June13, 2005

DIRECTV

BY HAND DELIVERY

Ms. Marlene H. Dortch
Secretary
Federal Communications Commission
445 12th Street, S.W.
Washington, DC 20554

Re: *DIRECTV Enterprises, Requests for Special Temporary Authority*
File No. SAT-STA-20050414-00083
File No. SAT-STA-20050427-00091
File No. SAT-STA-20050517-00104

Dear Ms. Dortch:

As you may be aware, a Satellite Control Processor ("SCP") on an HS601 satellite not operated by DIRECTV Enterprises, LLC ("DIRECTV") recently experienced an in-orbit failure. DIRECTV has requested authority to relocate the DIRECTV 1 satellite (also an HS601 design) from 101° W.L. to 72.5° W.L., to replace the DIRECTV 5 satellite currently providing service into the U.S. from that location.[1] In order to aid the Commission's consideration of that application and the two related applications also referenced above, DIRECTV hereby provides additional background information on this type of failure and the potential impact to service should such a failure occur. As discussed below, the risk of failure of the remaining SCP on DIRECTV 1 is very low and will not be increased by relocation of the satellite.

Background on "Tin Whisker" Failures

The early HS601 satellites are susceptible to a type of SCP failure commonly referred to as a "tin whisker" failure, so called because they are caused by the growth of a pure tin crystal on the SCP input power relay that resembles a whisker. Eight conditions must be present in order for this type of failure to occur:

- The plating must be pure tin.
- There must be physical stress in the tin plating (an imperfection or scratch).

[1] *See* DIRECTV Enterprises, Request for Special Temporary Authority, File No. SAT-STA-20050427-00091 (filed Apr. 27, 2005).

- There must be a large current source available.
- The SCP must be in a vacuum.
- The input power relay case must be grounded.
- The conformal coating (insulation) on the relay terminals must have voids or be absent.
- The whisker must grow to a sufficient length.
- The whisker must grow in the right direction.

The first four conditions exist in all cases, as they are part of the basic design of the satellite. After the problem had been diagnosed, inspections of unlaunched units indicated that 70% of the relays were grounded (condition 5). If the last three conditions also exist, the failure propagates as follows:

First, a tin whisker grows on the outside of the tin-plated relay case.

Next, the whisker bridges the gap between the grounded case and an energized bus power relay terminal that lacks the conformal coat, creating a short circuit.

At the inception of the short, the tin vaporizes and creates a localized plasma that can support a large current, which in turn causes the power supply fuse to blow.

Once the fuse has blown, the SCP has no primary power available and becomes non-operational.

Once this process became well understood, tin plating was eliminated on later models. In addition, several operators, including DIRECTV, now perform annual tests of the non-active SCPs on their in-orbit satellites. These tests have never uncovered a failed SCP.

To date, it is believed that 10 of the possible 44 SCPs (*i.e.*, 23%) in orbit have failed as a result of this phenomenon. DIRECTV currently operates only two satellites potentially susceptible to such failure: DIRECTV 1, which previously experienced such a failure, and DIRECTV 2, which has not. The primary SCP on DIRECTV 1 failed on July 5, 1998, after 4.5 years in orbit. Since that time, the satellite has continued to operate nominally using its back-up SCP, and it is expected to continue to operate until the end of its nominal fuel life several years from now.

Since whisker length and growth are time-based phenomena, a model was constructed in order to provide some possible statistical indications of failure probability as a function of time. That model and the underlying data have been presented to the

FCC previously[2] and, in summary, there seemed to be good correlation between the launch date of the satellite and the number of years until an SCP failed in orbit. Specifically, the data indicate that the median time to failure is approximately 5.5 years and that the mean time to failure is 6.2 years with a standard deviation of 2.6 years.

Notably, the latest (non-DIRECTV) failure occurred at 12.70 years into the satellite's life, or at 2.50 standard deviations of the mean, meaning that 98.76% of all failures will occur before this time if the model is correct. Since the most recent failure is the tenth failure, it is still within the bounds of the model (0.55 failures out of the 44 would have been expected at this time period, although, obviously, a partial failure cannot occur).

If the most recent failure is excluded from the model, it would have occurred at 5.5 standard deviations, or essentially outside the previous data. This means that the most recent failure is the extreme event predicted by the current model. Put another way, if another failure occurs on a satellite of similar age, another model will have to be developed which encompasses a bi-modal failure distribution.

This has implications for DIRECTV 1 (11.5 years on orbit). The longer an SCP remains operating past the critical in-orbit time, the lower its chances of failing in the future. Assuming continued validity of the current model, DIRECTV 1 is well past the point where a failure should be expected, although there always remains a remote possibility of another failure.

