A SPECIALIZED INCENTIVE CONTRACT STRUCTURE FOR SATELLITE PROJECTS

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1. Introduction. 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 as it applies to contracts for satellite vehicles, but the rationale is applicable to other aspects of satellite projects, as is outlined in paragraph 7. It is intended for satellite projects for which continuing changes are characteristic and for which prompt contractor response is essential, which, together with other circumstances, dictate the use of cost-plus-incentive-fee type contracts.

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, in all satellite projects, the achievement of satisfactory orbital performance is desired, 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. 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. And no cost saving by any means is an acceptable substitut 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. Maximum performance within contracted costs is the financial goal.)

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 achievement 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.

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 serious 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. Definition of Satisfactory Performance. In each contract, satisfactory performance is specifically defined according to one or the other of the following definitions:

(1) The number of revs completed prior to the occurrence of a "critical event." This is the most demanding definition and requires the highest level of performance for a given fee.

(2) The number of revs completed during which no "critical event" existed. This definition is less demanding in regard to the penalty for intermittent critical events which exist during a relatively small percentage of the flight.

c. Redundancy. Whenever the system design includes a redundant feature (such as a backup motor or actuator, for example) the loss of the primary feature will not constitute a "critical event" unless the backup feature also fails to operate properly. That is, for all functions which include redundant means, the "critical event" will consist of loss of the function and not loss of the primary or backup means per se.

d. Overriding Events. In any case where the contractors work, personnel, or equipment cause total loss of the data, as, for example, failure of a data capsule to re-enter as programmed, such loss is considered an overriding critical event and will result 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 will include the following provisions (variations to this approach are discussed later in paragraph 7 and the manner of handling changes in paragraph 6):

a. Performance

(1) As noted previously, this is the only way that 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 performance fee that can be earned by each vehicle under the contract is therefore:

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

The actual fee will depend upon the performance attained by each vehicle; it may vary from the maximum shown above to a minimum of zero, and is determined as outlined in the following subparagraphs.

(2) The performance score of each vehicle is computed on the basis of 100 points for maximum performance and zero points for unacceptable performance. Actual performance equal to that planned earns a score of 100 points; actual performance equal to 50% (or less) of that planned earns a score of zero. The full range of 100 points is distributed linearly between the extremes of 50% and 100% of the planned lifetime of the flight, with the median fee of 7.5% thus corresponding to a point score of 75, which requires actual performance equal to 75% of the planned performance. This relationship is expressed in the following simple formula by means of which the performance score of each individual vehicle is computed, based upon its individual flight performance:

$$\text{Performance score} = 2\left[100\left(\frac{a}{p}\right) - 50\right]$$

where: a = number of revs satisfactorily completed, as defined in 4b(1) or 4b(2)

p = number of revs planned for the flight

and $\frac{a}{p}$ is greater than .5 (the performance score is zero for .5 and all smaller values)

(3) The actual performance fee earned by each vehicle is then determined as follows:

$$\text{Actual fee (\$)} = \text{Maximum fee (\$)} \times \frac{\text{Performance Score}}{100}$$

Where the maximum fee is that calculated as described in subparagraph (1) above,

or: $\text{Maximum fee per vehicle} = \frac{15\% \times \text{target cost}}{\text{no of vehicles}}$

(4) The following table summarizes the results of the above formulae for varying degrees of orbital success:

If ratio of actual to planned performance $(\frac{a}{p})$ is:	then performance score is:	and the performance fee is:
.5	0	0 %
.75	50	7.5 %

.80	60	9.0%
.95	90	13.5%
1.00	100	15 %

(5) It should be noted that the simple formulae described above result in a median fee of 7.5% payable for 75% performance, so that 7.5% may be said to be the target fee and 75% may be said to represent par performance. However, these terms are only figures of speech in this incentive structure; it would be equally correct to call the target fee 15% and par performance as 100%. The actual fee is determined by the performance of each vehicle; it may vary from a maximum of 15% (of its pro-rata share of the target cost) to a minimum of zero. Further, the same fee is paid for a given performance regardless of the fee considered to be the "target."

b. Cost

(1) To achieve the necessary financial management under the terms outlined previously, the contract will provide 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 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 overuns 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 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 except on an after-the-fact basis, 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 could 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 maintain the desired perspective, the 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. This insures full attention to the short term schedule of each vehicle, that is, the period near its scheduled delivery date. 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 at the launch base or just prior to shipment to the base.

d. Additional Provisions

(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 would prevent the satellite vehicle contractor from having any chance to perform, then the performance score allocated to such flight will be awarded after completion of the contract and will be 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.

