A TECHNO-ECONOMIC INVESTIGATION OF ADVANCED MARINE VEHICLES

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SUMMARY

In recent years, both the quantity of high speed craft in service, and the number of locations in which they operate have grown at what could be described as a remarkable rate. The performance of these vessels has continued to improve at the same time, accompanied by a general increase in vehicle size, due mainly to an extensive international research effort in this sector. However, perhaps surprisingly to some observers, the application of Advanced Marine Vehicles in the commercial world has so far been restricted to passenger ferries; their have been very few attempts to apply the technology in an express freight service. The central objective of this Thesis is, therefore, to assess the economic viability of Advanced Marine Vehicles operating as cargo vessels.

In the initial stage of the study, the International Trading System was investigated, focussing on the factors most relevant to the design of a high speed cargo ship. This also provided useful benchmark data on cargo flows, against which a potential fast cargo service could be assessed. It became clear at this stage that economies of scale could be important in establishing concept viability.

In parallel with this trade study, the current status of Advanced Marine Vehicle Technology was examined, including consideration of the most promising areas of technical development. The objective was to identify the vehicle type offering most potential for carrying cargo and having scope for building larger vessels than those currently in service (to achieve the economies of scale identified as important in the trade study). It was concluded that the Surface Effect Ship best suited these requirements, although the possibility of using foil-assisted catamarans was recognised.

Thus discrete preliminary design solutions were developed for each vessel type, to carry 5000t, 3250t & 2000t deadweight with respective ranges of 3000nm, 1500nm, and 1000nm. Although these solutions contained some significant design uncertainties, they were judged to be acceptable in the context of examining economic viability. It was found that surface effect ships offer the most potential for scaling to large size while retaining the high speed advantage of the small craft currently in service.

Having estimated the build and operating costs of the SES design solutions, the Required Freight Rate for each was derived through discounted cash flow analyses. The results of a Sensitivity Study were used to allow design and cost uncertainties to be accounted for in the economic appraisal.

The limits of AMV economic potential were explored by making assumptions intended to simulate future technical progress. For example, the effect of mid-

journey refuelling on RFR was estimated by reducing fuel weight and increasing payload.

The economic study demonstrated that AMV's could realistically achieve unit costs $^{1}/5$th those of aircraft, but 3 times those of conventional ships. This was an encouraging finding, indicating that there are circumstances where an Advanced Marine Vehicle will be the most economic transport solution. However, based on the results derived in this study it is unlikely that they would be able to attract sufficient cargo volume to sustain an exclusively cargo service.

However, there is no reason to doubt their economic viability as passenger ferries, given that passengers, particularly in developed economies, attach a very high value to their time. If the current rate of technical development is maintained and significantly larger vessels are brought into service, then services carrying both passengers and cargo could well be introduced. This practice has become well established in the air freight industry.

It is highly likely that Advanced Marine Vehicles will continue to grow in popularity amongst operators and users. The development programmes underway in many countries can only help in the pursuit of more efficient vehicles, providing further impetus to their deployment. While many research projects rightly concentrate on propulsion system technology and fuel economy, future effort could profitably be focussed on material technology and structural optimisation. Improving the payload capacity and thus revenue earning potential of these vessels will be a vital step in maximising overall economic efficiency and hence market penetration.

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INTRODUCTION

Background

In a very short space of time, the shipping industry could well look back on this period as possibly the most exciting and challenging ever in its history. *Advanced Marine Vehicle (AMV) Technology,* which seeks to overcome the many limitations on the performance of a conventional hullform, is perhaps on the verge of a breakthrough which could ultimately revolutionise sea transport. There is a real excitement currently within the industry, and a tremendous research effort is underway in many countries. Academic interest in advanced concepts is arguably higher than in any other sector; international conferences devoted to the subject are frequently held attracting large numbers of delegates, both engineers and senior businessmen; and the pace of introducing the technology to the commercial world continues to accelerate.

Figure 1.1 shows the cumulative number of vessels delivered in the high speed category, since the 1950's (References 1 and 2). This graph clearly demonstrates the growth in the industry, but masks the *maturity* which may now be coming to fruition. The statistics also hide both a widespread belief that the rate of deliveries will continue to grow, and the increasing tendency of owners to commission vessels with ever larger capacity. There are also different concepts in the high speed category, so while Hydrofoils may have predominated in the 1960's and 1970's, Catamarans are now generally recognised as current market leader. More recently, the Surface Effect Ship has attracted a great deal of attention and could well replace the catamaran as the industry's favourite. Other emerging or younger technology such as the SWATH or foil-displacement hybrids have yet to prove themselves with the operators, but much work has already been done in terms of fundamental research.

The excitement and energy which prevales in the industry is partly responsible for this work being initiated, with the most recent developments in Japan and Norway offering particular inspiration. Japan is currently investing somewhere in the region of Yen 10 billion (US$75m) to develop their "Techno_Superliner", a vessel intended to carry 1000 tonnes of cargo at 50 knots over a 500 mile journey. Norway, currently the world leaders in the commercial application of fast craft, committed almost NOK130m (US$15m) in 1989 to a 5 year programme aimed at developing foil-support technology, air cushion systems and propulsion machinery for fast craft. Many other countries are also intent on nurturing the technology, notably France, with an on-going research project on Surface Effect Ships, and foil-assisted monhulls, and Germany, with a 6 year project sponsoring industrial and academic collaboration addressing design methodologies and specific hydrodynamic aspects of Advanced Marine Vehicles.

An important observation is that the vast majority of high speed, advanced marine vehicles operate as commercial passenger ferries, although their existence owes much to an early military interest which developed the technology. So far as could be determined, only two AMV's have been commissioned exclusively to carry cargo - Anne Lise and Anne Line, both operated by Gods-Trans of Norway to carry fish between the Faroe Islands and Norway/Holland/UK (although only recently Anne Lise was reported to have undergone a refit as a passenger vessel, Reference 3). Now, this poses the question that if AMV's can offer a competitive service carrying passengers, why not for freight also? Are passengers not simply a special category of cargo? Such questions lie at the heart of this research, prompting an early examination of why AMV's have not yet been exploited as cargo-only vessels. The basic thrust of this Thesis is then geared towards concluding whether or not they are ever likely to be.

At an early stage in the work, a definite *potential* for using AMV's as cargo vessels was identified, as illustrated in Figure 1.2 and 1.3. These show the gap in the *supply* of transport, between jet aircraft at one extreme and the monohull ship at the other (this 'gap' is partially filled by the modern railway where overland journey is possible). In Figure 1.2 a simple plot of Journey Time versus Distance for various block speeds indicates a 'niche' market may exist for a 50-60 knot ship. For example, a jet aircraft would complete a 1000 mile trip in 2 hours while a 20knot ship would take 50 hours; a 50 knot ship would provide a perfect balance between these two with a journey time of only 20 hours.

It is almost certainly true that the shipping industry would welcome the extended choice which a fast cargo vessel would provide; the question is whether or not they would attract sufficient cargo volume at the required freight rate. In Figure 1.3, the difference in cost of moving cargo in either jet aircraft of conventional ship is illustrated (with data from References 4 & 5). For an AMV cargo ship to be successful, a cost somewhere in between the two would be necessary, but where exactly? How low would the freight rate have to be to attract cargo that would otherwise go by conventional ship or aircraft?

While accepting that an AMV service would have to be economically competitive, it is not even clear that a technical solution is feasible. The vessels currently in service have very restricted operating envelopes, operating mostly in sheltered waters; if demand exists only for long range shipping, then these vessels would clearly be unsuitable. Therefore, much thought and effort must be given to considering the technical capabilities of Advanced Marine Vehicles before assessing their potential economic efficiency.

What is an Advanced Marine Vehicle?

There is no strict definition of what constitutes an Advanced Marine Vehicle. Many observers relate the term to purely high speed capability, generally on the basis of speed/length ratio (or Froude Number); however, such a definition would exclude some concepts which although perhaps less capable of high speed operation nevertheless outperform the simple monohull in some important respects.

A possible distinction between AMV's and normal ships is this:- many displacement monohulls will utilise 'advanced technology', such as sophisticated cargo-handling gear, extensive automation or high technology equipment which might be found on research vessels; an Advanced Marine Vehicle, on the other hand, will depend on more than simple Archimedean support principles for the hull design philosophy.

Thus a Submarine could be described as an AMV, because it operates away from the air/sea interface and consequently relies exclusively on control surfaces for stability. The Catamaran concept employs two high-L/B ratio hulls to minimise wavemaking resistance to attain high speed, while the hull separation ensures sufficient transverse stability. A SWATH also has twin hulls, but the operating principle is completely different from the catamaran - here, the buoyancy of each hull is deeply submerged which reduces the impact of the waves and thus provides superior seakeeping performance. An air cushion vehicle is raised at least partially out of the water by high pressure air flow, thereby reducing both wave and friction drag. Foil-assisted forms are also attracting support, which are essentially hybrid vessels seeking a balance between alternative concepts. An extreme example of an AMV is the Wing-in-the-Ground (WIG) vehicle, not in any commercial service but nevertheless a very interesting concept - this is really an aircraft which travels over the water at low altitudes, and experiences an augmented lift force due to the close proximity of the 'ground' which provides a lower drag/weight ratio than aircraft with the same speed potential.

It is vitally important to recognise that each concept depends on a trade off between conflicting performance characteristics. For instance, a SWATH suffers high powering and reduced payload capability in order to provide a stable platform; air cushion vehicles possess very high speed potential in calm water but their performance degrades sharply with increasing seastate. Almost by definition an AMV will operate in a strictly defined role, in other words a 'niche'; it is difficult to imagine the monohull being made obsolete by AMV technology, since the conventional form basically offers the best all round compromise. Nevertheless, there will undoubtedly be certain circumstances when the optimum all round form, the monohull, could be outperformed by a specialised concept; an Advanced Marine Vehicle.

Study Objectives

Given the foregoing discussion, the following study objectives were formulated

a) Identify international trading routes where AMV's might provide a competitive cargo-carrying service.

b) Investigate the technical performance of Advanced Marine Vehicle technology.

c) Assess the competitive level of current AMV technology.

and d) Quantify the economic effects of specific technological improvements, preferrably those which may be realiseable in the medium term (5-10 years).

Approach to the Study

In general terms, a 'case study' approach is adopted for the final analyses, where discrete vessel options are examined. However, early reading on the subject indicated that a reasonable understanding on the nature of International Trading would be required - quite simply, if countries did not trade there would be no need for cargo ships. This suggested a need to examine in some detail the influence of 'trade' on the demand for shipping. An attempt is therefore made to quantify the extent to which trade would influence the characteristics of a cargo-carrying AMV. Chapter 2 then, discusses the nature of world trade -it's historic developments and growth, current trading patterns and future projections, and the link between trade and the structure of international economies. This study will put into perspective the potential market for cargo AMV's, and identify some probable features of an Express Shipping Service.

Having identified to some extent a commercial specification for a cargo AMV in Chapter 2, Chapter 3 considers the feasibility of a technical solution. A comprehensive review of current vehicle technology is included, which shows the relative performance levels of the various concepts which were studied. The pace of change in the industry is significant, but some of the projected developments suggested by various sources are discussed, so that trends in technology development may be evaluated.

Chapter 4 presents the designs which were developed for the economic case studies. The design process was sufficiently detailed only to allow the derivation of first order cost estimates, and so by their nature the solutions contain significant design uncertainties. These uncertainties and consequent risks are discussed and shown to be acceptable in the general context of the thesis.

A spreadsheet 'Economic Appraisal' model was developed in order to analyse the operating economics of the design proposals, and this is described in detail in Chapter 5. The results of the various economic analyses are then given, with some comments regarding the competitiveness of the designs.

Having determined the current competitive level of Advanced Marine Vehicles, Chapter 6 is concerned with how future technology improvements might affect the economic situation and eventual viability of these craft. This part of the study is intended to provide a focus for future technical research, by highlighting the areas of technical progress likely to yield most economic benefit.

Finally, Chapter 7 includes an in-depth discussion of the preceding work, with explicit conclusions presented in Chapter 8.

Figure 1.1
Total No of Civil High Speed Craft Delivered Since 1956

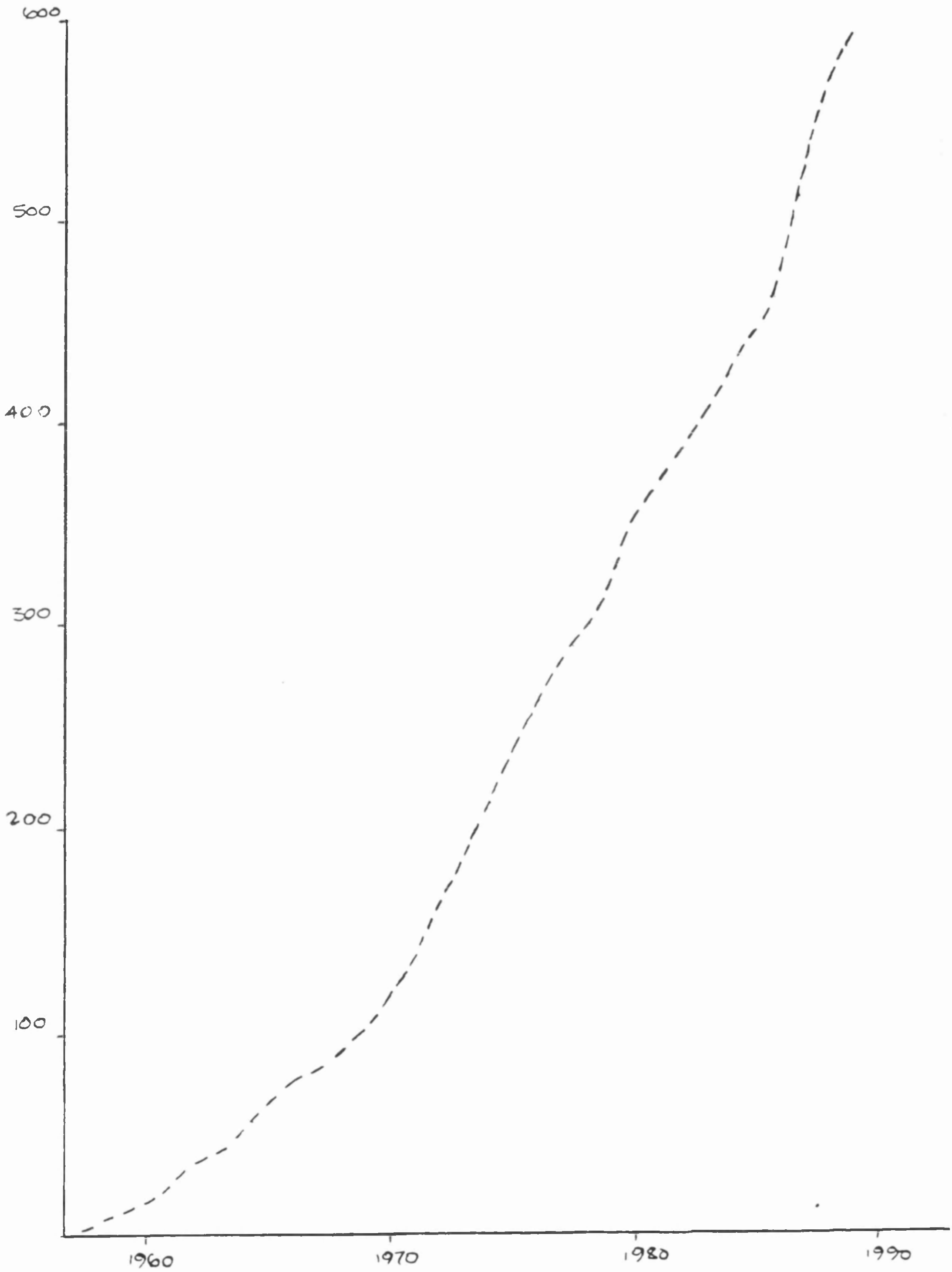


Figure 1.2
High Speed Ship Potential

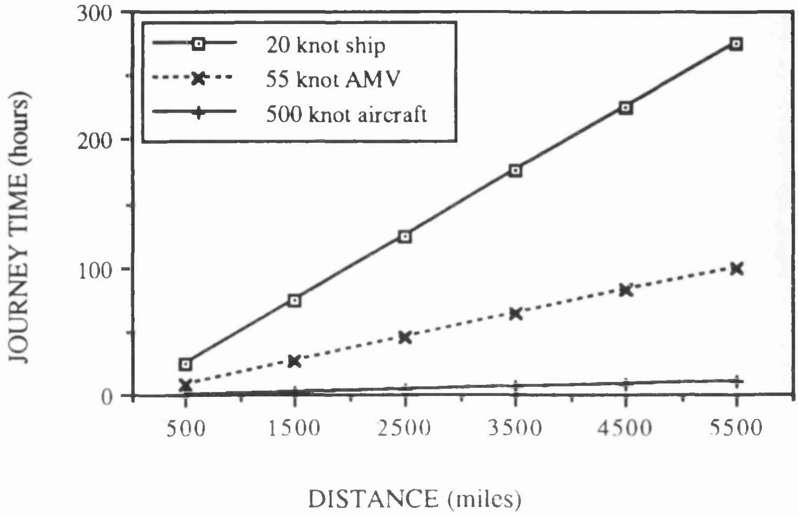


Figure 1.3
Typical World Freight Rates

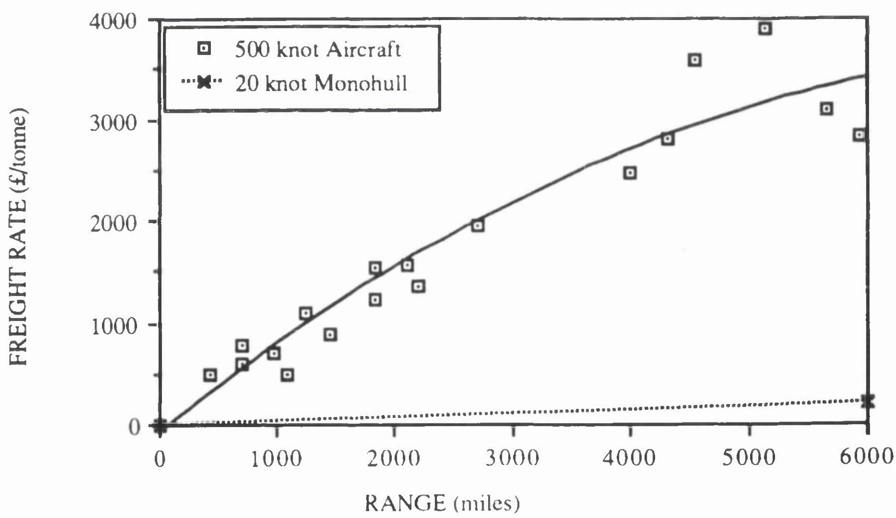
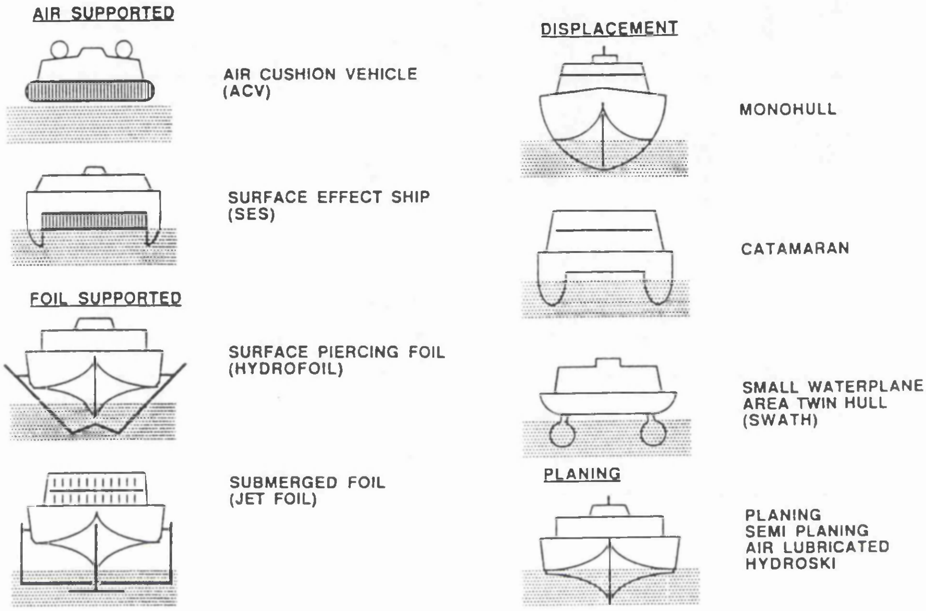


Figure 1.4
Alternative Advanced Marine Vehicles
(taken from Reference 6)



Chapter 2

THE DEMAND FOR AMV CARGO SHIPPING

General Comments

Is there a demand from the shipping market for high speed vessels? Are operators fully aware of the technology now available? What sort of cargo would a high speed ship carry?

Why are fast ships not being used to carry cargo at present?

Questions of this nature should be addressed well in advance of any serious attempt at designing a high speed cargo vessel. Failure to do so would risk producing a possibly brilliant technical solution to a problem which didn't exist - and therefore a ship for which there was never any demand. In contrast, an understanding of the reasons fundamental to any demand for fast cargo ships would be far more likely to produce a design solution for a real problem, and therefore one much more likely to succeed.

In trying to understand what factors will affect the demand for AMV cargo shipping, it is first important to understand why any form of cargo transport is required. Then, the question should be asked why we need different forms of transport. Each mode will have its own relative advantages attracting a different kind of business and so fast ocean transport will only be viable if it can offer some worthwhile benefits over both air and conventional sea services. The obvious advantage of air transport is speed, which makes it the only realistic option for urgent delivery of goods where transport cost is relatively unimportant. However, when freight charges need to be minimised then the conventional ship excels. So what exactly is a fast ship trying to achieve - a compromise between the slow speed of conventional shipping and the expense of air freight?

Consider two other aspects of the problem; how much freight volume is required to sustain a fast cargo ship service? and, with what mode would an AMV service be competing most, air or ship? Available data shows that air freight currently carries about 18m tonnes annually at an average distance of 1720 nautical miles (Reference 7). Over the mid-atlantic, the freight rate charged by operators is equivalent to $10,780 per tonne for general cargo (under 45kg). What fraction of air freight might we reasonably expect to be captured by an AMV cargo service? Or would custom be more likely to be gained at the expense of conventional shipping, given that the vast majority of goods are carried by sea? Even amongst countries of the European Community, which are very well connected by road and rail, 69% of trade volume is waterborne! (Reference 8). The 18m tonnes carried annually by air is dwarfed by the volume of container shipping alone, which amounts to more than 250m tonnes (Reference 9). On the other hand, the rate of growth of airfreight in the last 10 - 20 years, averaging around 8% (Reference 7) does indicate an accelerating demand for high speed cargo shipping. The growth in seaborne trade is not quite so spectacular, so greater competition amongst existing operators might be expected in the future, keeping freight rates low and making it more difficult for a fast ship service to win business.

In attempting to answer the questions raised above, this Chapter will concentrate on the non-technical aspects of a potential fast cargo ship service. Initially, the link between Trade and Transport will be discussed, before current transport options are reviewed. Consideration will then be given to trading patterns around the globe, examining what factors influenced their development. To place the patterns of world trade in perspective the international economies will be briefly surveyed, followed by an illustration of current trade distribution - where the largest trade routes are, how much trade exists, how it is growing, etc. A short discussion on the future of world trade follows, highlighting the implications for transport demand.

From the discussions in this chapter, it will be possible to make some early conclusions regarding the type of AMV service which *might* be successful. These conclusions are presented towards the end of the chapter. The outcome of the Trade Study will then be used in conjunction with the results of the economic analysis to conclude on the viability of an AMV cargo service.

Trade and Transport

There is an obvious link between trade and transport, in that if no goods were exchanged, vehicles would not be required to transport them. The implication in this statement is of course that the nature and level of trade will be a very significant influence on the demand for transport. So in this study, which seeks to quantify to some extent the level of demand for high speed cargo ships, it is first of all important to understand the fundamentals of the world trading system, and how an AMV freighter would serve part of the transport market.

Classical Trade Theory stems essentially from the observations of Adam Smith when he observed the benefits which could be realised by specialising in production (Reference 10). Ricardo built on this when he hypothesised on the theory of "Comparative Advantage" (described in Reference 11) which postulates that a region or population centre will specialise production in goods for which it is most suited, or historically where it has developed a skills advantage. By specialising in producing a limited range of goods, it will become increasingly more efficient in the allocation of resources, but at the same time more dependent on its neighbours for the supply of other goods. This results in the exchange of goods between specialist producers the extent of which is governed by the degree of overlap in the goods produced internally by each partner. Since the benefits of specialisation tend to outweigh the costs involved in transportation, world trade will tend to grow faster than the aggregate of world production. In fact, between 1950 and 1980, world exports rose by almost 50% more than world output. (Reference 12)

Comparative Advantage theory often manifests itself through labour cost differentials, for example in developing countries labour is less expensive than in developed countries. This means they will be better placed to compete in largely labour intensive industry, such as shipbuilding, steel making and agriculture. Developed economies, on the other hand, would tend to concentrate on capital intensive industries, producing high value manufactures or in service industries such as the financial sector.

The need for trade is further enhanced by the *Distribution of Natural Resources*; it is obvious that each nation does not enjoy an equal share of essential raw materials. Therefore, some countries will specialise in production of oil and other minerals for instance, which must be imported by other countries. The local climate can also be regarded as a natural resource, for example the level of sunshine may or may not allow the nurture of exotic fruits, or for example grapes leading to production of wine. Also, an island may be surrounded by fertile fishing grounds which would not only feed the local population, but would also be capable of supplying nations with no fishing stock of their own.

As international economies have developed, particularly in the latter half of this century, it has become increasingly apparent that *Tastes and Preferences* can be a significant stimulant of trade and hence transport demand. This is an expression of a developing consumer sophistication which accompanies wealth creation, whereby individuals with higher disposable income can proportionately spend more on leisure or the purchase of luxury products. Examples of goods most affected by tastes and preferences include fashion goods, quality wines and other such 'luxury' produce. It is important to note that all of these relate to the *retail business,* which is likely to become an increasingly important factor in world trade, as international economies grow and more consumers are able to participate fully in the economy. This observation may have important implications for the current study, as these goods are the type most likely to require low(er) cost high speed transportation.

Notwithstanding the above, which is more concerned with the creation of transport demand, one of the critical factors affecting the demand is *Available Technology.* The expansion of trade with regard to both volume and geography has very much been made possible by leaps in technology. Figure 2.1 shows the growth in dry cargo trades between 1969 and 1989 (data from Reference 13), a period which witnessed an explosion in the use of containers and the advent of the fully cellular ship. Perhaps equally significant in regard to the principle being established, as noted in Reference 14, is that thanks to the speed of airfreight Kenya has been able to find new markets in Europe for its perishable exotic fruit and vegetables.

Again, if technology improvements result in reduced transportation costs relative to production costs, then this ..... *"logically widens the range of international commodity exchanges, and pushes into international trade products which were previously excluded or were only traded over short distances"* (Reference 15) This is true of all economically viable technology improvements, which lends encouragement to the present study - the basic thrust of which is to consider the application of *advanced marine vehicle technology* to the transportation problem.

Transport Modes

A freight agent wishing to move some cargo is faced with a number of decisions before finalising the transport arrangements - which route to use, when to move it, what carrier, how payment will be made and when. The final decision, however, may not always be based on which combination of these offers the minimum freight charge, but is frequently made on the grounds of logistic efficiency.

Increasingly in the highly sophisticated transport industry of today, inter-modal transportation of goods offers the optimum shipping solution. For instance, if one wanted to import some exotic fruit, which is highly perishable, airfreight will quickly move the goods between countries whereupon road, rail or both will be necessary for internal distribution. It is important to emphasise that when 'intermodal distribution' is said to be on the increase, this means that shipping agents are seeking to determine the optimum solution. This will often include more extensive use of one particular mode than would be immediately obvious.

To highlight the choices available to a shipping agent and to some extent consider the competitors to high speed cargo ships a brief review of each freight transport mode is given below. The advantages and disadvantages are discussed, and summarised in Table 2.1.

Road Transport - Quite simply, this is the 'foundation' mode for all freight movement, the most basic transport choice available. It is used almost certainly in any distribution network, because it is the only mode which can offer door-to-door delivery. This is the major advantage of road transport, the inherent flexibility which can offer a direct link between buyer and seller.

This has obvious implications for cargo handling costs, because road transport offers a minimum transfer potential ie no repetitive loading/unloading. Such features combined with the fact that operators make little contribution to the infrastructure costs, which are shared by many users, serve to allow a low tonne-mile cost.

Perhaps the most significant disadvantage of moving freight by road is that of very limited capacity. Since large shipments cannot be moved as a single unit, economies of scale do not exist to promote economic efficiency.

The above serves to indicate that road transport would be dominant for short distance shipping, where its advantage of flexibility would be most beneficial. Also, at long distances for non-urgent small shipments of low value, the relatively low freight rate may be beneficial.

Railway - The chief advantages of the railway system are its high revenue earning capacity and speed over land in comparison to road transport. However, the speed advantage is not particularly significant over short distances because of penalties incurred due to increased cargo handling - offsetting any saving in journey time so that the overall transport duration is not much reduced. Nevertheless, over medium distances (say 500 -1000 miles), considerable economies of scale do exist. The system also has an attractive flexibility in being able to add additional carriages, which can be offloaded at various locations along the way allowing the remainder of the shipment to continue to the terminal.

Railways also offer some advantages in terms of less pollution to the environment. This feature is becoming increasingly important as governments attempt to regulate exhaust emissions from road vehicles.

Unfortunately, although the use of trains *appears* very attractive, it is a relatively expensive system to operate. The high costs are due mainly to the extensive investment in infrastructure which unlike roads is not financed by a multitude of users. Lower unit costs of investment would be necessary to enable railways to compete effectively, which would require much higher utilisation of tracks than that currently achieved.

Sea Transport - The carriage of goods by sea is currently characterised at present by high volume shipments at very slow speed. Economies of scale due to the large volumes more than compensate for any penalty imposed by the slow transit speed, making sea transport the only viable medium for bulky, low value non-perishable freight.

The cost advantages of shipping by sea could be linked to the inherent support provided by buoyancy, since investment in 'infrastructure' is negligible. In contrast, all other modes have to provide their own 'lift' - roads for trucks, tracks for trains and aerodynamic lift for aircraft. The only infrastructure cost for shipping companies is charged via port and harbour dues, which can be quite high and therefore discourages the use of sea transport for short coastal voyages of low bulk.

Sea transport is quite unique in respect of the speed restrictions - because ships operate in the sea/air interface, wave generation effectively rules out high speed for typical displacement vessels. Note that attempts to overcome this natural barrier tends to negate the inherent advantage of buoyancy, which implies a capital and operating cost penalty in much the same way as exists for aircraft as described below.

Air Freight - The one striking advantage of aircraft is obviously its speed. If a buyer wants something delivered 'as soon as possible' their really is no other choice. This makes air freight especially suitable for shipping perishable goods and very high value items.

Of course, this speed capability has to be paid for, and air transport is unquestionably the most expensive choice in normal circumstances. This tends to limit its use, although it has been the fastest growth sector in the transport industry in recent years (almost 8% pa increase each year over the last ten years! (Reference 7). The high cost of air transport is further increased by the need for highly trained crews, and 'redundancy' in the aircraft systems which increases capital cost, and high terminal dues.

Perhaps the greatest limitation for air transport is its low capacity similar to road transport, again ruling out any possibility of achieving economies of scale. The Boeing 747F freight-only aircraft has a payload of just 100tonnes, a mere fraction of that available on conventional ships. However, contrary to popular conception, the air freight industry imposes hardly any penalty for low density freight. A 'volume' penalty is not levied until a stowage factor of $7m^3$/tonne is exceeded (Reference 16), and there are very few commodities which stow at higher rates than this (for example motor vehicles at $7.5m^3$/tonne, whereas boxes of citrus fruit require only $2.6m^3$/tonne and crated machinery only $1.4m^3$/tonne).

One advantage of air freight not commonly appreciated is the security of the system (Reference 16). Statistically, in terms of work done (tonne-mile), this is by far the safest form of transport, a fact which is recognised by insurance companies and is apparent in the relatively low insurance premiums for high value freight in particular.

Nevertheless, it has to be noted that air transport really only excels in the movement of passengers, and that if it weren't for existing passenger services the volume of air freight carried worldwide would be very much reduced. It is a feature of the industry that freight follows the passenger, and it is not uncommon for a consignment to follow a fairly elaborate route before reaching its final destination.

It is worth considering the reason why aircraft are so successful at transporting passengers, to examine any implications for Advanced Marine Vehicle services. Speed is obviously very important to passengers, who in today's sophisticated world place a high value on their time; comfort will also be important to them, which is related to the available space during the journey. With surface transport over long distance and hence long duration, passengers demand much more space than they would for a journey lasting only a few hours - they will tolerate restricted conditions for a short term only. So for aircraft, passengers exhibit a much lower stowage factor than they would for say a normal ferry service, where overnight accommodation and entertainment space must be provided. Therefore, if freight rates were compared in terms of volume and not actual passenger numbers, then air freight rates would be seen to be far more expensive. As it is, comparing *passenger* freight rates shows the two modes roughly equal in many cases(although ferries have the advantage of being able to carry the passengers' cars). The essential observation is that passengers place a high value on their time and because of this are willing to tolerate less comfort in order to cut journey duration.

What are the implications of this observation? In passenger rates we are not comparing like with like; when considering cargo it is important to remember that space requirements will be the same no matter what mode is used. With passenger movements, the stowage factor is less for aircraft than it is for ships; for cargo it is the same in both cases. So although aircraft are undoubtedly superior for moving passengers, they are not necessarily so for moving freight.

Having reviewed the various transport modes available to freight agents, it is appropriate now to put their respective uses into perspective to examine what mode is used most often and why. A good example is provided in "Trade and Transport" (Reference 12) which presented data from a study of European freight movements. These showed how much of particular commodities were transported by which mode. Figure 2.2 summarises this data showing the relative importance of each mode.

By a wide margin, the most important is obviously waterborne transport which carries most freight in all categories except for *"Machinery and Transport Equipment"*. However, perhaps the most important point to note from the figure is the almost insignificant share achieved by airfreight. This mode is only used in two categories, for *'Machinery and Transport Equipment'* and for *'Fresh Fruit and Veg.'*. In each of these categories, the actual share achieved is less than 2% of volume, indicating the very restricted role for aircraft in the freight industry.

In respect of the foregoing, it is important to recall that neither transport costs nor the type of commodity alone will necessarily dictate which mode to use. It is a number of factors which must be taken into account, for example frequent and regular services allow for efficient and less costly inventories through stock reduction using such techniques as Just-in-Time scheduling. This can sometimes be more important than speed in transit.

Patterns of Trade and the Development of Transport Links

So far in this Chapter, some of the reasons *why* trade exists have been discussed. However, there are various factors influencing the distribution of trade which are not dependent on such fundamental concepts.

One strong influence on current world trading patterns is the history of trade itself. Early trading was partially determined by colonialism, where the colonial power would import raw materials from the discovered territories, then export manufactured items to other trade partners.

As such trade developed, ports were constructed and distribution networks became established. This involved considerable capital investment, which then exerted a strong influence on post-colonial trade expansion. As trade began to move away from the colonial system towards 'developed' economies, these ports and distribution networks were adapted to the new demands; any attempt to create an entirely new infrastructure would have been a costly burden on the fledgling transport industry

This is a very important feature of the international transport system, and is independent of the point in time. New trade routes rarely appear overnight, which is a concept known as *'transport corridors'*. Once a transport corridor becomes established, a process which takes decades rather than years, future trade will tend to flow through it even though it may not be the most direct route between two regions. The implications of this feature are significant for the current study, because a 'revolutionary' solution to a particular transport problem is unlikely to be successful. The possibility of a new transport concept being successful depends to a large extent on its ability to operate within the existing infrastructure limits. For example, AMV freight vehicles would be restricted to operating in ports which are currently in service - with consequent limits on draught, length, beam, cargo handling arrangements etc.

Geographical factors can also exert a strong influence on transport links. Basic land characteristics may, for example, dictate the predominant use of ships as in the case of Norway - where the landscape puts railways and roads at a distinct disadvantage. This can be used to advantage as in the case of Norway, where such pressure has been a spur in helping it to achieve the status of market leader in the application of Advanced Marine Vehicle technology! In contrast, North America and continental Europe are able to take advantage of vast areas of flat land to develop their rail networks to a more economic level.

In any trade study, the concept of *hinterland* and *foreland* must be understood, since they can affect commodity flow characteristics and even the viability of certain transport modes in individual cases. These are defined below:

Hinterland - the area surrounding a port where goods are produced for trade through it.

Foreland - the area surrounding a port which that port serves for the distribution of imported goods.

For high-value or perishable goods, speed of door-to-door delivery is essential, which limits the scope for various journey legs and intermodal transport. Air freight, for instance, can serve numerous small scale hinterlands and forelands quite easily, making it ideally suited for long range transport of such goods, because it minimises surface transport time. In contrast, a high speed ship service would serve much larger areas, implying considerable surface transport and probably more extensive cargo handling.

Longer distance usually narrows both modal and route options (Reference 17), because such services are less likely to be duplicated by various carriers. This means that trade between two distant countries would be inclined to pass through a few major ports. The implication of this is that the location of a port within a region may be relatively unimportant compared to the necessity of having first class internal distribution networks.

Perhaps the single most important influence on the distribution of trade is the relative level of national economies. It is obvious that countries exhibiting high levels of economic activity will be more likely to produce goods for trade. This is particularly evident in the current international climate, where countries of the OECD dominate the world trade scene, as illustrated in Figure 2.3 (Reference 14).

A feature of world trade with implications for the transport industry is reported in Reference 12. Empirical evidence strongly suggests that most countries have their most significant trade links with near neighbours. It is probably true that this is closely linked to transport costs, in that if the costs were reduced then long distance trade would expand. This feature is clearly a major factor in the growing tendency for the international community to form trade blocks, such as the EEC, EFTA or the countries of the Pacific Rim. These groups are intended to promote free trade within them, eliminating cross border barriers.

International Economies

In the previous section, the distribution of world trade was linked to the level of economic activity of individual nations. Before discussing this topic in more detail, this section will consider the respective levels of national economic activity and efficiency.

In broad terms, there is a huge gulf in the economies of OECD countries and the Third World nations. Figure 2.4, using data from Reference 14, illustrates the share of world output in US dollars attributed to various regions, showing that the OECD block accounts for almost 80% of the total. When the data is adjusted to account for relative prices as in Figure 2.5, the dominance of the OECD reduces slightly to approximately 65% of the worlds wealth.

To put individual economies into perspective, Figure 2.6 shows the output (Reference 18), in $*billion*, of the top 53 producers. In absolute terms, the United States is by far the largest single economy in the world, followed by Japan and then the countries of Western Europe. This figure shows with striking clarity the huge difference in economic activity between developed market economies and the developing world. This contrast becomes even more evident when the *relative* wealth of nations is compared. Figure 2.7 shows the same national outputs, but adjusted to reflect variations in the purchasing power of local currencies. The only nominally 'developing' country which can compare with the market economies of the West is the United Arab Emerites,which is due to its vast oil wealth, not its productive efficiency.

The reason for reviewing relative economic activity is to focus on the areas where trade might sustain high speed shipping. This is aided by Table 2.2, which shows the exports of the top 25 efficient economies as a proportion of GDP.

Current World Trade

This Section presents data on the level and distribution of world trade at the present time. There are two reasons for doing so -

(i) to show where an express cargo shipping service is most likely to be successful
(ii) to provide a benchmark by which the level of trade required to sustain such a service can be judged.

Trade can either be quantified by the 'value' of goods carried, or in terms of 'quantity', such as by weight or number of items carried such as containers. Both measures are important to this study; value because an AMV service will be expensive and its cost can be compared to the actual worth of the goods, and quantity because there is a need to match the carrying capacity with the anticipated demand.

Figures 2.8 - 2.14 illustrate the level and distribution of trade by value (Reference 18). These are trade maps showing the major sources and destinations of overseas imports and exports respectively, for the worlds seven largest economies. Note that these maps do not include trade between USA and Canada, nor between the countries of continental Europe because very little if any will go by sea.

The importance of the American economy to the level of trade is clear from these figures. Even though the level of USA exports and imports is small compared to its output, in absolute terms it still dominates world trade. (Note that the maps show exports from others countries to USA and Canada jointly).

Data on the level of trade in terms of quantity is sketchy. It tends to be available more for bulk shipping such as oil or grain, but these commodities are of no interest here because they are too low value and too heavy to be carried at high speed. However, some useful data on container traffic and air freight movements are given below. Table 2.3 quantifies the amount of container traffic between the USA and its important trade partners. Representative freight rates are also included.

Similar, alternative data is presented in Table 2.4 for the worlds two busiest routes.

Figure 2.15 illustrates the deployment of container traffic in specific regions, which gives a good perspective on the dominance of USA, Japan and Europe in this trade.

Figure 2.16 shows the ten largest international trade routes for air freight (Reference 19). This is important because it shows again the relative insignificance of this mode with respect to sea transport. The volume of air freight is of the order of a few percent of container traffic alone. Table 2.5 lists this data plus some additional information for other air freight routes of interest.

Finally in this Section, Figure 2.17 highlights a growing feature of world trade - the tendency for neighbouring countries to join together into trade groups. This intra-group trade forms a large fraction of total world trade, with most of it being short haul.

Projected Developments in World Trade

The present trade system will not remain static - it will be subjected to economic, political and technological pressures in the future just as it has been in the past. If a cargo AMV service is ever introduced, it will have to survive in this future system, and this Section speculates on what it may be like.

The biggest influence on the future world trade structure will be the development of the international economy. This Chapter has shown how the OECD countries currently dominate, but this need not always be so - indeed one hopes it will not as everyone would benefit in a more productive world These economies are predicted to grow at approximately 3% p.a. over the next 20 years, which is generally regarded as the maximum level of sustainable growth a developed economy is capable of. Economies now developing though are capable of much more rapid growth, as evidenced by the recent experiences of South America and East Asia. These nations are more than likely to become major exporters and importers in the near future. The countries of Eastern Europe, particularly the former Soviet Union, are also capable of developing their economies quickly up to the efficiency of the West, again becoming major trading nations in the process.

Considering that trade in the developed countries is forecast to grow at around 5 - 6% in the next 20 years, it is not impossible for trade in the emerging regions to reach growth rates of 10% or more. It is also interesting to note that ICAO

(Reference 7) forecast air freight to grow at almost 9% p.a. over the next 20 years, indicating a confidence in the future of high value trade.

Of course, such economic progress is heavily dependent on political events. The developing nations will find it difficult to create wealth and participate fully in international trade if their political systems are incapable of ensuring that the population receive fair reward - without this, there will be insufficient consumerism to create the necessary demand for trade. The current upsurge in interest for protectionist measures also threatens trade, implying restrictions on 'unfair' imports.

The tendency to form trade blocs was noted in the previous section and this is expected to grow in the future. It is reported in Reference 14 that the Pacific Rim, although not yet formally a trade bloc, is currently planning such a step; twelve of the fifteen potential members held a meeting in 1989, and plans for the group, reflecting the growing economic strength of the region, show that it could soon rival the importance of the European Community.

The formation of trade blocs will mean less demand for long distance trade in relative terms, as nations will concentrate trade links with their near neighbours. These would typically be in the 500 - 1000 mile range.

Technically, there appears to be increasing demand from operators for greater standardisation of containers between modes (Reference 8). Companies involved in carrying cargo will more and more tend towards operating all kinds of vehicles, and take on the task of transporting door to door - thereby a single carrier will be responsible for any given consignment, which will reduce the need for forwarding agents.

Chapter Summary - A Potential AMV Cargo Service

This Chapter has given some some indications of what type of AMV service might be viable.

The section on Trade and Transport provides some confidence that there may be a demand for such a service, because the type of trade which is likely to grow quickest in the near future will require fast, economic transport - fashion goods, electric manufactures, exotic fruits, all such consumer products. A clear link was also reported between technology and trade, indicating that the introduction of viable fast cargo ships would give a further boost to trade quite distinct from any increase due to economic progress.

The discussion on different transport modes tends to suggest that a high speed cargo ship could achieve economies of scale which are not available to the air freight industry. It would offer dramatic improvements in delivery time for goods not currently justifying air transport, and hence a reduction in the investment cost of goods in transit.

By considering the implications of how transport links develop, it can be concluded that an AMV Freighter would need to be able to operate within current infrastructure constraints. This will place restrictions on otherwise technically and economically feasible solutions, such as a hullform with a characteristic deep draught. This section also hints that most demand for trading high value goods is likely to be in the short sea shipping sector. This would tend to work against the speed advantage of fast ships, because the reduction in transit time would be a smaller proportion of the overall delivery time.

The tapestry of international economies shows that only countries of the OECD could possibly hope to sustain fast cargo ship services in the foreseeable future. This is because high-value consignments will be required in large quantities. The data on current world trade shows that an AMV Freight Service would be challenging conventional shipping more than it would air freight, simply because of the volumes required. This is in contrast to the initial hypothesis, which viewed a potential AMV freighter as a a direct competitor of the air cargo industry.

An AMV freight service would be looking to capture at least 10% of the conventional container market - it would be unrealistic to expect significantly more, and any less would probably not be sufficient to sustain the services. Viability therefore hinges on the prospect of at least 10% of the current container freight market being able to justify the increased cost due to higher speed.

The discussion on the projected developments in world trade should provide some confidence in the possibility of introducing AMV Freighters. There is every reason to expect the volume of high value trade to grow faster than normal trade. However, the tendency to form trade blocs serves to inject a note of caution - if this continues, trade will tend to become more short distance in relative terms making it increasingly difficult for cost savings to be made through reduced time in transit.

In overall terms then, a potential high-speed cargo ship would probably have the following features -

- cargo would be carried in containers, capable of using existing ports and cargo handling equipment.

- medium to long distance would be more beneficial, although demand is most likely to be for increased growth in short sea shipping.

- potential routes within current trade structures would concentrate between USA and Japan or Western Europe for long distance. Examples of possible routes for medium distance would be UK - Scandinavia or Japan - South Korea.

- sufficient payload volume to achieve economies of scale as an advantage over air freight.

