EPA SmartWay Truck Emissions
Test Protocol Workshop

Drive Cycle Development

Drive Cycle Development - Technical Topics

- Selection of initial vehicle applications
- Drive cycle applications & options:
  - Highway line haul
  - Regional haul
  - Local pick up and delivery
  - Neighborhood refuse truck
  - Utility service truck
  - Transit bus
  - Intermodal drayage truck
- Drive cycle load requirements
  - Accessory load
  - Cargo load
  - Power take-off (PTO) and service load

Selection of Initial Vehicle Applications

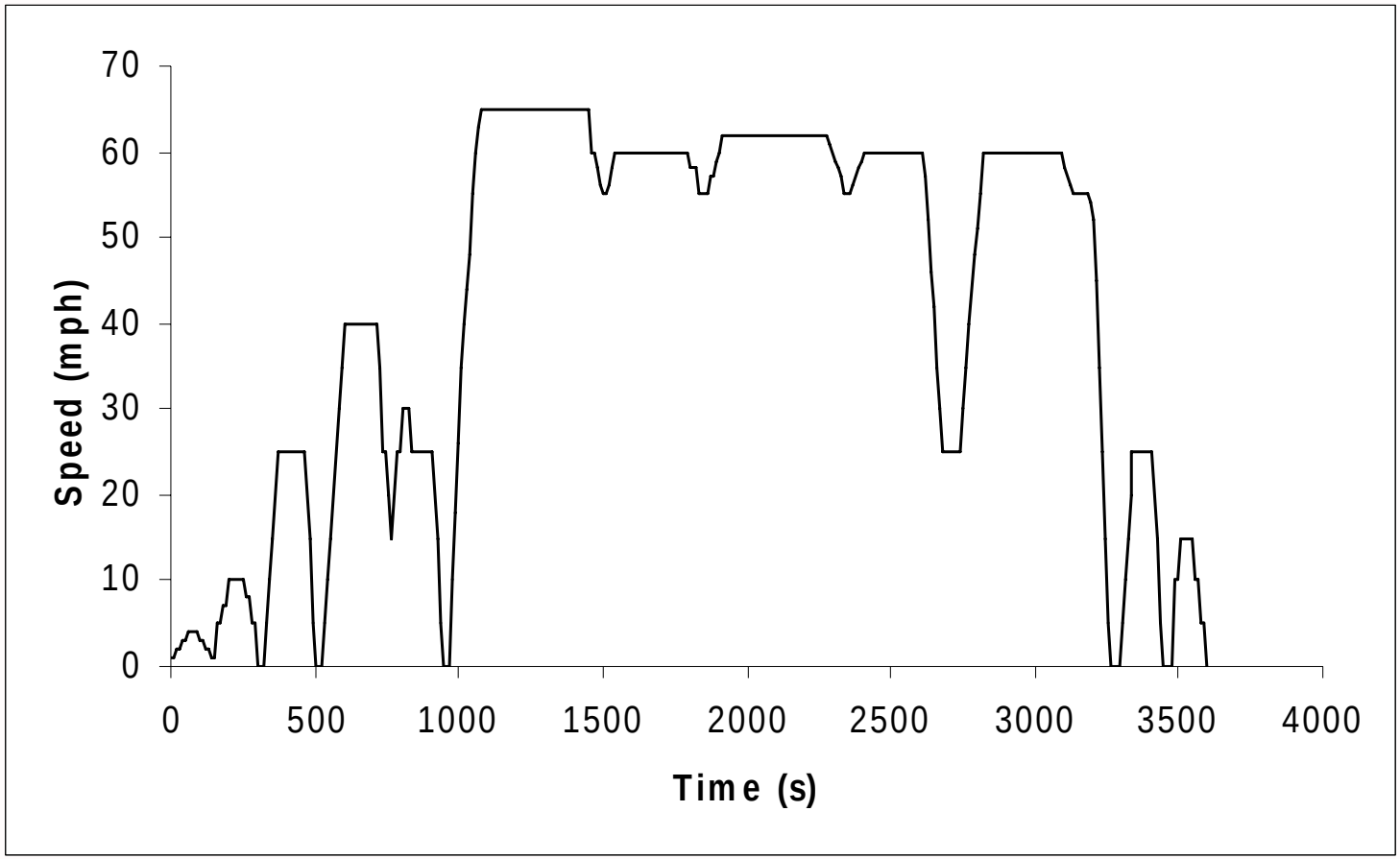
- Primary technical focus: Determine which truck applications to assess in the near term

  - Protocol: Defines initial priority as trucks that consume the most fuel, are first-to-market with hybrid designs, or are of emerging interest (line haul, regional haul, delivery, refuse, utility, transit bus, intermodal dray)
    - Comment: Consider including school bus and motor coach applications as potential hybrid candidates
    - Comment: Consider including construction truck. The sales are 4 to 8 times higher than bus, drayage, utility, or refuse. They are heavily loaded, and use a lot of fuel

