Commercial Space Transportation

QUARTERLY LAUNCH REPORT

Special Report:

Update of the Space and Launch Insurance Industry

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Associate Administrator for Commercial Space Transportation
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Special Report

Update of the Space and Launch Insurance Industry

INTRODUCTION

Insurance is a basic requirement for the maintenance of a commercial space industry. Space activity mishaps can result in hundreds of millions of dollars of expenses. Two recent launch vehicles that failed (a Titan 4A and the initial Delta 3) were valued at $1.3 billion and $225 million respectively (inclusive of payload). The replacement cost of the recently failed Galaxy 4 satellite, for example, was in the range of $200 to $250 million. In addition, consequences of mishaps will typically extend beyond the cost of a satellite and launch vehicle. Business operations can be delayed, possibly resulting in the deferral of a satellite venture's vital revenue streams. With such valuable assets at risk, insurance is essential to mitigate the high cost of a failure.

Certain types of space insurance, such as third party liability insurance, protect the general public from the hazards of space activity. The U.S. Federal Aviation Administration, through the Commercial Space Launch Act Amendments of 1988, requires third party liability insurance as a condition for the issuance of a commercial launch license. Under the 1972 United Nations Convention on International Liability for Damage Caused by Space Objects, governments are liable for injury or damage to third parties, caused by launch vehicles or payloads launched under their jurisdiction.

