M&O Closeout

1. M&O is going well with a staffing level of ~ 100 FTE’s. The in-kind contributions to the data analysis are large.

2. The U of W continues to support IceCube in a strong manner. Examples are taking over network maintenance and providing significant computing maintenance and support along with financial backup.

3. A significant fraction of the simulation effort needed for extracting the physics from the raw data is provided by in-kind contributions from the IceCube collaboration.

4. The TXS event is the first neutrino driven example of multi-messenger astronomy and has received world-wide recognition. The IceCube collaboration should be congratulated for triggering it and then forming a very effective collaborative effort for the complete analysis.

5. The latest stand-alone time-integrated point source search based on 10 years of data includes a three sigma post-trial identification of M77 as neutrino emitter.

6. The low energy results from the Deep Core data have become an important component of the IceCube physics output in the neutrino oscillation sector. It is becoming very competitive with the other world neutrino experiments. The data from the Upgrade project when completed has the potential of determining the unitarity of the mixing matrix, and the mass hierarchy in combination with other experiments.

7. Supercomputing resources that employ GPU’s could significantly enhance the simulation effort needed for the data analysis. The staff to support the routine software maintenance has very little time to develop new software to more effectively use these resources.

8. The Panel encourages IceCube to pursue acquiring additional computing effort.

9. The M&O software group is taking the necessary steps to prepare for the data coming from the Upgrade strings when they are operational.