Drive Cycle – General Comments

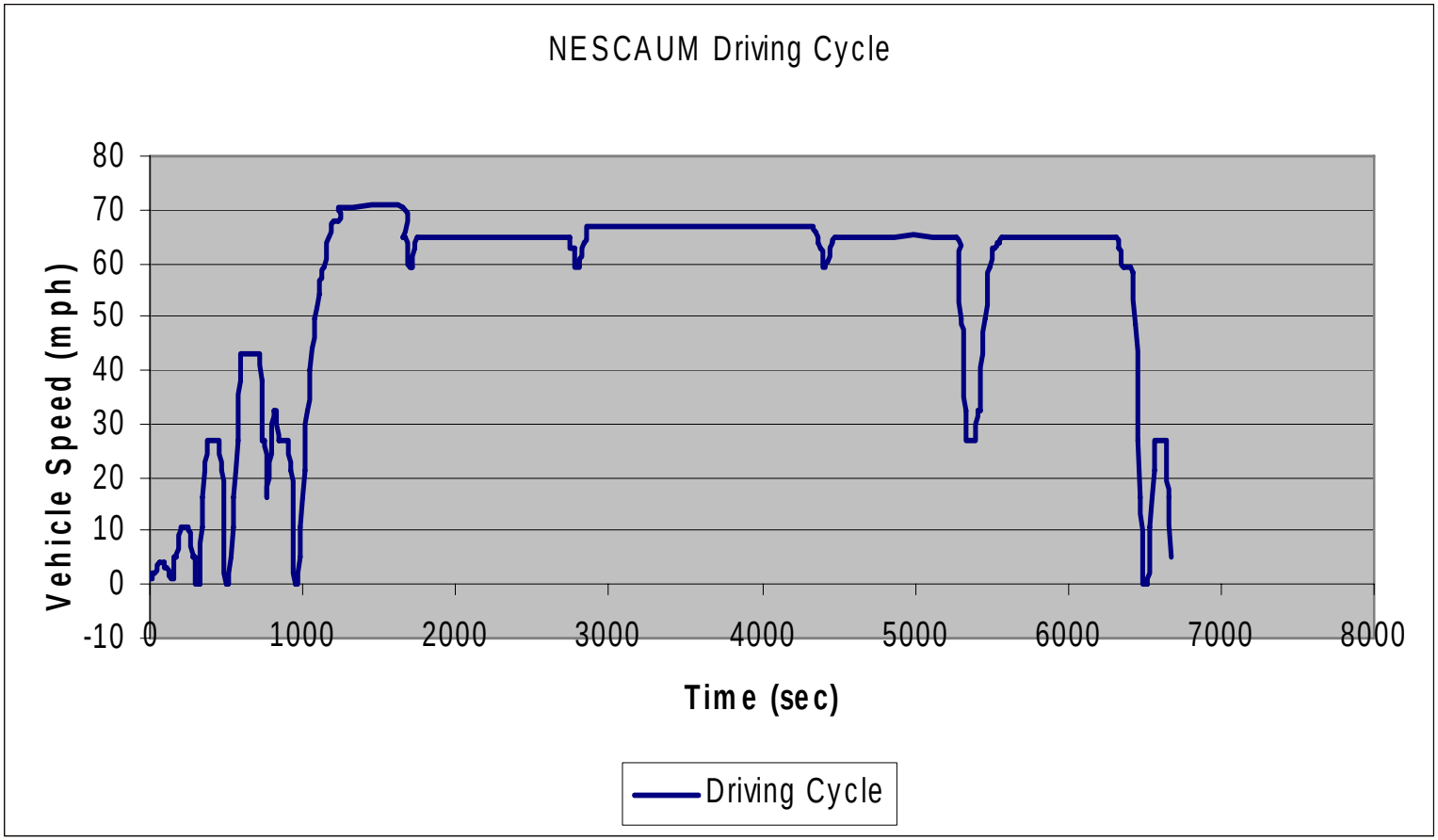
- Primary technical focus: Balance requirements for a drive cycle to be representative of a given application, versus broad diversity of actual in-use fleet operations
  - Comment: Large fleets distrust short MPG tests. EPA should leave the protocol open to longer test routes and define a criteria where fleet data would be accepted
  - Comment: More actual duty cycle data needed to develop these cycles
  - Comment: A series of modal tests at steady state would have a higher repeatability than complex cycles.

Highway Line Haul – EPA Cycle



- Average speed 47 mph Max speed 65 mph
- Distance 42 miles

Highway Line Haul – NESCAUM/SwRI Cycle



- Average speed 50 mph Max speed 70 mph
- Distance 103 miles
- Incorporates grade and altitude (not shown)

