BEFORE THE PUBLIC UTILITIES COMMISSION
OF THE STATE OF COLORADO

PROCEEDING NO. 22I-0471R

IN THE MATTER OF THE REGIONAL TRANSPORTATION DISTRICT'S CORRECTIVE ACTION PLAN REGARDING THE SABLE BOULEVARD AND EXPOSITION AVENUE DERAILMENT, RULE 4 CCR 723-7-7347

REGIONAL TRANSPORTATION DISTRICT'S SAFETY ASSURANCE AND SAFETY RISK MANAGEMENT ANALYSES OF 2019 SABLE/EXPOSITION DERAILMENT CORRECTIVE ACTION PLAN

The Regional Transportation District ("RTD"), by and through its undersigned counsel, respectfully provides its safety assurance and safety risk management analyses of its Corrective Action Plan, filed July 18, 2019 (**Attachment 1**, "2019 CAP"), and Addition to Corrective Action Plan, filed September 16, 2019 (**Attachment 2**, "2019 CAP Addition"), for the January 28, 2019 light rail vehicle derailment at the Sable Boulevard and Exposition Avenue intersection crossing ("2019 Accident" respectively) as follows:

I. INTRODUCTION

1. RTD has conducted a safety assurance analysis of the mitigation measures included in the 2019 CAP and 2019 CAP Addition for the 2019 Accident.[1] This safety assurance analysis consisted of reviewing the evidence that each mitigation measure was fully implemented as described and reviewing if the mitigation measure worked as originally expected. For those that did not work as expected, a safety risk analysis was conducted to determine what changes or mitigation measures should be made to the previous mitigation that did not work as originally expected.

[1] In the 2019 Accident Proceeding No. 19I-0347R, the Commission approved and closed the 2019 Accident corrective action plan in Decisions No. C19-0829, October 11, 2019, and No. C21-0060, February 3, 2021.

2. Overall, RTD determined that the 2019 CAP and 2019 CAP Addition mitigation measures were largely effective and worked as originally expected to meet or exceed its safety objectives. As discussed further below, of the 13 mitigation areas, there are five for which RTD has identified additional safety risk mitigation measures that should be taken related to: 1) enhanced evaluation and tracking of light rail vehicle ("LRV") operators, 2) radar speed sign preventative maintenance inspections, 3) in-cab camera tamper-resistant improvements and potential inward and outward facing audio and image recorders upgrades, 4) Automatic Train Stop upgrades, and 5) technology options for Communication Based Train Control. Anticipated implementation timelines are included for each measure below and in the 2022 Accident proposed CAPs, as applicable.

II. BACKGROUND

3. On September 21, 2022, RTD R Line Train 21, with light rail vehicles 316 and 286, derailed at the intersection of South Sable Boulevard and East Exposition Avenue ("2022 Accident").

4. On October 31, 2022, by Decision No. C22-0675, the Commission opened an investigative proceeding of the 2022 Accident and required RTD to file a proposed Corrective Action Plan (CAP). The Commission also ordered RTD to file this safety assurance and safety risk management analyses of the 2019 CAP and 2019 CAP Addition for the 2019 Accident.

5. On November 4, 2022, RTD filed its accident investigation report and proposed CAP and implementation schedule as highly confidential pursuant to § 40-18-104, C.R.S. and Commission Rules 7349(d)(I) and (IV). On November 23, 2022, in Decision C22-0763, the Commission re-classified the proposed CAP and implementation schedule as non-confidential.

III. 2019 CAP

6. Because the cause of the 2019 Accident was the operator's disregard for the speed limit, the 2019 CAP included the below proposed mitigation measures to address the human factor elements that likely contributed to the incident. *See* Decision No. C19-0829, p. 11 ¶ 26.

A. "Return to Work" Policies and Procedures

7. The 2019 CAP included an evaluation of "return to work" policies and procedures for LRV operators, with a specific focus on employees returning from extended leave. Following this evaluation, RTD created the below program for retraining operators after a prolonged absence. If the operator is out:

- 31 to 40 days: Full roundtrip ride check and refresh of any training they may request
- 41 to 60 days: Procedures and policies classroom training, two certification tests, and ride checks on the main line, Automatic Block Signals (ABS), and surface streets
- 61 to 90 days: Procedures and policies classroom training, two certification tests, revenue assignment (one day), ride checks on the mainline, ABS and surface streets
- 91 to 180 days: Procedures and policies classroom training, two certification tests, simulator training, revenue assignment (three days), ride checks on the mainline, ABS, and surface streets
- 181 to 364 days: Procedures and policies classroom training, two certification tests, simulator training, revenue assignment (five days), ride checks on the mainline, ABS, and surface streets

Before returning to service, all LRV operators take an exam to verify sufficient knowledge. This document contains their name and will include a signature line beginning immediately. Training

Instructors also verify and sign off that the operator has completed all training requirements and demonstrated all appropriate skills.