In any event, DIRECTV has no evidence that would suggest that satellite location or maneuvering of the satellite increases the risk of an SCP failure in any way. Thus, we believe that the recent tin whisker failure of a non-DIRECTV satellite should have no impact on DIRECTV's pending STA request.

Impact on Service

Orbital movement

If both SCPs on a satellite become disabled, it is no longer possible to control the satellite position. Figures 1 through 4 show the change in orbit longitude (east-west) and inclination (north-south) and apogee/perigee (radial) over time for such a case, assuming the failure occurred at 72.5 WL. The possibility of contact with another satellite diminishes over time. Figure 2, which is an expansion of the data in Figure 1, shows that although the eccentricity and therefore east-west longitudinal movement begins immediately, the satellite is still within the 0.05 degree station keeping constraints shown by the horizontal lines for about three weeks. This, interestingly, is one advantage of moving a satellite susceptible to SCP failure away from a crowded orbit position such as 101° WL, where six satellites currently operate. As Figure 3 depicts, the inclination of the orbit is also growing linearly at about one degree per year and the apogee and perigee

[2] *See* Letter from Henry Goldberg to Marlene H. Dortch, FCC File No. SAT-STA-20030324-00039 (dated April 24, 2003).

also diverge from synchronous as shown in Figure 4. The three measures of position (east–west, north–south, and radial) all diverge from the geosynchronous arc, and although the satellite will pass through the equatorial plane, the crossings are displaced from the geosynchronous arc. This is somewhat analogous to a satellite in transfer orbit passing through the equatorial plane. Therefore, although the satellite would remain near the geosynchronous arc, it is clear that as time passes the chance of contact with another satellite diminishes.

Figure 1. Longitude vs. Time (5 years)

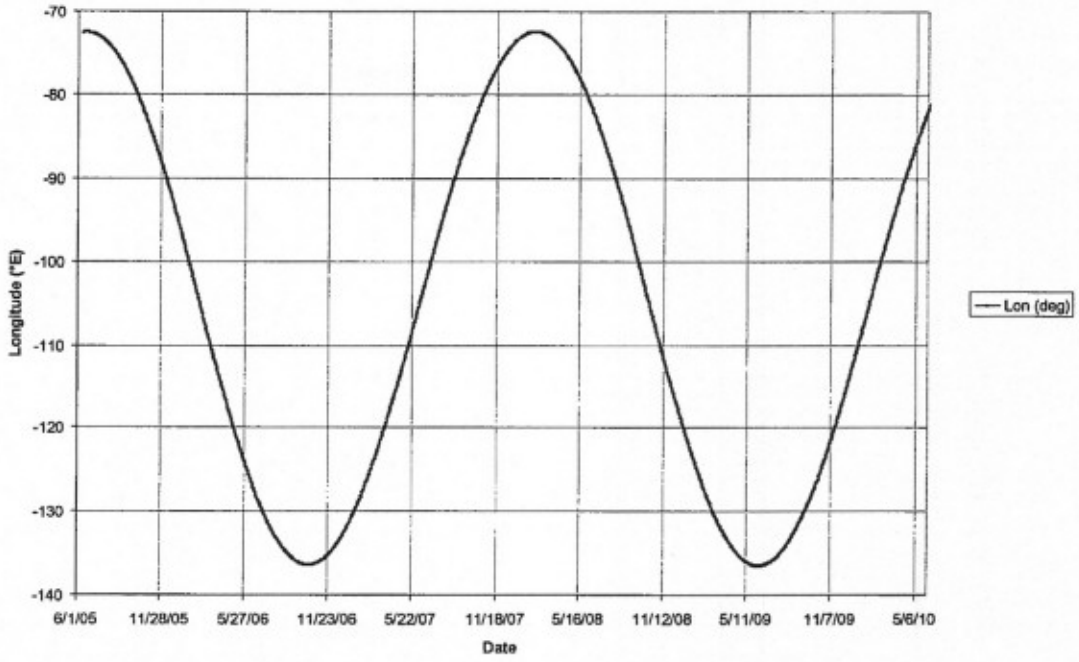


Figure 2. Longitude vs Time (5 weeks)