(2) Effect on Government Furnished Equipment (GFE) Failures. Equipment failures will generally be 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 will make 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 will be fully responsible under the incentive structure outlined herein.

(b) If the critical event is attributed to failure of GFE, the flight will be scored under the full incentive provisions outlined herein up to the critical event, and thereafter either at the average contractor performance score defined under 5d(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.

(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 will be treated as though it occurred in CFE.

(d) If the critical event is inconclusive as to whether caused by failure of CFE or GFE, the flight fee pool for that vehicle will be divided on the basis of total planned revs to the rev on which the critical event occurred. The contractor will be 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 will be reallocated evenly to the flights remaining under the instant contract. The reallocated fee dollars will be computed on the basis of the contractor's earned score at the point of the inconlcusive critical event projected through to planned mission completion. Thus, the occurrence of an inconclusive critical event involving GFE will 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.

(e) In the event of an inconclusive critical event on the last flight, the flight will be scored as if the failure were attributed to GFE.

(f) 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 5d(1) and elsewhere, the performance scores for flights having critical events due to failures of GFE and inconclusive failures will be 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. A situation may arise wherein either intentionally due to operational reasons or unintentionally due to a system malfunction or personnel error, the vehicle may be operated beyond contract specification requirements. If such a situation occurs, the following procedures will apply:

(a) Government decisions to fly out-of-spec will be 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 may or may not protest by deadline, as follows: When the notification is well prior to launch (R) day, deadline will be three working days (but not later than R-1). When notification is on R-1 day, deadline will be within six hours (but not later than local midnight on R-1 day). When notification is on launch day, deadline will not be later than the start of terminal count. When notification is given during flight, the deadline will not be 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, with a copy to the contracting officer.

(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 will be 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 will be 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 par 5d(1), whichever 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 will come under the full incentive provisions outlined herein regardless of whether the out-of-spec conditions cause or contribute to failures.

(d) The same provisions will apply to unintentional out-of-spec conditions except that notification of the out-of-spec condition will not be required of the Government and the deadline for protest will be

twelve hours after the occurrence of out -of-spec condition. This will provide 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 was caused by this contractor's personnel or equipment, no protest will be allowed, and the flight will be 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 par 5d(1) and elsewhere, protested flights will not be included, regardless of the actual performance attained in any portion of such flights.

(f) Flights on which protest is made will not be eligible for the additional incentive feature described in par 5d(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 will 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 will not be 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 will be 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 will therefore contain the following provision: Notwithstanding the performance fee computed on the basis of the critical event list, as previously described, whenever the contracting officer is able to determine after completion of the flight that the actual degradation to the desired 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 will not be eligible for this feature).

(b) Any such change of the performance score computed on the basis of critical events will be 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 will be 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 specifications, 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 will not be governed by the results of any specified calculation. In making this judgment the Contracting Officer will consider 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 will not be 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 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, and 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.

(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, will be awarded whether or not it is specifically attributable to such in-flight support.

e. Savings Clauses. The incentive structure also will contain savings clauses, covering the following provisions:

(1) Notwithstanding any other provisions, the maximum fee under the contract shall not be more than 15% of the target cost, and the minimum shall not be less than zero.

(2) In the event that any part or parts of the entire system are operating in such a manner that the mission is not being fully accomplished, even though no critical event may exist or have occurred in equipment supplied by any contractor, the Government will have the option of terminating the flight prior to completion of the planned duration. In this event, scoring for any contractor not causing the early termination will be scored as if the GFE failure caused the early termination (ie., scored as outlined in par 5d(2)(b).)

(3) The planned performance used in the performance computations based upon the critical event list (outlined in par 5a and par 7b) shall not exceed the maximum orbital lifetime called for in the contract.