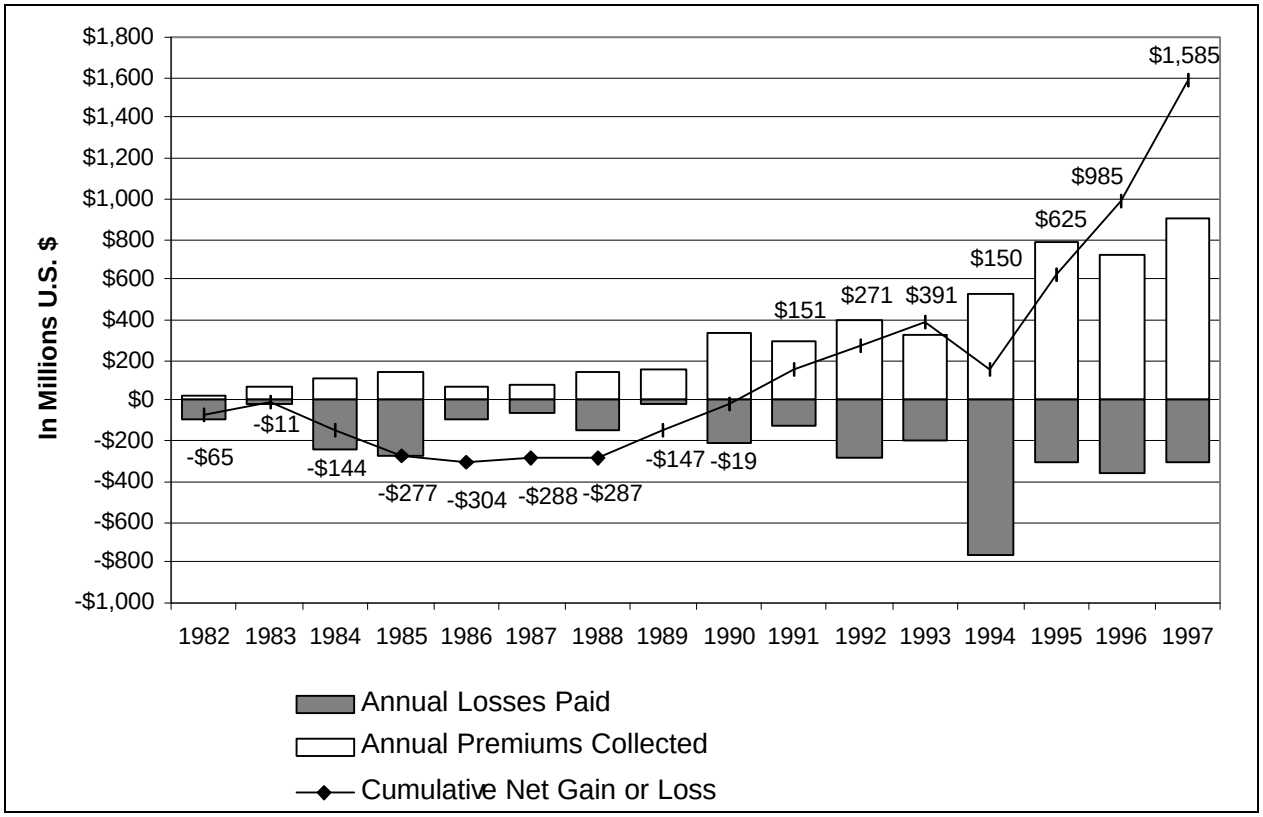

Figure 1. Approximate Launch Premiums Collected and Claims (1982-1997) (Source: International Technology Underwriters, International Space Brokers, and International Space Industry Report)

Table 1. Types of Space Insurance

Launch Insurance Pays the owner of a satellite for a failed launch or for a satellite damaged on that launch.
Government Property Insurance Pays the government for the loss of any government property due to launch operations.
Third Party or Liability Insurance Pays a third party for loss from a failed launch (e.g., debris falling on private property). It is required for a launch license.
Re-Launch Insurance Guarantees a second launch if the first launch results in failure.
Business Interruption Insurance Makes payment for revenue losses by organizations using a satellite.
On-Orbit Insurance This refers to insurance applicable during the on-orbit operations time period.
Constellation Insurance This covers the services provided by a LEO constellation, not the individual satellites in the constellation.

As a whole, space insurance comes in many different forms. It can help compensate for the failure of a launch or the partial or total loss of an on-orbit satellite, for losses suffered by third parties, and even for losses due to canceled government funding. Table 1 above summarizes the principal types of space insurance (see also Appendix 1).

Launch insurance indemnifies the owner of a satellite for a failed launch, failed vehicle, and/or failed satellite. Typically, $250 million to $300 million of coverage is provided, with the average premium for launch insurance currently ranging from around 15 percent to 25 percent. Third-party liability insurance indemnifies a third party from loss or damage caused by a satellite or launch vehicle. Usually, only $150 million to $200 million coverage is required (which typically sells for a 0.1 percent to 0.2 percent premium) for large vehicles.

THE SPACE INSURANCE MARKET – HISTORICAL

The space insurance industry dates from the 1960s, when it appeared as a response to the development of commercial communications satellites. Aviation insurance specialists issued the first policies, which featured low premiums and compensation that was paid on the provision of a minimum of evidence. In the late 1960s and the early 1970s, space insurance markets changed dramatically when a substantially larger number of insured launches failed, causing underwriters to suffer heavy losses. Brokers began to specialize in space insurance, and some of them hired space experts as consultants or staff members in an attempt to better understand and predict the space industry. This technical approach to underwriting was by no means universally accepted, however, and many underwriters continued to use more traditional actuarial methods to make underwriting decisions.

When a second wave of launch failures occurred in the mid-1980s, the space insurance industry's cumulative losses (total premiums collected less total claims paid out) reached close to $300 million by 1986. Underwriters raised premiums above 30 percent to cover previous losses and to restore industry profitability. Some satellite operators decided to self-insure rather than pay premiums at these levels, and high insurance cost was regarded as a barrier to entry into the market. By the end of the 1980s, the industry was nearing restored profitability with launch insurance premiums in the early 1990s falling to the 15 percent to 20 percent rate.

THE SPACE INSURANCE MARKET – RECENT

The space insurance industry has been profitable since 1991. The industry's cumulative profitability for the 1982-1997 period is approximately $1.6 billion[1] (see also Figure 1). The 1990s have seen an expansion in the number of insured launches following a period of slow growth in the 1980s. In 1997, there were 35 major insured launches, nearly double the 18 in 1990 (see Figure 2).

