Memorandum

U.S. Department
of Transportation

**Federal Highway
Administration**

6300 Georgetown Pike
McLean, Virginia 22101

Subject: **ACTION**: LTPP Directive GO-36
Termination of LTPP Seasonal Monitoring Program

Date: October 27, 2004

From: Jack Springer
Long Term Pavement Performance Team

Reply to
Attn of: HRDI-13

To: Dr. Frank Meyer, PM - LTPP North Atlantic Regional Contract
Dr. Frank Meyer, PM - LTPP North Central Regional Contract
Mr. Mark Gardner, PM - LTPP Southern Regional Contract
Mr. Kevin Senn, PM - LTPP Western Regional Contract

Attached is the Long Term Pavement Performance (LTPP) Directive GO-36 terminating the LTPP Seasonal Monitoring Program. Also attached is a memo sent to FHWA from TSSC detailing the reasons to terminate the SMP data collection activities. This directive should be transmitted to all appropriate personnel as soon as possible.

If you have any questions concerning this transmittal, please do not hesitate to call me at (202) 493-3144.

Attachments

LONG TERM PAVEMENT PERFORMANCE PROGRAM DIRECTIVE

For the Technical Direction of the LTPP Program

Program Area:	General Operations	Directive Number:	GO-36
Date:	October 27, 2004	Supersedes:	See Below
Subject:	Termination of LTPP Seasonal Monitoring Program		

All seasonal monitoring program (SMP) data collection activities shall be terminated effective October 31, 2004. ***Future monitoring measurements on test sections included in the SMP program shall be performed in accordance with the assigned LTPP monitoring category.***

Entry of SMP data into the regional databases and associated QC activities shall be completed and included in the May 2005 upload to the national pavement performance database. After the May 2005 upload, SMP monitoring measurements performed by highway agencies shall not be entered into the pavement performance database.

The attached memorandum from the LTPP Technical Support Services Contract (TSSC) team to the Federal Highway Administration (FHWA) LTPP team dated January 2, 2003 details the reasons for termination of the SMP data collection activities. The recommendations contained in that memorandum have been adopted by FHWA, except that completion of the last SMP data collection activities was delayed by one month, from September 30, 2004 to October 31, 2004, to allow time for close-out of SMP monitoring on the remaining active SMP test sections. The memorandum is formally included as part of this directive to support and document the termination decision.

Due to termination of the SMP data collection activities, all remaining active SMP directives shall be removed from the list of active directives as of October 31, 2004. They include:

- SM-01: File Naming Convention and Lane Specifications for Seasonal Monitoring Program
- SM-05: Rest and Battery Replacement for the ONSITE CR10 Datalogger
- SM-06: SMP Problem Report (SMPPR) Form
- SM-07: Data Collection Guidelines Under Less Than Ideal Conditions
- SM-09: Profile Measurement Requirements at SMP Rigid Test Sections
- SM-10: Use of ONSFIELD and MOBFIELD QC Programs
- SM-14: Monitoring of Instrumentation Area
- SM-21: Version 1.0 of MOBREF Software

- SM-24: Implementation of Resistivity Calibration Check Block
- SM-28: Interpretation and Entry of Manual TDR Traces into the IMS
- SM-31: LTPP SMP Phase II Monitoring
- SM-33: Upgrade of MOBFIELD Software to Version 3.0
- SM-35: Guidelines for SMP Phase II Equipment and Instrumentation Installation
- SM-41: Upgrade of ONSFIELD Software to Version 2.1
- SM-44: Upgrade of OnsPlus Software to Version 1.09
- SM-45: Upgrade of CR10 Procedure Manager Software to Version 5.12
- SM-46: Upgrade of SMPCheck Software to Version 3.4

Questions concerning this directive should be addressed to the FHWA LTPP leader for SMP operations.

Prepared by: TSSC

Approved by:

Aramis López, Jr.
Team Leader, LTPP Operations

LTPP Technical Support Services Contractor - c/o LAW PCS-12104 Indian Creek Ct., #A - Beltsville, MD 20705 - Tel 301-210-5105 - Fax 301-210-5032

MEMORANDUM

TO:	Jack Springer and Aramis Lopez
FROM:	Gonzalo Rada, Amy Simpson and Gary Elkins
DATE:	January 2, 2003
SUBJECT:	Termination of LTPP Seasonal Monitoring Program FHWA Contract No. DTFH61-02-C-00007 LAW PCS Project No. 10900-0-0210-02-101
PAPER FILE:	Instrumentation / SMP / SMP Assessment
CC:	H. Zhou

Executive Summary

A combination of failing sensors, test sections being rehabilitated or going out-of-study, and financial constraints has led FHWA to question continuation of the Long-Term Pavement Performance (LTPP) seasonal monitoring program (SMP). In response to the FHWA's concern, the LTPP Technical Support Services Contract (TSSC) team is recommending a multi-step approach for termination of the SMP. Highlights of the approach are provided below:

- SMP test sections failing to meet established sensor and test section conditions, highway agency support and data completeness criteria are immediately eliminated from the program; new or replacement test sections will not be considered.

