

**TRANSLATIONAL SCIENCE AT THE NEURAL INJURY CENTER**

MUS Research and Economic Development Initiative

1<sup>st</sup> Quarterly Report

August 2016-October 2016

Primary Objective Updates.....	p2-19
Primary Objective Budget Reports.....	p20-23

**Objective 1: Expand current clinical capabilities of the Neural Injury Center (NIC) and support translational research.**

*a) Hirings:*

- The Clinical Research Coordinator's contract will not be renewed, as it was determined by the PI's that the limited dollars needed to be reallocated to support the companies.
- The Neural Injury Center remains without a Director, though a candidate is being actively considered for the position at this time.
- Patient testing is now being done by trained technical staff in the Santos and Rau labs, rather than by the PIs.

*b) Equipment:*

- N/A

*c) Progress towards milestones:*

- Screening of student veterans, student athletes, ex-NFL athletes, and others in need has continued.
- The Medicare Application required a revision and was fully re-submitted in early November. When this is finally approved, the NIC will be able to expand its patient populations..
- The COO recently created her own consulting and services company, an LLC, in order to continue to support the private companies that were created by the MREDI funds, as well as to cover her own financial needs in the event the MREDI funding does not continue beyond the summer.
- The patient-centered outcomes UW Scholar project being conducted by the COO related to identifying barriers to TBI screening in 2 at-risk Montana populations is now well underway, and surveys are currently being disseminated. Results will be analyzed in the spring.
- The COO was just named the UM Navigator as a liaison to the University of Washington Institute of Translational Health Sciences. In this role, she will work to expand opportunities and collaborations with the UW translational research programs and programs like the NIC at UM.
- Progress related to dissemination of information about the Center:
  - 1) The **Montanan** magazine did an interview with Dr. Santos and Cindi Laukes and this article appeared in September.

- 2) A more recent brief article will be published in the magazine, *Distinctly Montana*, on the NIC's work.
  - 3) Student veteran advisors are meeting regularly with the COO and continue to spread the word about our research services throughout the regional veterans' community.
- The NIC collaborated with UM's Brain Initiative and UMHM to present a public talk on depression and suicide by an internationally recognized expert. This talk was successfully held and attended by 100 people in October.
  - NIC investigators met with a representative of the Shultz Foundation and are currently revising a white paper to be shared with them.
  - NIC investigators and COO continue to meet with donors at the request of Dean Humphrey, and regular bi-weekly meetings are now occurring with the NIC team and Dean Humphrey to update on progress and strategize for the future.

## Objective 2: Develop a comprehensive panel of objective tests to diagnose mild TBI (mTBI).

### a) *Hirings:*

- A recent graduate engineer was hired to facilitate the coding required for this project. Unfortunately, the engineer was recruited to a permanent position out of state.

### b) *Equipment purchased:*

- One laptop and 3 DAQ boards have been purchased to continue development of both systems; *BalanceLab* and *Lucius*.

### c) *Progress towards milestones:*

Our studies are on schedule and since our last report we have achieved the following milestones:

- Recruitment and data collection from control and TBI participants continues.
- Currently, all necessary data from balance and oculomotor performances have been gathered and are now being presented in journal article format, and presentations to local clinicians.
- A journal article based on these results have been published.  
Degani AM, Santos MM, Leonard CT, Rau TF, Patel SA, Mohapatra S, **Danna-dos-Santos A.** (2016) The effects of mild traumatic brain injury on postural control. *Brain Injury* (In press).
- Development of the balance system (*BalanceLab*) continues and the 1<sup>st</sup> clinical viable prototype was delivered in the month of February. Its user interface is also finalized and ready for commercialization.
- A second system for acquisition and analysis of analog bio-signals has also been developed and is ready for commercialization (*Lucius vs 1.0*).
- A spin-off company (*Synergy Applied Medical and Research*) was created for the commercialization of these products and, in order to increase the likelihood of the company's success we established a partnership with a Brazilian company (EMG systems of Brazil). This partnership will be officially launched in January 1<sup>st</sup> 2017 when the commercial website will be deployed online. EMG Systems of Brazil will be producing their entire line of products in Missoula and *Synergy* will represent and commercialize them.
- *Synergy* is also planning on become the first satellite clinical site arising from this award initiative.
- Since the research work has achieved many milestones earlier than expected, we have already started satellite research work by introducing investigations aiming to record normative data from school aged children and senior citizens (> 65 years of age).



**Objective 3: Develop miRNA inhibitors to reduce neuropathology after TBI.**

*a) Hirings:*

- Have a graduate student on a lab rotation project to characterize the interaction of miRNA with the mRNA of potential gene targets altered following TBI.

*b) Equipment purchased:*

- N/A

*c) Progress towards milestones:*

- Continued *in-vitro* testing of candidate miRNA agomiRs and inhibitors on protein expression of miRNA targets by western analysis using the WES System (ProteinSimple, San Jose, CA).
- Behavioral analysis in 16 rats exposed to mild and severe TBI paradigms continues. Testing of these animals will be followed by molecular analysis on the effects of the potential neuro-protective drug.
- Continuing analysis of human chronic traumatic encephalopathy (CTE) tissue received from the Center for Traumatic Encephalopathy brain bank, Boston University (Boston, MA). Both protein and miRNA measures are being evaluated.

