Summary of LASP study evaluations:

The Laboratory for the Atmospheric and Space Physics (LASP) is located at the University of Colorado in Boulder. The Polar/TIMAS instrument team is based at the LASP facility along with a portion of the Polar/CEPPAD team.

LASP appears to have the facilities, infrastructure and interest to take on a majority, but not the entirety, of the operations and data processing tasks for the Wind, Polar and Geotail spacecraft. With existing spacecraft operation rooms, appropriate network connectivity, and experienced staff members, it may be possible to operate Wind and Polar from the LASP facility. LASP personnel, with student support, are probably capable of processing and serving most of the required data products for the three spacecraft in a timely manner.

Re-engineering recommendations focus on the re-hosting of most all Wind and Polar operational and data processing procedures into the consolidated, multi-mission LASP/OASIS system. LASP also recommends that responsibility for Key Parameter processing, platform pointing data processing and quality control of level zero products be transferred to the individual instrument teams. LASP will not take on the responsibility of providing the Geotail/Sirius data to Japan.

Specific Strengths:

LASP has previous experience operating a number of space science missions, several simultaneously: SME (1981-1989), STRV-1A,1B (1996-1998), SNOE (1998-now), QuickSCAT (1999-now). ICESAT and SORCE will begin in 2002.

The LASP mission operations physical plant appears to be adequate for the operation of six satellites (four existing spacecraft plus Wind and Polar). The facility appears to comply with appropriate security standards. The ready availability of secure and open network connections is important and well addressed by the LASP team although verification of data bandwidth capabilities will be required and the existing method of network routing through GSFC will need further examination.

Successful, cost effective, conversion of spacecraft commanding, monitoring and control systems to the LASP OASIS software systems has the potential for significant long term cost savings. Wind and Polar operations would be well integrated with the established LASP mission operations and data processing procedures resulting in potentially reduced maintenance costs and operator training costs as long as multi-mission cost sharing applies. In addition, it is possible that science teams would be able to monitor instrument functions using this software rather than through instrument GSEs.

The LASP approach to minimize the amount of “hands on” attention is important and should, if this can be efficiently implemented, result in long term cost savings.

The LASP approach provides for a smooth, scalable, low-cost transition to single-spacecraft operations if and when some subset of the existing spacecraft are no longer supported.

LASP has expressed the willingness and ability to accommodate special commanding and processing requests and to work in a flexible fashion with GSFC engineers and the many PI instrument teams. Negotiations between GSFC and LASP regarding specific

approaches both during the transition and during operational periods can be expected to be amicable.

Specific Weaknesses:

None of spacecraft recently or currently operated by LASP approach the size and complexity of Polar and Wind. SME is closest at 437 kg and 6 science instruments but that mission ended 11 years ago. STRV1A and 1B were 52kg microsats flying ESA defense "monitoring" instruments. SNOE is a small student explorer with 3 instruments. QuikSCAT and ICESAT each have one instrument. SORCE (286kg) will be slightly more complex with 4 instruments. If all these spacecraft are relatively “simple” with little or no maneuvering and little science instrument commanding, which seems to be the case, then LASP has little experience with operating a large "hands-on" set of instrumentation such as Polar has, or experience with frequent spacecraft maneuvering such as Polar and Wind both have. The feasibility study does not adequately demonstrate how the additional operational complexities will affect their present spacecraft operations methods and how those impacts will be addressed.

The Polar, Wind and Geotail project would need to better understand the "little" need for additional computer hardware to support the Polar, Wind and Geotail operational and data processing activities. The submitted study does not detail the number, age or type of existing underutilized computer hardware. Similarly, the Polar, Wind and Geotail project needs to better understand the current LASP staffing plans and why the addition of three spacecraft does not create a need for some level of additional dedicated (non-student) professional support. This will be especially important to understand in consideration of the upcoming launches of ICESat and SORCE in 2002, the support of which the current staffing would necessarily be dedicated.