- SMP test sections meeting established criteria are monitored through September 30, 2003 or until criteria is no longer met, whichever comes first.

- SMP test sections still meeting established criteria as of September 30, 2003 and with less than two year's worth of seasonal monitoring will be considered on a case-by-case basis for continued monitoring through September 30, 2004.

Background and other information supporting the proposed multi-step approach for termination of the SMP are provided in this memorandum.

Overview of SMP

The objective of the Long-Term Pavement Performance (LTPP) seasonal monitoring program (SMP), as established in the early 1990s, was to:

"Provide data needed to attain a fundamental understanding of the magnitude and impact of temporal variations in pavement response and material properties due to the separate and combined effects of temperature, moisture and frost/thaw variations."

It was expected that successful completion of this objective would provide:

- *The means to link pavement response data obtained at random points in time to critical design conditions.*
- *The means to validate models for relationships between environmental conditions (e.g., temperature and precipitation) and in situ structural properties of pavement materials.*
- *Expanded knowledge of the magnitude and impact of the changes involved.*

The SMP was the first special monitoring study undertaken within the LTPP program. Subsequent special monitoring studies include the dynamic load-response (DLR) testing of the SPS-1 and -2 projects in North Carolina and Ohio completed a few years back, and the SPS-1 and -2 edge-drainage study recently completed. A program to survey SPS-1 and selected SPS-2, -5 and -6 projects using ground penetrating radar (GPR) for layer thickness determinations is expected to commence in the coming months. The use of the impact-echo hammer method for PCC layer thickness determinations at SPS-2 projects and the forensic investigation of LTPP test sections going out-of-study are also presently under consideration.

Planning of the SMP began in the late 1980s as an extension to the LTPP deflection-testing program ***to conquer the last frontier****;* i.e., provide the means to link deflection data obtained at random points in time to critical design conditions. The program was approved by the SHRP managers prior to the transfer of LTPP management from SHRP to FHWA in 1992. Although its focus remained on deflection testing activities, the program was expanded to include other pavement performance measurements such as roughness and distress. Planning activities culminated with the following three instrumentation pilot studies:

- LTPP Test Section 361011 in New York, October 1991.
- LTPP Test Section 163023 in Idaho, November 1991.
- LTPP Test Section 308129 in Montana, December 1992.

Resource limitations made it impossible to monitor all LTPP test sections scattered throughout North America on a seasonal basis. Therefore, to maximize the applicability of the data, a sampling factorial comprised of 64 test sections selected to obtain a balance of key pavement factors – pavement type, thickness, environment and subgrade type – was established. Recruitment by the LTPP regional contractors and the high level of interest by highway agencies led to the eventual inclusion of 65 test sections in the program, although two of those test

sections did not come about until the program was well underway. The distribution of SMP test sections by region is given below:

- North Atlantic Region: 19
- North Central Region: 15
- Southern Region: 16
- Western Region: 16

Instrumentation installation and data collection as part of the SMP began in August 1993 under FHWA management. Both activities were done in accordance with the "LTPP Seasonal Monitoring Program: Instrumentation and Data Collection Guidelines, Report FHWA-RD-94-110, April 1994" (hereafter referred to as 1994 SMP Guidelines) and various SMP directives issued by FHWA. Data collection at most SMP test sections was done on alternate years (i.e., every other year), although continuous moisture-temperature measurements were performed at a subset of test sections with the support of the highway agencies. SMP monitoring typically began in the fall (September or October) and lasted for 12 months in an attempt to capture frost and thaw conditions at test sections in freeze areas.

The original SMP plan was to monitor test sections for a period of five years, which translates to three full years of data since monitoring was done on alternate years. Despite financial constraints imposed on LTPP as a result of the 1998 TEA-21 highway reauthorization bill, the SMP experiment was successfully completed at the end of 1999. About half of the sections were monitored for 12-month periods starting in the fall of 1993, 1995 and 1997 and the remaining half were monitored for 12 months periods starting in the fall of 1994, 1996 and 1998.

