#	Requestor	Actionee	Presentation/ Slide/Topic	Action/ Recommendation/ Comment	Description/Rationale
1	Hill, Stuart Holtzman, Allan	Dickinson	06: System Engineering	Action (ISIS PDR)	Produce an ICD (or capture intent in existing instrument ICD) that captures all INTRA-suite interfaces electrical/mechanical/thermal (specifically the bracket to instrument interfaces), including information such as: o MLI baffling o Instrument to bracket clearances and access o Bolted interface definitions (does it carry shear, specifics on G-10 isolators) o Responsibility to provide thermal isolators, ground straps (who does this) o Ground lug locations on both instrument and bracket o There are several institutions involved in this suite, and communicating interfaces needs to be clean and easily understood. The APL presentation on EPI-Lo demonstrated that there was a lack in communication amongst the suite team
2	Hill, Stuart Holtzman, Allan	Dirks	06: System Engineering - 23	Action (ISIS PDR)	What is meant by a thermally isolated ground strap? Please provide a description.
3	Mason, Glenn	McNutt	07: EPI-Lo Sensor - 6	Action (ISIS PDR)	(Mason-06) The EPI-Lo team should re-examine the pointing strategy of the instrument to better optimize the sky coverage with improved coverage of the average Parker spiral directions. Rationale: The instrument's best sky coverage is pointed in the spacecraft ram direction, which is far from the average interplanetary magnetic field direction which will order particle motion in many cases. I cannot cite a single particle instrument doing interplanetary studies that has such a pointing strategy. On the contrary, such instruments have pointed generally along or opposite to the average Parker spiral, as is done for the main FOVs of the EPI-Hi instrument and many others that have flown in the past. No clear rationale for such a strategy was given. The inescapable conclusion is that the instrument is making a non-optimal use of resources. Other pointing strategies should be investigated, for example tilting the center of the FOV more towards the Parker spiral direction, which is now poorly sampled. Better sampling of the Parker spiral should be a high priority objective added to the instrument goals.
4	Mason, Glenn	McNutt	07: EPI-Lo Sensor - 6	Action (ISIS PDR)	(Mason-07) The EPI-Lo team should carry out a modeling study to assess the effects of electrons and protons penetrating the instrument walls and producing background signals directly or through secondary electron emission. Rationale: The dome head was stated to be Al 55 mils thick and will not afford much protection against penetrators. During intense events, particles penetrating the domes will emit secondary electrons that will be accelerated by the grids along with secondary electrons from particles passing through the apertures. At high intensities, the much larger area of the dome vs. the apertures makes it likely that unwanted secondary electrons may overwhelm the system, limiting the dynamic range of large events that can be studied

5	Hersman, Chris Persons, Dave Holtzman, Allan	Cooper	09: EPI-Lo Mechanical	Action (ISIS PDR)	Due to the number of questions during the EPI-Lo Mechanical presentation and schedule constraints of PDR, a Mechanical Splinter meeting was requested. Based on availability of participants, the meeting will be scheduled for a later date. Required participants include Scott Cooper, Stuart Hill, Dave Persons, Don Mitchell, Glenn Mason, Scott Weidner, Chip Beebe, and Chris Hersman. Meeting notices will also be sent to Dave McComas and Nick Alexander. Topics include the following: 1. Wedge CTE mismatch suggest cold and hot test to monitor Ni wedge & mcp grid distortion o Design with no clamping (grids can rattle) o Design grids with flexures at each screw 2. (09: EPI-Lo Mechanical - 13) Indicate the cable routing and the location of the other end of the red cables to the anode board in slide 13. I don't see it. Any additional actions arising from this splinter meeting will be captured as updates to this action item.
6	Hersman, Chris	Weidenbeck	13: EPI-Hi Technology Development	Action (ISIS PDR)	(cc: Andrew Peddie) Before declaring TRL 6 for the thin detectors, the set of TRL 6 tests listed on slide 8 of the EPI-Hi Technology Development presentation must be completed for L0 and L1 detectors from at least one manufacturer. Acoustic testing is a possible exception with an acceptable rationale. Rationale: The TRL 6 tests listed on slide 8 are consistent with the approved ISIS Technology Development Plan. The summary slide said “Prototypes from both sources have been subjected to all of the tests required for achieving TRL6 without problems”, but this is not yet true. TRL 6 cannot yet be claimed based on the testing completed because performance on the TRL 6 tests will differ between L0 and L1 detectors and between manufacturers. Successful testing on an L1 detector cannot be used to infer that an L0 detector would also pass, and vice versa. Similarly, successful testing on detectors from one manufacturer cannot be used to infer that detectors from another manufacturer would also pass. Regarding acoustic testing, testing on a suitable mechanical model may be sufficient.
