Appendix B
Instructional Materials for Drivers in Study
(Applies to both Canadian and U.S. Study Phases)

I. Fatigue Management Training Course for Driver Participants in Field Test of Fatigue Management Technologies (FMT), provided by Dr. G. Krueger, Krueger Ergonomics (Alexandria, VA)

Education Module on "Mastering Alertness and Managing Driver Fatigue"

1. We provided all driver participants with a 3-hour "tailored" course on mastering alertness and managing driver fatigue.
2. Course material and instruction was a 3-hour extract from the FMCSA-ATAF's 4-hr train-the-trainer course "Mastering Alertness and Managing Driver Fatigue," which Dr. Gerald Krueger helped develop; and since Oct. 1996 taught 60+ times, to over 3,200 safety and risk managers around the country.
3. Dr. Krueger's "tailored instruction" for the FMT participant drivers was cognizant of the trucking carriers' (Challenger Motor Freight, Con-Way Express) company policies, procedures, and scheduling practices, and in part was determined through discussion with officials of each company.
4. Dr. Krueger taught the course in groups of four drivers at a time (striving for group interaction) during the week prior to each driver's participation in the FMT study. The course was taught in each carrier's training room facility.
5. Course content included:
   - Ice breaker 20-question quiz & answer sheet:
     What do you know about fatigue? The questions are all answered in the video.
   - VHS Video (19 minutes): "The Alert Driver" (1996 ATA & Jim Slade)
   - VHS Video (4.5 minutes): Earl Pitts' Commentary on Fatigue (Circadian rhythms) by the Institute of Driver Behavior, 1998
   - Outline of major topics covered in the training were the following from the Course prepared by Star Mountain. (O'Neill, Krueger, & Van Hemel, 1996):

     - The nature and impact of fatigue related truck crashes, e.g. single roadway departures.
     - What is fatigue? (physical & general mental fatigue' acute & chronic).
     - Fatigue and waning attention, performance effects.
     - Recognizing signs of drowsy driving and what to do about them.
     - Circadian rhythms, two lull periods of day, and performance concerns.
     - The nature of sleep, sleep quantity and quality, sleep inertia, naps, sleep debt, recovery sleep etc., sleep strategies.

- Shift worker work-rest schedules and shift lag implications
- Sleep maladies, insomnia, apnea, etc. affect performance.
- Stimulants & hypnotics (brief coverage of caffeine, Melatonin etc.).
- Diet and nutrition, physical fitness, health and wellness.
- Fatigue countermeasures: preventive measures before long trips, and on the road countermeasures while making long drives.

II. Driver instructions on use of onboard AP+ black box recording system provided by Accident Prevention Plus (Palm Beach Gardens, FL)

The AP+ onboard recorder records many forms of data about your truck, some information about your driving, and especially it collects the information we are interested in regarding the fatigue management instruments, displays, and the HPCS.

The AP+ onboard **recorder turns on with the ignition switch of the truck**, and it records continuously all the while the truck is running.

We have given you two (2) different kinds of recorder cards. One is a simple **Smart ID Card** for identification of you as the driver, by **your participant number**, as the person who recorded those driving data. The **Smart ID Card is white** and is about the size of a standard credit card. There is a single thin slot in which to place this credit card shaped ID card. The card goes in only one way, and you should not force it. This card sort of snaps into place. As you insert the card, be sure to slip it in just above the white metal sheet in the slot, that is, do not slide your card under the white strip of sheet metal.

You can leave your Smart ID card in the recorder most of the time. But if you are turning the truck in for maintenance and expect the shop personnel will be driving the truck for some distance, then be sure to take your Smart Card out. But do not forget your card or misplace it; and be sure that you reinsert it into the recorder before your next drive.