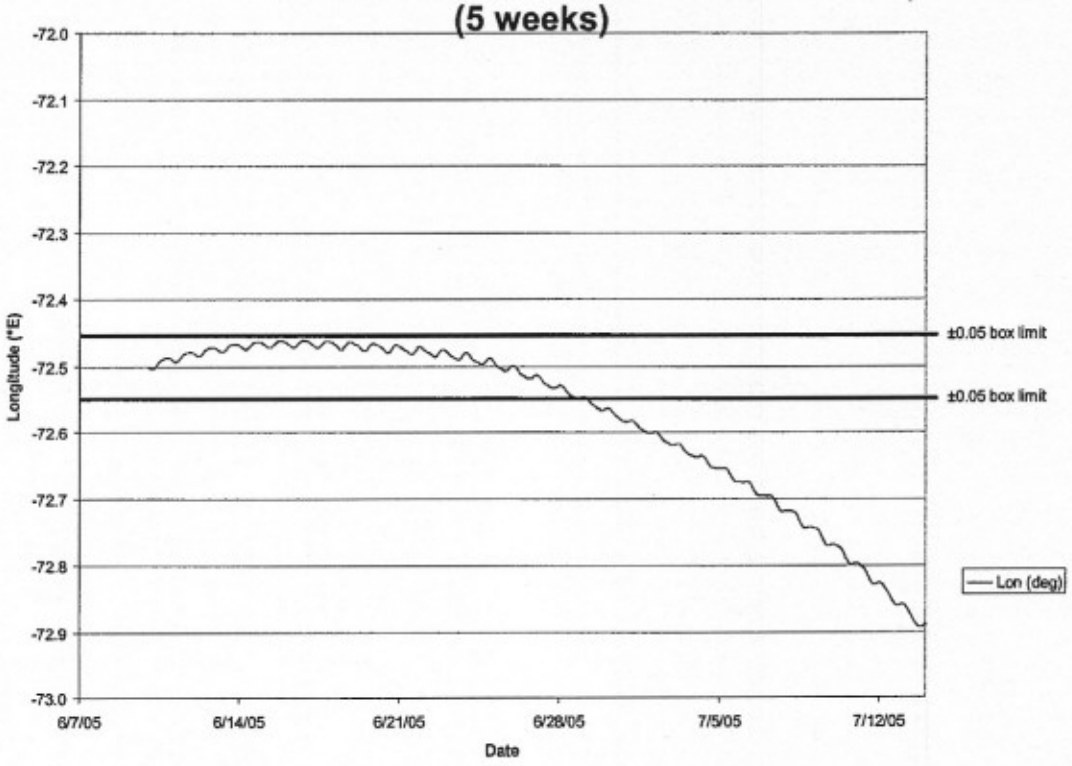


Figure 3. Inclination vs. Time (5 years)