The Polar, Wind and Geotail project would need to better understand the extent to which student operators are utilized, training procedures, and security screenings employed upon hiring. The NASA/SEC enterprise would need to balance the worth of the Wind and Polar assets with the inherent risks associated with the “constant flux” of non-professional personnel.

The cost estimates provided are optimistic and will need substantial reworking or clarification. In particular, the development/validation/transition costs for re-hosting the real time spacecraft monitoring, the command management (CMS), and the LZ processing software packages, all expected to be significant tasks, are considered to be extremely optimistic. Travel expenses between LASP and GSFC and/or HQ would necessarily be greater than proposed in the study both because the estimates provided are considered inadequate and because additional travel for HQ and GSFC mandated health, safety and design reviews will most likely be necessary for any transition of important SEC assets. The ongoing material costs do not appear to include the shared costs of occupying the facility, using common computer and other equipment, network security, or the cost of software licenses.

The conversion of Wind and Polar spacecraft monitoring and control systems to the LASP OASIS system has the potential for significant schedule delays and may represent a spacecraft health and safety concern. Although OASIS-CC evolved from the Multi Satellite Operations Control Center (MSOCC) developed by Goddard Space Flight Center and the Solar Mesosphere Explorer (SME) control center, the LASP OASIS-CC

uses an altered test and operation language based on GSFC's STOL, the Colorado System Test and Operations language (CSTOL). Conversion of the hundreds of real-time spacecraft and instrument "monitoring points" and the ~850-1000 Wind and Polar STOL procedures is a substantial task and may involve significant risk. Knowledgeable spacecraft engineers concede that there are adequate processes for the verification of these commanding procedures in the absence of a Wind or Polar spacecraft simulator; however the risk of using converted procedures on the spacecraft without simulator testing must be weighed.

There is concern that the required interface between the spacecraft engineers at GSFC and the commanding work at LASP would be cumbersome and add a layer of inefficiency. This concern applies to the routine operation of the spacecraft and becomes an even greater concern when considering anomaly analysis and resolution. This is considered to be a health and safety issue by the project office.

JPL currently requires Wind and Polar DSN scheduling to be coordinated with other ISTP missions before submission. The process to continue this level of coordination with the GSFC missions (e.g., SOHO) is not addressed.

LASP recommends producing the required LZ data products for the Wind, Polar and Geotail instrument teams (~30 LZ products) through existing LASP table-driven software. A substantial amount of definition and verification work on the part of each instrument team would be associated with this conversion. The LASP study does not specify whether unchanged LZ products are possible. Even small differences in the LZ products will result in substantial analysis software reprogramming efforts on the part each instrument team.

The transfer of KP processing to the individual instrument teams would result in substantial cost increases at many of those institutions during a period when most are absorbing substantial funding decreases and an associated loss of personnel. Distributing KP production would result in varying amounts of delivery delays to the NSSDC and, most likely, represent a higher overall cost to the project, as many teams would require new equipment and some software development to meet the new requirement.

It is not clear the extent to which an inability to implement "lights out" operation of the Polar spacecraft will affect LASP's ability to operate the spacecraft. In addition, the study does not adequately address what will probably be a frequent need for simultaneous spacecraft commanding and whether the LASP staff can adequately cover those needs.

There are several other issues that would have to be resolved. Whether the LASP software and production processes for LZ, orbit, attitude, etc. can produce files in a format identical to that currently produced needs to be clarified. Format changes will require costly software changes on the part of all instrument teams. On-line access to LZ and other data products would need to be 90-days rather than 30 days. Production of the 20-odd CD products would need to be handled in an automated manner or handled elsewhere. LASP does not suggest producing Polar platform attitude files from the collected LZ files which is a production process currently performed by the CDHF. It is not clear that this task could easily be shifted to one of the imaging teams. Ancillary data product would need to include the necessary model-derived ancillary parameters. There would also need to be provisions for the required Sirius data processing. All of these factors would substantially impact the cost, staffing and schedule estimates provided.