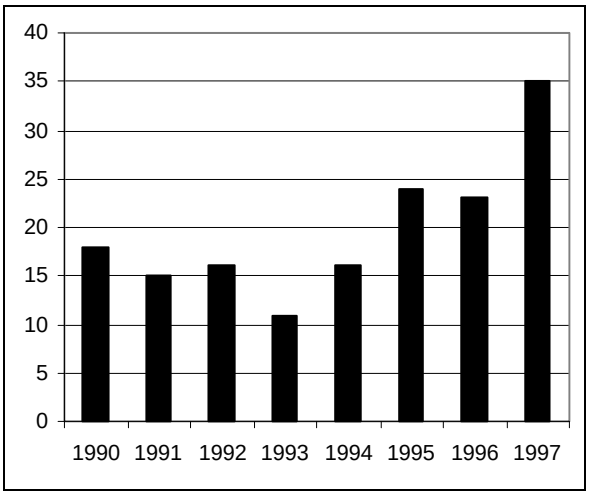

Figure 2. Insured Launches 1990-1997 (Source: International Space Brokers Group)

The increasing profitability of the space insurance market has drawn ever-increasing amounts of money into space insurance. As a result, insurance premiums in 1998 are quite low and the market soft (a soft market is one in which more money is available for insurance than is needed to cover demand). Although premiums are difficult to estimate precisely, a series of recent interviews by the Satellite Industry Association produced the list of approximate launch insurance rates in Table 2.

This year has seen two commercial launch failures thus far. The launch failure of the first Delta 3 resulted in the loss of PanAmSat's Galaxy 10 communications satellite. The cost of the Delta 3 launch and satellite were covered under a $4 billion insurance package, the largest such package to date (further discussion of this is provided below). However, lost revenues associated with the destruction of this satellite and the on-orbit failure of the Galaxy 4 satellite in May 1998 were not covered under the insurance deal.

The second failure, that of the Zenit 2 in September, will delay the deployment of the Globalstar LEO constellation, which will enter service with 12 fewer satellites than were initially planned. Globalstar's new launch plan will cost an additional $85 million (beyond what it will receive from insurance for the Zenit 2 failure).

Table 2. Launch Insurance Rates as of June 1998

USA	Atlas	15 – 17%
USA	Delta	15 – 17%
Europe	Ariane 4	15 – 17%
Russia	Proton	20%
China	Long March 3B	25%

(Source: Satellite Industry Association)

[1] This cumulative profitability does not take into account the time-value of money.

PROFITS AND VOLATILITY IN SPACE INSURANCE MARKETS

Almost every launch, launch vehicle, and payload has its own unique characteristics. This uniqueness (and the small number of launches in general) reduces the information that can be drawn from individual launches so that launch insurance has a relatively small actuarial base. An actuarial base may become larger with large constellation

deployments like Navstar/GPS, in which many identical payloads are launched on multiple identical launch vehicles, or Iridium, which used many similar launch vehicles, mainly Delta and Long March vehicles.

Generally, insurance spreads risk over either multiple events or long periods of time. The predictability of events increases as the number of occurrences grows. The total number of orbital launches is small and each launch is different enough that insurance rates are difficult to determine. Space insurance rates (particularly launch insurance rates) are, therefore, as much a matter of market forces as a matter of actuarial tables.

In addition to the lack of a strong actuarial basis, space insurance differs from most other forms of insurance in that it has short time lines for large dollar amounts of coverage. The lifetime of most launch policies, even with extended on-orbit coverage, is no more than five years and the riskiest portion of this is a launch that takes place in under half an hour. For a launch-plus-five-year policy (in which the payload is covered for five years of on-orbit service after its launch) about 75 percent of the premium goes to cover the launch while only 25 percent is left for the remaining five years. The brief duration of an actual launch event makes launch insurance potentially very profitable. When a launch succeeds, the launch portion of the premium immediately becomes profit (after expenses). Conversely, a series of launch failures in a short period of time will have a severe effect on underwriters' financial reserves. The large increase in premiums following a series of launch failures in the mid-1980s illustrates this effect.