8. **Safety Assurance Analysis.** RTD reviewed all accidents from 2019 to present and cross-referenced against LRV operators that had been out and there was no correlation between the LRV operators out on extended leave and LRV operators who had accidents. There have been no incidents since the 2019 derailment where an employee had recently returned to work and insufficient knowledge or lack of skills were identified as causal factors. For incidents required to be investigated return to work was not a causal or contributing factor. RTD has concluded that the return-to-work standard has been implemented and is working as intended.

9. **Safety Risk Analysis.** Not required as this mitigation measure is working as intended.

B. Psychological Fitness for Duty Policies and Procedures

10. The 2019 CAP included an investigation, assessment, and implementation of Psychological Fitness for Duty policies and procedures under direction of RTD's medical provider for "return to work" programs.

11. **Safety Assurance Analysis.** RTD contracts with Concentra to perform Medical Examiner Certificate (MEC) exams for LRV operators. Concentra confirmed these MEC exams are performed in compliance with 49 CFR 391, including psychological fitness for duty assessments consistent with 49 CFR 391.41(b)(9) Mental Disorders, and the corresponding Medical Advisory Criteria.

12. **Safety Risk Analysis.** Not required as this mitigation measure is working as intended.

C. Evaluation and Tracking of LRV Operators

13. The 2019 CAP included the development of means and methods for evaluation and tracking all LRV operators. Evaluation and tracking of LRV operators includes both announced

and unannounced ride checks/efficiency evaluations at least quarterly, assessment of operating rule violations including moving violations (e.g., speed, unfavorable signals or "red signal" violations, switch or "trailed or split switch" violations), programs that address identified deficiencies in training and retraining, and disciplinary actions that are consistent with the collective bargaining agreement. RTD developed efficiency check forms but has not yet created an automated electronic tracking process to identify hotspots on the alignment, concerning LRV operators, and other trends in the data.

14. **Safety Assurance Analysis.** RTD has determined that the evaluation and tracking of LRV operators is partially effective. Safety key performance indicators since 2019 indicate improvement in safe train operations as evidenced by:

- 40% reduction in red signal violations
- 30% reduction in work zone speed violations
- Minimal number of violations recorded from field supervisor radar checks, showing less than 1% of speed checks resulting in a speeding violation
- 22% improvement on operator efficiency check ratings showing improvement in train operations

15. **Safety Risk Analysis.** RTD Rail Operations determined that the operator quarterly ride check/efficiency evaluations were not effective because they did not coincide with operator shifts, which require three runboard changes per year where operators can bid a different line or shift. Rail Operations adjusted the evaluations to coincide with the runboards. This aligns field supervision with the operator bid schedule.

16. No electronic tracking software other than a Microsoft Excel spreadsheet was implemented. This tracking mechanism needs improvement to identify leading and lagging

indicators for quality assurance checks and radar checks. A safety management software solution was considered to be an option for tracking, but delays in implementation have RTD looking for other solutions. RTD has begun to identify potential vendors that provide solutions that simplify the tracking and reporting as part of the proposed CAP02-09212022, the second action item in the CAP implementation schedule table, with a target date of March 31, 2023.

17. With respect to assessment of deficiencies in training and retraining, LRV operators currently have two opportunities to pass written and practical exams before they are disqualified. The Quality Training Manual does not limit the number of attempts to pass written exams for operator recertification. The Quality Training Manual will be updated by February 28, 2023, to address this gap in the recertification testing procedure, limiting the attempts for recertification to two attempts.

18. Field supervision duties around ride checks are included in the proposed 2022 CAP and will be addressed. Light Rail Transportation implemented Internal Work Instruction LRT22-06, Operator Ride Checks, in October 2022 to address ride check evaluations. Upon a failed ride check, the operator will be relieved from service and referred for follow-up training on the identified deficiency that will include an observed ride check. When released to return to service, an unannounced ride check will be performed within 30 days to evaluate the operator's performance.

