergonomic, arrangement, and visibility requirements of the TS.

Contractor is responsible for all aspects of the LRV4 vehicle design and system integration. Contractor is the primary contractor and is responsible for working with their sub-suppliers to make the vehicles ready for revenue service, including complete integration with the wayside and any required safety certification support. Execution of this scope of work shall not delay the progress of other non-related activities under this Contract. Specific requirements are defined elsewhere in this document.

C.3 GENERAL ENGINEERING DESIGN

Contractor' design shall comply with Contract No. SFMTA-2013-19, and the operational needs list provided as Table C-1 of this Appendix.

Within 21 days of the notice to proceed of Modification No. 3, Contractor shall update and resubmit all existing design submittals relevant to this scope of work. The revised submittals shall provide acceptable designs that are fully functional and revenue service ready.

Compliant with the Section 20.7.1, Contractor shall provide a design submittal for interfaces between the LRV4 on-board equipment and the respective wayside CAD/AVL components and software. For example, the interface between LRV4 automatic passenger counter or passenger information system equipment, and the wayside software supporting its functionality. The design submittals shall establish the data management amongst LRV4 equipment, between LRV4 equipment and wayside components, and how the end-to-end functionality is compliant with all operational performance requirements as defined in C.4.

The design submittals shall specify radio/CAD/AVL operations in multi-car consists and address redundancy under failure conditions.

C.4 OPERATIONAL NEEDS

Contractor shall deliver LRV4 vehicles with a fully functional and revenue service ready radio/CAD/AVL system in accordance with the performance requirements listed in Contract No. SFMTA-2013-19, and the operational needs provided in Table C-1.

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C.5 WAYSIDE INTERFACES

The design shall provide integration between the LRV4 INIT APC system and the wayside components responsible for transfer, storage, and management of the LRV4 APC data within SFMTA's backend systems. This includes wayside APC software required to manipulate or manage the LRV4 APC data. The design shall provide real-time and bulk data APC reporting interfaces to the wayside CAD/AVL components including CAD stations, data interchange station, long term database, and reports servers.

The design shall provide integration of Televic software with the wayside CAD/AVL components for management and distribution of vehicle signage, audible messages, infotainment, and software and firmware updating for components under the DVCS scope.

The design shall provide for on-board Televic and INIT software to be remotely maintained and updated from wayside systems that are not part of SFMTA's core OrbCAD system.

C.6 OPERATOR'S CAB

The revised submittals for the design and ergonomics of the Operator's Cab shall provide a compliant design and demonstrate an integrated approach to fitting of equipment under this scope of work.

Additionally, Contractor shall provide an Operator's Cab forward visibility study with considerations made towards fitting of cab equipment consistent with frequency of use, while maximizing safety of the Operator, automobile drivers, and pedestrians. Contractor shall utilize the study to optimize cab space while avoiding direct placement of equipment within the area of the cab windows, potentially creating blind spots or otherwise obstructing the Operator's view (refer to Section 5.2).

C.7 TRAINING

Training is required for the additional scope of work covered by this Appendix which is above and beyond that already covered by the base Contract. All training required to operate, maintain, and update the on-board and wayside components shall be provided. Contractor shall provide software administrator training for the scope of work involving wayside components. All training shall comply with the Conformed Contract Documents.

Contractor shall include the training plan for all additional training required by this scope of work within CDRL 58 (Training Program Plan), for SFMTA's acceptance (refer to Section 22.2.6.1).

C.8 DOCUMENTATION

Documentation is required for the additional scope of work covered by this Appendix which is above and beyond that already covered by the base Contract. All manuals required to operate, maintain, and update the on-board and wayside components shall be provided. The radio/CAD/AVL wiring and cable assembly drawings shall be integrated into the vehicle wiring

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documentation. Manuals shall be provided for the Televic and INIT wayside application software. Contractor shall provide interface control documents for the Televic, INIT, and wayside software elements. Documentation shall comply with the requirements of the original Contract No. SFMTA-2013-19 (refer to Section 22.2).

C.9 TESTING, COMMISSIONING, SAFETY CERTIFICATION

Design validation and safety certification support is required for the additional scope of work covered by this Appendix which is above and beyond that already covered by the base Contract. All existing terms of the Section 21 shall apply including but not limited to design verification, commissioning, and safety certification. Contractor shall submit qualification and routine test procedures relevant to this scope of work, and include the procedures into CDRL 40 (Requirements Traceability Matrix (RTM)).

Qualification testing shall encompass all on-board and wayside components involved with radio/CAD/AVL and DVCS. Testing shall reasonably account for all operational scenarios and failure modes.