The **second card** we are giving you is a thicker white card, which says "**MEMO CARD**" on it, and perhaps the words AP+ Memory Card as well. Actually we might give you two such cards, one to use, and one as a backup. On the front of the white and black boxes of the recorder, there are two slightly wider slots, one on top of the other. One wider slot is for the AP+ Memory Card on it. It has **as set of five (5) green lights adjacent to the slot.** You are to place one Memory Card into the wider slot next to those green lights. The **Memory card will protrude or stick out from the slot about half way.**

The other wider slot remains open and empty, and we ordinarily will have a piece of tape over it so you will not make a mistake and try to insert your Memory Card into it.

The Memory card should collect data for several weeks; but we might ask that we swap out one of the Memory Cards about half way through, and have that card mailed to us by Challenger via express mail, so that we can examine the data collected to be sure everything is working correctly.

Do not try to force the cards into the machine, as they can get jammed, or break.

III. Driver instructions on the use of the Daily Diary provided by Dr. G. Krueger, Krueger Ergonomics (Alexandria, VA)

Participant Driver's Daily Activity Diary and Notebook Instructions

Herewith is a copy of the introductory paragraph and instructions for inclusion in the front of a small, stiff, covered notebook to be handed out to the FMT Participant Truck Drivers and kept by each as a Driver's Daily Activity Diary during the approximately four weeks of each driver's participation in the FMT Pilot study.

The booklets will present blank "check-off" sheets for each day of a driver's participation (i.e. about 30 to 35 pages). A page will be labeled for each day, irrespective of whether the driver is driving/working that day or not. During driver training, each driver will be encouraged to write something of daily interest each day on a separate page. They will be encouraged to write in the diary more frequently if they are so inclined and are able to find the time. The calendar date and the numbered day of participation (e.g., 1 through 32) for each driver's day in the study will be written at the top of each page – pencil will be used so that the date can be altered should there be a delay in a driver's participation.

Instructions to Participant Drivers

1. The data we are collecting from you, from your wrist, and from the devices that were placed in your truck, as well as from the black box recorder mounted in your truck, will provide information on many parameters that are of interest in this study. This recorded data will be exclusively for use during later analyses. It will not give us daily indications of your progress. As explained in the instructions and on the volunteer consent form, these data will be treated confidentially.

2. To help us interpret the data, we ask you to provide us with a set of your own notes in this driver's daily activity diary booklet. In this diary, please list whatever activity occurred that you think is important to give us a clear understanding of why things happened the way they did each day.

3. We are interested in your activities on your driving/working days, on your non-driving days, and on your days off. Please record what took place each day in simple terms. It would be a great help if you could add in the clock times associated with each of the activities/events referred to in your notes. If you refer to an entry at 8 p.m., for example, simply list that time in the left hand margin.

4. In general, we would ask you to document such items as:
   - long delays for traffic or loading/unloading, such as
     - Unloading freight from about 2 p.m. until 6 p.m.
     - It was slow moving on road from about 10 p.m. until 1:00 a.m.
   - descriptions of weather-related problems in driving, such as
     - Bad snowy highway
   - taking rest stops to have a meal or take a nap, such as
     - I took a nap in my truck sleeper berth from about 9:30 to 11:30 p.m.
   - waiting for the dispatcher and/or broker to assign a load
   - observations about the FMT devices, such as

- The lane tracker seemed to be giving me false readings this morning, so I watched it more carefully today

- notes about special road conditions, such as
  - The roads I traveled were very hilly today and I had a heavy load, which slowed the driving
  - Road construction caused me to slow down and I had to drive more carefully
- notes about off-duty periods and activities, such as
  - I took today off from work and went fishing
  - Slept much of the day
  - I mowed the lawn for about 90 minutes this afternoon
  - I slept/napped on the couch in front of TV intermittently for three hours Saturday
  - My wife and I went to a party and got home late, about 2:00 a.m., and so got little sleep tonight
- daily routine activities, such as
  - I slept at a motel from about 11:30 p.m. until 6:30 a.m., ate breakfast and then went back on the road to drive the next 8 hours or so

5. You probably get the idea. Your descriptions of day-to-day activities might help explain the data from the truck or FMT devices more clearly. For example, your notes from your days off work will help us determine why your wrist activity SleepWatch data appear the way they do.