D. Standard Operating Procedures and Rule Book

19. The 2019 CAP included a review and reassessment of training materials, to include Standard Operating Procedures and Rule Book materials with a focus on inclement weather operations. To increase comprehension and familiarity, RTD increased testing of new operators from four to 13 exams while in training. Operators are also tested and given a practical test on all

portions of the alignment and these results are documented and placed in their training files. This is in addition to the additional week of revenue instruction operators are required to complete before they are released for solo revenue service. Any deficiencies, detected during any of the training, are addressed and corrected before operators are released to the next phase of training. Operators are given a ride check on all areas of the alignment (all light rail lines) prior to being released for revenue service, which indicates completion of their initial training.

20. **Safety Assurance Analysis.** After review of information related to this mitigation measure it was evident that RTD had enhanced the training to include inclement weather, to include Standard Operating Procedure (SOP) 103.3 Inclement Weather Operations, Training Quality Manual, and Safety Campaigns around inclement weather. Procedures regarding inclement weather are adequate as evidenced by no known weather-related incidents or violations. On an annual basis, Light Rail Training reviews training content and applicable SOPs and the document footers are updated with the revision date as per the Training Quality Manual.

21. **Safety Risk Analysis.** Not required as this mitigation measure is working as intended.

E. Speed Sign Placement

22. The 2019 CAP included a confirmation of current placement and the addition of permitted speed signs in multiple locations across the light rail system. As of January 2020, RTD had installed eight radar-based speed monitoring strobes signs at the below locations.

- Sable and Exposition (R Line, Lincoln Bound) – two signs installed
- Aurora Metro Center horseshoe curves (R Line) – two signs installed at Sable and Ellsworth and two signs installed at Abilene and Exposition
- Mile High Station curve (CPV Extension, Outbound) – one outbound sign installed
- Ellsworth crossing R Line – one sign installed

23. RTD is procuring additional strobe signs for installation at the below locations.

- Iliff flyover (R Line, Lincoln Bound)
- Colfax and 13th Avenue (R Line near 1-225)
- Curves entering and exiting Federal Center (W Line)

24. The use of such signs will alert LRV operators if they are speeding as they are approaching critical points in the alignment where a related incident could occur and will give operators a visual notification to slow down. RTD has identified those critical points as curves of 10 mph, and areas/curves where the posted speed limit is low, and the preceding track speed limit is two to three times faster. RTD has also considered other potentially dangerous locations such as bridges/flyovers and may determine that it needs to procure more strobe signs.

25. **Safety Assurance Analysis.** RTD Maintenance of Way will begin installing the signs as an immediate mitigation to the speed related concerns and will complete installation at all identified sites (and any identified future sites) upon the Commission's approval of this CAP response.

26. Eight radar signs were purchased and installed in January 2020 and upgraded in March 2021 at the below locations:

Location Description	**Location Details**
• Empower Field	130+43 CPV
• Abilene and Ellsworth	933+75 PR
• Abilene and Exposition	847+46 PR
• Abilene and Exposition	842+29 PR
• Sable and Exposition	871+46A PR
• Sable and Exposition	867+16 PR

- Sable and Ellsworth 919+79 PR
- Sable and Ellsworth 915+63 PR

27. During the investigation of 2022 Accident, it was discovered that there was some confusion over which locations signs were required, however signs at Sable and Exposition are installed and functional. Once it was discovered that there were three remaining locations identified in the 2019 CAP, the radar speed signs were purchased and will be installed once received. With the uncertainty of the supply chain, it is difficult to determine a completion date. These signs will be installed within 10 business days of receipt.

Location Description	**Location Details**
• Iliff Flyover	R-Line, Lincoln Bound
• Curve at Colfax and 13th Avenue	R-Line, near I-225
• Curves entering and exiting Federal Center	W-Line

28. **Safety Risk Analysis.** During the operation of these signs after initial install, it was recognized that these signs needed to be included in preventative maintenance inspections to ensure reliability. The addition of verification of radar speed sign operation was added to the PM Inspection TK-I-T-03 Semi-Weekly Vehicle Track Inspection Checklist. This has proved effective by the minimal number of violations recorded from field supervisor radar checks, showing less than 1% of speed checks resulting in a speeding violation.

29. A formalized review to identify other potentially dangerous locations such as bridges/flyovers and determination of required number of radar speed signs for purchase will be completed by December 31, 2022.

