INSURANCE ISSUES FOR SMALL SATELLITES AND ELVs

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This paper is intended to identify to those considering the use of small satellites and expendable launch vehicles the issues which may affect their ability to obtain insurance for their activities. It first discusses the types of insurance which are presently associated with space activities, including physical damage and liability coverages. It then addresses those aspects of small satellites and ELVs which appear to be different than present insurable space activities, and concludes by discussing how those differences might affect insurance requirements.

These remarks are not intended to portray an established position on the part of the space insurance industry. However, speaking as a major underwriter of space insurance with an interest in the development of small satellites and ELVs, INTEC believes that the issues discussed in this paper reflect the types of concerns most underwriters would have regarding these new areas of space activities.

CHARACTERISTICS OF EXISTING SPACE INSURANCE COVERAGES

Space insurance can be classified into three general categories: physical damage, liability, and personal. In the category of physical damage, space insurance has historically addressed the risks associated with launch and on-orbit operations. For launch insurance including satellite initial operations, premium rates currently range from roughly 20% to 25% on sums insured typically ranging from $75-100 million per satellite. Premium rates for on-orbit insurance for communications satellites range from approximately 2% to 4% per year. The coverages vary widely by type and amount for each risk insured; on-orbit satellites typically have multiple-insured parties, giving rise to accumulations of coverage which may approach $200 million in some cases. Although re-entry systems are under consideration for use with small payloads, to date no coverages have been sought for such vehicles or activities.

In the liability category of space insurance, coverages to date have largely been concerned with damage or injury to "third parties," which refers to those parties not directly related to the activity itself (i.e., innocent bystanders). Liability requirements in the commercial space arena are still very much an evolving situation. In the past, NASA contracts for launch of commercial payloads (both on ELVs and on shuttle) required the payload owner to obtain third party liability insurance of between $250 and $500 million. For payloads launched from the shuttle, the cost of this coverage was roughly $300 to $500 thousand (equating to a rate of from .06 to .1%). (It should be noted that this rate was for a manned system, which at the time was perceived as being safer than ELVs.) However, for small payloads in the mid-deck and, in some cases, Getaway Specials in the payload bay, NASA had routinely waived its requirements for third party liability coverage.

In today's evolving commercial environment, the Department of Transportation (DOT) has responsibility for establishing the level of such coverages which will be required for licensing, and DOT is expected to release these figures shortly after this paper is presented at the conference. DOT's decision would remain subject to any decision made by Congress, such as the Nelson bill now pending in the House.

Liability other than that regarding third parties involves those parties directly participating in the activity, such as launch vehicle operators, payload manufacturers and owners, and in some cases, the U.S. government when government facilities (e.g., pads) are involved. U.S. government requirements regarding use of its facilities have been a major concern thus far in the development of the commercial ELV industry in the U.S. The agreement presently under consideration between DOT, Congress, and the Administration would require some minimum level of insurance for damage to government property, above which the government would indemnify the operator. Various proposals, including the pending legislation, have mentioned several figures on the order of $100 million as the level of required insurance to be carried by launch vehicle operators. In situations in which no government facilities are involved, DOT would have jurisdiction, but thus far no indications have been given as to what requirements might be imposed.

Those liabilities which might arise among the non-government parties involved in the launch fall into the category of what is known as product liability, i.e., the liability which a particular manufacturer or service provider assumes for the performance of his product. To date, these have usually been addressed via releases, indemnities, and cross waivers, and it is anticipated that such arrangements will continue to be the most effective approach to such concerns for commercial space activities. (For example, if a strap-on solid motor were to fail and cause the crash of an ELV, the solid motor manufacturer could be found liable. However, in order to avoid the potentially cumbersome legal wrangling which would otherwise ensue, the ELV operator would establish a series of releases, indemnities, or cross waivers with his subcontractors.)

The final insurance category, personal, includes injury, disability, life, and workman's compensation coverages. To date, only limited amounts of life insurance have been utilized for shuttle crews, and these were provided at very nominal rates. In the future, personal coverages will have to be developed for the space station and commercial orbital facilities such as the Industrial Space Facility (ISF).