By 1998, a number of SMP test sections went out-of-study and the number of malfunctioning sensors started to increase. Despite these problems and the impending completion of the program in 1999, SMP still enjoyed a great deal of support from highway agencies that wanted to extend the monitoring period. Consequently, planning activities for continuation of the SMP began in 1998 and they culminated in December 1999 with the issuance of LTPP Directive SM-31: LTPP SMP Phase II Monitoring.

The objectives of the SMP Phase II monitoring was to continue to provide the data needed to attain a fundamental understanding of the magnitude and impact of diurnal, seasonal and annual variations in pavement response and properties due to the separate and combined effects of temperature, moisture and frost penetration. This phase also provided for additional monitoring over short periods of time in an attempt to capture the effects of certain known weather patterns such as spring thaw.

The SMP Phase II monitoring sampling factorial consisted of 24 test sections providing a balance of key pavement factors – pavement type, thickness, environment and subgrade type. The test section inclusion and retention criteria included:

- Section must have been part of the original SMP study.
- Section must have full suite of data.

- Significant portion of moisture-temperature sensor in working order
- Highway agency willing to provide traffic control for minimum number of test cycles.

Despite relaxation of the above criteria and the installation of new sensors, the SMP Phase II monitoring only included 22 test sections distributed by region as follows:

- North Atlantic Region: 5
- North Central Region: 6
- Southern Region: 6
- Western Region: 5

Two of the above 22 sites have been taken out of the SMP Phase II monitoring program as a result of rehabilitation activities.

Data collection activities at the SMP Phase II monitoring test sections began in 2000, and they are being conducted in accordance with the 1994 SMP Guidelines except as modified by LTPP Directive SM-31. Instrumentation at the test sections is the same (i.e., original SMP instrumentation), but failed surface thermistors were replaced and new equipment for collecting continuous subsurface moisture-temperature measurements (using TDR, thermistor, and resistivity probes) implemented. Nonetheless, the number of sensors failing continues to increase to the point that a number of sections are nearing the minimum equipment requirements listed below:

- 8 TDRs
- 15 thermistors, including 2 in surface layer
- 28 electrodes in resistivity
- Ambient air temperature sensor
- Rain-gauge tipping bucket

Sensor failure is certainly not a surprise nor unexpected as their original life expectancy was five years, and most of the SMP instrumentation has now been in service for almost twice that length of time.

Future of SMP

As we approach the 10-year mark of the SMP, the LTPP team faces an important decision in terms of continuation of the program. A number of the factors affecting that decision were introduced in the previous section and they are repeated below:

- The objectives of the SMP were successfully accomplished at the end of 1999. The program could have been declared completed, but in the pursuit of additional high-quality, research-level data, a decision was made to continue monitoring a subset of the original SMP test sections, which were in good condition and had functional equipment.

Note: Although the intent of the objectives, as established in the 1994 SMP Guidelines, were completed, many recommendations for extension of the program to help fill in the gaps not addressed by the SMP effort were never implemented. For example, we were unable to do burst FWD testing during thaw periods, data such as soil suction are missing for evaluation and calibration of integrated climatic models, slab warping & curling measurements were not performed, seasonal "strength" measurements related to load restrictions nor other supporting laboratory testing were done, etc.

- Continuation of the SMP was predicated on having the 24 test sections that filled-out the sampling factorial, but we fell short of that target. Only 21 of 24 test sections plus one new section moved to the continuation phase, and that number was only achieved by relaxing the acceptance criteria. Of those 22 test sections, two have been rehabilitated, and thus taken out of the SMP. Furthermore, 5 of the remaining 20 test sections have begun to show significant signs of distress, rutting and/or roughness. Because the original target was not met and test sections are going out-of-the program earlier than anticipated, continuation of the SMP as originally envisioned will not be achieved.

- The life expectancy of the SMP instrumentation has long ago been exceeded; much of the equipment has now been in service for almost twice their expected life. More importantly, many of those sensors are beginning to fail and it is expected that sensor failures will accelerate in the coming months. Indeed, it is believed that active SMP test sections will need to be taken out-of-the program because of failed sensors and not because the pavements have failed.

Clearly, continuation of the intensive monitoring program would require a significant investment of resources by LTPP and participating highway agencies, which might be better assigned to other priority LTPP activities. This is especially true when viewed within the context of the current program financial constraints. Thus, the issue facing FHWA is how to move forward with the SMP.

Based on knowledge gained from the SMP to date, the natural tendency is to refine and expand the program in order to address a wider range of issues. For example, the SMP could be expanded to other sites to make-up for data gaps and limitations, to address bound base layers, supplemental test sections and drainage layers (full and edge drains), and to collect other important data such as slab warping & curling, burst FWD testing during thaw periods, soil suction, seasonal "strength" measurements and other supporting laboratory testing. However, given the current financial environment and other reasons noted earlier, termination, not expansion, of the SMP is viewed as the only realistic path forward.