(see next page for sample daily diary sheet)

Daily Diary Sheets

(This would be a page-by-page set of blank check-off sheets with the participant's dates on each page)

Driver Participant: _____ **Calendar Date:** _____ **Day in study:** _____

Today I had:

- ❑ long delays for traffic (time:_____)
- ❑ weather problems while driving (time:_____; weather:_____)
- ❑ slow moving on the road (time:_____)
- ❑ traffic jams, making it slow going (time: _____)
- ❑ numerous hilly roads, making it slow going (time: _____)
- ❑ considerable crosswinds (time: _____)
- ❑ long wait(s) for dispatcher/broker to assign load (time: _____)
- ❑ rest break(s) for hygiene/eating a meal (time: _____)
- ❑ rest break(s) including a sleep period (time: _____)
- ❑ sleep/nap(s) in motel, house etc. (time: _____)
- ❑ sleep/nap(s) in truck sleeper berth (time: _____)
- ❑ a day off from driving (time: _____)
- ❑ activities on my day off that included: _____

  _____

- ❑ FMT devices getting my attention (e.g. PERCLOS, SafeTRAC, SleepWatch)
  some observations/details: _____

  _____

- ❑ a number of delivery stops: number _____
- ❑ loading and/or unloading activities done by others (time: _____)
- ❑ personal physical activity in loading/unloading (time: _____)

My comments about this day/night, and activities, etc.:

_____

_____

_____

IV. Driver instructions on use of the Howard Power Center Steering provided by River City Products (San Antonio, TX)

The Howard Power Center Steering system was taught to drivers individually by representatives from River City Products, San Antonio, TX. Instruction was intensive and included both a discussion of how the system functioned and an over-the-road, hands-on experience with the instructor on board. The highly interaction nature of the instruction exceeded what could not be summarized in a simple script.

V. Driver instructions on use of the CoPilot® infrared retinal reflectance monitor for PERCLOS measurement (slow eyelid monitor) provided by Attention Technologies (Pittsburgh, PA)

The PERCLOS Monitor looks for a driver's level of alertness, or for indications of drowsy drivers. It really monitors the amount of eyelid closure, or the frequency of blinking over a period of time—that might indicate that a driver is getting drowsy.

Aiming the red light splashed on your face. The gray box emits a small splash of infrared light on the driver's face; but the infrared light is lower than the visible spectrum. You are likely to see a circular array of small red lights in this box, aimed toward your face. The actual red splash of light on your face is not so easily seen by the human eye. There is no health or injury risk from that small light bath.

If you can see a reflection of your nose and eyes in the plastic glass window, then the light is aimed correctly. If you cannot see your reflection, then please adjust the gray box on the swivel mount until you can see the reflection of your face in the gray box. Use two hands to turn the swivel, and try not to jar it loose, as it is not very rugged.

How PERCLOS works. The cameras in that gray box look for a small amount of light reflected from your eyes back toward the box. That permits the PERCLOS camera and electronics to compute a numerical index (numbers from 0 to 100) to indicate how often, or how long your eyelids were either drooping or were closed, as for example when you have a long blinking of the eyes.

Display of Alertness Score. The separate dark box display to the left of the PERCLOS camera presents the lighted index Alertness Score displayed from 0 to 100 to indicate how much eyelid closure the camera is detecting. In that way, it serves as a drowsy driver indicator. The display will be lighted only during your weeks 3 and 4 of driving in this study.

There are several ways to interpret the Alertness Score. One way is to consider the relationship between the score and the amount of time your eyes are closed. If you sit in the driver's seat and look out the front window and turn on the system, the display should start at 100 and stay high (95-100) while you look straight ahead. Now if you close your eyes for 3-4 seconds, the score should drop to about 90-92. If you close your eyes longer, the score will drop lower.

Another way to think about the Alertness Score is as a letter grade from A to F, with A= a score between 90 to 100, and a B = 80 to 89, C = 70-79, D = 60 to 69, and F = 0 to 59.

