A SPECIALIZED INCENTIVE CONTRACT STRUCTURE FOR SATELLITE PROJECTS

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1. Introduction

a. This paper describes the overall rationale and outlines the individual features of an incentive contract structure for satellite projects. This structure requires no increase in the maximum fee attainable on cost type contracts under current conventional incentive practice, but, by a specialized arrangement of the basis of fee calculation, places maximum incentive upon the achievement of acceptable flight performance while simultaneously insuring responsible financial and schedule management. The plan is described initially as it applies to contracts for satellite vehicles, but it is equally applicable to payloads, boosters, and other aspects of satellite projects, as is outlined later in paragraph 6. The application of this incentive approach to non-flying end items is outlined in paragraph 8, for the case of satellite mission software. This incentive structure is intended for satellite projects for which prompt contractor response is essential, which, together with other circumstances, dictate the use of cost-plus-incentive-fee type contracts.

b. It should be understood at the outset that this document is a description of the overall incentive approach, its principal provisions and features, and its underlying philosophy. It is not a contract exhibit, nor does it contain the complete aspects of the specific incentive structure for any particular project. It is based upon the approach actually used in a variety of projects, altered in some instances to reflect current perspective after several years of such experience. Taken as a whole, it serves as a guide both as to the general incentive approach to major characteristics of different kinds of satellite projects, and to the way essential contingencies are handled in order to preserve the full effectiveness of the incentive features while providing the necessary operating flexibility for the government and a fair and reasonable consideration for the contractor.

2. Objectives. Although this specialized approach is well suited to the general requirements of all satellite projects, it is particularly addressed

to certain additional characteristics of some satellite projects.

a. While the achievement of satisfactory orbital performance is desired in all satellite projects, for some projects the continuing achievement of this performance, repetitively, on pre-determined schedule, and in the face of continuing changes, is absolutely essential. For such projects, no realizable dollar penalty to the contractor for failure of his product to perform can adequately compensate the government for failure to obtain the desired results from the scheduled flight. It is therefore essential that the incentive structure of such contracts be designed to assure the maximum effort on behalf of the contractor to obtain the full performance on each flight.

b. Because of very long lead times for complex satellite vehicles, and extensive investment in associated specialized facilities, the government does not have, in practice, an acceptable option of simply changing contractors if the performance of the vehicles deteriorates. Typically, from eighteen months to two years would be required to change vehicle contractors on complex satellite projects, and, during this time, the deficiency which would prompt such action would continue unless solved by the original contractor. Although the government could take other actions against the unsatisfactory contractor, none of these would compensate for the period of time during which scheduled flight performance is not obtained to an acceptable degree. It is imperative, therefore, that the terms of the contracts for such projects provide the maximum incentive to the contractor to achieve and to maintain fully acceptable flight performance.

c. The actual cost to the government of flying such complex satellite vehicles far exceeds the pro-rata cost of the individual vehicle or component. Typically, the net cost of a single flight of a complex satellite project with relatively frequent flights is on the order of twelve to fourteen million dollars or more per flight. For those which fly less frequently, the cost is substantially higher. Yet the entire satellite vehicle may represent only about two or three million of this cost. For such projects, the unit of measurement in all matters relating to financial management must therefore be the cost of the loss of the entire flight, not simply the cost of the vehicle or component which was produced under the contract in question. Cost savings through manufacturing shortcuts which increase, in any way, the risk of flight failure must be balanced against the potential cost of the entire flight. No cost saving by any means is an acceptable

substitute for failure to perform on orbit as scheduled. It is therefore imperative that the contracts for such projects provide cost incentive adequate to insure responsible financial management without detracting from the necessary emphasis on orbital performance and without providing for any way in which any failure to perform can be offset by spending less than the contracted amount.

3. Overall Approach. In order for an incentive structure to meet the objectives outlined above, it must insure that the contractor will exert extra care because of this structure. If the incentive provisions of the contract mean nothing more than a task for the contracting officers -- a way of arriving at a mutually acceptable pre-negotiated fee -- then the incentive provisions will have little if any real effect upon the contractor's subsequent performance. In order to have the desired effect, the "word must get to the bird" -- the people who work on all aspects of the entire undertaking must be conscious of the incentive and must do their work with more care and quality because of it. For this reason, the incentive plan should be relatively simple and, in particular, the key points must be easily understood by all affected contractor personnel as imperatives to which they must respond. These, and the previously noted considerations lead to the following overall approach to such an incentive structure:

a. The achievement of satisfactory performance on orbit is of paramount importance, and the only way in which the contractor can earn any fee.

b. The measurement of performance must be based upon satisfactory flight operation in relation to criteria which are measurable prior to flight as well as normally determinable during flight, rather than the actual degree of attainment of the ultimate flight objectives. These criteria are covered by the contract technical specifications which form the basis of design and component, subsystem, system and acceptance test criteria. This is the only way to insure that the "word gets to the bird," for these criteria have tangible meaning to workers and supervisors at all levels and are the basis of the actions taken at each step of the design, fabrication and test process which pre-determine the degree of flight success.

c. The achievement of this performance must be attained under responsible financial management; therefore, the contractor must share overruns by deducting fee from that otherwise earned. (No

additional fee is paid for underruns, since any fee so paid would necessarily reduce the maximum fee which could be paid for performance and would to some extent emphasize cost reduction at the expense of maximum emphasis on performance. The complete specified performance within contracted costs is the financial goal, not some reduced level of performance at lower cost. If such lower performance is in fact acceptable, it should be the performance specified in the contract.)

d. The achievement of this performance on a pre-determined schedule is also an objective, therefore the contractor must pay a penalty for lateness by deducting fee from that otherwise earned.

e. The achivement of maximum performance is an essential objective; therefore, for each flight, the maximum incentive will be placed upon the attainment of maximum performance, and the median fee will require better than average performance.

f. The incentive must be applied so that, regardless of performance which has been obtained on previous flights, there is always a maximum incentive for each subsequent flight to be one hundred percent successful.

g. The relationship between the fee that can be earned by performance and the fee that can be lost by failure to meet schedule and/or poor financial management must be selected to retain the desired balance between these objectives, so that schedules and costs are controlled effectively, but do not become dominant over, or in any manner counterbalance, poor orbital performance.

h. The incentive structure must be such that the government is free to use the satellite system without becoming entangled in complicated interactions with the contractor's fee structure. This flexibility is imperative. At the same time, it must be provided in such a way that the contractor is afforded a reasonable opportunity to earn the full fee provided under the terms of the contract.

4. Basis of Performance Determination

a. "Critical Event" List. For the purpose of determining performance fee, the unit of measurement of orbital performance is the number of revolutions (revs) in orbit which are satisfactorily completed. As a

reference for determining satisfactory revs, a specific list of "critical events" is compiled and made a part of the contract. This list is based upon the contract requirements and technical specifications and includes all malfunctions of equipment provided by this contractor, which, if they occur during flight, will probably cause degradation to the designed flight capability, and which are measurable prior to flight and normally determinable during flight. The list includes events that either do or do not occur, as well as the required quantitative ranges for critical parameters such as bus voltage, temperature, attitude position and rates, etc., including the method of determination (telemetry, analysis, etc). While the "critical event" list does not contain 100% of the specific failures which can occur, it does contain all of those which can reasonably be anticipated and which can be determined by telemetry or analysis based upon telemetry.

b. "Critical Event" Weights. All "critical events" are assigned numerical weights in proportion to the seriousness of their occurrence on the planned mission capability, in increments of one tenth or more, ranging from as low as zero for serious degradation to as much as nine tenths for minor loss. In a system with a single mission, all events which cause serious mission degradation are weighted as zero. A satellite vehicle typically has all, or nearly all, of its "critical events" weighted as zero. The payload in a single payload system typically has most of its "critical events" weighted as zero, except for a few which cause degraded but still quite usable mission performance. In the case of a multi-payload mission where the payloads are provided by a single contractor, the "critical events" of each payload are weighted with the minimum value corresponding to the relative importance of loss of the individual payload to the multi-payload mission (instead of zero, as is the case for a single payload mission). Weights above this minimum value but less than unity are assigned as previously described.

c. Definition of Satisfactory Performance. Satisfactory performance is defined as performance during which no "critical event" existed. The basic interval of measurement is an entire rev; a "critical event" is considered to have existed throughout the rev if it existed at any time during the rev. The basic unit of measurement is the equivalent number of revs completed during which no "critical event" existed. This is computed by adding the net weights of each rev actually flown, where the net weight of a rev on which any "critical event" occurred is the product of all weights of all "critical events" which existed at any time during the rev, and the net weight of a rev on which no "critical event" occurred is unity.

d. Redundancy. Whenever the system design includes a redundant feature (such as a backup motor or actuator, for example), the loss of the primary feature constitutes a "critical event" only from the time of its occurrence until the backup feature is operating properly. That is, for all functions which include redundant means, the "critical event" consists of loss of the function and not loss of the primary or backup means per se.

e. Overriding Events. In any case where the contractor's work, personnel, or equipment cause total loss of the data, as, for example, a personnel error which causes catastrophic termination of the flight, such loss is considered an overriding "critical event" and results in the minimum performance score regardless of performance otherwise attained during that flight.

5. Incentive Structure. A typical application of this incentive philosophy to a satellite vehicle contract includes the following provisions (variations to this approach are discussed later in paragraph 6).

a. Performance.