Consensus Evaluation:

The Wind, Polar and Geotail Projects feel that the study as submitted fails to outline a cost effective plan for implementing a smooth transition into this system. The plan contains elements that most likely pose health and safety risks to the Wind and Polar spacecraft and, in addition, do not meet NASA obligations to the Japanese element of Geotail. Staff levels, cost profiles, software verification methods, and transition schedules are inadvisable or overly optimistic. There are also less critical, although important, details with regard to data service that would need to be addressed. A significant review and negotiation of their approach, both technically and for staffing, would need to be undertaken before further steps could be taken in this direction.

Nevertheless, the LASP capabilities remain of interest to the Polar, Wind and Geotail project because the yearly operational cost could be substantially lower than that charged by CSOC. Careful analysis would be necessary to compare the implied cost benefit accumulated over the life of each spacecraft versus the substantial cost of such a complete transition especially in light of the proposed scheduling.

Summary of CDHF study evaluations:

The Central Data Handling Facility at GSFC is the original data processing and distribution system built to serve the ISTP flight project including the Polar, Wind and Geotail spacecraft.

The CDHF group at GSFC recommends continuing as a separate facility and performing the Key Parameter (KP) and ancillary data processing, the limited CD production, NRT data service, and on-line data serving functions for Polar, Wind and Geotail.

For cost saving, the group recommends eliminating the deep storage archive of ISTP data and re-engineering the CD production and data distribution system. Cost savings could also result by shifting some responsibility for data and CD quality to the individual instrument teams. The group does not find that long term cost savings would result by re-engineering the remaining systems.

Specific Strengths:

The technical expertise, familiarity with system components, and pride in quality service the CDHF staff has shown over the years is to be commended and recognized as a potential asset for the future

The CDHF system currently in place for Polar, Wind and Geotail products is operating well and could, given proper funding, continue with little or no major renovation for the lifetime of Polar and Geotail. That is, it is not broken.

Continuing with the CDHF concept and structure would pose the least amount of disruption to the project office and instrument teams. There would be no need to adapt to new locations, interfaces or procedures.

The finding that substantial re-engineering of the KP processing procedures and on-line data distribution procedures would not be cost effective is based on the knowledge of those that understand the system best; their advice should be thoroughly considered.

Specific Weaknesses:

The CDHF system was designed to accommodate a large number of data products from many sources, perform most any type of processing function on that data and then serve that data immediately and efficiently to a worldwide base of customers. The downsized Polar, Wind and Geotail projects have a much more modest set of requirements.

The data processing system within the CDHF requires a substantial amount of operator control through obsolete GUI interfaces on VAX hardware. The CDHF group does not recommend elimination of operator functions and replacement by computer automation.

The CDHF feasibility study states that CDHF personnel cannot simplify most aspects of the existing infrastructure for a reasonable cost or within a reasonable schedule. This finding is not consistent with those of independent groups who have studied the system.

The plan to freeze all software and hardware upgrades in order to control costs will, most likely, result in substantial and costly hardware and software configuration problems during future years. The current CDHF manager routinely searches for and hoards spare computer parts to mitigate this problem.

The number of individual machines, obsolete machines and proprietary software packages are a cost driver in the system. These costs not only include the direct cost of machine maintenance and software licensing but also the costs associated with database maintenance and programming complexities when faced with constantly changing networking and security issues.

Consensus Evaluation:

Continuing with the CDHF concept and structure would pose the least amount of disruption to the project office and instrument teams. The Wind, Polar and Geotail instrument teams, as well as the U.S. science public would continue to be well served. It is not currently broken and the project would very much like not to have to fix it.

The CDHF has estimated that 8 FTEs will be required to continue to generate KPs, ancillary data products, the few CDs, and to serve the data to the investigators. A materials cost and sustaining engineering cost through the CSOC contract would also be applied. This cost (total of ~$1M) would consume a substantial portion of the future Polar, Wind and Geotail operations budget while serving a disproportionally small portion of the overall requirements. It is doubtful that the missions can afford this level of support for these functions in FYs 03-05.