The PERCLOS really only works well during darkness, at night, and while you are driving at highway speeds. It is not very meaningful in city traffic. When driving in city traffic, frequent mirror checking takes your eyes off the road for long periods of time. This will lower the Alertness Score even though you are not drowsy. PERCLOS is meant to work when driving long distances on the highway and at night.

During the first two weeks of our study, the baseline period, the Alertness Score index will be covered over with a cloth shroud so that you cannot see it. Then, during the second two weeks (week 3 and 4) of your participation in the study, we will uncover that Alertness Score index and ask you if it seems to be helpful or meaningful to you for monitoring your alertness and fatigue during night driving.

The PERCLOS will turn on whenever you turn on the engine ignition switch, and it should stay on while the engine is running. There should be no need for you to turn knobs or operate controls or switches on the PERCLOS system. We will likely have the two switches taped into the "on" position at all times to remind you not to fiddle with them. And the cloth shroud over the display will be removed before you begin week number three of your driving in the study.

VI. Driver instructions on use of Psychomotor Vigilance Test (PVT-192) provided by Dr. Dinges, University of Pennsylvania (Philadelphia, PA)

The PVT is a simple reaction time test, which takes about 11 minutes to perform.
We would like you to do this PVT twice per day on all your work-days (driving days). You do not have to take the PVT on your days off from work.

Take the reaction time test in a quiet place!

On your driving work days, please find a **quiet**, consistent place, like your truck cab to take the PVT for eleven (11) minutes without interruption. Please be sure there are no other people around you as that would be a distraction. Also be sure to turn your CB radio down or off, or be away from any other noises if possible.

We would like you to take the PVT test once about half-way through your work day, or half-way through a lengthy road trip. You may do this at what you consider to be your normal, off-the-road rest break spot, etc.

Then take the PVT 11-minute test a second time, at the end of each driving day, preferably soon after you have completed the drive. Perhaps this could be before you exit the truck, or if not, then as soon after that as it becomes practical to do so. However take it before you get ready to bed down for your sleep period. Remember, our study of RT is meant to look at how drowsy you become at the end of long drives.

Please get into the habit of storing the PVT box in the same place every time so you are more likely to remember where it is, and will also remember to take your reaction time tests twice per working day. Perhaps storing it in a safe, warm place in the cab or sleeper berth of the truck would make best sense, and make it easier for you to sit quietly in the truck cab to take your twice daily reaction time tests.

PVT Batteries and Charging:

We will hand you the PVT box with the batteries fully charged at the beginning of your 4+ week participation with us. Theoretically, you should easily get 2 weeks of use out of a fully charged PVT box before it needs to be recharged. If you want to make sure that the batteries are always closer to the fully charged state, then charge the batteries for 6 to 12 hours, say after 1 week of using the unit. Plug the recharging unit into the box and into a wall socket outlet for from 6-12 hours. Be sure to do this with the on-off switch turned to the off position.

The batteries in the PVT can become over-charged. You should not charge them for more than 24 hours.

Downloading PVT Data. We will attempt to "download" PVT data from your device at the two-week change-over period when you change from having NO visual displays to the condition WITH the displays turned on. If we have problems catching up to you, please continue to take your two PVT tests per working day. If you have any questions, do not hesitate to call Dr. Krueger at: (703) 704-1801 or (703) 768-3421.

Specific Instructions for taking the Psychomotor Vigilance Test (PVT)

At the beginning and at the end of each ten-minute reaction time (RT) test, there will be a sleepiness scale. Please indicate how sleepy you feel RIGHT NOW by using the LEFT button to move the cursor closer to "no" or "yes." The cursor only moves to the right. Press the RIGHT button to register your choice. Now you are ready to begin the test.

During the reaction time test, as soon as you see the red numbers in the top window, press and release the button using your preferred hand, (the hand you typically write with). You may use your thumb or finger, but once you have decided, always use the SAME ONE for all subsequent tests. The numbers in the display show how fast you responded each time – in milliseconds, that is, in thousands of a second. If the number displayed is .345, your reaction time was 345 milliseconds, or slightly over 1/3 of a second. That means the smaller the number, the faster your reaction time was, and the better you did. Try to do your best, and get the lowest number you possibly can.