A great deal of volatility remains in the industry even in the most profitable of times. The increasing reliability and stable price of launch vehicles, along with the growing pool of available underwriting money, help cushion the market against potential shocks, but the increasing value of some satellites (and, hence, higher possible claims for those launches, if they fail) provides a countervailing force. As an example, consider Intelsat satellite prices. The Intelsat 5 series (first launched in 1980) were built for approximately $60 million per satellite. Intelsat 7 A8 (lost in a 1996 Long March launch failure) cost $140 million, 2.3 times the price of the earlier Intelsat 5. Such increases in the price of satellites greatly increase the size of underwriters' exposure to losses, exacerbating insurance market volatility.

The year 1996 is an example of how thin the margin between success and failure can be. Although underwriters saw a net profit of $246 million,[2] this profit could easily have been erased had one or two more launches resulted in failure.

THE LAUNCH UNDERWRITING PROCESS

The current success of the space insurance market has brought in a considerable amount of new investment. With greater financial resources, insurers have been increasingly willing to underwrite higher totals on satellite launches. The maximum amount of coverage available for a single launch (an estimate often used as an indicator of industry health) has risen each year for the past 12 years. Underwriters worldwide have increased this amount from $150 million in 1987 to $300 to $350 million in the early

[2] Ignores operating costs; in 1996, worldwide premiums totaled $811 million and losses amounted to $565 million.

Table 3. Top Six Individual Underwriter Single Launch Maximums (March 1998)

Assicurazioni Generali S.p.A. (Italy)	$120 million
AGF/AGA (France)	$95 million
La Reunion Spatiale (France)	$95 million
Marham Space Consortium of London (Lloyd's of London)	$80 million
BIS/Brockbank (USA)	$75 million
INTEC/AXA (USA)	$65 million

(Source: International Space Industry Report)

1990s. In the latter 1990s, the available amount has risen from an estimated $555 million in 1995 to $650 million in 1996 and as much as $800 million to $1 billion in early 1998. These amounts may reflect an increase in underwriters' confidence in launch vehicles, the increased availability of capital and, in general, a better understanding of the commercial space transportation and satellite industries.

While the theoretical maximum represents the collective wisdom of the market as to what the maximum coverage for any single launch should be, it does not reflect the amount of coverage a single underwriter is willing to underwrite on a regular basis for a single launch. The amounts that some major space launch insurance underwriters were willing to underwrite for single launches (as of March 1998) are given in Table 3.

Currently, the world's four largest insurance-providing countries are the United States, France, the United Kingdom, and Italy. Insurance capacity is spread worldwide and insurance packages are almost always international. Figure 3 shows the division of world underwriting capacity[3] in March 1998.

[3] "Capacity" is the measure of an insurer's financial strength to issue contracts of insurance, usually determined by the largest amount acceptable on a given risk or, in certain other situations, by the maximum volume of business it is prepared to accept.

LARGE UNDERWRITING PACKAGES

The large sums involved in space insurance require that multiple insurers work together to underwrite individual policies. These policies will frequently cover multiple launches as well. Such arrangements allow individual underwriters to underwrite coverage much greater than that possible for any single launch, insured individually. Multiple-launch packages allow underwriters to offer lower rates for launches that are good risks and higher rates for launches that are bad risks. A multiple launch package allows actuarial tools to be applied, helping to limit overall uncertainty. As a result, multiple-launch insurance deals are a common form of underwriting.

The largest single space insurance package assembled to date is the $4 billion deal arranged for PanAmSat in January 1998. Space Machine Advisors of Greenwich, Connecticut was the primary insurer and three other major players participated in the deal: Aon of London, Gras Savoye of Paris, and Triangle Brokerage of Bermuda.