Summary of NSSTC study evaluations:

The National Space Science and Technology Center (NSSTC) is a NASA science research institute that includes the University of Alabama in Huntsville (UAH) Information Technology Research Center (ITRC) and Marshall Space Flight Center (MSFC) among others. Portions of the Polar/TIDE and Polar/UVI instrument teams are based at the NSSTC facility.

The NSSTC feasibility study has concluded that the UAH ITRC has the facilities, infrastructure and interest to take on the data processing and serving functions for the Wind, Polar and Geotail spacecraft. With their existing secure facility, appropriate

network connectivity, and experienced staff members, NSSTC personnel, with a small amount of student support, are capable of serving the required data products for the three spacecraft in an efficient and timely manner.

For cost saving, their study recommends substantial re-engineering of the LZ processing procedures (to include NRT and QL) and the KP processing software. Data distribution would be absorbed as an augmentation of the existing ITRC data distribution system that currently serves a NASA Earth Science mission.

In addition, the NSSTC study recommends that project management of the flight operations be transferred to their facility in order to control costs.

Specific Strengths:

NSSTC has broad experience and a good reputation for performing ground data processing and data serving for a number of instrument teams. Computer automation of data processing tasks has been a primary focus for many years. The NSSTC programming team has been on staff since the early 80's working through ISEE, DE, TRMM, Polar and several suborbital missions. They have good experience and are well familiar with the ISTP NRT data stream, the KP processing software, and Polar LZ files. They have extensive experience with Unix, PC and VMS scripting, C and Fortran, Oracle database maintenance and SQL.

The NSSTC physical plant appears to be adequate for performing the ground data processing and serving for the three spacecraft. The facility appears to comply with appropriate security standards. The ready availability of secure and open network connections is important and well addressed by the NSSTC team although verification of data bandwidth capabilities will be required.

MSFC and UAH solar and magnetospheric scientists would be available as needed for science oversight and user validation of the newly developed facility and its operation.

The NSSTC approach to minimize the amount of "hands on" attention is important and should, if this can be efficiently implemented, result in long term cost savings.

NSSTC has proposed an innovative approach for re-engineering the production of the LZ, Quicklook and NRT data products. The method has the potential for significant cost savings and increased reliability for QL and NRT. The programming effort would utilize existing code to ensure identical data products.

NSSTC has expressed the willingness and ability to accommodate special processing requests and to work in a flexible fashion with GSFC personnel and the many PI teams. Negotiations between GSFC and NSSTC regarding specific approaches both during the transition and during operational periods can be expected to be amicable.

Specific Weaknesses:

The study does not address the Polar, Wind and Geotail data system requirements in full or in sufficient detail. High-level recommendations were provided for two key data processing areas and the data distribution but little detail was provided with regard to the remaining data requirements or the data service system as a whole.

The NSSTC feasibility study provides little or no information regarding cost and schedule.

There is concern that the study addressed Polar requirements only, neglecting the Wind and Geotail spacecraft.

The method for re-engineering the KP processing software involves reproducing the system at NSSTC in order to better understand the code and data interactions and then, in parallel, developing a simplified version. This approach has the potential for substantial transition delays and cost overrun.

Although NSSTC suggests that management for the flight operations could be transferred to their control for cost saving purposes there is little or no mention of how those operations would be managed, maintained or streamlined. In addition, the experience of the NSSTC in managing the contracts for several complex spacecraft is not addressed.

There are several other issues that would need to be resolved. For example, specific plans regarding the various ancillary data products would need to be clarified and include the necessary model-derived ancillary parameters. There would need to be provisions for the required Sirius data processing and distribution.

Consensus Evaluation:

Several aspects of the NSSTC approach are of interest to the Polar, Wind and Geotail project. The re-engineering ideas for the LZ, NRT and QL data processing function are innovative and important to explore further. They are willing to undertake the job of re-engineering the KP processing system. Further study would be needed to understand the costs and scheduling before further action could be taken; it may be that the NSSTC expertise could be brought to bear on one or more re-engineering software tasks.

