Seismic Approach to Quality Management of HMA

MnDOT Contract No. 1034287

Report – 2nd Quarter, 2021

Prepared By

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Submitted To

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July 19, 2021

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SUMMARY

We provide a progress report for the 2nd quarter of 2021. This report summarizes key topics regarding work in progress. Details and supporting documents have been posted on the project pages created within the Park Seismic LLC website. The overall progress has been summarized by month and posted on the "Progress" page. Since March of 2021, however, the Park Seismic LLC website has been put on hold for any changes while the site is undergoing a renovation, which seems taking a longer time than previously expected. In consequence, the updated progress web pages for this period (April-June 2021) have been prepared in HTML but not been published online yet. Instead, the prepared HTML pages are converted to PDF pages in this report and presented in Appendix I. Minutes for monthly project meetings, which also would have been posted online, are presented in Appendix II.

Progress summary of the previous quarter (Q1-2021) was delivered to TAP members via email. This report summarizes the progress made since then for 5 tasks specified in the Scope of Work (SOW), namely:

- Task #1: Project Management and Administration
- Task #2: Hardware Development (Seismic Data Acquisition System) & Testing
- Task #3: Software Development & Testing
- Task #4: Delivery and Demonstration of Seismic Data Acquisition System and Software
- Task #5: Final Report

Progress on the first 3 tasks (#1 – #3) are summarized in this report. First, we provide brief snapshots of monthly progress that has been summarized in the corresponding HTML progress pages. Second, quantified indices are tabulated for all three tasks for both prime (Park Seismic LLC) and sub (Norrfee Tech, AB) contractors. Lastly, we present projections for the next quarter (Q3-2021) by compiling feedback and plans from all project participants.

MONTHLY PROGRESS

April 2021

✓ **Project Management and Administration (Task #1)**

The 1st quarterly report of 2021 (Q1-2021) was prepared and submitted to TAP members via email on April 20.

The monthly meeting was organized via Skype and the minutes were prepared by the administration staff. The monthly invoicing and payment to the sub-contractor has been managed by the staff. The progress web site has been prepared in HTML to reflect the progress status and presented in Appendix I in PDF.

- **ParkSEIS-HMA (PS-HMA) Display Module Updates (Tasks #2 & #3)**

The ParkSEIS-HMA (PS-HMA) software package has been updated on the display module. Previously, it displayed the shear-wave velocity (Vs), thickness (H), and temperature (T) of the HMA pavement for the measured records in the order of record number. Each XY-chart therefore

displayed the output values of Vs, H, and T in the Y axis with the record numbers in the X axis. This is because, previously, the GPS data were not used for coordinate information due to the unavailability of the GPS coordinate decoding module that converts latitude and longitude to local distance (i.e., UTM) coordinates.

The GPS data are now properly handled to generate UTM coordinates, which present data points in local X-Y (i.e., Easting-Northing) coordinates. The GPS and temperature measurements are made every one second, while the seismic measurements are made whenever the bouncing ball makes the impact on the pavement. Although the spatial interval between successive impact points varies with the survey speed and surface condition of the pavement (as well as the source characteristics), the average interval is about 0.5 m at a common survey speed of 20 km/hr with current source. This means there are about 11 impacts made every second. Every seismic record has its own timestamp measured in milliseconds and so does every GPS point. Therefore, by comparing the timestamp, the measurement location of each record can be deduced from the GPS data points. Because GPS data pints are measured less often than the seismic data, the GPS data are interpolated based on the timestamp to assign GPS data to the intermediate records. This is the way each record gets its own location information. Because the temperature data are measured every time GPS data are measured, each record gets its own temperature data in the same way.

The modules that can perform the aforementioned tasks are being constructed for the ParkSEIS-HMA (PS-HMA) software package. Once they are available, all output results of Vs, H, and T will be displayed with respect to the survey distance, not to the record number. In addition, there will be a separate UTM display that can show the survey path in an X-Y chart.

- **ParkSEIS-HMA (PS-HMA) TDMS File Handler (Tasks #2 & #3)**

The way the raw data files in TDMS format (*.tdms) are handled in PS-HMA has been modified. Previously, each raw file was copied from the PXI folder to a local folder in the laptop computer sequentially in the order of creation. Each copied file then would go through subsequent time-consuming steps of data conversion and analysis to generate output results (e.g., Vs, H, T, etc.). Although the survey itself usually takes only a few minutes to drive about 1-km distance, the PXI system could not be turned off until the PS-HMA completes all steps of operation with all files in the PXI folder. Termination of the PXI system as early as possible was previously recommended by Norrfee Tech to protect the system from excessive heat and also to save battery power.

Now, PS-HMA puts the highest priority on copying all raw TDMS files existing in the PXI folder so that they are copied to the local folder in the laptop computer as soon as possible. Then, the remaining analysis steps can proceed only within the laptop computer without need to communicate with the PXI system. This enables the PXI system to be turned off as soon as the survey is finished.

May 2021

✓ **Project Management and Administration (Task #1)**

A project update presentation was made on May 18, 2021, during the NRRA's "Research Pays Off" webinar series. It is posted on YouTube. It presented the historical development of seismic method

for pavement evaluation that ultimately led to the execution of current project at MnDOT. It also presented the progress made during the last 16 months of project execution as well as the projection for the remaining period. The presentation file (*.pptx) file will be available online once the HTML is published.

The monthly meeting was organized via Skype and the minutes were prepared by the administration staff. The monthly invoicing and payment to the sub-contractor has been managed by the staff. The progress web site has been prepared in HTML to reflect the progress status and presented in Appendix I in PDF.

- **"SETUP.TXT" and "STOP.TXT" to Control PXI System from ParkSEIS-HMA Software (Tasks #2 & #3)**

The parameters directly related to the PXI system's data recording have been controlled only by the PXI control software running on the PXI's operating system. They can now be controlled by the ParkSEIS-HMA (PS-HMA) software package. The "SETUP.TXT" file written by PS-HMA contains all those parameters specified by a graphical user interface (GUI) of PS-HMA, which is under construction. This file is written on the PXI folder immediately after the "ARM" button in PS-HMA is pressed down, 0.5-s before the "ARM.TXT" is written. Then, the PXI system carries the new parameters to update the corresponding functionalities immediately.

The "STOP.TXT" is written by PS-HMA on the PXI folder to signal that the PXI-control software can shut down the system. This is introduced to physically shut down the PXI system from PS-HMA without a physical access to the PXI system switch.

June 2021

✓ **Project Management and Administration (Task #1)**

The monthly meeting was organized via Skype and the minutes were prepared by the administration staff. The monthly invoicing and payment to the sub-contractor has been managed by the staff. The progress web site has been prepared in HTML to reflect the progress status and presented in Appendix I in PDF.

- **PXI Control Software Update (Tasks #2 & #3)**

The PXI control software being built at Norrfee Tech was updated to accommodate the changes and updates in PS-HMA outlined below.