F. Posted Speeds LRV Operator Bulletin

30. The 2019 CAP included the publication of a bulletin that is signed for by LRV operators regarding permitted speed on the alignments and adherence to posted speeds.

31. **Safety Assurance Analysis.** A safety campaign on "Speeds in Curves" was conducted in August 2019. Field Supervisors met with LRV operators to discuss the campaign and logged the operator's name and time of the meeting.

32. **Safety Risk Analysis.** Not required as this mitigation measure is working as intended**.**

G. Speed Limit Train Orders

33. The 2019 CAP included the addition of reminders included in Train Orders of speed limits on the light rail alignments.

34. **Safety Assurance Analysis.** Review of the information related to this mitigation measure indicated that these train orders have consistently included speed limits and areas of reduced speeds on the alignment. This has proved effective by the minimal number of violations recorded from Field Supervisor radar checks, showing less than 1% of speed checks resulting in a speeding violation.

35. **Safety Risk Analysis.** Not required as this mitigation measure is working as intended.

H. Field Supervisor Speed Adherence Campaign

36. The 2019 CAP included the implementation of a field supervisor campaign focused on speed adherence with violations of posted speeds triggering face to face meetings with LRV operators regarding speeding. In 2019, a monthly campaign was conducted for field supervisors on the below areas (these were in addition to the daily required speed, station, policy and safety checks):

- August: Speed in Curves

- September: Radio Procedures
- October: 20-second Gated Crossing Checks
- November: Speed in Stations
- December: Cell Phones

37. **Safety Assurance Analysis.** These Safety Campaigns continued from 2019 to present. This has proved effective by the minimal number of violations recorded from field supervisor radar checks, showing less than 1% of speed checks resulting in a speeding violation. Any violation of over five mph posted speed limit on straight track, or two mph in a curve, triggers a face-to-face meeting with a field supervisor. This requirement is included on the speed check form.

38. **Safety Risk Analysis.** Not required as this mitigation measure is working as intended.

IV. 2019 CAP ADDITION

39. To supplement the 2019 CAP, the 2019 CAP Addition addressed the below additional mitigation measures and information requested by the Commission related to possible technology that could be installed that would enhance LRV operator awareness, provide better oversight of operations, or prevent speeding, as well as analysis on LRV operator retention and vehicle door design.

A. Upgraded In-Cab and Forward-Facing Cameras

40. The 2019 CAP Addition included upgraded cameras to include in-cab and forward-facing cameras that were included in the 29 new LRVs in service but needed to be added to the existing 172 vehicles. The estimated cost in 2019 was $4 million, for which no budget was previously identified or appropriated in the short or long term.

41. **Safety Assurance Analysis.** To implement this camera upgrade within existing resources, RTD repurposed cameras once located in the passenger compartment to the interior operating cab. This was old technology and did not meet the Federal Transit Administration guidance for inward and outward facing image and audio recorders. These relocated cameras were only inward looking as there was only one camera per LRV available for relocation. After this was completed on 172 LRVs, the Amalgamated Transit Union Local 1001 filed a grievance on the use of these cameras. After an unsuccessful arbitration, RTD was ordered to disable these cameras.

42. Under revised rule 4 CCR 723-7, 7349(b), effective June 30, 2022, RTD was required to begin using all already installed forward-facing and operator facing in-cab cameras on LRVs to record activity at all times when the LRV power is on and to assist in the management of safe light rail operations.

43. RTD made all cameras functional as of June 30, 2022. Since then, there have been several occurrences of tampering with the cameras (e.g., covering the lens with tape or bags) or shutting them off at the breakers. During the investigation of the 2022 Accident, it was discovered that only a 40% reliability on video retrieval was possible as a result of cameras not functioning due to being tampered with or a malfunction.

44. **Safety Risk Analysis.** As an interim measure, RTD is making the cameras resistant to tampering that disables power. This is expected to be completed by March 31, 2023. As a longer-term measure, RTD is in the process of refining and expanding the scope of the upgrade project, which is expected to be completed by June 30, 2023. RTD is assessing whether the cameras will be similar to the current cameras in the Denver VIII LRVs or will meet the American Public Transportation Association's recommended practice for crash and fire protected inward and

outward facing audio and image recorders in rail transit operating compartments to ensure funds are available to meet the June 30, 2027 deadline. With respect to human factors, RTD is assessing the extent to which modifications to the collective bargaining agreement, code of conduct and discipline, and operator bulletins, as these pertain to operator tampering with cameras, are appropriate.

