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Recipient

Electro Magnetic Applications Inc.	143 Union Blvd #900, Lakewood, CO, 80228, United States of America	Timothy McDonald	tim@ema3d.com

THIS IS A PRELIMINARY LIST OF TASKS PERFORMED UNTIL THIS DATE AFTER LAST BILL AAA202407230 REQUESTED BY EMA BY TOM CHUMASH AND BO SHELBY. THIS IS NOT A BILL.

XXXXXXX Number	**Date**	**Payment Due**	**Project Name**
XXX202409120	September 12, 2024	NOT A BILL	Charge Plus Optimization

ITEM	**TIME [min]**	**RATE [$/minute]**	**SUBTOTAL**
August			
Backlog of configurations required to run charge on Linux. Fix problems with license, problems with transferring files into the Linux machine (WinSCP). Familiarize with modifications in the test suite regarding execution scripts and locations of files until successful execution of tests. Tests are needed to guarantee that the version used is not only correct but also compiled correctly. General overlook of data structures in VectorSolve , identify coverage of the given test, time properly.	180	5.0	$900.00
September			
Time measurements and determination of the time bottlenecks in FemQS::VectorSolve. Discovery of main bottleneck due to the usage of CSR-Format data structures that was underperformant in the past when working with FemMatrix::parvector to optimize FemMatrix::BiCGStabVectorSolve	120	5.0	$600.00
New FemQS.cpp file created with loop simplification to improve vectorization. Measurements give 70% speed-up on FemQS::UpdateGlob and 40% speed-up on FemQS::VectorSolve.	120	5.0	$600.00
Microsoft Teams chat, delivered new FemQS.cpp for testing, explained changes involved and impact of loop simplifications. Agreed on concentrating in BuildForce, BuildGrad and GradSolve!.	65	5.0	$325.00
Study of FemQS::BuildForce. Identification of critical loop and assignments. Findings show a high amount of branching, recommendations issued.	120	5.0	$600.00
Microsoft Teams conversation about the usage of MPI_AllReduce in ReadNew::PIC::VectorAll. Recommeded usage of MPI_Reduce instead to reduce operations by a factor of 2 since no redistribution of the final result is needed for writing results to disk.	30	5.0	$150.00
		Total	$3,175.00