The ParkSEIS-HMA software package (PS-HMA) has been updated to properly control the PXI acquisition system. By using the separate text file of "SETUP.TXT", it can provide key recording-related parameters (e.g., trigger level, max and min voltage levels, sampling rate, etc.) to the PXI control software (being built at Norrfee Tech) at the proper time of the PS-HMA execution. It also provides "STOP.TXT", "ARM.TXT", and "DISARM.TXT" at other proper stages and times of the PS-HMA execution so that the PXI control software can shut-down the system ("STOP.TXT"), make the system ready for recording ("ARM.TXT"), and disable the recording functionality ("DISARM.TXT"), respectively. It can now detect old TDMS files that may remain at the measurement folder in PXI

system (e.g., "c: \MeasurementFiles") and provide options to delete and backup. Details are explained in the readme file presented in Appendix III.

This newer version of PS-HMA was delivered to Norrfee Tech on June 25, 2021, to be used for next Joint Field Test (JFT).

PROGRESS BY TASKS AND NUMBERS

The entire work executed to accomplish the project goal is categorized into five (5) tasks (Tasks #1 – #5) as previously listed. In this report, the progress accomplishments made by both prime and sub contractors are described in the first 3 tasks (#1 – #3) by using the quantified indices used in the progress report form (Exhibit E in the project contract) submitted each month. These values are presented in tables on this page and then graphically displayed by using charts in the next page.

Work Completed – Prime* Contractor

This Period (%)

Task	Previous Quarter (Q1-2021)			This Quarter (Q2-021)		
	January	February	March	April	May	June
#1	4.6	3.8	2.3	6.2	6.9	3.5
#2	0	0	0	0	0	0
#3	3.8	2.3	3.8	2.5	0.2	3.4

To Date (%)

Task	Previous Quarter (Q1-2021)			This Quarter (Q2-021)		
	January	February	March	April	May	June
#1	89.6	93.5	95.8	101.9***	108.8***	112.3***
#2	0	0	0	0	0	0
#3	64.5	66.9	70.6	73.1	73.3	76.7

Work Completed - Sub** Contractor

This Period (%)

Task	Previous Quarter (Q1-2021)			This Quarter (Q2-021)		
	January	February	March	April	May	June
#1	2.5	2.5	2.5	2.5	0	0
#2	12.4	6.5	1.9	0.9	3.1	2.2
#3	0	0	0	0	26.7	0

To Date (%)

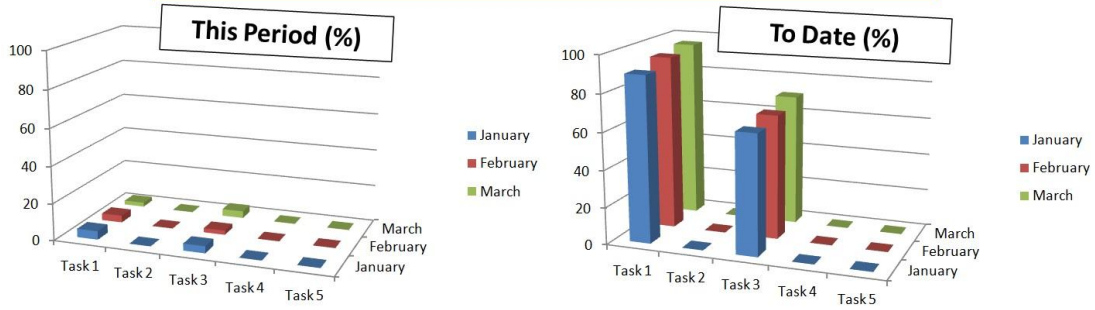
Task	Previous Quarter (Q1-2021)			This Quarter (Q2-021)		
	January	February	March	April	May	June
#1	92.5	95.0	97.5	100.0***	100.0***	100.0***
#2	70.1	76.5	78.4	79.4	82.5	84.6
#3	53.3	53.3	53.3	53.3	80.0	80.0

**Park Seismic LLC, **Norrfee Tech, AB*

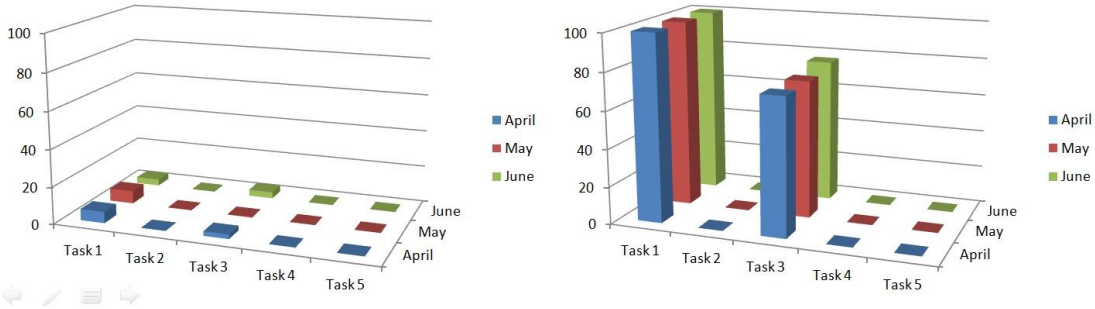
****New budget hours will be established in the amended budget-hour schedule under prepration.*

Prime Contractor (Park Seismic LLC)

Previous (1st) Quarter (January – March 2021)

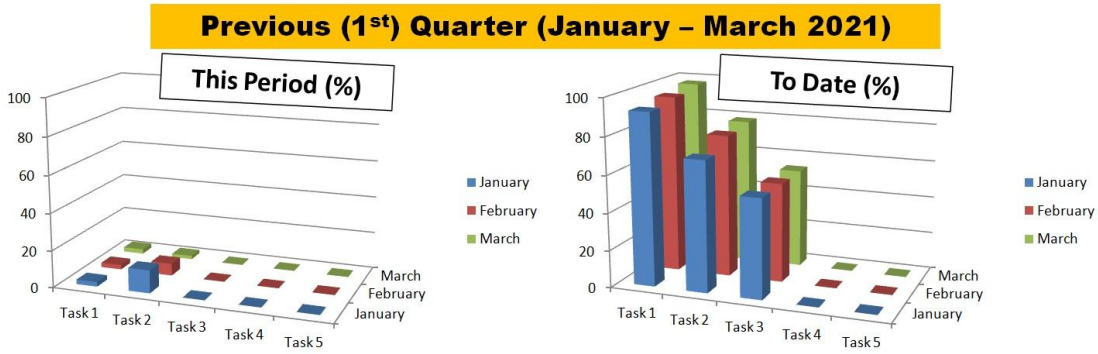


This (2nd) Quarter (April – June 2021)