Figure 2.1
Growth of Dry Cargo Trades 1969 - 1989

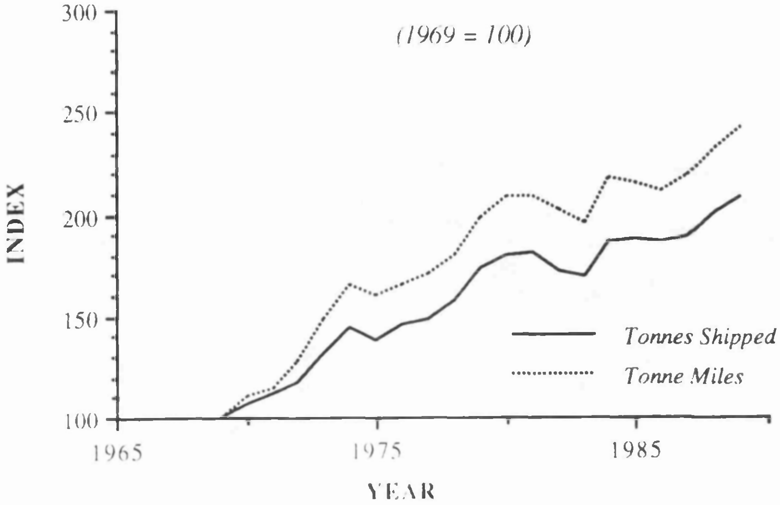


Figure 2.2
Use of Transport Modes in Western Europe

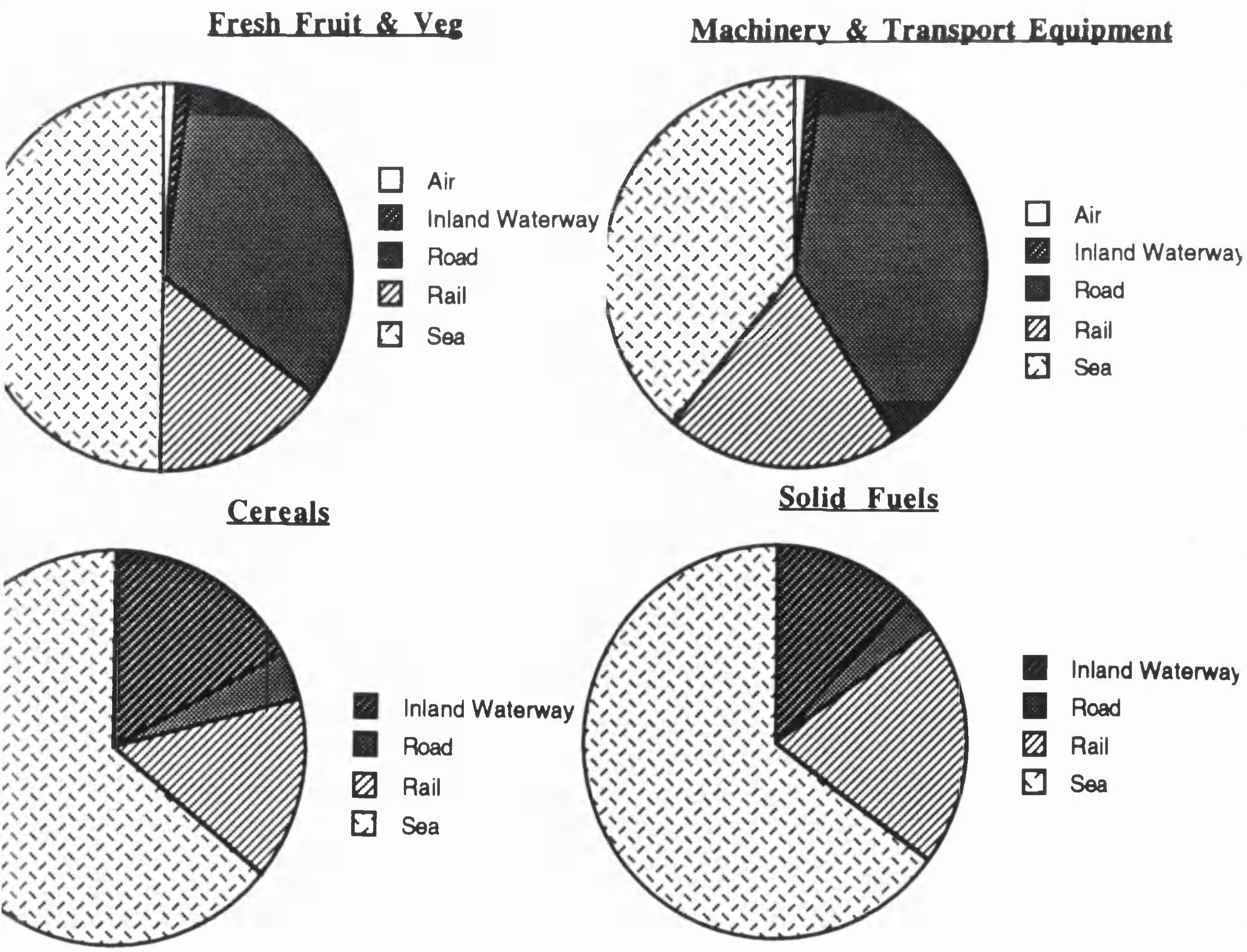


Figure 2.3
Trade Share Group of World Exports

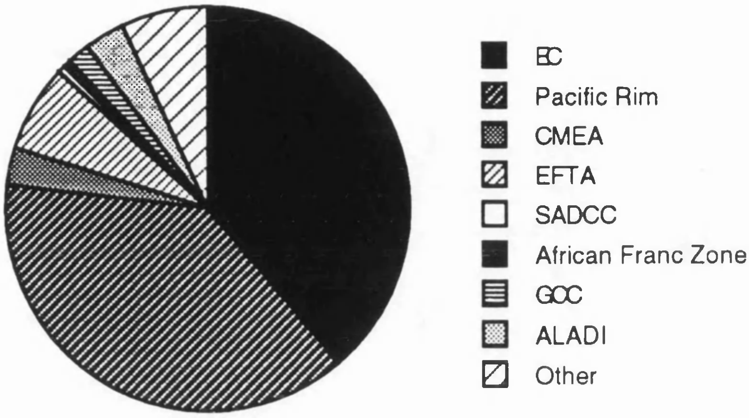


Figure 2.4
GDP by Economic Grouping

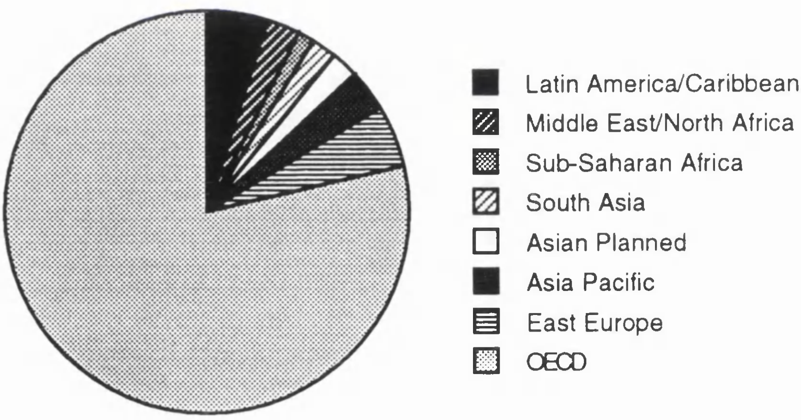


Figure 2.5
Per Capita GDP by Economic Grouping

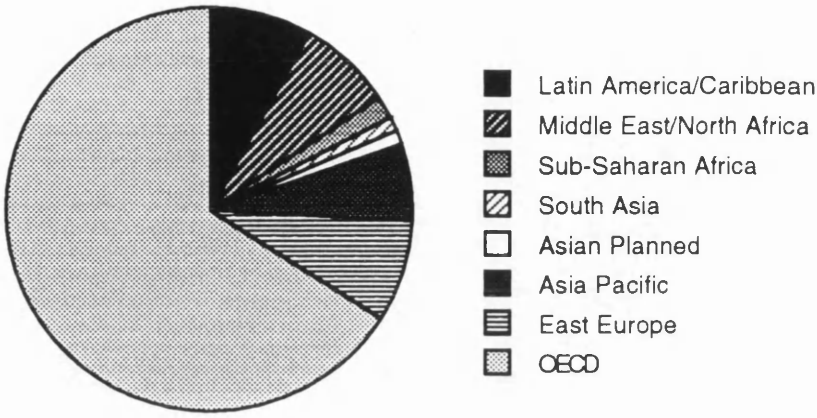


Figure2.6
Top 53 National Gross Domestic Products

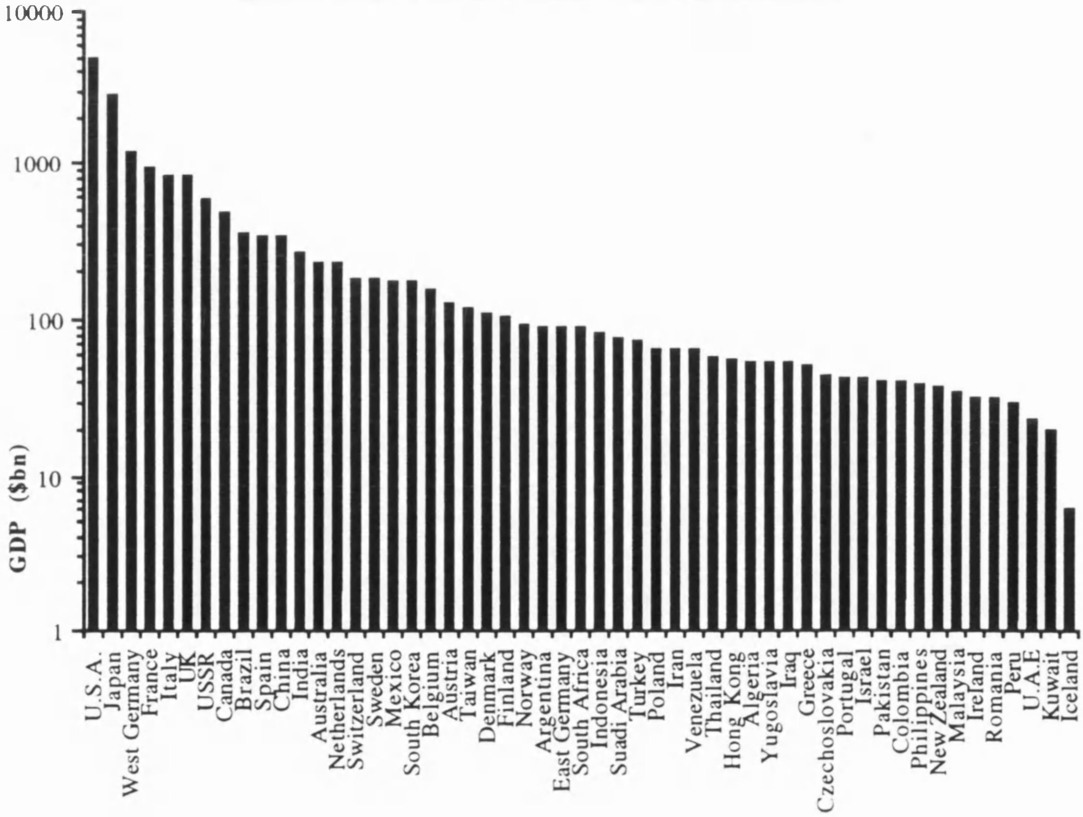


Figure 2.7
Relative per capita GDP

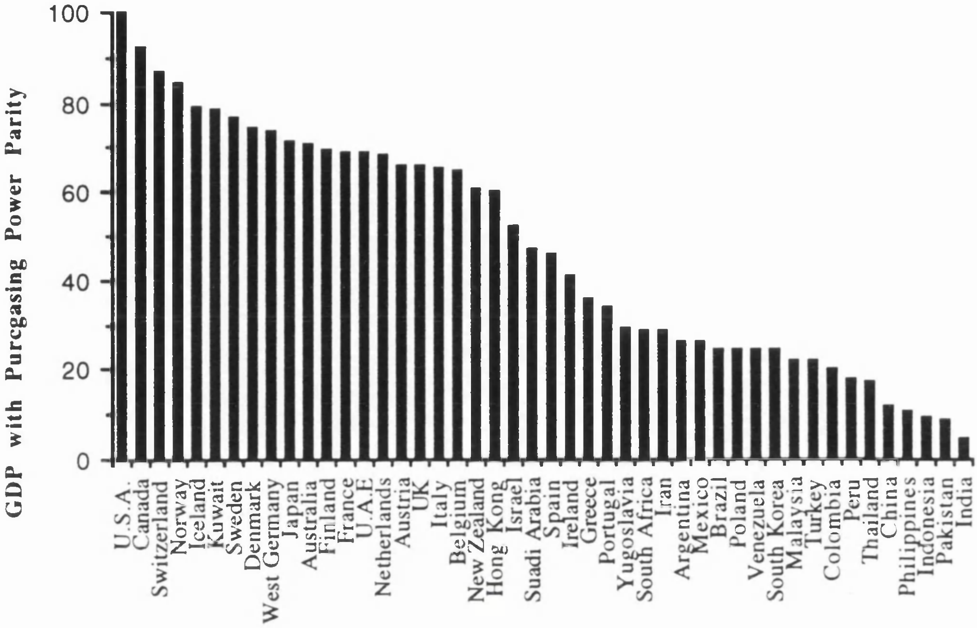
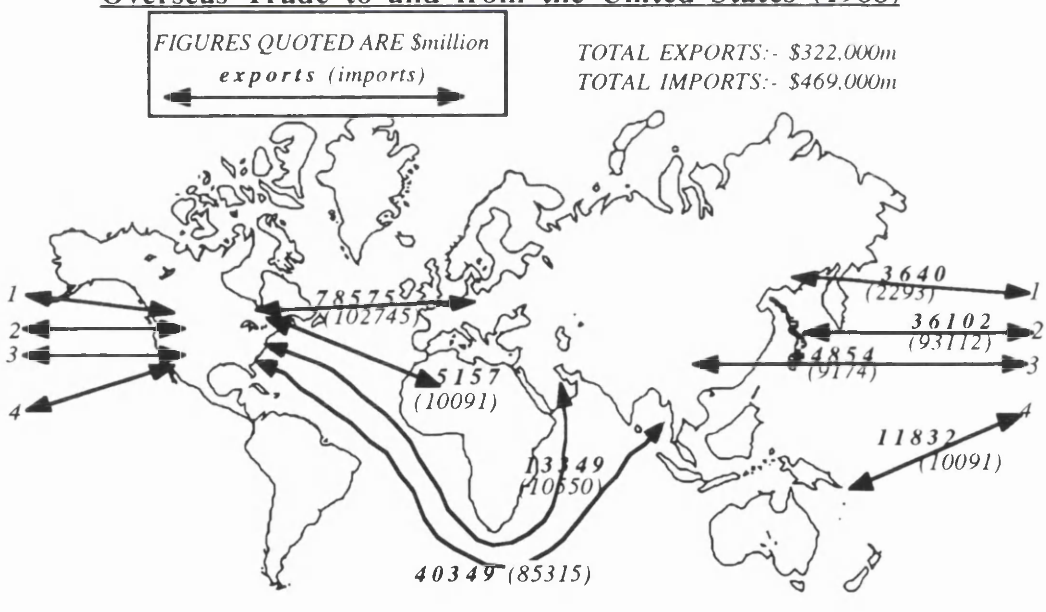
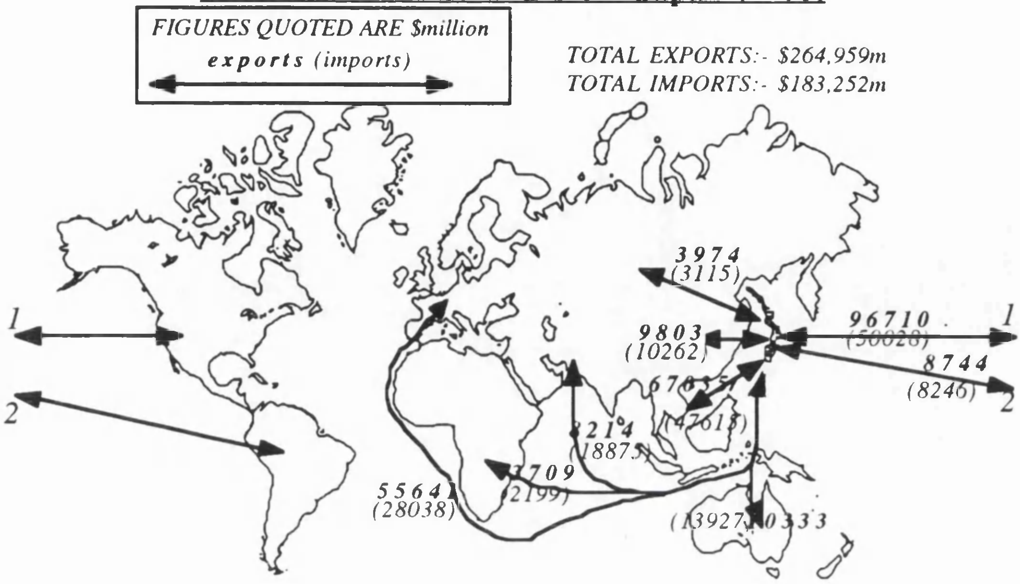


Figure 2.8
Overseas Trade to and from the United States (1988)



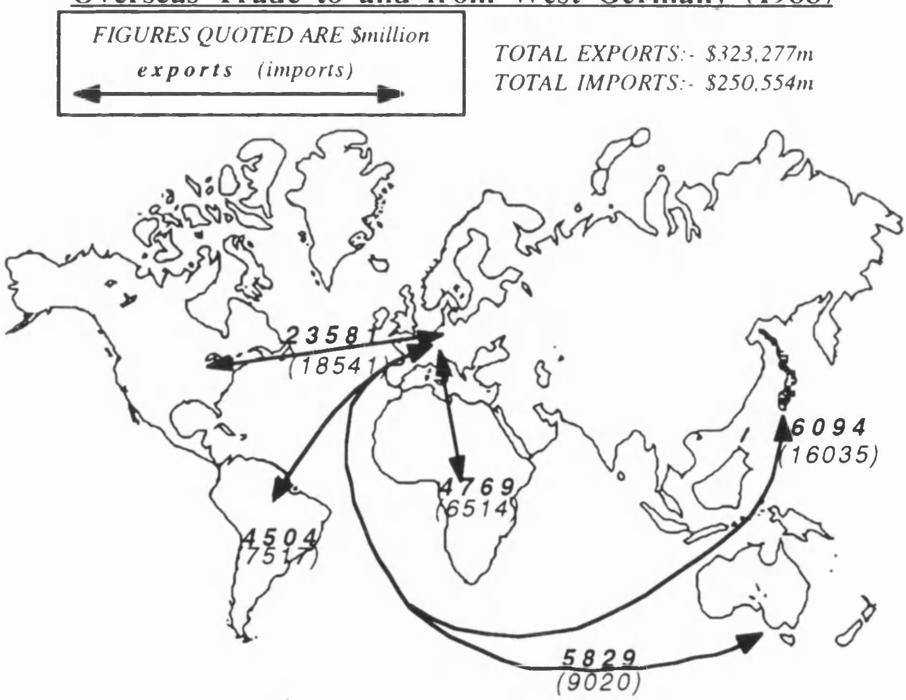
(1988 GDP = $4881billion)

Figure 2.9
Overseas Trade to and from Japan (1988)



(1988 GDP = $2860billion)

Figure 2.10
Overseas Trade to and from West Germany (1988)

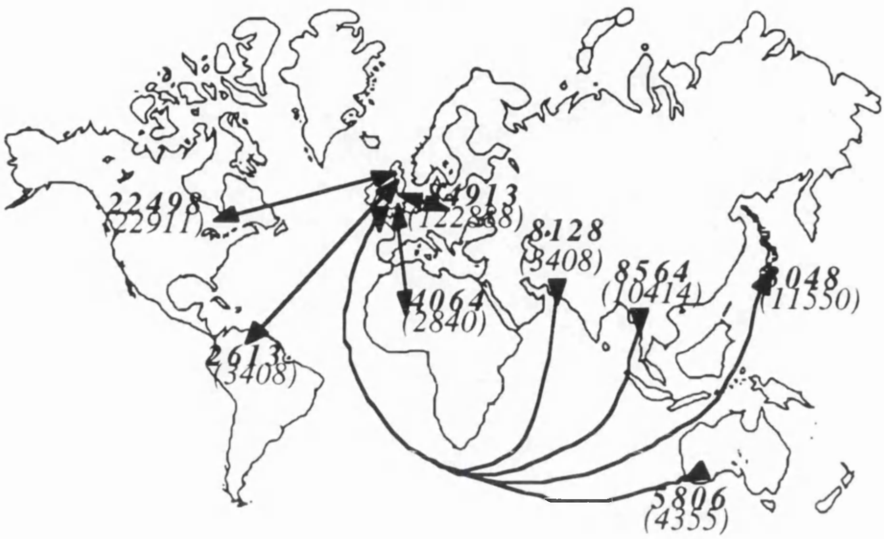


(1988 GDP = $1208 billion)

<u>**Figure 2.11**</u>

<u>**Overseas Trade to and from the United Kingdom (1988)**</u>

FIGURES QUOTED ARE $million *exports (imports)*	TOTAL EXPORTS:- $145,151m TOTAL IMPORTS:- $189,349m

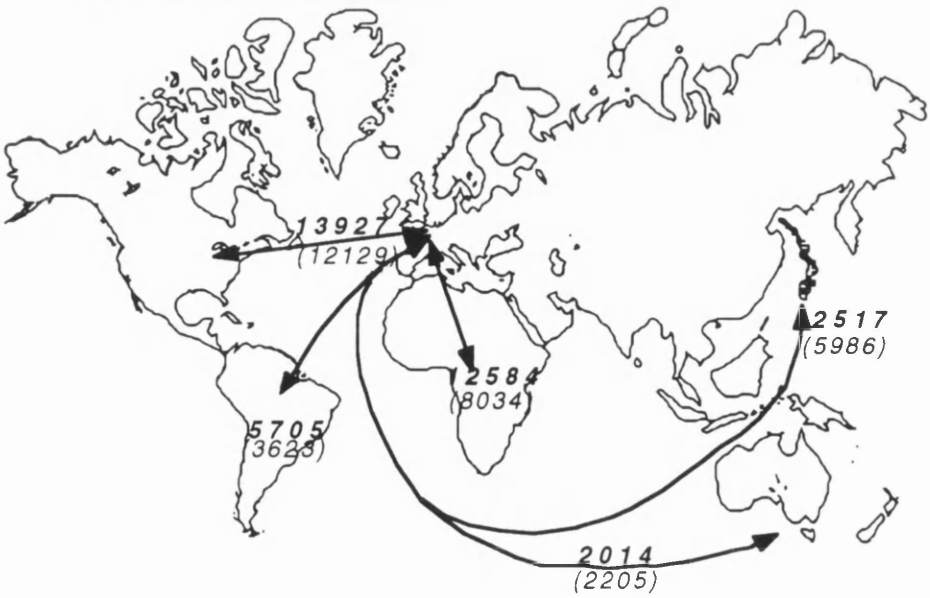


(1988 GDP = $826billion)

<u>**Figure 2.12**</u>

<u>**Overseas Trade to and from France (1988)**</u>

FIGURES QUOTED ARE $million *exports (imports)*	TOTAL EXPORTS:- $167,792m TOTAL IMPORTS:- $157,524m

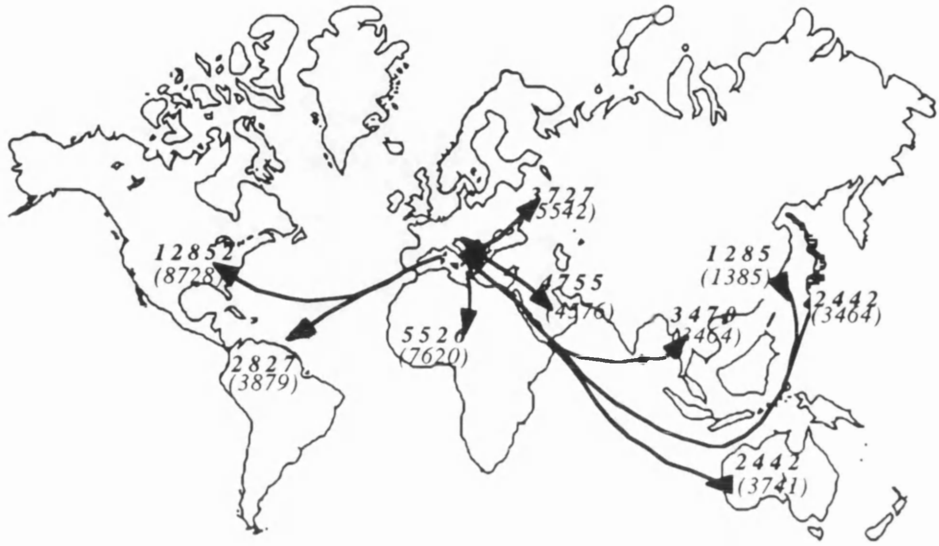


(1988 GDP = $950billion)

Figure 2.13
Overseas Trade to and from Italy

FIGURES QUOTED ARE $million
exports *(imports)*

TOTAL EXPORTS:- $128,516m
TOTAL IMPORTS:- $138,547m



(1988 GDP = $829 billion)

Figure 2.14
Overseas Trade to and from Canada (1988)

FIGURES QUOTED ARE $million
exports *(imports)*

TOTAL EXPORTS:- $112,683m
TOTAL IMPORTS:- $86,810m

(1988 GDP = 489 billion)

Figure 2.15
Worldwide TEU Deployment

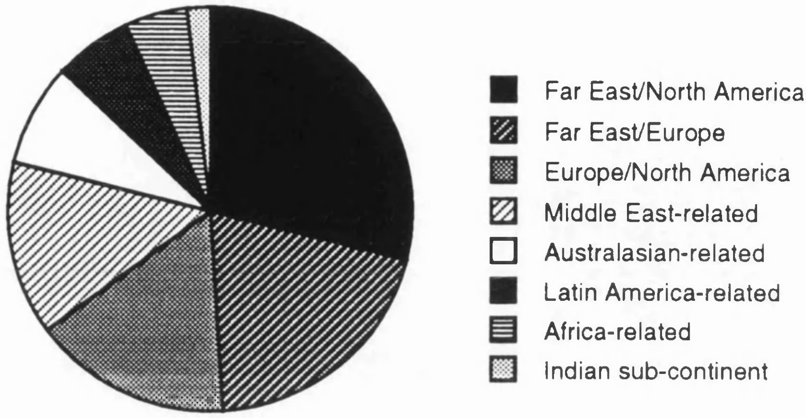


Figure 2.16
Worlds Top Ten Airfreight Routes

ROUTE KEY:

1. Tokyo - New York	6. Frankfurt - New York
2. Tokyo - San Francisco	7. London - New York
3. Tokyo - Los Angeles	8. Tokyo - Seoul
4. Tokyo - Taipei	9. Hong Kong - Bamgkok
5. Hong Kong - Taipei	10. Paris - New York

Figure 2.17
Intra-Group Trade

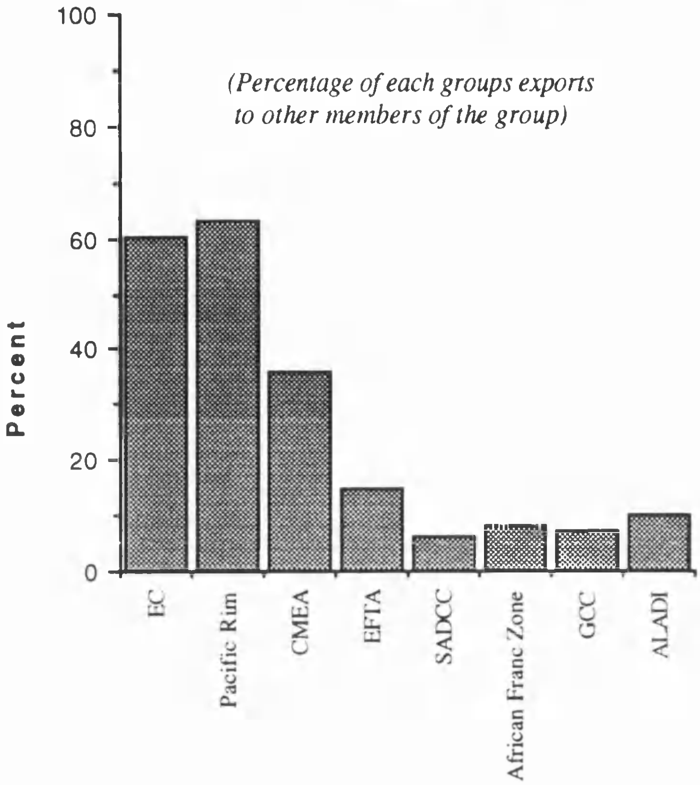


Table 2.1
Summary of Applicability of Each Transport Mode

Mode	Costs	Distance	Typical Goods	Advant-ages	Drawb-acks
Railway	Capital intensive: large initial investment. Viability depends on utilisation. High terminal costs	Increasing effectivenes s with journey length. Large shipments cheaper by long or short haul.	Minerals; unprocessed agricultural products; building materials; chemicals	Large volumes of bulk goods in relatively short time at low costs	Cost and time of assembling units
Waterways	Investment low, except wher canals etc required.	Increasing effectivenes s with length of haul.	Semi-finished and finished products; bulk raw goods - coal, oil, grain, cement.	Low freight rates; slow speed.	Slow speed
Motor Transport	Fixed costs negligible. Operates on small margins - operating costs high; vehicle turnover high.	Short haul, less costly than train. Wide area coverage	Perishable goods; lumber.	Light loads, short distances, short times. Flexible and convenient. Minimises distribution costs.	Small shipment size. High unit cost for long hauls. High vehicle operating costs.
Air Transport	Fixed costs low; investment in stock very high. Terminal, take-off costs high.	Long hauls, economy with distance.	Passengers dominant. Perishable, lightweight, high-value goods.	Speed.	Very high costs.

Table 2.2
Comparison of Export / GDP Ratio

COUNTRY	Exprts/ GDP %	COUNTRY	Exprts/ GDP %
U.S.A.	6.60	South Korea	35.50
Japan	9.26	Belgium	60.64
West Germany	26.76	Austria	24.47
France	17.66	Taiwan	50.84
Italy	15.33	Denmark	25.13
UK	17.57	Finland	21.10
USSR	18.96	Norway	24.74
Canada	23.08	South Africa	14.84
Brazil	9.54	Argentina	10.38
Spain	11.85	East Germany	36.60
India	4.96	Indonesia	23.15
Australia	14.05	Suadi Arabia	31.65
Netherlands	45.42	Turkey	16.12
Switzerland	27.64	Poland	21.47
Sweden	27.87	Venezuela	13.24
Mexico	11.87	Iraq	17.36

Table 2.3
Comparison of Container Cargo Volume on Selected Routes

ROUTE	DISTANCE (Nm)	Tons/pa (million)	Ship Rate $/tonne	Indicative Air Rate $/tonne
USA - N. Asia	5,500	10	167	2,800
USA - S. Asia	6,000	22	167	3,000
USA - N.Europe	3,700	27	158	1,700
USA - S Europe	4,000	12	158	2,000
USA - Germany	3,600	22	158	1,800
USA - UK	3,400	24	158	1,700

Table 2.4
World TEU Traffic 1988

Total TEU's moved = 14,018,000

ROUTE	TEU Deployed	ROUTE	TEU Deployed
ECNA - N.Europe	1,546,000	N.Europe - ECNA	1,398,000
WCNA - Japan	3,647,000	Japan - WCNA	3,882,000

Table 2.5
World's Ten Top Airfreight Routes

ROUTE	Air Freight Tons/year	ROUTE	Air Freight Tons/year
Tokyo - New York	142286	Frankfurt - New York	94148
Tokyo - San Franisco	115752	London - New York	91830
Tokyo - Los Angeles	106873	Tokyo - Seoul	86501
Tokyo - Taipei	102237	Hong Kong - Bangkok	80462
Hong Kong - Taipei	100643	Paris - New York	67592

Chapter 3

ADVANCED MARINE VEHICLE TECHNOLOGY

General Comments

The aim of this Chapter is simply to give the reader a 'feel' for what is currently happening in the Advanced Marine Vehicle market, in respect of applying the technology to high speed cargo shipping. It is important to grasp how far the technology has developed, what problems have yet to be overcome and how much potential remains to be exploited; it is also important to understand what vessel types have proven most successful and why. Such considerations will serve as a prelude to the following Chapter, which seeks to derive preliminary designs for economic case studies.

Chapter 1 touched on the variety of concepts which could be described as Advanced Marine Vehicles. This Chapter will focus on the most common vessel types, those which are most likely to be found operating commercially - Catamaran's, SWATH's, Air Cushion Vehicles,Surface Effect Ships and Hydrofoils - describing the principles underlying each concept and discussing their inherent advantages and disadvantages. Some promising new concepts will also be examined, although it is unlikely that such developments will bear fruit in the short term. However, such technology improvements need to be considered in later chapter's when longer term prospects are assessed.

It needs to be emphasised that the discussions of this Chapter are intended to provide a 'taste' of the Advanced Marine Vehicle market, and not a lengthy technical discourse on the history of development nor the operating characteristics of each concept. Such topics are amply covered in the literature, and readers are especially recommended to consult Reference 20 which is particularly comprehensive in its treatment of the most common AMV's.

Before proceeding to discuss individual vessel types, some general interest observations can be made regarding AMV's collectively, so that each type may be viewed in perspective. Figure 3.1 shows the number of company's operating high speed ships by vessel type - this chart does not distinguish between operators of large or small fleets, but nevertheless it indicates the relative popularity of each concept. It is especially interesting to note that only Catamaran's, Surface Effect Ship's and SWATH's (albeit only marginally) increased market penetration between 1988 and 1990. Could the air cushion vehicle and the hydrofoil now be losing favour? This trend is perhaps confirmed in Figure 3.2, which shows the number of builders active in producing each type, although there is no distinction between those having built in quantity and company's perhaps having nothing more than a 'construction licence' from the designer.

Deliveries and orders-outstanding-at-year-end are illustrated in Figures 3.3 and 3.4 respectively, which shows more explicitly the favoured position of the catamaran and to a lesser extent the surface effect ship. Note the discrepancy between the number of vessels on order at the end of the year and the number delivered throughout the following year, where less are actually delivered than were on order! This can be due to a number of reasons such as contract cancellation or overstated data. For SES's however, deliveries have not matched orders because in many case the vessels under construction (on order) were intended as demonstrators or prototypes, and so were never actually commissioned by operators (deliveries). This highlights the relative immaturity of SES technology in comparison to the catamaran; it also clearly demonstrates the faith which builders have in the potential of these craft.

It should also be noted that the SES data in Figures 3.3 and 3.4 exclude vessels built and operated in the USSR, a country which has many such vehicles working as passenger ferry's on inland waterways. In addition, the catamaran data includes wavepiercers and foil-assisted catamaran's which, it could be argued, are altogether different concepts. In general, the gap between the number of catamarans and the number of SES's in service appears wider than it actually is, and is narrowing.

Hydrofoils

(a) Design Philosophy

The hydrofoil, like the air cushion vehicle, seeks to remove the vessel from the air/water interface completely; in this instance, hydrodynamic lift is used in place of aerostatic lift. A hydrofoil is fitted with underwater "wings", which generate sufficient lift at forward speeds to lift the hull fully out of the water. This means that the total resistance is derived solely from air resistance and foil drag (with some contribution from spray acting on the main hull). The resulting low wavemaking drag thereby allows very high speed/length ratios to be achieved. In fact, in calm water conditions, the hydrofoil is almost the perfect vehicle for high speed ferries (Reference 21) - fixed foils would be possible which are straightforward and cost effective and once foilborne power demand rises very little as speed increases. However, performance in a seaway demands sophisticated ride control systems and safety measure which are expensive in capital and maintenance costs.

There are two main types of hydrofoil, those with fully submerged foils, and the more conventional type with surface piercing foil systems, see Figure 3.5. The latter type offer inherent stability, since by heeling and submerging the foil more on one side, a restoring force is generated due to greater lift on that side. With fully submerged foil systems, a sophisticated ride control system is necessary to ensure satisfactory motion.

Hydrofoils generally operate with foils having an aspect ratio of about 4 - higher ratios tend to make control settings difficult because the slope of the lift force curve increases with increasing aspect ratio - thus for a given change in effective angle of attack, the high aspect ratio foil produces a greater change in lift than the low aspect ratio foil, which is more difficult for the ride control system to react against.

The hydrofoil is the most mature of all AMV's, which implies that further development is unlikely to be dramatic.

(b) Advantages and Disadvantages

The hydrofoil is capable of achieving very high speeds relative to its length, and in low seastates will suffer very little speed loss in waves. In fact for small seastates the ride is very comfortable even at high speed, due to the vessel being lifted clear of the waves. It is a highly manoeuvrable craft at high speed, which makes it ideal for operating in coastal waters and some inland waterways. The achievable power/weight ratios are most attractive in the 30 - 45 knot speed range.

The biggest drawback of hydrofoils is their weight limitation - this is due to the 'cube rule', whereby the displacement increases with the cube of the linear dimension, with the lift capacity at a given speed increasing only with the square of the linear dimension (due to foil plan area). Thus, for a hydrofoil scaled geometrically from say 50m to 100m, the weight will increase by a factor of 8, but the foil area will increase only by a factor of 4. To achieve sufficient lift on the larger vessel, either double the number of foils would be required, or a higher speed would be necessary. There are clear limits on the number of foils which can be fitted, and the speed is effectively restricted by the effects of cavitation; for normal foil geometery's, cavitation becomes unacceptable above 50 - 55 knots which means that large vessels would find it very difficult to generate sufficient lift. Some research has been conducted into developing supercavitating or transcavitating foils, and although these do offer the capability of operating at higher speeds their lift capacity is much reduced to the point of being uneconomic in most circumstances.

Hydrofoils have met with mixed success in commercial operation; the high complexity of auxiliary systems (ride control, propulsion, foils) is costly to acquire and maintain, and the long struts limits harbour operations unless they are fully retractable which again raises costs. Also, foilborne operations are limited to seas where the waveheight is less than the strut height, which makes hydrofoils suitable for coastal waters, but not open ocean operation.

(c) Comments

The first successful 'flight' took place in 1953 on Lake Maggiore in Italy, with a vessel developed by Baron Hans von Schertel. Designated the Supramar PT10, the craft was capable of carrying 30 passengers and halved the journey time of conventional ferries operating the same route. This paved the way for a period of growth, which although not spectacular, nevertheless resulted in considerable development, mostly in Italy, to make the hydrofoil the high speed ship of the 1960's and early 1970's.

The hydrofoil is the most developed of all the advanced marine concepts, a process which was led initially by military who have now virtually given up deploying the form. They are now operated commercially in a variety of locations, and with varying degrees of success, but most notably have enjoyed something of a resurgence in popularity amongst the Japanese. Kawasaki Ship Group have recently become licensees to build the American 'Boeing Jetfoil', a fully submerged type hydrofoil with excellent ride control and manoeuvrability. Kawasaki originally estimated a market of around 20 vessels per year in Japan, and consequently planned production for 2 vessels per year to take place over a ten year period. However, the level of orders since introducing the build capability has now indicated a demand for 30 vessels in the market.

It is also of interest to note that when Boeing marketed the vessels as their own, the cost to Japanese companies would have been around 4 billion yen; Kawasaki now offer similar packages for around 3 billion yen (partly due to the effects of currency fluctuations but nevertheless a very significant price differential). When Kawasaki introduced the vessel, there was a marked reluctance from operators to put the hydrofoil into service. This was countered by some aggressive marketing by Kawasaki, who gathered extensive environmental data on actual and potential routes, enabling them to convince operators that a Jetfoil could be operated successfully.

The question of the maximum possible size of hydrofoil has arisen many times over the years, and is a difficult question to answer. What may be technically feasible is not necessarily economically or practically possible. For instance, although design studies have shown 2000t to be feasible, perhaps as big as 3000t, (Reference 20), the largest craft ever commissioned, a Russian Military Patrol Craft, has a displacement of only 400 tonnes (Reference 22); the largest vessel in commercial operation is less than half this size. It would appear that the risk involved in developing larger hydrofoils effectively forces potential operators to find alternative solutions.

The Catamaran

(i) Design Philosophy

The Catamaran is designed on a very straightforward principle - to achieve high speed, it is necessary to either overcome the wavemaking hump or at least shift it to a higher froude number. A catamaran will achieve high Froude No's by shifting the wavemaking hump, which is made possible by the use of high length-to-beam ratio sidehulls. [A single high L/B hull, while requiring relatively low power at high speeds, will suffer from insufficient transverse stability. Two hulls joined rigidly together generate high restoring moments giving excellent transverse stability yet still allowing high Froude Nos to be achieved].

Some catamaran's have been built with asymmetric sidehulls, which gives improved propulsion characteristics and will tend to reduce sidehull interference resistance at relatively low speeds. However, they do suffer increased form resistance and are useful primarily when the overall beam needs to be restricted to maximise hull separation. For high speed operation symmetrical hulls of the semi-planing or planing type have to be used to reduce wetted surface area so that frictional as well as wavemaking resistance is minimised.

It should be noted that an inherent feature of the catamaran and any other twin-hulled vessel is a large, useable deck area. Where such a platform is required irrespective of speed specifications then a catamaran would be a prime contender for the role.

In recent years, a novel variation to the simple catamaran has emerged in the form of the "wavepiercer", a concept first introduced in Australia. A snapshot of one of the early wavepiercer's is shown in Figure 3.6. The wavepiercer is characterised by very long sidehulls, longer than the conventional catamaran, and they are designed to have almost negligible freeboard. The sharp bow on each sidehull is designed to cut through oncoming waves and the reduction in buoyancy forward inhibits pitching in a seaway. The minimal reserve buoyancy supposedly allows the craft to "ride" the waves (Reference 23); however, vessel motions are not induced because of substantial reserve buoyancy, but because the wave imparts forces to the hull from the variation in pressure and velocity of the water particles; minimising freeboard should do little to mitigate against the forces from the waves.

The wavepiercing form is also strikingly different from normal catamaran's in that it has a centre 'bow', which travels out of the water in low seastates. In higher seas, the bow provides a pitch correction moment and helps to reduce the effects of plough in if the vessel surfs in following seas.

(b) Advantages and Disadvantages

The main advantage of the catamaran is the capability of high speed coupled with low investment cost. The form is relatively straightforward, with few, if any complicating features. Other advantages include a large deck area, shallow draught, and good manoeuvrability at low speeds due to differential propeller thrust. Also, because the machinery is positioned in the sidehulls, away from the payload which is carried on the deck platform, the associated noise and vibration can be removed from passengers in the role of a ferry.

As for disadvantages, the catamaran, like planing or semi-planing monohulls, are essentially calm water craft. The hulls are designed to achieve speed under the action of dynamic lift forces which are difficult to generate in a steady manner in waves. As a result, catamaran's suffer from poor seakeeping and so are confined to operating in restricted water if high speeds need to be maintained. The ride can be uncomfortable if the vessel 'corkscrews', a motion of combined heave, roll and pitch. However, some catamaran's are now being fitted with ride control systems which use active fin stabilisers which reportedly achieve substantial improvements in ride quality (Reference 24).

Although the catamaran has 'good' transverse stability in the sense of preventing capsize, the high restoring capability makes them very stiff in roll. This means that the roll amplitudes are small but the oscillations are of high frequency and consequently high accelerations. This is uncomfortable for passengers and may cause damage to cargo.

(c) Comments

The vast majority of in-service catamaran's are around 40m in size, with speeds in the range 30-40knots. Speeds above 40knots tend not to be considered for the catamaran, since the power demands start to climb rapidly above a certain Froude No. like any displacement form. However, a long vessel may be capable of such speeds since the speed/length ratio is reduced.

The largest commercial fast ferry in service at the present time is a catamaran, of the wavepiercer form. Six 74m International Wavepiercing Catamaran's have been commissioned in the last 2 years, all of them now operated by UK companies (five by Sea Containers Ltd with the most recent craft commissioned by Condor UK Ltd). These vessels travel at approximately 35knots, carry 450 passenger's and 84 cars, and displace around 750tonnes. Power is supplied by four Ruston 3,600kw medium speed diesel engines, giving a combined output of 14.4mW. The first 74m wavepiercer, *Hoverspeed Great Britain*, entered service following a blaze of publicity after recapturing the Hales Blue Riband Trophy for the UK, having beaten the previous fastest North Atlantic crossing for a passenger ferry. However, it soon attracted a different kind of publicity when high passenger seasickness rates were reported in the national media (Reference 25). The designer's now report that such problems were due to operating with the wrong trim and have largely been overcome (Reference 26).

Although these 74m wavepiercers are the biggest catamaran's in service, several larger ones have been designed, both conventional and wavepiercing. KMV Westamarin of Norway offer a 120m, 2000t *Ocean Flyer* which would carry 1200 passengers and 275 cars; INCAT Designs Pty of Australia have a 115m variant of their wavepiercer, which will take 1100 passengers and 340 cars with a maximum speed of around 40knots from a power of 30.5MW; Advanced Multihull Designs, another Australian company, also offer wavepiercing designs, with their largest being the AMD2000 hull at 92m length overall. This vessel is designed to carry 874 passengers and 196 cars (or 10 buses and 149 cars); powered by two Rolls Royce SM1C gas turbines rated at 16850kW each, the service speed is 40knots.

Although catamaran's are the most common high speed vessel, and many technical papers have covered their design, development and performance prediction, the same cannot be said for wavepiercers. In particular no test data is available in the literature to confirm their ability to 'ride the waves'; similarly, no results from loading or structural analysis have been published. This deficiency needs to be overcome before any confidence can be placed in their capability to operate long term in a seaway.

Why have catamaran's proven so popular with the operators? In strict technical terms they aren't very sophisticated vessels and have many ride problems associated with them. However, precisely because they are unsophisticated the risk associated with the investment is lower than for more technically advanced vessels, and this obviously has attractions for operators. Ambitious technical developments can often be derailed by the prevalence of cautious operators, a fact which should weigh heavily in any thoughts of designing radical solutions!

The Air Cushion Vehicle

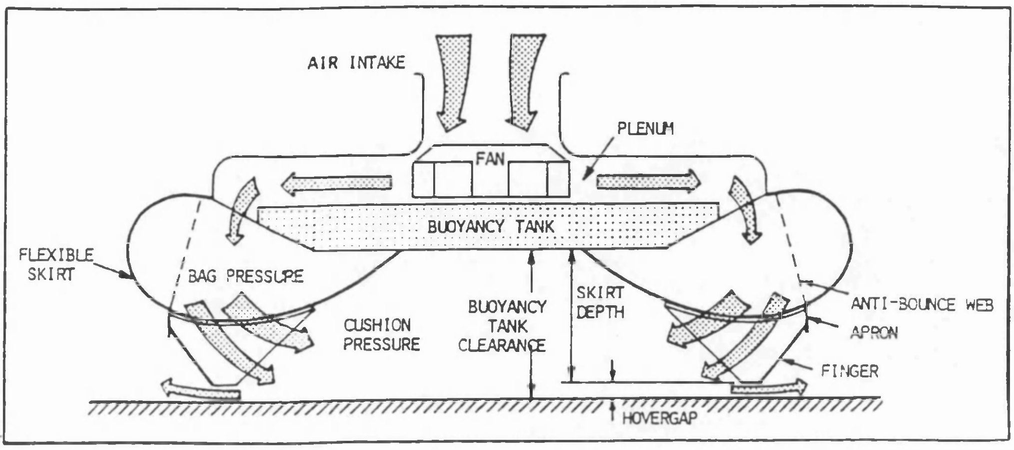
(a) Design Philosophy

The Air Cushion Vehicle is supported entirely by a high pressure cushion of air, which lifts the platform above the water surface. The objective of doing so is to remove the vessel completely from the air/water interface to minimise the wavemaking potential, and thus allow travel at the highest possible forward speed.

The operating principle relies on a constant air flow between the vehicle and water surface to maintain constant pressure in the cushion. The air cushion is retained by an assembly of flexible skirts, which allow air leakage as illustrated in the sketch below, using either an annular (peripheral) jet or a plenum chamber. Typical values of overpressure are within the range 150 - 500 Pa, with the lower values giving a softer but not necessarily more comfortable ride.

Typical Air Cushion Vehicle Arrangement

(Taken from Reference 21)



Thrust is almost invariably supplied by air propellers driven mostly by gas turbines, although other combinations have been tried. Recent commercial vehicles have tended towards operating on medium-high speed diesels to achieve cost savings, and their have been some attempts to develop drive trains using conventional marine propulsors, without much success.

The history of the development of the air cushion vehicle is well documented in References 20 and 21.

(b) *Advantages and Disadvantages*

There is no doubt that the ACV offers the highest speed potential of all the advanced marine vehicle concepts. Combined with this high speed are some unique advantages which have made the ACV attractive to many potential users - a zero draught makes it the prime choice for operating in shallow water, and also the amphibious capability makes it a multi-terrain vehicle ideally suited to regions of ice hazards, or for landing on beaches to minimise terminal development costs (potentially attractive in undeveloped regions). The payload fraction can also be quite high, which can offer the ACV an advantage over some other advanced marine vehicles. It is also worth noting that instead of a high speed capability, the ACV could achieve a given operating speed with less installed power than other competing vehicles.

These advantages combine to make the ACV an attractive option in certain circumstances, but it has to be said that these tend to be rather limited and generally unprofitable. The high speed and amphibious capability are very expensive to acquire and operate, due mainly to the flexible skirt system which must be fitted. The overriding need to minimise weight necessitates the use of high technology, expensive lightweight components. Sophisticated ride control systems are also generally required because the craft has inadequate inherent stability, and these are also expensive.

However, arguably the greatest disadvantages of the ACV in the context of potential cargo operations, are the dramatic reduction in performance when operating in a seaway, which effectively places limitations in the size of vessel. Firstly, since the weight (or displacement) increases as the cube of the linear dimension, and the cushion area as the square, the relative cushion pressure must be greater on larger vessels; this demands minimum air loss through leakage. However, with an ACV operating in an open sea environment with considerable waves, the induced motions cause considerable escape of air from the cushion which makes high cushion pressures difficult to achieve. These factors combine to place a limit on the size of ACV which is potentially feasible (perhaps a development limit of 1000t), and thus the restricted payload capability would make it impossible to achieve the economies of scale necessary to compete effectively with air transport. Also note that the air loss when operating in a seaway results in slamming of the rigid platform, which necessitates a reduction in speed. In fact, the speed loss in a seaway of an ACV is the most dramatic deterioration of all advanced marine vehicles.

The current skirt systems in operation are very expensive to maintain and have very short lives - a bag may last 3000 operating hours, whereas a skirt finger would probably need replacing every 400 operating hours. The air cushion vehicle generates considerable spray, which can cause extensive damage to the air propellers, and also to the engines unless elaborate filtration systems are used.

These discussion can be summarised by describing the ACV as being suitable not for long range, cruise forms of transport, but rather as a reasonably efficient short/medium range highly mobile and flexible amphibious system with a considerable work capacity.

(c) Comments

The first commercial hovercraft was the SRN Mk I (built by the British Hovercraft Corporation) service introduced on the English Channel in 1968. High fares tended to discourage passengers, however, and a failure to maintain schedules cancelled out the speed advantage and caused a drop in confidence. Also, an inability to operate at a profit destroyed the early interest shown by ferry operators.

Although never having fulfilled its initial potential, development of the craft has continued over the years, resulting in larger and more efficient vessels, with the SRN Mk III capable of carrying a payload of 90 tons. However, there appears to be limited scope for wider use, as very few commercial operators would consider investing in a new service due to high operating costs. Their future role, if any does exist, seems restricted to military operations which may derive some advantage from the unique amphibious capability.

The Surface Effect Ship

(a) Design Philosophy

A surface-effect-ship (SES) is essentially a cross between a Catamaran and an Air Cushion Vehicle. The slender twin hulls provide partial buoyancy , but the main support during transit (approximately 80% displacement) is provided by a pressurised air cushion. The air is retained by the sidehulls and fore & aft flexible seals, with the seals able to follow the wave contours in a seaway to minimise air loss. Figure 3.7 shows a typical SES configuration.

The principle objectives of an SES design are twofold:

(i) to require lower total power requirements compared to a catamaran of similar mission - this means that the saving in propulsion power due to the reduced draft must outweigh the power necessary to generate the aerostatic lift.

(ii) to offer operational advantages compared to a conventional air cushion vehicle - such as reduced air leakage, lower operating costs due to smaller seals and the provision of inherent longitudinal and transverse stability from the sidehulls.

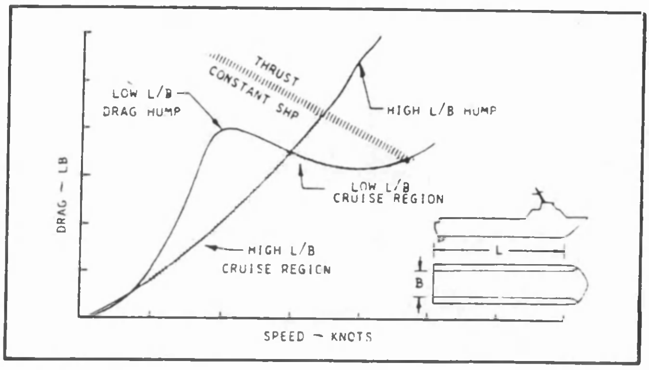
The air supply for the support cushion can also double as a ride control system. This uses variable flow fans to allow pressure fluctuations, in conjunction with regulating valves which open and close as required.

The main concept research for the SES occurred in the 1960's, which was followed by an intensive effort, led by the USA, to develop the technology in the 1970's. This produced several operational craft, both military and commercial. However, in the early 1980's a significant development occurred with the distinction between high and low Length-to-Beam ratio vessels. Early SES's were invariably of low L/B which was necessary to fulfil the promise of very high speeds, but which also demanded sufficient power and thrust to overcome a large primary cushion wavemaking hump. Theoretical and experimental research (References 27 & 28) suggested that an increase in the L/B ratio reduced the wavemaking hump, but also increased the wavemaking resistance at higher Froude Nos.

Typical total resistance curves for each type are shown below, which indicates the operating region of each type. Note how the available thrust has to be balanced with the power demand - care is required to ensure that sufficient thrust is available to power through the primatry wavemaking hump.

SES Typical Total Resistance Curves

(Taken from Reference 29)



This feature of SES operations was demonstrated most remarkably by the US Navy Sea Systems Command (NAVSEA) in the early 1980's (Reference 29). In its SES-200 test programme, a low L/B SES was purchased and a 50ft section inserted amidships to increase the ratio from 2.65 to 4.25, without any alterations to power plant, lift fans or other machinery. The new, high L/B vessel was 65tons heavier than the original (an increase of 45%) and yet throughout the speed range it consumed much less power than the original vessel (the low L/B craft had a higher total speed by about 3knots).

This was because the primary hump for the original vessel was around 20knots, which was well within the operating envelope, but with the new section added the primary hump shifted to 33knots which was outwith the operating envelope of both ships. This highlights the care which must be exercised when developing an SES design, where due regard must be given to balancing the selected dimensions with the operating profile.

(b) Advantages and Disadvantages

The main advantages of the surface effect ship are the low power requirements of the air cushion vehicle combined with the stability and the low(er) operating costs of the catamaran. The concept offers a wide design range, anything up to 100knots being possible for the low L/B form.

In common with most twin hulled vessels, the SES benefits from differential propeller thrust which gives excellent manoeuvrability at slow speeds. This, combined with the shallow draft, makes harbour navigation reasonably straightforward.

The SES possesses relatively good seakeeping, in comparison to other high speed vessels, because the air cushion acts as a motion damper as well as allowing an active ride control system as discussed earlier.

Amongst the disadvantages of this type of vessel, is a tendency to be weight sensitive, particularly the low L/B variety which need to power through the hump, and there is a risk that if the vessel exceeds the design displacement there may be insufficient thrust to achieve this. There is also a need for trim control while cushionborne, which may demand a reasonably sophisticated ballast system.

Although having relatively good seakeeping characteristics, the SES can give an uncomfortable ride; while the absolute motion displacements and accelerations aren't particularly severe, the oscillations can occur at high frequency which is unpleasant, a phenomenon known as 'the cobblestone effect'. Also, increasing seastate can result in significant degradation of speed, which is due to air loss associated with vessel motions causing an increase in mean draught and consequent increase in total resistance. Roll stability can also present some design problems, since a disturbance from equilibrium creates a destabilising moment due to the redistribution of cushion air as the pressure equalises. The design must have either sufficient buoyant hull stability to overcome this or else a ride control system capable of controlling the pressure on each side.