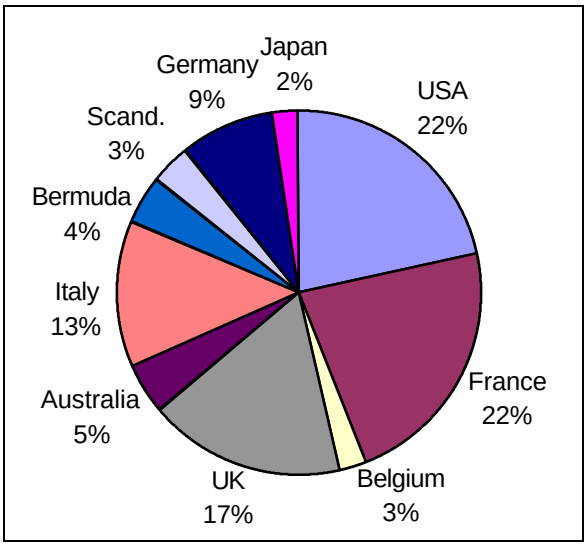

Figure 3. World Space Insurance Capacity (Approximate Total $1.2 B; as of March 1998) (Source: International Space Industry Report)

Table 4. Launches Covered in PanAmSat Space Insurance Package

Payload	Launch Vehicle	Satellite Bus	Status
Galaxy 10	Delta 3	HS-601 HP	Launch Failed
PAS 8	Proton	FS 1300	Future
PAS 6B	Ariane 42L	HS 601 HP	Future
Galaxy 11	Ariane 4	HS 702	Future
PAS 1R	Ariane 5	HS 702	Future
Galaxy 4R	H 2A	HS 601 HP	Future
Galaxy 10R	Ariane 5	HS 601 HP	Future
Galaxy 3C	Proton	HS 702	Future

Under this arrangement, PanAmSat extended its on-orbit insurance to three years for its 18 satellites currently on orbit and insured the launches of eight new satellites (on eight different launch vehicles, see Table 4) to be conducted over the same period. PanAmSat received a rate of approximately 14.5 percent for the entire package.

This package is notable not only for its high value but also for the number of new payloads and vehicles that it covers. In addition to the Sea Launch vehicle, the policy covered the Delta 3, Japan's H 2A, and the European Ariane 5. None of these vehicles have a long history. Neither the Delta 3 nor the H 2A had been launched when PanAmSat's insurance package was negotiated and the Ariane 5 has not yet had a fully successful launch.

The first three Hughes 702 satellites to be deployed are also covered by this contract. The first Hughes 702 satellite (Galaxy 11) is to be launched on an Ariane 4 vehicle. The second (PAS 1R) and third (Galaxy 3C) are to be launched on a Proton and an Ariane 5 respectively.

Another example of a large insurance package is the 1995 policy under which Intelsat insured ten launches for a cost of $2 billion. This coverage was arranged through International Space Brokers (ISB) of Rosslyn, Virginia, but underwriting was divided among insurance companies in four countries: the United States, France, the United Kingdom, and Germany. Although launch insurance premium rates for Arianespace had been running at about 17 percent of insured value, ISB was able to secure a rate below nine percent for each of the seven Ariane missions and a rate of somewhat over 11 percent for the Long March 3B flights.

UNDERWRITING & LAUNCH VEHICLE RELIABILITY

In addition to market forces and available capital (discussed previously), a very important issue in underwriting decisions is the availability of information about the systems involved. Both technical detail and operational history are used to predict the chance of success for a launch or the on-orbit lifetime of a satellite. See Table 5 for some examples of current vehicle family reliability.