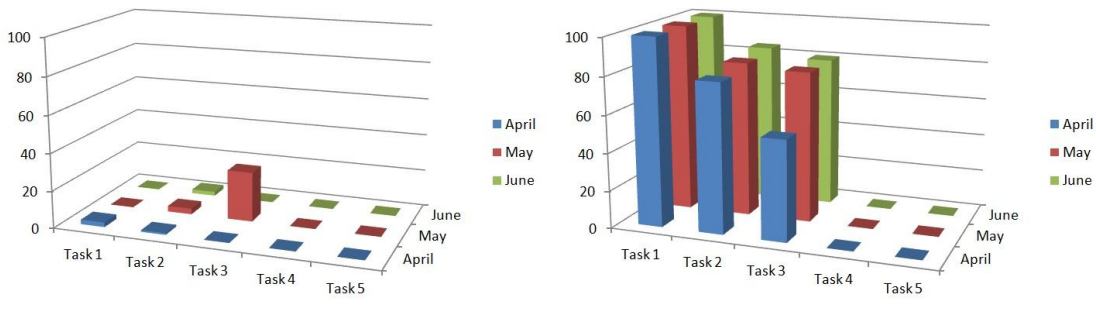


Sub Contractor (Norrfee Tech, AB)

Previous (1st) Quarter (January – March 2021)



This (2nd) Quarter (April – June 2021)



PROJECT PROJECTION

Projections made in the three tasks (#1 – #3) for the next three months (Q3-2021) are summarized below.

- **Task #1: Project Management and Administration**

  A draft version of the contract-amendment request is ready for Technical Liaison's review. It includes the request for extension of the project period by six (6) months until June 2022 without any change in the total budget amount already awarded. It also includes the request for budget reallocation between different expense categories. The finalized request form will be submitted during July 2021.

- **Task #2: Execution of the 2nd JFT and Completion of 2D Hardware System**

  According to the new project schedule requested in the contract amendment, the 2nd Joint Field Test (JFT) of both hardware system and ParkSEIS-HMA software package (PS-HMA) will take place throughout multiple months at Norrfee Tech, starting as early as July 2021, without the presence of the software developer from Park Seismic. At first, by using the current 1D system, it will take place on a considerably warmer day (e.g., 20 °C - 30 °C) than the previous 1st JFT performed during February (e.g., 8 °C). The main goal will be to evaluate the extent of Lamb-wave attenuation when the asphalt is at its upper temperature limit of the survey. The evaluation result will help design the 2D receiver-array system that allows the adjustment of the source distance from the array depending on the asphalt temperature. The adjustment will determine the maximum transverse dimension of the HMA road that the 2D array can measure simultaneously.

  Norrfee Tech plans to make a significant progress in the tasks outlined above during this summer (e.g., July - September) so that the first field test of the prototype 2D system can take place no later than this fall (e.g., October).

- **Task #3: Software Development & Testing**

  The ParkSEIS-HMA software package (PS-HMA) has completed a GUI to specify the recording related parameters to pass on to the PXI system (e.g., trigger level, measurement voltage level, sampling rate, etc.) by using a separate text file ("SETUP.TXT"). In addition, it can now generate another text file ("STOP.TXT") to physically shut down the system. These new functionalities will be tested soon through a lab test at Norrfee Tech.

  The module that displays the measured GPS points will be further improved. It will display them by local UTM coordinates in meters with the most optimum scale. The user will be able to scroll zoom and pan the displayed chart. In addition, a Google image of the survey area (*.JPG) can be imported as a background image so that the measurements points can be more realistically referenced. This module will be tested during a JFT at Norrfee Tech during this summer.

  The analysis module will be shifted toward the 2D data sets. Development of the subsequent pseudo-3D displays will follow.

Seismic Approach to Quality Management of HMA

MnDOT Contract No. 1034287

Quarterly Report (Q2-2021)

APPENDIX I:

Monthly Progress Web Pages (April-June 2021)

(Prepared web pages in HTML to be published online when the Park Seismic LLC website renovation is complete)

Park Seismic

Seismic Approach to Quality Management of HMA

MnDOT Contract No. 1034287
Federal Project Number: TPF-5 (341)
Execution: January, 2020 - December, 2021

PROJECT PROGRESS (April 2021)

Project Tasks | Summary (see details)

Task 1: Project Management and Administration
Task 2: Hardware Development (Seismic Data Acquisition System) & Testing
Task 3: Software Development & Testing
Task 4: Delivery and Demonstration of Seismic Data Acquisition System and Software
Task 5: Final Report

Year 1 (2020): JAN | FEB | MAR | APR | MAY | JUNE | JULY | AUG | SEP | OCT | NOV | DEC

Year 2 (2021): JAN | FEB | MAR | APR | MAY | JUN

Summary

- **The 1st Quarterly Report of 2021 Submitted**

  The first quarterly report in 2021 has been submitted to the TAP members on April 20. It is posted here.

- **ParkSEIS-HMA (PS-HMA) Display Module Updates**

  The ParkSEIS-HMA (PS-HMA) software package has been updated on the display module. Previously, it displayed the shear-wave velocity (Vs), thickness (H), and temperature (T) of the HMA pavement for the measured records in the order of record number. Each XY-chart therefore displayed the output values of Vs, H, and T in the Y axis with the record numbers in the X axis. This is because, previously, the GPS data were not used for coordinate information due to the unavailability of the GPS coordinate decoding module that converts latitude and longitude to local distance coordinates.

  The GPS data are now properly handled to generate UTM coordinates, which present data points in local X-Y coordinates. The GPS and temperature measurements are made every one second, while the seismic measurements are made whenever the bouncing ball makes the impact on the pavement. Although the spatial interval between successive impact points varies with the survey speed and surface condition of the pavement (as well as the source characteristics), the average interval is about 0.5 m at a common survey speed of 20 km/hr with current source. This means there are about 11 impacts made every second. Every seismic record has its own timestamp measured in milliseconds and so does every GPS point. Therefore, by comparing the timestamp, the measurement location of each record can be deduced from the GPS data points. Because GPS data pints are measured less often than the seismic data, the GPS data are interpolated based on the timestamp to assign GPS data to the intermediate records. This is the way each record gets its own location information. Because the temperature data are measured at the same time when GPS data are measured, each record gets its own temperature data in the same way.

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  ParkSEIS-HMA (PS-HMA) TDMS File Handler

  The way the raw data files in TDMS format (*.tdms) are handled in PS-HMA has been modified. Previously, each raw file was copied from the PXI folder to a local folder in the laptop computer sequentially in the order of creation. Each copied file then would go through subsequent time-consuming steps of data conversion and analysis to generate output results (e.g., Vs, H, T, etc.). Although the survey itself usually takes only a few minutes to drive about 1-km distance, the PXI system could not be turned off until the PS-HMA completes all steps of operation with all files in the PXI folder. Termination of the PXI system as early as possible is recommended to ptoretct the system from excessive heat and also to save battery power.