**Objective 4: VAST: Next Generation Learning, Complete the development of a computer-based cognitive training (CCT) system for TBI subjects with cognitive impairment.**

*a) Hirings:*

- N/A

*b) Equipment purchases:*

- N/A

*c) Progress towards milestones:*

**VAST Milestones Completed**

**Previous (Q1-Q4)**

- HTML5 mobile training app completed, including backend/database and user interface (UI), for mTBI treatment on iOS and Android mobile systems;
- Development of set of 8 training levels and 40 training exercises for mTBI identified and completed.
- Testing of prototype with 25 subjects completed and user feedback captured.
- Divergent thinking data obtained and scored from 25 subjects.
- Gamification of 8 levels of mTBI divergent thinking training completed, including intra-exercise scoring feedback and development of incremental training levels necessary for subject engagement and adequate progression through tasks.
- Prototype completed of new variation of figural Trail Making Test as part of updated figural training package.
- Research of RUFF figural test as potential component of mTBI training package.
- Enhancement of front-end UI/UX based on user feedback in Q2.
- Development of scoring norms for training exercises.
- Development of new components of training based on Trail Making Test, Ruff Figural Fluency Test, and Reyes Complex Figural Test.
- Additional gamification of exercise presentation, scoring, and presentation of training progress.
- Initial testing of Virtual Reality (VR) prototype and software platform, including eye-tracking

**Newly Completed (Q1 Y2)**

- Identification of testing subjects for training levels (mTBI and non-mTBI); preparation for controlled testing.
- Research and development of Virtual Reality version of tests.
- Research and development of hardware components of VR necessary to support TBI diagnostics and cognitive rehabilitation.

## **In Progress (Q6)**

- Testing platform with subjects.
- Completion of new testing elements for mobile platform.
- Development of new Virtual Reality version of tests.
- Research and initial testing of hardware components of VR necessary to support TBI diagnostics and cognitive rehabilitation.

**Objective 5: Complete the development and testing of a novel post-traumatic epilepsy diagnostic analysis program.**

### N-SITE LLC Status Report

<b>Project</b>	01030-MUSRI2015-01, Objective 5
<b>Reporting Period</b>	February 2016 – May 3, 2016
<b>Project/Engagement Manager</b>	Alex Philp, Ph.D. - PI

a) *Hirings:*

- N/A

b) *Equipment purchases:*

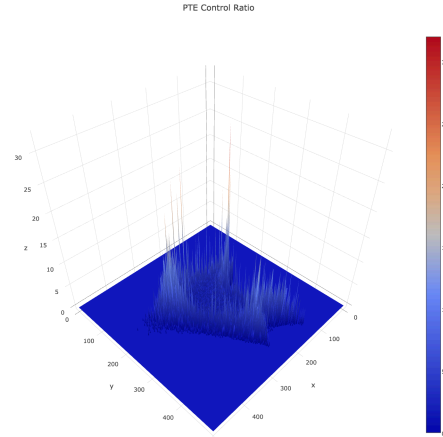
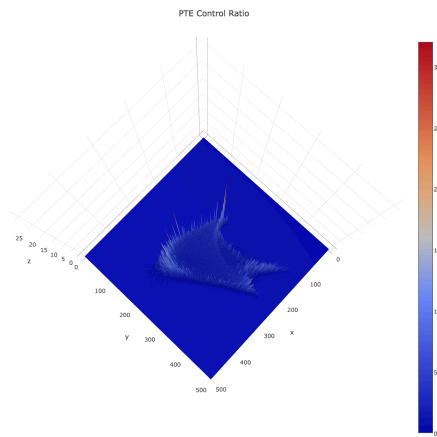
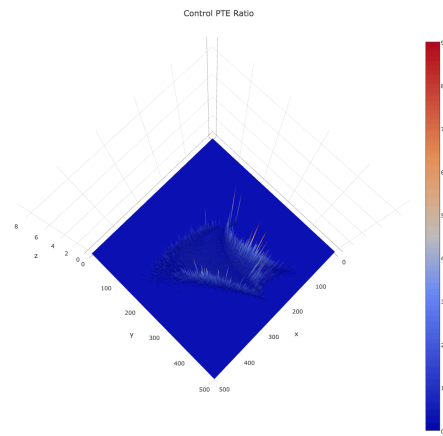
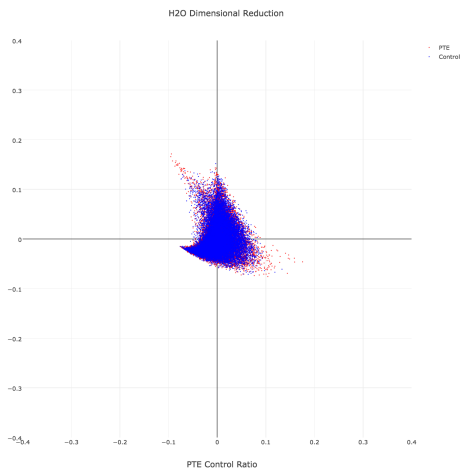
- N/A

