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April 24, 2003

BY HAND DELIVERY

SAT-STA-20030324-00039 IB2003000379
PanAmSat Licensee Corp.
Galaxy III-R

Marlene H. Dortch, Secretary
Federal Communications Commission
445 Twelfth Street, S.W.
Washington, D.C. 20554

Re: PanAmSat Licensee Corp.:
<u>Further Supplement to Request for STA</u>

Dear Madam Secretary:

As requested by the staff of the International Bureau, PanAmSat Licensee Corp. ("PanAmSat"), by its attorneys, hereby supplements further its March 3, 2003, request for special temporary authority ("STA") to: (1) relocate Galaxy III-R from 74° W.L. to 111.1° W.L.; and (2) operate the tracking, telemetry, and command ("TT&C") payload on Galaxy III-R during the relocation, and the March 27, 2003 further supplement.

The staff specifically asked PanAmSat to provide additional information regarding failure probability indicators for the primary spacecraft control processor (SCP) remaining on Galaxy III-R. Attached hereto is a PanAmSat memorandum regarding the requested information.

Further questions with respect to this matter should be directed to the undersigned or to Michael A. McCoin, at (202) 429-4900.

Sincerely,

Henry Goldberg
Attorney for PanAmSat Licensee Corp.

cc: Thomas S. Tycz
John Martin
Robert Nelson
Karl Kensinger
Jennifer Gilsenan

GOLDBERG, GODLES, WIENER & WRIGHT

**TO:** Jim Frownfelter

**FROM:** Bridget Neville

**DATE:** April 23, 2003

**RE:** SCP Failure Probability Indicators

**CC:** Kalpak Gude
Henry Goldberg

[redacted]

The primary spacecraft control processor (SCP) on Galaxy IIIR failed on April 21, 2001 after 5.4 years in orbit. Cause of the failure was attributed to a tin whisker induced short of the on/off relay in the unit power supply. The failure is one of 9 such failures to have occurred across 44 commercial SCPs operational on BSS 601 model satellites. Galaxy IIIR has continued to operate nominally using it's backup SCP and is expected to continue to operate until the end of its nominal fuel life, February 2005.

The failure mechanism for a tin whisker-induced failure of an on-orbit SCP includes several simultaneous conditions:

1) The SCP must contain a pure tin-plated on/off relay in the unit power supply.
2) There must be a physical stress in the tin, such as that caused by a surface scratch or an imperfection in the tin plating.
3) Conformal coating or other protective material on the relay must be absent or have significant voids.
4) The relay case must be grounded to the unit chassis.
5) A tin whisker must grow in the right direction and become long enough to contact power and ground terminals on the relay.

In an attempt to predict an individual SCP's susceptibility to failure, a detailed review of the failure conditions has been conducted to determine which, if any, can be correlated to the actual in-orbit failure statistics. Failure conditions #1 - #4 are principally manufacturing conditions and #5 is a function of time in orbit. These conditions are discussed below.

## I. Relay Correlation Assessment

Unit manufacturing records determine the presence and production history of a tin plated relay. One theory is that SCP failure susceptibility can be traced to a badly manufactured lot of relays. Table 1 shows the number of SCPs manufactured using relays from different lot codes and the resulting failure statistics of those SCPs. The relay in the failed SCP on Galaxy IIIR came from lot 1990-03. The remaining SCP has a relay from lot 1983-16.

**Table 1**
**Relay Manufacturing Data**

| Relay Mfg. Code | # of SCPs Manufactured | % of total SCPs | # of Failed SCPs | % of Failed SCPs | Failure Predict by Mfg % |
|---|---|---|---|---|---|
| 1982-44 | 2 | 4% | 0 | 0% | 0 |
| 1983-16 | 1 | 2% | 0 | 0% | 0 |
| 1988-37 | 3 | 7% | 2 | 22% | 1 |
| 1990-03 | 20 | 44% | 5 | 56% | 4 |
| 1991-18 | 1 | 2% | 0 | 0% | 0 |
| 1991-48 | 10 | 22% | 1 | 11% | 2 |
| 1992-40 | 2 | 4% | 1 | 11% | 0 |
| 1993-45 | 6 | 13% | 0 | 0% | 1 |

The data show that failures have occurred using relays from 4 different manufacturing lots produced many years apart. The lot with the highest percentage of failures was also used in the highest percentage of units manufactured. Applying the manufacturing percentages to the total number of failures creates a predicted failure rate for each manufacturing lot that is very close to that actually observed. There seems to be no correlation between the relay manufacturing lot and SCP failure.

**II. Production Location Assessment**

Another theory of failure prediction is that the location where the SCP itself was produced could indicate a unit's failure susceptibility. There is certainly some logic to this theory since both the conformal coating condition and the grounding of the relay to the chassis (failure conditions #s 3 & 4) are functions of the production process. SCPs with tin plated relays were produced at 2 locations, as shown in Table 2. Both SCPs on Galaxy IIIR were produced at site 1. It is important to note that manufacturing documentation and requirements used at both locations were identical since both were complying with the same standards for production, inspection, and acceptance test.