(1) Performance Score. The performance score of each vehicle is computed on the basis of the ratio of the number of revs satisfactorily completed, as defined in paragraph 4.c. above, to the number of revs planned for the mission, where the smallest interval of measurement is an entire rev. Actual satisfactory performance equal to that planned earns a score of unity, and actual satisfactory performance equal to 50% (or less) than that planned earns a score of zero. Satisfactory performance between 50% and 100% of that planned is scored on a linear basis between zero and unity. Thus a median performance score of 0.5 requires actual satisfactory performance of 75% of that planned. This relationship is expressed in the following simple formula by means of which the performance score of each vehicle is computed, based upon its individual flight performance:

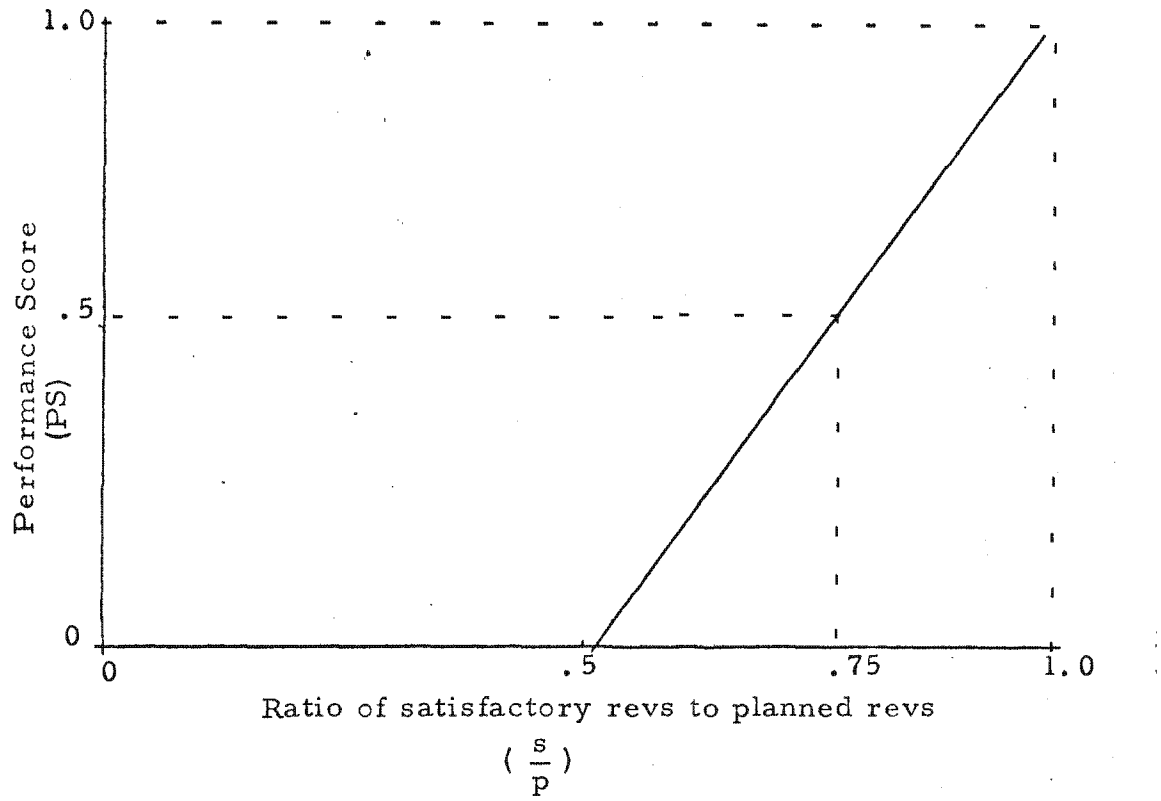
$$\text{Performance Score (PS)} = 2\left(\frac{s}{p}\right) - 1$$

Where: s = equivalent number of revs satisfactorily completed, as defined in paragraph 4.c.

p = number of revs planned for the flight

and $\frac{s}{p}$ is equal to or greater than 0.5 (the performance score is zero for 0.5 and all smaller values)

This relationship is graphically illustrated below.



(2) Applicable Fee. As noted previously, satisfactory performance is the only way in which the contractor can earn any fee (although he can lose fee on costs and schedules). To provide maximum incentive, the maximum fee is set at the maximum normally allowed for cost type contracts, that is, 15% of the target cost of the contract. The maximum fee that can be earned by each vehicle is defined as the applicable fee for that vehicle, and is computed initially * as:

$$\text{Applicable performance fee (\$) (per vehicle)} = \frac{15\% \text{ X target cost}}{\text{number of vehicles}}$$

* see paragraph 5.g. for effect of contract changes on applicable fee.

(3) Fee Earned. The actual fee earned by each vehicle is computed by multiplying its applicable fee by its performance score.

Fee earned = Performance Score X Applicable Fee

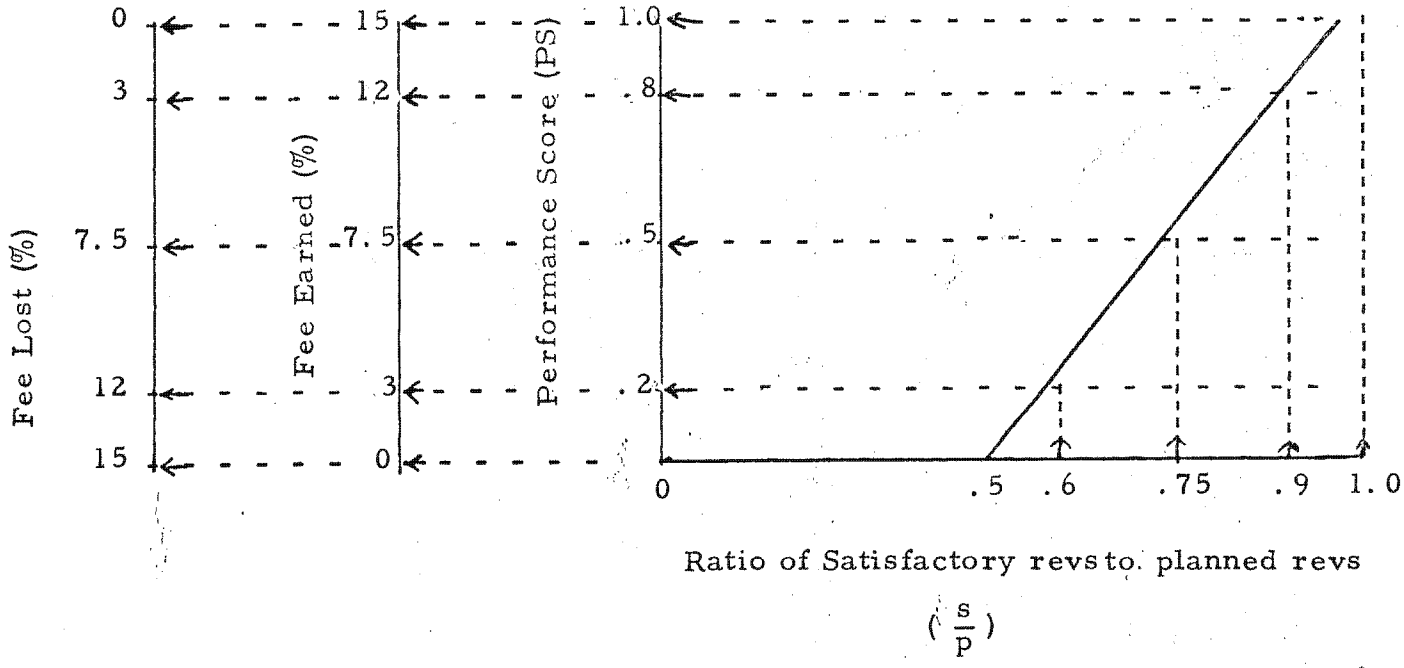
This may be expressed in terms of satisfactory revs by substituting the formula for the performance score:

$$\text{Fee earned} = \text{Applicable fee X } \left[2\left(\frac{s}{p}\right) - 1\right]$$

Similarly, the fee lost due to less than completely satisfactory performance may be expressed as the applicable fee less the fee earned, which reduces to:

$$\text{Fee lost} = \text{Applicable fee X } \left[2\left(1 - \frac{s}{p}\right)\right]$$

These relationships are graphically illustrated below, for the case where the applicable fee is 15%.



b. Cost

(1) To achieve the necessary financial management under the terms outlined previously, the contract provides for penalties for overruns, with these penalties to come from the fees otherwise earned by performance. To maintain the desired balance between performance and cost, as described previously, the maximum cost penalty is set at 9% of the target cost (in contrast to 15% maximum fee that can be earned by maximum performance.)

(2) The maximum penalty of 9% for overrun is assessed in two sharing ratios, as follows. Up to a fee penalty of 4.5% of the target cost, the sharing is 80/20. The contractor's share of 20% would reach this limit of 4.5% of the target cost at an overrun of 22.5%. Up to an additional fee penalty of 4.5%, the sharing is 70/30, which additional penalty applies for an additional 15% overrun. In summary, the contractor shares overruns at 80/20 up to 22.5% overrun, then at 70/30 up to an additional 15% overrun; he is liable for overrun fee penalties up to a total overrun of 37.5%, and he can lose up to 9% of the target cost in such fee penalties, all of which must come from fees earned on the basis of the performance criteria previously discussed.

(3) While percentage figures are used in the negotiation of the contract, and in explanations of the incentive fee structure, they are not used in listing the cost penalties in the contract, except as noted below when referring to final target cost. The percentages of penalizable overrun and corresponding fee penalties are all converted to specific dollar values, and a table of these values is included in the contract, as illustrated below:

$ Amount of Overrun	$ Amount of Penalty
$xxx	$yyy
$xxx	$yyy
$xxx	$yyy

The table concludes with the following statement; "Any amount of overrun between the last amount shown in the above table and 37.5% of the final target cost will be penalized at the maximum sharing ratio (i.e., 70/30 in the example discussed herein) up to a cumulative fee penalty of 9% of the final target cost." This provision insures that the subsequent

increase in target cost by addition of contract changes will not change the penalties for cost overruns from the values established in the original contract, yet it provides for extending the fee penalty up to the full range represented by the increase in the target cost over the original contract figure.

(4) While the dollar value of individual vehicle performance is calculated on a pro-rata basis, and shown in the contract accordingly, the penalties for cost are not allocable to individual vehicles, so the cost penalties pertain to the target cost of the entire contract. Accordingly, regardless of how well the contractor has done on performance, schedule, or cost, there is always a high incentive to exert close financial control, since loss of such control even near the end of the contract can wipe out considerable fees earned by the performance of previous vehicle flights.

c. Schedule

(1) While it is important to maintain a pre-determined schedule, there is no net value to the government in the contractor delivering the vehicles ahead of schedule. The incentive on schedule is therefore a negative incentive. To insure full attention to the short term schedule of each vehicle, that is, the period near its scheduled delivery date, a maximum schedule penalty is set at 0.5% of the target cost, and pro-rated as a specific amount to each vehicle. Penalty for each vehicle is assessed at a fixed rate of $2000 per day of variance from the contract schedule, up to the total pro-rated amount allocated to that vehicle. The long term schedule incentive is automatically covered under the negative cost incentive, for large schedule slips obviously will cause increases in program costs.

(2) The basis of delivery is specified as the completion of a specific overall test at a specified location. Typically this is an extensive, electrically mated systems performance test, conducted prior to shipment to the launch base.

d. Target Fee.