The use of flexible seals implies high operating costs, since to date none have been designed with material having a sufficently long operating life. They are subjected to high loads and by their nature must deform and so require significant elasticity. Much research has been undertaken into seal manufacture to minimise maintenance costs, and significant progress has been made; however, there is still some way to go to achieve a satisfactory seal life, especially for larger vessels.

(c) Comments

Estimates vary as to the total number of surface effect ships built to date, but a recent comprehensive publication devoted to this type quoted a figure of 297 (Reference 30) taking data from various sources. This would make it comparable to the total number of catamarans, which makes the estimate a little suspect, although the SES is very widely used in the USSR so a large number have certainly seen service.

The largest SES built to date is, in fact, Russian; this is the 650 ton *"Dergach"*, a patrol boat launched in 1987 but not commissioned until 1990. The *"Dergach"* is 64.5m long with a breadth of 17m (L/B=3.8, *almost* 'high'). However, this is set to be dwarfed by a 2000 tonne SES currently under construction at SEC in Italy, a car ferry which is to operate between Italy and Sardinia/Corsica (Reference 30). This vessel has a length of 92m, a breadth of 22.9m (L/B=4.02), and will carry 750 passengers and 180 cars at speeds up to 50knots. Due to be launched in 1993, many observers will watch with interest as this largest ever SES undergoes trials which may well confirm the SES as *the* advanced marine vehicle of the future.

Questions remain, however, as to the maximum size possible for an SES, which may be limited by the cushion pressure required to support them. It is a problem similar to the limit of hydrofoils; the displacement increases with the cube of the linear dimension while the cushion area increases as the square of the linear dimension. This means that the cushion pressure has to increase in proportion with the linear scale factor and a limit may be imposed by the ability of lift fan technology to supply air at the required pressure.

The 2000tonne vessel currently undergoing construction demonstrates the viability of a vessel this size, although there are certain to be unforeseen difficulties associated with the development. Detail design studies have also been carried out which clearly show the feasibility of vessels up to 3000 tonne, the most notable of which was the US Navy's $400m 3KSES programme (Reference 31). This sponsored extensive model tests and performance simulations, and was intended to result in an actual build. Unfortunately, the programme was cancelled in 1979 due to "high cost and perceived risk"; proponents of the programme blamed an inability of the military to place a value on the utility of speed. For a commercial vessel, the value of being able to travel at high speed can be quantified simply by considering relative operating economics.

A recent US Navy study has produced a design with a displacement of almost 20,000 tonne, which is certainly presented as being *technically* feasible (Reference 32). This is described as a fast sealift ship, capable of averaging 55knots in seastate 3 and with a payload of just over 4,500 tonnes. This design has a cushion pressure of approximately $20kn/m^2$, virtually double that required of the small SES's currently in service. This high pressure air is supplied by 8 rotating diffuser type fans driven by two LM-5000 gas turbines which generate a total of 64MW. These fans are reported as being widely used in industry, but would need some development to make them suitable for the marine environment. Thus it can be concluded that teh development of SES designs up to at least 20,000 tonnes could be technically feasible.

The SWATH (Small Waterplane Area Twin Hull)

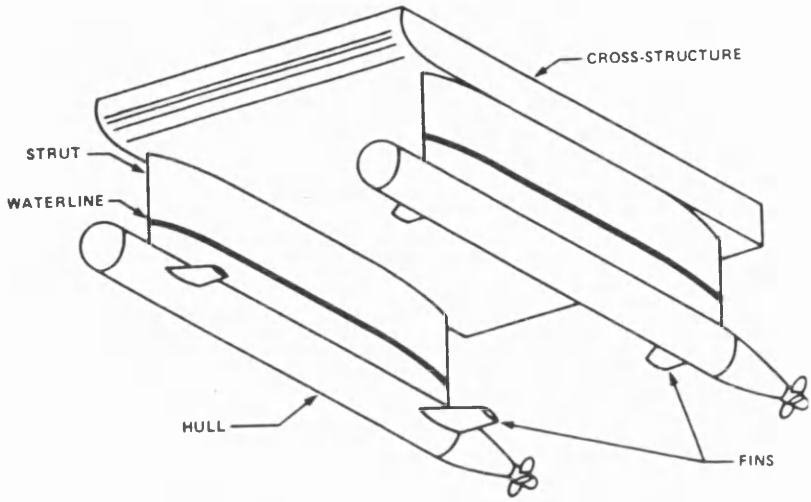
(a) Design Philosophy

The SWATH form has seen arguably the most fundamental research effort of all the possible AMV configurations in the last decade. Some International Conferences have been devoted almost exclusively to this form (References 33 & 34), but the number of commercially operating vehicles remains depressingly low.

The SWATH is a twin hulled vessel, which fundamentally was never envisaged to operate in a high speed role, although many could be regarded as doing so in classical terms (Reference 35). The principle objective of the SWATH is to provide a stable platform in the most severe sea conditions, either to provide comfort for passengers and crew or perhaps as a workbase for research vessels where low motions are vital to a successful mission.

Low motions are achieved by submerging most of the buoyancy at a deep draught; this takes advantage of the characteristic motion of water particles in waves, the magnitude of which decays exponentially with depth. A typical SWATH geometry is shown below:

Typical SWATH Geometry



The pontoons can be circular, elliptical or even rectangular in cross section, and will possess around 80-85 % of the total buoyancy. The remaining 15-20 % is displaced by the thin struts which connect the pontoons to the platform.

Since a SWATH uses thin surface-piercing struts with low waterplane, the inherent stability in pitch and roll is a fraction of that on a monohull of similar displacement. Therefore, the concept is dependent on control surfaces to ensure sufficient stability.

(b) Advantages and Disadvantages

The seakeeping capability of the SWATH has attractions for many applications - passenger ferries to reduce the incidence of seasickness; research vessels which need to acquire data at slow speed and minimise the risk of needing to seek shelter; military vessels required to deploy helicopters in high seas; diver support vessels which must remain on station etc. A general rule of thumb is that a SWATH will possess the seakeeping qualities of a monohull three times the displacement, which should allow platform cost savings.

In addition to greatly reduced motions in a seaway, the SWATH suffers very little speed loss in waves, making it very attractive where schedules must be maintained. It has recently been reported (Reference 36) that certain configurations may even lead to increased speed (or lower power) in waves, due to some complicated hydrodynamic interference effects.

Although seakeeping and the ability to maintain speed make the SWATH a very attractive vessel, there are many design and operational problems associated with the type. Perhaps the most serious is the low payload fraction, typically 10-15% of full load displacement which means low revenue earning capacity relative to size. In addition, because of the low waterplane area, the SWATH is very sensitive to weight growth meaning that even the already low design payload could be reduced when operational. This weight sensitivity also impacts on operations, necessitating a sophisticated ballast/trim control system.

The seakeeping advantage gained by deeply submerging the buoyancy also incurs penalties; principally, the large draught combined with the twin hulls produces a very high wetted surface area which greatly increases resistance. The deep draught also imposes practical limits to operations, restricting the ability to navigate in shallow waters and harbours. This may place a limit on the size of the concept due to the required beam and draught, with 35,000 LT suggested in Reference 20 although this seems a bit too optimistic.

The systems in a SWATH tend to be quite complicated, due to internal volume restrictions. Smaller SWATH's cannot fit machinery in the hulls and need complex drive trains with the engines fitted on deck or in the haunches. If it is possible to install machinery in the hulls, problems could arise when access is required for maintenance, especially if the engines need removed for overhaul or replacement.

(c) Comments

In spite of all the problems discussed above, the recent interest in SWATH's has continued: from 1968 until 1979 only 4 vessels were built, whereas since then more than 18 have been commissioned 9 of which have been delivered in the last 3 years. However, most have been slow speed, with the notable exception of *Patria* and *Seagull 2* both of which achieved 30knots. It was recently reported (Reference 37) that *Patria* exceeded all expectations of performance when undergoing trials.

Some of these SWATH's are large in comparison to other advanced forms. The largest up to 1992 was the 3,700t *Hibiki,*with a length of 64.7m. This year, though, has seen the delivery of *Radisson Diamond,* a 129m cruise vessel built in Finland, with a displacement of 11,740 tonne (Reference 38). However, this is not a high speed vessel, requiring almost 11,400 kW to achieve a service speed of around 12.5 knots

Performance Comparisons

To place the above discussion of the relative advantages of each AMV type in perspective, this section seeks to compare various performance characteristics.

Figure 3.8 emphasises the high speed potential, relative to length, of both hydrofoil and air cushion vehicles. The proposed curve for the Incat Catamarans (Wavepiercers) appear too optimistic and also unfairly demonstrates these as being efficient due to the relatively long sidehulls - in other words the length/displacement ratio for these craft are relatively high so the speed/length ratio used here is higher for a given displacement or payload capacity.

In Figure 3.9, the SES is illustrated as having a clear advantage in transport efficiency over catamarans, hydrofoils and SWATH's. The presentation is significantly unfair with regard to SWATH ships, being for calm water conditions, since in a seaway the catamaran and SES transport efficiency would be considerably reduced.

The superior seakeeping ability of the SWATH is illustrated in Figure 3.10, and to a lesses extent for hydrofoils also. For the SES and ACV curves, it should be remembered that while the percentage speed loss may be higher relative to other craft, the calm water speed is also higher meaning that the speed in a seaway could still be acceptable compared to other vessels.

Figure 3.11 demonstrates the effect of seakeeping in terms of vertical accelerations, which is an important parameter for passenger vessels but less so for cargo ships. The poor performance of the catamaran is typical of the type, although in this case the data is for a small vessel and would be more acceptable for a larger craft.

The cost advantage of low technology platforms is evident from Figure 3.12, although the possibility of using conventional or SWATH ships at speeds above 40knots would be questionable. Figure 3.13 relates relative platform cost to displacement and speed and suggests that a large 50knot SES would be reasonably cost efficient.

The commercial efficiencies of various types, which relates revenue earning potential and operating costs are compared in Figure 3.14, and highlights the price which must be paid for higher speed. Once again the SES appears most efficient although at slow speeds in a seaway the SWATH could be attractive.

Through all of the above comparisons, the surface effect ship is clearly shown to advantage over competitor vehicles, with the exception of seakeeping performance. However, the cost comparisons show that this advantage must be paid for and the essential question is whether vlaue for money would be obtained.

Projected Developments

There is absolutely no doubt that some exciting developments are in progress, and none more so than the Japanese Techno-Superliner project, already mentioned briefly in Chapter 1. This section expands on the objectives of this project and reported progress to date, as well as giving some additional information on some of the other more interesting projects.

(a) Techno-Superliner (Japan)

This program has attracted funding of 10 billion Yen (approximately \$75million), with one third being met by government for early research and the remainder coming from seven of the country's leading industrial organisations (Reference 39- Hitachi Zosen, Ishikawajima-Harima Heavy Industries, Kawasaki heavy Industries, Mitsubishi Heavy Industries, Mitsui Engineering & Shipbuilding Co., NKK Corporation and Sumitomo Heavy Industries. The project was initiated in 1989, with the objective of developing prototypes or large scale models of vessels capable of carrying 1,000t of cargo at 50knots over a journey length of 500Nm. This would be intended to allow fast sea transport of cargo between Japan and Taiwan, Hong Kong and Singapore, as well as allowing the development of some of Japan's lesser populated islands. Predictions of traffic demand vary between 2million and 4.5million tonnes per annum, which is between 7% and 15% of existing freight currently carried by sea and air.

So far, progress reports indicate that two forms have been targeted for further development: TSL-A is a surface effect ship and TSL-F is a combined foil and displacement type hybrid.

(i) TSL-A (from Reference 40)

LOA=	127m	BOA=	27.2	L/B=	4.67
P_S=	73MW	P_L=	13MW	Disp=	3000t
kW/tonne=	28.6	T_{off}=	5m	T_{on}=	1.4m

TSL-A is designed to operate within the limits of existing infrastructure, capable of carrying 150 TEU's. Powering is to be by Gas Turbine driven waterjets. Plans are being made to build a 70m prototype powered by gas turbines at a combined rating of 15370 kW, due for testing in 1994, at an estimated cost of \$53-75 million (Reference 41). Such a large prototype is considered essential due to known difficulties in scaling the performance of air cushion vehicles.

(ii) TSL-F

Dimensions are not yet published for this form, which consists of a torpedo-like lower hull with a sophisticated foil system connected to the main hull by a series of vertical struts (see Figure 3.15). The torpedo hull will provide a fraction of the total lift with the majority coming from the foil system; with such an arrangement, "exceptional seaworthiness" is expected since it combines the best features of SWATH's and Hydrofoil's. A 15m model is planned for completion early in 1996, which will be capable of 40 knots with an installed power of 2,800kW, and at an estimated build cost of Yen 15-25 billion (\$113 - \$188million dollars)(Reference 41)

However, this concept has some serious disadvantages which have not yet been discussed in progress reports:

* the complete lack of inherent stability will place considerable demands on the ride control system.

* it is doubtful if the foil system could generate anywhere near the required lift at the design speed due to cavitation; if more buoyancy were to be provided by the torpedo hull, the wetted surface would increase dramatically to create a higher power demand

*it is reported that a depth alongside of 15m would be required, which cannot be provided with current port facilities in the region; this would necessitate large amounts of capital to be spent upgrading facilities and would push up the required freight rates.

* the structural connections at the struts would be liable to fatigue problems

For both concepts, it has been reported that mid-journey refuelling may be necessary, although it is not clear how much deadweight has been allocated to fuel storage. Also, the 1000t payload is anticipated to be unloaded in one hour.

(ii) Foilcat Development

Various interests in Norway's marine industry have been involved in the world's most significant foil-assisted catamaran project, although organisations from other countries are also active in this promising sector (References 42,43,44) Kvaerner Fjellstrand tested their 9m prototype Foilcat in 1989 reporting trials performance much better than anticipated (Reference 45), with Westamarin completing technical trials of their fulls scale 29m prototype early in 1992 (Reference 46).

The foilcat concept is attractive because it combines the high speed potential of a a planing catamaran with the ride quality of a hydrofoil. However, given that most foilcats rely on raising the craft completely out of the water (eg Kvaerner-Fjellstrand), the question must be asked why use a twin hull rather than a conventional hydrofoil ? The answer appears to be that a twin hull form allows larger foils therefore larger lift so the concept may be capable of being extrapolated to larger sizes. Also, the twin hull configuration would permit easier retraction of foils giving lower construction cost.

A foilcat where the foils provide only partial lift, simply to reduce displacement of the catamaran and thus reduce power requirements, may be viable for large high speed catamarans, although there will be some point where the hull resistance reduction will be less than the additional drag due to foils. This is due to the 'cube rule' explained earlier where lift potential is limited by cavitation.

(iii) Slender Monohull

Both Kvaerner-Masa Yards of Finland and Sumitomo Heavy Industries of Japan are investigating the possibility of using very long and narrow monohulls as high speed cargo vessels. Kvaerner-Masa commissioned extensive model tests at Helsinki University to investigate the resistance performance of these vehicles which apparently showed performance better than that of a twin hull at high speed. These vessels have very low freeboard and deep draught to submerge buoyancy as much as possible for seakeeping benefits, and are fitted with a very pointed bow to minimise wavemaking resistance.

Although low power requirements have been reported, its difficult to believe that the slender monohull can outperform the SES; there would be such a high wetted surface area that although wavemaking resistance would be minimised, the frictional resistance would be enormous (consider that for the SES, even with a very low draught the frictional resistance will be almost half the total resistance). Also the slender monohull will suffer from a lack of manoeuvrability due to the length, and will require large bow thrusters to negotiate restricted waterways.

(iv) Magnetic Hydrodynamic Propulsion

Kamato-1 is the first vessel in the world to use Magnetic Hydrodynamic Propulsion; it is a prototype which was launched in March 1992 and utilises Fleming's left hand rule which states that an orthogonal force will be developed if an electric current is passed through a magnetic field. Thus by allowing water to flow through a tunnel along its length which is subject to a magnetic field, then driving current through a coil wrapped around this tunnel, a thrust is imparted to the ship giving forward or reverse motion.

Kamato-1 was built at the Mitsubishi Kobe Yard in Japan, launched in September 1990, and represents an investment of 5billion Yen ($37million). (Reference 40) Trials on the craft were successful in that the concept was shown to work, although the mechanical efficiency was very low, 1 or 2%, due to limited magnetic power. However 30% efficiency may be realisable in the medium term.

Magnetic Hydrodynamic Propulsion would be desirable if high enough efficiencies could be obtained, due to the lack of moving parts. This would remove the problem of cavitation and hence permit high speeds, and it would also imply low maintenance costs.

Figure 3.1
Worldwide High Speed Ship Operators

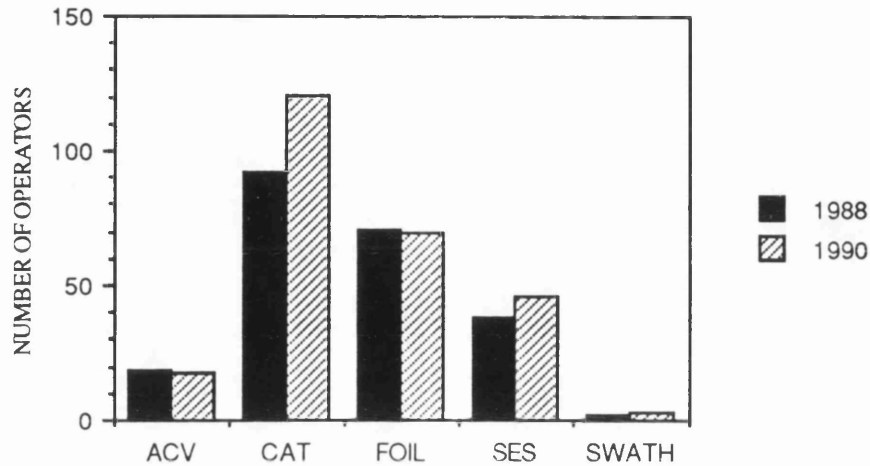


Figure 3.2
Worldwide Builders of High Speed Ships

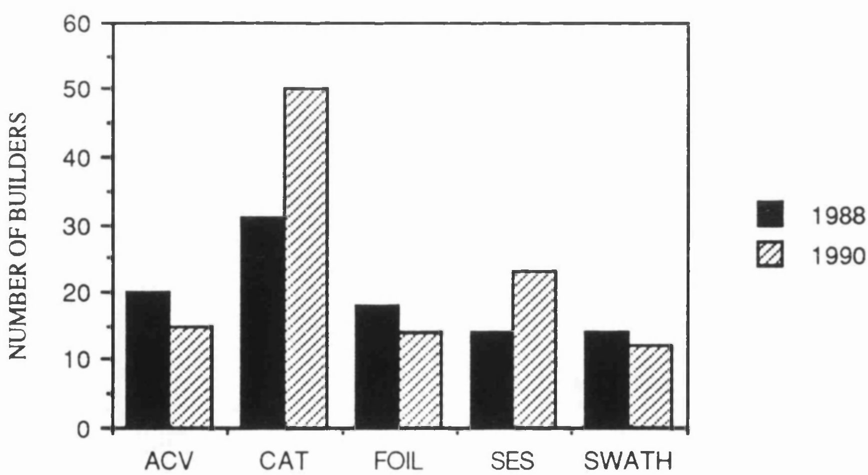


Figure 3.3
Worldwide AMV Deliveries

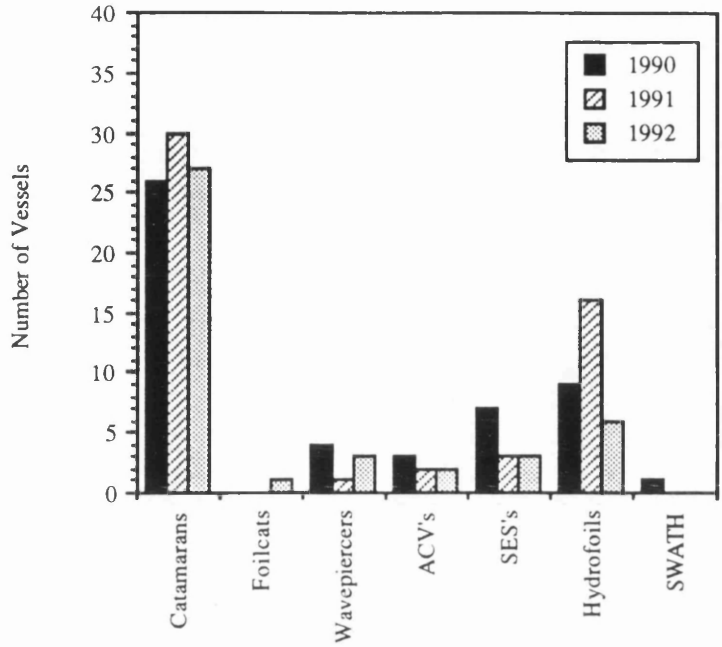


Figure3.4
Worldwide AMV Orders Outstanding at Year End

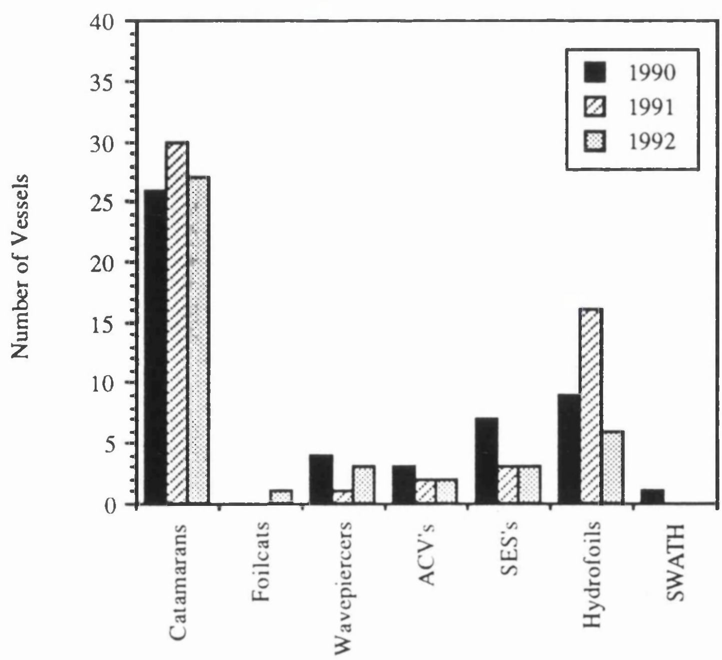


Figure 3.5
Hydrofoil Classification
(Taken from Reference 47)

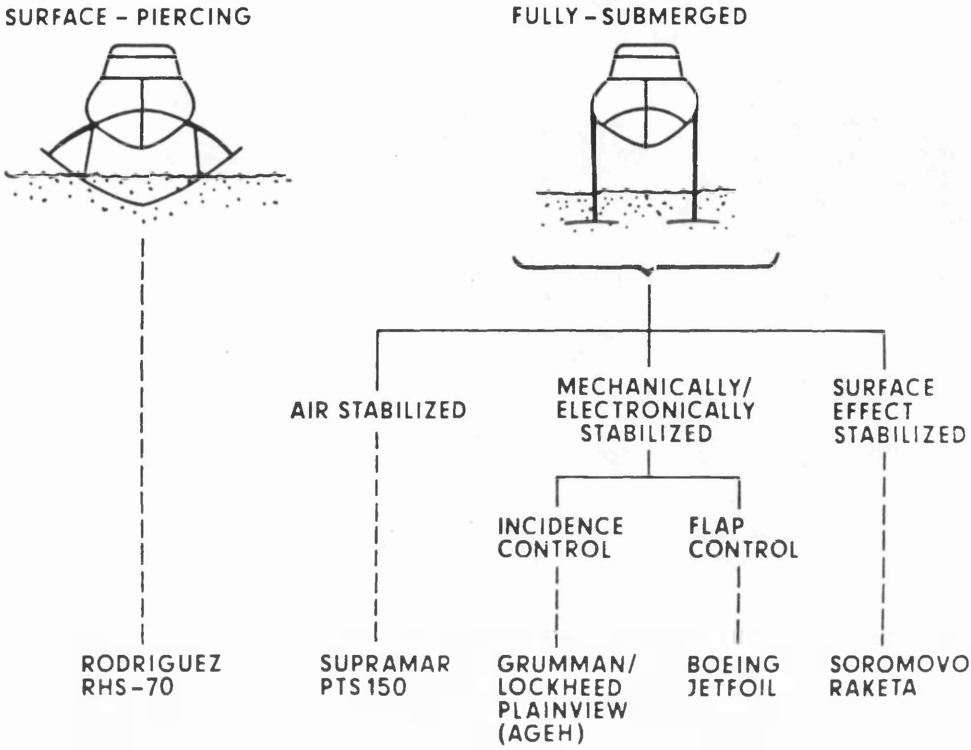


Figure 3.6
Wavepiercing Catamaran
(Taken from Reference 48)

Figure 3.7
Typical SES Configuration
(Taken from Reference 47)

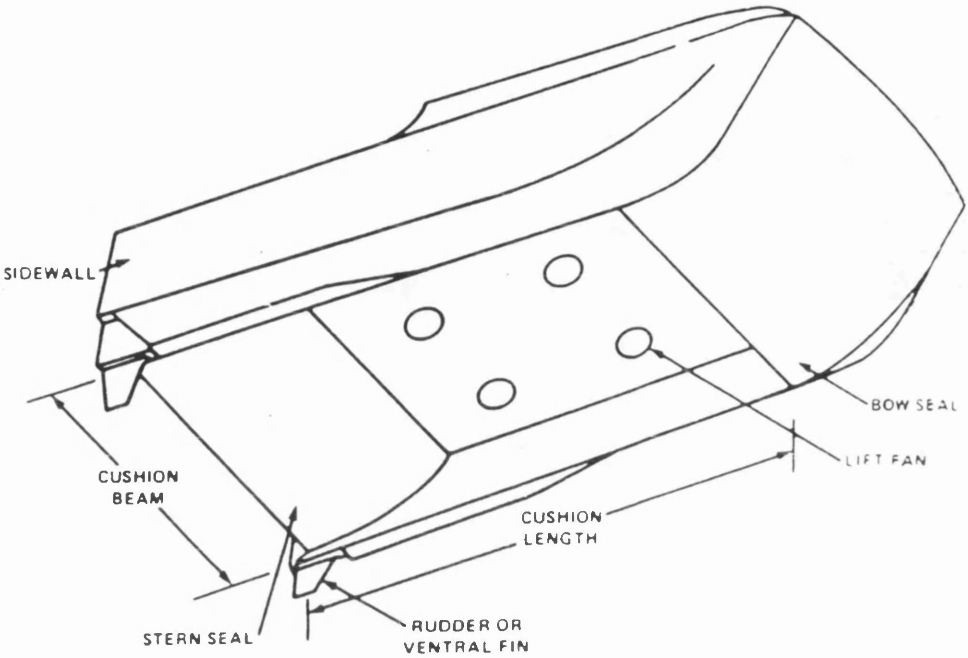


Figure 3.8
Specific Power Comparison of Selected Passenger Ferries
(Taken from Reference 6)

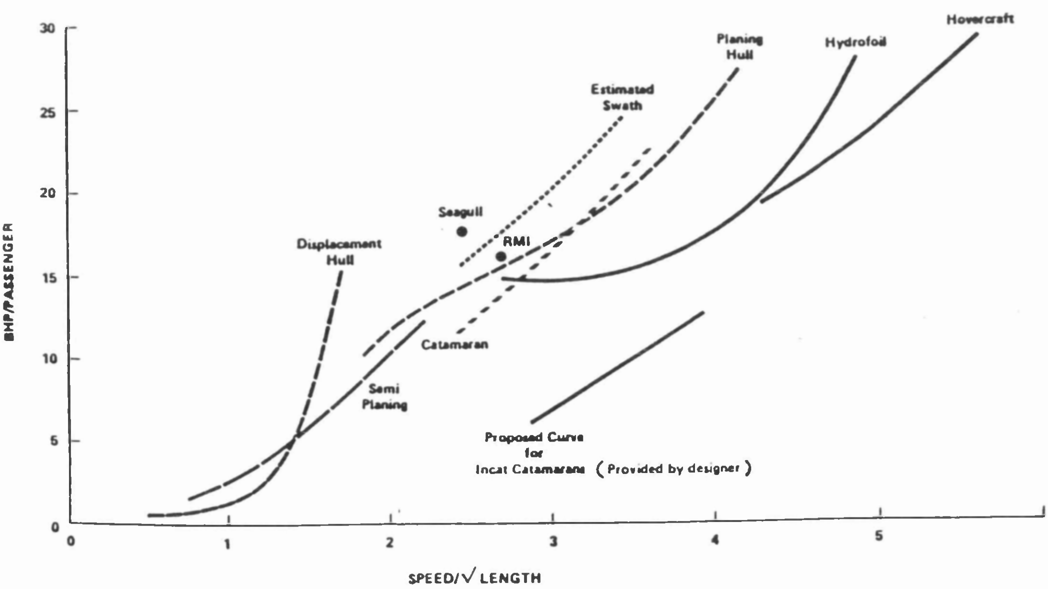


Figure 3.9
Comparison of AMV Transport Efficiency
(Taken from Reference 6)

E = (Max. A.U.W. - Light Weight) * Cruise Speed, knots, at 0/0 Conditions & Full Load
Cruise Power in kW

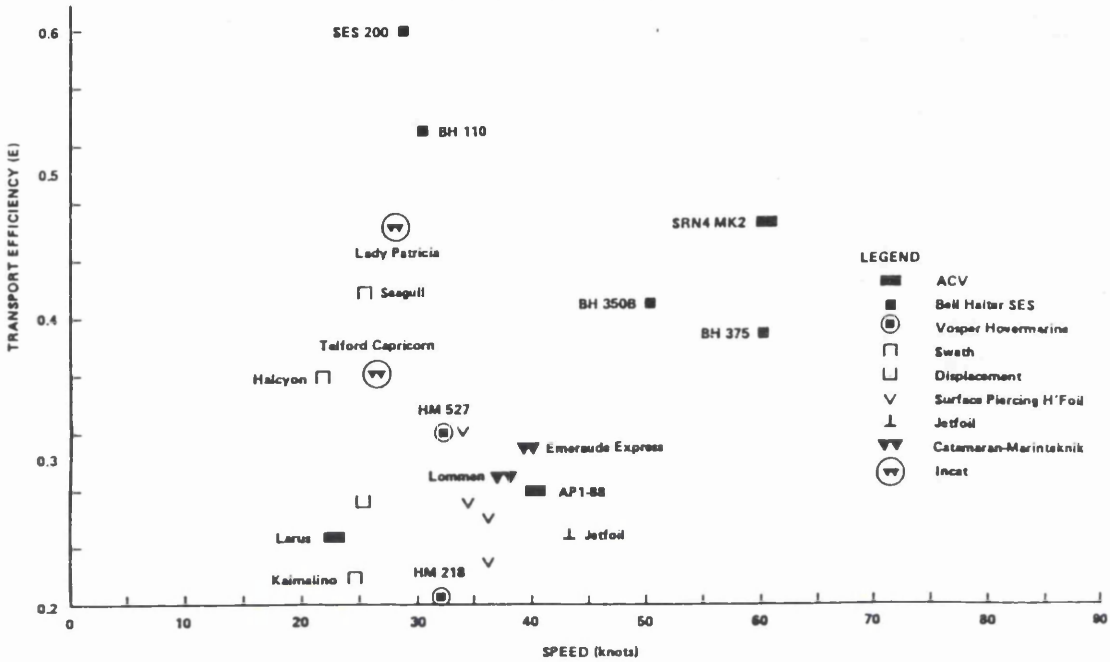


Figure 3.10
Typical AMV Speed Loss in a Seaway
(Taken from Reference 6)

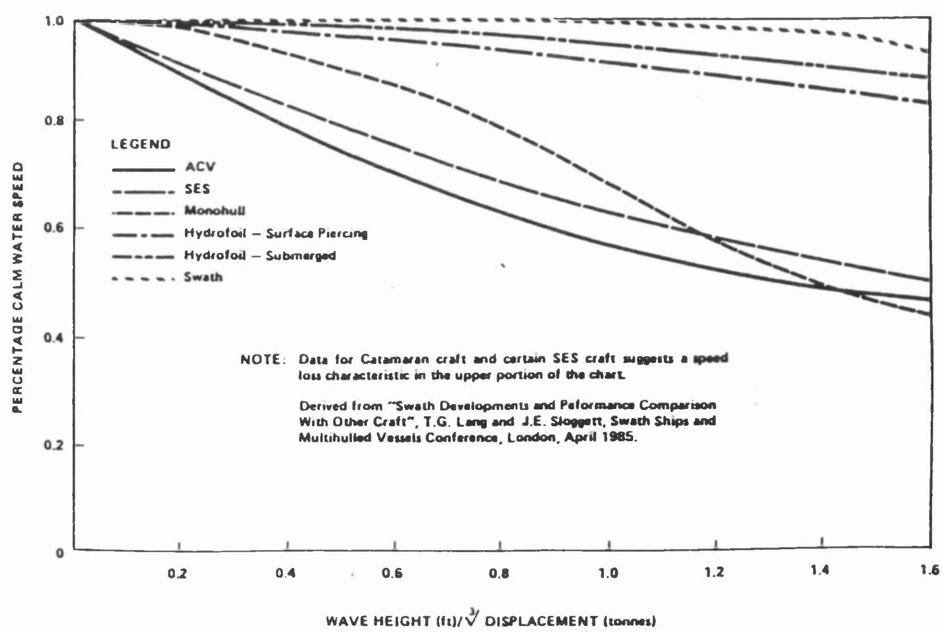


Figure 3.11
Vertical Acceleration Responses of Selected AMV Craft
(Taken from Reference 6)

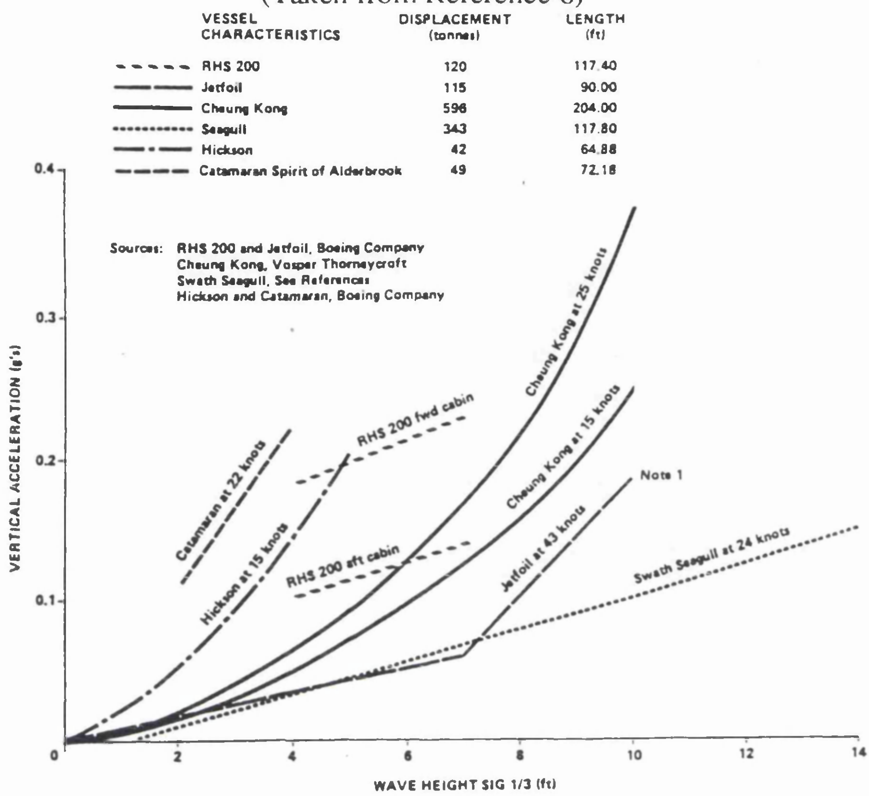


Figure 3.12
Relative Building Costs as a Function of Speed
(Taken from Reference 47)

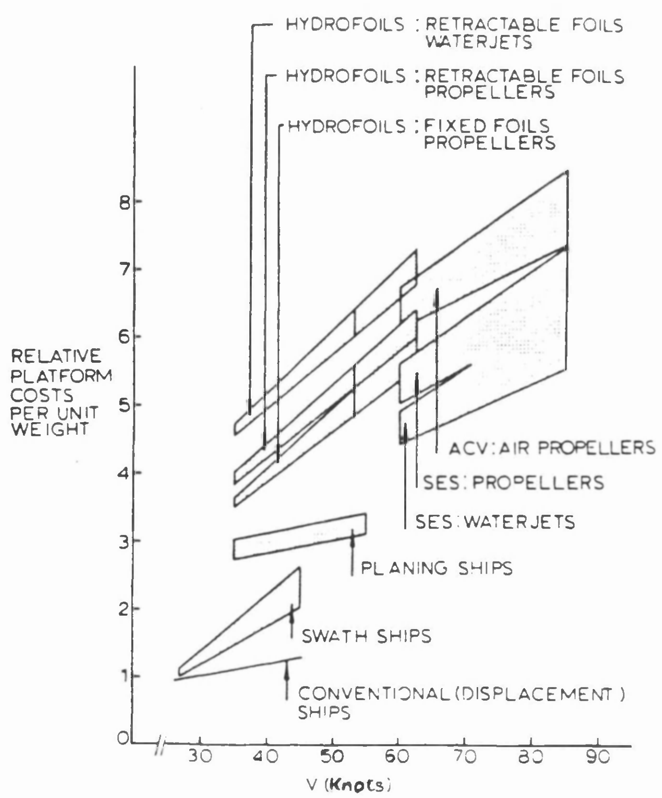


Figure 3.13
Relative Building Costs as a Function of Ship Weight

(Taken from Reference 47)

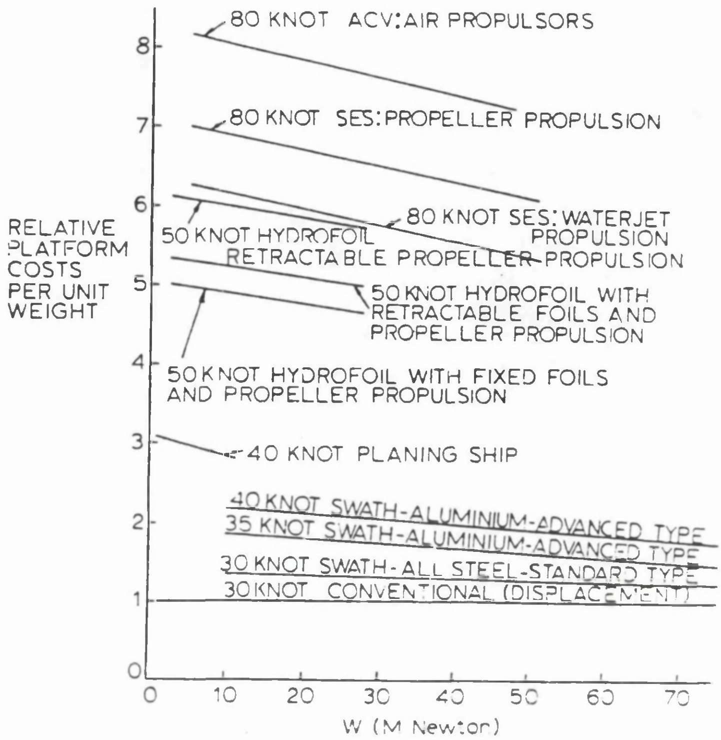


Figure 3.14
Comparison of AMV Commercial Efficiency

(Taken from Reference 6)

$$C = \frac{(\text{Max. A.U.W. - Light Weight}) * \text{Cruise Speed, knots, at 0/0 Conditions \& Full Load}}{\text{Notional Cost per Hour}}$$

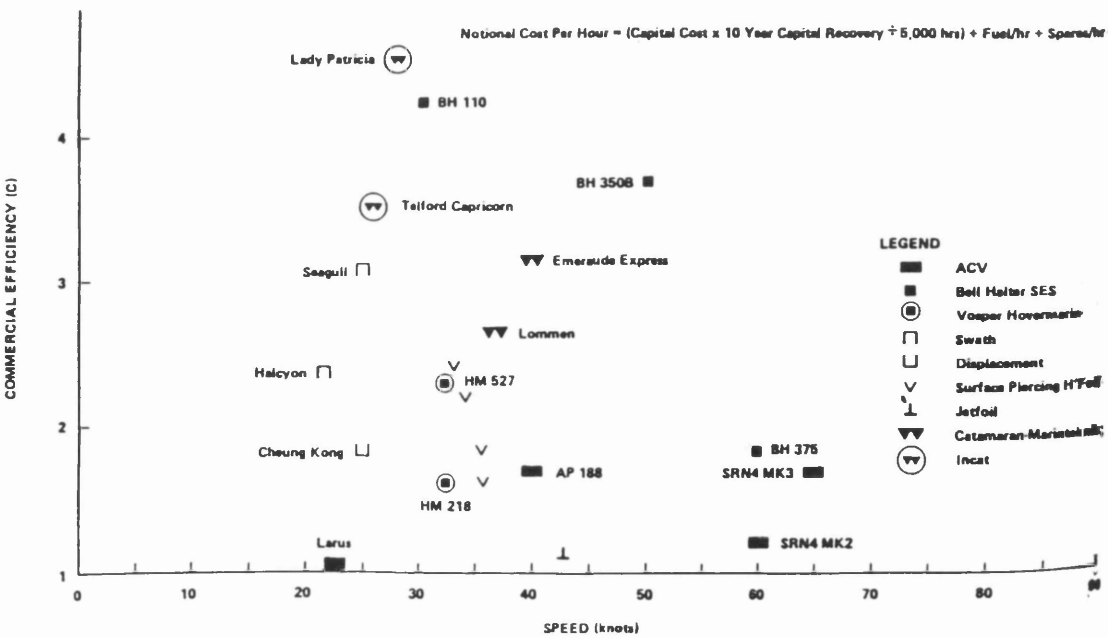
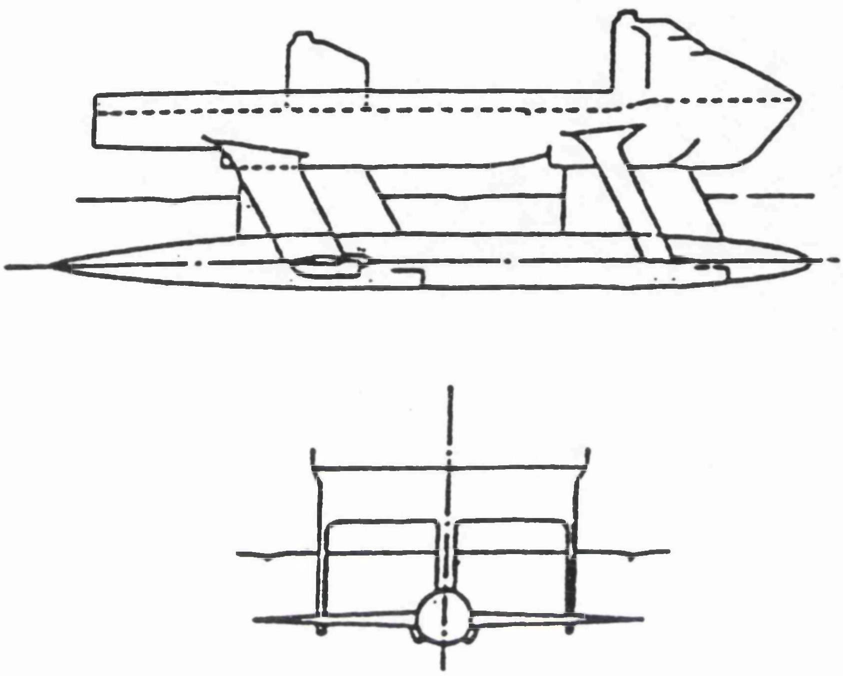


Figure 3.15
TSL-F Configuration: Foil Displacement Hybrid of Japanese Techno-Superliner
(Taken from Reference 49)



Chapter 4

AMV DESIGN PROPOSALS

General Comments

In this Chapter, the aim is to derive hull dimensions and predict power requirements for potential Advanced Marine Vehicles to carry cargo. In doing so, the ultimate objective should always remain in focus, which is to allow a realistic assessment of the potential economic performance. For instance, if the 'true' annual cost of the AMV Freighter design were £50million, one would be satisfied if the estimated charge were of that order; so long as the prediction was not of the order of say £20million, the preliminary design would be satisfactory for the stated purpose. Therefore, the technical design work in this Chapter is kept to the minimum level of detail consistent with the objective of allowing reasonable cost estimates.

Chapter 2 highlighted the need for an AMV Freighter to realise payload economies of scale relative to aircraft; by offering a larger capacity to shipping agents, the speed advantage of the aircraft could be offset by the saving due to lower unit costs of the AMV. Note that the scope for larger aircraft in the future is strictly limited; at best, doubling the payload may be technically possible, although it would require substantial capital investment in research and development.

An AMV Freighter would also need to offer a speed advantage relative to the conventional ship, of a magnitude such as to provide journey times somewhere in between ships and air cargo. Figure 1.2 demonstrated that this would be achieved between 50 and 60 knots

Before discussing targets for an AMV Freighter design, consideration should be given to the net objective - which is to more than offset the cost of increased speed by a reduction in the total transport cost. This is achieved primarily through a decrease in the cost of goods in transit, which is an inventory cost similar to stockholding cost and is directly proportional to the journey duration. Thus, by shortening journey time, ownership of the goods is transferred quicker with a consequent decrease in the investment cost of owning the goods. The increased cost due to higher speed is also partially offset by the greater work capacity of the faster vessel by virtue of more trips per operating period.

However, a decreased investment cost is only likely to achieve worthwhile gains where the saving in journey time is a significant proportion of the overall transit time; for instance the sea transport may be only one stage of a journey, which as well as needing time in port may also require considerable journey time overland to reach the final destination. Therefore, it is *likely* that for shipping agents to be attracted to high speed sea freight, the saving in investment cost would need to be a significant proportion of the overall transit cost. Otherwise there would be little incentive to use the AMV service, and logistically it may be more suitable to use either air or conventional ship.

Given the above, an AMV Freight design would need to achieve a high payload to give economies of scale, and long journeys coupled with high speed to provide substantial reductions in investment cost. However, by specifying the requirement for a long range, a problem arises in trying to balance payload while allowing sufficient fuel for the journey, which at the beginning of the design process cannot be estimated due to unknown power demands. Therefore, rather than specifying a target payload, deadweight is used instead so that if fuel requirements are too large the available payload is reduced and the design would be shown as uneconomic. The design parameters would not be invalid, however, so the effects of swapping fuel weight for payload could easily be estimated to quantify the economics of a reduced range vessel.

Three options for design targets were therefore formulated as follows:-

	Deadweight	Range
Option 1 -	5,000 t	3,000 Nm
Option 2 -	3,250 t	1,500 Nm
Option 3 -	2,000 t	1,000 Nm

Three options are necessary to allow a proper investigation of the effects of scale on the operating economics in conjunction with due consideration to the problem of fuelling for long range. Therefore, the design objective is to develop discrete solutions for each of these three options.

Candidate Concepts

Chapter 3 discussed the status of AMV technology as it has been applied commercially so far. The performance of each vessel type was briefly considered, including their relative advantages and disadvantages. This section discusses which forms offer most potential for development as cargo vessels, in light of the deadweight and speed demands specified above.

Since the overall objective is to assess the potential in the short to medium term, new concepts which have appeared in recent years are not considered at this stage due to envisaged difficulties in estimating technical performance. Thus, hybrids such as the foil-displacement version of Japan's Techno-Superliner (TSL-f) are ignored.

From an assessment of design principles and consideration of known performance characteristics, some of the AMV forms currently deployed as fast ferries can be rejected as potential cargo vessels:-

(i) Air Cushion Vehicles

ACV's offer unrivalled speed potential in calm conditions, but their performance in a seaway decreases rapidly as the seastate increases. A cargo AMV would need to offer a very reliable service due to the high value of goods which it would need to attract, which is extremely difficult to achieve for an air cushion vehicle. Also, their is a very high operating cost associated with these craft due to the all-round air skirts.

(ii) Hydrofoils

Hydrofoils are unsuitable because they are so limited in size - it would be virtually impossible to generate sufficient lift at the required speed to raise a large enough vessel completely out of the water, due to the loading limit imposed on the foil system by cavitation. Even if sufficient progress was achieved to make this technically possible, say through using supercavitating foils, the foil system would need to be fully retractable to minimise hullborne draught when operating in coastal waters; such a feature would add significantly to capital and operating costs.

(iii) SWATH's

At first glance, the SWATH would appear to offer the possibility for development as a fast cargo ship - the excellent seakeeping performance would imply low power margins and provide confidence in the ability to maintain schedules over long distance in exposed seas. However, this form is penalised by its very low payload fraction which would dictate a displacement of around 33,000 tonnes for a 5,000 tonne deadweight; a conservative specific power estimate of 20kW/tonne implies an installed power of almost 700mW would be required. Such enormous power would mean that the available deadweight would barely provide enough fuel capacity, even supposing the physical problems of installation could be overcome. Additionally, the deep draught associated with this vessel type would make infrastructure development a necessity, for example cargo terminals built in deep water connected by rail to inland distribution points.

(iv) Conventional Catamaran's

Catamarans can either be of the full displacement type or be partially supported by planing forces to provide lift and hence reduce wetted surface. Neither of these would be suitable for the AMV Freighter design objectives for the following reasons:

°the power requirements would prevent the full displacement type from offering competitive freight rates, and

°the seakeeping performance of the planing type would result in considerable speed loss in high seastates, implying poor reliability and inability to maintain schedules.

However, there would appear to be some potential for using catamaran's to carry cargo if a foil system could be used to

(a)provide sufficient lift combined with planing forces to substantially reduce power demands, and

(b)act as a ride control system to improve performance in a seaway by limiting the need to reduce speed.

Surface Effect Ships also offer the potential of scaling to a suitable size while retaining the relatively low power advantage, and the use of the aerostatic lift system for ride control purposes would help provide adequate seakeeping performance. The primary technical difficulty in building large SES's is associated with the ability to generate sufficiently large cushion pressures; these depend on the capacity of lift fans and, therefore, may be technologically limited at present.

For these two potentially technically viable solutions, it was therefore decided to attempt the derivation of design solutions for each target deadweight of 5000t, 3250t and 2000t. The design methodologies are discussed in the following sections.

SES Design Methodology

The majority of Surface Effect Ships currently in-service would be considered small craft by conventional shipping standards, between 30 - 40m long and around 100 - 200 tonnes displacement. The largest SES in the world is currently under construction in Italy, measuring 92m in length with a displacement of almost 2,000t, which represents a significant step in scale.

In this study, a further leap in work capacity is demanded, to provide the deadweight capacities specified above. Given that the confidence associated with a design solution is heavily dependent on the quality of available data, the need to extrapolate over a wide band implies significant uncertainties. This is compounded by the fact that the majority of available data in this instance comes from published material, which is invariably incomplete for reasons of commercial confidentiality. This weakness in the data can only be overcome by making some generalised assumptions at the beginning of the design process and making allowance for the uncertainties when forming conclusions on the results.

