POLAR Power Management

Fall 2001 Eclipse Seasobn

- Fall 2001 Eclipse Season
    - 21 eclipses over 16 days
    - Maximum eclipse duration – 157 min.; 31 min. or 25% longer than maximum of Fall 2000 season.
- Perform battery reconditioning starting in late July 2001.
    - 3 to 4 weeks required to complete reconditioning.
    - On WIND, a 12-hour cool down period was required after approximately 12 hours of reconditioning.
    - The process of successive discharge and cool down periods is required until the batteries are fully discharged.
    - During recharge, good temperature control of the batteries is maintained.
- Battery reconditioning will allow determination of battery capacity.
    - Battery capacity should be over 20 amp hours.
    - WIND battery capacity after reconditioning was near 31 amp hours, exceeding the 26.5 amp hour specification.
    - During the Fall 2000 eclipse period, the maximum Depth of Discharge (DOD) was approximately 9 amp hours.
    - Battery reconditioning discharges at approximately 1 amp, while eclipse loads discharge at 3 to 4.5 amperes.
    - Not sure how measured DOD correlates to flight loads during battery reconditioning

- Conditioning may give option of turning off loadshed during eclipse season if battery capacity has sufficient margin.

    - Is there significant capacity remaining after present loadshed battery minimum of 19.14 VDC is reached?
    - Minimum loadshed voltage (19.14 VDC) may be too high for the expected Fall 2001 loads
    - Loadshed values determined for a maximum DOD of approximately 25% during the nominal mission.
    - DOD of 9 amp hrs. (~ 34%) observed during the Fall 200o eclipse season
    - Expected DOD of 11.4 amp hrs. (~43%) at eclipse season loads during the Fall 2001 season

- Two-segment maneuver strategy used since launch

    - Maneuver starte at 93 deg. sun angle which occurs at middle of eclipse season near the maximum eclipse time.
    - Constant 90 deg. sun angle maintained during the maneuver.
    - Strategy resulted in raising apogee during the last three flip maneuvers because of orbit precession
    - During Fall 2000, maneuver started during eclipe times exceeding 140 minutes. Battery recharge time exceeded 7 hrs.
    - Realtime DSN supports of at least 7 hours required for each 4-hour maneuver.
    - Sufficient time must be available between eclipses to fully charge the batteries and do everything else within the 18 hr. orbit period

- Proposed FDF maneuver strategy to prevent raising apogee and alleviate HSA field-of-view problem

    - Revised strategy does not keep sun angle constant near 90 deg.
    - Allows a number of options for varying maneuver start times and number of segments.
    - Present proposed plan is for a 3-segment flip, 2 segments during maximum eclipse times and a third at the end of eclipse season
    - Revised flip-12 strategy takes sun angle to 153 deg. where the solar array power is lowest.
    - Solar array power level drops off for increasing sun angles over 140 deg., and especially over 150 deg.
    - The solar array capacity is lower than last year due to degradation.
    - Expected battery recharge time of approx. 8 hours.

- Lower solar array power levels at high sun angles will extend battery charge up time beyond the 8 hours now expected
- FOT will perform an analysis of solar array power at various sun angles
- Analysis will determine whether, under the proposed flip plan, there is sufficient time to fully charge the batteries between eclipses and do everything else within the 18 hr. orbit period
- If the sun angle is limited to approx. 140 deg., the apogee decrease will not be as great as the initial estimate in the proposal

- An alternative maneuver strategy
  - Perform all maneuvers outside of eclipse season; two segments before start and one at end of season
  - Should be able to perform the full apogee lowering as planned for revised FDF flip-12 plan
  - Spacecraft can tolerate the 153 deg. sun angle for a short time if maneuver is performed outside of eclipse season.
  - If there is a power problem during eclipse season, spacecraft is safe until spring 2002. Most of the 180 deg. flip is already completed
  - Will not require long realtime DSN maneuver supports during maximum eclipse times.
  - Recharge time of 8 hours will not be not be extended due to reduced, available battery charge power during realtime operations.
  - Only tape recorder playbacks and spacecraft/instrument health and safety monitoring required during this time.
  - Solar array capacity is lower than Fall 2000 season due to degredation.