To provide maximum emphasis that 100% performance is expected, and to provide maximum incentive to the contractor's internal management structure to achieve this performance, the target fee is defined as the maximum fee, par performance as performance with no "critical events",

and all accounting carried out on a penalty basis. The "target" fee is thus reduced by the penalties incurred on the schedule and flight performance of each vehicle, in addition to cost penalties on the entire contract. This method requires the full 15% fee to be put on the initial contract, but it pays exactly the same amount for the same performance as the conventional equal swing from a median target fee. Through this method the contractor's internal management perspective is changed in the following way for, say, a situation in which the vehicles on a certain project have attained an 80% performance (corresponding to a performance fee of 9%) with no variance in costs or schedules: If the incentive formula is described as 7.5% target fee, with a $\pm$ 7.5% fee swing over the 50% - 100% performance region previously discussed, then the management obviously will consider this work as "meeting par, and, in addition, earning 1.5% extra fee for the company." If the same incentive formula is described as 15% target fee, with a -15% fee swing over the same performance region, then the management must consider the same work as "costing the company 6% penalty for performance deficiencies." The money paid is the same, but this method offers additional assistance in insuring that the "word gets to the bird". Its advantage is more than psychological, for it forces the contractor's management to account on a loss basis for all performance which is in any manner unsatisfactory.

e. Fee Payment

The government makes monthly fee payment to the contractor. Initially, the fee payments are based upon the contracting officer's determination of percentage of completion of work applied to an amount which constitutes 8% of the target cost. Upon completion of each flight vehicle through Systems Test, the value of 8% is increased to a cumulative amount representing the entire fee applicable to that vehicle; i.e., the maximum that it could earn for 100% satisfactory flight performance. Payment of the maximum attainable fee applicable to the individual vehicle prior to validation of its earning by flight performance reinforces the expectation of complete success and provides essential additional incentive to the contractor's management since any of this fee that is not earned must be repaid to the government. The time when this full individual vehicle fee is paid is selected to meet the following criteria: it must be sufficiently in advance of the flight to insure that the money will be fully accounted for in the internal accounts of the company, but not further in advance than is necessary to assure that this action will have been completed prior to the flight. Thus, for a vehicle contract, this fee is

paid at the time the vehicle completes Systems Test, which is normally less than two months prior to flight.

f. Penalty Payment

Upon written demand by the contracting officer, as soon as the results of each flight have been analyzed by the government, the full amount of any fee lost due to schedule and performance penalties must be paid to the government in cash. No form of credit to future contractor billings is acceptable; each payment must be in the form of a check presented by the contractor to the contracting officer, made payable to the Treasurer of the United States and supported by a credit fee voucher. * In this way it necessarily reflects an actual loss to the internal company management and not merely an adjusted fee. Internal management echelons are automatically alerted to the actual outflow of company cash because of failure to meet target performance. This insures additional managerial attention toward keeping this outflow to a minimum. Settlement of cost penalties must necessarily await completion of the contract, since the cost penalties apply to the entire contract and are not pro-rated to individual vehicles.

g. Contract Changes

(1) The conventional approach to changes, considering each change as a separate contract, evaluating the risks, etc., on an individual basis, and arriving at a separately determined fee structure for each change, is fundamentally incompatible with the objectives of the incentive structure described herein. To consider each change in this manner would be to consider it out of context with the basic contract of which the change will become a part. While the change itself may be relatively simple,

* Contracts implementing this incentive fee structure normally cover a number of satellite flights and are normally incrementally funded. Contract obligations on current contracts are generally well below the contract face value (even with full payment of individual flight fees as herein described). Therefore, it is not usually necessary to de-obligate any funds when penalty payments are received. Government accounting records reflect the collection as an "Appropriation Refund" (i.e., collection of an erroneous disbursement) which is reapplied against current requirements.

and, taken out of context with the overall contract, involve seemingly little risk, in actuality any change can cost the entire flight, and thus any change involves some added risk to the entire flight. Changes provide an opportunity for schedule slippage, for performance degradation or failure due to workmanship or procedure involved in the change, and also provide opportunity for additional overruns.

(2) This overall incentive approach pre-determines the specific relationships of the vehicle performance and cost and schedule variances to the fee but not the fee to be paid. In practice, this fee may be as high as 15%, but it may be as low as zero. Applying this same philosophy to changes means that the fee for any given change could be as high as 15% of the target cost of the change, but it also means that the fee for such change could be zero, even for reasons unrelated to the change. On balance, the inclusion of changes within the same incentive structure described herein for the basic contract is fully consistent with the overall objectives described previously; for complex satellite projects which involve frequent changes throughout the life of the contract, such inclusion is imperative in order to attain these objectives. Accordingly, contract changes that affect the performance of a vehicle through design change, modification (no matter how minor), testing procedures, launch procedures, or operational procedures are included under the same performance incentive fee structure as the basic contract. Contract changes which the contracting officer determines have no bearing on the performance of a vehicle are negotiated to have such fee as may be equitable for the type of effort for which they are issued.

(3) The inclusion of the changes is easily handled by slight modification of the procedure already outlined for the basic contract, as described below:

(a) Performance

The applicable performance fee is described in paragraph 5.a.(2) as:

$$\text{Applicable Performance fee (per vehicle) (\$)} = \frac{15\% \text{ X target cost}}{\text{No. of vehicles}}$$

For changes, the additional applicable performance fee, to be added to each vehicle affected by the change, is determined as follows:

$$\text{Additional Applicable performance fee due to change (per vehicle affected) (\$)} = \frac{15\% \text{ X target cost of change}}{\text{No. of vehicles affected by the change}}$$

This additional increment of applicable performance fee is added to the applicable fee already allocated to this and other affected vehicles under the terms of the basic contract. Thus, the inclusion of a change involves changing the applicable performance fee for all vehicles affected by the change (but only those affected by the change). All other performance calculations are unaffected by the change (except that the change may involve changes to the "critical event" list for affected vehicles). The actual fee earned is determined in the same manner outlined in par 5.a.(3).

(b) Cost

The target cost of all changes comes under the full incentive structure of the basic contract as previously described, except for the effect of the increase in target cost on the possible fee penalty for overrun. As explained in paragraph 5.b.(3), the addition of changes does not alter the original table of overrun amounts and corresponding amounts of penalties. The increase in penalizable overrun due to the increase in target cost is penalized at the maximum sharing ratio, up to the full 9% of the final target cost. To insure that these costs are promptly negotiated and the changes definitized, a limit of 40% is placed on the percentage of the cost of the change which may be incurred prior to submission of the contractor's cost proposal in accordance with the changes clause of the contract. The cost proposal must be submitted prior to incurring costs beyond this limit.

(c) Schedule

The effect of changes upon schedules is taken into account

when changes are introduced, through the means of identifying the vehicles with which the change becomes effective. In all other respects, the change comes under the full schedule incentive provisions of the basic contract. That is, for each vehicle to which the change is applicable, there is an additional maximum penalty for schedule variance of:

$$\text{Additional maximum penalty (per vehicle)} = \frac{0.5\% \times \text{target cost of change}}{\text{No. of vehicles affected by the change}}$$

h. Contingency Provisions. The following additional contract provisions are essential aspects of this incentive structure.

(1) No Opportunity to Perform. Whenever an entire flight fails without the contractor having an opportunity to perform, as in the case of a booster failure, for instance, which prevents the satellite vehicle contractor from having any chance to perform, then the performance score allocated to such flight is awarded after completion of the contract and is equal to the average performance score of all vehicles on all flights flown under the instant contract on which this contractor did have an opportunity to perform. (It is important in this regard to note that the performance fee applicable to each vehicle is paid for work which is mostly done prior to the flight, i.e., for building a vehicle that will work properly when flown. The flight thus serves to validate the extent to which this work has been done. The average performance score attained in flight on all vehicles on which the contractor had an opportunity to perform is a reasonable measure of the average quality of the contractor's work, and thus is a fair basis for this fee in instances where he has no opportunity to perform. * Paying on this basis keeps the incentive motive at the highest possible level, since it provides a second reason for the contractor to achieve the highest possible performance score on each vehicle: first, because of the fee applicable to that vehicle, and second, because the performance of that vehicle will affect the average performance score, and consequently more of his fee than that applicable to the individual vehicle alone.)

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* Providing there is a reasonable number of flights per year to establish such an average. For projects with long orbital lifetime, and consequently very infrequent flights, this is handled differently, as is explained in paragraph 7.

(2) Effect of Government Furnished Equipment (GFE) Failures. Equipment failures are generally attributable to Contractor Furnished Equipment (CFE), Government Furnished Equipment (GFE), or inconclusive. Based upon analysis of flight data and any other data available, the senior government program official in charge of the flight makes a final determination as to the cause of "critical events," i. e., failures of Contractor Furnished Equipment or services (CFE), GFE, or inconclusive.

(a) If the "critical event" is attributed to failure of CFE, the contractor is fully responsible under the incentive structure outlined herein.

(b) If the "critical event" is attributed to failure of GFE, the flight is scored under the full incentive provisions outlined herein up to the critical event, and thereafter either at the average contractor performance score defined under 5h(1), or at the contractor performance score for the flight in question at the point of the GFE failure projected through to planned mission completion, whichever is less. (If the contractor's performance is below his average performance score, this prevents his performance being improved by the occurrence of a GFE failure.)

(c) If the "critical event" is attributed to failure of GFE, and the analysis shows that the contractor either caused the failure or failed to detect its obvious presence in the resulting test data in accordance with the contractor's contract test specifications, the failure is treated as though it occurred in CFE.

(d) If the "critical event" is attributed to GFE built or procured by the contractor, the failure is treated as though it occurred in CFE.