The fundamental assumption made for the SES designs was to fix the deadweight/displacement ratio; it is reasonable to suppose that this parameter remains fairly constant over a wide range of sizes, which assumes deadweight capacity is proportional to the cube of the scale factor. In deciding the magnitude of the ratio for design purposes, by referring to published design data, consideration must be given to the hull material to be used and the volumetric Froude Number, which can have a wide band for surface effect ships - anything from say, 1.5 to 4.5

Fixing a value for (dwt/Δ) dictates the displacement required for each target payload for options 1 - 3, and the design problem becomes one of solving for the 'optimum' dimensions for the desired displacement. The solution in this instance was generated through a parametric analysis of possible dimensions, governed by a range of Length/$\Delta^{1/3}$ ratios nested within a series of L/B ratios (note from Chapter 3 that the selection of the appropriate L/B ratio is perhaps the most crucial decision for the SES designer). The code for this parametric analysis is included in Appendix 1.

The success of the algorithm depends on a number of assumptions which were necessary to generate a range of feasible solutions; these assumptions are described below:

(i) Geometric Parameters

A typical SES cross-section shape was selected as the basis for the derivation of dimensions, and a series of relationships were specified in the code.

* Box Height = 5.5m (for two container height)
* Box Clearance = 4.0, 3.5 & 3.0 for options 1,2 and 3 respectively
* Sidehull Deadrise angle = 35^{o}
* (Sidehull beam)/BOA ranging from 0.15 - 0.35 at off cushion draft

(ii) Weight Balance

The objective was to calculate group weights based on simple relationships, and accept solutions where the summation of these weights gave at least a 10% less margin on the target lightship (=Displacement - Deadweight). The relationships used for the weight estimation are given below, taking data from Reference 50:

°Structure weight, W_S = (structure density * enclosed volume), where structure density, SD = 33.007*log(Disp.) - 39.766, illustrated in Figure 4.1

°Machinery weight, W_m = (Power * 2.5 / 1000), i.e. 2.5kg/kW, with Power = (user specified kW/tonne) * (Displacement)

°Outfit Weight, W_O = 7.5% of Displacement, higher than the more normal SES value of 5% to allow for containers and cell guides.

°Electric Weight, W_{el} = [(Power/85) *40]/1000

°Auxiliary Weight, W_{aux} = (enclosed volume) * 10 / 1000

The expected lightship density (= Lightship/ Enclosed Volume) of approximately 150 kg/m^3 was used as a filter to reject solutions with Lightship densities less than 100 and greater than 200.

Using the above relationships, a series of potentially feasible design solutions was generated for each option, for various combinations of L/B and $L/\Delta^{1/3}$ ratios. The selection of the solution to be used for power estimates was achieved by a process of elimination - three output files were generated giving firstly air cushion details such as pressure (CUSHION.OUT), weight breakdown and densities (WEIGHT.OUT) and finally geometry results (SESDES.OUT). The process of elimination consisted of examining each output file in sequence and narrowing the range of feasible options at each step as follows:

CUSHION.OUT: - Typical cushion pressures for vessels in-service would be around $10kN/m^2$ and detailed design studies have shown pressures up to $25kN/m^2$ are feasible. Consequently, from the range of solutions output to CUSHION.OUT all those having pressures more than 25 were rejected; forms having reasonable pressures but unrealistic dimensions were rejected also.

WEIGHT.OUT: - From those solutions requiring acceptable cushion pressure, those having the best weight balance were carried forward to consider hullform parameters. For example, solutions were rejected at this stage if the weight margin was more than 15% and less than approximately 7.5%. Acceptable weight balance results was strongly linked to Enclosed Volume as would be expected from the weight equation approximation. This implied that the range of feasible design solutions contained the most efficient geometries in terms of minimising Enclosed Volume for the required displacement.

SESDES.OUT: - From the now narrowed range of feasible solutions, one overall best form was selected for each option, based on the need to keep length as low as possible for reduced cost, and also to have the lowest possible enclosed volume without being too unrealistic. Particular attention was focussed on the L/B ratio, which needed to tend towards the high side because the volumetric Froude No. was fairly low; however, some allowance was made for the fact that the three options have different $(Fn)_v$ values and therefore require different L/B values.

The resulting design solutions from the above analysis are given in Table 4.1.

Having derived hull dimensions for each option, and a reasonably satisfactory weight breakdown, the next task was to predict power requirements. It was assumed that the lift system would be capable of supporting 80% of the gross weight. The total resistance for an SES can be broken down as follows (see Figure 4.2):

Wave Drag: - Wave drag is associated with the deformation of the free surface due to the cushion pressure, depending primarily on cushion pressure and area, varying substantially with cushion L/B ratio. The magnitude of wave drag for each option was predicted using wave drag parameter curves illustrated in Figure 4.3 from References 51, using the average of the two.

Sidehull Friction: - An estimate of the sidehull wetted surface area at the 'on cushion' draft was made and friction resistance coefficient estimated from the standard ITTC formulation.

Sidehull Wavemaking Drag: - Data for predicting this parameter was very scarce due to the geometry of the sidehull and the very high $L/\Delta^{1/3}$ ratio, the best available was a presentation of Series 64 results in Reference 52. This showed the ratio of Residuary Resistance to Displacement being asymptotic with increasing $L/\Delta^{1/3}$ for a given $(Fn)_V$.

Aerodynamic Drag: - This is made up of two sub-components, Momentum Drag (Rm) due to accelerating the cushion air supply, and the Profile Drag (Rp) arising from air resistance to forward motion. The Momentum Drag is calculated from

$Rm = (Rho)_{air} * Q_f * V_s$, where Q_f is the air supply flow rate , which is proportional to the cushion area and the square root of the cushion pressure, with Qf estimated from data of similar published designs..

The Profile Drag was calculated using a drag factor of 0.35 (Reference 21)

Seal Drag: - Seal Drag was assumed to be 5% of the total resistance, which includes an allowance for form and appendage effects.

The Propulsive Power at the shaft, Ps, was calculated using an overall propulsive efficiency of 65% (see "Design Uncertainties" below). The required Lift power, P_L was calculated using an assumed lift system efficiency of 70% (75% may be possible, see Reference 53) i.e $P_L = (P_c * Q_f) / 0.7$. Table 4.2 provides a breakdown of the powering estimate for each option.

Knowing the power requirements, the required fuel weight for each option could now be calculated. This assumed a specific fuel consumption of 230 grammes/kWhr which allows for gas turbines as the prime mover. Allowance was also made for the reduction in power demand due to decreased weight as fuel was consumed, based on the assumption that power would be reduced rather than speed increased; it was further assumed that the specific power would remain constant for each option throughout the trip. By making some allowance for other items of deadweight, the final payload weight was derived, with the deadweight breakdowns summarised in Table 4.3.

SES Design Uncertainties

(i) Dwt /Δ

The value of 0.35 assumed for this parameter drove the results of the design process more than any other factor, and so it can be argued that any uncertainty associated with it will have a profound influence on the final outcome. Given its overall importance, therefore, a conservative approach was more suitable than being optimistic and it is considered that the value taken reflects this. From published data, a value of 35 - 40% would be expected for craft with a high $(Fn)_v$ whereas the derived designs are very much towards the low side. For such vessels, it may be possible to achieve a deadweight as high as 60% of the displacement, albeit for craft with a light structure made from Aluminium or GRP. For the three SES options, it could also be expected that the larger vessel could have a higher (Dwt/Δ) fraction due to having a lower $(Fn)_v$, because the speed is the same for each. This could even be compounded with a lower structural fraction due to more efficient structural design; on the other hand, there would probably be more scope for using aluminium in certain regions of the smaller craft.

Given the above, there appear to be reasonable grounds for arguing that a value of 0.45 for the (Dwt/Δ) fraction may be possible, which would result in lower displacements and hence less fuel load leaving more payload capacity. The economic effect of such a change could easily be estimated by assuming similar specific power and build cost/per tonne displacement.

(ii) Resistance & Powering

The assumptions inherent in the power predictions appear to be validated by the results, which show specific powers (kW/tonne) agreeing very well with other published designs and technical investigations for similar sized vessels (Reference 32 & 54). However, because the designs are for vessels larger than those in service, there is some uncertainty associated with the ability to scale from known data; it is widely known that scale effects are particularly difficult to predict for air cushion vehicles, and for SES's albeit to a lesser extent. The difficulty is that since the proposed designs are for large vessels, a small increase in the specific power will produce a large increase in installed power.

The assumption most difficult to justify is that the installed propulsion power could actually be developed at the propulsor with the efficiency quoted (65%); at the design conditions, only a supercavitating propeller would have any possibility of meeting the demands of 38 - 58 MW per shaft (assuming 4 shafts). However, this is a question related to the overall technical feasibility which will be discussed in Chapter 7; it is necessary to assume that it is technically viable for the purpose of quantifying the economic characteristics. However, in this respect also other much more detailed studies have indicated that it would be possible (Reference 32).

With regard to individual components of resistance, it is considered that the two most significant by far have been estimated with reasonable accuracy, namely cushion wave drag and sidehull friction resistance. The greatest degree of uncertainty is associated with seal and sidehull wavemaking drags; the former because no method was available for generating an estimate, and the latter because the geometry of the sidehulls is far removed from more conventional forms. However, it was considered that a 15% power margin would adequately compensate for these uncertainties.

(iii) Weight Estimate & Enclosed Volume

The approach taken for the weight estimate is admittedly simplistic and does not attempt to build up from known weights for individual items such as prime movers. Nevertheless, for the purposes of this study it was only necessary to derive an adequate breakdown so that building costs could be estimated, which has been achieved. The weight fractions for each option are compared below to those of the USA 3KSES design (Reference 31), and show good agreement given that the 3KSES structural fraction is for aluminium.

	Option 1	Option 2	Option 3	3KSES
W_s/Δ	0.45	0.45	0.44	0.296
W_m/Δ	0.06	0.06	0.06	0.105
W_e/Δ	0.01	0.01	0.01	0.022
W_{aux}/Δ	0.05	0.05	0.05	0.038
W_o/Δ	0.08	0.08	0.08	0.058
Dwt/Δ	0.35	0.35	0.35	0.481

A space balance was attempted but proved difficult in that all three options exhibited large enclosed volumes. There is scope for reducing the calculated enclosed volumes for example by not covering the containers with deck plating (two decks were assumed for each option; it might be possible to build a box structure with shallow depth for strength purposes only which could result in less structural weight). Too much space for maximum payload weight is a common problem for twin hull designs, and it may be that consideration should be given to charging for carrying freight by volume; thus all light weight commodities would derive a considerable advantage in comparison to other transport modes. It is also relevant to the potential for carrying passengers who would positively welcome a high stowage rate!

(iv) Structural Design

Perhaps the most significant weakness in the design proposals is that no attempt has been made to derive structural scantlings. Thus the design process has not been synthesised as much as one would have liked. The justification for not considering structural design is based on the assumption that the structural weight fraction is consistent with other designs, and that detailed design studies which have included structural synthesis have concluded that strength requirements can be met. Nevertheless, considerable scope would appear to exist for rationalising the proposed design through structural analysis, including giving consideration to other materials.

(v) Overall Uncertainty

While some significant uncertainties exist in the proposed designs, there are none which might prevent a good estimate of building and operating costs to be made; for the design requirements, the solutions would have to close be to those derived here. In these circumstances, it is justifiable to accept the uncertainties and focus on the economic analysis, where the effects of alternative design solutions due to uncertainties can be assessed.

FOILCAT Design Methodology

From the beginning, it was recognised that a fully supported Foilcat (ie completely raised out of the water) would not be feasible due to the design deadweight and speed specifications. Published investigations suggested a maximum displacement for such craft would be in the region of 2000 - 3000 tonnes (Reference 44).

The aim, therefore, was to assess the possibility of a foil system being used on large catamaran's to reduce the otherwise enormous power demands, in the assumption that considerable seakeeping advantages could also be obtained.

The basic design approach for the foilcat was essentially the same as that described above for the SES - that is, to specify a (dwt/Δ) ratio and derive dimensions, weight and power estimates for the given displacements. However, a small allowance was made to reflect the more complicated lift system on the SES such that a foilcat could be expected to achieve a higher deadweight fraction. A value of 0.375 was assumed for the foilcat, in comparison to 0.35 for the SES. This would obviously result in a lower displacement for the corresponding deadweight, suggesting at the very least an advantage with respect to build costs if not necessarily for operating costs.

In deriving dimensions for the foilcat hullform, similar (L/B) and ($L/\Delta^{1/3}$) ratios to those derived for the SES were used. This assumed that the resistance advantages of a high L/B ratio applied to catamarans also, which is "less" true, and also that the selected ($L/\Delta^{1/3}$) ratio implied similar efficiency with respect to minimising enclosed volume. The resulting dimensions and geometric properties are given in Table 4.4.

A bodyplan was selected and scaled to the appropriate displacement, from which it was possible to calculate the enclosed volume associated with with the sidehulls. The box height was again assumed as 5.5m to allow two tiers of containers.

The total resistance of the foilcat was assumed to consist of the linear superposition of that due to the sidehulls (plus an interference allowance) and the drag due to the presence of the foils. Thus each component could be estimated independently of the other.

The sidehull resistance was estimated using the empirical method of Holtrop & Mennen (Reference 55), which is based on a regression analysis of extensive model data including fast craft. The speed -resistance curves were calculated for a range of draughts and assumed an interference allowance of 10%.

The derived total resistance estimates were checked using two alternative prediction methods: the first used a procedure described in Reference 56, which gave Residuary Resistance coefficients of high speed catamarans for various $L/\Delta^{1/3}$ ratios; the second used experimental model data presented in Reference 57, which although not for the same hullform nevertheless gave an indication of the order of drag to be expected. These checks indicated that the Holtrop & Mennen method probably understimated resistance, perhaps by as much as 10%

The foil system lift and drag properties were estimated using a method presented in Reference 52, summarised below; this was translated into computer code and is included in Appendix 2.

3 Dimensional Lift Curve Slope:

$$C_{l\alpha} = \frac{2\pi P(AR)\cos(\Lambda)}{(AR)+2P\cos(\Lambda)[1+\{1+((AR)/2P\cos(\Lambda))^2\}^{0.5}]-(AR)}$$

where

AR = foil aspect ratio

$P=[16(i/c)^2 + 1] / [16(i/c)^2 + 2]$

Λ = sweepback angle

α = angle of attack

i = submergence

c = chord

3 Dimensional Lift Coefficient

$$C_l = C_{l\alpha}(\alpha-\alpha_e)$$

where

α_e = effective angle of attack

Total Drag Coefficient:

$$C_d = C_{dp} + \delta C_{dp} + C_{di} + C_{dw}$$

where

C_{dp} = skin friction plus profile pressure drag

$= Cf[1+2(t/c)+60(t/c)^4]$; Cf = ITTC friction coefficient

(t/c) = maximum foil thickness/chord ratio

δC_{dp} = profile drag increment due to angle of attack

$= 0.005(C_l)^2$

C_{di} = induced drag coefficient

$$= \frac{(AR)+2P\cos(\Lambda)[1+\{1+((AR)/2P\cos(\Lambda))^2\}^{0.5}]-(AR)}{2\pi P(AR)\cos(\Lambda)(C_l)^{-2}}$$

C_{dw} = free-surface wave drag coefficient

$= 0.5(C_l)^2 / [(F_i)^2 e^{(2/F_i)^2}]$

F_i = Foil Froude number based on submerged

For simplicity at this stage, the above foil lift/drag procedure implicitly assumes that both the Munk interference and Planform correction factors are equal to unity; this results in an overestimate of lift and an underestimate of drag, which would be accounted for at a more detailed design stage.

After an initial parametric study, a foil aspect ratio of 5 was selected; higher ratio foils have better lift/drag ratios but the total lift is limited due to the fixed span. In addition such foils can create ride problems due to high lift slope curves (ie for a small change in effective angle of attack, the change in lift for a high aspect ratio is larger than that for a low one; this can be difficult to control in a seaway because the water particle motion in waves is effectively altering the angle of attack continuously).

Assuming two full foils on each option, the displacement at the operating speed of 55 knots was calculated by subtracting the lift from the gross weight. The resistance due to the sidehulls for the associated draught was interpolated from the data calculated previously, and the foil drag added to this to give the total resistance.

The propulsive power was estimated using an efficiency of 0.65 and a power margin of 15%, as in the case of the SES design. A full breakdown of the resistance and powering components is given in Table 4.5.

FOILCAT Design Uncertainties

(i) Hull Dimensions & Form

The major assumption in deriving dimensions was that the Foilcat would need the same ($L/\Delta^{1/3}$) value as for the SES design, and is justified by the need to select a reasonably high value to minimise wavemaking resistance. The L/B ratio was also based on the results for the SES, which possibly assigns a higher value than would be necessary (the SES L/B ratio was based on cushion wavemaking effects); the effect of doing so was a higher enclosed volume with consequent weight penalties although this was balanced with the fact that the foil span and hence lift would be reduced.

The bodyplan selected for the demihull was based on an existing catamaran design, although this had a lower demihull L/B ratio than that required. This was overcome by 'lengthening' the hull, in effect retaining the offset data but increasing the station spacing. Thus the lines have not been smoothed although the hull is sufficiently fair to derive the hydrostatic parameters as input to the statistical resistance prediction model.

The possibility of developing a semi-planing hull was considered, in an attempt to augment foil lift by that due to planing forces. However, it was neglected because the high L/B ratio for the demihull implies that insufficient planing surface exists in relation to displacement at a reasonable trim. Nevertheless, it may be that a more detailed investigation would have shown this to be possible, so the power predictions may be overestimated to the extent that they might be reduced due to planing effects.

(ii) Resistance & Propulsion

The demihull form is quite far removed from conventional twin hull characteristics, which made resistance prediction difficult. The statistical method described by Holtrop & Mennen was based on more normal hulls, and so strictly speaking is not suitable for the selected dimensions. As a consequences, it is likely that the resistance estimates are under-predicted although it is difficult to quantify by how much.

The foil lift and drag characteristics are consistent with expectations, ie the lift/drag ratios are consistent with normal foil geometries. However, in the calculations it was assumed that both the planform and Munk correction factors were both equal to zero which means that lift is slightly overestimated.

The powering uncertainties are similar to those described for the SES above, except that because the Foilcat requires more power, it is even more doubtful if it could be installed and developed at the propulsor.

The resulting power estimates, however, suggest that the uncertainties described above are not unacceptable; the specific power for the 189m design of 25 kW/tonne is reasonable given that the foil system is shown to provide no benefit.

Chapter Summary

The initial discussion emphasised the aim to derive designs sufficiently detailed to allow the economics of high speed cargo ships to be estimated. The design objectives were derived from the need to offer competition to existing air and sea cargo systems, and required as long a range as possible with a speed of 55 knots. From a consideration of fundamental concept characteristics it was concluded that the most likely craft suitable for this role would be Surface Effect Ships and perhaps foil-assisted Catamarans. Thus designs for three options with various deadweight capacities were derived for each form.

The design assumptions produced SES configurations which were slightly longer than the corresponding Foilcats, although with significantly lower power requirements. The power estimate for the SES is subject to less uncertainties than the Foilcat, although if anything the Foilcat power is likely to be higher than that calculated. Thus the SES remains the best concept suitable for economic evaluation.

However, it is clear that the performance of the Foilcat relative to the SES improves with decreasing size; as the potential lift becomes a larger fraction of the gross weight, the change in resistance will offset the induced foil drag. There would therefore appear to be some point where the Foilcat could outperform the SES, which is worthy of further investigation. It appears that a Foilcat of around 2000 - 3000 tonne would be feasible and it may be that crafts around 1000 -1500 tonne would be more efficient; it would remain to be proven however, that a vessel of this size would necessarily be better as a twin-hull rather than single hull configuration.

Finally, the question of overall technical viability should be addressed. The most doubtful aspects of the SES designs are the power requirements, both whether or not the required installation could be fitted (there are certainly no marinized gas turbines available with sufficient power, although larger units are commonplace in the electric generation industries) and transmitted to a suitable propulsor capable of delivering it. However, given that other, far more detailed, design studies have concluded that it is possible, the results of the SES design process are accepted for economic evaluation.

Figure 4.1
Structural Density Estimate

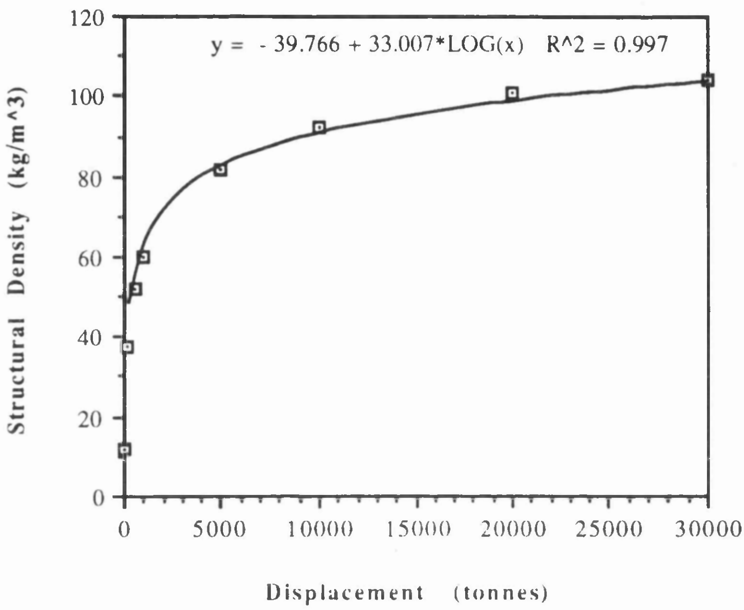


Figure 4.2
Components of SES Total Resistance
(Taken from Reference 52)

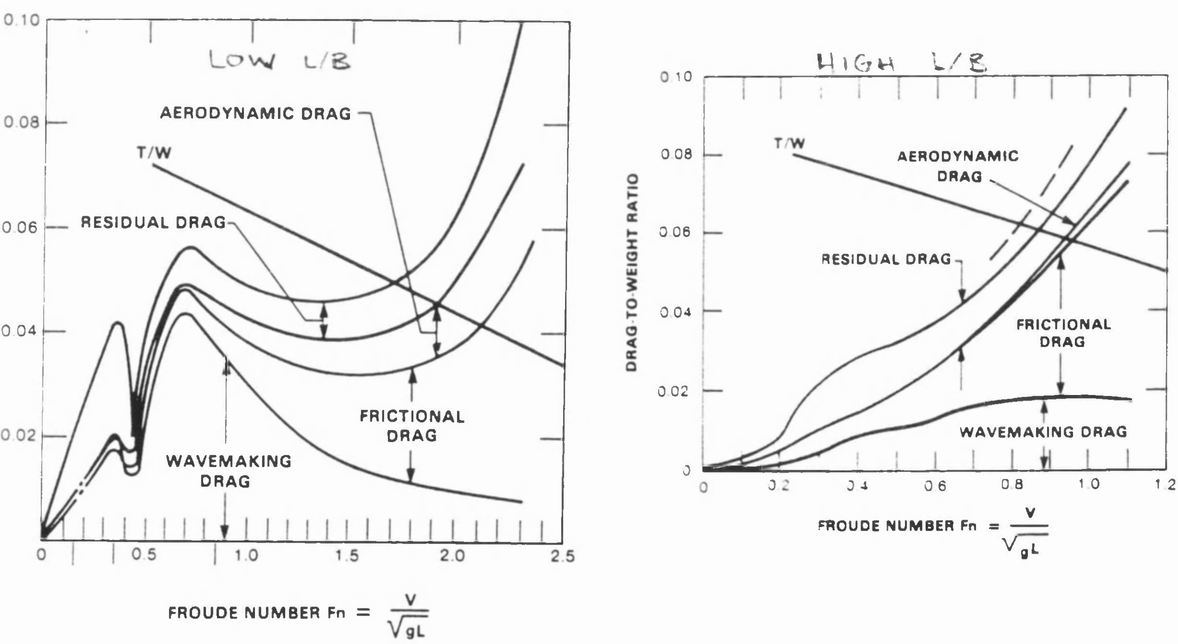
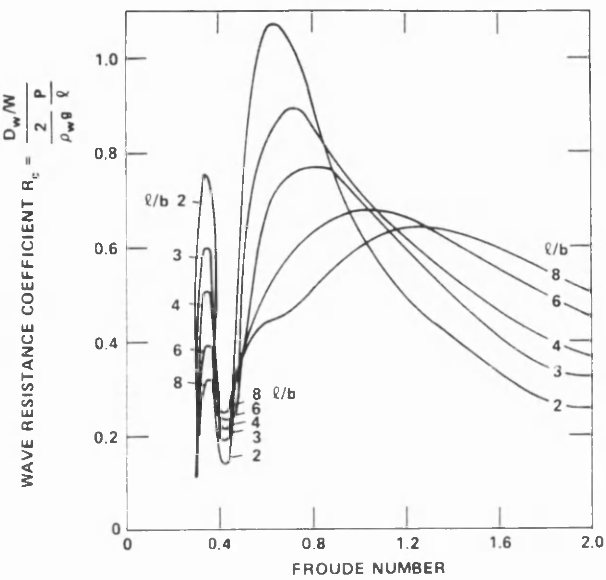
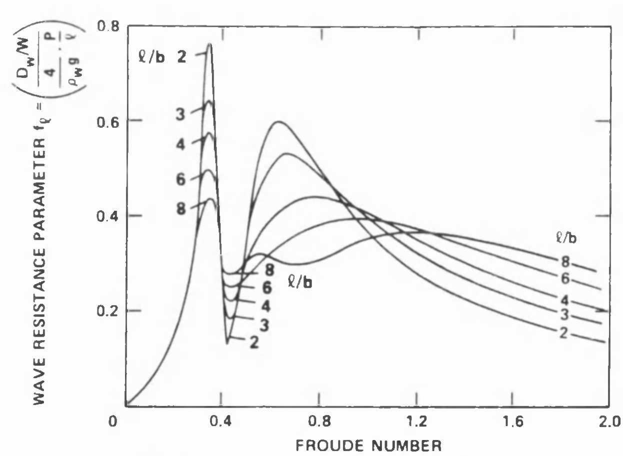


Figure 4.3
SES Wave Drag
(Taken from Reference 51)



Doctors' wave resistance coefficient.



Newman and Poole's wave resistance parameter.

Table 4.1
SES Design Solutions

HULL PARAMETER	Option 1 SES194	Option 2 SES157	Option 3 SES125
$L/\Delta^{1/3}$	8.0	7.5	7.0
b/BOA	0.175	0.175	0.15
LOA (m)	194.1	157.6	125.1
BOA (m)	38.8	35.0	31.3
L/B	5	4.5	4.0
Depth, D (m)	17.6	16.2	15.8
Depth -wet deck, D_{wd} (m)	12.1	10.7	10.3
Draught off cushion, T_{off} (m)	8.1	7.2	7.3
beam @ T_{on}, b (m)	6.8	6.1	4.7
b_{wd} (m)	8.3	7.5	5.6
Cushion L/B	6.0	5.4	4.6
Cushion Beam, Bc (m)	29.0	27.9	24.5
Draught on cushion, Tc (m)	2.5	2.2	2.2
Cushion Area, Ac (m^2)	5046	3689	2744
Cushion Pressure, Pc (kN/m^2)	22.2	19.7	16.3
Weight Steel, Ws (tonnes)	6425	4143	2508
Weight Machinery, Wm (tonnes)	840	564	369
Weight Electrics, Wel (tonnes)	158	106	70
Weight Auxiliaries, Waux (tonnes)	660	454	298
Weight Outfit, Wo (tonnes)	1200	770	472
Displacement, Δ (tonnes)	14286	9286	5714
Deadweight, dwt (tonnes)	5000	3250	2000
Enclosed Volume, EV (m^3)	58910	41116	27062

Table 4.2
SES Power Breakdown
Service Speed = 55knots

PARAMETER	Option 1 SES194	Option 2 SES157	Option 3 SES125
Air Flow Rate, Q_f (m^3/sec)	1864	1284	868
Lift Power, P_L (kW)	59115	36135	20212
Wave Drag (kN)	1672	1408	1020
Sidehull Friction Drag (kN)	1921	1403	1031
Sidehull Wave Drag (kN)	656	480	361
Momentum Drag (kN)	65	45	30
Profile Drag (kN)	101	84	73
Seal Drag (kN)	232	180	79
Total Drag (kN)	4646	3600	2647
Effetcive Power, Pe (kW)	131445	101851	74899
Shaft Power, P_S (kW)	202222	156694	115230
Design Margin	15%	15%	15%
Inclusive P_S (kW)	232555	180198	132514
Installed Power, P_I (kW)	291670	216333	152726
Displacement (tonnes)	14286	9286	5714
Specific Power (kW/tonne)	20.42	23.3	26.7

Table 4.3
SES Deadweight Breakdown

COMPONENT	Option 1 SES194	Option 2 SES157	Option 3 SES125
Fuel	3580	1380	700
Fresh Water	15	15	10
Stores	5	5	3
Luboil	20	15	10
Dieso	60	25	12
Sewage	1	1	1
Baggage	5	5	3
Payload	1314	1804	1261
Deadweight	5000	3250	2000

Table 4.4
FOILCAT Design Solutions

HULL PARAMETER	Option 1 FOILCAT 189	Option 2 FOILCAT 154	Option 3 FOILCAT 122
Displacement (tonnes)	13,333	8,667	5,333
$L/\Delta^{1/3}$	8.0	7.5	7.0
LOA (m)	189.6	154.1	122.3
L/B	5.0	4.5	4.0
BOA (m)	38.0	34.2	30.6
demi-hull Δ (tonnes)	6,666	4,334	2,666
Hullborne Draught, T_h (m)	6.27	5.85	5.40
Hullborne Beam, b (m)	8.58	7.10	5.77
b/BOA	0.226	0.208	0.189
b/T_h	1.369	1.214	1.068
demi-hull C_b	0.577	0.609	0.645
Depth Wet Deck, D_{wd} (m)	10.27	9.35	8.40
Depth, D (m)	15.77	14.85	13.90
LCB	-9.65	-7.53	-5.68
Deadweight, dwt (tonnes)	5000.0	3250	2000

Table 4.5
FOILCAT Power Estimate Breakdown
Speed = 55 knots

PARAMETER	Option 1 FOILCAT 189	Option 2 FOILCAT 154	Option 3 FOILCAT 122
LOA (m)	189.6	154.1	122.3
Gross Weight (tonnes)	13,333	8,667	5,333
Foil Aspect Ratio	5	5	5
Foil Span (m)	31.0	28.0	26.0
α_e @ cavitation limit	4.0 deg	3.5 deg	3.2 deg
Foil Lift (tonnes)	1,159	843	828
Foil Drag (kN)	696	505	488
Lift/Drag Ratio	16.32	16.36	16.64
Foilcat Total Resistance (kN)	6640	5436	4,050
Effective Power, P_e (kW)	187859	153801	114588
Shaft Power, P_s (kW)	289014	236617	176290
Margin	15%	15%	15%
Installed Power, P_I (kW)	332366	272109	202733
Specific Power (kW/t)	24.9	31.41	38.01

Chapter 5

ECONOMIC EVALUATION

General Comments

The Surface Effect Ship designs developed in Chapter 4 are used here for the purpose of assessing the economic viability of high speed sea freight systems. The objective is to estimate the economic performance of the designs and compare this with the known performance of both air and conventional sea services. Numerous publications are available describing the process of Investment Appraisal; Reference 58 is especially recommended as it discusses the technique as applicable to the ship design process.

In many economic investigations, various investment options will be analysed in a given model and the results compared to select the most 'attractive'. In such an investigation, it is often not necessary to include complicating effects such as tax and inflation into the economic model, as all investment options will be subject to the same factors. For this analysis, however, it is intended to compare estimated performance against 'real' data so it is necessary to construct a model capable of simulating a realistic financial regime. Thus the economic model used here incorporates tax, capital allowances, inflation, and interest relief.

The process of economic evaluation includes estimating building and operating costs, which is complicated by the fact that the proposed designs are considerably larger than anything currently in service. However, best estimates are made as described below with the aim of assessing the effect of uncertainties in these costs as part of the overall economic analysis.

A selected financial scenario is used to evaluate the economics, which forms the basis of a *Sensitivity Study* in which the effects of some design and cost estimate uncertainties are assessed. This study will also address the uncertainty associated with the financial system, by investigating the effects on the operating economics of alternative rates of tax and inflation, as well as the possibility of some operating costs escalating faster than inflation, such as Fuel and Repair & Maintenance.

Build Cost Estimates.

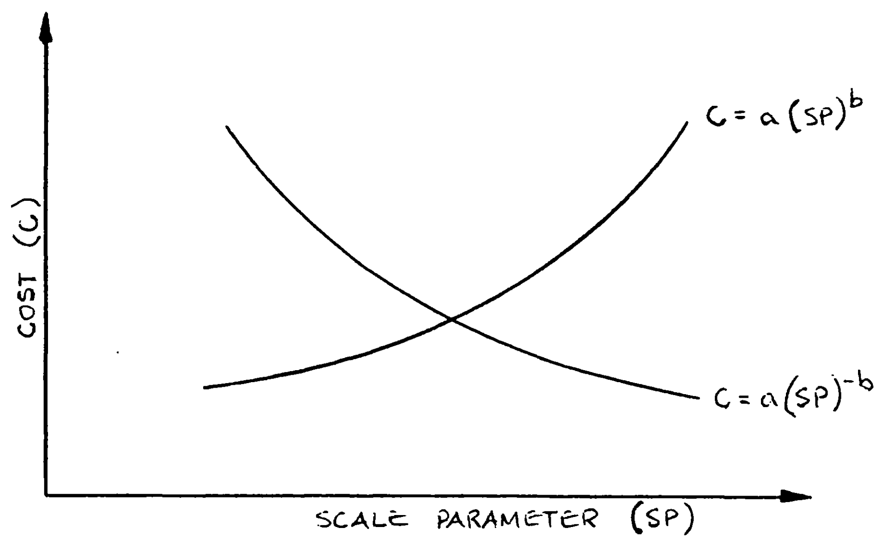
Build costs for each of the SES design options were estimated using known cost data relating to two existing twin hull designs, for which reasonably detailed cost estimates were available. A spreadsheet was developed which calculated the material and manhour costs of various components within the main weight groups of Hull Structure, Machinery, Electric System, Auxiliary Systems and Outfit.

For cost components such as Hull Structure or Prime Movers, the cost was estimated on the basis of design data such as Weight of Steel or Installed Power, using parameters such as (manhour/tonne) or (£/kW) as required. The cost of other components was estimated using the relationship

$C_i = a(SP)^b$, where

a = scale constant
SP = scale parameter
b = scale index

This method allows for both economies and diseconomies of scale in any given cost component as illustrated below:



The *Scale Parameter,* SP, was varied for each component and depended on its nature; for example the cabling cost was assumed to vary with enclosed volume. The scale parameters for most components were mostly generated from a relationship of hull dimensions, while for other components such as [Propuslors, Gearboxes and Transmission] the Installed Power would be used.

The data sets for the two twin hulled vesesl related to a 33m and a 70 m crafts, thus representing a good diffence in size for extrapolation purposes. These data were used to solve for (a) & (b), the scale constant and scale index respectively, by inserting the known component cost value and the scale parameter value calculated in the spreadsheet. For example,

Dataset :	Cabling Material Cost (Ci)	Cabling Scale Parameter (SP)

1	35	24
2	250	252

gives the following pair of equations:

a(24)b = 35..(i)

& a(252)b = 250..(ii)

which can be solved for both (a) and (b) to allow cost estimates on the new designs. Appendix 3 includes buildcost estimates for design options 1, 2 and 3.

Operating Cost Estimates

As in the case of estimating build costs, and indeed for the design process itself, the greatest difficulty in deriving estimates of operating costs lay in attempting to extrapolate the limited data available for in service vessels over a considerable increase in craft size. However, in estimating the value associated with the various costheads, some very useful data for conventional ships was available in Reference 59.

Knowing the duration of each trip, the number of trips per day or week was calculated, and hence number of trips per annum. This also gave number of operating hours for use in deriving an estimate of Repair & Maintenance costs. The assumed operating profile for each option is summarised below:

Option 1: 2 trips per week at 55 hours per trip, for an operating year of 48 weeks = 96 trips or 5280 operating hours each year.

Option 2: 2 trips of 27 hours per trip every 3 days giving 336 operating days in an operating year of 48 weeks, giving 224 trips or 6048 operating hours each year.

Option 3: 1 trip of 19 hours every day per week for 48 weeks in a year, giving 336 trips or 6384 operating hours each year.

By assuming simple relationships involving craft characteristics, operating cost profiles were derived for each design option as follows:

Cost Item	Assumed Cost or Cost Relationship
Registration:	£5000, £6000 and £7500 per annum assumed for Options 1, 2 and 3 respectively; initial registration fee disregarded.
Manning:	£5000 per month for each crew member, which allows for both direct and indirect labour costs; manning costs will vary for each

option according to vessel complement of 38, 29 and 24 for options 1, 2 and 3 respectively.

Insurance: Assumed as 1.5% of newbuild price

Repair & Maint.: Estimated as £500 per operating hour for Option 3, £600 for Option 2 and £750 for Option 1, the increase allowing for higher power requirements and hence higher maintenance costs.

Stores: Assumed as £300,000, £250,000 and £200,000 per annum for options 1, 2 and 3 respectively.

Victualling: Estimated using £4.50 per man per day at sea.

Administration: Taken as 0.1% of the purchase price per annum.

Fuel: Fuel price taken as £150/tonne, with fuel cost p.a. equal to (fuel per trip*no. trips p.a.*fuel cost)

Diesel: Generators assumed to consume half power while at sea, with full power when in port; diesel cost assumed as £150p.a.

Port Dues: Assumed equal to £0.75 per tonne cargo

Cargo Handling: Assumed equal to £100 per TEU moved.

The estimate of operating costs was made an integral part of the Investment Appraisal Model described below, so that the effect of escalating individal costheads at a rate faster than inflation could be assessed.

The resulting operating cost estimates for each design option are included in Appendix 4.

Investment Appraisal Model

(i) Economic Measure of Merit

The method used to evaluate the economic performance of the SES designs was that of *Required Freight Rate;* this allows the freight rate for one tonne of cargo carried on each option to be compared with current charges for air and sea cargo.

To calculate the Required Freight Rate, the level of revenue required to cover capital costs, operating costs and investment returns was found and divided by the annual tonnage carried. The investment return was included by discounting the annual cash flow by a specified rate of return using Discounted Cash Flow techniques. This was solved in an iterative process using a spreadsheet which is described below.

(ii) Finance Terms

Inputs to the calculation include debt ratio (the fraction of the purchase price funded by borrowings), interest rate, and loan period. The relevent columns are then calculated as follows:

Column	Item	Description
2	Capital =	Shipowner's equity at year 0, scrap value at end of project life
3	Loan Outstanding =	Previous Year's loan balance less end of year loan repayments.
4	Loan Repatment =	Initial Loan / Term of Loan
5	Interest =	(Interest Rate)*(Loan Outstanding at Year End)

(iii) Taxation

Current UK Corporation Tax rate of 33% is assumed, with capital allowances based on the declining balance method. Thus the scrap value at the end of the project life is assumed to equal the Initial Purchase Price less the sum of the capital allowances over the project life. Tax relief on capital is assumed to be delayed for one year, while the full relief on interest is deductable in the current year. Operating losses are accumulated, and are expressed as negative tax payments in the cash flow calculation. This is equivalent to the assumption that tax allowances can be claimed in the overall company balance sheet, that is, not restricted to a single project.

Column	Item	Description
6	Interest Relief =	(Tax Rate)*(Interest,C5)
7	Capital Allowance =	(Declining Balance %)*(Capital Value @ Previous Year End)
8	Relief on Capital =	(Tax Rate)*(Capital Allowance from two years before)

(iv) Cash Flow

'Base Revenue' is solved for zero NPV, with revenue in subsequent years increased by the rate of inflation. Operation costs for each year are calculated by the spreadsheet from the base year, allowing escalation of individual components faster than inflation. The 'Gross Surplus' is the annual revenue less the operation costs, loan repayments, and interest payments; the tax payable in any year is 33% of the gross surplus less capital and interest tax relief, giving the annual cash flow in column 13. The Discounted Cas Flow is the nominal cash flow discounted to year 0 by the discount rate selected for the analysis, including inflation, with the Net Present Value of the Investment (NPV) being the sum of the discounted cash flows.

The iteration process to solve for the 'Base Revenue' giving approximately zero NPV is controlled by selecting the initial value equal to [(Capital Recovery Factor*Price) plus (Operation Costs in Year 1)], then in subsequent iterations increasing or decreasing the revenue by one third of the current NPV; this ensures convergence by always adjusting the revenue in reducing amounts as the number of iterations increases. The rate of convergence can be controlled by dividing NPV by an amount other than 3. Finding the Base Revenue allows the Required Freight Rate to be calculated, dividing by the amount of cargo carried annually.

Column	Item	Description
11	Gross Surplus =	Annual Revenue - (Operating Costs + Loan Repayments + Interest on Loan) C9 - (C10 + C4 + C5)
12	Tax =	[Gross Surplus - (Relief on Capital + Interest Relief)] * Tax Rate [C11 - (C8 + C6)] * Tax Rate
13	Annual Cash Flow =	(Gross Surplus - Tax) C11 - C12
14	Discounted CF =	(Annual Cash Flow)*$[(1+\text{Discount Rate})*(1+\text{Inflation})]^{\text{year}}$
	NPV =	Σ(C14)

Base Economic Results

The Base Economic Results are those calculated for an assumed financial scenario which is considered to be realistic, that is neither obviously optimistic nor pessimistic. These results form the basis of the economic evaluation of the SES designs, but are supplemented by a sensitivity study which considers variations to the financial structure.

The basic assumptions for the project are:

° **a life of 15 years** - while 20 years may be possible, it is likely that since the technology is relatively immature some progress will be inevitable with new craft entering service being more economic.

° **a debt ratio of 75%** - ie the shipowner provides 25%of the capital, with the remainder borrowed at a favourable interest rate of 10% repayable over a ten year period.

° **inflation set at 5%** - historically this is optimistic but a consensus among governments appears to make control of inflation top priority, indicating the probability that inflation will be lower in most developed economies in the future compared to the past.

The discount rate was chosen as 17.5%, which could be considered high particularly with respect to the assumed interest rate; it would normally be sufficient to fix the interest rate and the discount rate at the same level, but in this instance it is complicated by the level of risk in the project.

The fact that a fast cargo ship of this size and form would represent a considerable technical achievement implies a reasonably high level of risk associated with the project. For this to attract the level of capital resources required demands a premium on the investment rate of return (discount rate) which justifies the 17.5% value. However, it would be right to argue that if the risk demands a higher discount rate than normal then the same would apply to the interest rate - the financiers would not be keen to lend at a rate incompatible with the risk level either.

A differential in interest and discount rates was applied because the finance is assumed to be on the type of favourable terms commonly seen in shipbuilding (where governments will tend to encourage the industry particularly in the high technology sector). In fact, an interest rate as low as 7 -8 % would probably have been used were this an appraisal of conventional shipping economics, so the value of 10% allows some measure of risk. However, while the finance may be available at attractive rates the shipowner will be faced with alternative investment projects, most of which will have lower risks. So while for average potential investments the discount rate is driven by the organisations marginal cost of capital, a high potential return would be necessary to justify the decision to invest in a high speed cargo Surface Effect Ship.

Having described the financial parameters affecting the economic evaluation, attention is now drawn to the results of the Required Freight Rate analyses. Tables 5.1-3 present the full disounted cash flow analysis for Options 1,2 and 3 and summarised below and compared to current air and sea transport costs:

Option	RFR (£/tonne)	RFR (£/tonne-nm)	Air Freight (£/tonne-nm)	Sea Freight (£/tonne-nm)
1	859	0.286	0.484	0.032
2	248	0.165	0.581	0.032
3	171	0.171	0.645	0.032

From these results, it is important to observe that the SES costs per mile travelled tends to increase with range, whereas those for aircraft tend to decrease. This shows the penalties incurred with aircraft at short ranges due to the increased fuel burned and extra landing charges during more frequent takeoff's.

Also from these results, it is possible to calculate the overall transit cost for each mode at the different distances as follows:

Total Transit Cost = Freight Rate + Ownership Cost

$$= \text{Freight Rate} + \frac{(\text{Value of Cargo / tonne})*(\text{Range})*(\text{Interest})}{(\text{Speed}*24*365)}$$

This was calculated for various value's of freight to for each transport mode, and the results are plotted in Figures 5.1- 3. These plots suggest that the value of freight which an AMV cargo vessel would need to attract is considerably higher than most tradeable commodities. This point is dealt with more fully in Chapter 7.

Sensitivity Analysis

Economic conditions which affect the viability of investments are by their nature cyclic, so that most of the governing financial parameters assumed for the above economic evaluation will vary throughout the project life. The potential effect of these variations on the required freight rates needs to be quantified as part of the economic evaluation.

A *Sensitivity Analysis* is used to identify the most important elements in the assumed cash flow scenarios as an aid to the final decision on the proposed investment - if the economic measure of merit varies to any significant extent with a given element then the decision would focus on the probability of that element increasing from the assumed value. In contrast, a robust measure of merit over all elements in the cash flow would indicate good investment potential due to the low combined probability of the conclusions being invalidated.

In this sensitivity analysis, emphasis was given to the elements considered most likely to vary from the assumed values. Thus the following parameters were varied between 'low and high' figures providing an envelope of possible values for each:

(i) Discount Rate - a high value was chosen initially to reflect the level of risk in a real project of this nature, and it is likely that technical progress in the short term will reduce this.

(ii) Interest Rate - finance was assumed to be available on generous terms due to government support, so a commercial loan would require interest closer to the discount rate.

(iii) Build Cost - there is considerable uncertainty in the original cost estimate and it is evident from the cash flow tables that the capital cost is a major factor in the overall analysis.

(iv) Fuel Price - the high power consumption in each option obviously dictates substantial fuel consumption, so any change in the fuel price is likely to have a significant impact on economic viability.

(v) Tax Rate - because the tax rate will depend on which country the operator is registered in, any sensitivity to tax rates would suggest that the success of the project may depend on location.

In addition to a simple variation in the above parameters, the possibility of either Fuel or Repair & Maintenance costs rising faster than inflation was addressed - Fuel because it has a volatile history and uncertain supply, and Repair & Maintenance because breakdown becomes more likely as the vessel ages.

All of the above variations were applied only to Option 2, the 157m design, to keep the results as simple as possile while still allowing a judgement to be made on the relative importance of each parameter. The results of the analysis are described below, with full output of the Cash Flow and Operating Cost breakdowns included in Appendix 5.

(i) Discount Rate

Varied from the reasonably low rate of 10% (equal to the assumed interest rate) to a high of 20%. The effect is shown in Figure 5.4, which was to produce a change of £4, or 1.6%, in the Required Freight Rate for every 2.5% difference in the discount rate. This shows relative insensitivity and implies that the project may be viable for company's with different marginal capital costs.

(ii) Interest Rate

The lowest level which might be expected allowing for state support would be around 8%; for simplicity, the interest rate was varied between 7.5% and 20%. The results illustrated in Figure 5.5 show that the viability of the project would be almost unaffected by the interest rate so long as it remained within the bounds of recent history.

(iii) Build Cost

This was varied from 80% of the original estimate to 150%, which tries to take account of the fact that cost estimates are normally more likely to be under than over predicted. These levels are not intended to allow for the possibility of subsidised prices. Figure 5.6 shows that, while obviously important, build cost fluctuations would not change RFR's too much, with a 50% increase in the former producing only a 12% change in RFR.

(iv) Fuel Price

Fuel price was varied from £120 ($185) to £225 ($350) per tonne, a wide range reflecting the volatile supply. The dominant nature of fuel price in the cash flow is illustrated in Figure 5.7, which shows that any increase in fuel price would need to be completely recovered in the freight charge. This is a very difficult position for any potential investment, where the viability tends to depend on a single factor, made even worse by the fact that in this case it's future level is quite unpredictable.

(v) Tax Rate

This was varied from a low of 25%, to a high of 45% which is towards the top end of the prevaling rates in most developed nations. This analysis produced unexpected results, which can be understood with the benefit of hindsight, as illustrated in Figure 5.8 - where an increase in the tax rate actually results in a lower required freight rate.

This peculiar situation is due to the assumption that capital and interest tax relief allowances are not restricted to the project, but may be recovered on the back of trading profits from other activities of the company, or within a group of companies. Thus in early years where interest payments and depreciation levels are high, the corresponding allowances are also high; when this is coupled with the fact that the high interest payments result in a low trading surplus the result is a 'negative' tax payment. Of course this is not an actual payment from the state, but it is a reduction in tax due from the company overall, directly attributable to this investment. So where the tax rate is high, the tax 'credit' is also high and it's importance is emphasised in the early years by the low discount factor.

(v) Fuel Escalation

The fuel price was escalated at rates 2.5% to 10% above the inflation rate, equivalent to fuel inflation ranging from 7.5% to 15%. The results are shown in Figure 5.9 and demonstrate that fuel escalation over the life of the project would not be as serious as would an increase in price above the assumed value throughout. Since the increase is cumulative, while the nominal effects may be larger in later years, their overall importance would be diminished due to discounting.

(vi) Repair & Maintenance Escalation

This element was escalated at the same rates as the fuel price, and the results also illustrated in Figure 5.9 show that the effect of escalating R & M costs ahead of inflation are not serious due to their insignificance relative to fuel costs.

To place the results of the Sensitivity Analysis in perspective, an envelope of probable economic performance was derived, by evaluating the RFR of each design option for best and worst operating terms. The financial controls were adjusted to reflect the best and worst that could reasonably be expected over the project life. The resulting cash flow analyses are presented in Tables 5.6 - 5.8 and operating costs in Appendix 6, with the RFR's calculated as given below:

Option	Best RFR (£/tonne)	Worst RFR (£/tonne)
1: L=194m	585	1121
2: L=158m	173	315
3: L=125m	120	219

Using these RFR's, the best and worst total transit costs for various goods values were also calculated which included the investment cost associated with ownership of the goods. These are compared to the relevant Air and Sea total transit costs in Figures 5.10 - 5.12.