**Table 2**
**Manufacturing Location**

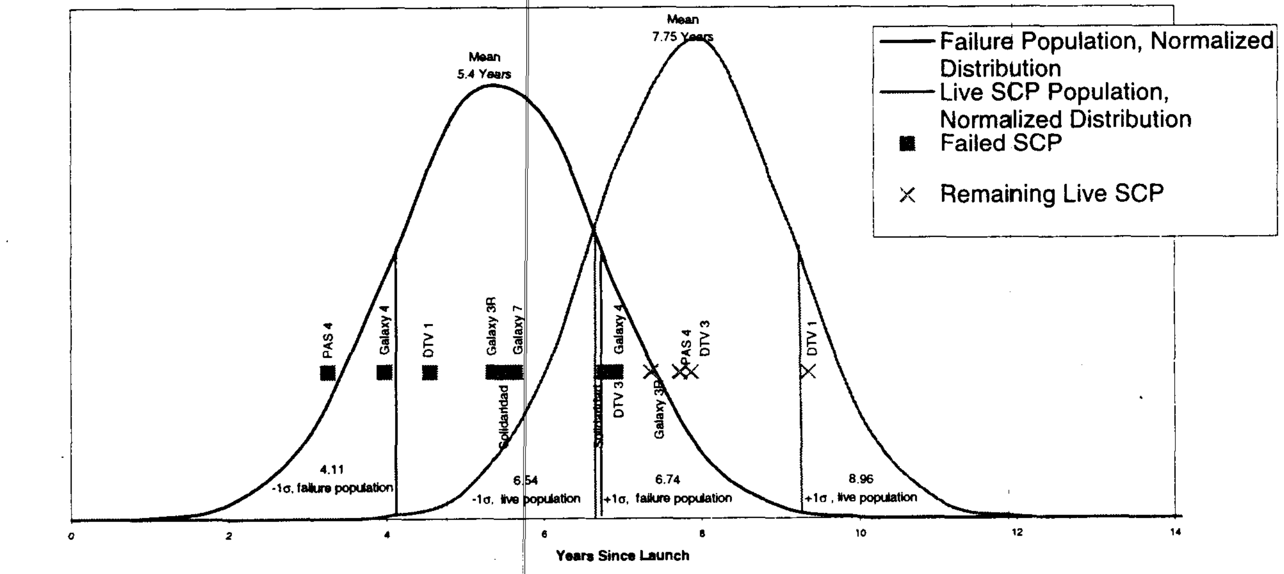
| Manufacturing Location | # of SCPs Manufactured | % of total SCPs | # of Failed SCPs | % of Failed SCPs |
|---|---|---|---|---|
| Site 1 | 25 | 57% | 7 | 78% |
| Site 2 | 19 | 43% | 2 | 22% |

While the data shows that more failures have occurred in site 1 produced units than in those from site 2, it clearly shows that units from site 2 have also suffered failures. Manufacturing location therefore cannot be used as the only or even the primary indicator of failure risk.

**Whisker Length Assessment**

The remaining condition that must be present for a tin whisker failure to occur is the growth of a whisker in the right direction and of sufficient length to make contact between power and ground terminals on the relay (failure condition #5). Figure 1 shows that time-in-orbit can be closely correlated with failure statistics and used as a proxy for determining if the tin whisker is present and of a length capable of causing a failure. Time in orbit shows a much stronger correlation than production location in assessing susceptibility of a unit to failure. Similarly, time in orbit can also be used to assess when a unit is no longer at risk of failure. If the time at which a tin whisker has been shown to reach critical length under very similar temperature and pressure conditions has passed, then a whisker must not be present at all. The longer an SCP remains operating past the critical in-orbit time, the lower it's chances of failing in the future, regardless of the location in which it was produced or the manufacturing lot code of it's relay.

**Figure 1. SCP Tin Whisker Failure Distribution**




**Notes**

1) Galaxy-IV: Time of redundant SCP failure is unknown (occurred between IOT and 3.98 years). It is the only spacecraft where the redundant SCP failed prior to the primary SCP failure. The primary SCP suffered a motor driver failure at 3.98 years, and a P failure is unknow

2) Galaxy-VII: Redundant SCP suffered a motor driver failure which caused the satellite to be deorbited. Redundant SCP data is not included in the analysis since we are unable to determine it's status.

At 7.4 years of time in orbit, the remaining SCP on Galaxy IIIR is well beyond the +1σ lifetime defined by a normal distribution analysis of in-orbit lifetimes for all failed SCPs. The normal distribution data predicts that 93% of all failures would have already occurred by a lifetime of 7.4 years. In orbit time is the only parameter which shows a strong correlation to failure probability. The risk of failure of the remaining SCP on Galaxy IIIR is extremely low and gets even lower with every day it continues to operate.

**Conclusion**

All available data indicate that the remaining SCP on Galaxy IIIR is highly unlikely to fail due to tin whiskers, because, at 7.4 years of age, the Galaxy IIIR SCP already has exceeded the lifetime of the oldest SCP to fail (6.9 years) and the age by which 93% of all failures already would have occurred. The risk of failure of the remaining SCP on Galaxy IIIR is extremely low and getting lower every day.