If you press too early (before the red numbers appear) you will see an error message, "FS, indicating a FALSE START. If you press the other button on the PVT you will see the message "ERR," indicating an Error. Avoid "FS" and "ERR." If you forget to release the button, the test screen will remind you after a short time. If you get an error signal, that trial is gone, so then just concentrate on doing better on the next reaction time event.

You will know that you are at the end of the 10 minutes of reaction time trials when you will see another sleepiness scale. **Please indicate how you feel on the sleepiness scale at the end of the PVT task BEFORE you turn off the PVT device; allow the machine to return to the displayed words: Select, Test and Setup, and then turn it off. Then please re-store it in a safe warm place. If you do not indicate how you feel on the sleepiness scale at the end of the PVT, some of the data will be lost and your time will have been wasted.**

Thank you.

VII. Driver instructions on use of the SafeTRAC® lane-tracking system provided by AssistWare (Wexford, PA)

The SafeTRAC system has a **small camera mounted in the center of the front windshield** facing outward onto the highway in front. The camera is facing the painted lines on the highway, or scanning for the contrast between the road's edge and the shoulder, etc. See the photo depicting the SafeTRAC display, and the small window camera next to the display.

The SafeTRAC display box shows **two** things:

(1) a **lane centering position display**, depicting a single vertical, a **hash-mark** that moves right and left to indicate **the position of your vehicle** between the painted lines on either side of your truck. There are also vertical solid line hash-mark indicators depicting a solid painted line on the highway in front of your truck.

When there is a "dashed line" painted on the road in front of your truck, a pair of horizontal hash marks, looking like and equal sign (=) will appear on the outside of your truck indicator on the display. These will be either right or left of your truck marker depending on whether the painted lines are right or left of your truck. Until perhaps you enter an intersection of streets where no painted lines are present—then the = sign will disappear until you get to the other side of the intersection.

When there are no painted lines, these hash-marks will disappear and return only after you again drive between a set of lines for a few minutes.

A solid painted line at the shoulder of the road will appear as a solid vertical line on the right side of the display. Or, if there is a solid painted line to the left of your vehicle, then the solid hash-mark will appear on the left of the lane tracking display.

(2) a **numerical lane tracking score from 1 to 99**, on the left side of the display. After you have pulled away from a stop, and have driven on a lane painted highway for a few minutes, the display on the left will present a lane-tracking score from 1 to 99, indicating the approximate percentage of time you vehicle tracked pretty much in the center of that driving lane for the past several minutes.

You can inform the SafeTRAC system that you are **purposely going to cross over a painted lane marking** --- for example when you plan to pass a vehicle in front of you—by simply **activating your turn signal**. This will tell the SafeTRAC system not to decrement your score for an intentional lane crossing.

What does the SafeTRAC score mean to me? Generally, a high score, say above 80 or 85 or so, would indicate you are driving predominately in the middle of the lane over time (measured in minutes). If you tend to "hug" one painted lane line or the other, like if you tend to drive nearer to the road shoulder, your score will likely reflect that fact. So you will have to learn how meaningful the score is to you to determine how well it reflects your alertness or your driving tendencies regarding lane tracking.

The SafeTRAC **should turn on automatically** whenever the truck ignition switch is turned on. You should not have to fiddle with any controls or knobs to make it work.

The **SafeTRAC display will be covered over during your first two weeks of driving**. We will lift the shroud off the display for your second two weeks so you can see the display for weeks 3 and 4.

During the weeks 3 and 4 of your driving, when you cross a lane without first activating your turn signal, the SafeTRAC **should emit a single small beep sound once.** Try it a few times during the first day of your third day of travel and you will quickly get the hang of it.

VII. Driver Instructions on the use of the SleepWatch® personal sleep management tool provided by Walter Reed Army Institute of Research (Silver Spring, MD)

The wrist-watch (**SleepWatch** monitor) we have given you should serve as a suitable replacement for your normal wrist-watch. We recognize some drivers might want to also wear your normal wrist-watch as well, at least until you become comfortable that this one is keeping proper time for you.