(4) A further savings provision will apply, although not specifically as a contract savings clause: 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.

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6. Changes.

a. 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, 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 since the overall costs are increased. Obviously certain provisions must be made to insure that changes do not increase the fee payable for previous flights not affected by the change. However, with the provisions of such safeguards, it is axiomatic that the overall approach to changes to an incentive contract as described herein be the same as the approach to the basic contract. In this regard it should be noted that this overall approach does not pre-determine the fee to be paid; the fee to be paid is determined by the individual performance of each vehicle, less penalties for cost and schedule variance. The overall approach pre-determines only the specific relationships of the vehicle performance and cost and schedule variances to the fee; 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 basic 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 will be 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 will be negotiated to have such fee as may be equitable for the type of effort for which they are issued.

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

(1) Performance

(a) The maximum performance fee is described in par 4a(1) as:

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

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

$$\text{Maximum additional Performance Fee due to change (Per vehicle affected) (\$)} = \frac{\text{15\% x target cost of change}}{\text{No of vehicles affected by the change}}$$

This additional increment of maximum performance fee is added to the maximum 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 maximum performance fee that all vehicles affected by the change can earn.

(b) All other performance calculations are unaffected by the change. The actual fee earned is determined in the same manner outlined in par 5a(3).

$$\text{Actual fee (\$)} = \text{Maximum fee (\$)} \times \frac{\text{Performance score}}{100}$$

The effect of the change is included in the maximum fee used in the above equation. This figure reflects only the changes applicable to each particular vehicle, and since performance is the only method

by which any fee can be earned, computation in this simple manner completely precludes subsequent changes affecting the fee paid for previous flights.

(2) Cost

(a) The target cost of all changes comes under the full incentive structure of the basic contract, in both sharing ratios and maximum fee penalties.

(b) To insure early definitization of changes, 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. The cost proposal must be submitted prior to incurring costs beyond this limit in order for the same terms as the basic contract to be applicable to the change. Otherwise an equitable adjustment will be negotiated on an individual basis.

(3) 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, each vehicle to which the change is applicable can result in an additional maximum penalty for schedule variance of:

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

7. Variations. The overall incentive approach described above may be varied in implementation without changing the basic philosophy. The following examples illustrate such variation.

a. Variation in target fee. As noted in paragraph 5a(5), the terms "target fee" and "par" are only figures of speech in this incentive structure, since under the formulae described the same

actual fee is paid for the same actual performance, regardless of the point in the performance range that is considered par and regardless of the fee (between 0 and 15%) that is considered the target. The only specific meaning that can be given to the term "target fee" in this approach is that funds based upon whatever is selected as the target fee must be put on the original contract; however, the amount paid is determined by the performance attained, regardless of the fee considered "target," in the same way that the fee is paid for performance which exceeds par on a conventional incentive approach. The target fee may arbitrarily be selected at the median of 7.5%, corresponding to 75% performance. Or, to provide additional psychological incentive, it may be selected higher, as for instance, 9%, which corresponds to 80% performance. In all cases, however, the maximum remains 15% and the minimum is zero.

b. Negative Performance Incentive.

(1) To provide the maximum psychological incentive, while paying exactly the same fee for the same performance obtained, the "target fee" may be selected as the maximum fee (i.e., 15%) and all scoring carried out on a negative basis. This requires no change in the formulae previously described. The performance score is computed exactly as described in paragraph 5, and the actual fee is also computed in the same manner previously described:

$$\text{Actual fee \$} = \underset{\substack{\text{(which is also} \\ \text{now the "target")}}}{\text{Maximum fee}} \times \frac{\text{perf score}}{100}$$

The "target" fee is thus reduced by the performance score of each flight, as shown. 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 approach described in paragraph 5. Its advantage is psychological; 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 can refer to 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 can refer to the same work as "costing the company 6% penalty for performance deficiencies." The

money paid is the same; this method offers, at no cost, additional psychological assistance in insuring that the "word gets to the bird".