Highway Line Haul

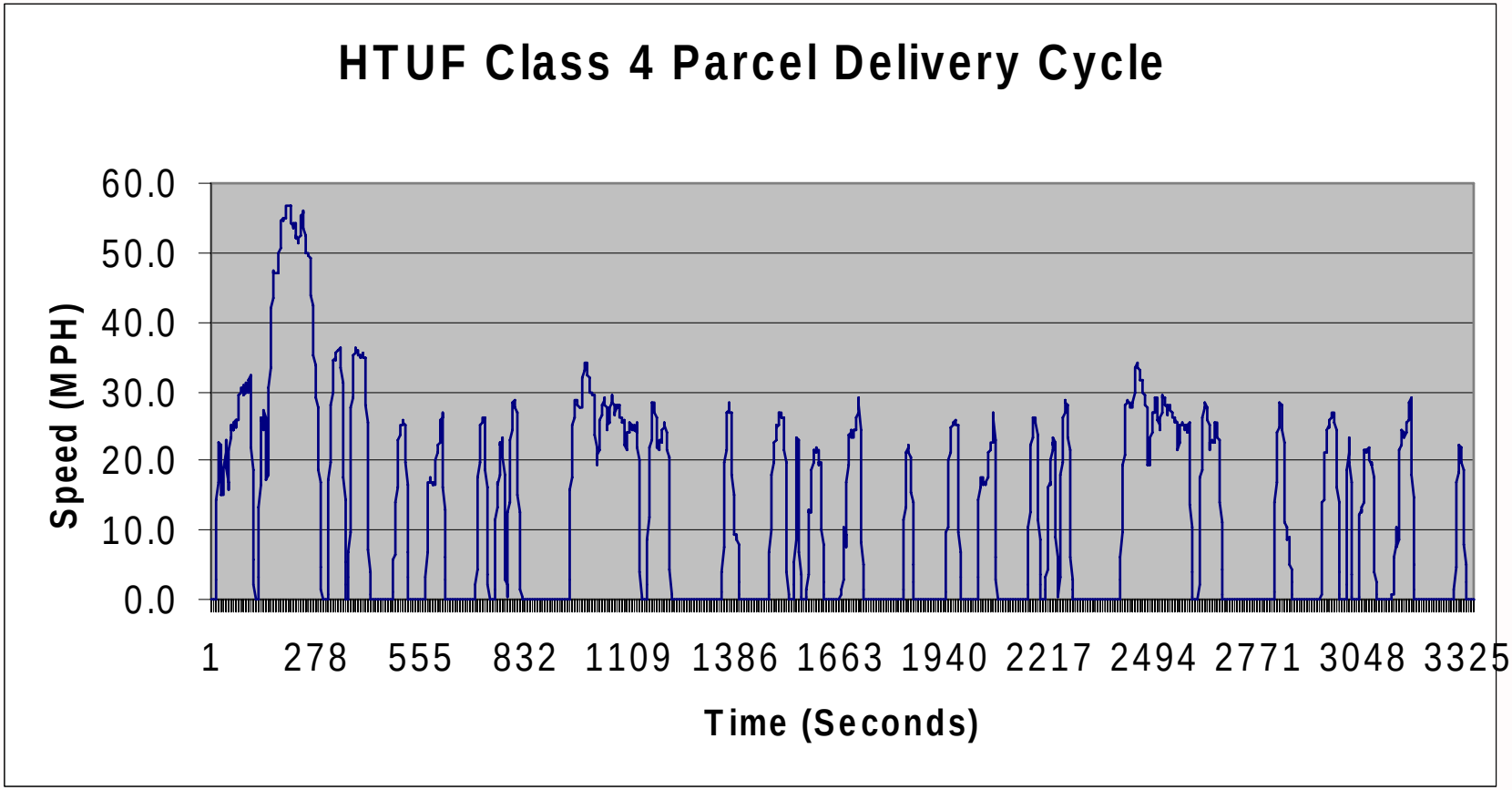
- Primary technical focus: Determine which drive cycle option best characterizes line haul operation
  - Protocol: NESCAUM/SwRI cycle has separate idling cycle
    - Comment: Should the line haul cycle include idle test?
  - Protocol: NESCAUM/SwRI cycle contains grades
    - Comment: How can grade be handled on a test track?
  - Protocol: EPA cycle 42 miles; NESCAUM cycle 103 miles
    - Comment: Longer tests are more representative
  - Protocol: Both cycle options include transient operation
    - Comment: A constant-speed cycle is more representative of coast-to-coast line haul than a cycle with 3-4 stops in 50 minutes. Many line haul fleets use cruise control for hours at a time.

Regional Haul

- Primary technical focus: Determine which drive cycle option best characterizes regional haul operation