Now, PS-HMA puts the highest priority on copying all raw files existing in the PXI folder so that they are copied to the local folder in the laptop computer as soon as possible. Then, the remaining analysis steps can proceed only within the laptop computer without the need to communicate with the PXI system. This enables the PXI system to be turned off as soon as the survey is finished.

Progress Table (Prime Contractor - Park Seismic LLC) - April 2021

Task	% of Total Contract	ENGINEERING ESTIMATE				Hours Budget	Hours Accrued This Period	Total Hours Accrued To Date	*% of Budget Hours Used
		% Work Completed This Period	% Work Completed To Date	Weight % Completed This Period	Weight % Work Completed to Date				
1	2	3	4	5	6	7	8	9	10
Task 1	25%	6.2%	101.9%	1.6%	25.9%	260	16	265	101.9%*
Task 2	2%	-	-	-	-	20	-	-	-
Task 3	63%	2.5%	73.1%	1.6%	45.7%	640	16	468	73.1%
Task 4	2%	-	-	-	-	20	-	-	-
Task 5	8%	-	-	-	-	84	-	-	-
TOTALS:	100%			3.1%	71.6%	1024	32	733	71.6%

Progress Table (Sub Contractor - Norrfee Tech) - April 2021

Task	% of Total Contract	ENGINEERING ESTIMATE				Hours Budget	Hours Accrued This Period	Total Hours Accrued To Date	*% of Budget Hours Used
		% Work Completed This Period	% Work Completed To Date	Weight % Completed This Period	Weight % Work Completed to Date				
1	2	3	4	5	6	7	8	9	10
Task 1	5%	**2,5%**	**100,0%**	**0,1%**	**4,4%**	40	**1**	**40**	**100,0%**
Task 2	82%	**0,9%**	**79,4%**	**0,8%**	**65,0%**	742	**7**	**589**	**79,4%**
Task 3	3%	**0,0%**	**53,3%**	**0,0%**	**1,8%**	30	**0**	**16**	**53,3%**
Task 4	7%					64			
Task 5	3%					30			
TOTALS:	100%			**0,9%**	**71,2%**	906	**8**	**645**	**71,2%**

Park Seismic LLC, Shelton, Connecticut, Tel: 347-860-1223, Fax: 203-513-2056, Email: contact@parkseismic.com

Park Seismic

Seismic Approach to Quality Management of HMA

MnDOT Contract No. 1034287
Federal Project Number: TPF-5 (341)
Execution: January, 2020 - December, 2021

PROJECT PROGRESS (May, 2021)

Project Tasks | Summary (see details)

Task 1: Project Management and Administration
Task 2: Hardware Development (Seismic Data Acquisition System) & Testing
Task 3: Software Development & Testing
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Task 5: Final Report

Year 1 (2020): JAN | FEB | MAR | APR | MAY | JUNE | JULY | AUG | SEP | OCT | NOV | DEC

Year 2 (2021): JAN | FEB | MAR | APR | MAY

Summary

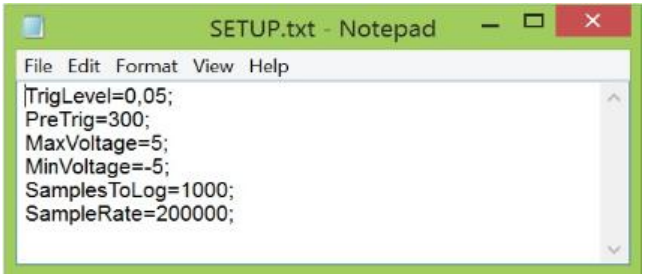
- **"SETUP.TXT" and "STOP.TXT" to Control PXI System from ParkSEIS-HMA Software**

  The parameters directly related to the PXI system's data recording have been controlled only by the PXI control software running on the PXI's operating system. They can now be controlled by the ParkSEIS-HMA (PS-HMA) software package. The "SETUP.TXT" file written by PS-HMA contains all those parameters specified by a graphical user interface (GUI) of PS-HMA, which is under construction. The structure of the file is displayed below. This file is written on the PXI folder immediately after the "ARM" button in PS-HMA is pressed down, 0.5-s before the "ARM.TXT" is written. Then, the PXI system carries the new parameters to update the corresponding functionalities immediately.

  The "STOP.TXT" is written by PS-HMA on the PXI folder to signal that the PXI-confrol software can shut down the system. This is introduced to physically shut down the PXI system from PS-HMA without an access to the PXI system switch.

- **NRRA Presentation ("Research Pays Off")**

  A project update presentation was made on May 18, 2021, during the NRRA's "Research Pays Off" webinar series. It is posted on YouTube. It presented the historical development of seismic method for pavement evaluation that ultimately led to the execution of current project at MnDOT. It also presented the progress made during the last 16 months of project execution as well as the projection for the remaining period. The presentation file (*.pptx) is available here.



Progress Table (Prime Contractor - Park Seismic LLC) - May, 2021

Task	% of Total Contract	ENGINEERING ESTIMATE				Hours Budget	Hours Accrued This Period	Total Hours Accrued To Date	*% of Budget Hours Used
		% Work Completed This Period	% Work Completed To Date	Weight % Completed This Period	Weight % Work Completed to Date				
1	2	3	4	5	6	7	8	9	10
Task 1	25%	6.9%	108.8%	1.8%	27.6%	260	18	283	108.8%*
Task 2	2%	-	-	-	-	20	-	-	-
Task 3	63%	0.2%	73.3%	0.1%	45.8%	640	1	469	73.3%
Task 4	2%	-	-	-	-	20	-	-	-
Task 5	8%	-	-	-	-	84	-	-	-
TOTALS:	100%			1.9%	73.4%	1024	19	752	73.4%

Progress Table (Sub Contractor - Norrfee Tech) - May, 2021

Task	% of Total Contract	ENGINEERING ESTIMATE				Hours Budget	Hours Accrued This Period	Total Hours Accrued To Date	*% of Budget Hours Used
		% Work Completed This Period	% Work Completed To Date	Weight % Completed This Period	Weight % Work Completed to Date				
1	2	3	4	5	6	7	8	9	10
Task 1	5%	**0.0%**	**100.0%**	**0.0%**	**4.4%**	40	**0**	**40**	**100.0%**
Task 2	82%	**3.1%**	**82.5%**	**2.5%**	**67.5%**	742	**23**	**612**	**82.5%**
Task 3	3%	**26.7%**	**80.0%**	**0.9%**	**2.6%**	30	**8**	**24**	**80.0%**
Task 4	7%					64			
Task 5	3%					30			
TOTALS:	100%			**3.4%**	**74.6%**	906	**31**	**676**	**74.6%**

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Park Seismic

Seismic Approach to Quality Management of HMA

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Execution: January, 2020 - December, 2021

PROJECT PROGRESS (June 2021)