Summary of Space Physics Data Facility study evaluations:

The Space Physics Data Facility has long been active as an integral part of ISTP. The ISTP data system project scientist is based in the SPDF and several ISTP data distribution processes (e.g., CDAWeb) are based there. Polar, Wind and Geotail continue to be served in this manner by the SPDF.

For the most substantial cost savings, the SPDF study recommends that most ground system work should be conducted under Government-directed task orders of an appropriate contract, such as a modification of the Indefinite Duration/Indefinite Quantity (ID/IQ) contract rather than the current CSOC Completion Form/Project Service Level Agreement (PSLA).

SPDF also finds that further cost savings can be found by consolidating the environment, equipment, maintenance and staff of the several separate facilities that serve Polar, Wind and Geotail. Within flight operations, the study recommends testing automated procedures for the routine Polar and Wind spacecraft contacts and data downloads along with restructuring of some procedures and personnel responsibilities in order to reduce staffing and further minimize risk, including considerable cross-training. Within data services, the study recommends re-engineering the KP data production, on-line data distribution and CD data distribution to eliminate the operator functions and database requirements. For security and risk reasons only, the study highly recommends porting the CMS software to a modern platform and less strongly recommends porting the NRT software from VAX to Alpha VMS.

Specific Strengths:

The SPDF has broad experience and a good reputation for managing mission operations, ground data processing and data serving for a number of instrument teams and missions including, most recently, the IMAGE spacecraft. Computer automation of data processing tasks has been a primary focus for many years. They have good experience and are well familiar with the ISTP NRT data stream, the KP processing software and files, and Polar LZ files.

Implementation of the SPDF recommendations would require no change of physical location for the flight operations equipment or personnel thereby minimizing risks to the spacecraft health and safety.

The SPDF approach to minimize the amount of "hands on" attention wherever possible is important and should, if this can be efficiently implemented, result in long term cost savings.

The use of government-directed task orders under an appropriate ID/IQ contract has the potential for significantly lowering the operations and data service costs.

The use of civil service programmers and data system personnel would minimize the cost of re-engineering efforts.

Civil service magnetospheric and heliospheric scientists associated with NSSDC and Code 690 would be available as needed for science oversight and user validation of the newly developed procedures and operation.

The SPDF study contains well considered cost estimates and schedules for each re-engineering recommendation and for the total ongoing operation that are compatible with anticipated project resources. Although further study will be necessary to verify these estimates, the study offers a solution that points toward a positive lifetime benefit versus implementation cost comparison.

Specific Weaknesses:

The majority of the identified cost savings depend on the implementation of an appropriate contract vehicle and the use of civil service personnel for the re-engineering tasks. Substantial project-level management to ensure success will be required.

Re-engineering of the data distribution process would require some level of adjustment, not expected to be significant, on the part of each instrument team.

Further re-engineering efforts will be required to support single-spacecraft operations on a cost effective stand-alone basis after some sub-set of the existing spacecraft are no longer required.

Consensus Evaluation:

The SPDF study is the most comprehensive and detailed study received. The recommendations are feasible and provide significant cost savings while maintaining the current level of operational risk.

Summary of Berkeley study evaluations:

The Space Science Laboratory (SSL) at the University of California at Berkeley has played a substantial role within ISTP from the beginning. The Wind/3DP, Polar/EFI and Polar/UVI instrument teams are based there.

Berkeley appears to have the facilities, infrastructure and interest to take on a majority, but not the entirety, of the operation and data processing tasks for the Wind, Polar and Geotail spacecraft. With an existing spacecraft operation facility, appropriate network connectivity, and experienced staff members, it may be possible to operate Wind and Polar from the Berkeley facility. Berkeley personnel, with student support, are probably capable of processing and serving many of the required data products for the three spacecraft in a timely manner.

Berkeley does not recommend substantial software re-engineering; any undertaken by the project would to be completed at GSFC before the operations are removed to the Berkeley facility. Cost savings would come from the use of undergraduate student labor and by automated spacecraft operations. Berkeley also recommends that responsibility for Key Parameter processing, platform pointing data processing and quality control of level zero products be transferred to the individual instrument teams. Berkeley states that it will not take on the responsibility of providing the Geotail/Sirius data to Japan.