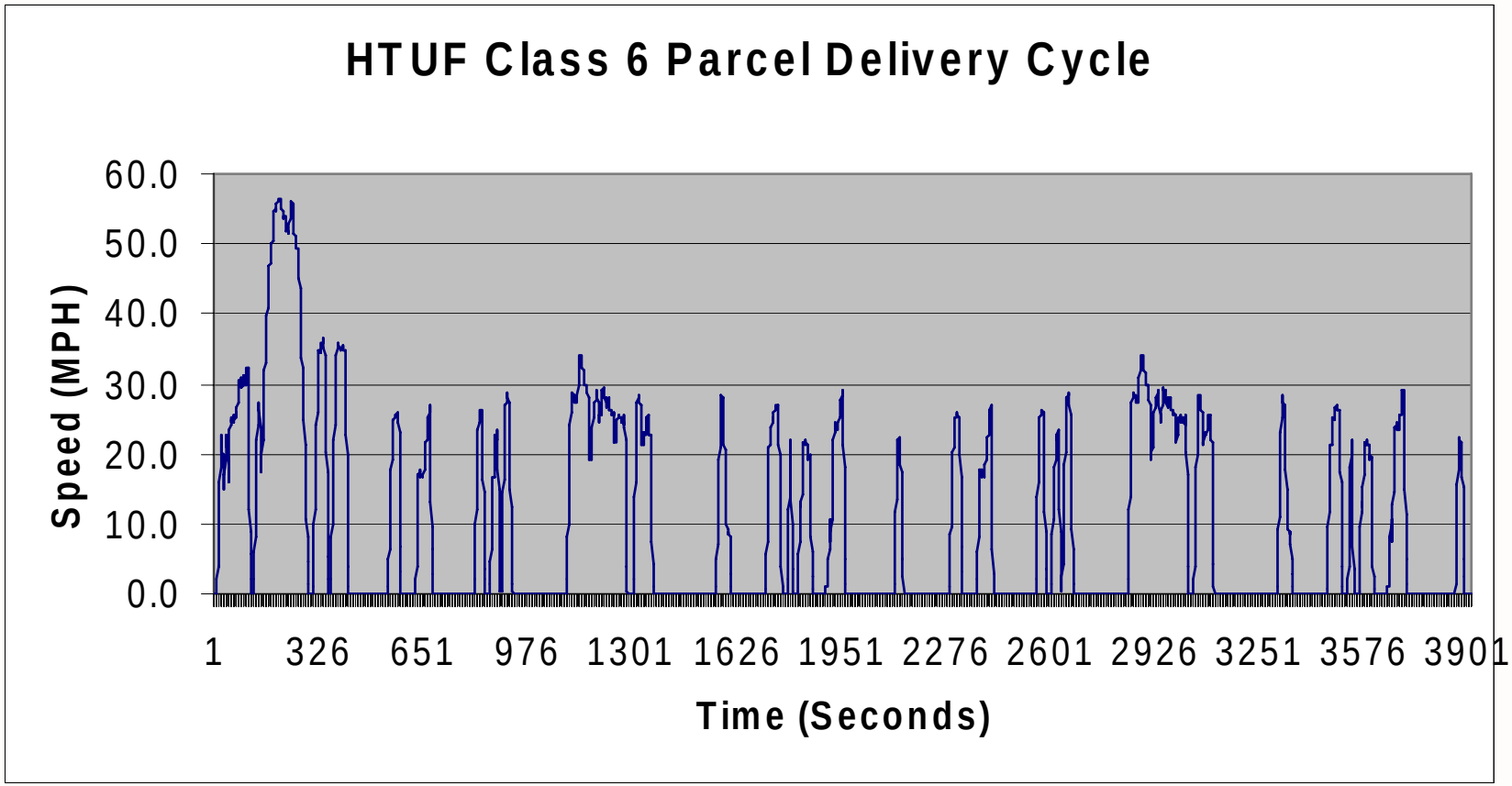
  - Protocol: Potential option may be to integrate line haul cycle with the Transient mode of the 4-mode California Air Resources Board Heavy-Heavy Duty Diesel Truck Emissions Test (HHDDT)
    - Comment: None

Local Delivery – Class 4 (Neighborhood)



- Average speed 21 (11) mph Max speed 57 mph
- Distance 11 miles
- Incorporates “stem” travel to and from P&D route

Local Delivery – Class 6 (Business)