c) *Progress towards milestones:*

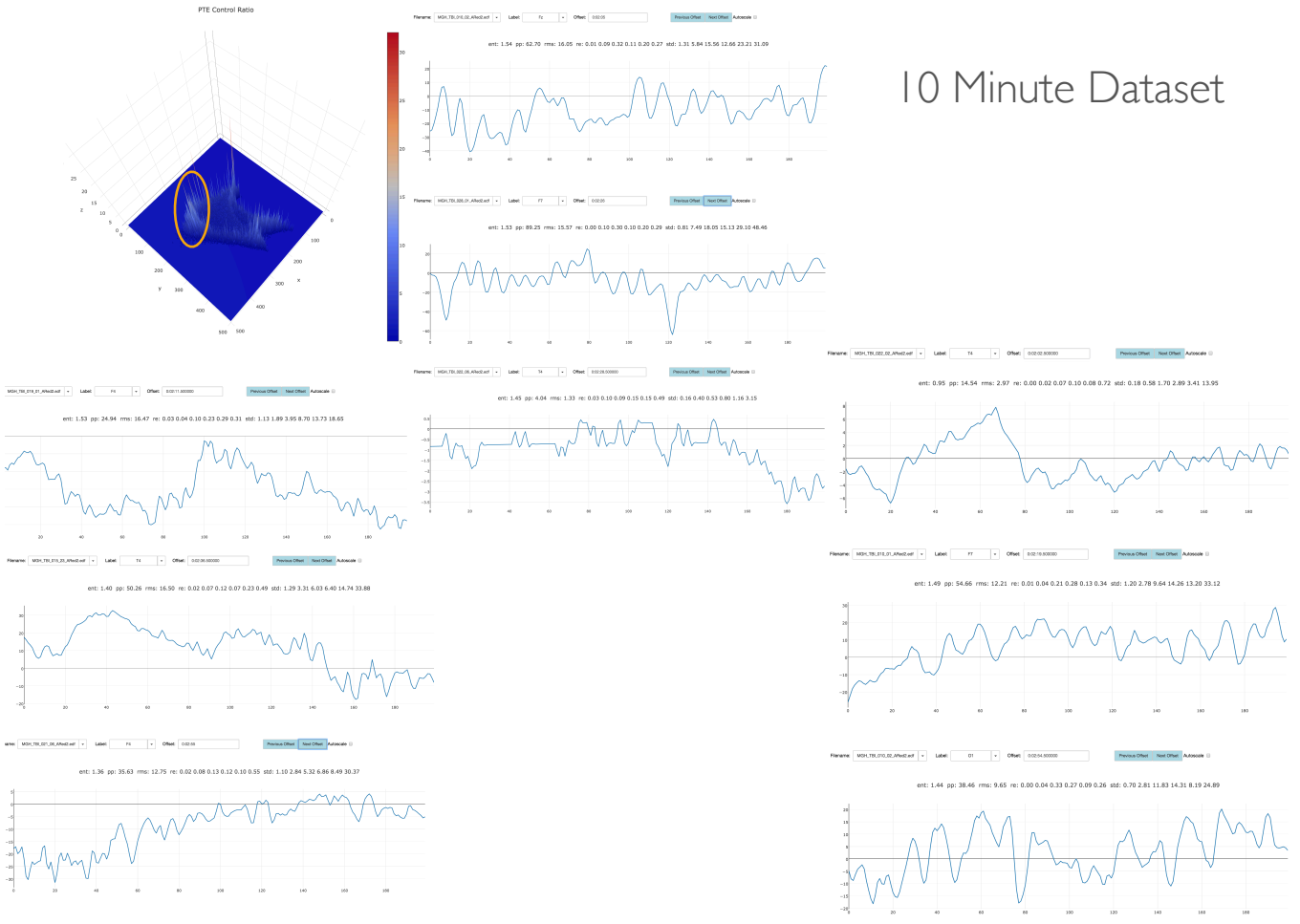
- N-SITE Objective 5 has entered into a comprehensive and systematic analysis of our TBI and PTE population cohorts. Working closely with members of the NIC Scientific team, Drs. Rau and Santos, we have been examining the data clouds and conducting two types of analysis: 1) general empirical analysis of patterns and statistical trends in the data using machine learning algorithms for desiccation and dimensional reduction prior to visualization and 2) primary EEG analysis of electrical signals to look for significant tests for electrical connectivity between different parts of the brain in the TBI and PTE populations.
- In area 1, for 10, 20 and 30 analysis and modeling of the data, we continue to find significant differences in the data between the TBI population and the patients that went on to development PTE. We have identified where this area are in the data fields, and are attempting to determine if they are 1) real 2) significant and 3) potentially indicative and diagnostic. In particular, we have found and it holds between different EEG time measurements that a PTE/*Control* ratio shows consistently that certain EEG low frequency bands contain the most of the RE – relative energy. So, low frequency bands are carrying the energy and this is different between the non-PTE group. This holds for 10, 20, and 30-minute sampling and modeling from EEG data. The goal is to determine if we have statistical artifacts and false signals, and also, to develop ways of accurately characterizing and creating a statistically valid method for development a research-level biomarker indicator for the TBI patient at risk of development PTE. We should have preliminary conclusions and findings about our methodology by end of December 2016.

- Regarding item #2, we have initial results from Dr. Santos' analysis, but we have not derived any conclusions because of the analysis of the EEG data. This will occur in the coming weeks. Again, the primary goal in analyzing the raw EEG data was to determine any connectivity issues, which may be indicative of a patient that is at risk of development PTE, or, in fact, has PTE.
- We have a program milestone for end of December 2016 for preliminary conclusions, results, and analysis of next steps based upon our findings.
- See attached slides 1-10 for analysis on item #1.