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Year 1 (2020): JAN | FEB | MAR | APR | MAY | JUNE | JULY | AUG | SEP | OCT | NOV | DEC

Year 2 (2021): JAN | FEB | MAR | APR | MAY | JUNE

Summary

- **ParkSEIS-HMA Updates for PXI Control**

  The ParkSEIS-HMA software package (PS-HMA) has been updated to properly control the PXI acquisition system. By using the separate text file of "SETUP.TXT", it can provide key recording-related parameters (e.g., trigger level, max and min voltage levels, sampling rate, etc.) to the PXI control software (being built at Norrfee Tech) at the proper time of the PS-HMA execution. It also provides "STOP.TXT", "ARM.TXT", and "DISARM.TXT" at other proper stages and times of the PS-HMA execution so that the PXI control software can shut-down the system ("STOP.TXT"), make the system ready for recording ("ARM.TXT"), and disable the recording funtionality ("DISARM.TXT"), respectively. It can now detect old TDMS files that may remain at the measurement folder in PXI system (e.g., "c:\MeasurementFiles") and provide options to delete and backup. Details are explained in this readme file.

  This newer version was delivered to Norrfee Tech on June 25, 2021, to be used for next Joint Field Test (JFT).

  PXI Control Software Update

  The PXI control software being built at Norrfee Tech was updated to accommodate the changes and updates in PS-HMA outlined above.

Progress Table (Prime Contractor - Park Seismic LLC) - June 2021

Task	% of Total Contract	ENGINEERING ESTIMATE				Hours Budget	Hours Accrued This Period	Total Hours Accrued To Date	*% of Budget Hours Used
		% Work Completed This Period	% Work Completed To Date	Weight % Completed This Period	Weight % Work Completed to Date				
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Task 1	25%	3.5%	112.3%	0.9%	28.5%	260	9	292	112.3%*
Task 2	2%	-	-	-	-	20	-	-	-
Task 3	63%	3.4%	76.7%	2.1%	47.9%	640	22	491	76.7%
Task 4	2%	-	-	-	-	20	-	-	-
Task 5	8%	-	-	-	-	84	-	-	-
TOTALS:	100%			3.0%	76.5%	1024	31	783	76.5%

Progress Table (Sub Contractor - Norrfee Tech) - June 2021

Task	% of Total Contract	ENGINEERING ESTIMATE				Hours Budget	Hours Accrued This Period	Total Hours Accrued To Date	*% of Budget Hours Used
		% Work Completed This Period	% Work Completed To Date	Weight % Completed This Period	Weight % Work Completed to Date				
1	2	3	4	5	6	7	8	9	10
Task 1	5%	**0.0%**	**100.0%**	**0.0%**	**4.4%**	40	**0**	**40**	**100.0%**
Task 2	82%	**2.2%**	**84.6%**	**1.8%**	**69.3%**	742	**16**	**628**	**84.6%**
Task 3	3%	**0.0%**	**80.0%**	**0.0%**	**2.6%**	30	**0**	**24**	**80.0%**
Task 4	7%					64			
Task 5	3%					30			
TOTALS:	100%			**1.8%**	**76.4%**	906	**16**	**692**	**76.4%**

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Seismic Approach to Quality Management of HMA

MnDOT Contract No. 1034287

Quarterly Report (Q2-2021)

APPENDIX II:

Monthly Minutes (April-June 2021)

(Prepared to be published online when the Park Seismic LLC website renovation is complete)

Monthly Meeting (April 2021)

Date: April 27, 2021
Time: 2:00 pm - 2:55 pm EST
Location: Park Seismic Office
Attendees:
In the office: Choon Park and Jin Park
Via Skype: Josefin Starkhammar and Nils Ryden

- Admin:
  - Norrfee Tech (NT)'s travel plan not clear at this moment, so they want to leave only a minimal amount for travel and use the labor budget if travel needs more budget.
  - Josefin proposes to adjust labor hours between her and Nils in Task #1, #2, and #3.
  - Nils proposed to leave budget for three (3) items in the future; a bicycle rack, a 12-V car battery, and an AC power converter. The total estimation is $500.
  - Josefin proposed a possible additional budget of $300 for the remaining circuit boards.
- Technical:
  - Choon presented topics on hardware by using a power-point file.
  - He discussed the quality of the data from the 1st JFT in February and commented it was a highly favorable quality that leaves room for further amplification by reducing measurement voltage. He mentioned it would be critical for the proper design of the 2D system to cover simultaneously as much laterally wide area as possible. Josefin and Nils responded with pros and cons for each possibility.
  - Choon showed the results of GPS data from the JFT and commented that its accuracy needs to be improved. Josefin and Nils commented they think it should be possible because the same device produced more accurate data previously. They will check this issue before the next field test.
  - Choon showed the temperature data commenting it shows rather abrupt changes here and there, indicating a possible link to the GPS issue. Josefin and Nils commented it might show the reality because the temperature may change abruptly depending on a shady or shining area. Nils also commented the device might not be able to tell a slight temperature difference smaller than 1 degree in Celsius.
  - Choon and Josefin briefly discussed the file naming convention for TDMS files.
  - Choon discussed how important expanding the shot offset (X1) is to expand the lateral width of the 2D array. He proposed the 2D arrays to have separation as far apart as 1 ft, which requires X to be longer than 0.5 m. Nils commented that, currently, the optimum X1 is only 0.15 m. Choon proposed to increase it by increasing impact power. Nils commented he would perform field tests for that. Choon also proposed to test a 1D array-oriented perpendicular to the moving direction for the purpose of 2D array design. Nils also commented he would perform field tests for that.

    - Nils commented we have to be more conservative in extending the shot point distance (X1) because it can be the only parameter that can make the entire data quality suffer from low S/N at any time. All agreed we should be.
    - Choon discussed the plan for another presentation at NRRA online meeting on May 18. Choon and Nils will exchange draft versions of presentation files at the earliest time of convenience.
- Agreed:
    - Jin will send a draft budget plan before the next meeting.
    - Norrfee Tech will perform field tests for GPS and source characteristics.
    - Choon and Nils will exchange draft presentation files at the earliest time of convenience before May 18.

Monthly Meeting (May 2021)

Date: May 18, 2021
Time: 2:30 pm - 3:31 pm EST
Location: Park Seismic Office
Attendees:
In the office: Choon Park and Jin Park
Via Skype: Josefin Starkhammar and Nils Ryden

1. Review of the morning presentation at NRRA Meeting (11:00 AM - 12:00 PM)

2. Administrative Issues:
    - Team Sweden approved the changes of their contract hours in the proposed Budget Amendment Form.
    - Jin will fill out and finalize the amendment to submit it to Mn DOT soon.