DIFFERENCES BETWEEN SMALL SATELLITES AND ELVS AND LARGE ONES

What Insurers Look At

In order to understand how insurers may be expected to approach risks involving small satellites and ELVs, it is useful to understand how insurers approach the large satellites and launch vehicles which they have been insuring since the mid-1960s. Their approach to evaluating these new risks will generally be the same as it has been for these risks in the past.

The largest factor in evaluating space risks is that of demonstrated reliability, that is, whether identical or very similar vehicles or spacecraft have been successfully flown before. In support of such track records, (and more importantly in the absence of such history), insurance underwriters examine the track record of the companies and individuals involved, the quality assurance and test programs, and the history of similar designs. In the course of establishing the rate at which they wish to offer insurance coverage, underwriters will also consider the level of coverage desired and the terms under which it could be provided. Such terms may include the definition of what constitutes a loss, how partial losses are defined, the size of any deductibles, the allocation of any salvage rights, and so forth.

In the final analysis, the rate for a given space endeavor will reflect the expected risk, tempered by the current state of the insurance market for space risks. High risks will produce high rates, and, as should be expected, a series of successes will indicate reduced risks and bring about reduced rates.

Fundamental Differences

The purpose of this section is to identify the differences between small satellites and ELVs and the larger ones with which insurers are accustomed to dealing. The question of which of these differences may be of significance to insurers in evaluating these new risks is addressed in a subsequent section. In this discussion, it is assumed that small satellites are placed in some low earth orbit (LEO) at various possible inclinations, and that the comparison is to large satellites located in geosynchronous orbit (GEO). The differences between small and large satellites can generally be divided into the following categories:

Lower Altitudes and Different Inclinations. Small satellites will face: a greater risk of decay resulting from atmospheric drag (as well as uncertainty as to the level of drag during any given period); a greater risk of impact with space debris; a much different radiation environment; different and possibly varying eclipse periods; shorter observation periods for the purpose of command, control, and communications; the presence of the earth in a major portion of the spacecraft's field of view for the purpose of attitude detection and control; a similar effect due to the proximity of the earth on the spacecraft's albedo heating and illumination environment; and the possibility that low altitude passes will raise overflight concerns in foreign countries.

Larger Number of Satellites. By design, small satellites will represent a greater number of spacecraft in orbits of varying altitude and inclination. In addition, such satellites will be part of multi-satellite systems which may be required to interact in order for the system to operate properly.

Smaller Size and Cost Per Unit. Also by design, small satellites are expected to be much lower in absolute cost and physical size, i.e., several hundred pounds vs. several thousand, and costing from under $1 million to perhaps $5 million vs. $10 million to $100 million per unit. For related reasons, they may also have a design life of one or a few years instead of 8 to 10 years.

Lower Launch Costs. Small satellites will generally have lower absolute launch costs, (although cost per pound may be higher than with large ELVs). Preliminary figures seem to indicate costs of $8 to $20 million per launch (versus $30 to $100 million for large spacecraft).

New/Different Launch Sites. Small ELVs are expected to be launched from different sites than are the large vehicles, although some of these are the same sites from which similar vehicles have been launched for the government for years (Wallops, Vandenberg). However, several locations are under consideration for the launch of both large and small vehicles which would be different than any used before for those vehicles. These include Florida (small ELVs), and Australia and Hawaii (both large and small). These new sites would present different range safety considerations and third party exposures than have been experienced before, and thus would require completely new analyses from those perspectives. New ranges might also mean new and perhaps less experienced range personnel, as well as new and untried ground processing and launch facilities and operations.

More Accessible for Servicing. Depending on the inclination of their orbits, some small satellites may be more readily accessible for servicing than large satellites (generally in GEO) have been to date. Such servicing could be accomplished via the shuttle, or in the future by small robotic devices. This accessibility makes servicing more possible, thus increasing the potential value of serviceable spacecraft designs. However, the lower cost, life span, and criticality of small spacecraft may dictate a fail/replace approach rather than one of fail/repair, given the somewhat low cost of launching a replacement. Thus the tradeoff of servicing versus replacement will probably have to be examined on a case-by-case basis.