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Table C-1 Operational Needs

No	Operational Need
1	A Mobile Data Terminal (MDT) shall be provided in each Cab. The MDT provides the Train Operator interface to the CAD/AVL System. The MDT contains a covert Microphone.
2	Central Control Dispatcher shall be able to hear all conversations after Emergency Alarm (EA) Activation. When the EA button is activated an Event Marker will be activated on the CCTV system and a silent indication will be shown on the MDT.
3	The Public Address (PA) to the Train from the Central Dispatcher shall be heard in the Operator's Cab as well as in the passenger area.
4	All of the onboard communications equipment shall be controlled by the VLU using the Radio and CAD/AVL System. Design documentation shall provide system description, and functionality of Televic/INIT/Xerox system. Wayside servers and software shall be provided as needed to support software/firmware updates/revisions to remotely maintain the on-board Televic/INIT/Xerox equipment.
5	Wireless Bulk Data Transfer (WBDT) shall support all necessary data transmission between the vehicle and the wayside. Design documentation shall provide system description, and functionality of Televic/INIT/Xerox system. Wayside servers and software shall be provided as needed to support software/firmware updates/revisions to remotely maintain the on-board Televic/INIT/Xerox equipment.
6	The Mobile Access Router (MAR) shall support: system segregation through Virtual LANs (VLANs), IPSec, VPN tunneling (including a deep inspection firewall) and Gigabit Ethernet ports with backwards compatibility to 100 Megabit.
7	The Mobile Access Router (MAR) shall distribute Network Time Protocol (NTP) System time and Vehicle Health Monitoring.
8	NMEA GPS string from VLU shall be compatible with onboard equipment.
9	The Mobile Access Router (MAR) also shall provide 3G and Wi-Fi module.
10	The CAD/AVL system shall provide single point logon for all systems dependent upon vehicle/Block ID, including but not limited to: Destination Signs, Passenger Information Signs, VLU, MDTs, Farebox, CAD system, DVCS, and Radio.
11	The transition from "inactive" to "active" CAB shall be seamless and instantaneous.
12	The radio shall be compatible with OpenSky2 radio infrastructure.
13	The Train Operator (TO) shall be able to communicate with the Central dispatcher from the active cab within a consist. Handling of voice communications in trailing cabs in the consist shall be functionally equivalent to LRV2/3 design.

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14	The Mobile radio in the active cab shall be able to Request To Talk to the Central dispatch console. Handling of voice communications in trailing cabs in the consist shall be functionally equivalent to LRV2/3 design.
15	In multicar consists, the VLUs shall be functionally redundant. If the Master VLU fails, then another shall take control. The design documentation shall address DVCS fall back modes.
16	The voice and data via the MDT in each Cab shall be functionally equivalent to LRV2/3 design.
17	Harris XG-75 Portable Radio Chargers shall be installed in each Cab.
18	The APC data shall be compatible with SFMTA wayside system. Wayside servers and software shall be provided as needed to support handling/storage/processing of APC data on the wayside.
19	The data collected by the APC shall be compatible with the wayside database. Wayside servers and software shall be provided as needed to support handling/storage/processing of APC data on the wayside.
20	Positions of the steps (up or down) at each stop shall be logged and transmitted via VLU Wireless Bulk Data Transfer (WBDT). Wayside servers and software shall be provided as needed to support software/firmware updates/revisions to remotely maintain the on-board Televic/INIT/Xerox equipment.
21	APC real-time passenger loading data shall be provided to the VLU upon door close events.
22	APC data shall be uploaded daily via VLU Wireless Bulk Data Transfer (WBDT) infrastructure. Wayside servers and software shall be provided as needed to support software/firmware updates/revisions to remotely maintain the on-board Televic/INIT/Xerox equipment.
23	An exception notification shall be sent to the vehicle health monitoring system, if APC data is not being collected or is incomplete. Design documentation shall include the handling and processing of the diagnostic data from APC.
24	Interface with Radio and CAD/AVL System shall include the following systems: Farebox, Destination Signs, EA Switches, GPS, Critical Control Point Speakers (CCP Speakers), Speed Sensor, Mobile Access Router (MAR), Door Status, Stop Request, Accessible Stop Request, Passenger Information Signs and APC.
25	Speed sensors shall be connected to the VLU for "Dead Reckoning" in the event of the loss of GPS signal.

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No	Operational Need
26	The Mobile Access Router (MAR) shall be connected to the VLU. The MAR shall have sufficient ports for integration of all required onboard equipment provided. CCTV system uses its own wayside communication method and does not require interface with the MAR.
27	Wireless Bulk Data Transfer (WBDT) shall perform the following: automatic uploading and downloading of data files at the Depot and push to corresponding equipment on the vehicle. These files will include: Audio Visual Annunciation (AVA), Destination Sign Image, Scheduling Data, Fare Collection Data, Logged Data, and Firmware for all subsystems. The logged Data shall include APC, Fare Collection, and Vehicle Location Logging. The onboard storage shall be sufficient to store all files and data for 7 days in the event of the unavailability of the WBDT. Equipment required to perform WBDT shall be provided. Design documentation shall provide system description, and functionality of LiveCom tool to generate audio and visual announcement data for PIS system. Design documentation shall describe process to update announcement data.
28	System shall include700/800 MHz and GPS Antennas.
29	Not applicable
30	Vehicle shall transmit location to the wayside every 60 seconds on the surface and every 20 seconds in subway, these transmissions are archived on the wayside.
31	The Farebox will be connected to the VLU via J1708. The Farebox will dispense a Fare receipt. Farebox will be connected to VLU in the same method as on LRV2/3. Clipper® does not have bidirectional communication with VLU.