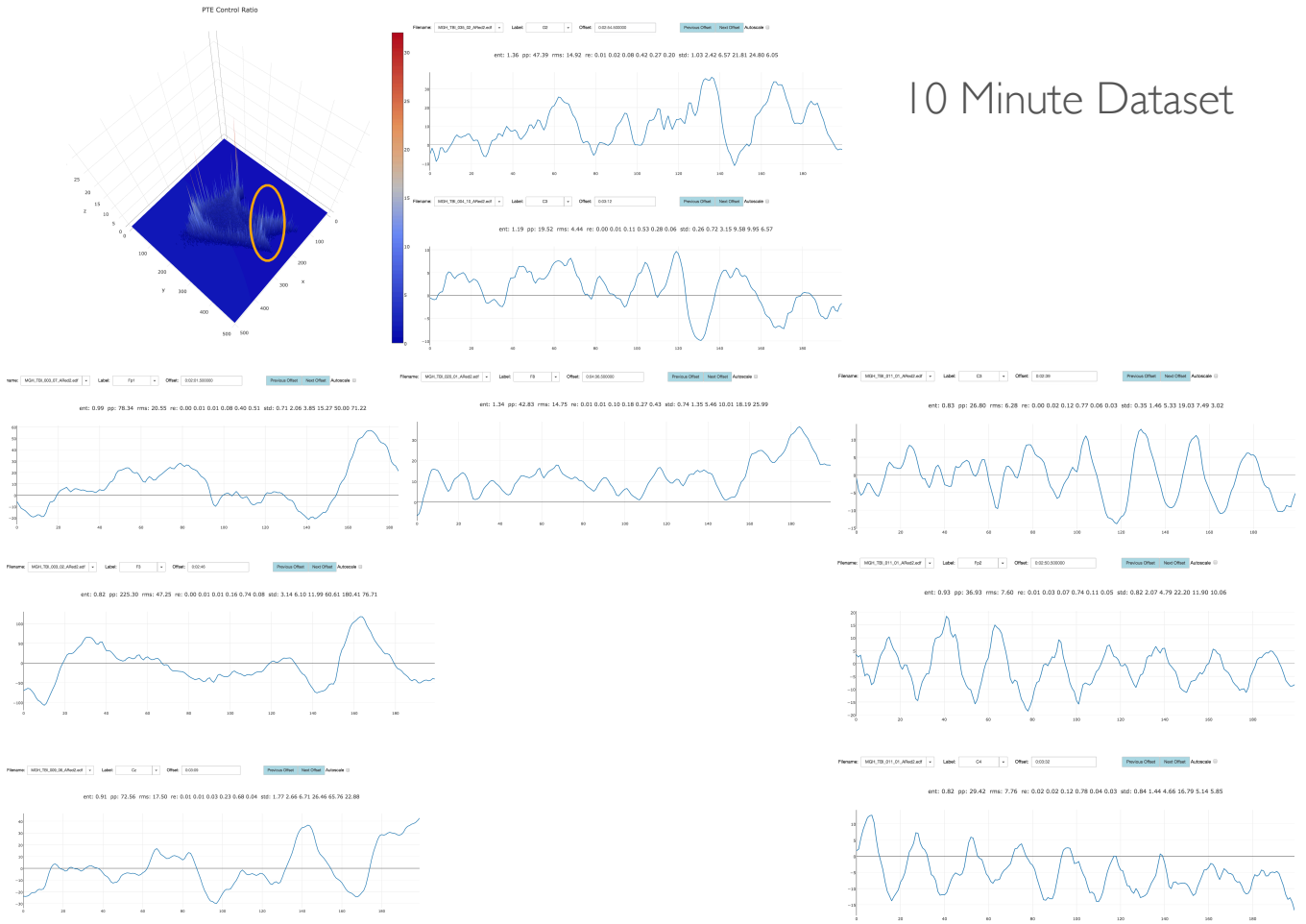
# 30 Minute Model, 10 Minute Dataset



# 10 Minute Dataset

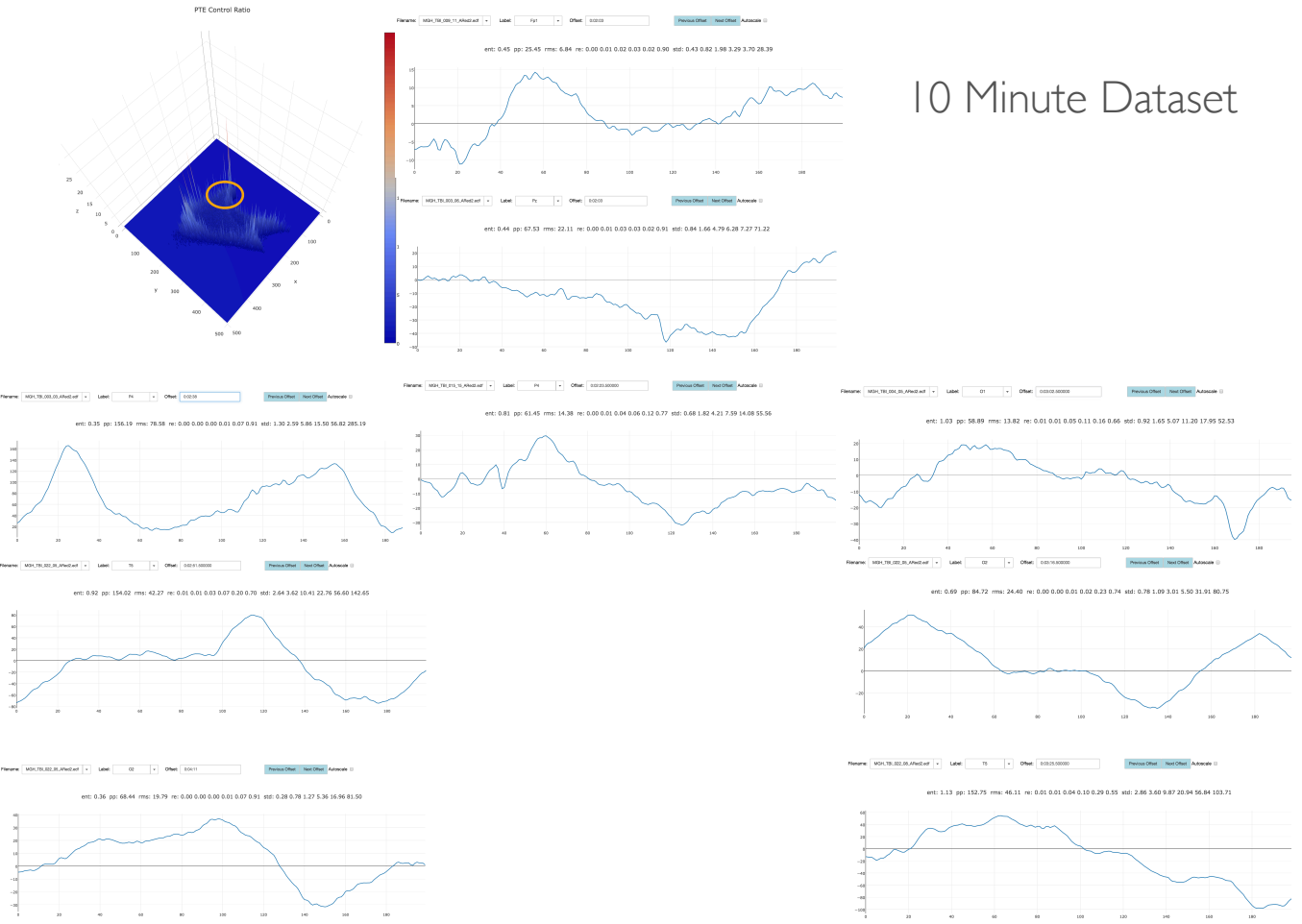


# 10 Minute Dataset

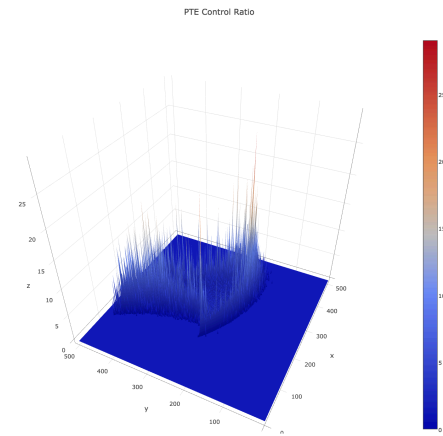
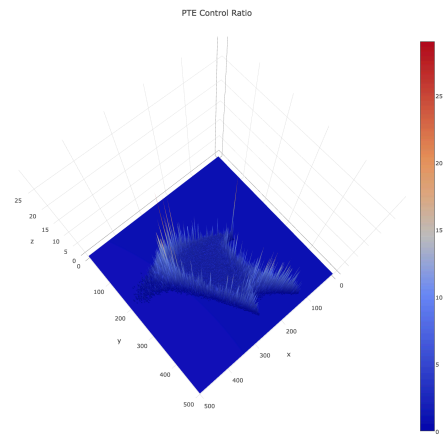
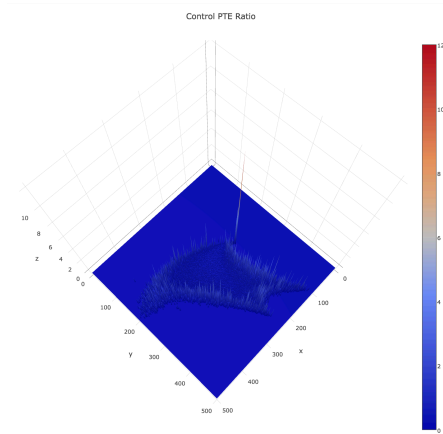
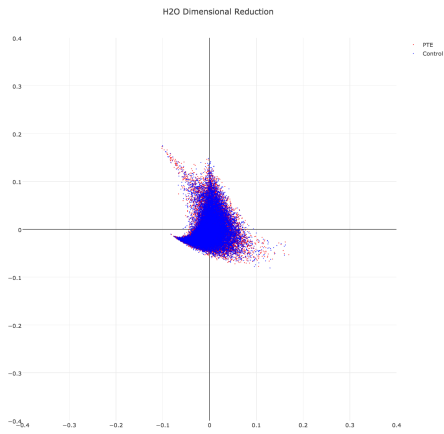




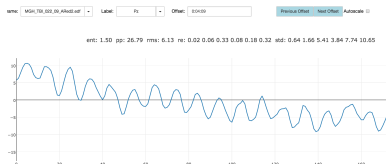
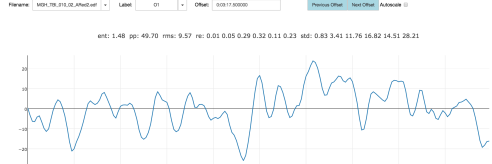
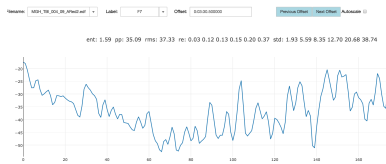
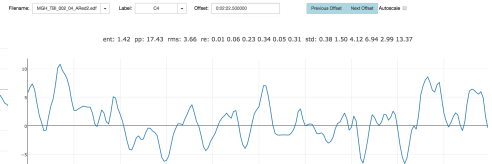
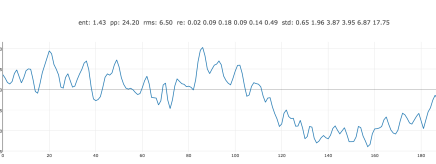
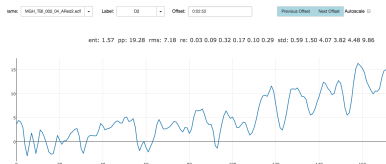
