Dear Dr. Alberson:

In your January 29 letter to Mr. Michael Halladay, you requested the Federal Highway Administration’s acceptance of a terminal designed for use with a 3-strand cable guardrail. To support your request, you also sent copies of a Texas Transportation Institute report dated March 2002, entitled “Crash Testing and Evaluation of a New Terminal for Cable/Wire Rope Guardrail,” and copies of the crash test videotapes. After staff review of the reported tests, we requested an additional test, NCHRP Report 350 test 3-30. This test was successfully conducted on February 13 and a revised report was sent to Mr. Halladay with your March 6 letter. Based on mutual agreement between our respective staffs, a decision was then made to run a second reverse-direction test (NCHRP Report 350 test 3-39) at an impact point considered to be more critical than that assumed for the original 3-39 test. Significant design changes were made before a successful test was run, the results of which were documented in a separate TTI report, dated August 2002, entitled “NCHRP Report 350 Test 3-39 with 820C Vehicle on the New Cable Terminal.”

The final design consists of three proprietary Cable Release Posts (CRP posts) on 1900-mm centers. These posts are two-part posts comprised of a 900-mm long W150 x 14 upper post and a 1980-mm long W150 x 22 anchor post. Each CRP post is used to anchor one of the three wire ropes in the cable guardrail. The cables were 19-mm diameter 3 x 7 wire rope. Standard line posts (S75 x 8 x 1600) with soil plates were used for the remainder of the 106-m long test installation, except for the second 3-39 test, which used 6kg/m (4lb/ft) Marion Steel Rib-Bak U-channel posts. Either type post can be used in this terminal. The first line post (post 4) was installed 1900 mm from the third CRP post, line posts 5 through 9 were on 2000-mm centers and the remaining length of need posts were on 5000-mm centers. Design details and layout dimensions are shown in Enclosure 1. The cable barrier was installed as a median barrier with the top and bottom cables on the field side of the barrier and the center cable on the impact side. Cable heights were 520 mm, 640 mm, and 750 mm to the center of the cables (for the S75 x 8 line posts) and each cable was tensioned to 25 kN (5620 lbs) for the ambient temperature at the test site of approximately 28 degrees C. Cable heights when U-channel posts were used were 530 mm, 615 mm, and 725 mm due primarily to the locations of the pre-punched holes in these posts. From post 9, the middle cable was lowered until it was just
above the bottom cable at post 7 through post 4. Patented locking hook bolts were used throughout the terminal area to delay release of the cables in a crash. These special bolts must also be used in the terminal in place of standard J-bolts when S75 x 8 steel posts are used in lieu of the U-channel posts. Spring compensators were not used in the final design to further limit cable deflections at the terminal.

Based on staff review of the results of the five NCHRP Report 350 tests that were conducted (and summarized in Enclosure 2), I agree that tests 3-31, 3-32, and 3-33 can be waived, and that your cable guardrail terminal as described above meets the appropriate evaluation criteria for a test level 3 (TL-3) guardrail anchor. Your proprietary design may be used on the National Highway System when selected by the contracting authority under the provisions of Title 23, Code of Federal Regulations, Section 635.411. Based on the reported test conditions, the barrier length of need should be considered to begin 300 mm downstream from the first line post (post 4). This terminal may also be used to anchor a roadside cable barrier (i.e., one with all three cables on the impact side of the line posts) provided the cable heights in the terminal are adjusted to match the tested design described above.

Because this terminal has been designed to withstand cable tension significantly higher than the generic 3-strand cable guardrail, adequate anchorage must be provided for each CRP anchor post. All testing was done with these posts installed in a compacted NCHRP Report 350 strong soil. In some soils, it is assumed that foundation tubes or concrete footings may be required to establish and maintain cable tension. Cable tension must be initially set based on ambient air temperature. I assume that users of this terminal will be provided installation/maintenance guidelines that correlate proper cable tension to temperature and describe a method or methods for measuring the tension with reasonable accuracy. I would appreciate receiving a copy of such guidelines for our files when they become available.