Re-entry Vehicles. Some applications of small satellites may involve the capability to return payloads to earth. Several re-entry technologies have been demonstrated over the years on both manned and unmanned vehicles. From an insurance perspective, this would represent an additional risk which would have to be evaluated as distinct from the launch and on-orbit risks. Such risks would entail both physical damage and third party liability exposures.

Different/Unproven Systems. Both small satellites and ELVs will represent markedly different and, in many cases, unproven systems. Lacking operational track records, the employment of demonstration or test programs would provide a useful basis on which insurers could base initial judgements.

Unusual Payloads. Many small satellites are likely to represent unusual payloads and thus unique risks. This increase in one or few-of-a-kind missions will make it more difficult to compare performance to past missions and thus to judge the likelihood of success.

New Organizations and/or Management Teams. Many of the new small satellites and ELVs represent the efforts of new companies or management teams, which may lack track records. In such cases, the value of experienced personnel may be crucial to establishing the credibility of the venture. The absence of any demonstrated performance by the team (regardless of personnel qualifications) will make it more difficult to evaluate the overall risks.

HOW DIFFERENCES MIGHT AFFECT INSURANCE CONSIDERATIONS

The fundamental differences between large and small satellites and ELVs discussed above may affect insurance considerations in a number of ways.

Quality Assurance. The presence and degree of credibility of any quality assurance program will be of concern to insurers. On one hand, smaller organizations may have less structured QA programs, while on the other hand such small organizations may have a greater degree of oversight by virtue of their small size.

Number of Single Point Failures. In small satellites there may be (by design) fewer redundancies and thus a larger number of single point failures in any one spacecraft. However, where such satellites are part of a multi-satellite network, the redundancy may be at the network level and thus enable the system to tolerate the failure of one or a few individual satellites before system operation is significantly affected. In such cases, it may make sense for owner/operators to insure the operation of the system rather than individual satellites, effectively creating a multi-satellite "deductible" for their coverage. Such an approach would not, however, eliminate the need to demonstrate proper design of individual spacecraft so as to minimize the likelihood of single point failures occurring.

Levels of Standardization or Economies of Scale. Depending on the number of similar spacecraft or ELVs to be built, there may be a reasonable level of standardization possible, with associated economies of scale. In the case of one or few-of-a-kind spacecraft, just the reverse can be expected, resulting in a more difficult risk evaluation.

Number of Identical Risks. Similarly, the low cost of building and launching spacecraft to LEO may also permit a large number of very similar or identical risks to evolve.

These could include multiple re-flights of re-entry vehicles, thus permitting insurers to develop more confidence in at least one class of the new, smaller vehicles.

Repair Versus Replace Economies. In somewhat the same way, for sufficiently inexpensive spacecraft and launch vehicles, the economic tradeoffs between repair and replacement may be much different than that to which insurers have been accustomed. The potentially low cost of replacing failed units may override the temptation to take advantage of the relative accessibility of low earth orbit, unless such servicing were to become quite inexpensive. This could also give rise to a requirement (perhaps regulatory) to de-orbit failed spacecraft in order to avoid cluttering the lower altitudes.

HOW REQUIREMENTS FOR OBTAINING INSURANCE MIGHT BE AFFECTED

In response to these different types of risks, insurers might elect to address them in a number of different ways. For example, insurers might seek more insight into the early phases of a program's development in order to become comfortable with both the design of the spacecraft and the launch vehicle, as well as with the companies and the individuals involved. They might also seek more extensive involvement in pre-launch and quality assurance reviews. In some cases, it may be desirable for the company to conduct one or more demonstration, if the market turns out to be reluctant to provide the desired coverage . Another approach for insurers may be to employ unique policy wordings or provisions, such as one or two-flight or large dollar deductibles on multi-flight programs. Alternatively, unusual financing or pricing arrangements might be conceived in order to make it possible for insurers to be comfortable with certain types of new risks.