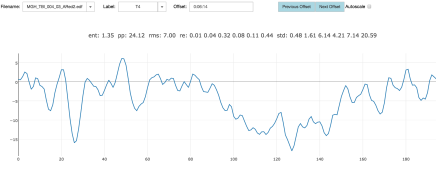
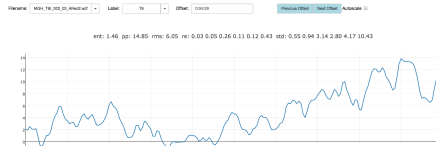
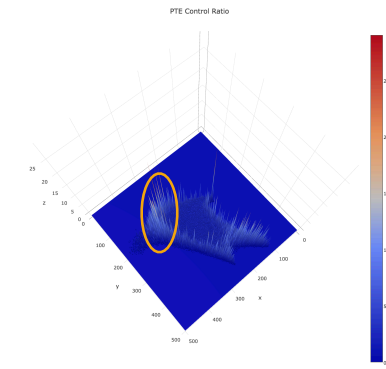
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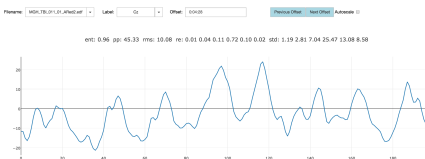
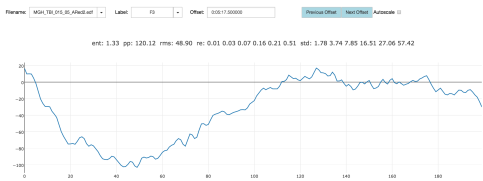
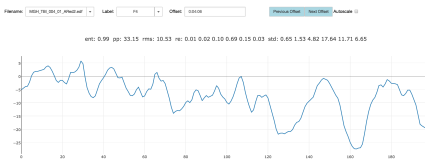
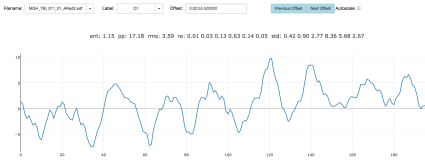
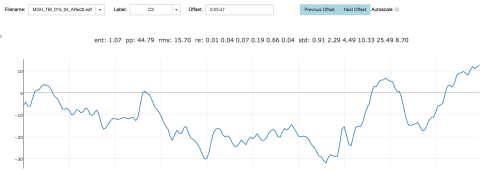
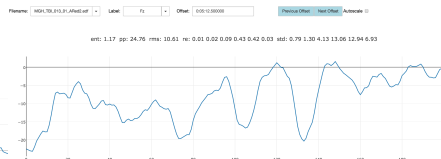
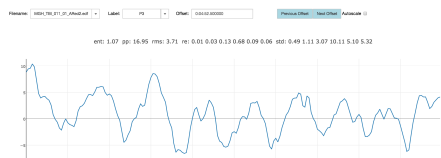
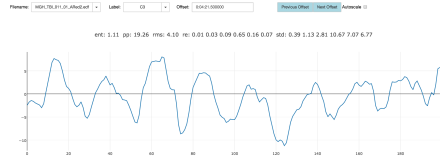
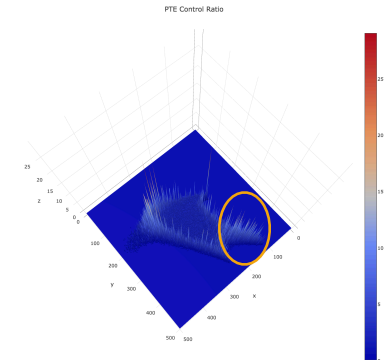
# 30 Minute Model, 20 Minute Dataset