One option for phasing out the SMP is to continue monitoring as we have been and end SMP monitoring as the sections change experiments or go out-of-study, the instrumentation fails, or the LTPP program ends. The advantage of this approach is that it allow for the collection of data through the failure portion of the performance curve for a few test sections. However, SMP equipment appears to be failing faster than the test sections, thus data collection through the failure portion of the pavement performance curve may not be a realistic expectation.

Furthermore, this option may not provide for the best utilization of limited LTPP resources; the resources currently being expended on the SMP might be better used to achieve other goals of the LTPP program.

An alternate option is to collect data through another complete cycle and end all SMP associated data collection after that point. At the end of the completed cycle, a visit could be made to each site for additional investigations and retrieval of the salvageable equipment. This option would prevent an unannounced overlay from taking the section out before we have a chance to retrieve equipment and/or perform additional testing that might be warranted. Although resource requirements for this option are lower than those for the first one, it still requires a significant commitment that must be viewed within the overall priorities of the LTPP program.

Other options range from immediate termination of the SMP, which is not recommended because it would not support the good-will efforts by participating agencies (e.g., Montana purchased sensors and instrumented SMP test section within last year, Arizona only recently completed hook-up of electrical and telecommunications equipment that enable high frequency sampling of moisture measurements, etc.), to combinations of the first two options. The approach being recommended by the LTPP TSSC is as follows:

1. Assess status of active SMP Phase II monitoring test sections. Test sections failing to meet the criteria below in its entirety are immediately eliminated from the program:

    a. Significant portion of moisture-temperature measurement equipment is in working condition – at least 8 TDRs, 15 thermistors in temperature probe including two in surface layer, 28 electrodes in resistivity probe, ambient air temperature probe and rain-gauge tipping bucket must be functional.
    b. Highway agency is willing to provide traffic control required to conduct minimum number of test cycles per day, at least six test days per year.
    c. Test section has not been overlaid or received other rehabilitation treatment that has altered the thickness of the pavement layers or caused a change in LTPP experiment designation.
    d. Test section is an active LTPP test section.
    e. Test section has full suite of pavement performance data required to support LTPP objectives.

2. New or replacement test sections ***will not*** be considered for inclusion into the SMP Phase II monitoring program.

3. Test sections meeting above criteria are monitored through September 30, 2003 or until test section no longer meets criteria set forth in Item No. 1, whichever comes first.

4. Test sections still meeting criteria set forth in Item No. 1 as of September 30, 2003 will be evaluated for possible seasonal monitoring continuation.

    a. Sections with two or more year's worth of seasonal monitoring data since January 1, 2000 will be considered candidates for elimination from the SMP as of

September 30, 2003 unless justification for continued monitoring can be provided by the regional contractors.

b. Sections with less than two year's worth of seasonal monitoring data since January 1, 2000 will be considered candidates for monitoring continuation through September 30, 2004.

Regional contractors will work with the FHWA LTPP team to make final decisions on a section-by-section basis.

5. All SMP monitoring activities will cease by September 30, 2004.

6. If test section is taken out of SMP, but remains an active LTPP test section, monitoring of the test section will continue in accordance with LTPP Directive GO-21. If test section remains active, but includes the application of a structural overlay or other rehabilitation treatment, consideration should be given to retrieving salvageable equipment.

7. As SMP test sections go out-of-study, the regional contractors are encouraged to pursue forensic investigations with the respective highway agencies. If feasible, they should be performed in accordance to the draft LTPP forensic investigation guidelines.

Conclusion

As much as we would like to see the program continue for many more years, the reality is that equipment and test sections are failing and those failures will only accelerate in the coming months. Furthermore, continuation as a formal program within LTPP cannot be justified, especially in view of current financial constraints and other program priorities – SPS traffic and materials data resolution action plans, clearing the traffic data backlog, increased monitoring at SPS projects, population of SPS-9 tables, etc. Accordingly, we have proposed a plan for terminating the SMP experiment by September 30, 2004 (end of FY 2004).

Since the contents of this document will be discussed during the January 2003 LTPP RSC Project Managers Meeting in Reston, Virginia, we recommend that the memorandum be distributed to the regions at the earliest time possible so they have ample time to review and prepare to discuss at the referenced meeting. Let us know if there are changes to the document that you would like us to make prior to its distribution.

Please do not hesitate to contact us if you have any questions or would like to discuss the contents of this memorandum.

Thanks and regards.