Specific Strengths:

Berkeley has previous experience operating a number of space science missions, some simultaneously: EUVE (1996-2001), FAST (1999-present), and HESSI (in 2002), in addition to supporting instrument operations and RDAFs for many more. Two of the missions (EUVE and FAST) were transitioned to Berkeley from GSFC, giving the Berkeley team ample experience to apply toward a similar move for Polar and Wind (see Hartnett et al., AIAA, 1997).

Several of the mission operations systems (TPOCC, CMS and the monitoring/control system) used by Wind and Polar are identical, or sufficiently similar, to those previously used by the EUVE spacecraft and so are familiar to Berkeley flight operations personnel. This experience would imply less risk to routine spacecraft operations and less risk for the transition schedule.

Berkeley's nearly autonomous operations for FAST and HESSI implies that personnel there are well experienced with implementing such systems and are committed to applying this model wherever possible for Wind and Polar.

The Berkeley facility appears to comply with all appropriate security standards. The ready availability of secure and open network connections is important and well addressed by the Berkeley team although verification of data bandwidth capabilities will be required.

Berkeley's transition schedule includes two people training for one month at GSFC for the ground data processing systems, 1 person training for one month at GSFC for DSN scheduling, and 2 people training for two months at GSFC for spacecraft operations. Overall, this level of training shows a realistic understanding of the level of effort involved in this type of transition. The level of training for the ground data processing systems and DSN scheduling is considered realistic; additional time for the operational systems will most likely be necessary because of the multiple spacecraft.

Specific Weaknesses:

It is not clear that the Berkeley mission operations physical plant is adequate for the operation of five satellites (2 existing spacecraft (FAST and HESSI), CHIPS upcoming, plus Wind and Polar). In addition to full operations for these spacecraft, the Berkeley MSOC supports real-time data downloads from IMAGE. The Berkeley study does not adequately address what will probably be a frequent need for simultaneous spacecraft commanding and whether their staff can adequately cover those needs. It is not clear the extent to which an inability to implement "lights out" operation of the Polar spacecraft will affect Berkeley's ability to operate the spacecraft. These concerns may pose a health and safety issue for the Polar and Wind spacecraft.

None of spacecraft recently or currently operated by Berkeley has quite the size and complexity of Polar and Wind. EUVE had an imager and 3 spectrometers, FAST is a Small Explorer (SMEX) class with four instruments; HESSI is a SMEX class satellite with one primary instrument. These spacecraft all have relatively "simple" operational requirements in comparison with Wind and Polar although the Berkeley team does have maneuvering experience and a good amount of science instrument commanding experience. Substantial experience is lacking with operating a large "hands-on" set of instrumentation, such as that carried by Polar, and with the level of maneuvering required for both Polar and Wind. The feasibility study does not discuss how the additional operational complexities will affect Berkeley's present spacecraft operations methods and how those impacts will be addressed.

Berkeley's approach is to use the Government Furnished Equipment (GFE) program wherever possible. In particular they plan to transfer the TPOCC and CMS systems used by Polar and Wind operations to Berkeley. However, their study does not provide information on how the spacecraft would be monitored and commanded during the physical transfer of this equipment, how the lack of a backup system for one or more components for periods of time would be mitigated, or how simultaneous monitoring and commanding between Berkeley and GSFC would be performed during an operations "handover". Although three independent hardware "strings" of the TPOCC exist, two are regularly in use for simultaneous, or overlapping, Wind and Polar contacts with the third acting as the trending/plotting monitor. Software for the two spacecraft are independent and access independent databases so that the two spacecraft cannot be operated simultaneously from the same machine. Also, two fully independent and redundant CMS systems do not currently exist. Regardless, description of a feasible "handover' plan is neglected in this study.

The Berkley approach to minimize the amount of software re-engineering and run the GSFC codes "as is" will increase the number of staff required over that provided in the staffing estimates. The increased cost associated with this might be mitigated by the extensive use of undergraduate students.