7	Wagner, Ken	Cook	14: EPI-Hi Electronics - 5	Action (ISIS PDR)	Create an EPI-Hi Internal Electrical Interface Control Document Rationale: A single definition document should exist, because internal cards are built by different organizations (e.g. LVPS power supply at APL, Bias Board at Space Instruments), and definitions for connector pinouts, interface signals, shielding need to be captured.
8	Wortman, Kristin	Davis	15: EPI-Hi Software - 11	Action (ISIS PDR)	A 16-bit shift register to capture time history of discriminator output was added to the PHASICS to assist with identification of crosstalk in software. The corresponding software requirements need to be added to the specifications to support the required algorithms to detect crosstalk and to correct crosstalk.
9	Holtzman, Allan	Do	17: ISIS Power- 19	Action (ISIS PDR)	Provide a description of the thermal analysis. Slide 19 shows case temp = 13.2 C. Does plot show board temps? Not sure how case temperatures are represented in the analysis.
10	Persons, Dave	Alexander	19: ISIS Structural	Action (ISIS PDR)	Develop a FEM analysis plan that addresses trading models between APL, SWRI and CalTech: o Modeling requirements such as type of elements, modeling technique for bolts, material properties, boundary conditions, etc o Choose an analysis code such as Ansys o Set a schedule for model updates
11	Hill, Stuart	Alexander	19: ISIS Structural	Action (ISIS PDR)	Develop a bracket frequency requirement such that it will be guaranteed to avoid coupling with the instrument modes. This requirement could be captured in an INTRA-instrument ICD. Creating this document to capture intra-instrument interfaces is recommended. o Usually have a desired minimum frequency defined by the instruments o A frequency requirement exists in the EDTRD, but this is required to avoid coupling at the S/C level, but not intra-instrument suite o This requirement would allow constant re-evaluation of the bracket as the instrument modes change due to design maturation

12	Hill, Stuart	Adams	19: ISIS Structural	Action (ISIS PDR)	Include sine vibe analysis of the integrated instrument suite (with the updated model as requested in Dave Persons' action item). o The test is required, with levels currently baselined in the EDTRD based on past mission experience o ISIS did not conduct analysis on the individual instruments or on the suite
13	Persons, Dave	Alexander	19: ISIS Structural	Action (ISIS PDR)	Rerun the presented analyses with the following FEM improvements: o Higher order tets [tetrahedral], solid elements with midsized nodes o Representation of individual boxes joined by discrete bolts
14	Hersman, Chris Holtzman, Allan	Dirks	20: ISIS Thermal-22	Action (ISIS PDR)	For the warm up case thermal analysis, the simulation needs to start at the cold survival temperature to verify that the EPI-Hi LET 1 and EPI-Hi LET 2 do not exceed their maximum temperatures. Because the EPI-Hi LETs warm up faster, but the control algorithm keeps the heaters powered until the last component reaches temperature, could the LETs get too hot? It would also be worth knowing the steady state temperatures for the contingency case of the heaters stuck on to determine if damage would occur.
15	Holtzman, Allan	Dirks	21: AI&T - 2	Action (ISIS PDR)	The conditionality of thermal balance test was indicated in several places in the presentation, in certain cases it was acknowledged to be in error, but EDTRD-0190 states they are required. Provide clarification that it is required in all cases or justify why it's not required for some cases.
16	Hersman, Chris	Dickinson	28: Risk Status - 8	Action (ISIS PDR)	Provide a complete description of each of the top 10 risks on slide 8, including mitigation plans similar to slide #9. Detail for only 1 was given in the risk presentation. Note: All risks identified "Research" as the Approach, but it seems some might be "Mitigate."