Figure 5.1
SES194 versus Aircraft/Ship Total Transit Cost

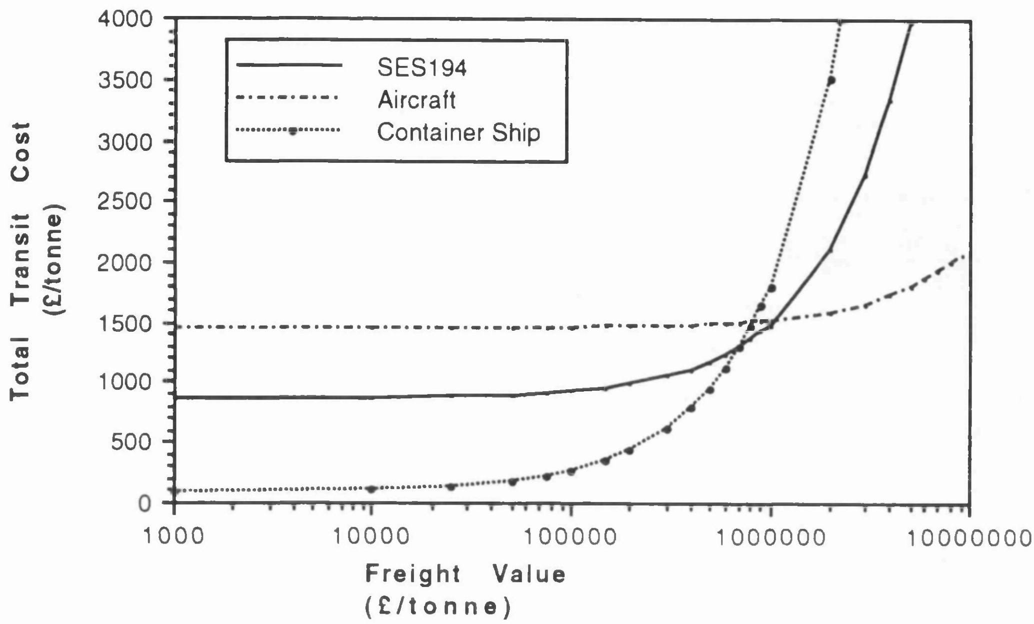


Figure 5.2
SES157 versus Aircraft/Ship Total Transit Cost

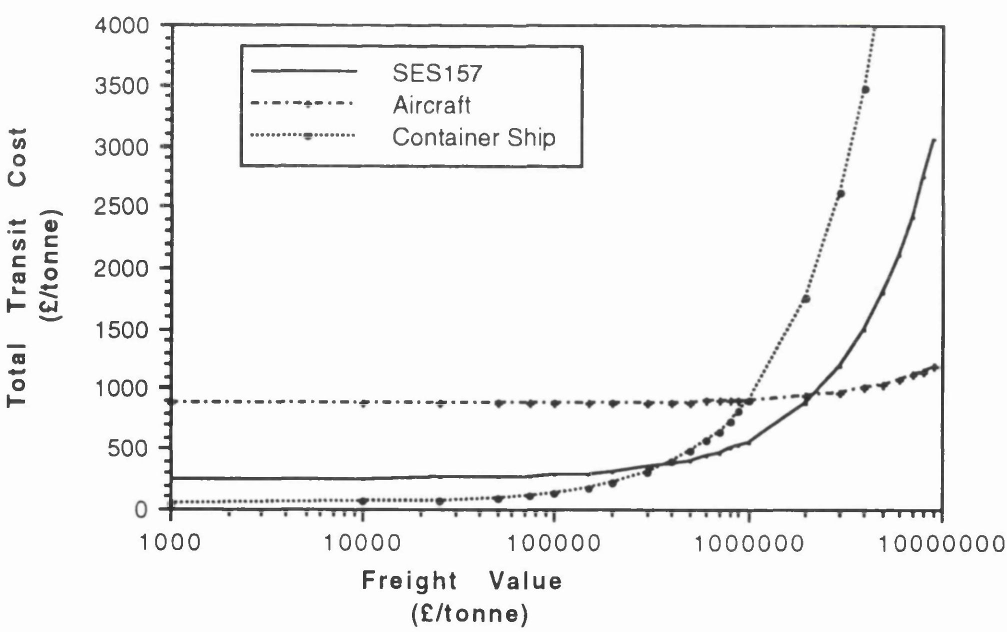


Figure 5.3
SES125 versus Aircraft/Ship Total Transit Cost

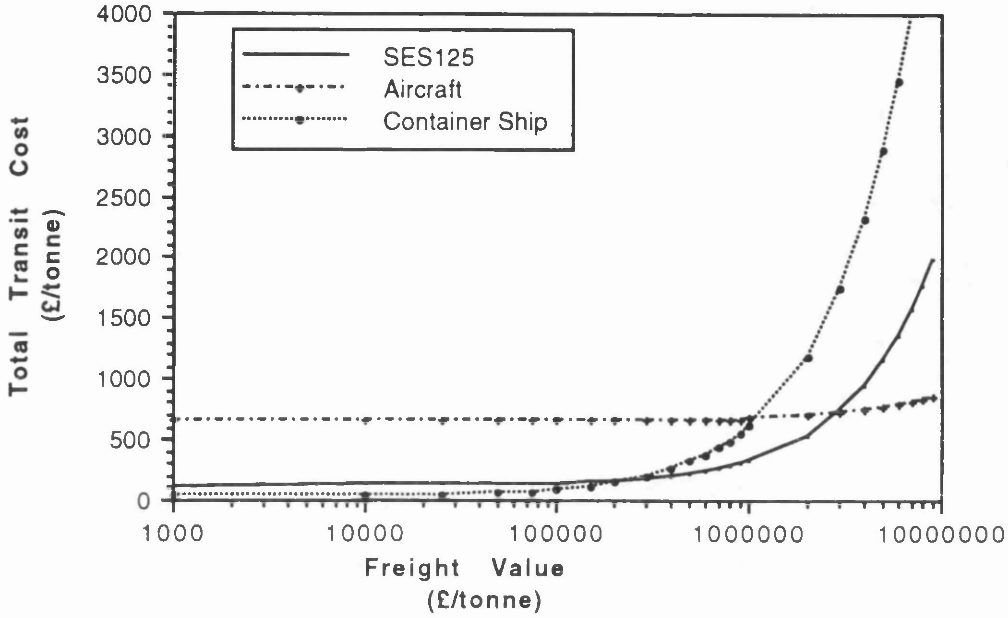


Figure 5.4
SES157 RFR Sensitivity with Discount Rate

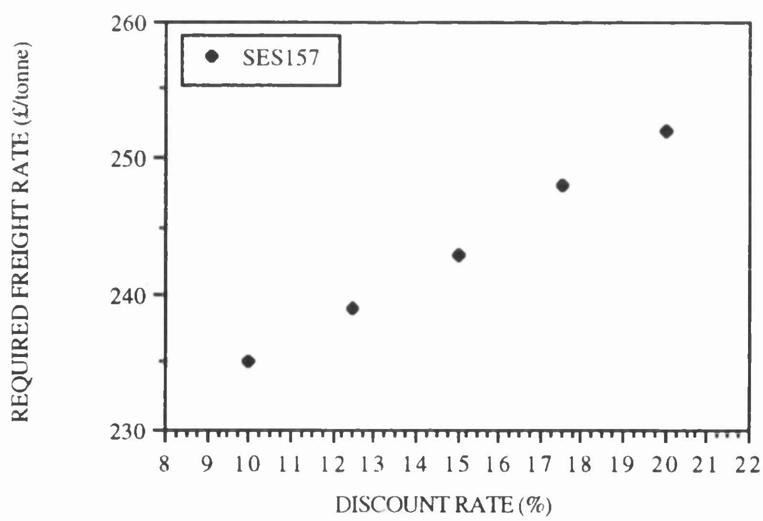


Figure 5.5
SES157 RFR Sensitivity with Interest Rate

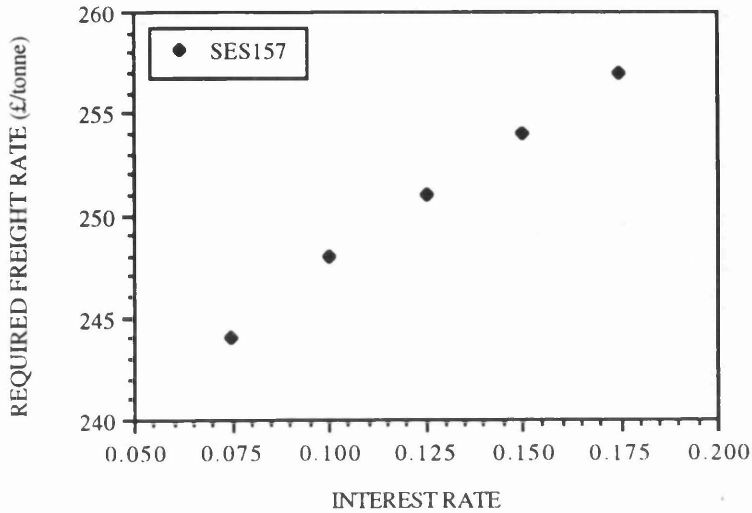


Figure 5.6
SES157 RFR Sensitivity with Build Costs

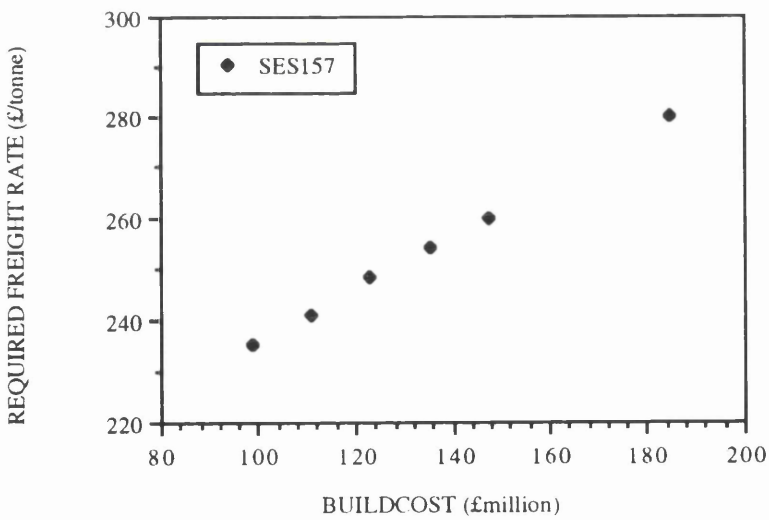


Figure 5.7
SES157 RFR Sensitivity with Fuel Price

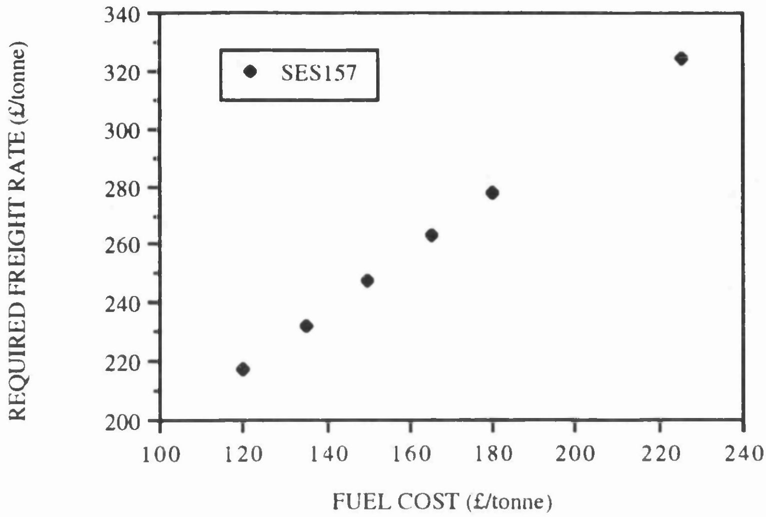


Figure 5.8
SES157 RFR Sensitivity with Tax Rate

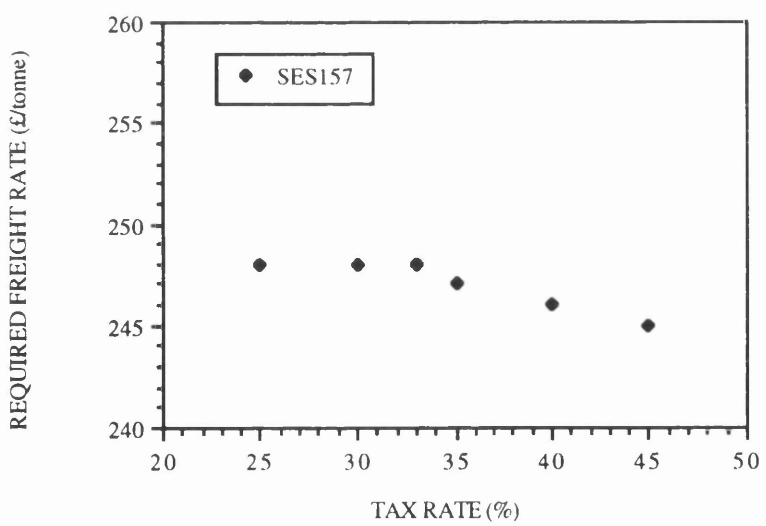


Figure 5.9
SES157 RFR Sensitivity with Fuel/Repair & Mainteneance Escalation

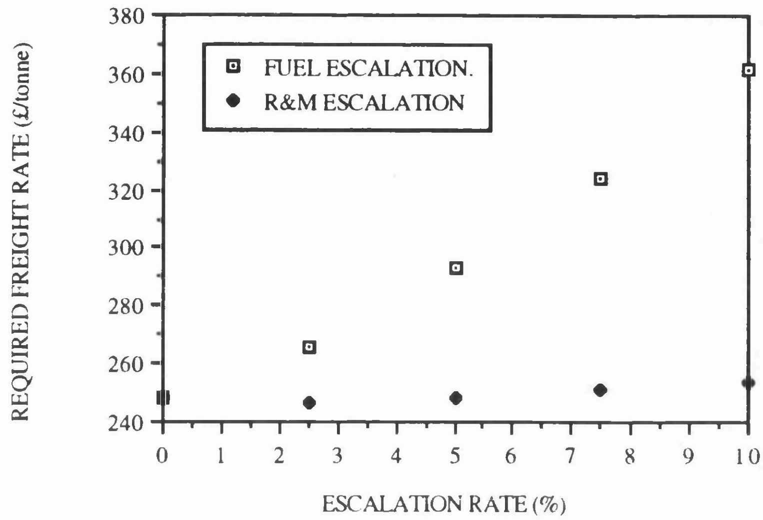


Figure 5.10
SES194 Best/Worst versus Aircraft/Ship Total Transit Cost

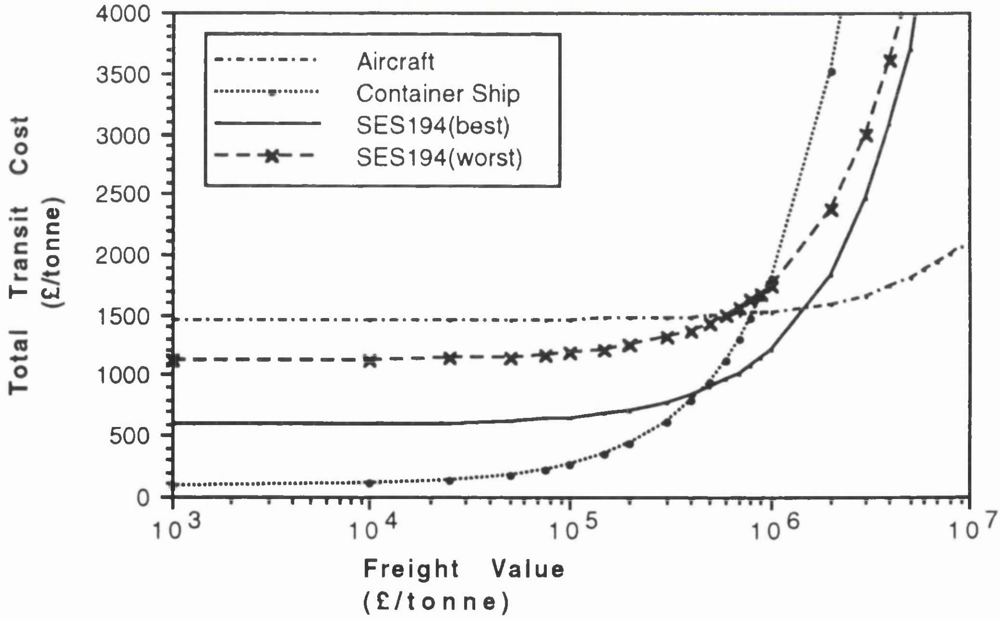


Figure 5.11
SES157 Best/Worst versus Aircraft/Ship Total Transit Cost

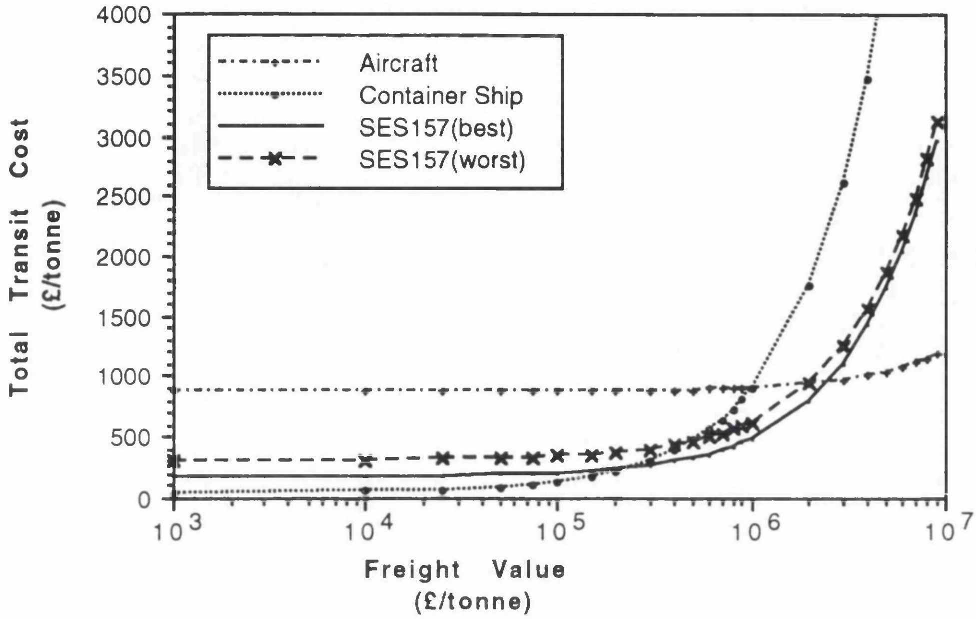


Figure 5.12
SES125 Best/Worst versus Aircraft/Ship Total Transit Cost

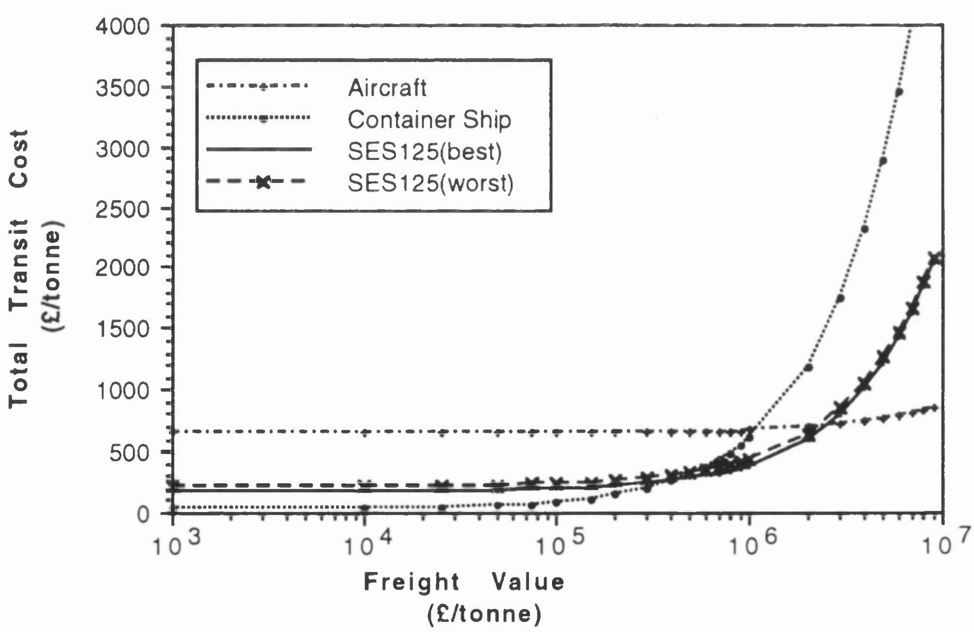


Table 5.1
SES194 Discounted Cash Flow Analysis

PROJECT LIFE: 15 PRICE: 168000000 DEBT RATIO: 0.75 LOAN YEARS: 10 INTEREST RATE: 0.1

DECLINING BAL.: 0.2

TAX RATE: 0.33 INFLATION RATE: 0.05 DISCOUNT RATE: 0.175 BASE REVENUE: 86640406

SCRAP VALUE: 5910975

YEAR	CAPITAL	LOAN OUTSTANDING	LOAN REPAYMENTS	INTEREST PAYMENTS	RELIEF ON INTEREST	CAPITAL ALLOWANCE	RELIEF ON CAPITAL	ANNUAL REVENUE	OPERATING COSTS	GROSS SURPLUS	TAX	ANNUAL CASH FLOW	DISCOUNTED CASH FLOW
0	-42000000	0	0	0	0	0	0	0	0	0	0	-42000000	-42000000
1	0	126000000	12600000	12600000	4158000	33600000	0	86640406	60899167	541239	-1193531	1734770	1406096
2	0	113400000	12600000	11340000	3742200	26880000	11088000	90972426	63944125	3088301	-3874827	6963128	4574568
3	0	100800000	12600000	10080000	3326400	21504000	8870400	95521048	67141331	5699716	-2144038	7843754	4176788
4	0	88200000	12600000	8820000	2910600	17203200	7096320	100297100	70498398	8378702	-537312	8916014	3848239
5	0	75600000	12600000	7560000	2494800	13762560	5677056	105311955	74023318	11128637	975738	10152900	3551847
6	0	63000000	12600000	6300000	2079000	11010048	4541645	110577553	77724484	13953069	2419700	11533369	3270342
7	0	50400000	12600000	5040000	1663200	8808038	3633316	116106431	81610708	16855723	3814538	13041184	2997277
8	0	37800000	12600000	3780000	1247400	7046431	2906653	121911752	85691243	19840509	5176531	14663978	2731709
9	0	25200000	12600000	2520000	831600	5637145	2325322	128007340	89975805	22911534	6519022	16392512	2475147
10	0	12600000	12600000	1260000	415800	4509716	1860258	134407707	94474596	26073111	7853028	18220083	2229866
11	0	0	0	0	0	3607773	1488206	141128092	99198325	41929767	13345715	28584052	2835469
12	0	0	0	0	0	2886218	1190565	148184497	104158242	44026255	14135778	29890477	2403294
13	0	0	0	0	0	2308974	952452	155593721	109366154	46227568	14940788	31286779	2038955
14	0	0	0	0	0	1847180	761962	163373408	114834461	48538946	15766405	32772541	1731130
15	5910975	0	0	0	0	1477744	609569	171542078	120576185	50965893	16617587	40259281	1723687
16	0	0	0	0	0	0	487655	0	0	0	-160926	160926	5585
17	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0
												NPV	0

REQUIRED FREIGHT RATE = 859 £/tonne

(with 80% load factor)

Table 5.2
SES157 Discounted Cash Flow Analysis

PROJECT LIFE: 15 | PRICE: 123000000 | DEBT RATIO: 0.75 | LOAN YEARS: 10 | INTEREST RATE: 0.1

DECLINING BAL.: 0.2

TAX RATE: 0.33 | INFLATION RATE: 0.05 | DISCOUNT RATE: 0.175 | BASE REVENUE: 80011015

SCRAP VALUE: 4327678

YEAR	CAPITAL	LOAN OUTSTANDING	LOAN REPAYMENTS	INTEREST PAYMENTS	RELIEF ON INTEREST	CAPITAL ALLOWANCE	RELIEF ON CAPITAL	ANNUAL REVENUE	OPERATING COSTS	GROSS SURPLUS	TAX	ANNUAL CASH FLOW	DISCOUNTED CASH FLOW
0	-30750000	0	0	0	0	0	0	0	0	0	0	-30750000	-30750000
1	0	92250000	9225000	9225000	3044250	24600000	0	80011015	61164751	396265	-873835	1270100	1029463
2	0	83025000	9225000	8302500	2739825	19680000	8118000	84011566	64222988	2261078	-2836927	5098004	3349237
3	0	73800000	9225000	7380000	2435400	15744000	6494400	88212144	67434138	4173007	-1569742	5742748	3058006
4	0	64575000	9225000	6457500	2130975	12595200	5195520	92622752	70805845	6134407	-393389	6527796	2817461
5	0	55350000	9225000	5535000	1826550	10076160	4156416	97253889	74346137	8147752	714380	7433373	2600459
6	0	46125000	9225000	4612500	1522125	8060928	3325133	102116584	78063444	10215640	1771566	8444074	2394358
7	0	36900000	9225000	3690000	1217700	6448742	2660106	107222413	81966616	12340797	2792787	9548010	2194435
8	0	27675000	9225000	2767500	913275	5158994	2128085	112583534	86064947	14526087	3789960	10736127	2000001
9	0	18450000	9225000	1845000	608850	4127195	1702468	118212710	90368194	16774516	4772855	12001661	1812161
10	0	9225000	9225000	922500	304425	3301756	1361974	124123346	94886604	19089242	5749538	13339704	1632580
11	0	0	0	0	0	2641405	1089580	130329513	99630934	30698579	9770970	20927609	2075969
12	0	0	0	0	0	2113124	871664	136845989	104612481	32233508	10349409	21884099	1759554
13	0	0	0	0	0	1690499	697331	143688288	109843105	33845183	10938791	22906392	1492807
14	0	0	0	0	0	1352399	557865	150872702	115335260	35537443	11543261	23994182	1267435
15	4327678	0	0	0	0	1081919	446292	158416338	121102023	37314315	12166448	29475545	1261985
16	0	0	0	0	0	0	357033	0	0	0	-117821	117821	4089
17	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0
												NPV	0

REQUIRED FREIGHT RATE = 248 £/tonne

(with 80% load factor)

Table 5.3
SES125 Discounted Cash Flow Analysis

PROJECT LIFE: 15 | PRICE: 85000000 | DEBT RATIO: 0.75 | LOAN YEARS: 10 | INTEREST RATE: 0.1

DECLINING BAL.: 0.2

TAX RATE: 0.33 | INFLATION RATE: 0.05 | DISCOUNT RATE: 0.175 | BASE REVENUE: 58088944

SCRAP VALUE: 2990672

YEAR	CAPITAL	LOAN OUTSTANDING	LOAN REPAYMENTS	INTEREST PAYMENTS	RELIEF ON INTEREST	CAPITAL ALLOWANCE	RELIEF ON CAPITAL	ANNUAL REVENUE	OPERATING COSTS	GROSS SURPLUS	TAX	ANNUAL CASH FLOW	DISCOUNTED CASH FLOW
0	-21250000	0	0	0	0	0	0	0	0	0	0	-21250000	-21250000
1	0	63750000	6375000	6375000	2103750	17000000	0	58088944	45065103	273841	-603870	877711	711417
2	0	57375000	6375000	5737500	1893375	13600000	5610000	60993391	47318358	1562533	-1960478	3523011	2314513
3	0	51000000	6375000	5100000	1683000	10880000	4488000	64043061	49684276	2883785	-1084781	3968566	2113256
4	0	44625000	6375000	4462500	1472625	8704000	3590400	67245214	52168490	4239224	-271854	4511079	1947026
5	0	38250000	6375000	3825000	1262250	6963200	2872320	70607475	54776914	5630561	493677	5136884	1797065
6	0	31875000	6375000	3187500	1051875	5570560	2297856	74137849	57515760	7059589	1224253	5835336	1654637
7	0	25500000	6375000	2550000	841500	4456448	1838285	77844741	60391548	8528193	1929975	6598218	1516479
8	0	19125000	6375000	1912500	631125	3565158	1470628	81736978	63411125	10038353	2619078	7419275	1382115
9	0	12750000	6375000	1275000	420750	2852127	1176502	85823827	66581682	11592145	3298315	8293831	1252307
10	0	6375000	6375000	637500	210375	2281701	941202	90115018	69910766	13191753	3973258	9218495	1128206
11	0	0	0	0	0	1825361	752961	94620769	73406304	21214465	6752296	14462169	1434612
12	0	0	0	0	0	1460289	602369	99351808	77076619	22275188	7152030	15123158	1215952
13	0	0	0	0	0	1168231	481895	104319398	80930450	23388948	7559327	15829621	1031614
14	0	0	0	0	0	934585	385516	109535368	84976973	24558395	7977050	16581345	875870
15	2990672	0	0	0	0	747668	308413	115012136	89225821	25786315	8407708	20369279	872104
16	0	0	0	0	0	0	246730	0	0	0	-81421	81421	2826
17	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0
												NPV	0

REQUIRED FREIGHT RATE = 171 £/tonne

(with 80% load factor)

Table 5.4
SES194 Best Discounted Cash Flow Analysis

PROJECT LIFE: 20　PRICE: 142800000　DEBT RATIO: 0.75　LOAN YEARS: 15　INTEREST RATE: 0.08

DECLINING BAL.: 0.2

TAX RATE: 0.25　INFLATION RATE: 0.05　DISCOUNT RATE: 0.1　BASE REVENUE: 66396772

SCRAP VALUE: 1646372

YEAR	CAPITAL	LOAN OUTSTANDING	LOAN REPAYMENTS	INTEREST PAYMENTS	RELIEF ON INTEREST	CAPITAL ALLOWANCE	RELIEF ON CAPITAL	ANNUAL REVENUE	OPERATING COSTS	GROSS SURPLUS	TAX	ANNUAL CASH FLOW	DISCOUNTED CASH FLOW
0	-35700000	0	0	0	0	0	0	0	0	0	0	-35700000	-35700000
1	0	107100000	7140000	8568000	2142000	28560000	0	66396772	52358689	-1669916	-952979	-716937	-620725
2	0	99960000	7140000	7996800	1999200	22848000	7140000	69716611	54976623	-396812	-2384003	1987191	1489620
3	0	92820000	7140000	7425600	1856400	18278400	5712000	73202442	57725454	911387	-1664253	2575640	1671627
4	0	85680000	7140000	6854400	1713600	14622720	4569600	76862564	60611727	2256437	-1006691	3263128	1833606
5	0	78540000	7140000	6283200	1570800	11698176	3655680	80705692	63642313	3640179	-396575	4036754	1963913
6	0	71400000	7140000	5712000	1428000	9358541	2924544	84740976	66824429	5064547	178001	4886547	2058307
7	0	64260000	7140000	5140800	1285200	7486833	2339635	88978025	70165650	6531575	726685	5804890	2116996
8	0	57120000	7140000	4569600	1142400	5989466	1871708	93426926	73673933	8043394	1257321	6786072	2142706
9	0	49980000	7140000	3998400	999600	4791573	1497367	98098273	77357630	9602243	1776319	7825924	2139428
10	0	42840000	7140000	3427200	856800	3833258	1197893	103003186	81225511	11210475	2288946	8921530	2111638
11	0	35700000	7140000	2856000	714000	3066607	958315	108153346	85286787	12870559	2799561	10070998	2063815
12	0	28560000	7140000	2284800	571200	2453285	766652	113561013	89551126	14585087	3311809	11273278	2000168
13	0	21420000	7140000	1713600	428400	1962628	613321	119239064	94028682	16356781	3828765	12528016	1924494
14	0	14280000	7140000	1142400	285600	1570103	490657	125201017	98730116	18188501	4353061	13835440	1840116
15	0	7140000	7140000	571200	142800	1256082	392526	131461068	103666622	20083246	4886980	15196266	1749875
16	0	0	0	0	0	1004866	314021	138034121	108849953	29184168	7217537	21966631	2190038
17	0	0	0	0	0	803893	251216	144935827	114292451	30643376	7598040	23045336	1989250
18	0	0	0	0	0	643114	200973	152182619	120007073	32175545	7993643	24181902	1807235
19	0	0	0	0	0	514491	160779	159791749	126007427	33784322	8405886	25378436	1642129
20	1646372	0	0	0	0	411593	128623	167781337	132307799	35473538	8836229	28283681	1584515
21	0	0	0	0	0	0	102898	0	0	0	-25725	25725	1248
22	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0
												NPV	0

REQUIRED FREIGHT RATE = 585 £/tonne

(with 90% load factor)

Table 5.5
SES194 Worst Discounted Cash Flow Analysis

PROJECT LIFE: 12 | **PRICE:** 193200000 | **DEBT RATIO:** 0.5 | **LOAN YEARS:** 8 | **INTEREST RATE:** 0.12

DECLINING BAL.: 0.2

TAX RATE: 0.4 | **INFLATION RATE:** 0.05 | **DISCOUNT RATE:** 0.175 | **BASE REVENUE:** 113159011

SCRAP VALUE: 13276603

YEAR	CAPITAL	LOAN OUTSTANDING	LOAN REPAYMENTS	INTEREST PAYMENTS	RELIEF ON INTEREST	CAPITAL ALLOWANCE	RELIEF ON CAPITAL	ANNUAL REVENUE	OPERATING COSTS	GROSS SURPLUS	TAX	ANNUAL CASH FLOW	DISCOUNTED CASH FLOW
0	-96600000	0	0	0	0	0	0	0	0	0	0	-96600000	-96600000
1	0	96600000	12075000	11592000	4636800	38640000	0	113159011	69638095	19853917	6086847	13767070	11158719
2	0	84525000	12075000	10143000	4057200	30912000	15456000	118816962	73120000	23478963	1586305	21892658	14382824
3	0	72450000	12075000	8694000	3477600	24729600	12364800	124757810	76776000	27212811	4548164	22664646	12068893
4	0	60375000	12075000	7245000	2898000	19783680	9891840	130995701	80614799	31060901	7308424	23752477	10251803
5	0	48300000	12075000	5796000	2318400	15826944	7913472	137545486	84645539	35028946	9918830	25110117	8784416
6	0	36225000	12075000	4347000	1738800	12661555	6330778	144422760	88877816	39122944	12421346	26701597	7571366
7	0	24150000	12075000	2898000	1159200	10129244	5064622	151643898	93321707	43349191	14850147	28499043	6549982
8	0	12075000	12075000	1449000	579600	8103395	4051698	159226093	97987793	47714300	17233201	30481099	5678234
9	0	0	0	0	0	6482716	3241358	167187397	102887182	64300215	24423543	39876672	6021080
10	0	0	0	0	0	5186173	2593087	175546767	108031541	67515226	25968856	41546370	5084654
11	0	0	0	0	0	4148938	2074469	184324106	113433118	70890987	27526607	43364380	4301643
12	13276603	0	0	0	0	3319151	1659575	193540311	119104774	74435537	29110385	58601755	4711776
13	0	0	0	0	0	0	1327660	0	0	0	-531064	531064	34609
14	0	0	0	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0
												NPV	0

REQUIRED FREIGHT RATE = 1121 £/tonne

(with 80% load factor)

Table 5.6
SES157 Best Discounted Cash Flow Analysis

PROJECT LIFE: 20 | PRICE: 104550000 | DEBT RATIO: 0.75 | LOAN YEARS: 15 | INTEREST RATE: 0.08

DECLINING BAL.: 0.2

TAX RATE: 0.25 | INFLATION RATE: 0.05 | DISCOUNT RATE: 0.1 | BASE REVENUE: 62827186

SCRAP VALUE: 1205379

YEAR	CAPITAL	LOAN OUTSTANDING	LOAN REPAYMENTS	INTEREST PAYMENTS	RELIEF ON INTEREST	CAPITAL ALLOWANCE	RELIEF ON CAPITAL	ANNUAL REVENUE	OPERATING COSTS	GROSS SURPLUS	TAX	ANNUAL CASH FLOW	DISCOUNTED CASH FLOW
0	-26137500	0	0	0	0	0	0	0	0	0	0	-26137500	-26137500
1	0	78412500	5227500	6273000	1568250	20910000	0	62827186	52549303	-1222617	-697717	-524900	-454459
2	0	73185000	5227500	5854800	1463700	16728000	5227500	65968545	55176768	-290523	-1745431	1454908	1090615
3	0	67957500	5227500	5436600	1359150	13382400	4182000	69266972	57935607	667266	-1218471	1885737	1223870
4	0	62730000	5227500	5018400	1254600	10705920	3345600	72730321	60832387	1652034	-737041	2389076	1342462
5	0	57502500	5227500	4600200	1150050	8564736	2676480	76366837	63874006	2665131	-290350	2955481	1437865
6	0	52275000	5227500	4182000	1045500	6851789	2141184	80185179	67067707	3707972	130322	3577650	1506975
7	0	47047500	5227500	3763800	940950	5481431	1712947	84194438	70421092	4782046	532037	4250009	1549944
8	0	41820000	5227500	3345600	836400	4385145	1370358	88404160	73942147	5888913	920539	4968374	1568767
9	0	36592500	5227500	2927400	731850	3508116	1096286	92824368	77639254	7030214	1300519	5729694	1566367
10	0	31365000	5227500	2509200	627300	2806493	877029	97465586	81521217	8207669	1675835	6531834	1546021
11	0	26137500	5227500	2091000	522750	2245194	701623	102338865	85597277	9423088	2049679	7373409	1511007
12	0	20910000	5227500	1672800	418200	1796155	561299	107455809	89877141	10678367	2424717	8253650	1464409
13	0	15682500	5227500	1254600	313650	1436924	449039	112828599	94370998	11975501	2803203	9172298	1409004
14	0	10455000	5227500	836400	209100	1149539	359231	118470029	99089548	13316581	3187062	10129518	1347228
15	0	5227500	5227500	418200	104550	919632	287385	124393531	104044026	14703805	3577967	11125837	1281159
16	0	0	0	0	0	735705	229908	130613207	109246227	21366980	5284268	16082712	1603421
17	0	0	0	0	0	588564	183926	137143867	114708538	22435329	5562851	16872478	1456415
18	0	0	0	0	0	470851	147141	144001061	120443965	23557096	5852489	17704607	1323155
19	0	0	0	0	0	376681	117713	151201114	126466164	24734950	6154309	18580641	1202273
20	1205379	0	0	0	0	301345	94170	158761170	132789472	25971698	6469382	20707695	1160091
21	0	0	0	0	0	0	75336	0	0	0	-18834	18834	914
22	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0
												NPV	0

REQUIRED FREIGHT RATE = 173 £/tonne

(with 90% load factor)

Table 5.7
SES157 Worst Discounted Cash Flow Analysis

PROJECT LIFE: 12 | PRICE: 141450000 | DEBT RATIO: 0.5 | LOAN YEARS: 8 | INTEREST RATE: 0.12

DECLINING BAL.: 0.2

TAX RATE: 0.4 | INFLATION RATE: 0.05 | DISCOUNT RATE: 0.175 | BASE REVENUE: 101789020

SCRAP VALUE: 9720370

YEAR	CAPITAL	LOAN OUTSTANDING	LOAN REPAYMENTS	INTEREST PAYMENTS	RELIEF ON INTEREST	CAPITAL ALLOWANCE	RELIEF ON CAPITAL	ANNUAL REVENUE	OPERATING COSTS	GROSS SURPLUS	TAX	ANNUAL CASH FLOW	DISCOUNTED CASH FLOW
0	-70725000	0	0	0	0	0	0	0	0	0	0	-70725000	-70725000
1	0	70725000	8840625	8487000	3394800	28290000	0	101789020	69925492	14535903	4456441	10079462	8169777
2	0	61884375	8840625	7426125	2970450	22632000	11316000	106878472	73421767	17189955	1161402	16028553	10530282
3	0	53043750	8840625	6365250	2546100	18105600	9052800	112222395	77092855	19923665	3329906	16593759	8836154
4	0	44203125	8840625	5304375	2121750	14484480	7242240	117833515	80947498	22741017	5350811	17390206	7505784
5	0	35362500	8840625	4243500	1697400	11587584	5793792	123725191	84994873	25646193	7262000	18384192	6431448
6	0	26521875	8840625	3182625	1273050	9270067	4635034	129911450	89244616	28643584	9094200	19549384	5543322
7	0	17681250	8840625	2121750	848700	7416054	3708027	136407023	93706847	31737800	10872429	20865371	4795523
8	0	8840625	8840625	1060875	424350	5932843	2966422	143227374	98392190	34933684	12617165	22316519	4157279
9	0	0	0	0	0	4746274	2373137	150388742	103311799	47076943	17881522	29195421	4408291
10	0	0	0	0	0	3797020	1898510	157908180	108477389	49430790	19012912	30417878	3722693
11	0	0	0	0	0	3037616	1518808	165803589	113901259	51902330	20153409	31748921	3149417
12	9720370	0	0	0	0	2430092	1215046	174093768	119596321	54497446	21312960	42904856	3449693
13	0	0	0	0	0	0	972037	0	0	0	-388815	388815	25339
14	0	0	0	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0
												NPV	0

REQUIRED FREIGHT RATE = 315 £/tonne

(with 80% load factor)

Table 5.8
SES125 Best Discounted Cash Flow Analysis

PROJECT LIFE: 20 PRICE: 72250000 DEBT RATIO: 0.75 LOAN YEARS: 15 INTEREST RATE: 0.08

DECLINING BAL.: 0.2

TAX RATE: 0.25 INFLATION RATE: 0.05 DISCOUNT RATE: 0.1 BASE REVENUE: 45772240

SCRAP VALUE: 832986

YEAR	CAPITAL	LOAN OUTSTANDING	LOAN REPAYMENTS	INTEREST PAYMENTS	RELIEF ON INTEREST	CAPITAL ALLOWANCE	RELIEF ON CAPITAL	ANNUAL REVENUE	OPERATING COSTS	GROSS SURPLUS	TAX	ANNUAL CASH FLOW	DISCOUNTED CASH FLOW
0	-18062500	0	0	0	0	0	0	0	0	0	0	-18062500	-18062500
1	0	54187500	3612500	4335000	1083750	14450000	0	45772240	38669638	-844898	-482162	-362736	-314057
2	0	50575000	3612500	4046000	1011500	11560000	3612500	48060852	40603120	-200768	-1206192	1005424	753677
3	0	46962500	3612500	3757000	939250	9248000	2890000	50463894	42633276	461119	-842033	1303151	845763
4	0	43350000	3612500	3468000	867000	7398400	2312000	52987089	44764939	1141650	-509338	1650987	927718
5	0	39737500	3612500	3179000	794750	5918720	1849600	55636443	47003186	1841757	-200648	2042405	993647
6	0	36125000	3612500	2890000	722500	4734976	1479680	58418265	49353346	2562420	90060	2472360	1041405
7	0	32512500	3612500	2601000	650250	3787981	1183744	61339179	51821013	3304666	367668	2936998	1071099
8	0	28900000	3612500	2312000	578000	3030385	946995	64406138	54412063	4069574	636145	3433429	1084107
9	0	25287500	3612500	2023000	505750	2424308	757596	67626444	57132667	4858278	898733	3959545	1082449
10	0	21675000	3612500	1734000	433500	1939446	606077	71007767	59989300	5671967	1158097	4513869	1068388
11	0	18062500	3612500	1445000	361250	1551557	484862	74558155	62988765	6511890	1416445	5095445	1044192
12	0	14450000	3612500	1156000	289000	1241246	387889	78286063	66138203	7379360	1675618	5703742	1011990
13	0	10837500	3612500	867000	216750	992996	310311	82200366	69445113	8275753	1937173	6338580	973702
14	0	7225000	3612500	578000	144500	794397	248249	86310384	72917369	9202515	2202442	7000074	931011
15	0	3612500	3612500	289000	72250	635518	198599	90625903	76563238	10161166	2472579	7688587	885354
16	0	0	0	0	0	508414	158879	95157199	80391399	14765799	3651730	11114069	1108055
17	0	0	0	0	0	406731	127104	99915059	84410969	15504089	3844246	11659843	1006466
18	0	0	0	0	0	325385	101683	104910811	88631518	16279294	4044403	12234891	914375
19	0	0	0	0	0	260308	81346	110156352	93063094	17093258	4252978	12840280	830839
20	832986	0	0	0	0	208246	65077	115664170	97716248	17947921	4470711	14310196	801689
21	0	0	0	0	0	0	52062	0	0	0	-13015	13015	631
22	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0
												NPV	0

REQUIRED FREIGHT RATE = 120 £/tonne

(with 90% load factor)

Table 5.9
SES125 Worst Discounted Cash Flow Analysis

PROJECT LIFE: 12 | PRICE: 100000000 | DEBT RATIO: 0.5 | LOAN YEARS: 8 | INTEREST RATE: 0.12

DECLINING BAL.: 0.2

TAX RATE: 0.4 | INFLATION RATE: 0.05 | DISCOUNT RATE: 0.175 | BASE REVENUE: 74133988

SCRAP VALUE: 6871948

YEAR	CAPITAL	LOAN OUTSTANDING	LOAN REPAYMENTS	INTEREST PAYMENTS	RELIEF ON INTEREST	CAPITAL ALLOWANCE	RELIEF ON CAPITAL	ANNUAL REVENUE	OPERATING COSTS	GROSS SURPLUS	TAX	ANNUAL CASH FLOW	DISCOUNTED CASH FLOW
0	-50000000	0	0	0	0	0	0	0	0	0	0	-50000000	-50000000
1	0	50000000	6250000	6000000	2400000	20000000	0	74133988	51607634	10276354	3150542	7125813	5775735
2	0	43750000	6250000	5250000	2100000	16000000	8000000	77840688	54188015	12152672	821069	11331603	7444526
3	0	37500000	6250000	4500000	1800000	12800000	6400000	81732722	56897416	14085306	2354122	11731183	6246839
4	0	31250000	6250000	3750000	1500000	10240000	5120000	85819358	59742287	16077071	3782828	12294243	5306316
5	0	25000000	6250000	3000000	1200000	8192000	4096000	90110326	62729401	18130925	5133970	12996955	4546799
6	0	18750000	6250000	2250000	900000	6553600	3276800	94615842	65865871	20249971	6429268	13820702	3918927
7	0	12500000	6250000	1500000	600000	5242880	2621440	99346634	69159165	22437469	7686412	14751058	3390260
8	0	6250000	6250000	750000	300000	4194304	2097152	104313966	72617123	24696843	8919876	15776966	2939045
9	0	0	0	0	0	3355443	1677722	109529664	76247979	33281685	12641585	20640100	3116501
10	0	0	0	0	0	2684355	1342177	115006148	80060378	34945769	13441437	21504332	2631809
11	0	0	0	0	0	2147484	1073742	120756455	84063397	36693058	14247726	22445331	2226523
12	6871948	0	0	0	0	1717987	858993	126794278	88266567	38527710	15067487	30332171	2438807
13	0	0	0	0	0	0	687195	0	0	0	-274878	274878	17914
14	0	0	0	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0
												NPV	0

REQUIRED FREIGHT RATE = 219 £/tonne

(with 80% load factor)

Chapter 6

AMV ECONOMIC POTENTIAL

General

Chapter 5 established the competitive position of Advanced Marine Vehicles at the perceived present level of technology, suggesting that while freight rates would be considerably lower than those currently charged for air, they may be prohibitive when compared to conventional sea services.

This Chapter aims to explore the potential limits of economic performance, primarily to provide a focus for further research by quantifying the effect of specific progress in different technological areas. This will indicate the potentially most fruitful areas for future research, by showing where technical advances are likely to yield the greatest benefit.

The problem is simply to consider where improvements in design, construction and operation could come from, and calculate the effect of assumed progress on the economic efficiency. For example, since the high power demands result in massive fuel consumption, there may be a justifiable case for mid-journey refueling which would require a floating service station and would allow more revenue earning cargo to be carried. The benefit of such an option would be judged against the reduction in freight rate which could be achieved, and if sufficiently attractive may act as an incentive to consider the problem in more detail.

The results from this part of the investigation should be considered in conjunction with those from the sensitivity study, since those effects could be experienced in addition to any benefits arising from technical progress. For this part of the investigation, consideration is worth giving only to the costheads which form a significant proportion of the total annual costs. For example, it is unlikely that overall viability of AMV cargo ships would be much affected by increased automation, since the manning cots are not particularly significant.

Similarly, it is not envisaged that improvements in construction techniques are likely to produce a significant increase in economic potential, unless they were to realise a reduction in price of around 50%. Progress on such a scale is extremely unlikely; the following calculations seek to investigate progress which might be possible, without trying to pre-judge outcomes too much in the process.

Advanced Materials and Other Weight Control Measures

In the design methodology for the Surface Effect Ship's derived in Chapter 4, the major assumption lay in the selection of the (dwt/Δ) ratio. The value eventually chosen was based on that perceived to be achievable without too much difficulty and was deliberately conservative. It allowed for a hull constructed of steel and did not anticipate exceptionally rigourous weight control measures being adopted during design and construction.

For some of the Surface Effect Ships currently in service however, where the speed is low relative to the size for this type of vessel (ie low Fn_v), it is possible to achieve a higher value than the 0.35 value assumed in the designs. Where advanced structural material such as aluminium or fibre reinforced plastics are used, it is possible to achieve a (dwt/Δ) ratio as high as approximately 0.6.

To attempt using aluminium or FRP for a vessel with a large displacement such as the derived designs would undoubtedly present substantial technical difficulties. In particular the requirement to operate in open seas, outwith the sheltered regions in which craft currently operate, would result in structural loadings higher than those which have been imposed on existing vessels.

Nevertheless, there is no doubt that considerable scope exists for weight saving measures, including the use of advanced materials - even if it were only in areas not subjected to high structural loads. If this were allied with other strict weight control measures, a significant improvement in the (dwt/Δ) fraction could be achieved. The scale of improvement which could be achieved would need to be quantified as part of a detailed design study, which is outwith the scope of this analysis. However, the impact of an assumed weight saving on the economic viability could easily be investigated. In doing so, an allowance would have to be made for the increased construction cost due to the use of more expensive materials and the effort required to control weight.

To assess the effect of reduced lightship weight on the economic viability, a (dwt/Δ) fraction of 0.55 was assumed, which produced the following:

Length	Δ	dwt	payload
194m	14286 t	7857 t	4171 t
158m	9286 t	5107 t	3661 t
125m	5714 t	3143 t	2404 t

The payloads quoted above assume that all of the increased deadweight can be allocated to carrying cargo, which is dependent on the available space being capable of accommodating it ie the volume utilisation will be higher than on the original designs. It was further assumed that, although additional containers would be required to carry the increased payload, the weight of these additional containers is still included as part of the lightship.

The Required Freight Rate for the modified designs was calculated by increasing the payload in the cash flow and operating cost spreadsheets to the new value, and increasing the purchase price, arbitrarily, by a factor of 1.5. The operating costs are increased due to higher port dues and cargo handling charges, and the assumption of 80% payload utilisation is retained. The revised operating costs and corresponding cash flow analyses are given in Tables A6.1 - A6.6.

A higher (dwt/Δ) fraction could also be utilised to reduce the displacement for a given deadweight specification, thus for the deadweights used previously of 5000t, 3250t and 2000t, the corresponding displacements would be 9091t, 5909t and 3636t respectively. These first two displacements are very close to the revised Options 2 and 3 derived above and so will have similar economic performance. However, the reduced displacement of 3636t is worth evaluating because it is arguably more technically feasible, in the short term, than the designs presented so far.

A craft of this displacement would need to be around 108m long, based on a $L/\Delta^{1/3}$ ratio of 7. The power and purchase price could be estimated using the following data:

Option	Displacement	Power (kW/t)	BuildCost (£/t)
1	14286	20.42	11765
2	9286	23.50	13206
3	5714	26.73	14661

Thus for a displacement of 3636 t, a specific power of 28.5 kW/t and a unit build cost of £15300/t could be assumed, giving an installed power of approximately 104mW and a purchase price of around £56m. This price would be increased by 50% to £84m to account for the advanced structure and weight control effort.

For this new option, the fuel consumed on each trip was calculated on the same basis as before to be 427 t, resulting in a payload of 1461. The operating costs and cash flows are given in Tables A6.7 and A6.8.

A summary of the revised freight rates for the higher (dwt/Δ) ratios is given below, including those derived for the base designs as a comparison:

Option	Δ	dwt	payload	RFR	Comparable RFR
SES194	14286	7857	4171	323	859
SES157	9286	5107	3661	144	248
SES125	5714	3140	2404	106	171
SES108	3636	2000	1461	120	N/A

The results show a remarkable drop in charges, particularly for the long range design; these figures are much closer to the current sea freight charges implying that with a high (dwt/Δ) ratio, an AMV cargo vessel could be economically competitive. They clearly demonstrate the vital importance of weight control in high speed ships seeking to earn revenue on a charge per unit weight. This is further illustrated by the low freight rate for the 108m vessel, which is only 70% of that required for the original SES125, which had the same deadweight but lower payload fraction.