B. Enhanced Automatic Train Control

45. The 2019 CAP Addition included the exploration of Enhanced Automatic Train Control (EATC) technologies, which would establish vehicle to wayside communications to monitor vehicle position and speed and would provide signal enforcement and civil speed control of all light rail trains and thus eliminate red signal violations and govern the speed of all LRVs. In 2019, the estimated cost was $12-15 million for which $7 million was in the 2019 budget, $2 million was in the 2020 budget, and $1 million per year in budget years 2021-2025.

46. **Safety Assurance Analysis.** The capital funds currently budgeted for EATC are not sufficient to acquire any type of system currently available for a fleet of RTD's size. Current funds available include $3 million, with the Mid-Term Financial Plan projecting $2 million per year through 2027.

47. To be prepared for increased future availability of capital funding, RTD commissioned HNTB Corporation to study its Light Rail Transit (LRT) signal system to evaluate the current signaling technology alternatives to upgrade and improve the safety and efficiency of the LRT transit operations. On January 25, 2022, HNTB issued its report (**Attachment 3**).

48. **Safety Risk Analysis.** Automatic Train Stop has been included as a mitigating measure in the 2022 Accident proposed CAP. RTD is now in the process of developing a strategic plan to evaluate which, if any, technology to incorporate into its light rail system. This will include an

analysis of finances, grant funding availability, timetables, and accountable personnel, to develop realistic expectations. This plan is expected to be completed by March 31, 2023.

C. Communication Based Train Control

49. The 2019 CAP Addition included the exploration of Communication Based Train Control/ultra-wideband communication technologies, which would provide very sophisticated control of train position, speed, braking distance, and signal systems at a cost estimated in 2019 of approximately $100 million, which RTD previously determined was cost prohibitive.

50. **Safety Assurance Analysis.** As discussed above, RTD commissioned HNTB Corporation to evaluate LRT signal system upgrade options and that report was completed in January 2022.

51. **Safety Risk Analysis.** As discussed above, the capital funds currently budgeted for EATC are not sufficient to acquire any type of system currently available for a fleet of RTD's size. RTD anticipates it will complete a strategic plan by March 31, 2023, to evaluate which, if any technology to incorporate into its light rail system.

D. Operator Retention

52. The 2019 CAP Addition included an assessment of any issues with obtaining and recruiting and retaining LRV operators and how the limited numbers of operators may have led to issues that contributed to the 2019 Accident.

53. **Safety Assurance Analysis.** RTD eliminated mandating operator overtime in April 2020. Operators can volunteer for overtime and receive an additional $2/hour incentive. RTD hired a Human Resources ("HR") Recruiter and HR student intern in June 2022 dedicated to Rail Operations. RTD has created new a position of Light Rail, Business Employee Coordinator, to support recruitment. The position was posted and RTD is optimistic that the position will be

filled by January 2023. RTD Light Rail currently has 25 vacancies for full time LRV operators, and due to a reduction in service (elimination of C and F light rail lines) in the most recent runboard, there are less trips to cover.

54. **Safety Risk Analysis.** Not required as this mitigation measure is working as intended.

E. Vehicle Door Design

55. The 2019 CAP Addition included reports from Siemens and IFE Automatic Door Systems that demonstrated the vehicle and door interface performed as designed according to manufacturers and RTD specifications.

56. **Safety Assurance Analysis.** Siemens suggested an enhancement that had the possibility to withstand forces above the original 890 Newton design limit. Detailed engineering work has not been performed to determine the level of improvement over the original design, but Siemen's believes it would improve the door performance. The enhancement is the addition of a bracket that would prevent the rollers from lifting out of the lower guiding rail – thereby increasing the force the door mechanism could withstand. In addition, there would have to be an evaluation completed to ensure that this enhancement would not affect life safety egress characteristics of the door system. After reviewing the study, it was determined that the vehicle and door interface performed as designed according to manufacturers and RTD specifications and no other action by RTD is necessary.

57. **Safety Risk Analysis.** Not required as this mitigation measure is working as intended.

V. CONCLUSION

58. RTD remains committed to continuous assessment of and improvement in its safety management system and LRV operations. The 2019 CAP and 2019 CAP Addition mitigation measures were largely effective. In the five areas where RTD has identified the need for

additional safety risk mitigation measures, RTD has begun implementing several measures and will await the Commission's approval of the remaining 2022 Accident proposed CAPs.

Respectfully submitted this 30th day of November 2022.

Regional Transportation District

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