(e) If the "critical event" is inconclusive as to whether caused by failure of CFE or GFE, the flight is scored normally up to the occurrence of this critical event, but the contractor's earning on this flight is limited to revs on which no inconclusive "critical events" exist. The otherwise earnable fee represented by the portion of the flight during which inconclusive "critical events" exist is reallocated to subsequent flights. This allocation is used instead of scoring on the no-opportunity-to perform basis for the following reasons. In the no-opportunity-to-perform case, it is clear that the contractor is not at fault, so his average

performance score is a fair basis for payment, as outlined previously. In the inconclusive case, it is not clear that the contractor is not at fault; the very fact that the failure is inconclusive means that he cannot be exonerated. Thus there is no basis for paying him any fee for the period of flight during which the inconclusive failure existed. Yet, by the same token, it is not clear that he is at fault either, and there is no basis for depriving him of the opportunity to earn the fee in question, which opportunity was a consideration in the original contract. Accordingly, settlement of inconclusive "critical events" is handled as follows: If the "critical event" is inconclusive as to whether caused by failure of CFE or GFE, the flight fee pool for that vehicle is divided on the basis of total planned revs to the rev on which the inconclusive "critical event" occurred. The contractor is scored under the incentive structure outlined herein for all revs prior to the inconclusive "critical event" and the computed fee dollar value of the revs after the "critical event" is reallocated evenly to the flights remaining under the instant contract. The reallocated fee dollars are computed on the basis of the contractor's earned score at the point of the inconclusive "critical event" projected through to planned mission completion. Thus, the occurrence of an inconclusive "critical event" involving GFE does not reduce the fee dollars that can be earned by the contractor. However, to get these dollars the contractor must earn them by satisfactory performance on subsequent flights.

(f) In the event of an inconclusive "critical event" on the last flight, the flight is scored as if the failure were attributed to GFE.

(g) For purposes of determining the average performance of vehicles on flights on which the contractor had an opportunity to perform, for use as outlined in 5h(1) and elsewhere, the performance scores for flights having "critical events" due to failures of GFE and inconclusive failures are computed on the basis of the contractor's earned score up to the point of such "critical event" projected through to planned mission completion.

(3) Flights Out of Specification Limits. Situations arise wherein either intentionally due to operational reasons or unintentionally due to a system malfunction or personnel error, the vehicle is operated beyond contract specifications. When such a situation occurs, the following procedures apply:

(a) Government decisions to fly out-of-spec are given by the senior government official in charge of the program at the field location where the decision occurs to the senior contractor official present. The contractor has the option to protest, by deadline, as follows: When the notification is well prior to launch (R) day, deadline is three working days (but not later than R-1). When notification is on R-1 day, deadline is within six hours (but not later than local midnight on R-1 day). When notification is on launch day, deadline is not later than the start of terminal count. When notification is given during flight, the deadline is not later than the initiation of command generation for the commands which will produce the out-of-spec condition. Protest must be in writing, signed, and given to the senior responsible program official at the scene.

(b) If the contractor protests prior to launch and the government elects to fly out-of-spec anyway, then the performance score for that flight is computed on the basis of the average of all flights flown under the instant contract on which the contractor had an opportunity to perform, regardless of the actual performance achieved on the protested flight. If the contractor protests during the flight and the government elects to fly out-of-spec anyway, the performance score is computed under the full incentive provisions outlined herein up to the out-of-spec condition and thereafter at either the performance condition just prior to out-of-spec flight projected through to completion of the mission, or the average performance defined in paragraph 5.h.(1), which ever results in the lower net performance score, regardless of the actual performance achieved after the out-of-spec condition occurs.

(c) If the contractor does not protest, then the flight comes under the full incentive provisions outlined herein regardless of whether the out-of-spec conditions cause or contribute to failures.

(d) The same provisions apply to unintentional out-of-spec conditions except that notification of the out-of-spec condition is not required of the government and the deadline for protest is twelve hours after the occurrence of out-of-spec condition. This provides additional incentive for prompt identification of such conditions by the contractor's personnel who assist the government by technical analysis and advice during the conduct of such flights. However, if the unintentional out-of-spec condition is caused by this contractor's personnel or equipment, no protest

is allowed, and the flight is scored under the full incentive structure otherwise described herein.

(e) For the purpose of determining the average performance of vehicles on flights on which the contractor had an opportunity to perform, for use as outlined in paragraph 5.h.(1) and elsewhere, protested flights are not included, regardless of the actual performance attained in any portion of such flights.

(f) Flights on which any protest is made are not eligible for the additional incentive feature described in paragraph 5.h.(5) below, for any part of the flight.

(4) Government Option to Fly After Initial Acceptance

Effective with the first satisfactory completion of the initial acceptance tests at the launch base, or the factory, on the basis of which the schedule incentive provisions of the contract are computed, the performance incentives become fully effective in the manner outlined below: The government may, at its option, launch the vehicle in the condition in which it may exist at any time after satisfactory completion of this test. The government may, at its option, elect to repair a "critical event" or deficiency which occurs between completion of this test and launch, in which case such event or deficiency is not considered in the vehicle performance scoring. However, if the government elects to launch vehicles with known deficiencies which develop subsequent to satisfactory completion of this test, the contractor is held to the incentive provisions as though these deficiencies had occurred in flight on rev one.

(5) Additional Incentive for In-Flight Support

(a) In order to provide additional incentive to the contractor's effort which supports the government during the conduct of flights, provision is made for the possibility of a higher performance score than that which would be computed by the performance formulae with respect to "critical events". To effect this, the incentive structure provides that irrespective of the performance fee computed on the basis of the "critical event" list (as previously described), when the contracting officer is able to determine after completion of the flight that the actual degradation of performance was less than computed, then he will unilaterally determine

and award the contractor the higher score (except that flights on which any protest is filed are not eligible for this feature).

(b) Any such change of the performance score computed on the basis of "critical events" is limited to those cases where the contracting officer is able to determine, through the method described here, a performance score which is higher than the one computed on the basis of "critical events". This determination by the contracting officer is unilateral and is not in any sense intended to be an equivalent or alternate scoring method to the computation based upon "critical events". The latter is based upon specification, and measurement and analysis and computation in relation to these specifications. The post-flight determination is not based upon any of these per se; it is based on judgment of overall mission results in relation to results desired by the government. While the contracting officer may make any calculations he deems appropriate to the circumstances of each mission, to assist him in arriving at a quantitative determination, his determination is based solely on his unilateral judgment of the results achieved in comparison with the results desired by the government for each particular mission and is not governed by the results of any specified calculation. In making this judgment the Contracting Officer considers all factors that he deems appropriate to each individual mission, including all pertinent operational factors, the government's expectations for the mission, and the actual performance attained by similar vehicles on previous flights, whether or not such performance conforms in all respects to the extant vehicle performance specifications. Since his determination can only raise the contractor's earned performance score, and since it rests on comparison of actual mission results with government desires, it is not subject to any dispute by the contractor. It is intended that the contractor will make every effort to attain performance which will permit his score to be determined by the "critical event" computation rather than being willing to rely upon the post-flight method. This latter is intended solely as added incentive for the contractor to do everything possible to help the government salvage as much as possible even though some "critical events" have occurred. Through competent and diligent technical analysis, diagnostic tests, both in-flight and at the factory, the devising of in-flight work-around procedures and provision of technical advice to enhance the degree of success which may be achieved in spite of the deficiencies which have occurred, the final effect of many "critical events" on the degree of mission success often can be altered substantially.

(c) While the sole reason for this provision is the added incentive for diligent and competent support to the government during flight operations, through means described above, the higher score, if such is determined to exist as outlined above, is awarded whether or not it is specifically attributable to such in-flight support.

i. Additional Provisions. The incentive structure also contains the following additional provisions:

(1) The maximum fee under the contract is limited to not more than 15% of the final target cost, and the minimum limited to not less than zero (or a lower specified limit).

(2) The government has the option of terminating the flight prior to completion of the planned duration, even though no "critical event" may exist or have occurred. In this event, scoring for any contractor not causing the early termination is scored as if a GFE failure caused the early termination (i. e., scored as outlined in par 5h(2)(b).).

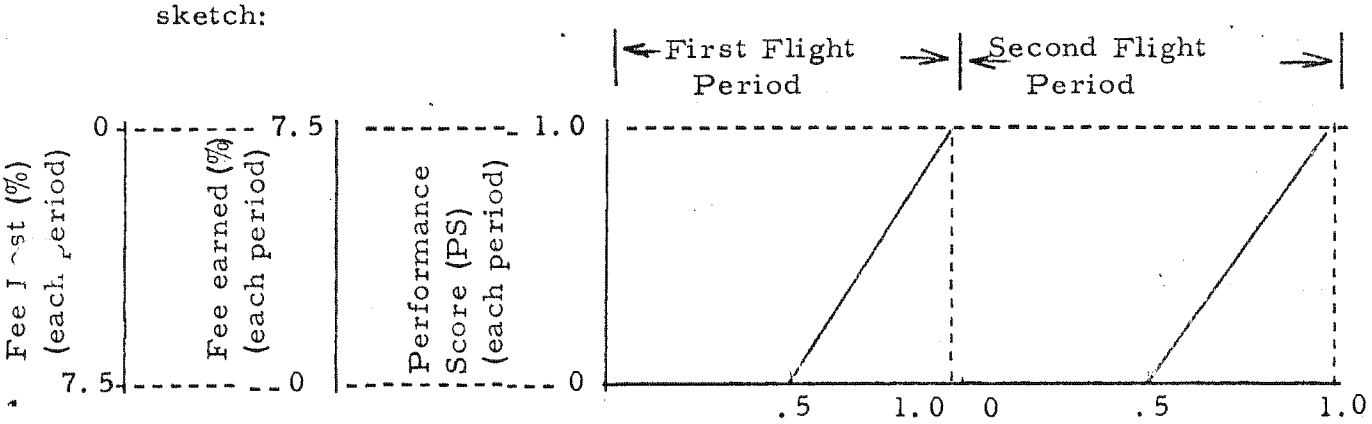
(3) The planned performance used in the performance computations based upon the "critical event" list (outlined in par 5a) does not exceed the maximum orbital lifetime called for in the contract.

(4) Whenever the incentive structure outlined herein is incorporated into a contract under which work is being done, it is applicable only to equipment not yet fabricated as a system and tested at the time of its contractual effectivity. It is not acceptable as a gamble in any sense, nor as an expression of the contractor's confidence in his product. There must be the opportunity, as well as the interest, to "get the word to the bird," to build in the quality essential to assure maximum performance.