Note the economies of scale which are evident when comparing RFR's for the 125m and 108m craft above - both are designed for the same operating profile, such as range, number of trips per year. With the larger ship being able to carry more cargo, the increased build and operating costs are more than offset by the higher revenue. This implies that a vessel should be as large as possible for a given route, providing that demand for the service enables a high payload utilisation to be achieved.

Mid-Journey Refueling

Although Surface Effect Ships have low power requirements relative to speed, they are far higher than anything installed in conventional cargo ships, and thus consume fuel very quickly. This obviously implies they are unsuitable for long distance transport, a fact clearly suported by the economic calculations in the previous Chapter.

The fuel weight as a fraction of displacement is particularly high in the Option 1 design (almost 23%), where the target range of 3000Nm would allow transatlantic crossings. This obviously restricts the amount of revenue earning payload which could be carried, so any development limiting the amount of fuel weight should be a significant boost towards achieving economic viability. One potential method of achieving this would be to provide a means of refuelling at the half way stage by building a floating storage vessel. This concept is also recognised as potentially applicable in the Japanese Techno-Superliner Project (Reference 41), which has a low target distance of only 500Nm.

Note, however, that reducing the fuel weight by 50% would automatically increase the fuel consumed on each journey, because the vessel would be operating at a higher average displacement.

For this analysis, the fuel required for a half journey was calculated by the method described in Chapter 4, with the weight saving attributed completely to additional payload. Fuel required per trip was double that for the half journey, and it was assumed that the operaing schedule in terms of number of trips per year would be unaffected by the need to stop for refuelling.

The fuel price was increased to allow for investment recovery for the floating storage unit. The amount of any increase would depend on the utilisation of the service, with a lower charge if volumes were high. In these calculations, a premium of 25% was assumed for each trip, which implies a real premium of 50% on the refueling stopover, since fuel for half the journey would be taken on in port at normal rates. Besides, the sensitivity study showed that any increase in fuel price would need to be recovered directly from freight rates, so the effect of any departure from the premium assumption is immediately evident.

The fuel requirements, payload and Required Freight Rates for mid-journey refuelling are summarised below, with the full operating costs and cash flows tabulated in Appendix 6, Tables A6.9 - A6.14. The figures in brackets below are the original results, included for comparison purposes.

Option	Fuel Weight	Fuel per Trip	Payload	RFR
SES194	1763	3256	2807	488
	(3256)	(3256)	(1314)	(859)
SES157	673	1346	2385	226
	(1254)	(1254)	(1804)	(248)
SES125	341	1346	2385	226
	(631)	(631)	(1261)	(171)

Option 1SES194 is shown to derive substantial benefits from refueling at the halfway stage, as would be expected due to the high fuel fraction, which when reduced by half allowed the payload to be more than doubled. It would appear that the potential for refueling on the shorter distance routes is not particularly viable, as the increased revenues could be significantly reduced by the higher fuel price coupled with more fuel per trip.

Hydrodynamic Efficiency Improvements

The Surface Effect Ship design options were conservative in the installed power estimates, which were based on predictions of component drag factors. The resulting Drag/Weight ratio's of 0.03315, 0.03952 and 0.04722 for options 1, 2 and 3 respectively are low relative to speed, but there is no reason why better designs cannot achieve significantly better performance. In addition, propulsor technology developments could realistically be expected to allow overall improved propulsion efficiency.

Examples of how lower specific power could be achieved are:

- reduced wetted surface area, for example by minimising spray
- optimization's of cushion shape and dimensions

- increased lift and propulsion system efficiency
- reduced appendage drag, including that due to seals
- improved seal design for less air leakage
- improved ride control systems for minimising speed loss

While scope undoubtedly exists for improving SES hydrodynamic performance, the possibility cannot be discounted of a new and novel hullform being developed with lower specific power demands. For instance, if the many technical problems of Wing-in-the-Ground effect vehicles could be overcome the drag/weight ratio would probably be less even than that for aircraft. We have also yet to see results for the combined foil-displacement hybrid option being developed in the Japanese techno-superliner program, although it is doubtful if this will yield lower power demands.

In this section, therefore, RFR's were derived on the assumption of each deign option achieving reductions in specific power of 10% and 20%. The original and revised specific powers are given below:

Option	Current kW/t	Δ	(kW/t)*0.9	P_I	(kW/t)*0.8	P_I
1	20.42	14286	18.38	262548	16.34	233376
2	23.30	9286	20.97	194727	18.64	173091
3	26.73	5714	24.06	137462	21.38	122188

The reduced installed power implies lower fuel consumption and the corresponding revised fuel weights are given below:

Option	Current Fuel Wt	Fuel Wt @ (kW/t)*0.9	Fuel Wt @ (kW/t)*0.8
1	3580	2969	2672
2	1380	1136	1017
3	700	572	511

In the economic calculations, it was assumed that purchase prices would be reduced at the rate of £/kW installation cost used in the build cost estimates eg £110/kW, £125/kW and £135/kW for options 1, 2 and 3 respectively. Machinery weight savings due to the lower installed powers were ignored. The results of the Investment Analysis are summarised below, and full details included in Appendix 6, Tables A6.15 - A6.26.

Option	Current RFR	RFR @ (kW/t)*0.9	RFR @ (kW/t)*0.8
1	859	665	527
2	248	219	193
3	171	154	138

Once again benefits are most pronounced on Option 1, where high fuel consumption due to power demands are compounded by the need for a large fuel fraction due to long range; any saving in fuel consumption and weight therefore tends to offer a relatively more significant benefit.

It is interesting to note from the previous section that, for Options 2 and 3 there is less advantage to be had from mid-journey refuelling compared to the assumed reduction in specific power; the opposite is true for Option 1, where mid-journey refuelling shows more benefit than a major reduction is specific power.

Reduced Specific Fuel Consumption

Original calculations assumed a specific fuel consumption of 230g/kWhr, which is about average for a gas turbine plant operating at design conditions; however it may be possible even with current technology to obtain a lower value of around 220 g/kWhr, for instance the General Electric LM5000 plant (Reference 60). Reference 61 reports on a project by United Turbines seeking to develop a gas turbine which would use ceramics for critical components - this would allow the turbine to operate at much higher temperatures giving increased operating efficiency. Although potential applications will be a long time away, if the project is successful hte specific fuel consumption could be as low as 200g/kWhr.

The specific fuel consumption is unquestionably one of the prime areas where power plant manufacturers are spending time and money researching methods of boosting performance, for example by reducing turbine inlet temperatures and producing higher gas turbine efficiencies. It is therefore, worth quantifying the economic benefits for AMV cargo vessels of reduced gas turbine specific fuel consumptions.

Required Freight Rates have been derived using SFC's of 200 and 180 g/kWhr, values which would represent exceptional technical progress were they ever to be achieved. However, these values represent extreme discreet solutions by which more realistic developments could be judged.

Using these SFC's, revised fuel weights were calculated and the savings dedicated to payload capacity. The results are summarised below, with full details included in Appendix 6, Tables A6.27 - A6.38.

Option	Fuel Used @ SFC230	Fuel Used @ SFC200	Fuel Used @SFC180	RFR @ SFC230	RFR @ SFC200	RFR @ SFC180
1	3256	2877	2617	859	622	513
2	1254	1100	996	248	213	192
3	631	553	500	171	150	137

Combined Economic Potential

In the Sensitivity Study as part of the economic analysis, the 'best' of all financial and operational parameters were applied simultaneously to estimate the minimum required freight rate at current technology limits. A similar approach can be taken with the calculations in this Chapter, to explore the limits of economic potential with a series of assumed technical improvements.

Economic analyses have therefore been undertaken for two scenarios, intended to represent possible and extreme levels of technical progress. By doing so, the most optimistic economic results will be derived which can be used to assess the long term future for AMV cargo shipping. The assumed performance improvements relative to the base design options are summarised below; the cash flows in each case are presented in Tables 6.1 - 6.6, and the operating cost estimates in Appendix 6, Tables A6.39 - A6.44:

Options	dwt/Δ	Mid-journey refuelling	Hydrodynamics kW/t reduction	SFC g/kWhr
1a,2a,3a	0.45	yes	10%	200
1b,2b,3b	0.55	yes	20%	180

Note that the purchase price for each option has been increased by 50% above the base design options, to reflect the advanced materials and weight control necessary to achieve the higher deadweight fractions.

Using the above data, revised fuel consumptions and hence payload capacities were calculated, and the economics of each option were derived as summarised below

Option	Dwt	Fuel Weight	Other Dwt	Payload	RFR £/tonne	RFR £/t-nm
1a	6429	1400	429	4600	302	0.1007
1b	7857	1131	429	6297	200	0.0667
2a	4179	531	192	3456	156	0.1040
2b	5107	427	192	4488	110	0.0733
3a	2571	269	108	2194	117	0.1170
3b	3143	216	108	2819	85	0.0850

Note that the fuel consumption per trip is twice the fuel weight quoted above, due to assuming that refuelling occurs half way.

The Total Transit Cost for each of the above was calculated and plotted in Figures 6.1 - 6.3. These plots show the most competitive position likely to be achieved for AMV's relative to both conventional ships and aircraft.

Figure 6.1
SES194a/b versus Aircraft/Ship Total Transit Cost

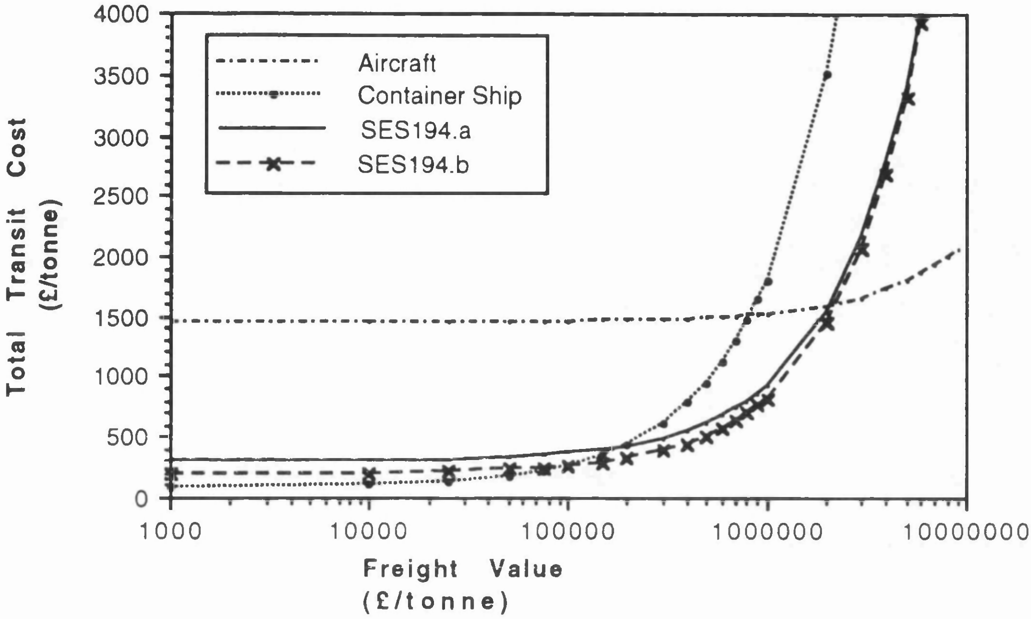


Figure 6.2
SES157a/b versus Aircraft/Ship Total Transit Cost

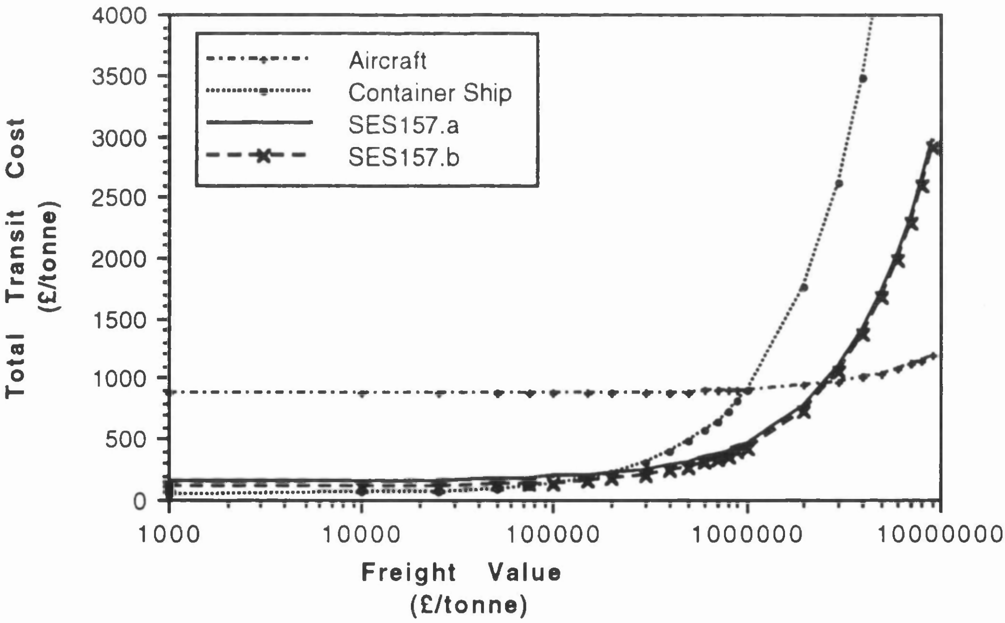


Figure 6.3

SES125a/b versus Aircraft/Ship Total Transit Cost

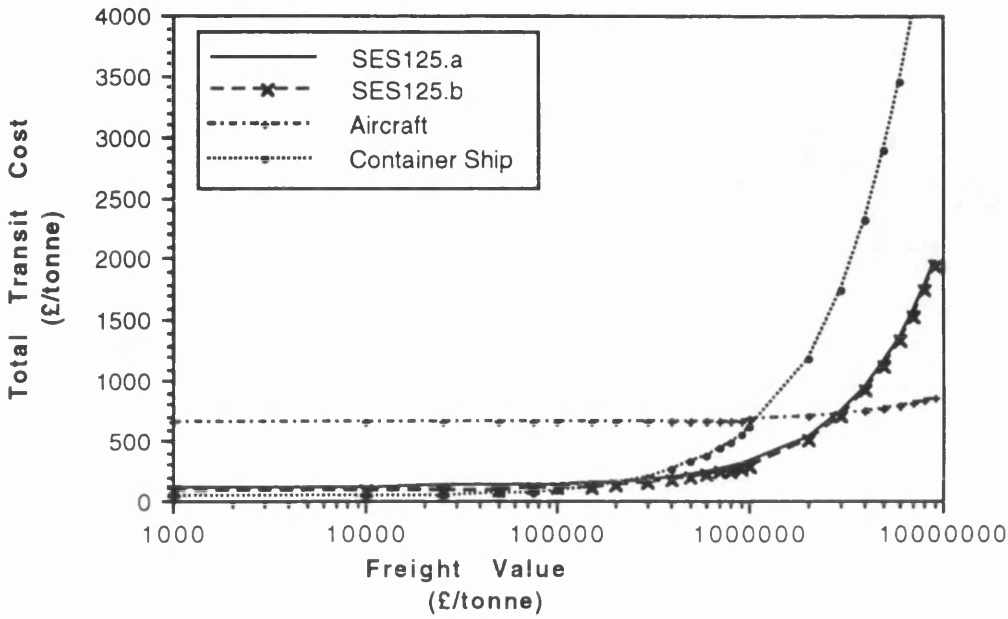


Table 6.1
SES194a Discounted Cash Flow Analysis

PROJECT LIFE: 15 | PRICE: 247200000 | DEBT RATIO: 0.75 | LOAN YEARS: 10 | INTEREST RATE: 0.1

DECLINING BAL.: 0.2

TAX RATE: 0.33 | INFLATION RATE: 0.05 | DISCOUNT RATE: 0.175 | BASE REVENUE: 106573989

SCRAP VALUE: 8697577

YEAR	CAPITAL	LOAN OUTSTANDING	LOAN REPAYMENTS	INTEREST PAYMENTS	RELIEF ON INTEREST	CAPITAL ALLOWANCE	RELIEF ON CAPITAL	ANNUAL REVENUE	OPERATING COSTS	GROSS SURPLUS	TAX	ANNUAL CASH FLOW	DISCOUNTED CASH FLOW
0	-61800000	0	0	0	0	0	0	0	0	0	0	-61800000	-61800000
1	0	185400000	18540000	18540000	6118200	49440000	0	106573989	68697594	796395	-1756196	2552591	2068969
2	0	166860000	18540000	16686000	5506380	39552000	16315200	111902689	72132474	4544215	-5701530	10245745	6731149
3	0	148320000	18540000	14832000	4894560	31641600	13052160	117497823	75739097	8386726	-3154798	11541524	6145846
4	0	129780000	18540000	12978000	4282740	25313280	10441728	123372714	79526052	12328662	-790616	13119278	5662409
5	0	111240000	18540000	11124000	3670920	20250624	8353382	129541350	83502355	16374995	1435729	14939266	5226289
6	0	92700000	18540000	9270000	3059100	16200499	6682706	136018417	87677473	20530945	3560416	16970529	4812075
7	0	74160000	18540000	7416000	2447280	12960399	5346165	142819338	92061346	24801992	5612821	19189171	4410279
8	0	55620000	18540000	5562000	1835460	10368319	4276932	149960305	96664414	29193892	7616895	21576997	4019515
9	0	37080000	18540000	3708000	1223640	8294656	3421545	157458320	101497634	33712686	9592275	24120411	3642002
10	0	18540000	18540000	1854000	611820	6635724	2737236	165331236	106572516	38364721	11555169	26809551	3281088
11	0	0	0	0	0	5308580	2189789	173597798	111901142	61696657	19637266	42059390	4172191
12	0	0	0	0	0	4246864	1751831	182277688	117496199	64781489	20799787	43981702	3536275
13	0	0	0	0	0	3397491	1401465	191391573	123371009	68020564	21984303	46036261	3000177
14	0	0	0	0	0	2717993	1121172	200961151	129539559	71421592	23199139	48222453	2547235
15	8697577	0	0	0	0	2174394	896938	211009209	136016537	74992672	24451592	59238656	2536283
16	0	0	0	0	0	0	717550	0	0	0	-236792	236792	8217
17	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0
												NPV	1

REQUIRED FREIGHT RATE = 302 £/tonne

(with 80% load factor)

Table 6.2
SES194b Discounted Cash Flow Analysis

PROJECT LIFE: 15 **PRICE:** 242385000 **DEBT RATIO:** 0.75 **LOAN YEARS:** 10 **INTEREST RATE:** 0.1

DECLINING BAL.: 0.2

TAX RATE: 0.33 **INFLATION RATE:** 0.05 **DISCOUNT RATE:** 0.175 **BASE REVENUE:** 96899369

SCRAP VALUE: 8528164

YEAR	CAPITAL	LOAN OUTSTANDING	LOAN REPAYMENTS	INTEREST PAYMENTS	RELIEF ON INTEREST	CAPITAL ALLOWANCE	RELIEF ON CAPITAL	ANNUAL REVENUE	OPERATING COSTS	GROSS SURPLUS	TAX	ANNUAL CASH FLOW	DISCOUNTED CASH FLOW
0	-60596250	0	0	0	0	0	0	0	0	0	0	-60596250	-60596250
1	0	181788750	18178875	18178875	5999029	48477000	0	96899369	59760737	780883	-1721988	2502871	2028669
2	0	163609875	18178875	16360988	5399126	38781600	15997410	101744338	62748773	4455702	-5590475	10046177	6600039
3	0	145431000	18178875	14543100	4799223	31025280	12797928	106831555	65886212	8223368	-3093348	11316716	6026136
4	0	127252125	18178875	12725213	4199320	24820224	10238342	112173133	69180523	12088522	-775216	12863739	5552116
5	0	109073250	18178875	10907325	3599417	19856179	8190674	117781789	72639549	16056040	1407763	14648277	5124491
6	0	90894375	18178875	9089438	2999514	15884943	6552539	123670879	76271526	20131040	3491065	16639974	4718345
7	0	72715500	18178875	7271550	2399612	12707955	5242031	129854423	80085103	24318895	5503493	18815402	4324375
8	0	54536625	18178875	5453663	1799709	10166364	4193625	136347144	84089358	28625248	7468532	21156717	3941222
9	0	36357750	18178875	3635775	1199806	8133091	3354900	143164501	88293826	33056025	9405435	23650590	3571063
10	0	18178875	18178875	1817888	599903	6506473	2683920	150322726	92708517	37617447	11330096	26287351	3217179
11	0	0	0	0	0	5205178	2147136	157838862	97343943	60494919	19254769	41240151	4090924
12	0	0	0	0	0	4164143	1717709	165730805	102211140	63519665	20394646	43125020	3467395
13	0	0	0	0	0	3331314	1374167	174017346	107321697	66695649	21556089	45139560	2941739
14	0	0	0	0	0	2665051	1099334	182718213	112687782	70030431	22747262	47283169	2497619
15	8528164	0	0	0	0	2132041	879467	191854123	118322171	73531953	23975320	58084796	2486881
16	0	0	0	0	0	0	703574	0	0	0	-232179	232179	8057
17	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0
												NPV	1

REQUIRED FREIGHT RATE = 200 £/tonne

(with 80% load factor)

Table 6.3
SES157a Discounted Cash Flow Analysis

PROJECT LIFE: 15 | PRICE: 180450000 | DEBT RATIO: 0.75 | LOAN YEARS: 10 | INTEREST RATE: 0.1

DECLINING BAL.: 0.2

TAX RATE: 0.33 | INFLATION RATE: 0.05 | DISCOUNT RATE: 0.175 | BASE REVENUE: 96652090

SCRAP VALUE: 6349020

YEAR	CAPITAL	LOAN OUTSTANDING	LOAN REPAYMENTS	INTEREST PAYMENTS	RELIEF ON INTEREST	CAPITAL ALLOWANCE	RELIEF ON CAPITAL	ANNUAL REVENUE	OPERATING COSTS	GROSS SURPLUS	TAX	ANNUAL CASH FLOW	DISCOUNTED CASH FLOW
0	-45112500	0	0	0	0	0	0	0	0	0	0	-45112500	-45112500
1	0	135337500	13533750	13533750	4466138	36090000	0	96652090	69003241	581349	-1281980	1863329	1510297
2	0	121803750	13533750	12180375	4019524	28872000	11909700	101484695	72453403	3317167	-4161979	7479145	4913576
3	0	108270000	13533750	10827000	3572910	23097600	9527760	106558929	76076073	6122106	-2302926	8425032	4486318
4	0	94736250	13533750	9473625	3126296	18478080	7622208	111886876	79879877	8999624	-577130	9576754	4133421
5	0	81202500	13533750	8120250	2679683	14782464	6097766	117481220	83873871	11953349	1048047	10905302	3815064
6	0	67668750	13533750	6766875	2233069	11825971	4878213	123355281	88067564	14987091	2599017	12388074	3512698
7	0	54135000	13533750	5413500	1786455	9460777	3902570	129523045	92470942	18104852	4097223	14007629	3219397
8	0	40601250	13533750	4060125	1339841	7568622	3122056	135999197	97094490	21310832	5560148	15750684	2934148
9	0	27067500	13533750	2706750	893228	6054897	2497645	142799157	101949214	24609443	7002128	17607315	2658573
10	0	13533750	13533750	1353375	446614	4843918	1998116	149939115	107046675	28005315	8434993	19570322	2395115
11	0	0	0	0	0	3875134	1598493	157436070	112399009	45037062	14334728	30702334	3045598
12	0	0	0	0	0	3100107	1278794	165307874	118018959	47288915	15183340	32105575	2581395
13	0	0	0	0	0	2480086	1023035	173573268	123919907	49653361	16048007	33605353	2190056
14	0	0	0	0	0	1984069	818428	182251931	130115902	52136029	16934808	35201221	1859420
15	6349020	0	0	0	0	1587255	654743	191364527	136621697	54742830	17849069	43242781	1851425
16	0	0	0	0	0	0	523794	0	0	0	-172852	172852	5998
17	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0
												NPV	0

REQUIRED FREIGHT RATE = 156 £/tonne

(with 80% load factor)

Table 6.4
SES157b Discounted Cash Flow Analysis

PROJECT LIFE: 15 PRICE: 176400000 DEBT RATIO: 0.75 LOAN YEARS: 10 INTEREST RATE: 0.1

DECLINING BAL.: 0.2

TAX RATE: 0.33 INFLATION RATE: 0.05 DISCOUNT RATE: 0.175 BASE REVENUE: 88817938

SCRAP VALUE: 6206523

YEAR	CAPITAL	LOAN OUTSTANDING	LOAN REPAYMENTS	INTEREST PAYMENTS	RELIEF ON INTEREST	CAPITAL ALLOWANCE	RELIEF ON CAPITAL	ANNUAL REVENUE	OPERATING COSTS	GROSS SURPLUS	TAX	ANNUAL CASH FLOW	DISCOUNTED CASH FLOW
0	-44100000	0	0	0	0	0	0	0	0	0	0	-44100000	-44100000
1	0	132300000	13230000	13230000	4365900	35280000	0	88817938	61789637	568301	-1253208	1821509	1476400
2	0	119070000	13230000	11907000	3929310	28224000	11642400	93258835	64879119	3242716	-4068568	7311284	4803296
3	0	105840000	13230000	10584000	3492720	22579200	9313920	97921777	68123075	5984702	-2251239	8235942	4385628
4	0	92610000	13230000	9261000	3056130	18063360	7451136	102817866	71529228	8797637	-564177	9361815	4040651
5	0	79380000	13230000	7938000	2619540	14450688	5960909	107958759	75105690	11685069	1024525	10660545	3729439
6	0	66150000	13230000	6615000	2182950	11560550	4768727	113356697	78860974	14650723	2540685	12110038	3433859
7	0	52920000	13230000	5292000	1746360	9248440	3814982	119024532	82804023	17698509	4005265	13693244	3147141
8	0	39690000	13230000	3969000	1309770	7398752	3051985	124975758	86944224	20832534	5435357	15397177	2868295
9	0	26460000	13230000	2646000	873180	5919002	2441588	131224546	91291435	24057111	6844973	17212138	2598905
10	0	13230000	13230000	1323000	436590	4735201	1953271	137785774	95856007	27376767	8245679	19131088	2341359
11	0	0	0	0	0	3788161	1562616	144675062	100648807	44026255	14013001	30013254	2977243
12	0	0	0	0	0	3030529	1250093	151908815	105681248	46227568	14842567	31385001	2523458
13	0	0	0	0	0	2424423	1000075	159504256	110965310	48538946	15687828	32851118	2140903
14	0	0	0	0	0	1939539	800060	167479469	116513576	50965893	16554725	34411168	1817687
15	6206523	0	0	0	0	1551631	640048	175853443	122339255	53514188	17448466	42272245	1809872
16	0	0	0	0	0	0	512038	0	0	0	-168973	168973	5864
17	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0
												NPV	0

REQUIRED FREIGHT RATE = 110 £/tonne

(with 80% load factor)

Table 6.5
SES125a Discounted Cash Flow Analysis

PROJECT LIFE: 15 | PRICE: 124410000 | DEBT RATIO: 0.75 | LOAN YEARS: 10 | INTEREST RATE: 0.1

DECLINING BAL.: 0.2

TAX RATE: 0.33 | INFLATION RATE: 0.05 | DISCOUNT RATE: 0.175 | BASE REVENUE: 68753135

SCRAP VALUE: 4377288

YEAR	CAPITAL	LOAN OUTSTANDING	LOAN REPAYMENTS	INTEREST PAYMENTS	RELIEF ON INTEREST	CAPITAL ALLOWANCE	RELIEF ON CAPITAL	ANNUAL REVENUE	OPERATING COSTS	GROSS SURPLUS	TAX	ANNUAL CASH FLOW	DISCOUNTED CASH FLOW
0	-31102500	0	0	0	0	0	0	0	0	0	0	-31102500	-31102500
1	0	93307500	9330750	9330750	3079148	24882000	0	68753135	49690828	400807	-883852	1284659	1041264
2	0	83976750	9330750	8397675	2771233	19905600	8211060	72190792	52175370	2286997	-2869447	5156445	3387631
3	0	74646000	9330750	7464600	2463318	15924480	6568848	75800332	54784138	4220844	-1587736	5808580	3093061
4	0	65315250	9330750	6531525	2155403	12739584	5255078	79590348	57523345	6204728	-397899	6602627	2849759
5	0	55984500	9330750	5598450	1847489	10191667	4204063	83569866	60399512	8241153	722569	7518585	2630270
6	0	46653750	9330750	4665375	1539574	8153334	3363250	87748359	63419488	10332746	1791874	8540872	2421805
7	0	37323000	9330750	3732300	1231659	6522667	2690600	92135777	66590462	12482265	2824802	9657463	2219591
8	0	27992250	9330750	2799225	923744	5218134	2152480	96742566	69919986	14692605	3833406	10859200	2022928
9	0	18661500	9330750	1866150	615830	4174507	1721984	101579694	73415985	16966809	4827569	12139241	1832935
10	0	9330750	9330750	933075	307915	3339606	1377587	106658679	77086784	19308070	5815447	13492622	1651295
11	0	0	0	0	0	2671684	1102070	111991613	80941123	31050490	9882979	21167511	2099766
12	0	0	0	0	0	2137348	881656	117591194	84988179	32603014	10468048	22134966	1779725
13	0	0	0	0	0	1709878	705325	123470753	89237588	34233165	11064187	23168978	1509919
14	0	0	0	0	0	1367902	564260	129644291	93699468	35944823	11675586	24269237	1281964
15	4377288	0	0	0	0	1094322	451408	136126505	98384441	37742064	12305917	29813435	1276452
16	0	0	0	0	0	0	361126	0	0	0	-119172	119172	4136
17	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0
												NPV	[illegible]

REQUIRED FREIGHT RATE = 117 £/tonne

(with 80% load factor)

Table 6.6
SES125b Discounted Cash Flow Analysis

PROJECT LIFE: 15 PRICE: 121320000 DEBT RATIO: 0.75 LOAN YEARS: 10 INTEREST RATE: 0.1

DECLINING BAL.: 0.2

TAX RATE: 0.33 INFLATION RATE: 0.05 DISCOUNT RATE: 0.175 BASE REVENUE: 64170569

SCRAP VALUE: 4268568

YEAR	CAPITAL	LOAN OUTSTANDING	LOAN REPAYMENTS	INTEREST PAYMENTS	RELIEF ON INTEREST	CAPITAL ALLOWANCE	RELIEF ON CAPITAL	ANNUAL REVENUE	OPERATING COSTS	GROSS SURPLUS	TAX	ANNUAL CASH FLOW	DISCOUNTED CASH FLOW
0	-30330000	0	0	0	0	0	0	0	0	0	0	-30330000	-30330000
1	0	90990000	9099000	9099000	3002670	24264000	0	64170569	45581716	390852	-861900	1252752	1015402
2	0	81891000	9099000	8189100	2702403	19411200	8007120	67379097	47860802	2230195	-2798178	5028373	3303491
3	0	72792000	9099000	7279200	2402136	15528960	6405696	70748052	50253842	4116010	-1548301	5664311	3016238
4	0	63693000	9099000	6369300	2101869	12423168	5124557	74285454	52766534	6050620	-388016	6438636	2778979
5	0	54594000	9099000	5459400	1801602	9938534	4099645	77999727	55404861	8036466	704622	7331844	2564941
6	0	45495000	9099000	4549500	1501335	7950828	3279716	81899713	58175104	10076109	1747369	8328740	2361654
7	0	36396000	9099000	3639600	1201068	6360662	2623773	85994699	61083859	12172240	2754642	9417598	2164462
8	0	27297000	9099000	2729700	900801	5088530	2099018	90294434	64138052	14327682	3738195	10589487	1972684
9	0	18198000	9099000	1819800	600534	4070824	1679215	94809156	67344955	16545401	4707665	11837736	1787410
10	0	9099000	9099000	909900	300267	3256659	1343372	99549614	70712203	18828511	5671008	13157503	1610282
11	0	0	0	0	0	2605327	1074697	104527094	74247813	30279281	9637513	20641769	2047614
12	0	0	0	0	0	2084262	859758	109753449	77960203	31793246	10208051	21585195	1735521
13	0	0	0	0	0	1667409	687806	115241121	81858214	33382908	10789383	22593524	1472417
14	0	0	0	0	0	1333928	550245	121003177	85951124	35052053	11385597	23666457	1250123
15	4268568	0	0	0	0	1067142	440196	127053336	90248680	36804656	12000272	29072952	1244749
16	0	0	0	0	0	0	352157	0	0	0	-116212	116212	4033
17	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0
												NPV	0

REQUIRED FREIGHT RATE = 85 £/tonne

(with 80% load factor)

Chapter 7

DISCUSSION

General

Recall the central aims of this Thesis:

a) Identify international trading routes where AMV's might provide a competitive high speed cargo service

b) Investigate the technical feasibilty of developing an AMV cargo liner

c) Assess the competitive level of current AMV technology

and d)Quantify the economic effects of specific technological improvements

This Discussion is intended to assess the results from the foregoing analyses against these stated aims, with the overall objective of answering the two fundamental questions posed at the beginning of the Thesis:

Why are AMV's not being used to carry freight at the present time ?

and

Is there reason to believe they ever will be?

In the discussion of the results of each Chapter, the uncertainties and calculation assumptions will be addressed, in an attempt to analyse whether the final outcomes would have been fundamentally different in alternative scenarios.

The Demand for AMV Cargo Shipping

The basic reason for investigating the current world trading system was to assess whether or not the level of trade would physically and economically sustain an AMV cargo service. The hope was to obtain sufficient data on trade volumes and the value of trade flows with which the results of the economic evaluation could be compared.

Only having devoted considerable effort towards investigating the trading system did an appreciation develop of just how complicated it really is. It also proved to be very necessary, and the eventual conclusions on overall viability of cargo AMV's depends as much on this work as any technical or economic analysis.

One of the greatest difficulties in assessing overall viability is that so frequently the choice of carrier, and mode, is based not on economics but on logistic efficiency. This is primarily influenced by what carrier offers the required availability at the right time. In other words the cheapest route is not always the one eventually chosen.

It is also difficult to predict with any confidence how trade will develop in the near future, what with the increasing tendency for governments to take a hard line in blocking 'unfairly subsidised' imports. If this were to continue, trade volumes would decline sharply and there would be an even greater impetus towards the formation of more protectionist trade blocks, requiring only short distance transport.

Even with such difficulties uppermost in mind, it is still possible to obtain valuable information from comparing the results of the economic evaluations with the trade flow data presented in Chapter 2.

Table 7.1 shows the annual work capacity of each design option and variant, together with the annual value of freight required at the ship/AMV breakeven point (ie the value of freight at which it becomes more economic to use the corresponding design option). These data should be compared to the trade volumes, by weight and value, presented in Chapter 2, with the following observations highlighted:

(i) By Weight

°the volume of trade required to sustain a single vessel in service is not prohibitive compared to container cargo volume (refer Table 2.3). For example, assuming that perhaps 10% of the current market could be captured by an express service, then approximately 2.4million tonnes would flow between the UK and the USA. This level would sustain 24 vessels at current technology levels, and perhaps 6 to 8 if more technically advanced craft were developed (ie with higher dwt/Δ ratios and lower fuel weight etc)

°however, when compared to the volume of air freight on the top ten air routes (Table 2.5), then clearly even one AMV freighter would require virtually all the annual cargo carried by air. For instance, on the London - New York route less than 100,000 tonnes is carried whereas a single Option 1 SES design would need at least that, perhaps as much as around 300,000 tonnes each year.

(ii) By Value

°comparing the annual value of freight required with the value of trade in Figures 2.8 to 2.14 reinforces the perception that there is simply not enough trade in freight of sufficient value to fill the gap in transport cost between air and sea. The data in Table 7.1 shows that, while the total value of imports to the USA amounted to around £300m (at current exchange rates), a single AMV would need to carry freight to a total value in the range £50-100m. In other words, between one sixth and one third of the entire value of imports to the USA, from all regions of the globe, would need to flow on one route, to sustain one vessel.

°the same conclusions would be reached if considering the shorter range vehicles, which would be of interest primarily in Asia. Here, a single version of design option 2 could not be sustained even by the entire annual trade between Japan and South East Asia (Taiwan, Hong Kong etc). This emphasises that an AMV cargo service is clearly uneconomic under the current assumptions and results.

Advanced Marine Vehicle Technology

The variety of options available under the loose term of 'Advanced Marine Vehicles' makes a critical appraisal of the relative advantages vital when considering a specific operating role (the wrong choice could easily be the result of a decision made without due care, which could discredit the potential viability of AMV's in general). Some of the concepts proposed by various designers may look appealing, but the fundamental design philosophy should always be questioned rigorously.

Given this variety of choice and propensity for publishing new concepts, it would not be surprising if many potential operators are bewildered to the extent of neglecting potential opportunities in this field. For that reason, amongst others, AMV technology is currently undergoing a critical phase in its development. There is so much research and development underway in so many regions that it is unthinkable that significant progress and market penetration wont be made. If AMV's are not particularly viable now they may be if progress is maintained - but to maintain progress demands scarce capital resources.

The present phase is so critical because of the effort to introduce vessels with much larger passenger carrying capacity. For so long now AMV's have essentialy been small craft, but operators are now attempting to realise important economies of scale even though to do so presents enormous technical challenges. So while there are some promising developments in progress, it is still too early to speculate on the eventual shape of the AMV shipping sector from purely technical considerations.

Perhaps one of the basic problems in the drive for more *advanced* AMV's is the uncertainty of knowing how much development has actually been influenced by operators. It appears from most published material that progress has been driven mainly by builders and designers, in other words, supply is trying to lead demand. There needs to be a balance between both sides of the equation, and it would be interesting to investigate the influence operators have had, or indeed are currently having, in the AMV market. The future involvement of operators is critical to sustained progress; there must be an opportunity for them to lead the direction of further developments, by specifying in their own terms the operating requirements for specific tasks.

In general terms there is no reason why AMV's should not continue to be introduced, even in larger sizes although there must be technical limits to how big they can be (eventually sheer power requirements will prevent them getting bigger). However, the industry would undoubtedly do itself an enormous favour by clarifying the circumstances in which the various options would offer the optimum all round performance. Unfortunately, while the self-interested builders and designers continue to promote their preferred 'solution', irrespective of whether or not it is in fact the most suitable form, this looks a remote possibility.

In many ways the Techno-Superliner project in Japan will mark a historic point in the sector, even if it does not lead to fast cargo ships. It should either confirm the SES as the most viable high speed vehicle, above 35knots that is, or introduce a new form in the shape of the combined foil-displacement hybrid. Alternatively, the results will prove what many observors have long believed - that the price of speed is so often not worth paying for.

AMV Design Proposals

It has already been mentioned in Chapter 4 that deriving design solutions for the specified operating requirements was particularly difficult due to the scarcity of useable data. The design proposals would be far more credible had they been based on more detailed data from vessels actually built, although it would not have removed the problem of scaling to such large dimensions.

However, the fundamental design assumption is valid and most likely conservative; it is almost inconceivable that further development of the design proposals would reduce the estimated dwt/Δ ratios. It is much more likely that strict weight control measures would in fact increase available deadweights and hence payloads.

It is probably fair to say that, for the SES designs, the two most important aspects have been estimated with reasonable accuracy - the dimensions (and hence weights) will have most bearing on buildcost and the required power will dictate the fuel consumption and hence operating costs. For these reasons the principal design objectives are considered to have been achieved, in so far as there is no reason to doubt the validity of the consequent economic evaluations.

Even so there are obvious weaknesses in the design solutions, most notably with regard to structural strength and space balance. However, it is considered that these could be expected to be resolved at a more detailed design stage. More questionable is the overall technical viability due to the level of installed power which would be required.

It is almost impossible to imagine the estimated power of almost 300MW for design option 1 being installed even allowing for remarkable technical progress in the long term. Even the smallest option considered, which required 150MW would find it difficult to attrract supporters for technical feasibility. The most powerful marinised gas turbine available, the General Electric LM5000 is capable of generating only 33MW - thus at least 5 units for option 3 and 9 for option 1 would be needed to deliver the required power. It is interesting to note that, based on a realistic machinery fit of two LM5000 turbo units, the maximum size of vessel possible, and hence arguably technically feasible, would be around 2500t (@30kW/tonne, ie 75000kW).

It is also worth pointing out that although the LM5000 is the largest *marinised* gas turbine, much larger sets are regularly used in industry, for example, the ABB GT13E unit is quoted at 150MW in Reference 60. Even so, there would need to be a quite tremendous demand for fast ships to justify even thinking about marinising units of that magnitude.

Apart from the power problem, considerable development would be needed to achieve sufficient lift fan work capacity to generate the required cushion pressures. In addition, the seals currently deployed on surface effect ships would need restructuring and possibly reconstructed with alternative materials.

With regard to the foilcat design proposals, although in general the power estimates were less satisfactory than those for the SES's, it is difficult to believe that they would require less power at the chosen dimensions. The basic problem is trying to obtain sufficient lift at the design speed, due to the cavitation barrier. However at smaller vessel size, and hence higher volumetric Froude Number, it may well be that a design could be developed to generate sufficient lift , perhaps by using 3 or 4 foil systems. In such case, the lift would need to be similar to that provided by the aerostatic system of the SES, while at the same time producing a foil drag less than the equivalent drag associated with SES lift power. This aspect is certainly worthy of future research.

Economic Evaluation

(i) Build and Operating Cost Estimates

The basic validity of the economic evaluations is dependent to a large extent on the accuracy of the build and operating cost estimates; the investment appraisal model is itself relatively straightforward bar a few complicating features such as the treatment of taxation and choice of discount rate. Thus it is important to justify the assumptions in these estimates to lend credibility to the resulting economic evaluations.

The buildcosts are unfortunately not based on shipyard estimates, but on the basis of detailed estimates of another twin hull design. While this is not the most desirable situation it is a typical approach taken at early stages in the design process. It is nevertheless heavily reliant on the quality of the available data. Of course, the other significant problem is the scale differential between the original data and the new designs, which was partially offset by the fact that the original data itself covered a wide scale difference.

With regard to the buildcost estimates, the major components of cost are associated with the hull construction and propulsion plant, both of which can be estimated with reasonable confidence. These two items make up almost 75% of the actual construction costs, so if these are estimated with good accuracy then the final total will also be within acceptable tolerance.

The operation costs in some ways are more difficult to predict, particularly Repair and Maintenance and Insurance; the former because of the size of the power plants which are far bigger than anything even remotely considered, and the latter because of the novelty and hence increased risk factors. To allow for these two components, additional premiums above normal values were allowed, eg a higher R&M cost per operating hour and a higher percentage of insured price.

While acknowledging that the uncertainties in some operating cost components are considerable, they almost become irrelevant when compared to the dominance of fuel costs in the overall total. Since fuel costs are so high, and can be estimated to high degree of accuracy, the contribution of operating costs to the task of economic evaluation can be considered as having been adequately represented.

The investment appraisal process is also subject to significant uncertainties due to many complicating features, primarily those associated with raising finance. In a market where supply is so much in excess of demand, prospective purchasers can very often obtain products at prices below true cost, mainly because many governments are prepared to subsidise their national shipbuilding industry. These uncertainties, and those of build and operating costs, are addressed by the sensitivity study which allows an judgement to be made of the relative importance of individual factors.

(ii) Economic Evaluation

One of the initial perceptions at the beginning of this study was that long range transport at high speed would be more attractive than short distance. This is due to the assumption that, at short distance the choice of available mode would be wider and the selection of carrier would depend less on economics, and more on logistics. While this is unquestionably true, there is a heavy penalty to pay at long distance due to the need to carry substantial volumes of fuel. Thus the base economic evaluations show design option 1 to be much more uneconomic than options 2 & 3, with RFR's closer to air freight charges; the RFR's for options 2 & 3 are closer to sea freight charges.

It is considered that the air and sea freight rates used for comparison are accurate, although the actual charge levied on air cargo is very complicated and depends on specific circumstances. The possibility of these rates being lower than they would otherwise be due to a highly competitive market must also be considered; this may be particularly true for conventional ships where there seems to be an oversupply of cargo space, which will depress freight charges.

The RFR's for options 2 & 3 are really quite low compared to initial expectations, although they are still significantly higher than those of conventional shipping. The evaluation of RFR's, however, does not in itself answer the fundamental question of economic viability in a competitive marketplace. To do so requires some method of accounting for the value of time, or in other words the utility of speed. This was attempted by calculating the Total Transit Cost, assumed to include the actual freight charge and an additional cost due to the physical ownership of the goods (which is similar to a stockholding or inventory cost)

The Total Transit Cost used here is probably too simplistic to accurately place a value on time for cargo shipments: for high value goods, particularly perishables, there could be significant depreciation in value while in transit; there is also the possibility, again for high value cargo, of increased insurance costs for slow speed transport; finally, it is extremely difficult to place a value on time for a spare part which is desperately needed for some manufacturing plant. All of these factors would tend to increase the value of time or utility of speed and favour AMV's or aircraft, with the end result of reducing the 'breakeven' value of freight. The simplicity of the Total Cost calculations is further emphasised by the breakeven values between air and conventional ships, which suggest that freight valued at around £1million/tonne would be all that air cargo service could attract. It's difficult to imagine much high value freight exists in the system, except perhaps from the odd piece of art treasure!

Even allowing for the fact that the Total Transit Cost calculations do not fully reflect the value of time, the results are still useful in assessing AMV economic viability. Leaving aside the 'spare part' argument, where similar situations will almost always demand air transport, the ownership cost will generally outweigh costs due to depreciation while in transit or insurance. Thus, while it could reasonably be expected that the breakeven values will be lower than those calculated, it is extremenly doubtful whether the difference would be such as to bridge the gap between required and realistic freight values. So the conclusions would be no different were a more sophisticated total cost analysis undertaken.

(ii) Sensitivity Study

The Sensitivity Study confirmed that the uncertainties in the build and operating costs do not have a significant bearing on the RFR's. However, the tax rate variations highlighted the favourable assumptions related to capital and interest relief in the calculation of tax charges. In effect, a single company operating a single vessel would have a completely different investment appraisal result; the calculations implicitly assume that the operating company would either belong to a group of companies with shared balance sheets and hence capital allowances, or that the company itself had a sufficient operating revenue from previous capital investment projects to accommodate the 'negative' tax payment from this single venture.

More importantly, the Sensitivity Study underlined the belief that fuel costs would dominate in a high speed shipping operation, and in these calculations the fuel cost is of the same order as the capital charges. It is clearly an undesirable situation because any increase in fuel price would need to be recovered completely in higher freight rates, which is an almost impossible situation for a company to be able to justify making such a large investment.

The Best/Worst scenarios produced a considerable difference in breakeven values for each design option, but showed that even in the most favourable operating conditions the AMV designs would not be in a position to compete effectively with sea transport.

It cannot be overemphasised that the economic assessment of AMV cargo ships has so far relied on preliminary designs and uncertain cost estimates. While there is no substantial reason for questioning their validity, some doubt is inevitable. For this reason, a similar evaluation of the economics of a more credible design was derived. Tables 7.2 and 7.3 give the cash flow and operating costs for a Westamaran 12000, a displacement catamaran design produced by the respected Norwegian builder, Westamarin. This design has the following characteristics and estimated costs, published in Reference 62:

Main Dimensions Capacities

LOA (m)	124.5	Deadweight (t)	750
BOA (m)	34.0	Fuel (t)	126
Depth (m)	9.5	Passengers	1200
Draught (m)	4.5	Cars	300

Powering

2 * Gas Turbines (mW)	55
4 Waterjets	
Service Speed (knots)	40

Costs

Purchase Price	$65m
Maintenance	1% Price
Crew (per man, 9 off)	$40,000
Insurance	1% Price
Harbour Dues	500,000
Administration	500,000

It was assumed for the analysis that the dwt/D ratio was 0.45, giving a displacement of 1700t. This implies a specific power of 32kW/t, which is reasonable for a craft of this size and form. With these conditions, the fuel capacity of 126 tonnes would allow a maximum range of 400nm.

Note that the RFR for this design is presented in US dollars, and that at current exchange rates would be equivalent to approximately £70/tonne or £0.175/tonne-nm. This simple exercise therefore, confirms the legitimacy of the SES design investment appraisals as the results are of a similar order. However, the higher unit transport cost of the W12000 design reflects the small payload capacity relative to the SES design solutions, which benefit from economies of scale. These are partially obscured by the fact that the service speed of the Westamarin vessel is only 40 knots, compared to the 55knot cargo AMV's.

Economic Potential

Even though based on simplistic assumptions, this was a valuable exercise. It was important to explore the limits of economic potential firstly as an impetus for targetting future research objectives and secondly to realistically estimate the long term possibilities for high speed cargo shipping.

The conclusions of this section depend primarily on the assumption that additional cargo payload can be accommodated within the derived design dimensions. This implies that the original design options carried significant void space, which would be uneconomic no matter what vehicle type was in question. In practice, if the dimensions of the design were insufficient to accept the given payload the economics would be only marginally affected by any change, due to the overwhelming influence of fuel costs.

The single most important achievement would undoubtedly be to increase the deadweight capacity as a fraction of payload. This has been shown to have a profound effect on the results of the investment appraisal calculations. It is also very probably the most 'realiseable' improvement in practice with a ratio of 0.45 perfectly realiseable through stringent weight control measures and good design. Any significant research in advanced structural design could realistically raise this to 0.55 at which point the operating economics would be dramatically improved.

There are no practical reasons why mid-journey refuelling could not be made available, but serious doubts exist as to the economics of doing so. However, it would be a useful exercise to consider the best means of providing such a facility and to assess the effect this would have on fuel costs.

It is doubtful if significant reductions in specific powers could be achieved, even through the development of radically alternative hullforms. Nevertheless, any reduction would be welcome, and the aim should be to minimise both displacement and wetted surface. Therefore, any vehicle which achieves an increased separation from the air/water interface is a candidate for high speed operation. It has to be said that some of the concepts currently being advanced do not inspire confidence in a belief that this can be achieved.

With regard to specific fuel consumption, again it is difficult to imagine any leaps in efficiency, in the short term at least. Even so, any improvement would be welcomed simply because of the predominant nature of the fuel costs for high speed ships. It is, however, unlikely to significanlty affect the relative economics of Advanced Marine Vehicles.

It is revealing to note that, even with all possible technological improvements combined, the most optimistic Avanced Marine Vehicle economics could not achieve a competitive total transit cost. Basically, there is virtually no justification for believing that an AMV freight service would attract customers without some from of state subsidy.

Discussion Summary

To summarise the investigation of AMV economics, it has become increasingly obvious that high speed ships would always be welcomed by cargo vessel operators - but not at any price! The effect of higher speed on operating costs must always be offset by lower transport costs for the freight owner.

AMV cargo vessels would need to attract volume from the trade currently carried by conventional ships, and it would therefore most likely be of low value relative to airfreight. A significant fraction of current airfreight would most probably be attracted by an AMV service, but this would not be enough on its own to employ even a single craft on a given route.

Surface Effect Ships appear to hold the greatest promise for extrapolating to larger size, which would be necessary to achieve operating economies of scale. Realistically, this would require substantial investment at high risk and so will only be achieved, if ever, over a relatively long timescale.