3. Technical Issues:
    - Josefin and Choon talked about how to communicate between the Josefin's program to control PXI system and Choon's ParkSEIS (PS) program that gets inputs from the user on the acquisition-related parameters such as triggering level, pre-trigger time, min and max voltage, etc.
    - Josefin proposed to use a text file called "SETUP.TXT" that contains values for those key parameters to be written by the PS program.
    - Both discussed the possible ways of the communication and also how the new parameters become effect in the PXI system.
    - Both also discussed how a TDMS file is saved according to the new parameters set in the "SETUP.TXT" file.
    - Josefin informed that her PXI program can now shut down the system when a text file "STOP.TXT" is written by the PS program. Choon responded it is a great approach that enables the one program (PS) can control everything without the need to access the PXI system from the control laptop computer.
    - Josefin proposed to include the PXI program in the startup menu so that it is automatically executed when the system is powered on.
    - Josefin, Nils, and Choon discussed the possible ways to supply the 12-V power to the PXI system that included using an external dedicated battery, using the survey vehicle power from the 12-V DC socket, and using both. Choon proposed to add a power-surge protector to alarm the possible abrupt disconnection of the power.
    - Josefin asked Choon if it is time to move on to start building the 2D system. Choon replied that although it is almost the time, one more joint field test (JFT) should be executed for the testing purpose of PS program.

4. Agreed:
    - Jin will come up with the draft version of the contract amendment by next month's meeting.

Monthly Meeting (June 2021)

Date: July 6, 2021 (took place after one week delay per request from Norrfee Tech)
Time: 2:30 pm - 3:36 pm EST
Location: Park Seismic Office
Attendees:
In the office: Choon Park and Jin Park
Via Skype: Josefin Starkhammar and Nils Ryden

1. Administrative Topics:

    - A draft Contract Amendment has been submitted to Jason Richter at MnDOT for his review and comment.
    - Even after the completed 2D system delivered to CT we still need support from team Sweden for Joint Field Test until the actual delivery to MnDOT takes place in next Spring.

2. Technical Topics:

    - Choon mentioned Park Seismic will continue the JFT even after the system is delivered sometime later this year, and discussed how to maintain the system.
    - All discussed how to deliver the system from Sweden to the States.
    - Choon, Nils, and Josefin discussed the next JFT to take place on a warm day.
    - Choon asked about the near-future schedule at Norrfee Tech. Josefin replied she already started building the 2D system to be finished by September.
    - Nils discussed his plan to build a frame to hold the entire 2D source/receiver set on a multi-bike rack, which he recommended one sold at Walmart.
    - Choon and Nils discussed how to harness the 2D set on the rack rigidly.
    - All discussed how to load the PXI system in the car trunk without Wi-Fi interruption.
    - Choon asked that next JFT should collect GPS data without any issue.
    - All discussed where and when the next JFT should take place.
    - Choon asked about the optimum cruising speed of the survey to see if JFT can take place at a local road without interfering existing traffic.
    - Choon, Nils, and Josefin discussed how to level the entire 2D arrays longitudinally and transversely.
    - Choon asked Nils how the ortho-photo is being used for his own GPS display module development.

3. Agreed:

    - Choon and Jin will submit the contract amendment within a few weeks.
    - The next JFT with current 1D system will be executed sometime this summer by Norrfee Tech.

Seismic Approach to Quality Management of HMA

MnDOT Contract No. 1034287

Quarterly Report (Q2-2021)

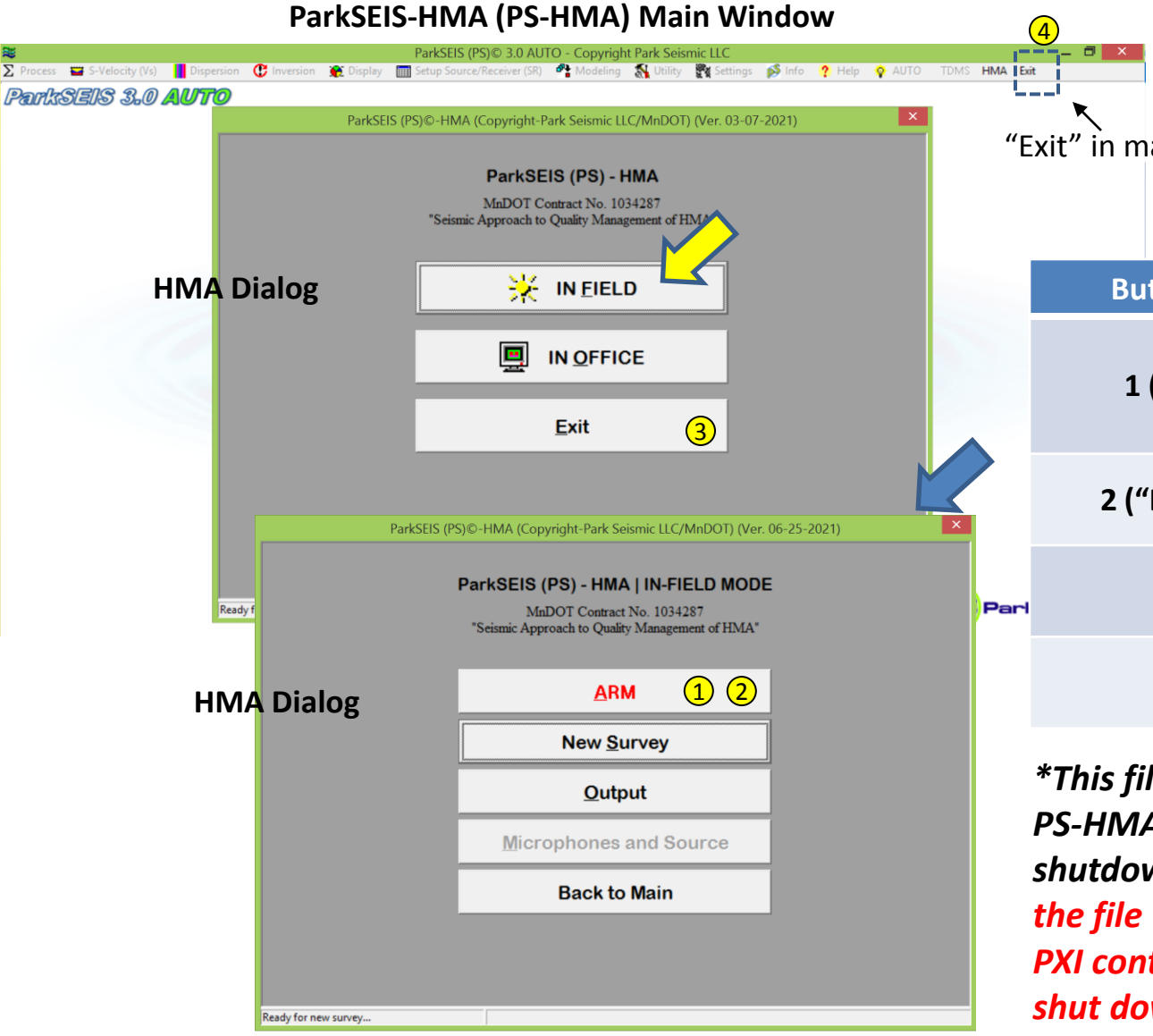
APPENDIX III:

Summary of ParkSEIS-HMA Updates ("Readme06252021")

(Prepared to be published online when the Park Seismic LLC website renovation is complete)

Text Files Written on PXI

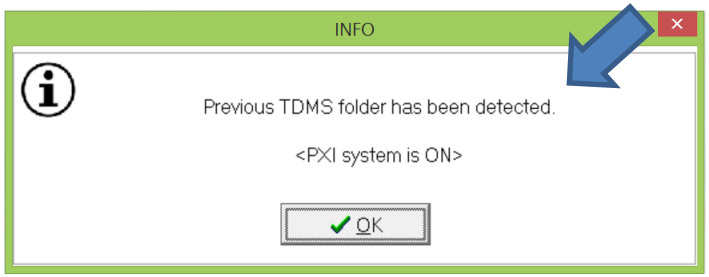
ParkSEIS-HMA (PS-HMA) Main Window



Button Click	Text File on PXI
1 ("ARM")	"SETUP.TXT", and "ARM.TXT" with 0.5-second seperation
2 ("DISARM")	"DISARM.TXT"
3	*NONE*
4	"STOP.TXT"*

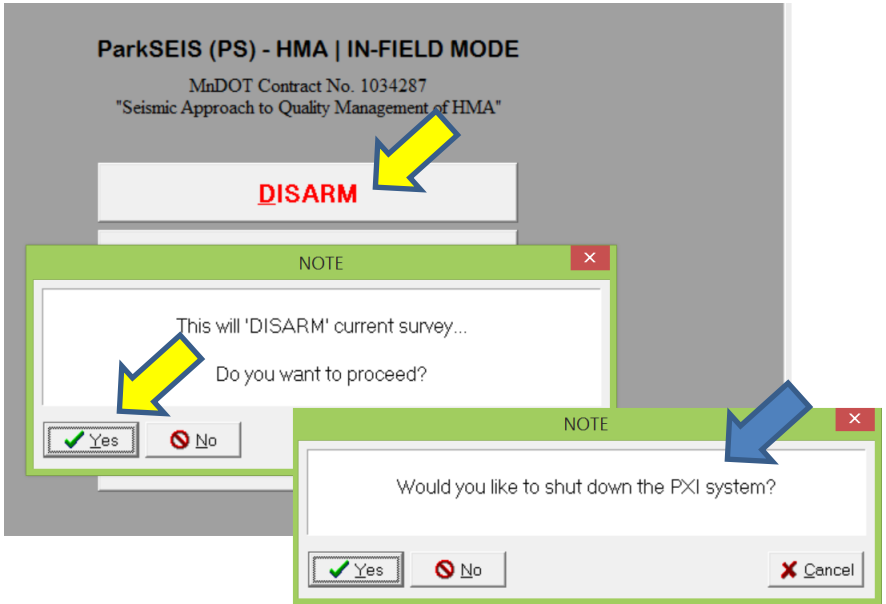
This file ("STOP.TXT") is written when PS-HMA program is closed to signal the shutdown of the PXI system. Therefore, the file will have be to deleted by the PXI control software right before its shut down.

PXI Detection and Shutdown



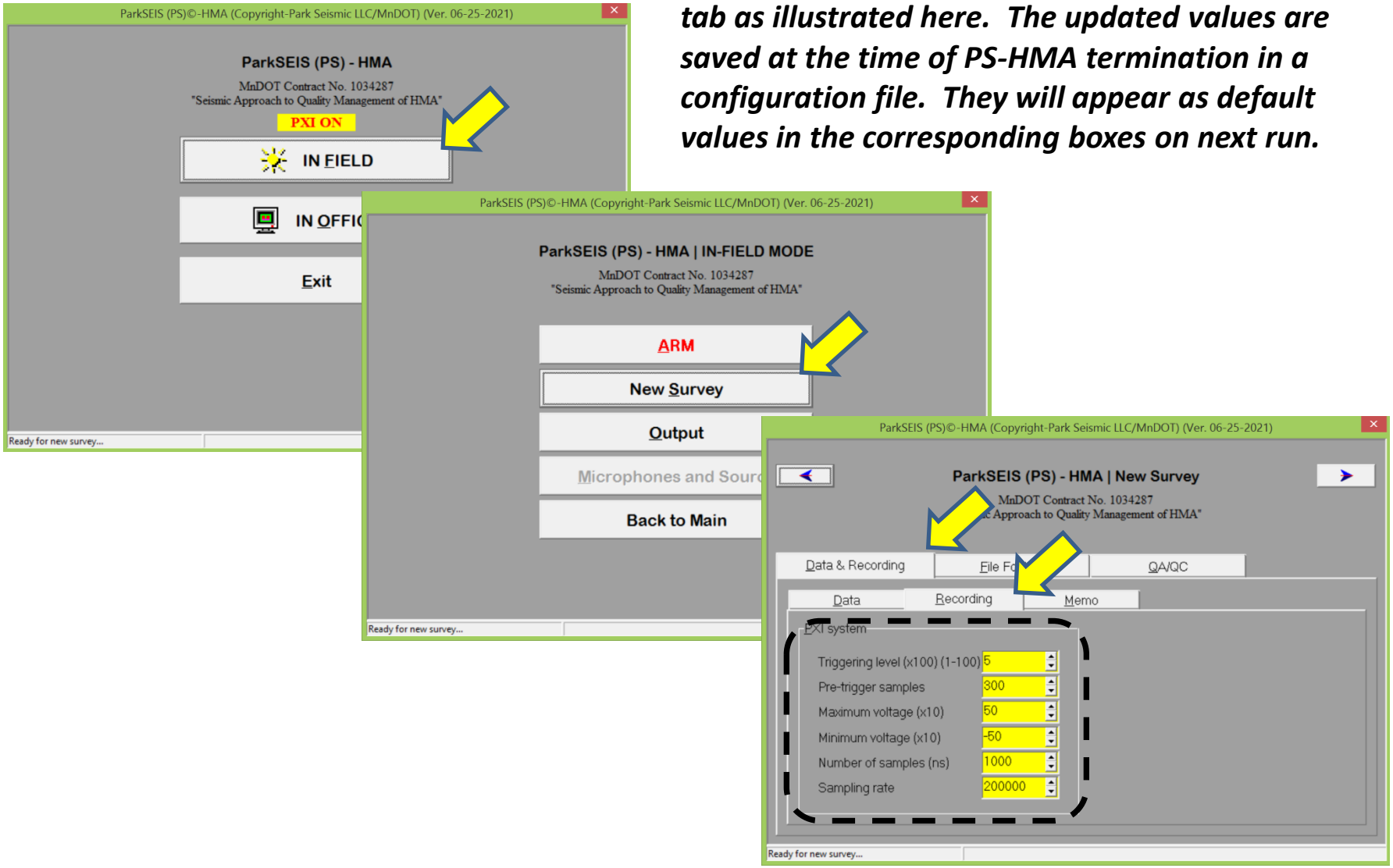
After the first run of the program, the PS-HMA will remember the previous PXI folder and try to detect it at the beginning of the execution. If it is detected, it will display the message as shown on top. It will then show "PXI ON" label on the main menu of the HMA dialog (middle). This label will be used for some other purposes in the future.