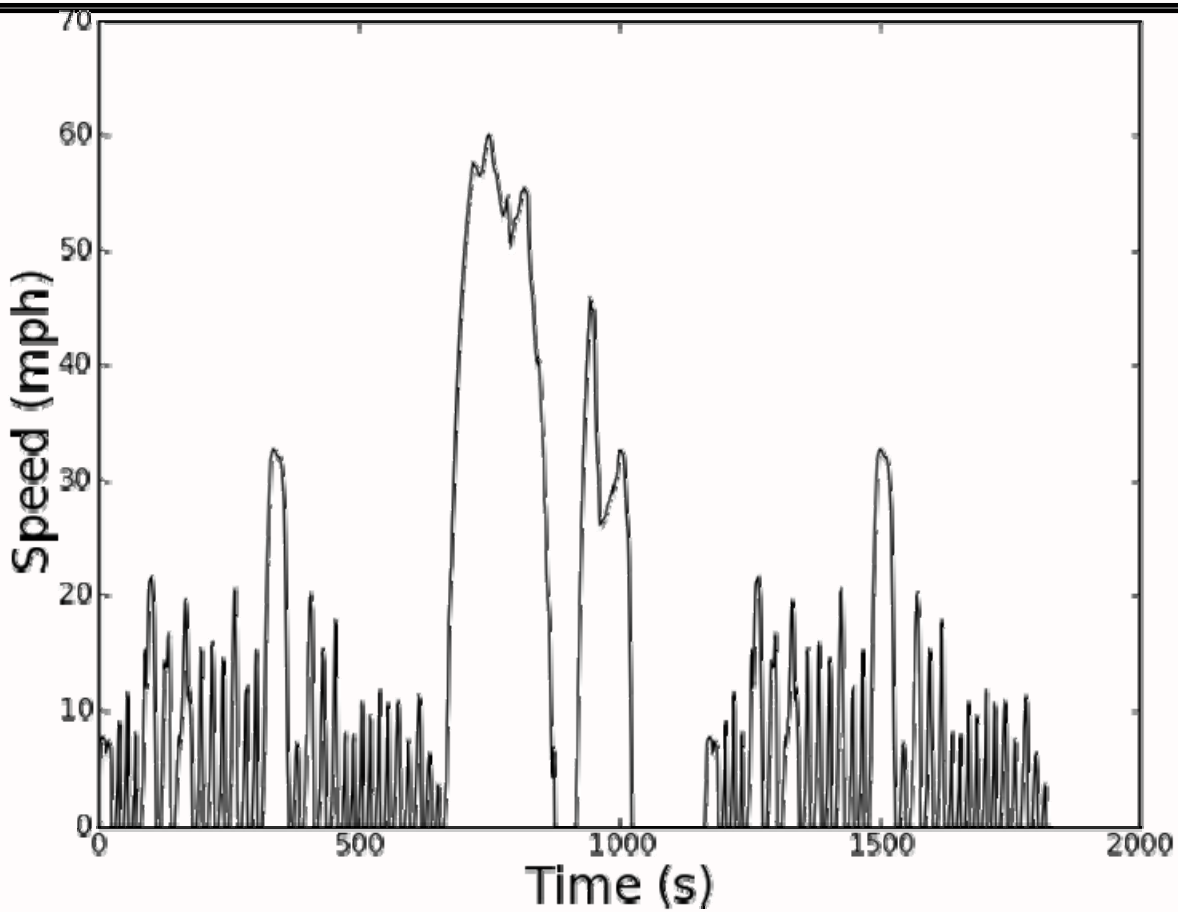


- Average speed 20 (10) mph Max speed 57 mph
- Distance 11 miles
- Incorporates “stem” travel to and from P&D route

Local Pick Up and Delivery

- Primary technical focus: Determine which drive cycle best simulates urban/suburban delivery truck operation.
  - Protocol: Proposes two drive cycles. Both options developed by the HTUF parcel delivery working group
    - One represents a class 6 delivery truck, predominantly in residential delivery service.
    - The other represents a class 4 delivery truck, predominantly in business delivery service.
    - Comments: None

Neighborhood Refuse Truck



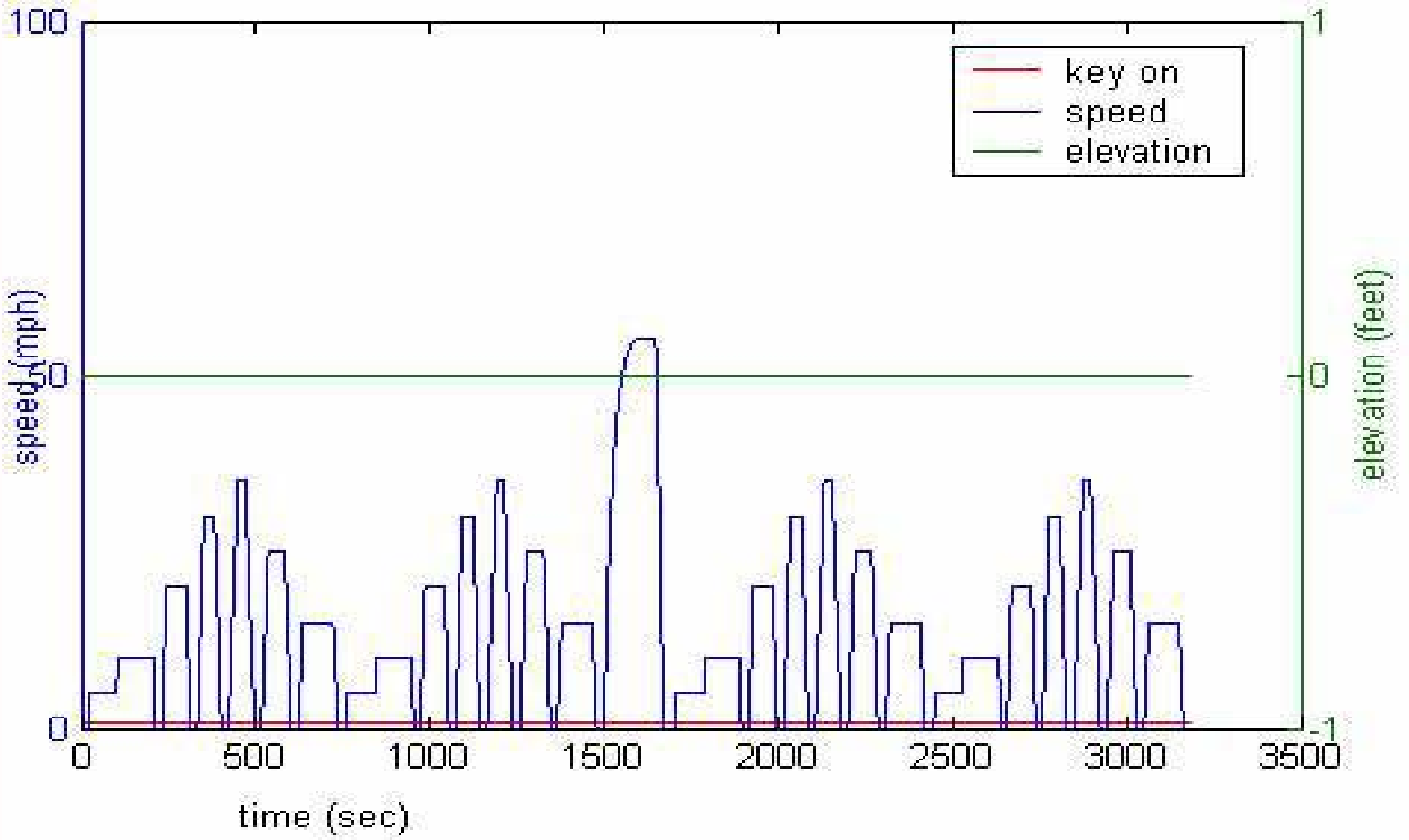
- Average speed 39 (11) mph Max speed 60 mph
- Distance 6 miles
- Incorporates aggregated “stem” travel to and from collection route