Technically, AMV's are most likely to be limited in size by the sheer power demands, because of the physical problems of installation and developing the required power at the propulsor. Regardless of which hullform is considered, a power plant installation of 4 LM5000 gas turbines at 33,000kW each would limit the vessel to around 5000 - 6000 tonnes at an approximate speed of 50knots.

It is difficult to imagine that AMV's will ever be sufficiently economic to fill a role as a cargo vessel - there is simply not enough trade in high value goods to warrant such a service. The only possible freight which could justify the required freight charges would be perishables not currently capable of sustaining air freight costs but which is physically impossible to send by conventional ship. So in answer to the two fundamental questions posed by this thesis, AMV's at current technolgy levels are less economic than larger vessels would be and even these are unlikely to be viable as cargo ships in the future.

It is important to note that these arguments do not apply to passenger vessels, which are likley to become more competitive than they are at present due to achieving economies of scale in the future. A useful study would be to quantify the value placed by commuters and tourists on their time as an aid to examining future applications of AMV's as passenger ferries. If an AMV cargo service is ever likely to be introduced, it will develop gradually on the back of an extensive high speed passenger ship network.

By increasing the dwt/Δ ratio and balancing passenger volumes with freight, the transport costs could be priced at similar levels to conventional services, using this income to supplement passenger revenue. Some research into the optimum passenger/cargo mix would be very informative, and would need to allow for both passenger and cargo volumes on a given route. Thus the amount of payload allocated to cargo or passengers would probably vary depending on the route under consideration.

Table 7.1

Annual Work Capacities and Breakeven Values of Trade

Design Option	Nominal Payload	Actual Payload	No. Trips per annum	Annual Payload	Ship/AMV Breakeven	Annual Value (£m)
SES194.base	1314	1051	96	100896	697830	70408
SES194.best	1314	183		113568	515205	58510
SES194.worst	1314	1051		100896	940107	94853
SES194a	4600	3680		323280	188499	60938
SES194b	6297	5038		483648	94892	45894
SES157.base	1804	1443	224	323232	366535	118476
SES157.best	1804	1624		363776	228878	83260
SES157.worst	1804	1443		323232	425269	137461
SES157a	3456	2705		619360	197676	122433
SES157b	4488	3590		804160	113246	91068
SES125.base	1261	1009	336	339024	382136	129553
SES125.best	1261	1135		381360	283023	107934
SES125.worst	1261	1009		339024	514287	174356
SES125a	2194	1755		589680	2334647	137671
SES125b	2819	2255		757680	145366	110141

Table 7.2
Westamarin W12000 Catamaran Discounted Cash Flow Analysis

PROJECT LIFE: 15 PRICE: 65000000 DEBT RATIO: 0.75 LOAN YEARS: 10 INTEREST RATE: 0.1

DECLINING BAL.: 0.2

TAX RATE: 0.33 INFLATION RATE: 0.05 DISCOUNT RATE: 0.125 BASE REVENUE: 46344108

SCRAP VALUE: 2286984

YEAR	CAPITAL	LOAN OUTSTANDING	LOAN REPAYMENTS	INTEREST PAYMENTS	RELIEF ON INTEREST	CAPITAL ALLOWANCE	RELIEF ON CAPITAL	ANNUAL REVENUE	OPERATING COSTS	GROSS SURPLUS	TAX	ANNUAL CASH FLOW	DISCOUNTED CASH FLOW
0	-16250000	0	0	0	0	0	0	0	0	0	0	-16250000	-16250000
1	0	48750000	4875000	4875000	1608750	13000000	0	46344108	37866507	-1272399	-950779	-321620	-272271
2	0	43875000	4875000	4387500	1447875	10400000	4290000	48661313	39759832	-361019	-2012635	1651616	1183656
3	0	39000000	4875000	3900000	1287000	8320000	3432000	51094379	41747824	571555	-1368657	1940212	1177128
4	0	34125000	4875000	3412500	1126125	6656000	2745600	53649098	43835215	1526383	-773963	2300346	1181478
5	0	29250000	4875000	2925000	965250	5324800	2196480	56331553	46026976	2504577	-216861	2721437	1183285
6	0	24375000	4875000	2437500	804375	4259840	1757184	59148130	48328325	3507306	312096	3195209	1176111
7	0	19500000	4875000	1950000	643500	3407872	1405747	62105537	50744741	4535796	820561	3715235	1157693
8	0	14625000	4875000	1462500	482625	2726298	1124598	65210814	53281978	5591336	1314757	4276578	1128137
9	0	9750000	4875000	975000	321750	2181038	899678	68471354	55946077	6675278	1799770	4875507	1088788
10	0	4875000	4875000	487500	160875	1744830	719743	71894922	58743381	7789041	2279780	5509262	1041538
11	0	0	0	0	0	1395864	575794	75489668	61680550	13809119	4366997	9442121	1511157
12	0	0	0	0	0	1116691	460635	79264152	64764577	14499574	4632850	9866725	1336814
13	0	0	0	0	0	893353	368508	83227359	68002806	15224553	4902495	10322058	1183921
14	0	0	0	0	0	714683	294807	87388727	71402946	15985781	5178022	10807759	1049422
15	2286984	0	0	0	0	571746	235845	91758164	74973094	16785070	5461244	13610810	1118811
16	0	0	0	0	0	0	188676	0	0	0	-62263	62263	4333
17	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0
												NPV	2

REQUIRED FREIGHT RATE = 123 $/tonne

(with 80% load factor)

VESSEL DATA		COSTHEAD	ESCALATION RATE
Length	124.5	Registration	0
Breadth	34	Manning	0
Draught	4.5	Insurance	0
Payload (max)	700	R & M	0
Power	55000	Stores	0
No. Containers	100	Victualling	0
Complement	15	Administration	0
Annual Op. Hours	6720	Fuel Oil	0
No. Trips per annum	672	Diesel Oil	0
Fuel Load per Trip	122	Port Dues	0
Dieso per week	20	Cargo Handling	0

YEAR	REGISTRATION	MANNING	INSURANCE	R & M	STORES	VICTUALING	ADMINISTRATION	FUEL OIL	DIESEL OIL	PORT DUES	CARGO HANDLING	TOTAL OPERATING COSTS
0	3000	900000	975000	3360000	200000	18900	65000	24595200	288000	282240	5376000	36063340
1	3150	945000	1023750	3528000	210000	19845	68250	25824960	302400	296352	5644800	37866507
2	3308	992250	1074938	3704400	220500	20837	71663	27116208	317520	311170	5927040	39759832
3	3473	1041863	1128684	3889620	231525	21879	75246	28472018	333396	326728	6223392	41747824
4	3647	1093956	1185119	4084101	243101	22973	79008	29895619	350066	343064	6534562	43835215
5	3829	1148653	1244375	4288306	255256	24122	82958	31390400	367569	360218	6861290	46026976
6	4020	1206086	1306593	4502721	268019	25328	87106	32959920	385948	378229	7204354	48328325
7	4221	1266390	1371923	4727857	281420	26594	91462	34607916	405245	397140	7564572	50744741
8	4432	1329710	1440519	4964250	295491	27924	96035	36338312	425507	416997	7942800	53281978
9	4654	1396195	1512545	5212463	310266	29320	100836	38155228	446783	437847	8339940	55946077
10	4887	1466005	1588172	5473086	325779	30786	105878	40062989	469122	459739	8756938	58743381
11	5131	1539305	1667581	5746740	342068	32325	111172	42066139	492578	482726	9194784	61680550
12	5388	1616271	1750960	6034077	359171	33942	116731	44169446	517207	506862	9654524	64764577
13	5657	1697084	1838508	6335781	377130	35639	122567	46377918	543067	532206	10137250	68002806
14	5940	1781938	1930433	6652570	395986	37421	128696	48696814	570220	558816	10644112	71402946
15	6237	1871035	2026955	6985199	415786	39292	135130	51131654	598731	586757	11176318	74973094
16	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0

Chapter 8

CONCLUSIONS

It is difficult avoid the conclusion that Advanced Marine Vehicles are unlikely ever to find a role as cargo vessels, unless a revolutionary new vessel with completely unforeseeable characteristics is developed. Given the increasing use of high speed ships as passenger ferries it was assumed in the early stages that somehere in the future there would be some cargo ship operator who would risk investment in the technology. Sadly, for those involved in the promotion of Advanced Marine Vehicles, there simply isn't any logical reason to justify sufficient freight volume being shipped at high speed.

In forming this conclusion, however, there is no substantial reason to doubt the viability of AMV's as passenger ships. By virtue of the high value which commuters and tourists place on their time, the industry should continue to demand larger vehicles so that economies of scale are achieved.

Surface Effect Ships appear to offer the most attractive, lowest cost solution to large, fast ships. Only detailed design and build can really overcome the uncertainties regarding how large they can be, specifically in respect of the high power installations.

With regard to further work, research should primarily seek to increase deadweight capacity as a fraction of displacement, through lighter structural materials, more efficient structural arrangements and strict weight control at the detailed design stages.

There has yet to be published a clear statement of the benefits derived by fitting foil systems to catamaran vessels, and it seems that further research is required to identify the advantages explicitly. In particular, the maximum size of vessel capable of achieving improved performance through foil technology at sub-cavitation speeds needs to be determined

A detailed investigation of the optimum passenger/cargo mix should be made, with the cargo freight rate restricted to a level similar to conventional sea freight. By carrying freight at this charge, the 'spare' capacity of a purely passenger ship may be used thereby supplementing passenger revenue. It is possible that by combining passengers and freight in this way, the overall viability of Advanced Marine Vehicles would be significantly improved.

Although unlikely to be in demand in the short to medium term, some consideration should be given to the possibilty of refuelling at sea as a means of extending range. A concept design and feasibility study would demonstrate the feasibility of such a venture.

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Appendix 1

SESDES: SES design Procedure

```
      REAL  I,J,LB, LSHIP, KWTN, L, LBOX, LSD, MW, MARGIN

      OPEN(UNIT=3,FILE='SESDES.DAT',FORM='FORMATTED',STATUS='OLD')
      OPEN(UNIT=4,FILE='SESDES.OUT',FORM='FORMATTED',STATUS='NEW')
      OPEN(UNIT=5,FILE='WEIGHTS.OUT',FORM='FORMATTED',STATUS='NEW')
      OPEN(UNIT=6,FILE='CUSHION.OUT',FORM='FORMATTED',STATUS='NEW')


      PRINT *, 'HOW MANY L/DISP**0.333 RATIOS DO YOU WISH TO ANALYSE?'
      READ *, NR

      DO 700 RD=1,NR
      READ(3,*)DWT,DWDSP,LB,ALPHA,CB,CLR,HBOX

C      PRINT *, 'INPUT REQUIRED DEADWEIGHT?'
C      READ *, DWT
C      PRINT *, 'INPUT DWT/DISPMNT RATIO'
C      READ *, DWDSP
C      PRINT *, 'INPUT LENGTH-BREADTH RATIO'
C      READ *, LB
C      PRINT *, 'INPUT SIDEHULL DEADRISE ANGLE(deg.)'
C      READ *, ALPHA
C      PRINT *, 'INPUT BLOCK COEFFICIENT'
C      READ *, CB
C      PRINT *, 'INPUT CLEARANCE TO WET DECK'
C      READ *, CLR
C      PRINT *, 'BOX HEIGHT'
C      READ *, HBOX


      ALPHA=ALPHA*3.1415297/180
      DISP=DWT/DWDSP
      LSHIP=DISP-DWT

      PRINT *, 'DISPLACEMENT=',DISP,'tonnes'
      PRINT *, 'INPUT KW/tonne FOR MACHINERY WEIGHT CALCULATION'
      READ *, KWTN

      WRITE(4,10)DWT,DISP
      WRITE(5,10)DWT,DISP
      WRITE(6,10)DWT,DISP
 10   FORMAT(//3X,'DEADWEIGHT=',F7.1,'tonnes',5X,'DISPLACEMENT='
     & ,F7.1,'tonnes')

      WRITE(4,15)LB,CB,ALPHA*180/3.1415297
      WRITE(5,15)LB,CB,ALPHA*180/3.1415297
      WRITE(6,15)LB,CB,ALPHA*180/3.1415297
 15   FORMAT(/3X,'LENGTH/BOA=',F5.2,5X,'BLOCK COEFF.=',F5.3,
     & 5X,'DEADRISE ANGLE=',F3.0)

      WRITE(4,20)
 20   FORMAT(/////3X,'L/DISP**3',2X,'b/BOA',6X,'LOA',7X
     & ,'BOA',6X ,'DEPTH',3X,'D wet dk',3X,'DRAUGHT',4X,'BEAM',5X
```

```
     & ,'BEAM WD',5X,'Cp',7X,'ENCL.VOL',5X,'LSHIP DENS'//)

       WRITE(5,30)LSHIP
   30  FORMAT(//3X,'TARGET LIGHTSHIP WEIGHT=',F7.1)

       WRITE(5,40)
   40  FORMAT(/////3X,'L/DISP**3',2X,'b/BOA',6X,'LOA',4X,'st.den',5X
     & ,'STEEL',4X,'MACHINERY',3X,'ELECTRIC',3X,'AUXILIARY',3X
     & ,'OUTFIT',6X,'TOTAL',5X,'MARGIN',6X,'MARGIN')

       WRITE(5,45)
   45  FORMAT(108X,'(tonnes)',4x,'(percent)'//)


       WRITE(6,50)
   50  FORMAT(/////3X,'L/DISP**3',2X,'b/BOA',6X,'LOA',5X
     & ,'Lc/Bc',6X,'Bc',7x,'Tc',6x,'AREA'
     & ,3X,'PRESSURE'//)


       PRINT *, 'INPUT MIN,MAX,STEP L/DISP**0.33 RATIO'
       READ *, RMIN,RMAX,RSTEP


       IF (RSTEP.EQ.0) THEN
       N=1
       ELSE
       N=((RMAX-RMIN)/RSTEP)+1
       END IF

       RATIO=RMIN-RSTEP

       DO 500 I=1,N
       RATIO=RATIO+RSTEP
       L=DISP**0.33333*RATIO
       BOA=L/LB



       DO 600 J=0.15,0.35,0.025
       BMBOA=J
       BM=BOA*BMBOA

C      ********************************************
C      CHECK DEMIHULL BEAM TO BREADTH OVERALL RATIO
C      ********************************************

       CHK=(BOA-2*BM)/L
       IF (CHK.GT.0.24) THEN
       GO TO 600
       ELSE IF (CHK.LT.0.10) THEN
       GO TO 600
       END IF
```

```
T=DISP/(CB*1.025*2*L*BM)
WD=T+CLR
TWD=T/WD

IF (TWD.GT.0.75) THEN
GO TO 600
END IF

D=WD+HBOX

WDD=WD/D
IF (WDD.GT.0.7) THEN
GO TO 600
END IF

BMWD=0.45*BM*WD/T+0.55*BM

TANA=TAN(ALPHA)
CSA1=BOA/2*(D-WD)
V1=CSA1*L*2

CSA2=(BMWD+BM)/2*(WD-T)

CSA3=(0.8*BM*T)-(0.5*(0.25*BM)**2*TANA)

CM=CSA3/(BM*T)
CP=CB/CM

V2=CSA2*CP*L*2
V3=CSA3*L*CP*2


LBOX=0.85*L

V4=(L-LBOX)*BOA*(D-WD)



EV=V1+V2+V3-V4




SD=33.007*ALOG10(DISP)-39.766
SW=EV*SD/1000
POWR=KWTN*DISP
MW=POWR*2.5/1000
EW=POWR/85*40/1000
AUXW=EV*10/1000
OUTW=DISP*0.075

WEIGHT=SW+MW+EW+AUXW+OUTW
BALANCE=LSHIP-WEIGHT
MARGIN=BALANCE/WEIGHT*100

IF (MARGIN.LT.0) THEN
```

```
      GO TO 600
      END IF

      LSD=LSHIP*1000/EV
      IF (LSD.GT.200) THEN
      GO TO 600
      ELSE IF (LSD.LT.100) THEN
      GO TO 600
      END IF


      ICOUNT=0

      Tc=0.3*T
      DISPON=0.2*DISP
      DELTA1=0.995*DISPON
      DELTA2=1.005*DISPON


100   BMc=BM-0.4*BM/T*(T-Tc)

      ICOUNT=ICOUNT+1
      IF (ICOUNT.GT.30) THEN
      PRINT *, 'CUSHION DIMENSIONS NOT CALCULATED'
      GO TO 600
      END IF

      CBc=0.9*CB
      DISPc=L*BMc*Tc*CBc*1.025*2


      IF (DISPc.LT.DELTA1) THEN
      Tc=1.005*Tc
      GO TO 100
      ELSE IF (DISPc.GT.DELTA2) THEN
      Tc=0.995*Tc
      GO TO 100
      END IF

      Lc=0.9*L
      Bc=BOA-2*BMc
      Ac=Lc*Bc
      Pc=(DISP-DISPc)*9.81/Ac



      WRITE(4,200)RATIO,J,L,BOA,D,WD,T,BM,BMWD,CP,EV,LSD
200   FORMAT(5X,F4.1,5X,F5.3,5X,F5.1,5X,F5.2,5X,F5.2,5X,F5.2,5X,F5.2
     & ,5X,F5.2,5X,F5.2,5X,F5.3,5X,F8.1,5X,F5.1)

      WRITE(5,250)RATIO,J,L,SD,SW,MW,EW,AUXW,OUTW,WEIGHT,BALANCE,MARGIN♦
250   FORMAT(5X,F4.1,5X,F5.3,5X,F5.1,4X,F5.2,4X,F7.1,5X,F6.1,5X
     & ,F6.1,5X,F6.1,5X,F6.1,5X,F7.1,4X,F8.1,4X,F4.1)

      WRITE(6,300)RATIO,J,L,Lc/Bc,Bc,Tc,Ac,Pc
300   FORMAT(5X,F4.1,5X,F5.3,5X,F5.1,5X,F4.1,5X
```

```
     &  ,F4.1,5X,F4.1,5X,F7.1,5X,F5.1)

      IF (J.EQ.0.35) THEN
      WRITE(4,350)
      WRITE(5,350)
      WRITE(6,350)
350   FORMAT(//)
      END IF



600   CONTINUE

500   CONTINUE

700   CONTINUE


      CLOSE(3)
      CLOSE(4)
      CLOSE(5)
      CLOSE(6)

      STOP


      END
```

Appendix 2

FOIL: Hydrofoil Lift and Drag Estimates

```
      REAL MK,L

      PI=3.141592654
      PRINT *, 'INPUT: MIN ASPECT RATIO, MAX ASPECT RATIO, INCREMENT'♦
      READ *, AR1,AR2,ARS


      OPEN(UNIT=4,FILE='FOIL.DAT',STATUS='OLD')
      OPEN(UNIT=5,FORM='FORMATTED',FILE='FOIL.OUT',STATUS='NEW')
      OPEN(UNIT=6,FORM='FORMATTED',FILE='FOIL.CHK',STATUS='NEW')


      PRINT *, 'INPUT: VMIN, VMAX, INCREMENT (m/s)'
      READ *, V1,V2,VS


      PRINT *,'HOW MANT FOIL VARIATIONS?'
      READ *, FC

      DO 400 H=1,FC
      READ(4,*) SP,T,SWP,MK,PF,TCR
      WRITE(5,5)SP,T,SWP,MK,PF,TCR
      WRITE(6,5)SP,T,SWP,MK,PF,TCR
 5    FORMAT(/////5X,'SPAN=',F5.2,3X,'DRAUGHT=',F5.2,3X,'SWEEPBACK='
  &   F5.2,3X,'MUNK=',F5.2,3X,'PLANFORM=',F5.2,3X,'THK/CHORD=',F5.2)

      SWP=SWP*PI/180





      IF (ARS.GT.0) THEN
      N=((AR2-AR1)/ARS)+1
      ELSE
      N=1
      END IF

      AR=AR1-ARS

      DO 300 I=1,N

      AR=AR+ARS
      C=SP/AR
      P=(16*(T/C)**2+1)/(16*(T/C)**2+2)
      WRITE(5,10)AR,SP,C
      WRITE(6,10)AR,SP,C
10    FORMAT(//5X,'ASPECT RATIO=',F5.2,3X,'SPAN='
  &   F5.2,3X,'CHORD=',F5.2)
      WRITE(5,15)
      WRITE(6,15)
15    FORMAT(5X,'______________________________________________')
```

```
      CLA1=2*PI*P*AR*COS(SWP)
      CLA2=AR+2*P*(1+MK)*(1+PF)*COS(SWP)*(1+(1+(AR/2*P*COS(SWP))**2)
     &    **0.5)-((1+MK)*(1+PF)*AR)
      CLA=CLA1/CLA2

      WRITE(5,20)C,CLA
20    FORMAT(/5X,'CHORD=',F5.2,10X,'LIFT CURVE SLOPE=',F5.2)




      AE=0.0279252
      DO 200 J=1,10
      AE=AE+0.0017453292
      CL=CLA*AE*0.8
      AED=AE*180/PI
      WRITE(5,30)AED,CL
      WRITE(6,30)AED,CL
30    FORMAT(///5X,'EFFECTIVE ANGLE OF ATTACK (deg)=',F5.2,10X
     &    ,'LIFT COEFFICIENT=',F5.3)




      WRITE(5,40)
40    FORMAT(/5X,'SPEED(knots)',5x,'LIFT(tonnes)',5x,'DRAG(kN)'
     &    7x,'PRESSURE(N/m**2)',5x,'DRAG COEFF')


      IF (VS.EQ.0) THEN
      M=1
      ELSE
      M=((V2-V1)/VS)+1
      END IF

      WRITE(6,45)
45    FORMAT(/5X,'SPEED',7X,'CF',7X,'CDP'7X,'DCDP'
     &    6X,'CDI',8X,'CDW',7X,'CD')

      V=V1-VS
      DO 100 K=1,M
      V=V+VS
      L=1025*SP*C*V**2*CL/2
      FNC=V/SQRT(9.81*C)
      PR=L/(SP*C)



      RN=V*C/1.16E-6
      CF=0.075/(ALOG10(RN)-2)**2
      TH=TCR*C
      CDP=CF*(1+2*(TH/C)+60*(TH/C)**4)
```

```
      DCDP=0.005*CL**2
      CDI1=2*P*(1+MK)*(1+PF)*COS(SWP)*(1+SQRT(1+
     &   (AR/(2*P*COS(SWP)))**2))-AR*(1+MK)*(1+PF)
      CDI2=2*PI*AR*COS(SWP)/CL**2
      CDI=CDI1/CDI2
      FNH=V/SQRT(9.81*T)
      CDW=0.5*CL**2/(FNH**2*EXP(2/FNH**2))

      CD=CDP+DCDP+CDI+CDW

      D=1025*SP*C*V**2*CD/2


      WRITE(5,50)V/0.5144,L/9810,D/1000,PR,CD
 50   FORMAT(9X,F5.2,6X,F10.1,7X,F10.1,10X,F10.1,10X,F6.4)

      WRITE(6,60)V/0.5144,CF,CDP,DCDP,
     &   CDI,CDW,CD
 60   FORMAT(5X,F5.2,4X,F6.4,4X,F6.4,4X
     &   F6.4,4X,F7.4,4X,F6.4,4X,F7.4)

100   CONTINUE
200   CONTINUE
300   CONTINUE
400   CONTINUE

      CLOSE(4)
      CLOSE(5)
      CLOSE(6)


      STOP
      END
```

Appendix 3

SES Design Build Cost Estimates

INPUT DATA

LOA	194.1	m	Steel Cost	500	£/tonne
BOA	38.8	m	Aluminium Cost	3000	£/tonne
Hs	6.8	m	Labour Cost	9	£/hour
Draught Off	8.1	m	Overhead Rate	1.5	
Depth	17.6	m	Insulation Cost	400	£/cu.metre
Depth Wet Dk	12.1	m	Deck Covering Cost	100	£/sq.metre
Encl. Volume	58910	m^3			
No of Decks	2		Steel Manhours	300	per tonne steel
			Alumin Manhours	900	per tonne alumn.
Prop. Power	232555	kw			
Lift Power	59115	kw	Power Cost	110	£/kw
Generators	4651	kw	Electric Cost	165	£/kw
Air Flow Rate	1864	m^3/s			
Weight Steel	6425	tonnes			
Weight Sup/St	0	tonnes			
Weight Machy	840	tonnes			
Weight Electr.	158	tonnes			
Weight Aux.	660	tonnes			
Weight Outfit	1200	tonnes			
Displacement	14286	tonnes			
Deadweight	5003	tonnes			

COST SUMMARY

ITEM	LABOUR HOURS	LABOUR COST -£ 1,000	LABOUR + OVERHEAI COST -£ 1,000	MATERIAL COST -£ 1,000
Hull	2049620	18447	46116	6023
Machinery	29176	263	656	57044
Electric	34681	312	780	6492
Auxiliaries	94982	855	2137	6425
Outfit	10216	92	230	4691
Sub-totals	2218674	19968	49920	80676

COST SUMMARY

ITEM	£ 1,000
Construction	130596
Design	7836
Classification	200
Trials	3265
Margin	4257
Profit	21923
TOTAL PRICE	168077

ITEM	MULTIPLIER	MATERIAL COST (£1,000)	MANHOURS REQUIRED
1.STRUCTURE			
Hull & Superstructure	6425	3213	1927500
WT Doors / Fire Doors / Hatches	73362	172	21628
Rudders	61002	272	272
Stress Relieving	6425	868	
Radiography	6425	868	
Heats	6425	3	2619
Electrodes	3212.5	80	
Margin		548	97601
Total		6023	2049620
2.PROPULSION			
Prime Movers	232555	25581	4393
Propulsors, Shafting, Transmission	232555	6298	5514
Shaft Alignment	232555	32	3076
Machining	840		1496
Systems - Fuel, Luboil, Cooling	1658	177	1835
Seats	1658	17	1418
Lift Engines	59115	6503	2286
Lift Fans	1864	1951	1524
Seals	437	2598	3280
Intakes and Exhausts		4813	0
RCS	14286	3786	1524
Air Intake Filters	232555	104	1440
Margin		5186	1389
Total		57044	29176
3.ELECTRICAL			
Generators	4651	767	1860
Distribution Equipment		271	2071
Cabling		857	21314
Navigation Eqpt + Communications		354	1463
Automation		3425	3171
Lighting + Fire Detection		213	2050
Pipework		16	1100
Margin		590	1651
Total		6492	34681
4.AUXILIARIES			
Air Conditioning		2892	18329
A/C Ducting		1308	6163
Fuel Systems		423	2201
Waste Water + Sewage System		41	3082
SW Systems + Firefighting		946	27976
FW Systems		30	1378
ER Gas Drench System		46	28653
Hydraulic System		156	2677
Margin		584	4523
Total		6425	94982
5.OUTFIT			
Deck Machinery		58	440
Preparation and Painting		313	
Insulation		459	0
Gaurdrails,Ladders		91	3288
Container Cells		750	1500
Accommodation		2593	4059
Margin		426	929
Total		4691	10216

INPUT DATA

OA	157.6 m	Steel Cost	500 £/tonne
OA	35 m	Aluminium Cost	3000 £/tonne
h	6.1 m	Labour Cost	9 £/hour
aught Off	7.2 m	Overhead Rate	1.5
epth	16.2 m	Insulation Cost	400 £/cu.metre
epth Wet Dk	10.7 m	Deck Covering Cost	100 £/sq.metre
ncl. Volume	41116 m^3		
o. of Decks	2	Steel Manhours	300 per tonne steel
		Alumin Manhours	900 per tonne alumn.
op. Power	180198 kw		
ft Power	36135 kw	Power Cost	125 £/kw
enerators	4327 kw	Electric Cost	165 £/kw
ir Flow Rate	1284 m^3/s		
eight Steel	4143 tonnes		
eight Sup/St	0 tonnes		
eight Machy	564 tonnes		
eight Electr.	106 tonnes		
eight Aux.	454 tonnes		
eight Outfit	770 tonnes		
isplacement	9286 tonnes		
eadweight	3250 tonnes		

COST SUMMARY

TEM	LABOUR HOURS	LABOUR COST -£ 1,000	LABOUR + OVERHEAD COST -£ 1,000	MATERIAL COST -£ 1,000
ull	1324300	11919	29797	3789
achinery	24208	218	545	46187
ectric	29407	265	662	4436
uxiliaries	72144	649	1623	4299
utfit	8121	73	183	3712
ub-totals	1458180	13124	32809	62422

OST SUMMARY

TEM	£ 1,000
onstruction	95231
esign	5714
lassification	200
rials	2381
argin	3106
rofit	15995
OTAL PRICE	122627

ITEM	MULTIPLIER	MATERIAL COST (£1,000)	MANHOURS REQUIRED
STRUCTURE			
ull & Superstructure	4143	2072	1242900
T Doors / Fire Doors / Hatches	50911	124	15579
dders	39715	188	242
ress Relieving	4143	503	
adiography	4143	503	
ats	4143	3	2517
ectrodes	2071.5	52	
argin		344	63062
tal		3789	1324300
PROPULSION			
ime Movers	180198	22525	3890
opulsors, Shafting, Transmission	180198	5306	4968
aft Alignment	180198	30	2833
achining	564		1179
ystems - Fuel, Luboil, Cooling	1124	135	1632
eats	1124	13	1212
ift Engines	36135	4517	1808
ift Fans	1284	1355	1205
eals	253	1505	1900
ntakes and Exhausts		4056	0
CS	9286	2461	1205
ir Intake Filters	180198	86	1223
argin		4199	1153
otal		46187	24208
ELECTRICAL			
enerators	4327	714	1731
istribution Equipment		212	1913
abling		631	17671
avigation Eqpt + Communications		286	1401
utomation		1993	2567
ighting + Fire Detection		183	1961
ipework		14	764
argin		403	1400
otal		4436	29407
AUXILIARIES			
ir Conditioning		1869	14423
A/C Ducting		821	5534
uel Systems		296	1527
aste Water + Sewage System		34	2767
SW Systems + Firefighting		681	21404
FW Systems		27	1272
ER Gas Drench System		41	19461
Hydraulic System		140	2320
Margin		391	3435
Total		4299	72144
OUTFIT			
Deck Machinery		49	305
Preparation and Painting		246	
Insulation		366	0
Guardrails,Ladders		73	3009
Container Cells		750	1500
Accommodation		1889	2920
Margin		337	387
Total		3712	8121

INPUT DATA

LOA	125.1	m
BOA	31.3	m
Hs	4.7	m
Draught Off	7.3	m
Depth	15.8	m
Depth Wet Dk	10.3	m
Encl. Volume	27062	m^3
No. of Decks	2	
Prop. Power	132514	kw
Lift Power	20212	kw
Generators	2650	kw
Air Flow Rate	868	m^3/s
Weight Steel	2508	tonnes
Weight Sup/St	0	tonnes
Weight Machy	369	tonnes
Weight Electr.	70	tonnes
Weight Aux.	298	tonnes
Weight Outfit	472	tonnes
Displacement	5714	tonnes
Deadweight	2000	tonnes

Steel Cost	500	£/tonne
Aluminium Cost	3000	£/tonne
Labour Cost	9	£/hour
Overhead Rate	1.5	
Insulation Cost	400	£/cu.metre
Deck Covering Cost	100	£/sq.metre
Steel Manhours	300	per tonne steel
Alumin Manhours	900	per tonne alumn.
Power Cost	130	£/kw
Electric Cost	165	£/kw

COST SUMMARY

ITEM	LABOUR HOURS	LABOUR COST -£ 1,000	LABOUR + OVERHEAI COST -£ 1,000	MATERIAL COST -£ 1,000
Hull	804055	7236	18091	2260
Machinery	19933	179	448	33582
Electric	24157	217	544	3047
Auxiliaries	53377	480	1201	2752
Outfit	6778	61	153	2922
Sub-totals	908301	8175	20437	44563

COST SUMMARY

ITEM	£ 1,000
Construction	65000
Design	3900
Classification	200
Trials	1625
Margin	2122
Profit	10927
TOTAL PRICE	83774

ITEM	MULTIPLIER	MATERIAL COST (£1,000)	MANHOURS REQUIRED
STRUCTURE			
Hull & Superstructure	2508	1254	752400
WT Doors / Fire Doors / Hatches	33648	86	10741
Ladders	28584	141	222
Stress Relieving	2508	269	
Radiography	2508	269	
Seats	2508	4	2404
Electrodes	1254	31	
Margin		205	38288
Total		2260	804055
PROPULSION			
Prime Movers	132514	17227	3360
Propulsors, Shafting, Transmission	132514	4316	4381
Shaft Alignment	132514	27	2566
Machining	369		915
Systems - Fuel, Luboil, Cooling	737	100	1437
Seats	737	10	1022
Lift Engines	20212	2628	1370
Lift Fans	868	788	913
Seals	147	873	1102
Intakes and Exhausts		2978	0
RCS	5714	1514	913
Air Intake Filters	132514	68	1005
Margin		3053	949
Total		33582	19933
ELECTRICAL			
Generators	2650	437	1060
Distribution Equipment		160	1748
Cabling		446	14289
Navigation Eqpt + Communications		243	1355
Automation		1316	2184
Lighting + Fire Detection		156	1867
Pipework		12	505
Margin		277	1150
Total		3047	24157
AUXILIARIES			
Air Conditioning		1140	10992
A/C Ducting		484	4897
Fuel Systems		197	1009
Waste Water + Sewage System		28	2449
SW Systems + Firefighting		469	15800
FW Systems		24	1162
ER Gas Drench System		37	12551
Hydraulic System		123	1973
Margin		250	2542
Total		2752	53377
OUTFIT			
Deck Machinery		41	202
Preparation and Painting		189	
Insulation		285	0
Guardrails,Ladders		58	2721
Container Cells		750	1500
Accommodation		1333	2033
Margin		266	323
Total		2922	6778

Appendix 4

SES Base Design Operating Costs

Table A4.1
SES194 Operating Costs

VESSEL DATA	
Length	194.1
Breadth	38.8
Draught	6.8
Payload	1314
Power	291670
No. Containers	150
Complement	38
Annual Op. Hours	5280
No. Trips per annum	96
Fuel Load per Trip	3256
Dieso per week	85

COSTHEAD	ESCALATION RATE
Registration	0
Manning	0
Insurance	0
R & M	0
Stores	0
Victualling	0
Administration	0
Fuel Oil	0
Diesel Oil	0
Port Dues	0
Cargo Handling	0

YEAR	REGISTRATION	MANNING	INSURANCE	R & M	STORES	VICTUALING	ADMINISTRATION	FUEL OIL	DIESEL OIL	PORT DUES	CARGO HANDLING	TOTAL OPERATING COSTS
0	7500	2280000	2520000	3960000	300000	37620	168000	46886400	612000	75686	1152000	57999206
1	7875	2394000	2646000	4158000	315000	39501	176400	49230720	642600	79471	1209600	60899167
2	8269	2513700	2778300	4365900	330750	41476	185220	51692256	674730	83444	1270080	63944125
3	8682	2639385	2917215	4584195	347288	43550	194481	54276869	708467	87616	1333584	67141331
4	9116	2771354	3063076	4813405	364652	45727	204205	56990712	743890	91997	1400263	70498398
5	9572	2909922	3216230	5054075	382884	48014	214415	59840248	781084	96597	1470276	74023318
6	10051	3055418	3377041	5306779	402029	50414	225136	62832260	820139	101427	1543790	77724484
7	10553	3208189	3545893	5572118	422130	52935	236393	65973873	861145	106498	1620980	81610708
8	11081	3368598	3723188	5850724	443237	55582	248213	69272567	904203	111823	1702029	85691243
9	11635	3537028	3909347	6143260	465398	58361	260623	72736195	949413	117414	1787130	89975805
10	12217	3713880	4104814	6450423	488668	61279	273654	76373005	996884	123285	1876487	94474596
11	12828	3899574	4310055	6772944	513102	64343	287337	80191655	1046728	129449	1970311	99198325
12	13469	4094552	4525558	7111591	538757	67560	301704	84201238	1099064	135922	2068826	104158242
13	14142	4299280	4751836	7467171	565695	70938	316789	88411300	1154017	142718	2172268	109366154
14	14849	4514244	4989428	7840529	593979	74485	332629	92831865	1211718	149854	2280881	114834461
15	15592	4739956	5238899	8232556	623678	78209	349260	97473458	1272304	157347	2394925	120576185
16	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0

Table A4.2
SES157 Operating Costs

VESSEL DATA		COSTHEAD	ESCALATION RATE
Length	157.6	Registration	0
Breadth	35	Manning	0
Draught	7.2	Insurance	0
Payload	1804	R & M	0
Power	216333	Stores	0
No. Containers	200	Victualling	0
Complement	29	Administration	0
Annual Op. Hours	6048	Fuel Oil	0
No. Trips per annum	224	Diesel Oil	0
Fuel Load per Trip	1254	Port Dues	0
Dieso per week	648	Cargo Handling	0

YEAR	REGISTRATION	MANNING	INSURANCE	R & M	STORES	VICTUALING	ADMINISTRATION	FUEL OIL	DIESEL OIL	PORT DUES	CARGO HANDLING	TOTAL OPERATING COSTS
0	6000	1740000	1845000	3628800	250000	32886	123000	42134400	4665600	242458	3584000	58252144
1	6300	1827000	1937250	3810240	262500	34530	129150	44241120	4898880	254580	3763200	61164751
2	6615	1918350	2034113	4000752	275625	36257	135608	46453176	5143824	267310	3951360	64222988
3	6946	2014268	2135818	4200790	289406	38070	142388	48775835	5401015	280675	4148928	67434138
4	7293	2114981	2242609	4410829	303877	39973	149507	51214627	5671066	294709	4356374	70805845
5	7658	2220730	2354739	4631371	319070	41972	156983	53775358	5954619	309444	4574193	74346137
6	8041	2331766	2472476	4862939	335024	44070	164832	56464126	6252350	324916	4802903	78063444
7	8443	2448355	2596100	5106086	351775	46274	173073	59287332	6564968	341162	5043048	81966616
8	8865	2570772	2725905	5361390	369364	48588	181727	62251699	6893216	358220	5295200	86064947
9	9308	2699311	2862201	5629460	387832	51017	190813	65364284	7237877	376131	5559960	90368194
10	9773	2834277	3005311	5910933	407224	53568	200354	68632498	7599771	394938	5837958	94886604
11	10262	2975990	3155576	6206479	427585	56246	210372	72064123	7979759	414685	6129856	99630934
12	10775	3124790	3313355	6516803	448964	59059	220890	75667329	8378747	435419	6436349	104612481
13	11314	3281030	3479023	6842644	471412	62011	231935	79450695	8797685	457190	6758167	109843105
14	11880	3445081	3652974	7184776	494983	65112	243532	83423230	9237569	480049	7096075	115335260
15	12474	3617335	3835622	7544015	519732	68368	255708	87594391	9699447	504052	7450879	121102023
16	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0

Table A4.3
SES125 Operating Costs

VESSEL DATA		COSTHEAD	ESCALATION RATE
Length	125.1	Registration	0
Breadth	31.3	Manning	0
Draught	7.3	Insurance	0
Payload (max)	1261	R & M	0
Power	152726	Stores	0
No. Containers	150	Victualling	0
Complement	24	Administration	0
Annual Op. Hours	6384	Fuel Oil	0
No. Trips per annum	336	Diesel Oil	0
Fuel Load per Trip	631	Port Dues	0
Dieso per week	84	Cargo Handling	0

YEAR	REGISTRATION	MANNING	INSURANCE	R & M	STORES	VICTUALING	ADMINISTRATION	FUEL OIL	DIESEL OIL	PORT DUES	CARGO HANDLING	TOTAL OPERATING COSTS
0	5000	1440000	1275000	3192000	200000	28728	85000	31802400	604800	254218	4032000	42919146
1	5250	1512000	1338750	3351600	210000	30164	89250	33392520	635040	266928	4233600	45065103
2	5513	1587600	1405688	3519180	220500	31673	93713	35062146	666792	280275	4445280	47318358
3	5788	1666980	1475972	3695139	231525	33256	98398	36815253	700132	294289	4667544	49684276
4	6078	1750329	1549770	3879896	243101	34919	103318	38656016	735138	309003	4900921	52168490
5	6381	1837845	1627259	4073891	255256	36665	108484	40588817	771895	324453	5145967	54776914
6	6700	1929738	1708622	4277585	268019	38498	113908	42618258	810490	340676	5403266	57515760
7	7036	2026225	1794053	4491465	281420	40423	119604	44749170	851014	357710	5673429	60391548
8	7387	2127536	1883756	4716038	295491	42444	125584	46986629	893565	375595	5957100	63411125
9	7757	2233913	1977943	4951840	310266	44567	131863	49335960	938243	394375	6254955	66581682
10	8144	2345608	2076841	5199432	325779	46795	138456	51802758	985155	414094	6567703	69910766
11	8552	2462889	2180683	5459403	342068	49135	145379	54392896	1034413	434798	6896088	73406304
12	8979	2586033	2289717	5732373	359171	51591	152648	57112541	1086134	456538	7240893	77076619
13	9428	2715335	2404203	6018992	377130	54171	160280	59968168	1140441	479365	7602937	80930450
14	9900	2851102	2524413	6319942	395986	56879	168294	62966577	1197463	503333	7983084	84976973
15	10395	2993657	2650633	6635939	415786	59723	176709	66114906	1257336	528500	8382238	89225821
16	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0

Appendix 5

SES Sensitivity Study: Discounted Cash Flows and Operating Costs

Table A5.1

SES157 Discounted Cash Flow Analysis - 10% Discount Rate

PROJECT LIFE: 15 **PRICE:** 123000000 **DEBT RATIO:** 0.75 **LOAN YEARS:** 10 **INTEREST RATE:** 0.1

DECLINING BAL.: 0.2

TAX RATE: 0.33 **INFLATION RATE:** 0.05 **DISCOUNT RATE:** 0.1 **BASE REVENUE:** 75820702

SCRAP VALUE: 4327678

YEAR	CAPITAL	LOAN OUTSTANDING	LOAN REPAYMENTS	INTEREST PAYMENTS	RELIEF ON INTEREST	CAPITAL ALLOWANCE	RELIEF ON CAPITAL	ANNUAL REVENUE	OPERATING COSTS	GROSS SURPLUS	TAX	ANNUAL CASH FLOW	DISCOUNTED CASH FLOW
0	-30750000	0	0	0	0	0	0	0	0	0	0	-30750000	-30750000
1	0	92250000	9225000	9225000	3044250	24600000	0	75820702	61164751	-3794049	-2256639	-1537410	-1331091
2	0	83025000	9225000	8302500	2739825	19680000	8118000	79611737	64222988	-2138751	-4288870	2150119	1611753
3	0	73800000	9225000	7380000	2435400	15744000	6494400	83592324	67434138	-446814	-3094283	2647469	1718244
4	0	64575000	9225000	6457500	2130975	12595200	5195520	87771940	70805845	1283595	-1994157	3277752	1841824
5	0	55350000	9225000	5535000	1826550	10076160	4156416	92160537	74346137	3054400	-966427	4020827	1956165
6	0	46125000	9225000	4612500	1522125	8060928	3325133	96768564	78063444	4867620	6720	4860901	2047504
7	0	36900000	9225000	3690000	1217700	6448742	2660106	101606992	81966616	6725376	939698	5785678	2109990
8	0	27675000	9225000	2767500	913275	5158994	2128085	106687342	86064947	8629895	1844217	6785678	2142582
9	0	18450000	9225000	1845000	608850	4127195	1702468	112021709	90368194	10583515	2729825	7853690	2147019
10	0	9225000	9225000	922500	304425	3301756	1361974	117622794	94886604	12588690	3604356	8984334	2126503
11	0	0	0	0	0	2641405	1089580	123503934	99630934	23873000	7518529	16354471	3351465
12	0	0	0	0	0	2113124	871664	129679131	104612481	25066650	7984346	17082304	3030837
13	0	0	0	0	0	1690499	697331	136163087	109843105	26319983	8455475	17864507	2744260
14	0	0	0	0	0	1352399	557865	142971241	115335260	27635982	8935779	18700203	2487130
15	4327678	0	0	0	0	1081919	446292	150119804	121102023	29017781	9428591	23916867	2754067
16	0	0	0	0	0	0	357033	0	0	0	-117821	117821	11747
17	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0
												NPV	0

REQUIRED FREIGHT RATE = 235 £/tonne

(with 80% load factor)

Table A5.2
SES157 Operating Costs - 10% Discount Rate

VESSEL DATA		COSTHEAD	ESCALATION RATE
Length	157.6	Registration	0
Breadth	35	Manning	0
Draught	7.2	Insurance	0
Payload	1804	R & M	0
Power	216333	Stores	0
No. Containers	200	Victualling	0
Complement	29	Administration	0
Annual Op. Hours	6048	Fuel Oil	0
No. Trips per annum	224	Diesel Oil	0
Fuel Load per Trip	1254	Port Dues	0
Dieso per week	648	Cargo Handling	0

YEAR	REGISTRATION	MANNING	INSURANCE	R & M	STORES	VICTUALING	ADMINISTRATION	FUEL OIL	DIESEL OIL	PORT DUES	CARGO HANDLING	TOTAL OPERATING COSTS
0	6000	1740000	1845000	3628800	250000	32886	123000	42134400	4665600	242458	3584000	58252144
1	6300	1827000	1937250	3810240	262500	34530	129150	44241120	4898880	254580	3763200	61164751
2	6615	1918350	2034113	4000752	275625	36257	135608	46453176	5143824	267310	3951360	64222988
3	6946	2014268	2135818	4200790	289406	38070	142388	48775835	5401015	280675	4148928	67434138
4	7293	2114981	2242609	4410829	303877	39973	149507	51214627	5671066	294709	4356374	70805845
5	7658	2220730	2354739	4631371	319070	41972	156983	53775358	5954619	309444	4574193	74346137
6	8041	2331766	2472476	4862939	335024	44070	164832	56464126	6252350	324916	4802903	78063444
7	8443	2448355	2596100	5106086	351775	46274	173073	59287332	6564968	341162	5043048	81966616
8	8865	2570772	2725905	5361390	369364	48588	181727	62251699	6893216	358220	5295200	86064947
9	9308	2699311	2862201	5629460	387832	51017	190813	65364284	7237877	376131	5559960	90368194
10	9773	2834277	3005311	5910933	407224	53568	200354	68632498	7599771	394938	5837958	94886604
11	10262	2975990	3155576	6206479	427585	56246	210372	72064123	7979759	414685	6129856	99630934
12	10775	3124790	3313355	6516803	448964	59059	220890	75667329	8378747	435419	6436349	104612481
13	11314	3281030	3479023	6842644	471412	62011	231935	79450695	8797685	457190	6758167	109843105
14	11880	3445081	3652974	7184776	494983	65112	243532	83423230	9237569	480049	7096075	115335260
15	12474	3617335	3835622	7544015	519732	68368	255708	87594391	9699447	504052	7450879	121102023
16	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0

Table A5.3
SES157 Discounted Cash Flow Analysis - 12.5% Discount Rate

PROJECT LIFE: 15 | PRICE: 123000000 | DEBT RATIO: 0.75 | LOAN YEARS: 10 | INTEREST RATE: 0.1

DECLINING BAL.: 0.2

TAX RATE: 0.33 | INFLATION RATE: 0.05 | DISCOUNT RATE: 0.125 | BASE REVENUE: 77206979

SCRAP VALUE: 4327678

YEAR	CAPITAL	LOAN OUTSTANDING	LOAN REPAYMENTS	INTEREST PAYMENTS	RELIEF ON INTEREST	CAPITAL ALLOWANCE	RELIEF ON CAPITAL	ANNUAL REVENUE	OPERATING COSTS	GROSS SURPLUS	TAX	ANNUAL CASH FLOW	DISCOUNTED CASH FLOW
0	-30750000	0	0	0	0	0	0	0	0	0	0	-30750000	-30750000
1	0	92250000	9225000	9225000	3044250	24600000	0	77206979	61164751	-2407771	-1799167	-608604	-515221
2	0	83025000	9225000	8302500	2739825	19680000	8118000	81067328	64222988	-683160	-3808525	3125365	2239841
3	0	73800000	9225000	7380000	2435400	15744000	6494400	85120695	67434138	1081557	-2589920	3671477	2227488
4	0	64575000	9225000	6457500	2130975	12595200	5195520	89376730	70805845	2888385	-1464576	4352961	2235721
5	0	55350000	9225000	5535000	1826550	10076160	4156416	93845566	74346137	4739429	-410367	5149796	2239138
6	0	46125000	9225000	4612500	1522125	8060928	3325133	98537844	78063444	6636901	590582	6046318	2225564
7	0	36900000	9225000	3690000	1217700	6448742	2660106	103464737	81966616	8583121	1552754	7030367	2190712
8	0	27675000	9225000	2767500	913275	5158994	2128085	108637973	86064947	10580527	2487925	8092602	2134782
9	0	18450000	9225000	1845000	608850	4127195	1702468	114069872	90368194	12631678	3405719	9225959	2060322
10	0	9225000	9225000	922500	304425	3301756	1361974	119773366	94886604	14739262	4314045	10425217	1970910
11	0	0	0	0	0	2641405	1089580	125762034	99630934	26131100	8263702	17867398	2859574
12	0	0	0	0	0	2113124	871664	132050136	104612481	27437655	8766777	18670878	2529664
13	0	0	0	0	0	1690499	697331	138652642	109843105	28809538	9277028	19532509	2240342
14	0	0	0	0	0	1352399	557865	145585274	115335260	30250015	9798409	20451605	1985829
15	4327678	0	0	0	0	1081919	446292	152864538	121102023	31762515	10334354	25755839	2117134
16	0	0	0	0	0	0	357033	0	0	0	-117821	117821	8199
17	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0
												NPV	0

REQUIRED FREIGHT RATE = 239 £/tonne

(with 80% load factor)

Table A5.4
SES157 Operating Costs - 12.5% Discount Rate

VESSEL DATA	
Length	157.6
Breadth	35
Draught	7.2
Payload	1804
Power	216333
No. Containers	200
Complement	29
Annual Op. Hours	6048
No. Trips per annum	224
Fuel Load per Trip	1254
Dieso per week	648

COSTHEAD	ESCALATION RATE
Registration	0
Manning	0
Insurance	0
R & M	0
Stores	0
Victualling	0
Administration	0
Fuel Oil	0
Diesel Oil	0
Port Dues	0
Cargo Handling	0

YEAR	REGISTRATION	MANNING	INSURANCE	R & M	STORES	VICTUALING	ADMINISTRATION	FUEL OIL	DIESEL OIL	PORT DUES	CARGO HANDLING	TOTAL OPERATING COSTS
0	6000	1740000	1845000	3628800	250000	32886	123000	42134400	4665600	242458	3584000	58252144
1	6300	1827000	1937250	3810240	262500	34530	129150	44241120	4898880	254580	3763200	61164751
2	6615	1918350	2034113	4000752	275625	36257	135608	46453176	5143824	267310	3951360	64222988
3	6946	2014268	2135818	4200790	289406	38070	142388	48775835	5401015	280675	4148928	67434138
4	7293	2114981	2242609	4410829	303877	39973	149507	51214627	5671066	294709	4356374	70805845
5	7658	2220730	2354739	4631371	319070	41972	156983	53775358	5954619	309444	4574193	74346137
6	8041	2331766	2472476	4862939	335024	44070	164832	56464126	6252350	324916	4802903	78063444
7	8443	2448355	2596100	5106086	351775	46274	173073	59287332	6564968	341162	5043048	81966616
8	8865	2570772	2725905	5361390	369364	48588	181727	62251699	6893216	358220	5295200	86064947
9	9308	2699311	2862201	5629460	387832	51017	190813	65364284	7237877	376131	5559960	90368194
10	9773	2834277	3005311	5910933	407224	53568	200354	68632498	7599771	394938	5837958	94886604
11	10262	2975990	3155576	6206479	427585	56246	210372	72064123	7979759	414685	6129856	99630934
12	10775	3124790	3313355	6516803	448964	59059	220890	75667329	8378747	435419	6436349	104612481
13	11314	3281030	3479023	6842644	471412	62011	231935	79450695	8797685	457190	6758167	109843105
14	11880	3445081	3652974	7184776	494983	65112	243532	83423230	9237569	480049	7096075	115335260
15	12474	3617335	3835622	7544015	519732	68368	255708	87594391	9699447	504052	7450879	121102023
16	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0