17	Mason, Glenn	Kinnison	06: System Engineering - 20	Action (SPP)	(Mason-01) The spacecraft team should assess possible scenarios leading to an off-pointing incident, caused by possible problems with the spacecraft pointing system such as a freezing up of a momentum wheel or a poorly controlled thruster firing. The spacecraft team should assess how long would the spacecraft take to detect such an event? How long would it take to respond? How long could the EPI instruments be in direct sunlight for such an incident? The ISIS EPI-Lo and -hi teams should make an assessment of the vulnerability of the instrument to such an incident, and consider mitigating strategies. Rationale: The location of several EPI-Lo and EPI-Hi entrance apertures is extremely close to umbra, with stated plans to shim the instrument even closer to the umbra if final spacecraft design details allow this. If an off-pointing incident of even a few degrees for a few seconds took place, many EPI-Lo apertures, and the primary EPI-Hi apertures could be exposed to sunlight which heats the foils and could damage or destroy them, resulting in severe degradation of science performance.

18	Petro, Susanna	Kinnison	08: EPI-Lo & 13: EPI-Hi Technology Development	Action (SPP)	The TRL 6 has to be achieved by PDR. According to the definition of TRL6 as reported in NASA NPR 7120.8 and NPR 7123.1B (both documents calling for an engineering module), the ISIS EPI-Hi and EPI-Lo are not yet at TRL 6 even if in the presentation it was stated: Successfully completed TRL6 Technology Developments. They explained that in order to achieve TRL 6, they have to comply with SOLAR PROBE PLUS ISIS TECHNOLOGY DEVELOPMENT PLAN, SwRI® Project 16105 Document No. 16105-TECH_DEV_PLAN-01 Rev 0 Chg 0 Contract NNN06AA01C. In this document, provided to the board for PDR, the paragraph 3.5 Test and Analysis Plans to Achieve TRL 6 has a TRL 6 achieving path which is different from the one reported in the aforementioned NASA NPR. Request for action: 1. Please explain and clarify this incongruence 2. Provide a plan with dates in which the TRL 6 will be achieved 3. Provide a detailed table in which the TRL of the different element of the EPI Hi instrument are showed. 4. In the splinter meeting discussion which occurred after the day 1 PDR the SwRI instrument manager stated that he does not consider the ISIS operational temperature as a relevant environment for TRL 6 testing. Please justify this affirmation. Rationale: TRL6 development is due at PDR and it is fundamental to eliminate the most serious schedule and funding threats.
19	Holtzman, Allan	Adams	20: ISIS Thermal - 9	Action (SPP)	Describe risk posture on heater redundancy, or lack thereof, with regard to the EPI-Lo Dual use heaters. Why not have redundant operational and survival heaters? I think I know the answer, if the operational heater failed, then survival temperatures would not allow the instrument to operate anyway, so it would be pointless. I just am worried about the lack of redundancy on the physical heater element.
20	Hill, Stuart Persons, Dave	Lockwood	EDTRD	Action (SPP)	Instruments should be acoustically tested if they have foils, doors, etc. Not currently required by EDTRD. Provide a requirement for instruments that have thin foils to conduct an acoustic test in the EDTRD. Update the acoustic levels captured in the EDTRD to reflect test levels, not flight levels. o Acoustic test levels shown in presentation are just the flight levels, test levels are +3dB higher o Test levels are mentioned as needing to be +3dB higher, but this information is captured in the Observatory portion of the EDTRD
21	Hill, Stuart Holtzman, Allan	Dickinson	06: ISIS System Engineering	Recommendation	Launch pressure vent testing should be conducted on the EM versions of each instrument o Issues for venting discovered at the EM level can be avoided in the final FM designs o Avoid schedule impacts of discovering venting issues at the FM level late in the integration schedule. (also see action for detailed plan for EPI-Lo purge and venting)
22	Hill, Stuart	Alexander	06: System Engineering - 20	Recommendation	Need to make sure that the worst case height of the bracket is tested in mechanical testing. Talk of adjusting the height of the bracket to sit at the edge of the umbra requires modification of bracket height. Worst case height needs to be represented in mechanical testing to ensure possible heights are enveloped.