6. Variations. Although the typical illustrations described earlier in this paper have referred to contracts for satellite vehicles, the basic incentive approach is applicable to all major aspects of satellite projects, including major components, with only slight variations to suit the particular item in question. An obvious difference between applications is the makeup of the "critical event" list, which differs considerably between, say, a vehicle contract and a payload contract. Yet, with this difference, which simply results from following the definition of this list given in paragraph 4, the approach outlined herein is applicable to all

contractors involved in such projects, including integrating contractors. The following subparagraphs illustrate major characteristics of selected variations.

a. In the case of a project in which data are to be returned in more than one data capsule, the applicable fee for that flight is divided in proportion to the relative length of the planned flight which is served by each capsule, and each flight period is scored separately in the same manner as previously discussed in paragraph 5a. For example, if 15% is taken as the fee applicable to the entire flight, and the flight is divided into two periods on the basis of two separate data capsules, then the performance scoring for all orbital aspects is carried out as previously described, but on the basis of the two separate flight periods, each of which can earn a maximum of 7.5% fee, as illustrated in the following sketch:

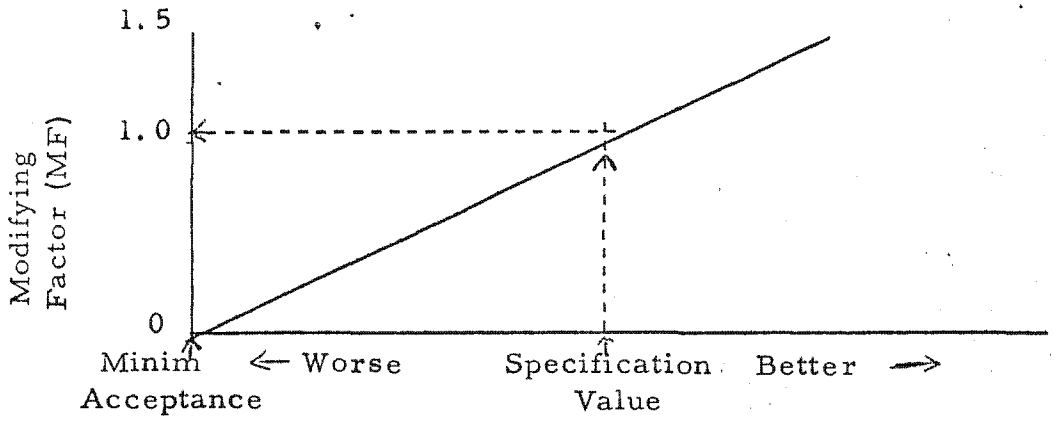


(Scored separately for each flight period, with planned revs for the second period starting at completion of planned revs for the first)

b. In the case of a project which includes a very critical component which is difficult to manufacture repetitively to conform exactly with specifications, but which is quite usable within a close range of specifications, the previously described performance scoring may be modified to place a specific incentive upon the quality of such a component. This is done by modifying the formula for the performance score to include the term (0.33 MF + 0.67) as a multiplying factor, i.e.,

$$(PS) = \left[2\left(\frac{s}{p}\right) - 1\right] \quad X \quad \left[0.33\ MF + 0.67\right]$$

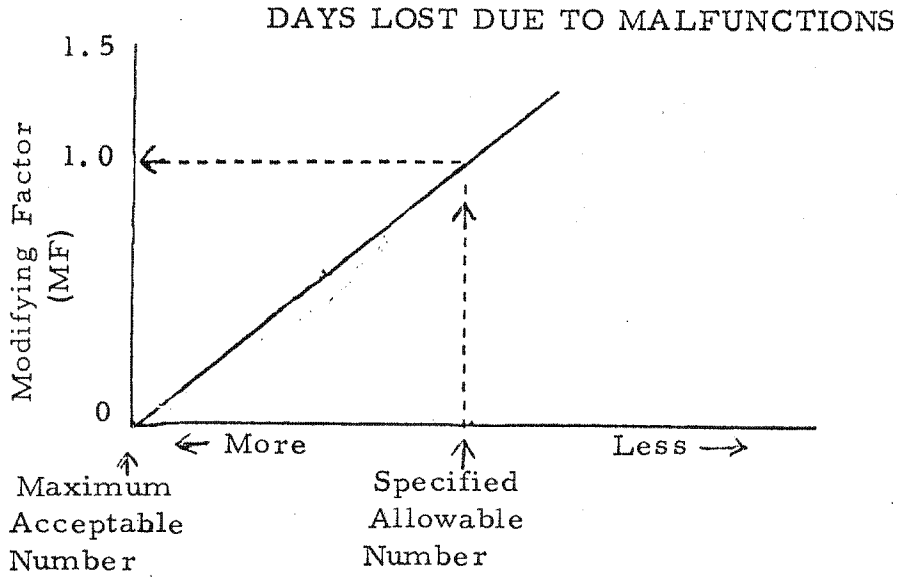
The modifying factor, MF, is determined on the basis of the individual acceptance test of each of these critical components, in accordance with the sketch below:



ACCEPTANCE TEST MEASUREMENT OF QUALITY

As can be seen from the sketch, and the modified performance score formula, the effect of the modifying factor is to alter the performance score only when the acceptance test measurement of quality is below or above the specification value; when MF = 1, the performance score formula is the same as previously described. If the acceptance test measurement is below specification, the otherwise earned orbital performance score is lowered proportionately, down to a maximum reduction of a third of the possible score. This balance insures a realistic penalty for below-specification quality while still keeping an effective incentive for a completely successful flight. It is also possible for the modifying factor, MF, to exceed a value of unity for any unit which exceeds the specified quality. This has the effect of compensating for the occurrence of some critical events, and thus provides incentive to exceed the specified manufacturing quality. The modifier is not used in the computation of the contractor's average performance score which is used in no-opportunity-to-perform and other cases previously described. However, in the scoring of no-opportunity-to-perform cases, the modifier for the particular flight in question is used, with this average score, in determining the performance score for that flight. It should be noted that the use of this modifier technique does not alter the fundamental principle that the only way any fee can be earned is in flight, in the latter part, as previously described.

c. In the case of a critical component which is not necessarily unusually difficult to manufacture but which must function properly throughout an extended period of ground use prior to flight, the same modifier technique may be used as described above, with only the determination of the modifier, MF, adapted to the particular component. As an example, consider a complex flight command system which is also used in extensive ground testing of the satellite vehicle and payload in the system level tests conducted before any of the hardware is shipped to the launch base. Time lost in system tests due to malfunctioning of such a command system during these tests seriously affects the entire flow of system flight hardware and impacts all other contracts involved in the entire satellite system. Command system malfunctioning during such system level tests often requires that the entire test be repeated, in addition to the time lost in identifying and correcting the malfunction. In such a case, the modifier, MF, is determined on the following basis and used in the computation of the performance score of each individual flight as previously described.



d. In the case of satellite system elements which have a specific function to be accomplished that is essentially either satisfactory or unsatisfactory, the computation of performance score is not made on a rev basis, but is computed on a complete success or complete failure basis. Thus, a data capsule either is de-orbited into a recovery zone within specified boundaries, or it is not, and it earns or loses its full applicable fee accordingly. Similarly, a booster either launches its payload into a specified space boundary within specified velocity tolerances, or it does not, and either earns or loses its full applicable fee accordingly. Other aspects of the basic incentive structure, such as use of the contractor's average performance score in cases of no-opportunity-to-perform, GFE failures, etc. apply as previously discussed.

e. In the case of satellite systems which employ more than one satellite in orbit in some related manner, the same performance scoring on a rev basis and on a go-no go basis, as applicable, is used with a further variation concerning the proportion of the contract fee that can be earned by each satellite. The total fee is not divided equally between each satellite, but is proportioned in accordance with the relative importance of the success of each launch. For example, if the complete system involves two satellites, success on the first launch is relatively more important than success on the second, since it allows a chance at earlier validation of the complete satellite system and earlier identification of corrective work which may be required. A failure of, say, the booster on the first launch totally precludes any checkout of the satellite vehicle or

payload until the next launch, which may be some months later, and thus sequentially postpones the discovery of corrective work which may be required. Other factors concerning the division of the applicable fee include the relative worth of particular combinations of operating satellites in multi-satellite system configurations.

f. In the case of follow-on buys of on-going systems, the maximum fee that can be earned is held at the 15% level, in order to keep the contractor's incentive at the maximum, and compensating steps are taken in other ways to tighten the management proportionate to the relative reduction in risk associated with increased system maturity. The following variations address this objective without changing the basic philosophy of this incentive structure:

(1) The minimum possible fee may be set at a value less than zero. This variation could be appropriate for folow-on buys of very mature vehicles. It is preferable to reducing the maximum fee in such cases, since it keeps the incentive for continued top performance at a higher level. Under such presumed conditions of low risk, it is not unreasonable to impose a "below zero" profit possibility for unsatisfactory performance.

(2) The minimum acceptable performance point may be set at a value higher than the 50% discussed in paragraph 5, with the full 0 - 15% fee distributed over the reduced performance range between this point and 100%. This variation is particularly well suited for repetitive buys of reasonably mature systems, instead of reducing the fee structure; it counters the reduction in risk without reducing the emphasis or incentive on continued maximum performance.

(3) The cost sharing ratios may be varied with the risks associated with the individual project. For instance, the initial sharing of 80/20, as discussed in paragraph 5, may be set at 90/10 for the initial buy of a complex new project, with appropriate progressive increases; in follow-on contracts the initial sharing may be progressively increased to 80/20, 70/30, 50/50, etc., consistent with the degree to which the project has matured. However, the relationship of the maximum fee which can be lost and the maximum fee that can be earned through performance must be kept such that the emphasis is never taken off the necessity of attaining and maintaining maximum performance in orbit.