Sincerely yours,

(official signed by Janet A. Coleman)

for

Carol H. Jacoby, P.E.
Director, Office of Safety Design

2 Enclosures
DETAIL 1
NOTE: CABLE RAIL HEIGHTS ARE TO THE MIDDLE OF THE CABLE.
TRAPEZOIDAL SOIL PLATE

LOCKING HOOK BOLTS
Summary of results for test 220502-1, NCHRP Report 350 test 3-34.
Summary of results for test 220502-2, NCHRP Report 350 test 3-35.
General Information
Test Agency ............ Texas Transportation Institute
Test No. ................. 220502-3
Date .................... 10/25/01

Test Article
Type .................. End Treatment
Name .................. New Terminal For Cable Guardrail
Installation Length (m) .... 106.4
Material or Key Elements . Three-Cable Guardrail System Anchored With New Breakaway Steel Posts

Soil Type and Condition .... Standard Soil, Dry

Test Vehicle
Type .................. Production
Designation ............. 820C
Model .................. 1997 Geo Metro
Mass (kg) ............... 844
Curb .................... 844
Test Inertial ............ 820
Dummy .................. 76
Gross Static ............. 896

Impact Conditions
Speed (km/h) ............. 102.1
Angle (deg) ............. 20.0

Exit Conditions
Speed (km/h) ............. 74.5
Angle (deg) ............. 20.5

Occupant Risk Values
Impact Velocity (m/s)
x-direction ............. 7.2
y-direction ............. 1.7
THIV (km/h) ............. 26.8
Ridedown Accelerations (g's)
x-direction ............. -5.5
y-direction ............. -2.9
PHD (g's) ............. 5.6
ASI ..................... 0.67
Max. 0.050-s Average (g's)
x-direction ............. -7.4
y-direction ............. 3.0
z-direction ............. 2.4

Test Article Deflections (m)
Dynamic ................ 2.29
Permanent ............. 2.29
Working Width ........... 1.82

Vehicle Damage
Exterior
VDS ..................... 11FL3
CDC ..................... 11FLEW3
Maximum Exterior
Vehicle Crush (mm) .... 300
Interior
OCDI ..................... FS0002000
Max. Occ. Compart.
Deformation (mm) ....... 34

Post-Impact Behavior
(during 1.0 s after impact)
Max. Yaw Angle (deg) .... -1.7
Max. Pitch Angle (deg) ... -10.2
Max. Roll Angle (deg) .... 6.9

### General Information
- Test Agency: Texas Transportation Institute
- Test No.: 220502-7
- Date: 06/24/02

### Test Article
- **Type**: End Treatment
- **Name**: New Terminal for Cable Guardrail
- **Installation Length (m)**: 106.0
- **Material or Key Elements**: Three-Cable Guardrail System Anchored With New Break-Away Steel Posts

### Soil Type and Condition
- **Type**: Standard Soil, Dry

### Test Vehicle
- **Type**: Production
- **Designation**: 820C
- **Model**: 1997 Geo Metro
- **Mass (kg)**:
  - Curb: 780
  - Test Inertial: 820
  - Dummy: N/A
  - Gross Static: 820

### Impact Conditions
- **Speed (km/h)**: 100.2
- **Angle (deg)**: 21.1

### Exit Conditions
- **Speed (km/h)**: N/A
- **Angle (deg)**: N/A

### Occupant Risk Values
- **Impact Velocity (m/s)**:
  - x-direction: 6.7
  - y-direction: 4.6
  - THIV (km/h): 27.7
- **Ridedown Accelerations (g's)**:
  - x-direction: -14.4
  - y-direction: 9.9
  - PHD (g's): 14.4
  - ASI: 0.80
- **Max. 0.050-s Average (g's)**:
  - x-direction: -8.3
  - y-direction: 6.0
  - z-direction: 2.9

### Test Article Deflections (m)
- **Dynamic**: 0.77
- **Permanent**: 0.15
- **Working Width**: 1.00

### Vehicle Damage
- **Exterior**
  - VDS: 11FL3
  - CDC: 11FLEW3
- **Maximum Exterior Vehicle Crush (mm)**: 400
- **Interior**
  - OCDI: LF002000
  - Max. Occ. Compart. Deformation (mm): 17

### Post-Impact Behavior
- **Max. Yaw Angle (deg)**: -83.4
- **Max. Pitch Angle (deg)**: 18.0
- **Max. Roll Angle (deg)**: 17.5

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