23	Mason, Glenn	McNutt	07: EPI-Lo Sensor - 6	Recommendation	(Mason-09) The EPI-Lo team should carry out a detailed stray light analysis of the system using a detailed spacecraft model including antennas, to ensure that the foil thicknesses and transparencies in UV are sufficiently low to prevent stray light causing high count rates in any aperture. Rationale: Although the aperture FOVs generally avoid spacecraft structures, there was no analysis shown of stray light issues such as reflections/glints from structures or antennas such as the wave antennas. These may impinge directly into the FOV and produce high count rates on the foils. Additionally, stray light impinging on the aperture fields-of-regard may also lead to high count rates, especially since the aperture walls did not appear to have baffling to cut down reflectivity. Due to the MCP anode design where 20 apertures feed into a single electronics chain, a problem in any single one of them could have a large effect on instrument performance. The susceptibility of the instrument to such problems needs detailed study.

24	Holtzman, Allan	McNutt	07: EPI-Lo Sensor - 7	Recommendation	Update EPI-Lo sensor presentation, fields of view chart (slide 07): Move x-axis numbers down to the bottom so they are visible, add labels to chart axes, maybe add a coordinate system for reference.
25	Mason, Glenn	Gurnee	08: EPI-Lo Technology Development	Recommendation	(Mason-10) The EPI-lo team needs to develop an extremely detailed test and verification plan to ensure that an instrument of this complexity will perform as planned. Rationale: The instrument is much more complex than the cited heritage instruments, both in terms of detector head, required secondary electron acceleration and timing, and data processing with multiple ion species, and dynamic range in energy and count rate. Calibration at accelerators, for example, will trigger only one or two apertures, while is space there will be ~80 apertures all feeding into a single processor. Therefore heritage techniques of assessing the in-flight performance of the instrument may easily fail to accurately test and verify that the instrument will perform as planned in flight. Electronic pulsers, while able to pulse multiple apertures, are unable to reproduce the complex input of a particle event, and so are also unlikely to be usable to convincingly verify that the instrument meets its performance requirements. It will be a major task to verify that the instrument will work properly in an intense particle event with all ~80 apertures exposed to high fluxes.
26	Mason, Glenn	Cooper	09: EPI-Lo Mechanical	Recommendation	(Mason-04) The EPI-Lo team should evaluate what deformations of the electron acceleration grids are permissible for the instrument to stay within its performance specifications, and verify that thermal or vibration stresses will not result in unacceptable deformations of the grids. Rationale: The thin Ni grids are delicate and yet need to be precisely located so that the secondary electron acceleration and trajectory bending is carried out with the precision required for the instrument to meet its timing requirements (which affect the energy and mass resolution). If the grids are deformed due to stresses in vibration, or thermal stresses arising from non-matched thermal coefficients, the science performance of the instrument can be degraded.
27	Mason, Glenn	Cooper	09: EPI-Lo Mechanical	Recommendation	(Mason-05) The EPI-Lo team should develop and test detailed procedure to handle the red-tag cover both during I&T and launch operations. Rationale: With thin, delicate foils open to the air, removal of the red tag cover during I&T or during launch preparations could set up an air pressure imbalance sufficient to damage multiple aperture foils. The slip of a technician's hand could severely damage the instrument if the cover were removed too fast, etc.
28	Mason, Glenn	Cooper	09: EPI-Lo Mechanical	Recommendation	(Mason-08) The EPI-Lo team should develop a detailed plan to address issues associated with venting near the foils, and purging. (also see recommendation for launch pressure testing of EM) Rationale: No details were shown of the mounting and venting provisions for the aperture foils for EPI-Lo. Since the foils are unable to withstand small pressure differentials it is important to provide for adequate venting around each foil, and in-between the two foils on each aperture. These considerations are also important for controlling the purging of the sensor, which was not addressed in the presentations.
29	Hill, Stuart	Cooper	09: EPI-Lo Mechanical	Recommendation	The use of Torlon screws seems like a new implementation for APL. Develop a Torlon screw use guide/plan that captures issues as below. Note, some of this information could require testing of the screws. o Usable sizes o Torques (by screw size) o De-rating o Lubrication o Number of install/removal cycles allowed

30	Mason, Glenn Persons, Dave	Cooper	09: EPI-Lo Mechanical - 17	Recommendation	(Mason-02) The EPI-Lo team should carry out realistic acoustic tests as soon as possible to determine the ability of their foils to survive acoustic. Perhaps a test of a single wedge assembly mounted in a block with a close-fitting recess. Consider carrying an instrument-level risk until the test is completed Rationale: The EPI-Lo instrument has very thin foils that in launch configuration are exposed to the air (no protective covers). This exposes them to the full acoustic environment in launch, and could result in damage or loss of some or all foils. This activity is urgent, since if a vulnerability is discovered, devising a mitigating strategy could consume considerable time and resources. Since the foils are too thin to be modeled, realistic tests are required.