Neighborhood Refuse Truck

- Primary technical focus: Determine which drive cycle best characterizes refuse truck operation

  - Protocol: Proposes option developed by National Renewable Energy Laboratory, representing a truck with automatic side loader
    - Comment: None
  - Protocol: Proposes that drive cycle may be more suitable for chassis dynamometer
    - Comment: None

Utility Service Truck



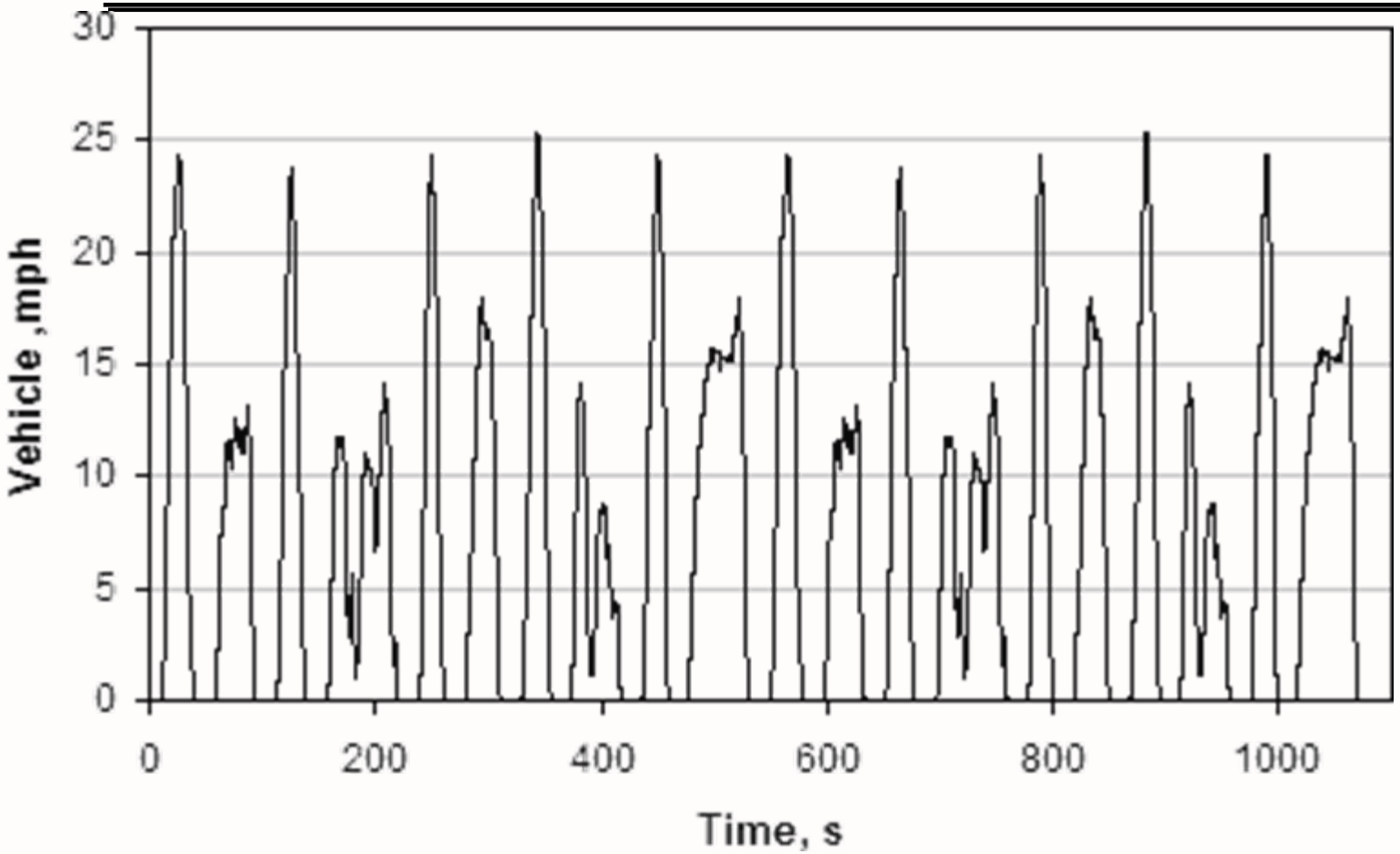
- Average speed 14 mph Max speed 55 mph
- Distance 12 miles

Utility Service Truck

- Primary technical focus: Determine which drive cycle best simulates neighborhood utility, telecommunications, or cable service truck operation. Is more data needed?