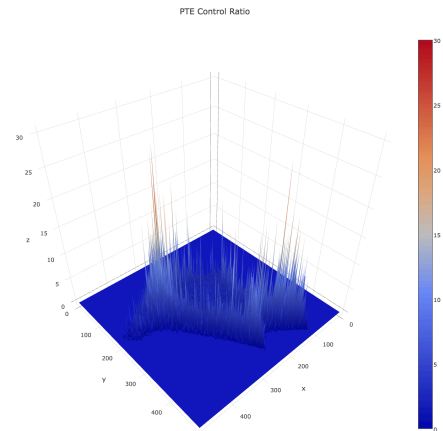
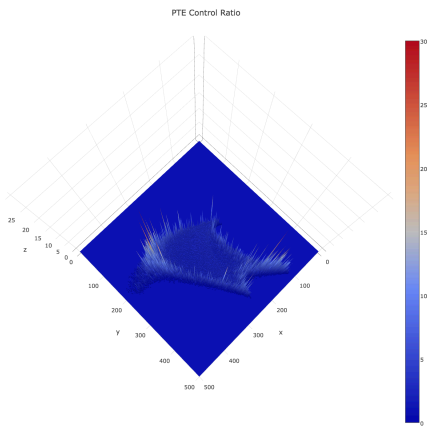
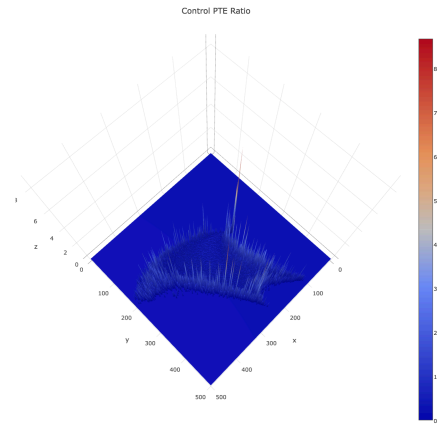
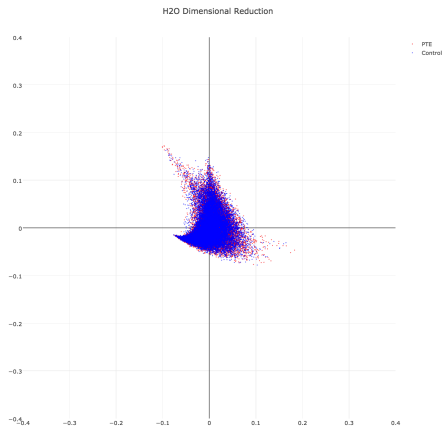
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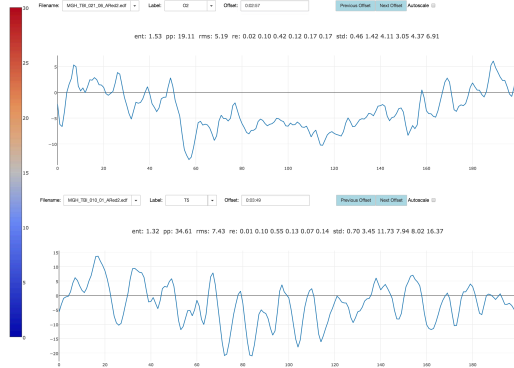
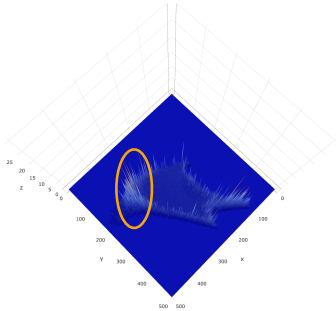
# 20 Minute Dataset