Setting the time on the SleepWatch dial. This wrist-watch displays the time-of-day in either the 12-hour clock or the 24-hour format. To set the time on the watch face, simply depress the left button for 3-4 seconds until the display flashes either 24H or 12H; and if you wish to change from one to the other, while that 24H or 12H is flashing, depress the right button to change. Depress the left button again to confirm your change.

If you need to reset the time on the dial face, after depressing the left button for 3-4 seconds, and passing through and confirming the 24 or 12 hour setting, then depress the left button again, and it should bring up the Hour setting. If it needs correcting, you can advance the hours by depressing the right button until you reach the desired hour for setting. Then depress the left button to confirm the hour setting. Next, do the same thing for setting the minutes (1-60), and then for the seconds in the same fashion. This procedure is much like that of setting other digital watches.

Reading the SleepWatch's Reaction Time Performance Predictor indicator: "P"
While the SleepWatch is on your wrist, you will probably see some "hash marks" stretching from the 0900 position upwards toward the 12 or even 1 or 2 o'clock on the clock face dial. The hash marks indicate the device is capturing movement data from your wrist, and gives you a relative indication of how much sleep you have been obtaining or losing. More hash marks indicate you have been sleeping adequately; fewer hash marks indicate you have not been getting enough rest or sleep.

More importantly, at any time, if you simply depress the left button once for about 1-2 seconds, the display will present a digital reading of a Reaction Time Performance Predictive value labeled "P." The P number is based upon a sleep and performance predictive model developed after many years of sleep and sleep deprivation research at the US Army's Walter Reed Army Research Institute in Washington, DC. The P number is like a "fuel gauge" indicating your level of alertness, or your readiness to perform on tests or tasks that require thinking and especially reaction time.

Generally, the higher P score is indicating you are getting more daily sleep, perhaps even more restful, as opposed to tossing and turning sleep. If for example the number displayed is between 75 and 90 P you get some indication you are averaging a fair number of hours of sleep each 24 hour day; whereas if the P value is down around 50-60 you are probably not getting nearly enough sleep to maintain adequate levels of driver alertness. If we measured you on a reaction time test at that precise moment, you would probably not score your faster reaction times.

The sleep and performance model also incorporates calculations based on circadian rhythm physiology (body clock); it takes into account whether or not you are working through the night, e.g. during 0100-0530 hours; or during the known mid-afternoon lull from 1300-1600 hours. If you are awake then, the P values may drop somewhat for a while, perhaps until your next sleep.

Gaining the best accuracy from your SleepWatch. The best accuracy is obtained by wearing the SleepWatch continuously 24-hours per day, seven days per week. If you take the SleepWatch off and set it down for a while, the model inside will become confused, and will start to give you ranges of P values, such as it will flash 65-70 indicating it can't be sure how much sleep you got or missed. So to be maximally effective, we ask you to wear the SleepWatch all the time. And we much prefer you wear it on your non-dominant wrist. So if you are right-handed, please wear the SleepWatch on the left wrist.

Batteries or troubles with the SleepWatch. The battery life of the SleepWatch should last for 4-5 weeks. Thus, you should not have to do anything about batteries in the watch. If the SleepWatch does not seem to be working properly, please call Dr. Krueger.

Water Immersion and the SleepWatch The SleepWatch can be worn in the shower, but it was not designed to be totally immersed in water, so, please do not go swimming or bathe with the SleepWatch on your wrist.

Swapping off the SleepWatch every two weeks and/or shipping it to us. We will attempt to extract data from the SleepWatch every two weeks, at the time when we switch from the NO visual feedback on the displays to WITH visual feedback on the displays test conditions on the Driver Alertness and Fatigue monitoring devices in your truck.

If we are unable to marry up or arrange for that swap, we would like you to continue to wear the SleepWatch continuously 24/7 until we do catch up to you, or make other arrangements via phone to have us ship you a new watch.