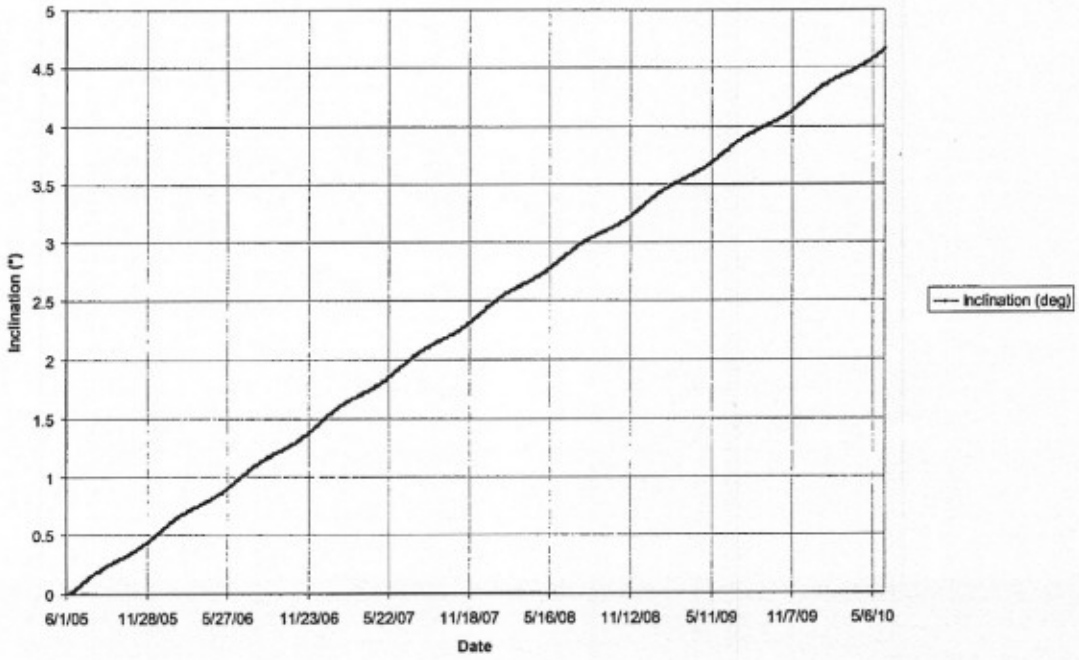
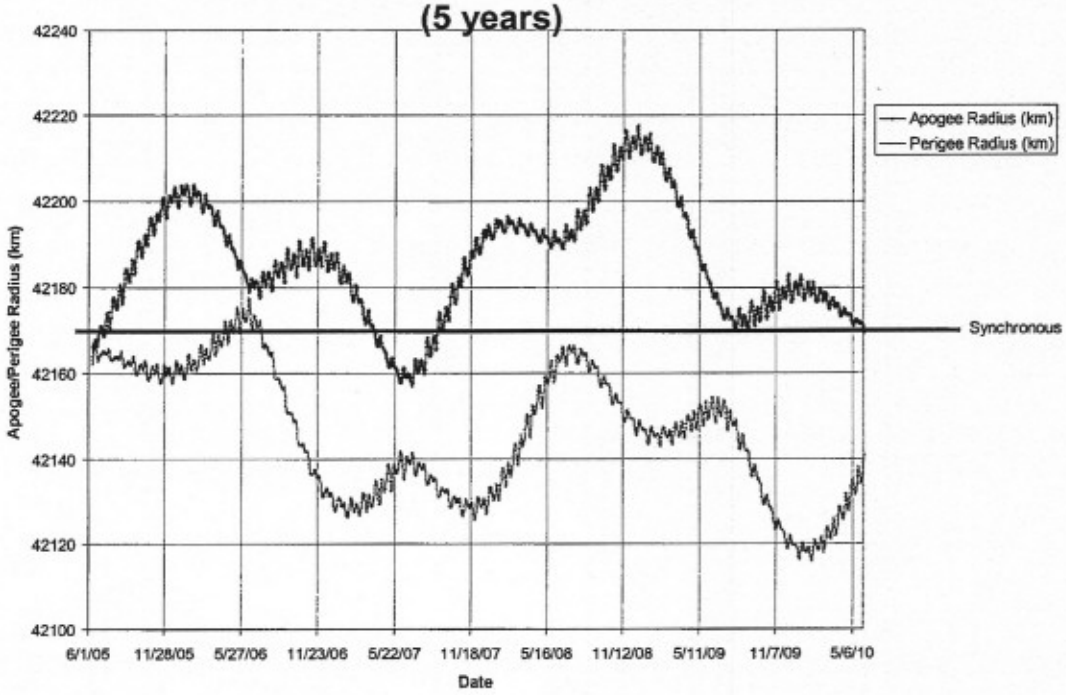


Figure 4. Apogee and Perigee vs. Time (5 years)



DIRECTV 6 at 110° WL

Although not susceptible to "tin whisker" SCP failures because it is based on a different design, DIRECTV 6 has experienced a large number of solar array failures since its launch in March 1997. Because of this, DIRECTV chose to place the satellite where it was authorized to operate on the fewest DBS channels (3), in order to minimize the power requirements and thereby extend the useable lifetime of the satellite. As it now stands, DIRECTV 6 can withstand one more failure on each of the North and South power busses before DIRECTV will be required to reduce power or turn off transponders. In addition, DIRECTV anticipates that the satellite will run out of fuel in July 2007.

This is why DIRECTV requested authority to relocate DIRECTV 5, which has no power failures, is not an HS601 design, and has greater than 10 years of life remaining, from 72.5° WL to 110° WL.[3] DIRECTV 1 would replace DIRECTV 5 at 72.5° WL. An alternative move of DIRECTV 1 to 110° WL to replace DIRECTV 6 is possible, but such a move would eliminate service from 110° WL for subscribers in Hawaii and most of Alaska due to the coverage limitations of DIRECTV 1, and therefore that alternative was not considered further. In the event of a failure or de-orbit of DIRECTV 6 before a replacement arrives (for example, because DIRECTV 5 is not relieved at 72.5° WL),

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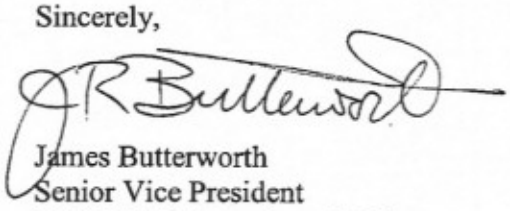
3 *See* DIRECTV Enterprises, Request for Special Temporary Authority, File No. SAT-STA-20050517-00104 (filed May 17, 2005).

consumers throughout all fifty states will be deprived of three transponders of high-definition programming, roughly seven channels of programming using current compression technology.

* * *

I am filing a copy of this letter in each of the above-captioned files. Please contact me if you have any questions,

Sincerely,



James Butterworth
Senior Vice President
DIRECTV Enterprises, LLC