# 30 Minute Model, 30 Minute Dataset

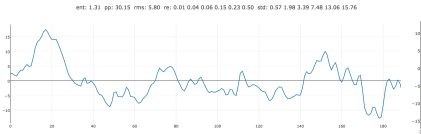


PTE Control Ratio

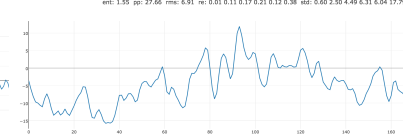


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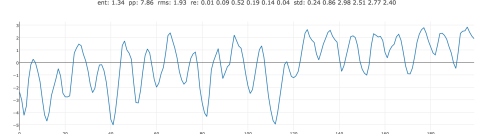
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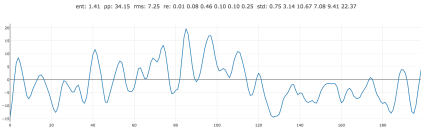
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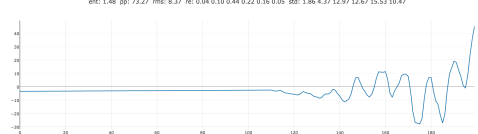
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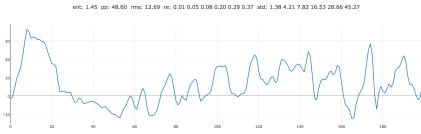
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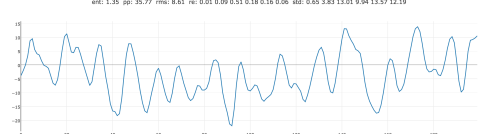
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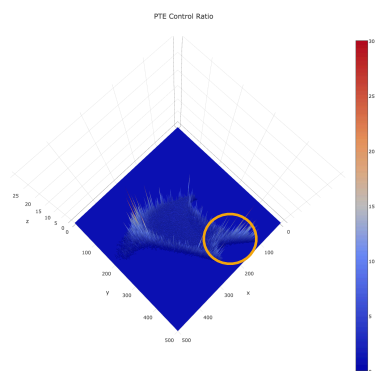


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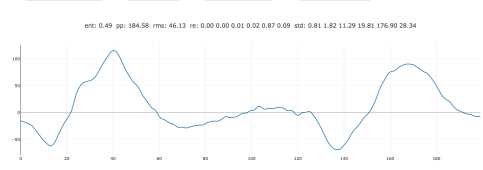
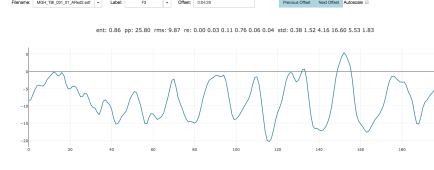
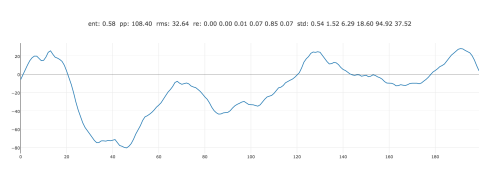
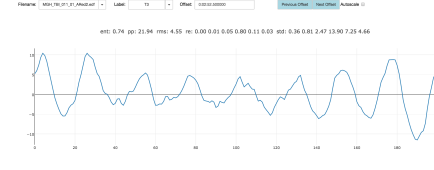
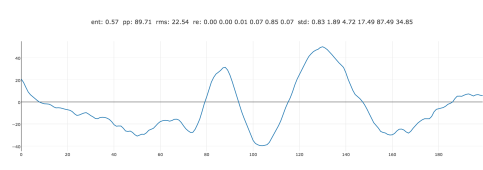
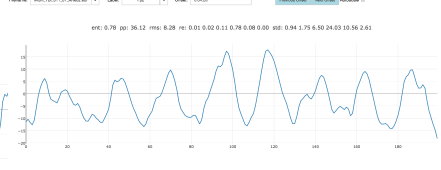
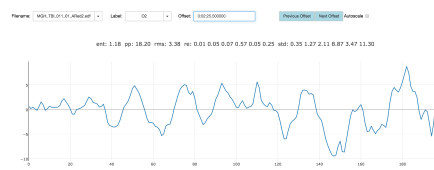
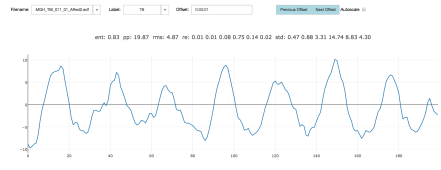
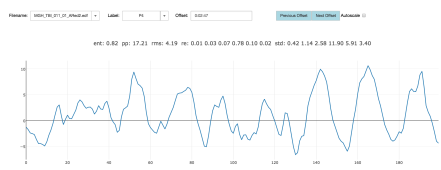


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# 30 Minute Dataset



## Quarterly Budget Reports

### Objective 1:

#### MUS MREDI Objective 1 - Operating Statement - Inception to Date

Institution: University of Montana (BMED/NIC)

PI: Dr. Sarjubhai Patel

Banner #: MPHR01

Report Date: 11/10/2016

Account	Description	Total Budget	Expenses to Date	Remaining
61124	Contract Professional	-	129242.67	
61125	Classified Employee		11786.23	
<b>61199</b>	<b>Personnel Services-General</b>	<b>383,000.00</b>	<b>141,028.90</b>	<b>241,971.10</b>
61401	FICA	-	8703.68	
61402	Retirement		990.27	
61403	Group Insurance	-	42065.17	
61404	Workers Compensation	-	863.11	
61409	Medicare Tax	-	2035.56	
61410	State Unemployment Tax	-	352.66	
61415	TIAA-CREF Retirement	-	12459.44	
61415A	TIAA-CREF 1% HB95	-	1297.72	
61498	Grant & Contract Leave Assessmen	-	16801.19	
<b>61499</b>	<b>Benefits-General</b>	<b>185,863.00</b>	<b>85,568.80</b>	<b>100,294.20</b>
62102	Consult & Professional Services		11,869.05	
62191	Printing		326.25	
<b>62199</b>	<b>Contracted Services-General</b>	<b>47,000.00</b>	<b>12,195.30</b>	<b>34,804.70</b>
62208	Laboratory Supplies	-	1,423.63	
62210	Minor Equipment		4.88	
62241	Office Supplies		156.70	
62245	Computer Equipment <\$5,000		3,931.25	
62282	Ink		242.26	
<b>62299</b>	<b>Supplies-General</b>	<b>-</b>	<b>5,758.72</b>	<b>(5,758.72)</b>
62371	Telephone Equipment		291.50	
62382	Data Circuits-Add/Move/Change		42.00	
<b>62399</b>	<b>Communications-General</b>	<b>-</b>	<b>333.50</b>	<b>(333.50)</b>
62401	In State Personal Car Mileage		65.07	
62408	In state Lodging		207.3	
62497	Non-Employee In State		675.4	
<b>62499</b>	<b>Travel-General</b>	<b>-</b>	<b>947.77</b>	<b>(947.77)</b>
62815	Recruiting		142.00	
<b>62899</b>	<b>Other Expenses</b>	<b>-</b>	<b>142.00</b>	<b>(142.00)</b>
<b>TOTALS</b>		<b>615,863.00</b>	<b>245,974.99</b>	<b>369,888.01</b>