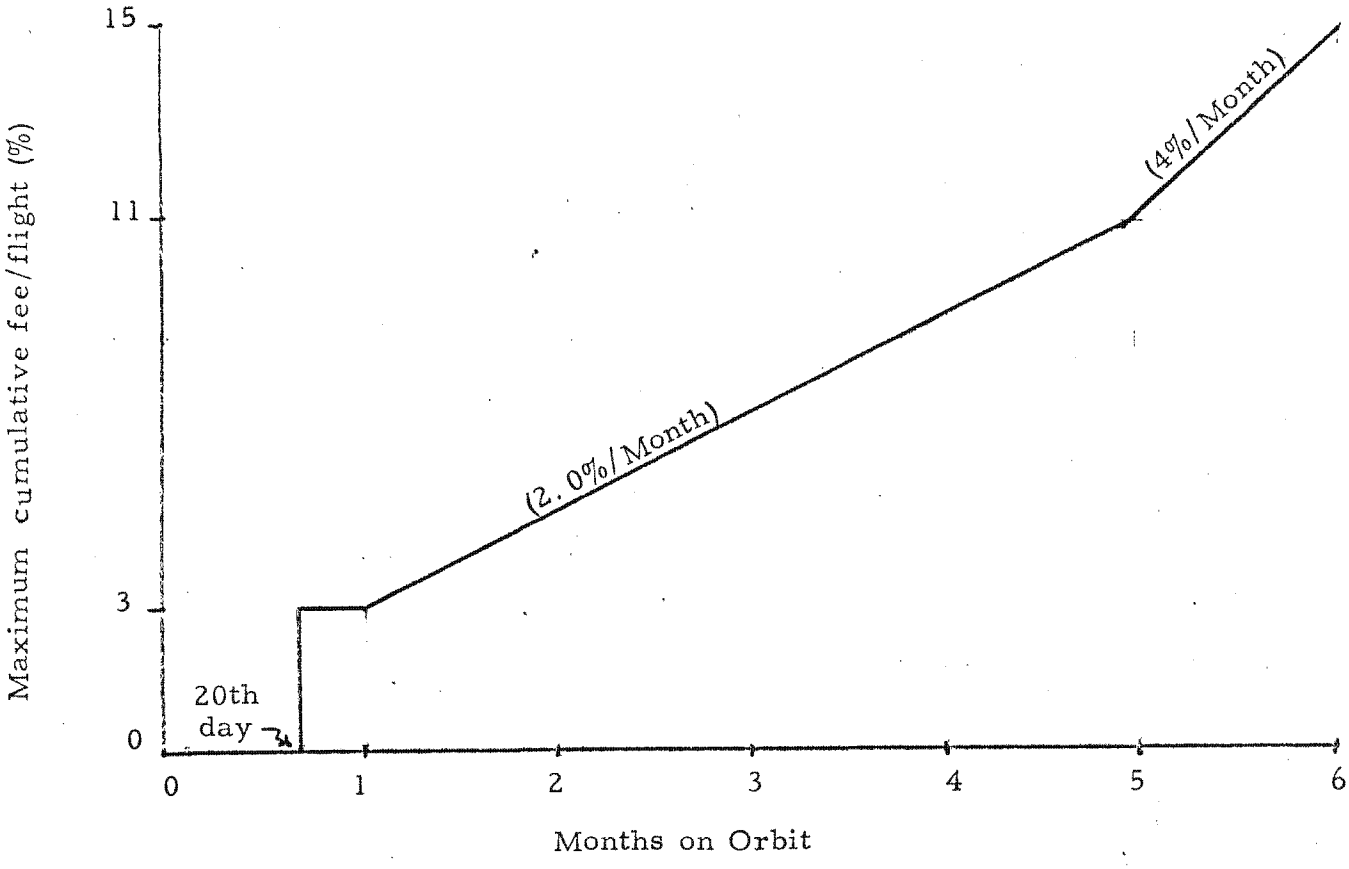
7. Projects with Long Orbital Lifetimes

a. While the cost, schedule and most of the other provisions of the structure outlined in the previous paragraphs are applicable to any type of satellite project, a further variation in the manner of performance scoring is desirable for projects of long orbital lifetimes, considered here to be lifetimes in excess of one or two months and ranging up to a few years. In these applications, flights are too infrequent for the average performance score to be meaningful. In addition, the much longer period of useful life makes it desirable to use a different structure for determining the performance fee earned throughout the flight. Except as described in the following paragraphs, the other aspects of the overall incentive approach apply as previously described.

b. The fee structure for this type of satellite is based on allowing a specified increase in the rate at which the fee may be earned as the flight progresses. Initiation of fee earning starts only after an initial period on orbit with no fee, so that no fee is paid for "infant mortality". The rate is then increased in specific steps, with the last month of the planned mission being the most valuable month. This feature insures maximum attention to the achievement of the entire mission lifetime as specified in the contract.

c. As an example, the subsequent discussion in this paragraph considers the application of this structure to a satellite with a planned orbital lifetime of six months. The maximum rates at which fee may be earned are illustrated in Figure 1.

Figure 1



Specifically, until the twentieth calendar day on orbit the contractor can earn no fee. On this day he can earn a maximum of 3% fee (on the target cost applicable to that vehicle on the day of launch) providing that the vehicle performance at that time is fully satisfactory (i.e., no critical events exist). No further fee can be earned until completion of the first month. After the completion of the first month, the maximum fee that can be earned is increased at a linear rate (2.0%/month) that will reach a cumulative total of 11% at the completion of the next to last month. During the last month, the maximum fee that can be earned is increased at a linear rate (4%/month) that will reach a cumulative total of 15% at the completion of the last month. No fee can be earned after the 180th day (last).

d. The above description, illustrated in Figure 1, outlines the maximum % fee that can be earned if no "critical events" occur. The actual % fee that is earned is computed for each day on orbit, with the maximum % fee reduced by the proportion (by whole revs) of that day during which the vehicle performance was not satisfactory, (as defined in paragraph 4). The cumulative % fee earned by the vehicle is the sum of the % fee earned on each day. These calculations are illustrated below for the flight illustrated in Figure 1 for all days after completion of the first month:

$$\text{Actual fee earned per given day (\%)} = \underbrace{\left(\begin{array}{l}\text{\%/Month}\\ \text{for that month}\\ \text{(from Fig 1)}\end{array}\right)\left(\frac{1}{30}\right)}_{\text{maximum possible fee for that day}}\underbrace{\left(\frac{s}{p}\right)}_{\text{Reduction for unsatisfactory performance that day}}$$

(where s = satisfactory revs and p = total revs for that day)

Then, the actual % fee earned in a given month or on a given flight is the sum of the actual fee earned on each day of the period in question, with each day computed as above. (The actual fee earned on the twentieth day is computed in the same manner, and this fee then covers the entire first month).

e. The performance fee dollars earned by the flight are then computed as follows:

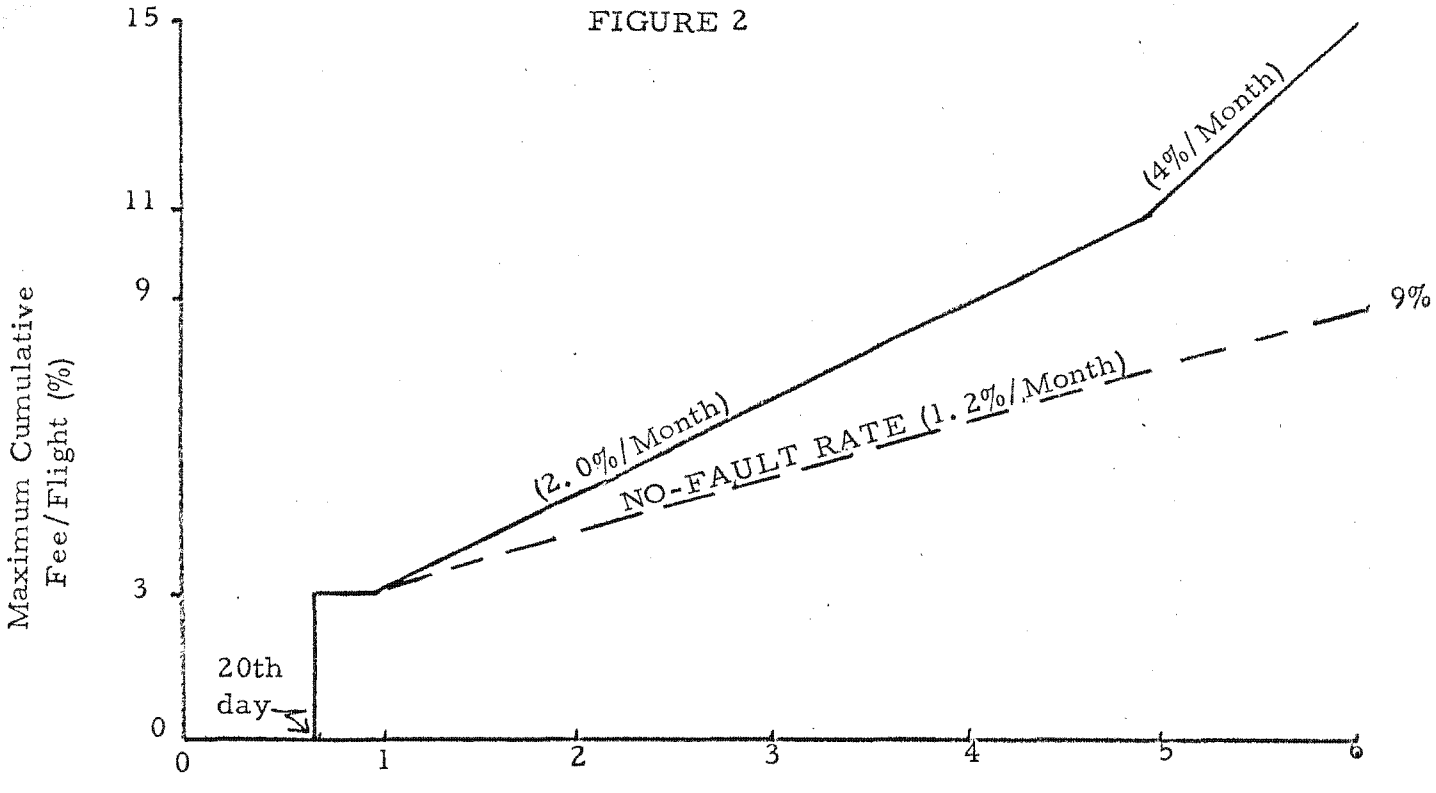
$$\text{Fee dollars earned for the flight} = \left(\begin{array}{l}\text{actual fee earned}\\ \text{by the flight (\%)}\end{array}\right) \times \left(\begin{array}{l}\text{target cost applicable}\\ \text{to that flight}\end{array}\right)$$

f. As previously noted, long lifetime systems do not afford a reasonable chance to develop a significant average performance of flights having an opportunity to perform, both due to the long flight lifetime and the long time between individual launches. For these and other reasons, these flights tend to be somewhat independent even though covered under a common contract. Therefore, the average performance score of all vehicles on all flights flown under the instant contract on which this contractor had an opportunity to perform, described in paragraph 5.h.(1) as the basis of scoring whenever the contractor has no opportunity to perform, is not applicable to the long lifetime system. Instead of using this average, cases where the contractor has no opportunity to perform, and all other cases previously described in which the average is employed are scored by use of the "no-fault" rate as described in the following

paragraph. (i.e., in addition to the specific examples described below, the no-fault rate is substituted in similar manner for previously described cases where the average performance of paragraph 5.h.(1) was used.)

g. A linear rate equivalent to rising from 3% fee at the completion of the first month to 9% at the end of the last month (1.2% per month) is defined as the no-fault rate, and illustrated in Figure 2. If, at any time, any contractor is precluded from proper fee earning operation through no fault of his own, he earns fee for that day at the no-fault rate. If, through no fault of his own, the contractor is precluded from earning any fee on performance during the flight he is credited with 9% fee. If he has already earned the first 3% but has not completed 30 calendar days, he is credited with 9% fee. If the contractor has earned more than 3% fee, his final fee is the sum of what he has earned plus that which he is credited with for the remainder of the first 180 calendar days at the no-fault rate. For example, suppose that the contractor has earned 7% fee in 95 days on orbit. He is then credited with additional fee of $\left(\frac{180-95}{30}\right)(1.2\%)$ or 3.4% for a total of 10.4% fee. However, in no event is the contractor credited with any fee not earned if at any time it is determined that he could not earn this fee if other associate contractors were performing properly.