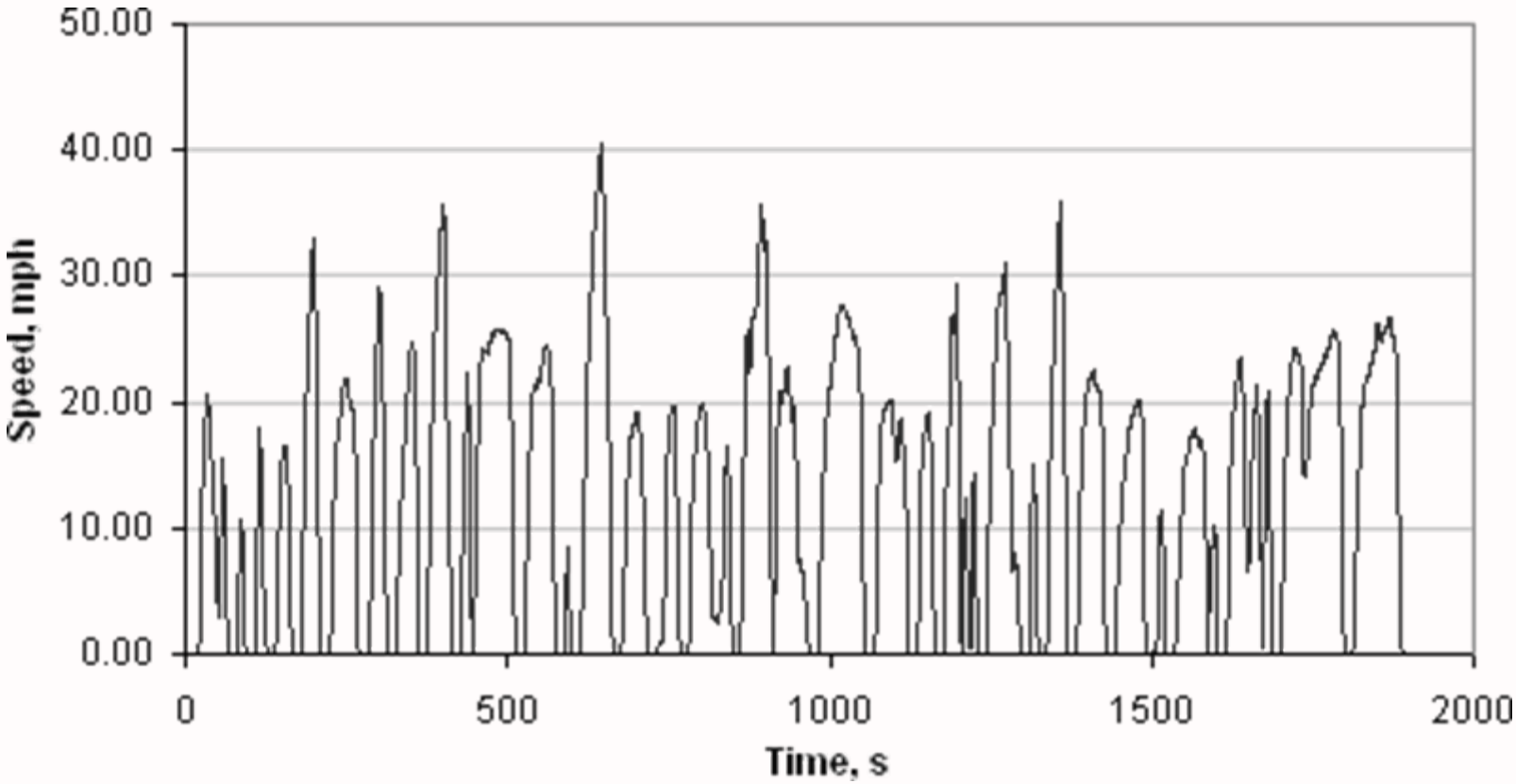
  - Protocol: Potential option may be to use Combined International Local and Commuter Cycle (CILCC), a composite cycle developed by National Renewable Energy Laboratory, Eaton, and International Truck and Engine
    - Comment: None

Transit Bus – Manhattan Cycle



- Average speed 7 mph Max speed 25 mph
- Distance 4 miles (cycle x 2)