**Objective 2:**

**MUS MREDI Objective 2 - Operating Statement - Inception to Date**

**Institution: University of Montana (BMED/NIC)**

**PI: Dr. Sarjubhai Patel**

**Banner #: MPHR02**

**Report Date:** 11/10/2016

<b>Account</b>	<b>Description</b>	<b>Total Budget</b>	<b>Expenses to Date</b>	<b>Remaining</b>
61123	Contract Faculty	-	187,567.99	
61124	Contract Professional		3,654.99	
61126	Graduate Teaching Assistant		9,733.32	
61127	Graduate Research Assistant		2,674.26	
61225	Student		10,862.74	
<b>61199</b>	<b>Personnel Services-General</b>	<b>334,478.00</b>	<b>214,493.30</b>	<b>119,984.70</b>
61401	FICA	-	11,766.22	
61403	Group Insurance	-	15,786.13	
61404	Workers Compensation	-	1,322.10	
61409	Medicare Tax	-	2,751.79	
61410	State Unemployment Tax	-	486.14	
61415	TIAA-CREF Retirement	-	18,409.53	
61415A	TIAA-CREF 1% HB95	-	1,912.21	
61498	Grant & Contract Leave Assessment		10,417.95	
<b>61499</b>	<b>Benefits-General</b>	<b>130,949.00</b>	<b>62,852.07</b>	<b>68,096.93</b>
62157	Printing Services-Internal		285.00	
<b>62199</b>	<b>Contracted Services-General</b>	<b>37,500.00</b>	<b>285.00</b>	<b>37,215.00</b>
62208	Laboratory Supplies	-	13,531.33	
62210	Minor Equipment		1,040.94	
62241	Office Supplies		30.45	
62245	Computer Equipment <\$5,000		1,905.50	
62249	Minor Software <\$100,000		30,349.58	
62282	Ink		143.88	
<b>62299</b>	<b>General Supplies</b>	<b>25,000.00</b>	<b>47,001.68</b>	<b>(22,001.68)</b>
62304	Postage & Mailing		4.94	
<b>62399</b>	<b>Communications-General</b>	<b>-</b>	<b>4.94</b>	<b>(4.94)</b>
62426	Foreign Travel		2,359.68	
<b>62499</b>	<b>Travel-General</b>	<b>-</b>	<b>2,359.68</b>	<b>(2,359.68)</b>
62701	Buildings & Grounds		427.80	
<b>62799</b>	<b>Repairs &amp; Maintenance</b>	<b>-</b>	<b>427.80</b>	<b>(427.80)</b>
<b>TOTALS</b>		<b>527,927.00</b>	<b>327,424.47</b>	<b>200,502.53</b>

**Objectives 3, 4 & 5**

**MUS MREDI Objectives 3, 4 & 5 - Operating Statement - Inception to Date**  
*Includes Subcontracts to VAST (Obj 4) and N-SITE (Obj 5)\**

**Institution: University of Montana (BMED/NIC)**

**PI: Dr. Sarjubhai Patel**

**Banner #: MPHR03**

**Report Date:** 11/10/2016

Account	Description	Total Budget	Expenses to Date	Remaining
61123	Contract Faculty	-	76,750.99	
61125	Classified Employee	-	82,114.52	
<b>61199</b>	<b>Personnel Services-General</b>	<b>250,844.00</b>	<b>158,865.51</b>	<b>91,978.49</b>
61401	FICA	-	9,201.53	
61402	Retirement	-	3,395.38	
61402C	ORP-Staff TIAA Cref	-	3,552.09	
61403	Group Insurance	-	35,693.38	
61404	Workers Compensation	-	3,610.12	
61409	Medicare Tax	-	2,151.95	
61410	State Unemployment Tax	-	397.20	
61415	TIAA-CREF Retirement	-	7,342.51	
61415A	TIAA-CREF 1% HB95	-	761.50	
61498	Grant & Contract Leave Assessment		13,833.03	
<b>61499</b>	<b>Benefits-General</b>	<b>122,932.00</b>	<b>79,938.69</b>	<b>42,993.31</b>
62147	Subcontract Payments*	-	50,000.00	
62147A	Sub Contract Payments > 25,000*	-	348,933.00	
62195	Professional Services-Internal	-	85.91	
<b>62199</b>	<b>Contracted Services-General</b>	<b>562,000.00</b>	<b>399,018.91</b>	<b>162,981.09</b>
62208	Laboratory Supplies	-	36,897.16	
62208A	Laboratory Supplies - Animals		3,015.95	
62210	Minor Equipment		4,254.09	
62245	Computer Equipment <\$5,000		324.95	
62249	Minor Software < \$100,000		150.00	
62263	Veterinary Supplies		101.25	
<b>62299</b>	<b>General Supplies</b>	<b>155,268.00</b>	<b>44,743.40</b>	<b>110,524.60</b>
62304	Postage & Mailing		271.25	
<b>62399</b>	<b>Communications-General</b>	<b>-</b>	<b>271.25</b>	<b>(271.25)</b>
62802	Subscriptions		99.00	
<b>62899</b>	<b>Other Expenses</b>	<b>-</b>	<b>99.00</b>	<b>(99.00)</b>

<b>TOTALS</b>	<b>1,091,044.00</b>	<b>682,936.76</b>	<b>408,107.24</b>
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*Subcontract Subtotals Next Page ---->*

<b>Subcontract Totals to Date*</b>			
<b>Company</b>	<b>Total Budget</b>	<b>Expenses to Date</b>	<b>Remaining</b>
VAST (Objective 4)	262,000	141,333.00	<b>120,667.00</b>
N-SITE (Objective 5)	300,000	257,600.00	<b>42,400.00</b>
<b>TOTALS</b>	<b>562,000</b>	<b>398,933.00</b>	<b>163,067.00</b>