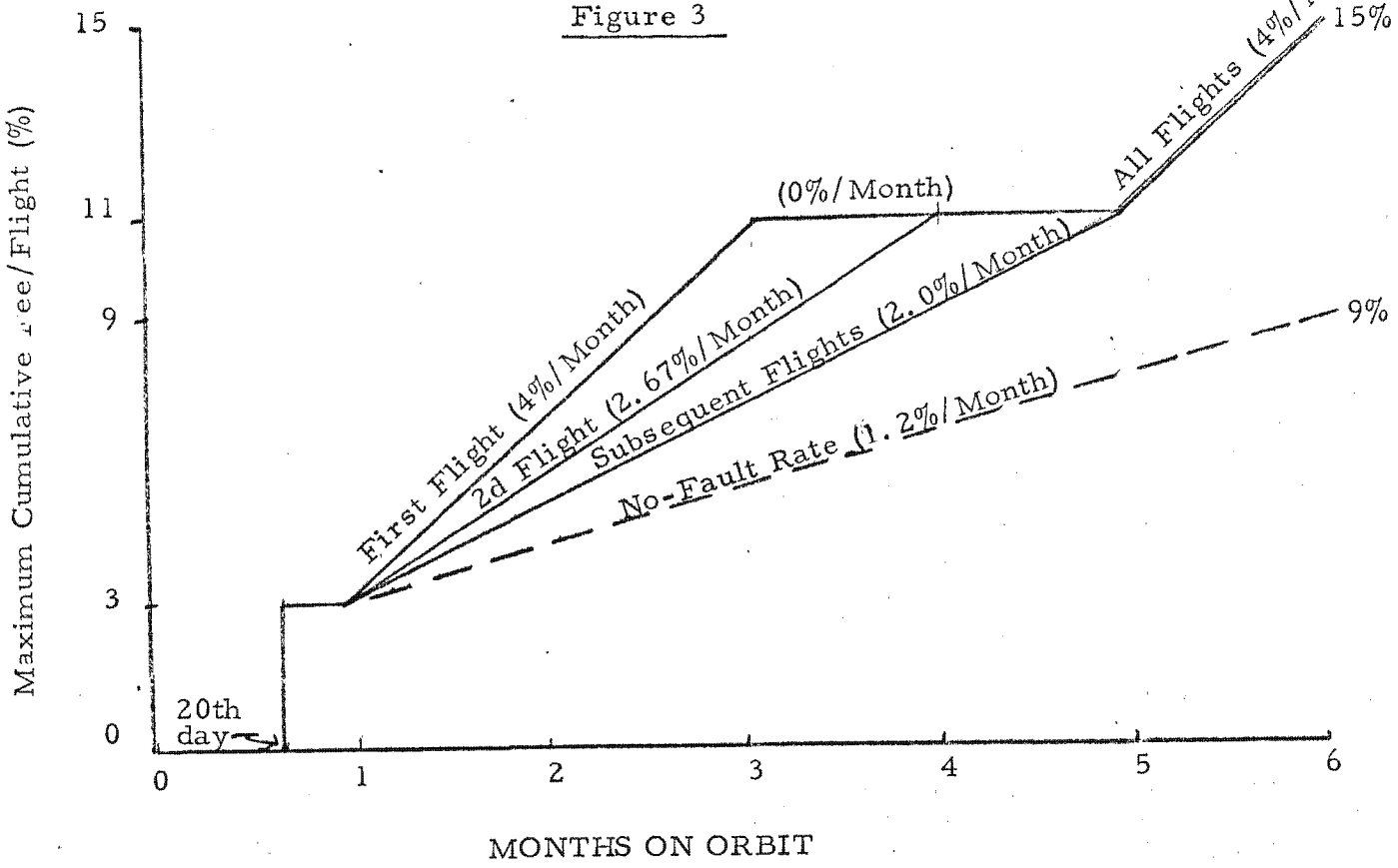
FIGURE 2



h. However, the provisions of subparagraph 7.g. notwithstanding, if at any time any contractor is precluded from earning performance fee through no fault of his own and he has been performing in a manner that would result in a performance fee earning rate less than the no-fault when performance is calculated on the same basis used between the end of the first month and the end of the next to the last month, he is credited with a performance fee based on extending that performance rate from 30 days, or such later date as the event may occur, to 180 days.

i. The effect of higher risk in the initial flights of new projects is taken into account by varying the maximum earning rates of these flights as illustrated in Figure 3.

Figure 3



The computation of the % performance fee that can be earned by all vehicles during the first month is the same, as already described, as is the fee which can be earned during the last month. The variation between flights occurs between the first and last month, and includes periods when no fee can be earned, as illustrated in Figure 3.

j. The fee payment for each individual system is increased from an incremental value of 8% to the full 15% applicable to that vehicle at the completion of systems test, as previously described. The performance account is balanced at the end of each month of the flight, and the contractor pays the government by check as previously described for fee penalties due to less than 100% performance. The amount due at the end of each month is computed as follows:

$$\text{Penalty dollars due for the month} = \left[\left(\begin{array}{c}\text{maximum possible}\\ \text{fee for that month}\\ (\%)\end{array}\right) - \left(\begin{array}{c}\text{actual fee earned}\\ \text{for the month (\%)}\end{array}\right)\right] X \left[\begin{array}{c}\text{target cost}\\ \text{applicable}\\ \text{to that flight}\end{array}\right]$$

In addition, any fee that cannot be earned is due at the conclusion of the month in which this inability to earn is established (i.e., if the satellite power system fails in the first month of flight, the fee that cannot be earned is due at the end of that month rather than continuing to be due incrementally at the end of each month.)

8. Application to Satellite Mission Software

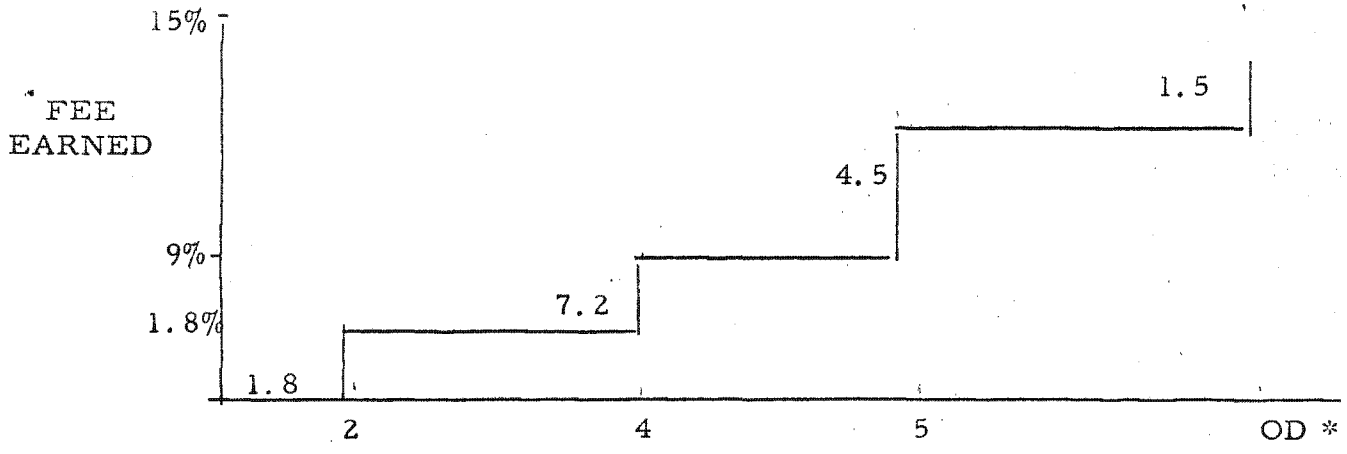
a. This paragraph describes the application of this incentive fee structure to the development of a non-flying end item. The example illustrated is the development of the project-peculiar on-orbit software for a satellite project. This software is mandatory for flight of the satellite project, in regard to both availability and functional adequacy. For this reason, its development is handled in two stages (under the same contract): first, an Initial Operational Capability (IOC), providing mandatory features on a minimum risk basis to meet the first launch date, followed by a Full Operational Capability (FOC) providing a more complete capability at a later date. The basis of performance measurement is the satisfactory demonstration of selected computer program subsystem milestones.*

* standard computer program subsystem milestones as defined in SSD Exhibit 61-47B, 1 April 1966

The fee range is from a maximum of 15% of final target cost to a minimum of zero.

b. The basic incentive structure provides for a single way in which fee can be earned, in discrete steps, up to a maximum fee of 15% of target cost. Performance is measured on the basis of satisfactorily demonstrating accomplishment of milestones 2, 4, and 5, and completion by the contractor of an Operational Demonstration (OD) of the adequacy of the software at the milestone 8 level of performance. The contract contains two schedules: a schedule for delivery of the end items which are referred to in these milestones and OD, and a separate schedule for completion of these demonstrations of their adequacy to the government. Performance under the incentive structure relates to the dates for satisfactory demonstration, not to the earlier delivery dates. Upon satisfactory demonstration of milestones 2, 4, 5 and the OD, a specific increment of fee is earned, as outlined in the chart of Figure 1. The specific criteria as to what constitutes satisfactory demonstration of each milestone and the OD are included in the contract. These criteria must be met completely; there is no provision for graduated or partial earning of these incremental steps of fee.