Table 5. Lifetime Vehicle Reliability Rates

Vehicle	Launch Attempts	Reliability
Atlas 1 & 2	49	95.9%
Delta 2	73	98.6%
Delta 3	1	0.0%
Ariane 4	81	96.3%
Ariane 5	2	50.0%
Proton	254	89.4%
Soyuz	958	99.3%
Long March	54	90.7%

(Source: STAR Database, October 14, 1998)

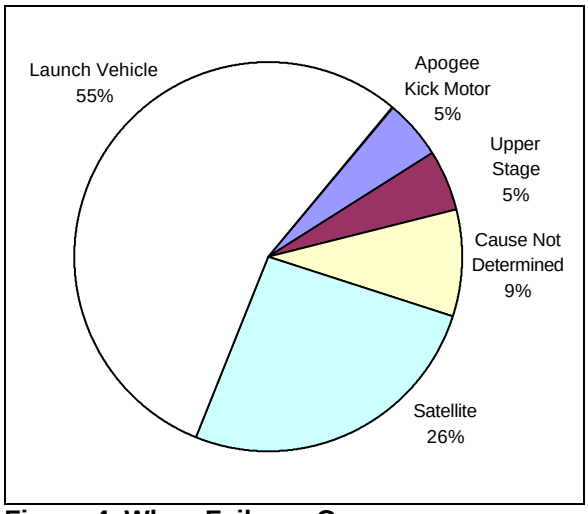

Figure 4. When Failures Occur
(Source: Assicurazioni Generali, 1995)

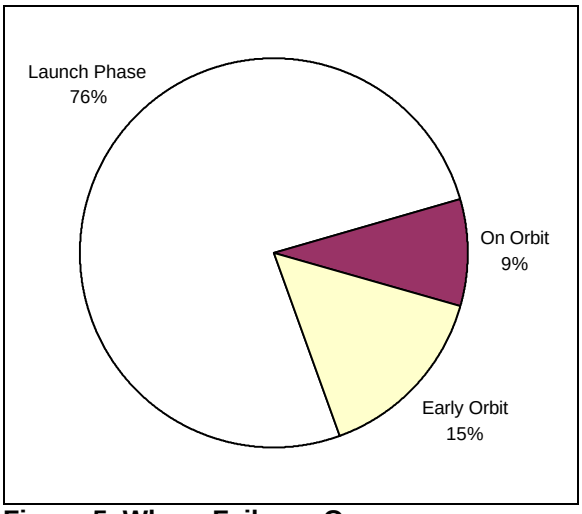

Figure 5. Where Failures Occur
(Source: Assicurazioni Generali, 1995)

Because the first flight of a launch vehicle is a more uncertain event than the fortieth, insurance is likely to cost more for the first launch of a new vehicle than for an older vehicle with a record of successful flights. Ten launches are generally considered an adequate number to prove a vehicle if they have been successful. All else being equal, as a launch vehicle's record improves, its user's insurance premiums will decline as underwriters place more trust in the vehicle. Since the majority of failures and mishaps take place during the launch phase, trust in the reliability of a launch vehicle is important (see Figures 4 and 5).

The recent loss of the first Delta 3 launch vehicle is an example of the uncertainties inherent in the use of a new vehicle. Although it drew from the proven design of the Delta 2, the Delta 3 still experienced unforeseen problems which resulted in its failure. Because of this failure, it will likely cost more to insure future Delta 3 launches until the vehicle is proven.

Similarly, Sea Launch must deal with the perceived uncertainties of both a new launch vehicle (the untested Zenit 3/SL) and of its novel ocean-going launch platform (a converted oil drilling platform). Boeing plans to test the Zenit 3/SL by conducting its initial launch with a dummy payload instead of the originally manifested Galaxy 11. This test will hopefully please underwriters who have been concerned about the risk of launching commercial spacecraft on the initial launch of commercial vehicles, but it will cost Sea Launch in both time and money.

Concerns about vehicle reliability appear any time that a launch vehicle fails. One recent example is the Air Force's investigation of the 1997 Delta 2/GPS launch failure. In this case, there were concerns that the restriction of information would reduce underwriters' ability to make informed judgments. This concern caused notable complaints about the Air Force's investigation and reiterated the point that information about launch vehicles and satellites is essential to the space insurance industry today.