31	Wortman, Kristin	Hayes	11: EPI-Lo Software - 33	Recommendation	EPI-Lo has a test port that will be used for ground testing. The code that supports the associated test port command that directs the signals to the test port will be left in the flight code. It is recommended that support for an additional test port command be added to enable the test port before sending/executing the request to direct the signals. Implementing a two command scheme before test port use will provide an additional safeguard during flight that the test port code will not be exercised.
32	Wortman, Kristin	Davis	15: EPI-Hi Software - 3	Recommendation	Since the SPP spacecraft flight software is not supporting time-tagged commands for instruments, if there is a need for this functionality, a requirement needs to be added to support time-tagged commands in instrument software.
33	Hill, Stuart	Dirks	20: ISIS Thermal	Recommendation	Need to make sure that the ground strap(s) is present in all thermal testing
34	Mason, Glenn	Mitchell	25: EPI-Lo Calibration	Recommendation	(Mason-03) The EPI-Lo team should develop a detailed strategy to ensure that sufficient resources and time will be provided in the schedule to calibrate the instrument in order to achieve performance requirements. Rationale: EPI-Lo has ~80 fields of view for ions and ~80 fields of view for electrons. While the electron FOVs probably do not need much calibration since the instrument does not detect which aperture is penetrated, the ion FOVs need individual calibrations if the ion measurements are to be successfully combined in count rate data, etc. Detailed heavy ion calibrations of 80 FOVs is a very large task, so ample schedule and resources must be set aside early to ensure that late in the program this will be done carefully and completely.
35	Holtzman, Allan	Dickinson	06: System Engineering - 20	Comment	S/C pointing margin on umbra keep-in: I'm assuming GN&C is aware of the extremely short duration survival time on accidental solar exposure.
36	Hill, Stuart	Dickinson	06: System Engineering - 30	Comment	Alignments - Think about how this will be done on the spacecraft.
37	Persons, Dave	Cooper	09: EPI-Lo Mechanical	Comment	Torlon screws are very long – torque will go to twisting, not preload
38	Hill, Stuart	Cooper	09: EPI-Lo Mechanical	Comment	Think about red tag covers.
39	Holtzman, Allan	Cooper	09: EPI-Lo Mechanical	Comment	EPI-Lo wedges: These are identical? What is the flight sparing philosophy for these? Alignment procedures? On-orbit distortion predictions, and resulting performance?
40	Hill, Stuart	Kecman	14: EPI-Hi Electronics - 29	Comment	Harness diagram needs to be updated to show an operational heater service from the S/C, not powered thru the DPU
41	Holtzman, Allan	Cook	14: EPI-Hi Electronics - 6	Comment	EPI-Hi, S/C-supplied thermistors: be clear where they are and who is installing them. Should this information be on the MICD?
42	Persons, Dave	Alexander	19: ISIS Structural - 14	Comment	Consider saving additional bracket mass with isogrid construction o Take saved mass and add to wedge walls to reduce penetrators o If 7075-T73 is difficult to find in such a large chunk, consider 7050 alloy
43	Hill, Stuart	Alexander	19: ISIS Structural - 15	Comment	Bracket frequency looks really low – this is probably going to go down over time, need to watch this and coordinate this frequency with instrument frequencies
44	Hill, Stuart	Alexander	19: ISIS Structural - 4	Comment	Random vibe Grms seems really high
45	Persons, Dave	Dickinson	21: AI&T	Comment	Written and released Test Plans for acoustics, vibe, TV and Tbal? o Including details like presence of ground straps during thermal testing, o Vibration test with tallest G10 spacers and tallest bracket? o Fixturing and test equipment needs
46	Persons, Dave	Lockwood	EDTRD	Comment	Acoustic test levels need a prototype/qual column in EDTRD

47	Hersman, Chris	Dickinson	MICD	Comment	Add purge interfaces/connectors for both EPI-Hi and EPI-Lo to the MICD.