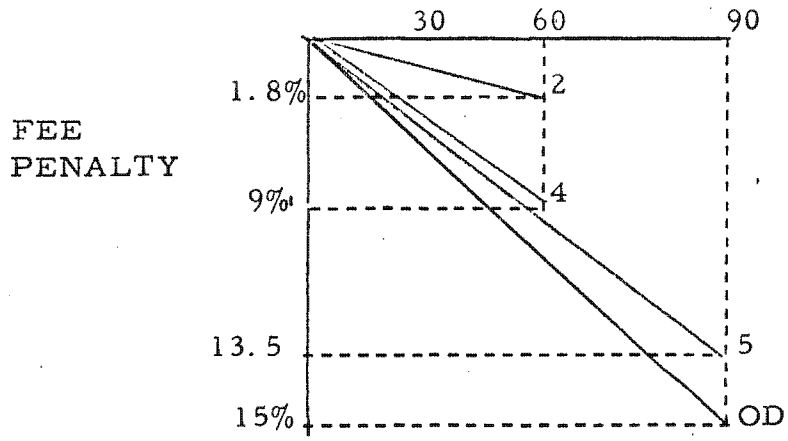
FIGURE 1.



*OD = Operational Demonstration by the contractor of the operational adequacy of his software at the milestone 8 level of performance.

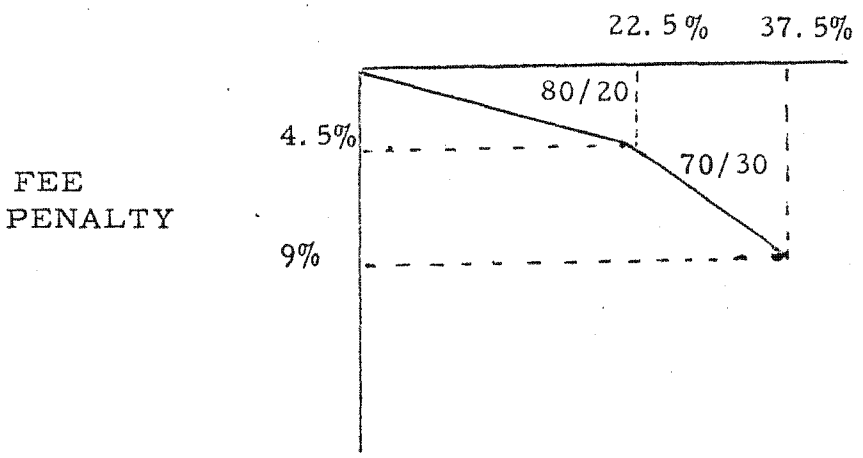
c. The incentive structure provides for fee penalties for failure to meet the contract dates for satisfactory demonstration of milestones 2, 4, 5 and the OD. These penalties are assessed as outlined in the chart of Figure 2, on a linearly graduated basis in units of whole days late. "Days late" means calendar days from the date specified in the contract. The chart shows both the maximum fee penalty for lateness in demonstrating each milestone and the OD, and the time when this maximum penalty is reached in each case. Penalties for lateness in satisfactorily demonstrating a specific milestone are not always related to the increment of fee that can be earned by this milestone. For example, as shown in the charts, satisfactory demonstration of milestone 2 can earn 1.8% fee, and 60 days lateness can lose 1.8% fee. However, satisfactory demonstration of milestone 4 can earn 7.2% but 60 days lateness can lose 9%. In other words, at the degree of lateness corresponding to maximum penalty for each milestone and the OD, the penalty is equal to the maximum amount that could have been earned by satisfactorily demonstrating that and all previous milestones on the contract schedule, and within target cost.

FIGURE 2 DAYS LATE IN DEMONSTRATING MILESTONES



d. The incentive structure provides for cost penalties up to a maximum of 9% of final target cost, assessed in two sharing ratios, as illustrated in the chart of Figure 3. The initial sharing is 80/20 up to an overrun of 22.5%, at which the fee penalty is 4.5% of target cost. Subsequent sharing is on a 70/30 basis, up to a maximum fee penalty of 9% of final target cost.

FIGURE 3 OVERRUN



e. The balance of a maximum that can be lost by cost overrun of 9% compared with the maximum that can be earned of 15% is intended to provide for two different incentives, both of which are essential, as previously discussed. The penalty for cost overrun must be severe enough to insure responsible financial management. However, even at the maximum cost penalty, there must still remain an incentive for the work to be successful in the event the government chooses to proceed in the face of such increased costs (which, in actuality, is a probable course of action if there is tangible reason to expect functional success, since the total cost of the software, even in such an overrun condition, is but a fraction of the cost of even a single flight of many satellite systems, which cannot fly without this software).

f. The effect of a two-step procurement, such as an IOC followed by a later FOC, is as follows. The IOC milestones and OD constitute the only way that any fee can be earned, as outlined above in paragraph 8.b. The earned fee percentages pertain to the total fee for the contract, i.e., the total IOC/FOC task. However, these steps are earned on satisfactorily demonstrating milestones 2, 4, 5 and the OD of the IOC only, as outlined in the chart of Figure 1. The fee penalty for lateness in demonstrating milestones and the OD is the same as previously discussed, as illustrated in the chart of Figure 2, except that these penalties apply separately to both the IOC and the FOC. That is, the maximum penalty for lateness in demonstrating the OD of the IOC is 15%; it is also 15% for failure to demonstrate the OD of the FOC. This insures priority to the IOC, but also insures responsible attention to the FOC. No fee can be earned except by satisfactorily completing IOC milestones and OD, and the full 15% can be lost by failure to meet these. Yet any fee earned in the IOC can be lost by failure in the FOC. Cost penalties are the same as previously described, and pertain to the target cost of the entire IOC/FOC contract.

g. The government makes payments to the contractor as follows:

(1) Cost payments are made monthly upon the contracting officer's determination of percentages of completion of work.

(2) Fee payments are made in lump sum steps on the milestone and OD demonstration schedule in the contract. The amounts are the full percentage of contract target cost that can be earned by the milestone for which the scheduled demonstration date has been reached (regardless of the status of satisfactory demonstration). For example, as indicated in the chart of Figure 1, no fee is paid until the scheduled demonstration date for milestone 2, at which time a lump sum payment of 1.8% of the target cost of the contract is paid. No additional fee is paid until the scheduled milestone 4 demonstration date, at which time a lump sum payment of 7.2% of the target cost of the contract is made.

h. The contractor makes payments to the government for fee lost due to lateness in satisfactorily demonstrating milestones and the OD as follows. At each 30-day interval following the scheduled dates for satisfactory demonstration of milestones 2, 4, 5 and the OD, all fee adjustments due to performance penalties up to that date become due, and

the contractor makes such adjustments by refunds in the form of a check presented by the contractor to the Contracting Officer, made payable to the Treasurer of the United States and supported by a credit fee voucher, as previously discussed for other applications.

i. Changes to the original contract come under the same fee structure, in the same manner previously discussed for other applications.

9. Implementation. Several points related to the contract, its negotiation, and its implementation at the contractor's plant are fundamental to the overall incentive approach outlined herein:

a. A full description of this incentive fee structure, together with specific provisions intended for the work in question, is included in the bidder's package for the source selection competition, together with the requirement that proposals must be based upon this structure. In this manner, the costs and schedules are proposed in the full knowledge of the fee structure that will apply to any resulting contract, and the full effect of performance, schedule, and cost variance is considered in the initial preparation of the competitive proposals.

b. In negotiating the contract, agreement is reached on the entire incentive structure prior to beginning any other aspects of the negotiation. If necessary, higher level management is brought in to settle this matter before proceeding. The negotiation then proceeds on the basis of defining and agreeing to the work necessary to achieve the desired capability and the identification and justification of the costs involved, all in full realization of the incentive structure which will apply. The differences between this initially agreed to incentive exhibit and the final incentive exhibit of the negotiated contract are:

(1) The initial exhibit does not have the detailed list of "critical events" nor allowable quantitative ranges. However, the content of this list is clear, since the items are all taken from or are consistentwith the vehicle contract requirements and technical specifications. There is no valid basis for objecting to putting anything on the "critical event" list which meets the definition of this list in paragraph 4.a. Therefore, this degree of incompleteness which necessarily exists at the start of negotiations has no valid bearing upon ability to reach full agreement on the incentive exhibit at the outset.

(2) The initial exhibit is written in terms of percent of applicable target cost, whereas the final exhibit is written in terms of dollar amounts that have been obtained by applying these percentage figures to the subsequently agreed target costs.

c. To be effective, the basic incentive structure must be simple, even though it is necessary in the contract exhibit to address the major contingencies and allowable options as previously discussed. If the basic incentive structure is not simple it will not readily be grasped by the many people at all levels of the contractor's plant whose work affects the chance of success. If they don't understand it, they will not do anything differently because of the incentive structure. If they do not, the incentive contract will have failed to achieve its fundamental purpose. In the final analysis, far more actual incentive can be realized by a simple structure than a complex structure, even if some subtle points and contingencies must be omitted in order to attain a simple structure.

d. The entire incentive approach presumes that the contractor will take specific internal implementing action. This should include a clear explanation of the essential features of the incentive structure to all who work in any manner on the vehicle, with the explanation specifically keyed to the manner in which the work of each one can affect the fee which can be realized by the company. It should include some tangible internal management actions which place an additional incentive on the work quality wherever feasible. It contemplates in all cases that the contractor is not simply being offered a higher fee for potential success as compensation for accepting a lower fee for potential failure, but that he will, because of this structure, devote better and more careful managerial attention and even selectively spend some of this potentially higher fee where necessary to assure maximum expectation of the highest level of success and corresponding net return.

10. Summary. The incentive structure described herein is fully consistent with the basic objectives of incentive contracting and meets the objectives outlined in paragraphs 1 and 2. It is flexible and adaptable to all major aspects of complex satellite projects. It provides maximum incentive to attain and maintain the highest levels of performance, on a continuing, scheduled basis, yet it retains firm financial control through substantial penalty provisions for overruns, and a reasonable penalty provision for schedule variance. In all applications, it results in no fee for failures or

even half way successful flights, a relatively low fee for good performance with poor financial management, and even lower for poor performance. The contractor has the opportunity and the incentive to make the maximum fee; the government has increased probability of getting the best possible performance at the contracted price, under conditions which provide essential operating flexibility and which are fully compatible with prompt response to contract changes.