CONCLUSIONS

When asked, many underwriters state that the introduction of new and changed launch and satellite systems is one of the most important issues for the future of the space industry. As the industry builds larger, more powerful satellites and launch vehicles, underwriting challenges will increase. Underwriters feel that only time and experience will bring these new systems to the levels of maturity that will provide satisfactory reliability.

The issues surrounding the introduction of new technology issue are already evident. Both of this year's commercial failures, the Delta 3 and the Zenit 2, are new vehicles to the commercial launch industry. As a result of these launch failures and of other claims, insurance claims for 1998 will total close to $1 billion.

Appendix 1. Types of Space Transportation Insurance

Launch Insurance

Launch insurance indemnifies the owner of a satellite for a failed launch, failed vehicle, and/or failed satellite. Typically, $250 million to $300 million coverage is provided, with the average premium for launch insurance currently ranging from around 15 to 25 percent (although premiums have been as high as 26 to 30 percent). Cross-waivers by co-launching parties are agreements not to sue each other in the event of failure. There is no government requirement for this type of insurance for commercial launches, but NASA may require it for its payloads. This type of insurance now often includes coverage for the first three to five years of on-orbit operation as well as the launch itself.

Government Property Insurance

Government property insurance indemnifies the government for loss of any government property due to launch operations. FAA/AST typically requires $75 million to $80 million coverage for large vehicles with lesser amounts for smaller vehicles. Such insurance typically requires a 1.5 percent to 2.0 percent premium.

Third Party or Liability Insurance

Liability insurance indemnifies a third party from loss related to hardware or mission failure (e.g., debris falling on private property). FAA/AST can demand up to $500 million coverage but usually requires only $150 to $200 million coverage (which typically sells for 0.1% to 0.2% premium) for large vehicles. Third party insurance is required for a launch license because governments are liable for injury or damage to third parties under the 1972 United Nations Convention on International Liability for Damage Caused by Space Objects. This convention obligates the launching country to assume liability for damage done by either a launcher or a satellite. Other launch providers, around the world, also require liability insurance for commercial launches. Arianespace requires 400 million French francs in liability insurance, which is currently included in Ariane's launch price. Long March also requires third-party liability insurance. No claims have been filed under these policies to date.

Re-Launch Insurance

Re-launch insurance is a form of first-party insurance begun by Arianespace, which is now regularly offered by many launch service providers. With re-launch insurance, the launch service provider guarantees a second launch if the first launch results in failure. In this case, the launch provider acts as the insurance company. Re-launch insurance began as an enticement to payload owners who could not get a commitment from insurance underwriters sufficiently in advance to schedule a launch and begin manufacture of the spacecraft. A launch provider will typically offer one rate if the customer requires a cash payment in the event of failure and another rate if the customer will accept a re-launch.

Business Insurance

This type of insurance involves indemnification for revenue loss typically for satellite owners if the satellite fails to attain operational status. In recent years, premiums for this insurance have become too costly and very few satellite life insurance policies are sold.

On-Orbit Insurance

On-orbit insurance is becoming more commonplace and refers to insurance applicable during the on-orbit operations time period. It encompasses coverage for satellite owners and satellite manufacturers and includes satellite life insurance, manufacturer incentive insurance, and insurance of satellites during on-orbit testing. Premiums from these policies have increased from less than $50 million a year in the 1980s to more than $100 million expected in 1996. Note that this type of insurance is for on-orbit operations only and is not related to the performance of the launch vehicle.

Constellation Insurance

While on-orbit insurance is coverage of individual satellites, constellation insurance is the coverage of a constellation or part of a constellation. In the case of Iridium, the operation of an orbital plane (there are six such planes in the Iridium system) but not the individual satellite that make up the plane might be covered. These satellites are easy to replace and, to some degree, are interchangeable. It is the service provided by the constellation or plane itself, not the individual satellites, that is insured.