301 October 26, 2001

TO: 460/STEREO Project Manager

FROM: 301/Systems Review Manager

SUBJECT: Review Team Report on the Solar TErrestrial RElations Observatory (STEREO) Instrument Preliminary Design Reviews (PDR)

The four STEREO instrument PDRs were conducted as scheduled in the month of September, 2001. The In situ Measurement of Particles And CME (Coronal Mass Ejection) Transients (IMPACT) instrument PDR was conducted on September 11-13, 2001 at the Johns Hopkins University, Applied Physics Laboratory (JHU/APL). The STEREO WAVES (SWAVES) instrument PDR was conducted on September 14, 2001 at JHU/APL. The PLAsma and Supra Thermal Ion Composition (PLASTIC) instrument PDR was conducted on September 25, 2001 at the Boeing Building on Greenbelt Road. The Sun-Earth Connection Coronal and Heliospheric Investigation (SECCHI) instrument PDR was conducted on September 26-28 at the Naval Research Laboratory (NRL).

The review teams generated 29 Requests For Action (RFAs) and 9 recommendations/comments against the IMPACT PDR; 8 RFAs and 2 recommendations/comments against the SWAVES PDR; 17 RFAs and 9 recommendations/comments against the PLASTIC PDR; and 42 RFAs and 16 recommendations/comments against the SECCHI PDR.

In general, given the substantial heritage of many instrument components and subsystems, the instrument designs are at PDR level. This is especially true of the SWAVES instrument, which in many respects is at CDR level. The instrument teams are experienced and knowledgeable, and are attuned to the development challenges ahead. It is the assessment of the review team that the STEREO mission development effort should proceed as planned, with appropriate adjustments resulting from the RFA resolutions.

The Project's decision to conduct the instrument PDRs ahead of the Observatory PDR did introduce some system level issues that probably would have been more appropriately addressed at the Observatory level review. As such, the review team was concerned that the instrument presentations lacked a clear and coherent definition and flowdown of critical mission level requirements to the instrument level. In particular, the following requirements definition and flowdown should be clearly delineated by the Observatory PDR, including: a) Level 1science requirement flowdown to instrument level;

b) Minimum science requirements and flowdown to instrument level; c) The associated system level reliability assessment calculated down to instrument level; d) EMI/EMC requirements. The Project recognizes these issues and is proceeding toward Observatory PDR with the expressed intent of resolving these issues as documented by the RFAs.

Another area of concern is the single string system architecture of the instrument designs. The centrally distributed power and data sources are susceptible to single point failures and failure propagation, which may render entire instrument suites useless. The review team recommends that the Project and instrument teams should perform early failure mode and effects analyses (FMEA) for all the instrument designs. The Project should judiciously evaluate and incorporate appropriate redundancy and failure isolation design features to improve the reliability and robustness of the instrument designs.

The low mass reserve (66.4 Kg current estimate against a launch allocation of 71.3 Kg,) and the substantial negative power reserve (69.5 watts current estimate against a launch allocation of 53.8 watts) on the SECCHI instrument were major problems that had surfaced only shortly before the PDR. The Project and the SECCHI team are still in the process of evaluating this issue.

The review teams also identified the following issues and areas of risk:

a) All the instruments have Application Specific Integrated Circuit (ASIC) development efforts. Specific RFAs have been generated against the individual ASIC. In general, these ASIC are all schedule drivers with limited schedule reserves. The review team recommends that the Project and the instrument teams should critically evaluate the ASIC development schedules and develop detailed risk management and mitigation plans where appropriate.
b) The review team was concerned about the multi-institutional involvement required supporting the flight software development efforts for IMPACT, PLASTIC, and SECCHI. Clear definition of requirements, ICDs, and responsibility flow should be accomplished promptly. To promote early testing and risk mitigation of instrument interfaces and flight software, the review team recommends that robust system level test beds be developed.
c) The SWAVES instrument performance demands very stringent EMI/EMC requirements. In addition to properly flowing these requirements from mission level to instrument level (all instruments), proper implementation and verification processes must be defined exercised. The Project indicated that such an EMI/EMC committee has already been assembled for this purpose. The review team recommends that this committee conduct a technical interchange meeting with the cognizant members of the review team to review and close the relevant RFAs.
d) The SECCHI instrument has very stringent contamination control requirements. Similar to the EMI/EMC requirements, in addition to properly flowing these requirements from mission level to instrument level (all instruments), proper implementation and verification processes must be defined and exercised.
e) The overall Engineering Test Unit (ETU) development and test program for the instruments needs better definition. Some keys instruments do not include ETU hardware for cost reasons and some instrument ETUs are being developed and

qualified too late to be effective. The Project and the instrument teams should better assess the instrument development risks and then define the ETU development effort consistent with the risk mitigation objectives.

f) The review team was concerned about the management, coordination, and responsibility flow of this multi-national and multi-institutional mission effort. Time limitations did not allow detailed discussion on these issues relating to organizational responsibilities and hierarchy, requirements integration and flowdown, schedule integration and management, risk identification and management, conflicts resolution and decision flows, ITAR management, and etc. These issues are likely to be raised again at the Observatory PDR. It is recommended that the Project conduct a briefing on these issues with the chairmen and selected members of the Independent Integrated Review Team prior to the Observatory PDR.

As many of the RFAs are targeted for closure by Observatory PDR, the Project is requested to provide closure responses for these RFAs prior to the Observatory PDR and to provide a closure status and plan for the remaining open RFAs.

Richard Ho

Note: A hardcopy of the RFAs is enclosed with this letter to the STEREO Project Manager. Electronic copies of the RFAs have been forwarded to review team members and STEREO Project Representatives.

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