(2) An alternate method of computing this variation, which produces identical results, is to employ penalty points, as follows. A possible total of 100 points is assigned to each vehicle. Since performance incentive assessment can only be a reduction in fee, point determination results in penalties for vehicle performance less than 100 per cent success. Therefore penalty points will range from 0 for completely satisfactory performance to 50 for maximum fee penalty. Fee will be 15% for a net performance score of 100, 7.5% for a net score of 75% and 0 for a net score of 50. Penalty points will be determined as follows:

$$\text{Penalty points} = \frac{a}{p}(100)$$

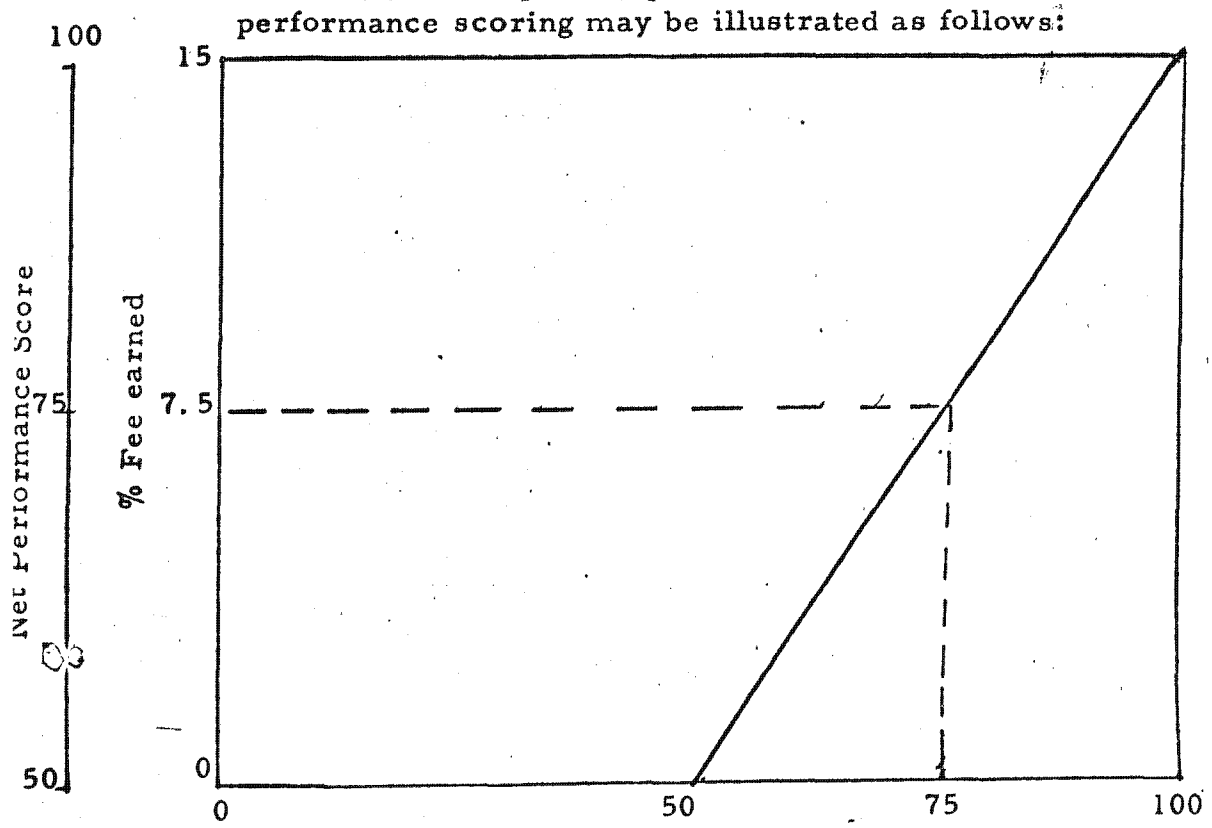
Where: a = number of satisfactory revs (as defined in par 4b)

p = number of planned revs

and net performance score = 100 - penalty points or

$$\text{Net score} = 100 - \frac{a}{p}(100)$$

(3) If the penalty point method is used, this variation in performance scoring may be illustrated as follows:



(4) When using this all-negative performance incentive, the matter of fee payment will be handled as follows:

(a) The Government will make monthly fee payment to the contractor. The fee payments will be 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 the first unit through Systems Test, the value of 8% above will increase to a cumulative of 15% based on percentage of completion of work and including full fee for performance of the first flight article. Thereafter, fee payment will continue at 15% based on percentage of work completed, subject to adjustment by the amount of any fee lost for flight and schedule incentives.