The Polar, Wind and Geotail project would need to better understand the extent to which student operators are utilized, training procedures, and security screenings employed upon hiring. The NASA/SEC enterprise would need to balance the worth of the Wind and Polar assets with the inherent risks associated with the "constant flux" of non-professional personnel.

The cost estimates provided would need significant reworking or clarification. Travel expenses between LASP and GSFC and/or HQ would necessarily be greater than proposed in the study both because there appear to be errors in the estimates and because additional travel for HQ and GSFC mandated health, safety and design reviews will most likely be necessary in any transition of important SEC assets. Development costs for the re-hosting of the NRT data stream is not included at all. The ongoing material costs do not appear to adequately cover the shared costs of occupying the facility, using common computer and other equipment, network security, or the cost of software licenses.

There is concern that the required interface between the spacecraft engineers at GSFC and the commanding work at Berkeley would be cumbersome and add a layer of inefficiency. This concern applies to the routine operation of the spacecraft and becomes an even greater concern when considering anomaly analysis and resolution. This is considered to be a health and safety issue by the project office.

JPL currently requires Wind and Polar DSN scheduling to be coordinated with other ISTP missions before submission. The process to continue this level of coordination with the GSFC missions (e.g., SOHO) is not addressed.

The transfer of KP processing to the individual instrument teams would result in substantial cost increases at many of those institutions during a period when most are absorbing substantial funding decreases and an associated loss of personnel. Distributing KP production would result in varying amounts of delivery delays to the NSSDC and, most likely, represent a higher overall cost to the project, as many teams would require new equipment and some software development to meet the new requirement.

The Berkeley approach does not provide for a smooth, scalable, low-cost transition to single-spacecraft operations if and when some subset of the existing l spacecraft are no longer supported. The existing TPOCC, CMS and LZ processing systems serve three spacecraft in a tightly integrated fashion. Further re-engineering efforts will be required to downsize these systems in order to cost effectively operate the Wind spacecraft on a stand-alone basis.

In several areas the Berkeley study indicates a lack of understanding of the Wind, Polar and Geotail operational system. In the sections addressing the production of Sirius data for Geotail, Berkeley states that to reduce operational complexity it will not produce Sirius data files. However, because Berkeley's approach is to use the current level zero processing system essentially "as is", Berkeley will be producing Sirius data files whether it wants to or not, unless substantial modifications are made to the level zero processing software. The Berkeley study simply adopted the LASP LZ approach that, necessarily, excludes Sirius data production. Similarly, LASP's re-hosting of the current TPOCC into OASIS precludes them from efficiently hosting instrument team GSEs. Berkeley's approach to transfer the Wind, Polar and Geotail TPOCC equipment "lock, stock and barrel" actually makes hosting the GSEs quite feasible.

There are several other issues that would have to be resolved. On-line access to LZ and other data products would need to be 90-days rather than 30 days. Production of the 20-odd CD products would need to be handled in an automated manner or handled elsewhere. Berkeley does not intend to produce definitive Polar platform attitude files from the collected LZ files which is a production process currently performed by the CDHF. It is not clear that this task could easily be shifted to one of the imaging teams.

Ancillary data products would need to include the necessary model-derived ancillary parameters. There would also need to be acknowledgement of the required Sirius data processing and distribution. All of these factors would substantially impact the cost, staffing and schedule estimates provided.

Consensus Evaluation:

The Wind, Polar and Geotail project feels that the study as submitted fails to outline a feasible plan for implementing a smooth transition into the Berkeley system since it contains several errors and misconceptions.. Their plan contains elements that pose health and safety risks to the Wind and Polar spacecraft.

Nevertheless, the Berkeley capabilities for hosting mission operations are well known within the space physics community and remain of interest to the Polar, Wind and Geotail project because the yearly operational cost could be lower than that currently charged by CSOC. The Berkeley team would need to undertake a more detailed study based on a modification to its current approach before continuing.