Transit Bus – Orange County



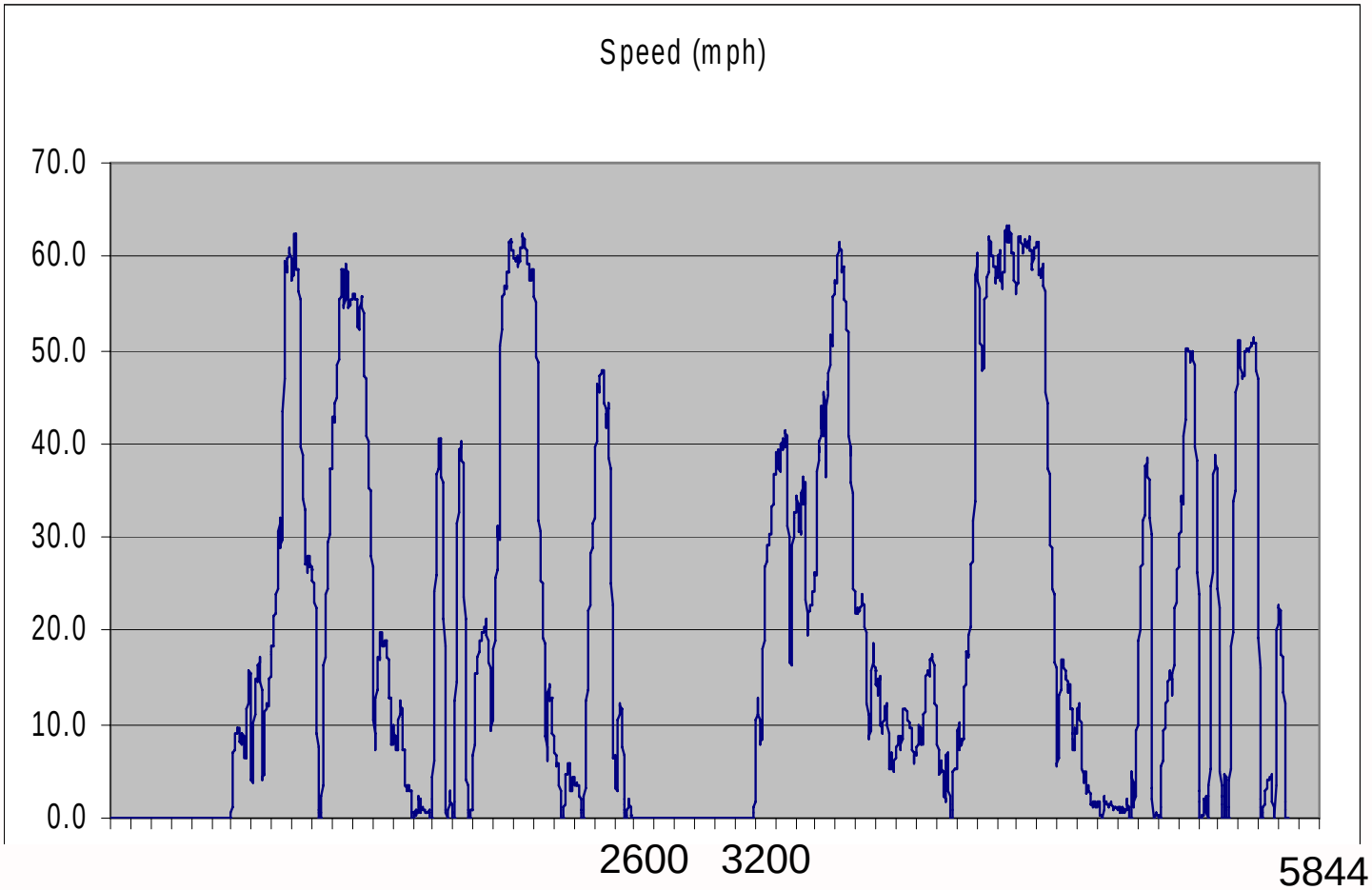
- Average speed 12 mph Max speed 41 mph
- Distance 6.5 miles

Transit Bus

- Primary technical focus: Determine which drive cycle best simulates large local passenger transit bus operation.

  - Protocol: Proposes two drive cycle options. The W.V.U Manhattan Bus cycle is predominantly urban; the Orange County Bus cycle is predominantly suburban.
    - Comments: None
  - Protocol: Proposes a formula that combines average speed and percent idle into a “Cycle Index” factor that determines which cycle to use.
    - Comments: None

Intermodal Drayage Truck



- Average speed 25 mph Max speed 63 mph
- Distance 32 miles
- Two 10-minute idle phases, with 4600 seconds travel time

Intermodal Drayage Truck

- Primary technical focus: Determine which drive cycle best simulates intermodal cargo drayage truck operation. Is more data needed?

  - Protocol: Potential option may be to use the Texas drive cycle developed by University of Texas.
    - Comment: None

Load Requirements – Accessory Load

- Primary technical focus: Determine appropriate accessory load requirements for each drive cycle
  - Protocol identifies the following accessory loads to be considered for each drive cycle: heating, ventilation, and defrosting; air conditioning; lamps and lights; miscellaneous (power accessories, etc)
    - Comment: None

Load Requirements – Cargo Load

- Primary technical focus: Determine appropriate accessory load requirements for each drive cycle
  - Protocol proposes the following cargo loads:
    - Line and regional haul – 75% cargo weight capacity
    - Delivery & refuse – 50% cargo wt capacity (indexed to volume?)
    - Utility & drayage truck –Need more data (42% for intermodal dray?)
    - Transit bus –Cites SAE J2711: 150 lbs x one-half passenger count
      - Comment: Need recommendations for equipment specifications and payload to represent shorter (20') containers.
      - Comment: Increase all test weights (about 20%) to simulate grade effects on load since can't do this on test track
      - Comment: Transit bus cargo load – use over-all length multiplied by a lb/ft factor (suggest 100 lb/ft) to be independent of seating configuration

Load Requirements – PTO Load

- Primary technical focus: Determine power take-off (PTO) and other service load requirements for each vocational truck drive cycle
  - Protocol references Eaton/SwRI/Ohio State University work to develop hydraulic and electric test cycles to measure PTO and service demand for utility trucks
  - Protocol mentions need to develop PTO and other vocational service power requirements for refuse and other vocational trucks
    - Comment: Quantifying the energy demand to account for the nontractive work performed by the vehicle should be a completely separate procedure

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