(b) Notification of the performance incentive penalty, if any, will be given the contractor in writing after reviewing his analysis of each flight. Based upon the vehicle fee lost, the contractor will reimburse the Government for incentive fee adjustment concurrent with target fee billings.

c. Minimum Acceptable Performance. 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 on continued maximum performance.

d. Cost sharing ratios. 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 95/05 or 90/10 for the initial buy of a new project, with appropriate progressive increases; in followon contracts it 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.

e. Applications

(1) Although the typical illustrations described 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.

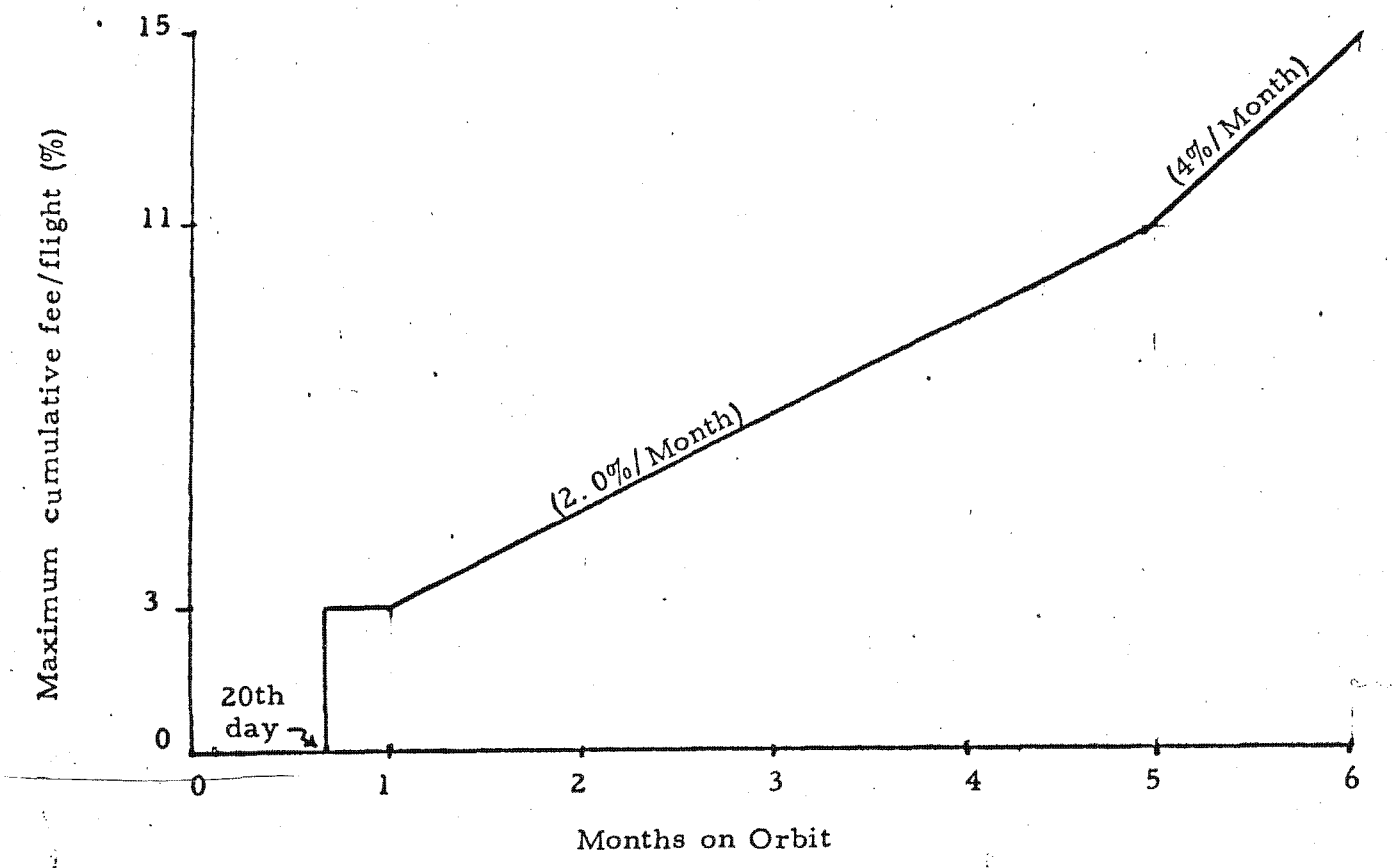
(2) An obvious difference between applications will be the makeup of the critical event list, which will differ considerably between, say, a vehicle contract and a payload contract. Yet, with this difference, which simply results from following the definition of this list given in par 4a, the approach outlined herein is applicable to all contractors involved in such projects, including integrating contractors.