PXI can be shut down, when the user clicks the "Exit" on the main menu of PS-HMA (not the "Exit" on the HMA dialog) as previously shown (i.e., item 4 click). The same option will also be provided at the time of "DISARM" (bottom). Please refer to "Suggestions for Next JFT" on the last page for further information.

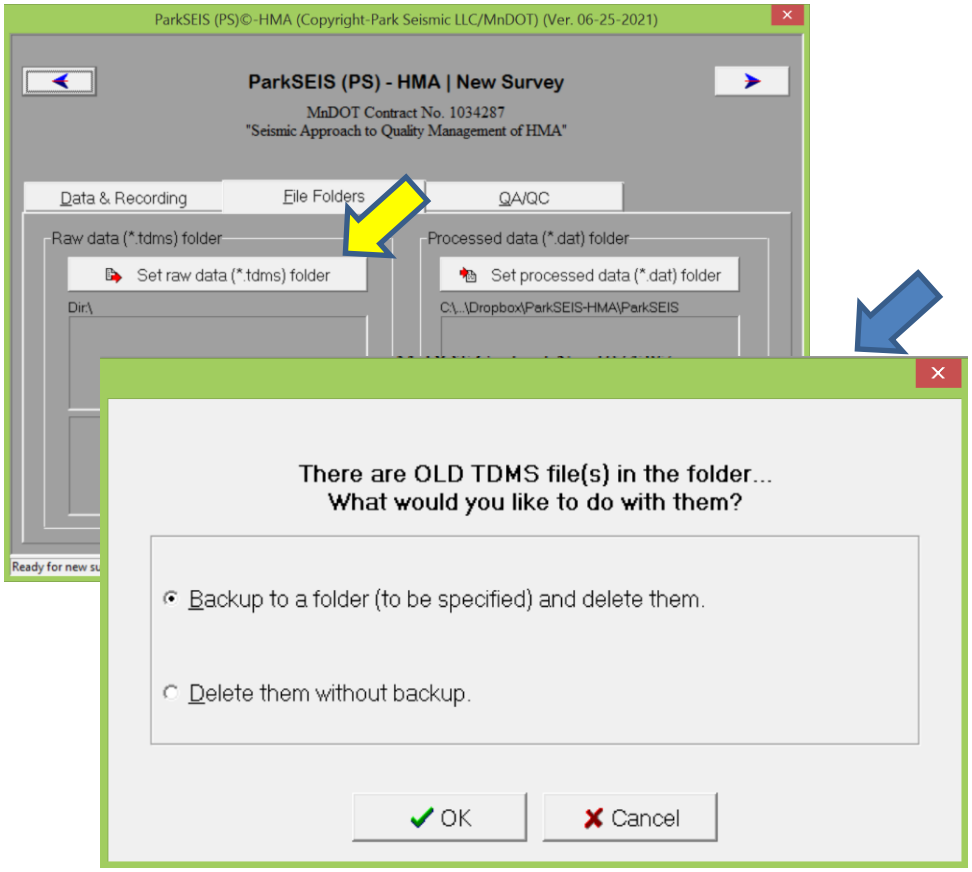


“SETUP.TXT” Parameters in PS-HMA

The six (6) parameters included in “SETUP.TXT” file can be changed in PS-HMA by going to a dedicated tab as illustrated here. The updated values are saved at the time of PS-HMA termination in a configuration file. They will appear as default values in the corresponding boxes on next run.



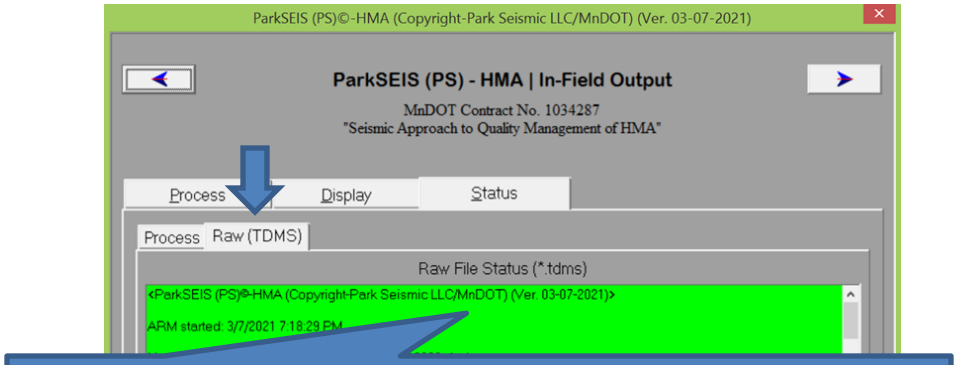
Backup or Delete of OLD TDMS files



When specifying the PXI folder by clicking the "Set raw data (*.tdms) folder" button (top), the PS-HMA will check if there are old TDMS files existing in the folder. If so, then it will provide options; i.e., "Backup to a folder" in the laptop computer and then delete them, or just "Delete them without backup" (bottom). If the first option is chosen, then a further dialog will appear to set a backup folder within the designated folder in the C drive of the laptop computer (e.g., "C:\Seismic Data\OldMeasurementFiles\Backup0623 2021\").

Suggestions for Next JFT

1. **It is recommended repeating the previous JFT executed on February, but this time on a “warm” day. Run the same (or similar) survey previously performed (e.g., collecting 50, or more, TDMS files continuously). As soon as the survey is finished and the survey vehicle stops, then wait until all acquired TDMS files are copied to the laptop computer. This task will be accomplished first because it gets the highest priority in PS-HMA now. When the panel in the “Raw (TDMS)” tap becomes lime color as shown below, it indicates all TDMS files have been copied.**
2. **Then, click the ‘DISARM’ button by going back to the “In-Field Mode” page in the HMA dialog. The “DISARM.TXT” file will be written on the PXI folder.**
3. **At that time, the program (PS-HMA) will ask if you want to shutdown the PXI system. If chosen so, then it will write “STOP.TXT” on the PXI folder (right after deleting “DISARM.TXT”), which should shut down the PXI system.**
4. **Let the program (PS-HMA) finish the remainder of the analysis. It should not take more than 20 minutes to finish the entire analysis because of the updated analysis algorithm.**



When all TDMS files have been copied, this panel color becomes lime. This is when the “DISARM” button can be clicked and the PXI can be turned off.