8. Projects with Long Lifetimes on Orbit

a. While the cost, schedule and 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 lifetimes, considered here to be lifetimes in excess of one month on orbit. This variation in performance scoring includes limiting the definition of satisfactory performance to that of par 4b(2) (i.e., revs where no critical event existed). In addition, a different structure is used for determining the performance fee earned throughout the flight, as is explained in the following subparagraphs for the case of vehicles with a planned lifetime of six months.

b. The fee structure for these long life satellites is based on allowing the initiation of fee earning only after an "infant mortality" period, and increasing the rate at which fee may be earned as the flight progresses, with the last month of the planned mission being the most valuable month. 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).

c. 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 par 4b(2). 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:

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

(where a=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).

d. The performance fee dollars are then computed as follows, depending upon the type of incentive swing employed:

(1) If the target fee with ± swing is used, then

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

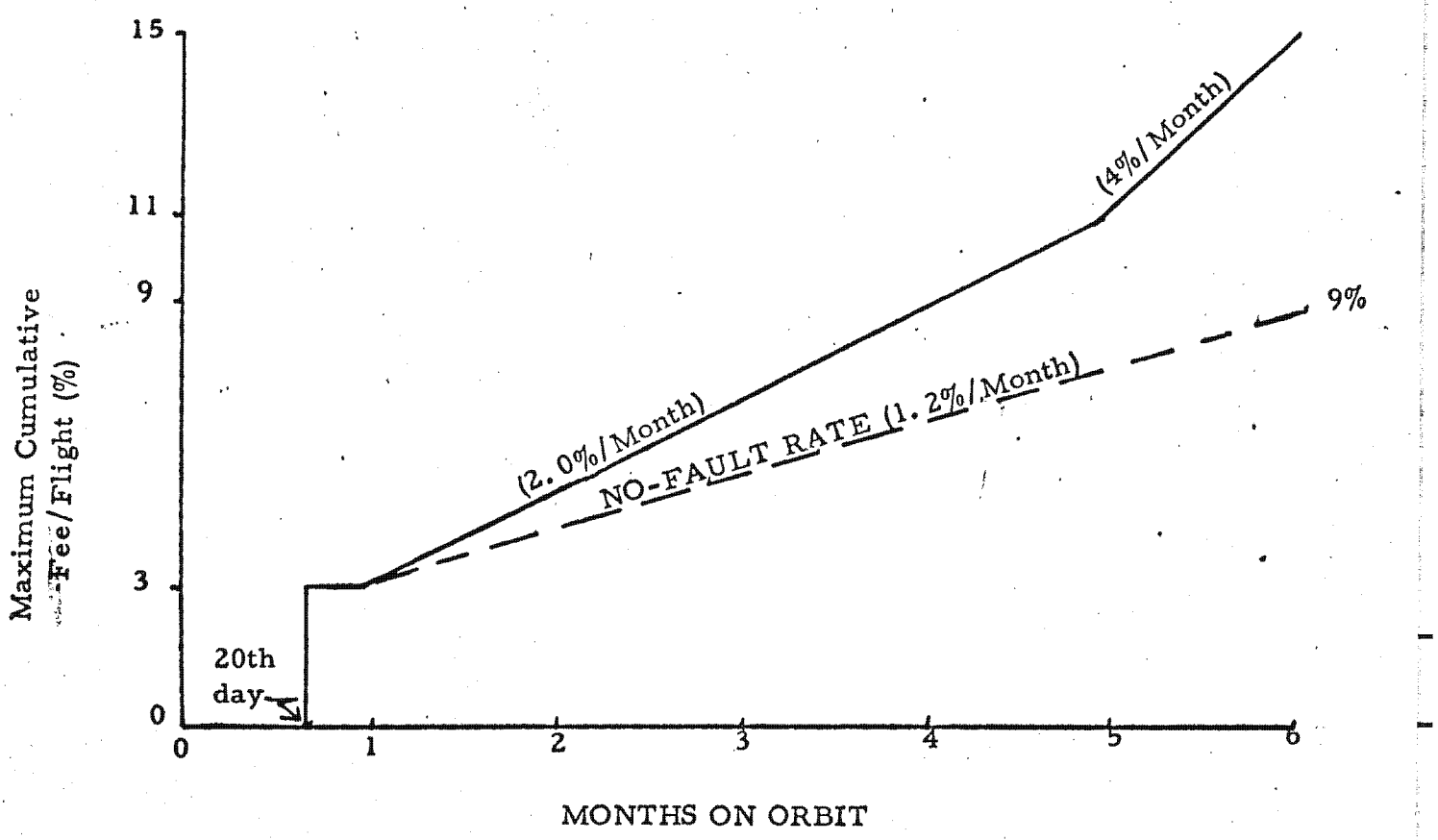
(2) If the all-negative swing method is used, then the performance account is balanced at the end of each month of the flight, and the contractor will invoice the Government for fee which must be returned due to less than 100% performance, as previously described. The amount due at the end of each month is computed as follows:

$$\text{Fee dollars to be returned for the month} = \left[\left(\begin{array}{l}\text{Maximum possible} \\ \text{fee for that month}\end{array}\right) - \left(\begin{array}{l}\text{actual fee earned} \\ \text{for the month}\end{array}\right)\right] \times \left[\begin{array}{l}\text{target cost} \\ \text{applicable} \\ \text{to that flight}\end{array}\right]$$

e. 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 did have an opportunity to perform," described in par 5d(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 (par 5d(2)(b), (e), (g), and 5d(3)(b)), will instead be 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 will be substituted in similar manner for previously described cases where the average performance of par 5d(1) was used.)

f. 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 will earn 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 will be credited with 9% fee. If he has already earned the first 3% but has not completed 30 calendar days, he will be credited with 9% fee. If the contractor has earned more than 3% fee, his final fee will be the sum of what he has earned plus that which he will be 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 will then be 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 will the contractor be 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.

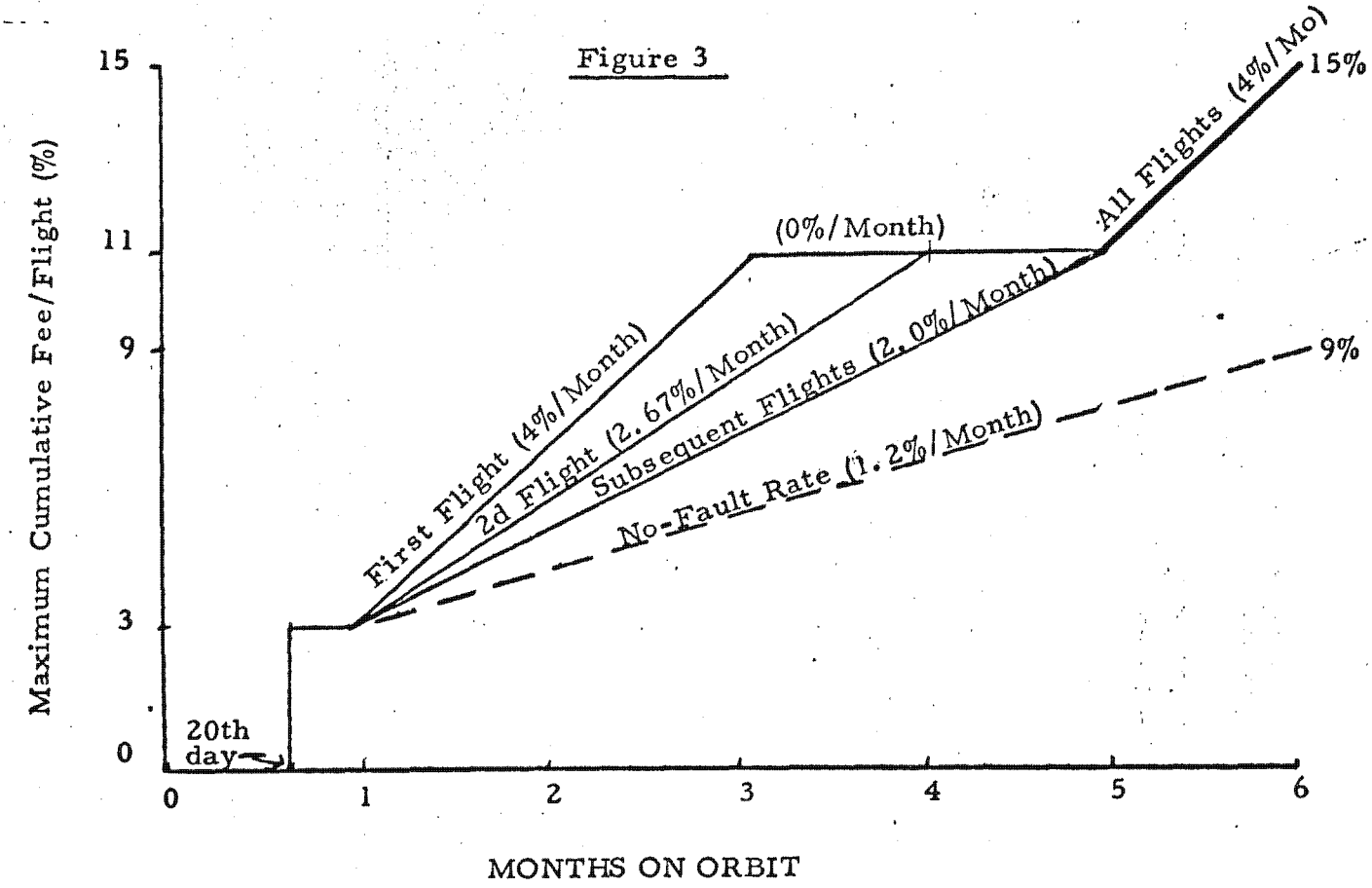
Figure 2



g. However, the provisions of subparagraph 8f 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 will be 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.

h. 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. After the completion of the first month the maximum % fee may be earned at the linear rate determined by a straight line drawn from 3% at the end of the first month to 11% fee at the completion of the third month. No fee will be earned during the fourth and fifth months. During the last month fee earning will be the same for all vehicles, as previously outlined above. The second vehicle of a new series may earn maximum % fee after the first month at a linear rate determined by a straight line drawn from 3% at the end of the first month to 11% at the end of the fourth month, with no fee earning possible in the fifth month.

9. Contracting Procedures. 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. In negotiating the contract, the entire incentive structure should be agreed to prior to beginning any other aspects of the negotiation. If necessary, higher level management should be brought in to settle this matter before proceeding. The negotiation should then proceed 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 only difference between this initially agreed to incentive exhibit and the final incentive exhibit of the negotiated contract will be:

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

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

b. 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.

c. 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 also include some tangible internal management actions which place an additional incentive on the work quality wherever feasible. And it certainly 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. 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 are fully compatible with prompt response to contract changes.

DEPARTMENT OF THE AIR FORCE
OFFICE OF THE SECRETARY

MEMORANDUM

for Mr Charles [illegible]

Bob;

You may be interested in the attached incentive plan for CPIF contracts on satellite vehicles. The cost of such vehicles is 20-30% of the total cost of a launch, and the useful result depends almost entirely on the number of days of satisfactory operation in orbit.

DEPARTMENT OF THE AIR FORCE

OFFICE OF THE SECRETARY

MEMORANDUM

I have discussed this plan with you before in general terms. This is a more detailed account of the manner of implementation.

I would appreciate any comments you might have.

Al