Table A5.5
SES157 Discounted Cash Flow Analysis - 15% Discount Rate

PROJECT LIFE: 15 | PRICE: 123000000 | DEBT RATIO: 0.75 | LOAN YEARS: 10 | INTEREST RATE: 0.1

DECLINING BAL.: 0.2

TAX RATE: 0.33 | INFLATION RATE: 0.05 | DISCOUNT RATE: 0.15 | BASE REVENUE: 78605753

SCRAP VALUE: 4327678

YEAR	CAPITAL	LOAN OUTSTANDING	LOAN REPAYMENTS	INTEREST PAYMENTS	RELIEF ON INTEREST	CAPITAL ALLOWANCE	RELIEF ON CAPITAL	ANNUAL REVENUE	OPERATING COSTS	GROSS SURPLUS	TAX	ANNUAL CASH FLOW	DISCOUNTED CASH FLOW
0	-30750000	0	0	0	0	0	0	0	0	0	0	-30750000	-30750000
1	0	92250000	9225000	9225000	3044250	24600000	0	78605753	61164751	-1008998	-1337572	328574	272111
2	0	83025000	9225000	8302500	2739825	19680000	8118000	82536041	64222988	785553	-3323850	4109402	2818411
3	0	73800000	9225000	7380000	2435400	15744000	6494400	86662843	67434138	2623705	-2081011	4704716	2672219
4	0	64575000	9225000	6457500	2130975	12595200	5195520	90995985	70805845	4507640	-930222	5437862	2557877
5	0	55350000	9225000	5535000	1826550	10076160	4156416	95545784	74346137	6439647	150705	6288943	2449864
6	0	46125000	9225000	4612500	1522125	8060928	3325133	100323074	78063444	8422130	1179708	7242422	2336474
7	0	36900000	9225000	3690000	1217700	6448742	2660106	105339227	81966616	10457611	2171336	8286276	2213856
8	0	27675000	9225000	2767500	913275	5158994	2128085	110606189	86064947	12548742	3137436	9411306	2082345
9	0	18450000	9225000	1845000	608850	4127195	1702468	116136498	90368194	14698304	4087705	10610599	1944266
10	0	9225000	9225000	922500	304425	3301756	1361974	121943323	94886604	16909219	5030131	11879089	1802651
11	0	0	0	0	0	2641405	1089580	128040489	99630934	28409555	9015592	19393963	2437295
12	0	0	0	0	0	2113124	871664	134442513	104612481	29830033	9556262	20273771	2110031
13	0	0	0	0	0	1690499	697331	141164639	109843105	31321535	10105987	21215547	1828611
14	0	0	0	0	0	1352399	557865	148222871	115335260	32887611	10668816	22218795	1585990
15	4327678	0	0	0	0	1081919	446292	155634015	121102023	34531992	11248281	27611389	1632229
16	0	0	0	0	0	0	357033	0	0	0	-117821	117821	5768
17	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0
												NPV	0

REQUIRED FREIGHT RATE = 243 £/tonne

(with 80% load factor)

Table A5.6
SES157 Operating Costs - 15% Discount Rate

VESSEL DATA	
Length	157.6
Breadth	35
Draught	7.2
Payload	1804
Power	216333
No. Containers	200
Complement	29
Annual Op. Hours	6048
No. Trips per annum	224
Fuel Load per Trip	1254
Dieso per week	648

COSTHEAD	ESCALATION RATE
Registration	0
Manning	0
Insurance	0
R & M	0
Stores	0
Victualling	0
Administration	0
Fuel Oil	0
Diesel Oil	0
Port Dues	0
Cargo Handling	0

YEAR	REGISTRATION	MANNING	INSURANCE	R & M	STORES	VICTUALING	ADMINISTRATION	FUEL OIL	DIESEL OIL	PORT DUES	CARGO HANDLING	TOTAL OPERATING COSTS
0	6000	1740000	1845000	3628800	250000	32886	123000	42134400	4665600	242458	3584000	58252144
1	6300	1827000	1937250	3810240	262500	34530	129150	44241120	4898880	254580	3763200	61164751
2	6615	1918350	2034113	4000752	275625	36257	135608	46453176	5143824	267310	3951360	64222988
3	6946	2014268	2135818	4200790	289406	38070	142388	48775835	5401015	280675	4148928	67434138
4	7293	2114981	2242609	4410829	303877	39973	149507	51214627	5671066	294709	4356374	70805845
5	7658	2220730	2354739	4631371	319070	41972	156983	53775358	5954619	309444	4574193	74346137
6	8041	2331766	2472476	4862939	335024	44070	164832	56464126	6252350	324916	4802903	78063444
7	8443	2448355	2596100	5106086	351775	46274	173073	59287332	6564968	341162	5043048	81966616
8	8865	2570772	2725905	5361390	369364	48588	181727	62251699	6893216	358220	5295200	86064947
9	9308	2699311	2862201	5629460	387832	51017	190813	65364284	7237877	376131	5559960	90368194
10	9773	2834277	3005311	5910933	407224	53568	200354	68632498	7599771	394938	5837958	94886604
11	10262	2975990	3155576	6206479	427585	56246	210372	72064123	7979759	414685	6129856	99630934
12	10775	3124790	3313355	6516803	448964	59059	220890	75667329	8378747	435419	6436349	104612481
13	11314	3281030	3479023	6842644	471412	62011	231935	79450695	8797685	457190	6758167	109843105
14	11880	3445081	3652974	7184776	494983	65112	243532	83423230	9237569	480049	7096075	115335260
15	12474	3617335	3835622	7544015	519732	68368	255708	87594391	9699447	504052	7450879	121102023
16	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0

Table A5.7

SES157 Discounted Cash Flow Analysis - 20% Discount Rate

PROJECT LIFE: 15 **PRICE:** 123000000 **DEBT RATIO:** 0.75 **LOAN YEARS:** 10 **INTEREST RATE:** 0.1

DECLINING BAL.: 0.2

TAX RATE: 0.33 **INFLATION RATE:** 0.05 **DISCOUNT RATE:** 0.2 **BASE REVENUE:** 81417990

SCRAP VALUE: 4327678

YEAR	CAPITAL	LOAN OUTSTANDING	LOAN REPAYMENTS	INTEREST PAYMENTS	RELIEF ON INTEREST	CAPITAL ALLOWANCE	RELIEF ON CAPITAL	ANNUAL REVENUE	OPERATING COSTS	GROSS SURPLUS	TAX	ANNUAL CASH FLOW	DISCOUNTED CASH FLOW
0	-30750000	0	0	0	0	0	0	0	0	0	0	-30750000	-30750000
1	0	92250000	9225000	9225000	3044250	24600000	0	81417990	61164751	1803239	-409534	2212773	1756169
2	0	83025000	9225000	8302500	2739825	19680000	8118000	85488890	64222988	3738401	-2349410	6087811	3834600
3	0	73800000	9225000	7380000	2435400	15744000	6494400	89763334	67434138	5724196	-1057849	6782046	3390385
4	0	64575000	9225000	6457500	2130975	12595200	5195520	94251501	70805845	7763156	144098	7619058	3022867
5	0	55350000	9225000	5535000	1826550	10076160	4156416	98964076	74346137	9857939	1278741	8579198	2701432
6	0	46125000	9225000	4612500	1522125	8060928	3325133	103912280	78063444	12011336	2364146	9647190	2410891
7	0	36900000	9225000	3690000	1217700	6448742	2660106	109107894	81966616	14226278	3414996	10811282	2144289
8	0	27675000	9225000	2767500	913275	5158994	2128085	114563288	86064947	16505842	4443279	12062563	1898783
9	0	18450000	9225000	1845000	608850	4127195	1702468	120291453	90368194	18853259	5458840	13394418	1673358
10	0	9225000	9225000	922500	304425	3301756	1361974	126306025	94886604	21271922	6469822	14802099	1467634
11	0	0	0	0	0	2641405	1089580	132621327	99630934	32990393	10527268	22463124	1767641
12	0	0	0	0	0	2113124	871664	139252393	104612481	34639912	11143522	23496390	1467421
13	0	0	0	0	0	1690499	697331	146215013	109843105	36371908	11772610	24599298	1219286
14	0	0	0	0	0	1352399	557865	153525763	115335260	38190503	12418771	25771733	1013809
15	4327678	0	0	0	0	1081919	446292	161202051	121102023	40100029	13085733	31341973	978517
16	0	0	0	0	0	0	357033	0	0	0	-117821	117821	2919
17	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0
												NPV	1

REQUIRED FREIGHT RATE = 252 £/tonne

(with 80% load factor)

Table A5.8

SES157 Operating Costs - 20% Discount Rate

VESSEL DATA		COSTHEAD	ESCALATION RATE
Length	157.6	Registration	0
Breadth	35	Manning	0
Draught	7.2	Insurance	0
Payload	1804	R & M	0
Power	216333	Stores	0
No. Containers	200	Victualling	0
Complement	29	Administration	0
Annual Op. Hours	6048	Fuel Oil	0
No. Trips per annum	224	Diesel Oil	0
Fuel Load per Trip	1254	Port Dues	0
Dieso per week	648	Cargo Handling	0

YEAR	REGISTRATION	MANNING	INSURANCE	R & M	STORES	VICTUALING	ADMINISTRATION	FUEL OIL	DIESEL OIL	PORT DUES	CARGO HANDLING	TOTAL OPERATING COSTS
0	6000	1740000	1845000	3628800	250000	32886	123000	42134400	4665600	242458	3584000	58252144
1	6300	1827000	1937250	3810240	262500	34530	129150	44241120	4898880	254580	3763200	61164751
2	6615	1918350	2034113	4000752	275625	36257	135608	46453176	5143824	267310	3951360	64222988
3	6946	2014268	2135818	4200790	289406	38070	142388	48775835	5401015	280675	4148928	67434138
4	7293	2114981	2242609	4410829	303877	39973	149507	51214627	5671066	294709	4356374	70805845
5	7658	2220730	2354739	4631371	319070	41972	156983	53775358	5954619	309444	4574193	74346137
6	8041	2331766	2472476	4862939	335024	44070	164832	56464126	6252350	324916	4802903	78063444
7	8443	2448355	2596100	5106086	351775	46274	173073	59287332	6564968	341162	5043048	81966616
8	8865	2570772	2725905	5361390	369364	48588	181727	62251699	6893216	358220	5295200	86064947
9	9308	2699311	2862201	5629460	387832	51017	190813	65364284	7237877	376131	5559960	90368194
10	9773	2834277	3005311	5910933	407224	53568	200354	68632498	7599771	394938	5837958	94886604
11	10262	2975990	3155576	6206479	427585	56246	210372	72064123	7979759	414685	6129856	99630934
12	10775	3124790	3313355	6516803	448964	59059	220890	75667329	8378747	435419	6436349	104612481
13	11314	3281030	3479023	6842644	471412	62011	231935	79450695	8797685	457190	6758167	109843105
14	11880	3445081	3652974	7184776	494983	65112	243532	83423230	9237569	480049	7096075	115335260
15	12474	3617335	3835622	7544015	519732	68368	255708	87594391	9699447	504052	7450879	121102023
16	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0

Table A5.9
SES157 Discounted Cash Flow Analysis - 7.5% Interest Rate

PROJECT LIFE: 15 **PRICE:** 123000000 **DEBT RATIO:** 0.75 **LOAN YEARS:** 10 **INTEREST RATE:** 0.075

DECLINING BAL.: 0.2

TAX RATE: 0.33 **INFLATION RATE:** 0.05 **DISCOUNT RATE:** 0.175 **BASE REVENUE:** 78970136

SCRAP VALUE: 4327678

YEAR	CAPITAL	LOAN OUTSTANDING	LOAN REPAYMENTS	INTEREST PAYMENTS	RELIEF ON INTEREST	CAPITAL ALLOWANCE	RELIEF ON CAPITAL	ANNUAL REVENUE	OPERATING COSTS	GROSS SURPLUS	TAX	ANNUAL CASH FLOW	DISCOUNTED CASH FLOW
0	-30750000	0	0	0	0	0	0	0	0	0	0	-30750000	-30750000
1	0	92250000	9225000	6918750	2283188	24600000	0	78970136	61164751	1661635	-205112	1866748	1513068
2	0	83025000	9225000	6226875	2054869	19680000	8118000	82918643	64222988	3243780	-2286599	5530379	3633294
3	0	73800000	9225000	5535000	1826550	15744000	6494400	87064575	67434138	4870437	-1138669	6009106	3199841
4	0	64575000	9225000	4843125	1598231	12595200	5195520	91417804	70805845	6543834	-82473	6626307	2859979
5	0	55350000	9225000	4151250	1369913	10076160	4156416	95988694	74346137	8266307	904193	7362114	2575531
6	0	46125000	9225000	3459375	1141594	8060928	3325133	100788129	78063444	10040310	1839283	8201027	2325441
7	0	36900000	9225000	2767500	913275	6448742	2660106	105827535	81966616	11868419	2737363	9131057	2098606
8	0	27675000	9225000	2075625	684956	5158994	2128085	111118912	86064947	13753340	3610299	10143042	1889517
9	0	18450000	9225000	1383750	456638	4127195	1702468	116674857	90368194	15697913	4467807	11230107	1695662
10	0	9225000	9225000	691875	228319	3301756	1361974	122508600	94886604	17705122	5317893	12387228	1516011
11	0	0	0	0	0	2641405	1089580	128634030	99630934	29003096	9211461	19791636	1963283
12	0	0	0	0	0	2113124	871664	135065732	104612481	30453251	9761924	20691327	1663652
13	0	0	0	0	0	1690499	697331	141819018	109843105	31975914	10321932	21653981	1411187
14	0	0	0	0	0	1352399	557865	148909969	115335260	33574709	10895559	22679151	1197971
15	4327678	0	0	0	0	1081919	446292	156355468	121102023	35253445	11486361	28094762	1202868
16	0	0	0	0	0	0	357033	0	0	0	-117821	117821	4089
17	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0
												NPV	0

REQUIRED FREIGHT RATE = **244 £/tonne**

(with 80% load factor)

Table A5.10
SES157 Operating Costs - 7.5% Interest Rate

VESSEL DATA		COSTHEAD	ESCALATION RATE
Length	157.6	Registration	0
Breadth	35	Manning	0
Draught	7.2	Insurance	0
Payload	1804	R & M	0
Power	216333	Stores	0
No. Containers	200	Victualling	0
Complement	29	Administration	0
Annual Op. Hours	6048	Fuel Oil	0
No. Trips per annum	224	Diesel Oil	0
Fuel Load per Trip	1254	Port Dues	0
Dieso per week	648	Cargo Handling	0

YEAR	REGISTRATION	MANNING	INSURANCE	R & M	STORES	VICTUALING	ADMINISTRATION	FUEL OIL	DIESEL OIL	PORT DUES	CARGO HANDLING	TOTAL OPERATING COSTS
0	6000	1740000	1845000	3628800	250000	32886	123000	42134400	4665600	242458	3584000	58252144
1	6300	1827000	1937250	3810240	262500	34530	129150	44241120	4898880	254580	3763200	61164751
2	6615	1918350	2034113	4000752	275625	36257	135608	46453176	5143824	267310	3951360	64222988
3	6946	2014268	2135818	4200790	289406	38070	142388	48775835	5401015	280675	4148928	67434138
4	7293	2114981	2242609	4410829	303877	39973	149507	51214627	5671066	294709	4356374	70805845
5	7658	2220730	2354739	4631371	319070	41972	156983	53775358	5954619	309444	4574193	74346137
6	8041	2331766	2472476	4862939	335024	44070	164832	56464126	6252350	324916	4802903	78063444
7	8443	2448355	2596100	5106086	351775	46274	173073	59287332	6564968	341162	5043048	81966616
8	8865	2570772	2725905	5361390	369364	48588	181727	62251699	6893216	358220	5295200	86064947
9	9308	2699311	2862201	5629460	387832	51017	190813	65364284	7237877	376131	5559960	90368194
10	9773	2834277	3005311	5910933	407224	53568	200354	68632498	7599771	394938	5837958	94886604
11	10262	2975990	3155576	6206479	427585	56246	210372	72064123	7979759	414685	6129856	99630934
12	10775	3124790	3313355	6516803	448964	59059	220890	75667329	8378747	435419	6436349	104612481
13	11314	3281030	3479023	6842644	471412	62011	231935	79450695	8797685	457190	6758167	109843105
14	11880	3445081	3652974	7184776	494983	65112	243532	83423230	9237569	480049	7096075	115335260
15	12474	3617335	3835622	7544015	519732	68368	255708	87594391	9699447	504052	7450879	121102023
16	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0

Table A5.11

SES157 Discounted Cash Flow Analysis - 12.5% Interest Rate

PROJECT LIFE: 15 **PRICE:** 123000000 **DEBT RATIO:** 0.75 **LOAN YEARS:** 10 **INTEREST RATE:** 0.125

DECLINING BAL.: 0.2

TAX RATE: 0.33 **INFLATION RATE:** 0.05 **DISCOUNT RATE:** 0.175 **BASE REVENUE:** 81051895

SCRAP VALUE: 4327678

YEAR	CAPITAL	LOAN OUTSTANDING	LOAN REPAYMENTS	INTEREST PAYMENTS	RELIEF ON INTEREST	CAPITAL ALLOWANCE	RELIEF ON CAPITAL	ANNUAL REVENUE	OPERATING COSTS	GROSS SURPLUS	TAX	ANNUAL CASH FLOW	DISCOUNTED CASH FLOW
0	-30750000	0	0	0	0	0	0	0	0	0	0	-30750000	-30750000
1	0	92250000	9225000	11531250	3805313	24600000	0	81051895	61164751	-869106	-1542558	673452	545858
2	0	83025000	9225000	10378125	3424781	19680000	8118000	85104489	64222988	1278376	-3387254	4665630	3065180
3	0	73800000	9225000	9225000	3044250	15744000	6494400	89359714	67434138	3475576	-2000814	5476390	2916170
4	0	64575000	9225000	8071875	2663719	12595200	5195520	93827699	70805845	5724980	-704305	6429285	2774943
5	0	55350000	9225000	6918750	2283188	10076160	4156416	98519084	74346137	8029198	524566	7504631	2625388
6	0	46125000	9225000	5765625	1902656	8060928	3325133	103445039	78063444	10390970	1703850	8687120	2463275
7	0	36900000	9225000	4612500	1522125	6448742	2660106	108617291	81966616	12813175	2848211	9964963	2290264
8	0	27675000	9225000	3459375	1141594	5158994	2128085	114048155	86064947	15298833	3969621	11329212	2110486
9	0	18450000	9225000	2306250	761063	4127195	1702468	119750563	90368194	17851119	5077904	12773215	1928660
10	0	9225000	9225000	1153125	380531	3301756	1361974	125738091	94886604	20473362	6181183	14292180	1749149
11	0	0	0	0	0	2641405	1089580	132024995	99630934	32394062	10330479	22063582	2188654
12	0	0	0	0	0	2113124	871664	138626245	104612481	34013765	10936893	23076871	1855457
13	0	0	0	0	0	1690499	697331	145557557	109843105	35714453	11555650	24158803	1574426
14	0	0	0	0	0	1352399	557865	152835435	115335260	37500176	12190963	25309213	1336898
15	4327678	0	0	0	0	1081919	446292	160477207	121102023	39375184	12846535	30856328	1321103
16	0	0	0	0	0	0	357033	0	0	0	-117821	117821	4089
17	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0
												NPV	0

REQUIRED FREIGHT RATE = 251 £/tonne

(with 80% load factor)

Table A5.12

SES157 Operating Costs - 12.5% Interest Rate

VESSEL DATA		COSTHEAD	ESCALATION RATE
Length	157.6	Registration	0
Breadth	35	Manning	0
Draught	7.2	Insurance	0
Payload	1804	R & M	0
Power	216333	Stores	0
No. Containers	200	Victualling	0
Complement	29	Administration	0
Annual Op. Hours	6048	Fuel Oil	0
No. Trips per annum	224	Diesel Oil	0
Fuel Load per Trip	1254	Port Dues	0
Dieso per week	648	Cargo Handling	0

YEAR	REGISTRATION	MANNING	INSURANCE	R & M	STORES	VICTUALING	ADMINISTRATION	FUEL OIL	DIESEL OIL	PORT DUES	CARGO HANDLING	TOTAL OPERATING COSTS
0	6000	1740000	1845000	3628800	250000	32886	123000	42134400	4665600	242458	3584000	58252144
1	6300	1827000	1937250	3810240	262500	34530	129150	44241120	4898880	254580	3763200	61164751
2	6615	1918350	2034113	4000752	275625	36257	135608	46453176	5143824	267310	3951360	64222988
3	6946	2014268	2135818	4200790	289406	38070	142388	48775835	5401015	280675	4148928	67434138
4	7293	2114981	2242609	4410829	303877	39973	149507	51214627	5671066	294709	4356374	70805845
5	7658	2220730	2354739	4631371	319070	41972	156983	53775358	5954619	309444	4574193	74346137
6	8041	2331766	2472476	4862939	335024	44070	164832	56464126	6252350	324916	4802903	78063444
7	8443	2448355	2596100	5106086	351775	46274	173073	59287332	6564968	341162	5043048	81966616
8	8865	2570772	2725905	5361390	369364	48588	181727	62251699	6893216	358220	5295200	86064947
9	9308	2699311	2862201	5629460	387832	51017	190813	65364284	7237877	376131	5559960	90368194
10	9773	2834277	3005311	5910933	407224	53568	200354	68632498	7599771	394938	5837958	94886604
11	10262	2975990	3155576	6206479	427585	56246	210372	72064123	7979759	414685	6129856	99630934
12	10775	3124790	3313355	6516803	448964	59059	220890	75667329	8378747	435419	6436349	104612481
13	11314	3281030	3479023	6842644	471412	62011	231935	79450695	8797685	457190	6758167	109843105
14	11880	3445081	3652974	7184776	494983	65112	243532	83423230	9237569	480049	7096075	115335260
15	12474	3617335	3835622	7544015	519732	68368	255708	87594391	9699447	504052	7450879	121102023
16	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0

Table A5.13
SES157 Discounted Cash Flow Analysis - 15% Interest Rate

PROJECT LIFE: 15 **PRICE:** 123000000 **DEBT RATIO:** 0.75 **LOAN YEARS:** 10 **INTEREST RATE:** 0.15

DECLINING BAL.: 0.2

TAX RATE: 0.33 **INFLATION RATE:** 0.05 **DISCOUNT RATE:** 0.175 **BASE REVENUE:** 82092774

SCRAP VALUE: 4327678

YEAR	CAPITAL	LOAN OUTSTANDING	LOAN REPAYMENTS	INTEREST PAYMENTS	RELIEF ON INTEREST	CAPITAL ALLOWANCE	RELIEF ON CAPITAL	ANNUAL REVENUE	OPERATING COSTS	GROSS SURPLUS	TAX	ANNUAL CASH FLOW	DISCOUNTED CASH FLOW
0	-30750000	0	0	0	0	0	0	0	0	0	0	-30750000	-30750000
1	0	92250000	9225000	13837500	4566375	24600000	0	82092774	61164751	-2134477	-2211281	76804	62253
2	0	83025000	9225000	12453750	4109738	19680000	8118000	86197412	64222988	295674	-3937581	4233255	2781122
3	0	73800000	9225000	11070000	3653100	15744000	6494400	90507283	67434138	2778145	-2431887	5210032	2774335
4	0	64575000	9225000	9686250	3196463	12595200	5195520	95032647	70805845	5315553	-1015222	6330774	2732425
5	0	55350000	9225000	8302500	2739825	10076160	4156416	99784280	74346137	7910643	334753	7575890	2650317
6	0	46125000	9225000	6918750	2283188	8060928	3325133	104773494	78063444	10566300	1636133	8930167	2532192
7	0	36900000	9225000	5535000	1826550	6448742	2660106	110012168	81966616	13285552	2903636	10381917	2386093
8	0	27675000	9225000	4151250	1369913	5158994	2128085	115512777	86064947	16071580	4149282	11922298	2220970
9	0	18450000	9225000	2767500	913275	4127195	1702468	121288415	90368194	18927721	5382953	13544769	2045159
10	0	9225000	9225000	1383750	456638	3301756	1361974	127352836	94886604	21857483	6612827	15244655	1865718
11	0	0	0	0	0	2641405	1089580	133720478	99630934	34089544	10889988	23199556	2301340
12	0	0	0	0	0	2113124	871664	140406502	104612481	35794021	11524378	24269643	1951360
13	0	0	0	0	0	1690499	697331	147426827	109843105	37583722	12172509	25411213	1656045
14	0	0	0	0	0	1352399	557865	154798168	115335260	39462909	12838664	26624244	1406361
15	4327678	0	0	0	0	1081919	446292	162538077	121102023	41436054	13526622	32237110	1380221
16	0	0	0	0	0	0	357033	0	0	0	-117821	117821	4089
17	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0
												NPV	0

REQUIRED FREIGHT RATE = 254 £/tonne

(with 80% load factor)

Table A5.14

SES157 Operating Costs - 15% Interest Rate

VESSEL DATA		COSTHEAD	ESCALATION RATE
Length	157.6	Registration	0
Breadth	35	Manning	0
Draught	7.2	Insurance	0
Payload	1804	R & M	0
Power	216333	Stores	0
No. Containers	200	Victualling	0
Complement	29	Administration	0
Annual Op. Hours	6048	Fuel Oil	0
No. Trips per annum	224	Diesel Oil	0
Fuel Load per Trip	1254	Port Dues	0
Dieso per week	648	Cargo Handling	0

YEAR	REGISTRATION	MANNING	INSURANCE	R & M	STORES	VICTUALING	ADMINISTRATION	FUEL OIL	DIESEL OIL	PORT DUES	CARGO HANDLING	TOTAL OPERATING COSTS
0	6000	1740000	1845000	3628800	250000	32886	123000	42134400	4665600	242458	3584000	58252144
1	6300	1827000	1937250	3810240	262500	34530	129150	44241120	4898880	254580	3763200	61164751
2	6615	1918350	2034113	4000752	275625	36257	135608	46453176	5143824	267310	3951360	64222988
3	6946	2014268	2135818	4200790	289406	38070	142388	48775835	5401015	280675	4148928	67434138
4	7293	2114981	2242609	4410829	303877	39973	149507	51214627	5671066	294709	4356374	70805845
5	7658	2220730	2354739	4631371	319070	41972	156983	53775358	5954619	309444	4574193	74346137
6	8041	2331766	2472476	4862939	335024	44070	164832	56464126	6252350	324916	4802903	78063444
7	8443	2448355	2596100	5106086	351775	46274	173073	59287332	6564968	341162	5043048	81966616
8	8865	2570772	2725905	5361390	369364	48588	181727	62251699	6893216	358220	5295200	86064947
9	9308	2699311	2862201	5629460	387832	51017	190813	65364284	7237877	376131	5559960	90368194
10	9773	2834277	3005311	5910933	407224	53568	200354	68632498	7599771	394938	5837958	94886604
11	10262	2975990	3155576	6206479	427585	56246	210372	72064123	7979759	414685	6129856	99630934
12	10775	3124790	3313355	6516803	448964	59059	220890	75667329	8378747	435419	6436349	104612481
13	11314	3281030	3479023	6842644	471412	62011	231935	79450695	8797685	457190	6758167	109843105
14	11880	3445081	3652974	7184776	494983	65112	243532	83423230	9237569	480049	7096075	115335260
15	12474	3617335	3835622	7544015	519732	68368	255708	87594391	9699447	504052	7450879	121102023
16	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0

Table A5.15
SES157 Discounted Cash Flow Analysis - 17.5% Interest Rate

PROJECT LIFE: 15 **PRICE:** 123000000 **DEBT RATIO:** 0.75 **LOAN YEARS:** 10 **INTEREST RATE:** 0.175

DECLINING BAL.: 0.2

TAX RATE: 0.33 **INFLATION RATE:** 0.05 **DISCOUNT RATE:** 0.175 **BASE REVENUE:** 83133653

SCRAP VALUE: 4327678

YEAR	CAPITAL	LOAN OUTSTANDING	LOAN REPAYMENTS	INTEREST PAYMENTS	RELIEF ON INTEREST	CAPITAL ALLOWANCE	RELIEF ON CAPITAL	ANNUAL REVENUE	OPERATING COSTS	GROSS SURPLUS	TAX	ANNUAL CASH FLOW	DISCOUNTED CASH FLOW
0	-30750000	0	0	0	0	0	0	0	0	0	0	-30750000	-30750000
1	0	92250000	9225000	16143750	5327438	24600000	0	83133653	61164751	-3399848	-2880004	-519844	-421353
2	0	83025000	9225000	14529375	4794694	19680000	8118000	87290336	64222988	-687028	-4487908	3800880	2497065
3	0	73800000	9225000	12915000	4261950	15744000	6494400	91654852	67434138	2080715	-2862960	4943674	2632500
4	0	64575000	9225000	11300625	3729206	12595200	5195520	96237595	70805845	4906125	-1326138	6232264	2689906
5	0	55350000	9225000	9686250	3196463	10076160	4156416	101049475	74346137	7792088	144939	7647149	2675246
6	0	46125000	9225000	8071875	2663719	8060928	3325133	106101949	78063444	10741630	1568417	9173213	2601109
7	0	36900000	9225000	6457500	2130975	6448742	2660106	111407046	81966616	13757930	2959060	10798870	2481922
8	0	27675000	9225000	4843125	1598231	5158994	2128085	116977398	86064947	16844327	4328943	12515383	2331454
9	0	18450000	9225000	3228750	1065488	4127195	1702468	122826268	90368194	20004324	5688002	14316322	2161658
10	0	9225000	9225000	1614375	532744	3301756	1361974	128967582	94886604	23241603	7044472	16197131	1982287
11	0	0	0	0	0	2641405	1089580	135415961	99630934	35785027	11449498	24335529	2414026
12	0	0	0	0	0	2113124	871664	142186759	104612481	37574278	12111863	25462415	2047263
13	0	0	0	0	0	1690499	697331	149296097	109843105	39452992	12789368	26663624	1737665
14	0	0	0	0	0	1352399	557865	156760901	115335260	41425642	13486366	27939275	1475825
15	4327678	0	0	0	0	1081919	446292	164598946	121102023	43496924	14206709	33617893	1439339
16	0	0	0	0	0	0	357033	0	0	0	-117821	117821	4089
17	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0
												NPV	0

REQUIRED FREIGHT RATE = 257 £/tonne

(with 80% load factor)

Table A5.16
SES157 Operating Costs - 17.5% Interest Rate

VESSEL DATA		COSTHEAD	ESCALATION RATE
Length	157.6	Registration	0
Breadth	35	Manning	0
Draught	7.2	Insurance	0
Payload	1804	R & M	0
Power	216333	Stores	0
No. Containers	200	Victualling	0
Complement	29	Administration	0
Annual Op. Hours	6048	Fuel Oil	0
No. Trips per annum	224	Diesel Oil	0
Fuel Load per Trip	1254	Port Dues	0
Dieso per week	648	Cargo Handling	0

YEAR	REGISTRATION	MANNING	INSURANCE	R & M	STORES	VICTUALING	ADMINISTRATION	FUEL OIL	DIESEL OIL	PORT DUES	CARGO HANDLING	TOTAL OPERATING COSTS
0	6000	1740000	1845000	3628800	250000	32886	123000	42134400	4665600	242458	3584000	58252144
1	6300	1827000	1937250	3810240	262500	34530	129150	44241120	4898880	254580	3763200	61164751
2	6615	1918350	2034113	4000752	275625	36257	135608	46453176	5143824	267310	3951360	64222988
3	6946	2014268	2135818	4200790	289406	38070	142388	48775835	5401015	280675	4148928	67434138
4	7293	2114981	2242609	4410829	303877	39973	149507	51214627	5671066	294709	4356374	70805845
5	7658	2220730	2354739	4631371	319070	41972	156983	53775358	5954619	309444	4574193	74346137
6	8041	2331766	2472476	4862939	335024	44070	164832	56464126	6252350	324916	4802903	78063444
7	8443	2448355	2596100	5106086	351775	46274	173073	59287332	6564968	341162	5043048	81966616
8	8865	2570772	2725905	5361390	369364	48588	181727	62251699	6893216	358220	5295200	86064947
9	9308	2699311	2862201	5629460	387832	51017	190813	65364284	7237877	376131	5559960	90368194
10	9773	2834277	3005311	5910933	407224	53568	200354	68632498	7599771	394938	5837958	94886604
11	10262	2975990	3155576	6206479	427585	56246	210372	72064123	7979759	414685	6129856	99630934
12	10775	3124790	3313355	6516803	448964	59059	220890	75667329	8378747	435419	6436349	104612481
13	11314	3281030	3479023	6842644	471412	62011	231935	79450695	8797685	457190	6758167	109843105
14	11880	3445081	3652974	7184776	494983	65112	243532	83423230	9237569	480049	7096075	115335260
15	12474	3617335	3835622	7544015	519732	68368	255708	87594391	9699447	504052	7450879	121102023
16	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0

Table A5.17
SES157 Discounted Cash Flow Analysis - Build Cost £98.4m

PROJECT LIFE: 15 | PRICE: 98400000 | DEBT RATIO: 0.75 | LOAN YEARS: 10 | INTEREST RATE: 0.1

DECLINING BAL.: 0.2

TAX RATE: 0.33 | INFLATION RATE: 0.05 | DISCOUNT RATE: 0.175 | BASE REVENUE: 75828482

SCRAP VALUE: 3462142

YEAR	CAPITAL	LOAN OUTSTANDING	LOAN REPAYMENTS	INTEREST PAYMENTS	RELIEF ON INTEREST	CAPITAL ALLOWANCE	RELIEF ON CAPITAL	ANNUAL REVENUE	OPERATING COSTS	GROSS SURPLUS	TAX	ANNUAL CASH FLOW	DISCOUNTED CASH FLOW
0	-24600000	0	0	0	0	0	0	0	0	0	0	-24600000	-24600000
1	0	73800000	7380000	7380000	2435400	19680000	0	75828482	60751471	317012	-699068	1016080	823570
2	0	66420000	7380000	6642000	2191860	15744000	6494400	79619907	63789044	1808862	-2269541	4078403	2679390
3	0	59040000	7380000	5904000	1948320	12595200	5195520	83600902	66978497	3338405	-1255793	4594199	2446405
4	0	51660000	7380000	5166000	1704780	10076160	4156416	87780947	70327421	4907526	-314711	5222237	2253969
5	0	44280000	7380000	4428000	1461240	8060928	3325133	92169994	73843792	6518202	571504	5946698	2080368
6	0	36900000	7380000	3690000	1217700	6448742	2660106	96778494	77535982	8172512	1417253	6755259	1915486
7	0	29520000	7380000	2952000	974160	5158994	2128085	101617419	81412781	9872638	2234230	7638408	1755548
8	0	22140000	7380000	2214000	730620	4127195	1702468	106698290	85483420	11620869	3031968	8588902	1600001
9	0	14760000	7380000	1476000	487080	3301756	1361974	112033204	89757591	13419613	3818284	9601329	1449729
10	0	7380000	7380000	738000	243540	2641405	1089580	117634864	94245471	15271394	4599630	10671763	1306064
11	0	0	0	0	0	2113124	871664	123516608	98957744	24558863	7816776	16742087	1660775
12	0	0	0	0	0	1690499	697331	129692438	103905632	25786806	8279527	17507279	1407643
13	0	0	0	0	0	1352399	557865	136177060	109100913	27076147	8751033	18325114	1194245
14	0	0	0	0	0	1081919	446292	142985913	114555959	28429954	9234609	19195345	1013948
15	3462142	0	0	0	0	865536	357033	150135208	120283757	29851452	9733158	23580436	1009588
16	0	0	0	0	0	0	285627	0	0	0	-94257	94257	3271
17	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0
												NPV	0

REQUIRED FREIGHT RATE = 235 £/tonne

(with 80% load factor)

Table A5.18

SES157 Operating Costs - Build Cost £98.4m

VESSEL DATA		COSTHEAD	ESCALATION RATE
Length	157.6	Registration	0
Breadth	35	Manning	0
Draught	7.2	Insurance	0
Payload	1804	R & M	0
Power	216333	Stores	0
No. Containers	200	Victualling	0
Complement	29	Administration	0
Annual Op. Hours	6048	Fuel Oil	0
No. Trips per annum	224	Diesel Oil	0
Fuel Load per Trip	1254	Port Dues	0
Dieso per week	648	Cargo Handling	0

YEAR	REGISTRATION	MANNING	INSURANCE	R & M	STORES	VICTUALING	ADMINISTRATION	FUEL OIL	DIESEL OIL	PORT DUES	CARGO HANDLING	TOTAL OPERATING COSTS
0	6000	1740000	1476000	3628800	250000	32886	98400	42134400	4665600	242458	3584000	57858544
1	6300	1827000	1549800	3810240	262500	34530	103320	44241120	4898880	254580	3763200	60751471
2	6615	1918350	1627290	4000752	275625	36257	108486	46453176	5143824	267310	3951360	63789044
3	6946	2014268	1708655	4200790	289406	38070	113910	48775835	5401015	280675	4148928	66978497
4	7293	2114981	1794087	4410829	303877	39973	119606	51214627	5671066	294709	4356374	70327421
5	7658	2220730	1883792	4631371	319070	41972	125586	53775358	5954619	309444	4574193	73843792
6	8041	2331766	1977981	4862939	335024	44070	131865	56464126	6252350	324916	4802903	77535982
7	8443	2448355	2076880	5106086	351775	46274	138459	59287332	6564968	341162	5043048	81412781
8	8865	2570772	2180724	5361390	369364	48588	145382	62251699	6893216	358220	5295200	85483420
9	9308	2699311	2289760	5629460	387832	51017	152651	65364284	7237877	376131	5559960	89757591
10	9773	2834277	2404248	5910933	407224	53568	160283	68632498	7599771	394938	5837958	94245471
11	10262	2975990	2524461	6206479	427585	56246	168297	72064123	7979759	414685	6129856	98957744
12	10775	3124790	2650684	6516803	448964	59059	176712	75667329	8378747	435419	6436349	103905632
13	11314	3281030	2783218	6842644	471412	62011	185548	79450695	8797685	457190	6758167	109100913
14	11880	3445081	2922379	7184776	494983	65112	194825	83423230	9237569	480049	7096075	114555959
15	12474	3617335	3068498	7544015	519732	68368	204567	87594391	9699447	504052	7450879	120283757
16	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0

Table A5.19

SES157 Discounted Cash Flow Analysis - Build Cost £110.7m

PROJECT LIFE: 15 **PRICE:** 110700000 **DEBT RATIO:** 0.75 **LOAN YEARS:** 10 **INTEREST RATE:** 0.1

DECLINING BAL.: 0.2

TAX RATE: 0.33 **INFLATION RATE:** 0.05 **DISCOUNT RATE:** 0.175 **BASE REVENUE:** 77919749

SCRAP VALUE: 3894910

YEAR	CAPITAL	LOAN OUTSTANDING	LOAN REPAYMENTS	INTEREST PAYMENTS	RELIEF ON INTEREST	CAPITAL ALLOWANCE	RELIEF ON CAPITAL	ANNUAL REVENUE	OPERATING COSTS	GROSS SURPLUS	TAX	ANNUAL CASH FLOW	DISCOUNTED CASH FLOW
0	-27675000	0	0	0	0	0	0	0	0	0	0	-27675000	-27675000
1	0	83025000	8302500	8302500	2739825	22140000	0	77919749	60958111	356638	-786452	1143090	926517
2	0	74722500	8302500	7472250	2465843	17712000	7306200	81815736	64006016	2034970	-2553234	4588204	3014313
3	0	66420000	8302500	6642000	2191860	14169600	5844960	85906523	67206317	3755706	-1412768	5168474	2752205
4	0	58117500	8302500	5811750	1917878	11335680	4675968	90201849	70566633	5520966	-354050	5875016	2535715
5	0	49815000	8302500	4981500	1643895	9068544	3740774	94711942	74094965	7332977	642942	6690036	2340414
6	0	41512500	8302500	4151250	1369913	7254835	2992620	99447539	77799713	9194076	1594409	7599666	2154922
7	0	33210000	8302500	3321000	1095930	5803868	2394096	104419916	81689699	11106717	2513508	8593209	1974991
8	0	24907500	8302500	2490750	821948	4643095	1915276	109640912	85774183	13073478	3410964	9662514	1800001
9	0	16605000	8302500	1660500	547965	3714476	1532221	115122957	90062893	15097064	4295570	10801495	1630945
10	0	8302500	8302500	830250	273983	2971580	1225777	120879105	94566037	17180318	5174584	12005733	1469322
11	0	0	0	0	0	2377264	980622	126923060	99294339	27628721	8793873	18834848	1868372
12	0	0	0	0	0	1901812	784497	133269213	104259056	29010157	9314468	19695689	1583599
13	0	0	0	0	0	1521449	627598	139932674	109472009	30460665	9844912	20615753	1343526
14	0	0	0	0	0	1217159	502078	146929308	114945609	31983698	10388935	21594764	1140691
15	3894910	0	0	0	0	973727	401663	154275773	120692890	33582883	10949803	26527990	1135787
16	0	0	0	0	0	0	321330	0	0	0	-106039	106039	3680
17	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0
												NPV	0

REQUIRED FREIGHT RATE = 241 £/tonne

(with 80% load factor)

Table A5.20
SES157 Operating Costs - Build Cost £110.7m

VESSEL DATA		COSTHEAD	ESCALATION RATE
Length	157.6	Registration	0
Breadth	35	Manning	0
Draught	7.2	Insurance	0
Payload	1804	R & M	0
Power	216333	Stores	0
No. Containers	200	Victualling	0
Complement	29	Administration	0
Annual Op. Hours	6048	Fuel Oil	0
No. Trips per annum	224	Diesel Oil	0
Fuel Load per Trip	1254	Port Dues	0
Dieso per week	648	Cargo Handling	0

YEAR	REGISTRATION	MANNING	INSURANCE	R & M	STORES	VICTUALING	ADMINISTRATION	FUEL OIL	DIESEL OIL	PORT DUES	CARGO HANDLING	TOTAL OPERATING COSTS
0	6000	1740000	1660500	3628800	250000	32886	110700	42134400	4665600	242458	3584000	58055344
1	6300	1827000	1743525	3810240	262500	34530	116235	44241120	4898880	254580	3763200	60958111
2	6615	1918350	1830701	4000752	275625	36257	122047	46453176	5143824	267310	3951360	64006016
3	6946	2014268	1922236	4200790	289406	38070	128149	48775835	5401015	280675	4148928	67206317
4	7293	2114981	2018348	4410829	303877	39973	134557	51214627	5671066	294709	4356374	70565633
5	7658	2220730	2119266	4631371	319070	41972	141284	53775358	5954619	309444	4574193	74094965
6	8041	2331766	2225229	4862939	335024	44070	148349	56464126	6252350	324916	4802903	77799713
7	8443	2448355	2336490	5105086	351775	46274	155766	59287332	6564968	341162	5043048	81689699
8	8865	2570772	2453315	5361390	369364	48588	163554	62251699	6893216	358220	5295200	85774183
9	9308	2699311	2575981	5629460	387832	51017	171732	65364284	7237877	376131	5559960	90062893
10	9773	2834277	2704710	5910933	407224	53568	180319	68632498	7599771	394938	5837958	94566037
11	10262	2975990	2840019	6206479	427585	56246	189335	72064123	7979759	414685	6129856	99294339
12	10775	3124790	2982019	6516803	448964	59059	198801	75667329	8378747	435419	6436349	104259056
13	11314	3281030	3131120	6842644	471412	62011	208741	79450695	8797685	457190	6758167	109472009
14	11880	3445081	3287676	7184776	494983	65112	219178	83423230	9237569	480049	7096075	114945609
15	12474	3617335	3452060	7544015	519732	68368	230137	87594391	9699447	504052	7450879	120692890
16	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0

Table A5.21

SES157 Discounted Cash Flow Analysis - Build Cost £135.3m

PROJECT LIFE: 15 PRICE: 135300000 DEBT RATIO: 0.75 LOAN YEARS: 10 INTEREST RATE: 0.1

DECLINING BAL.: 0.2

TAX RATE: 0.33 INFLATION RATE: 0.05 DISCOUNT RATE: 0.175 BASE REVENUE: 82102282

SCRAP VALUE: 4760446

YEAR	CAPITAL	LOAN OUTSTANDING	LOAN REPAYMENTS	INTEREST PAYMENTS	RELIEF ON INTEREST	CAPITAL ALLOWANCE	RELIEF ON CAPITAL	ANNUAL REVENUE	OPERATING COSTS	GROSS SURPLUS	TAX	ANNUAL CASH FLOW	DISCOUNTED CASH FLOW
0	-33825000	0	0	0	0	0	0	0	0	0	0	-33825000	-33825000
1	0	101475000	10147500	10147500	3348675	27060000	0	82102282	61371391	435891	-961219	1397110	1132409
2	0	91327500	10147500	9132750	3013808	21648000	8929800	86207396	64439960	2487186	-3120619	5607805	3684161
3	0	81180000	10147500	8118000	2678940	17318400	7143840	90517766	67661958	4590307	-1726716	6317023	3363806
4	0	71032500	10147500	7103250	2344073	13854720	5715072	95043654	71045056	6747848	-432728	7180576	3099207
5	0	60885000	10147500	6088500	2009205	11083776	4572058	99795837	74597309	8962528	785817	8176710	2860505
6	0	50737500	10147500	5073750	1674338	8867021	3657646	104785628	78327175	11237204	1948723	9288481	2633793
7	0	40590000	10147500	4059000	1339470	7093617	2926117	110024910	82243533	13574877	3072066	10502811	2413878
8	0	30442500	10147500	3044250	1004603	5674893	2340893	115526155	86355710	15978695	4168956	11809740	2200002
9	0	20295000	10147500	2029500	669735	4539915	1872715	121302463	90673495	18451968	5250141	13201827	1993377
10	0	10147500	10147500	1014750	334868	3631932	1498172	127367586	95207170	20998166	6324492	14673674	1795838
11	0	0	0	0	0	2905545	1198537	133735966	99967529	33768437	10748067	23020370	2283566
12	0	0	0	0	0	2324436	958830	140422764	104965905	35456859	11384349	24072509	1935510
13	0	0	0	0	0	1859549	767064	147443902	110214200	37229702	12032670	25197031	1642087
14	0	0	0	0	0	1487639	613651	154816097	115724910	39091187	12697587	26393600	1394178
15	4760446	0	0	0	0	1190111	490921	162556902	121511156	41045746	13383092	32423099	1388184
16	0	0	0	0	0	0	392737	0	0	0	-129603	129603	4498
17	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0
												NPV	0

REQUIRED FREIGHT RATE = 254 £/tonne

(with 80% load factor)

Table A5.22

SES157 Operating Costs - Build Cost £135.3m

VESSEL DATA		COSTHEAD	ESCALATION RATE
Length	157.6	Registration	0
Breadth	35	Manning	0
Draught	7.2	Insurance	0
Payload	1804	R & M	0
Power	216333	Stores	0
No. Containers	200	Victualling	0
Complement	29	Administration	0
Annual Op. Hours	6048	Fuel Oil	0
No. Trips per annum	224	Diesel Oil	0
Fuel Load per Trip	1254	Port Dues	0
Dieso per week	648	Cargo Handling	0

YEAR	REGISTRATION	MANNING	INSURANCE	R & M	STORES	VICTUALING	ADMINISTRATION	FUEL OIL	DIESEL OIL	PORT DUES	CARGO HANDLING	TOTAL OPERATING COSTS
0	6000	1740000	2029500	3628800	250000	32886	135300	42134400	4665600	242458	3584000	58448944
1	6300	1827000	2130975	3810240	262500	34530	142065	44241120	4898880	254580	3763200	61371391
2	6615	1918350	2237524	4000752	275625	36257	149168	46453176	5143824	267310	3951360	64439960
3	6946	2014268	2349400	4200790	289406	38070	156627	48775835	5401015	280675	4148928	67661958
4	7293	2114981	2466870	4410829	303877	39973	164458	51214627	5671066	294709	4356374	71045056
5	7658	2220730	2590213	4631371	319070	41972	172681	53775358	5954619	309444	4574193	74597309
6	8041	2331766	2719724	4862939	335024	44070	181315	56464126	6252350	324916	4802903	78327175
7	8443	2448355	2855710	5106086	351775	46274	190381	59287332	6564968	341162	5043048	82243533
8	8865	2570772	2998496	5361390	369364	48588	199900	62251699	6893216	358220	5295200	86355710
9	9308	2699311	3148421	5629460	387832	51017	209895	65364284	7237877	376131	5559960	90673495
10	9773	2834277	3305842	5910933	407224	53568	220389	68632498	7599771	394938	5837958	95207170
11	10262	2975990	3471134	6206479	427585	56246	231409	72064123	7979759	414685	6129856	99967529
12	10775	3124790	3644690	6516803	448964	59059	242979	75667329	8378747	435419	6436349	104965905
13	11314	3281030	3826925	6842644	471412	62011	255128	79450695	8797685	457190	6758167	110214200
14	11880	3445081	4018271	7184776	494983	65112	267885	83423230	9237569	480049	7096075	115724910
15	12474	3617335	4219185	7544015	519732	68368	281279	87594391	9699447	504052	7450879	121511156
16	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0

Table A5.23
SES157 Discounted Cash Flow Analysis - Build Cost £147.6m

PROJECT LIFE: 15 PRICE: 147600000 DEBT RATIO: 0.75 LOAN YEARS: 10 INTEREST RATE: 0.1

DECLINING BAL.: 0.2

TAX RATE: 0.33 INFLATION RATE: 0.05 DISCOUNT RATE: 0.175 BASE REVENUE: 84193548

SCRAP VALUE: 5193213

YEAR	CAPITAL	LOAN OUTSTANDING	LOAN REPAYMENTS	INTEREST PAYMENTS	RELIEF ON INTEREST	CAPITAL ALLOWANCE	RELIEF ON CAPITAL	ANNUAL REVENUE	OPERATING COSTS	GROSS SURPLUS	TAX	ANNUAL CASH FLOW	DISCOUNTED CASH FLOW
0	-36900000	0	0	0	0	0	0	0	0	0	0	-36900000	-36900000
1	0	110700000	11070000	11070000	3653100	29520000	0	84193548	61578031	475517	-1048602	1524120	1235355
2	0	99630000	11070000	9963000	3287790	23616000	9741600	88403226	64656932	2713293	-3404312	6117605	4019084
3	0	88560000	11070000	8856000	2922480	18892800	7793280	92823387	67889779	5007608	-1883690	6891298	3669607
4	0	77490000	11070000	7749000	2557170	15114240	6234624	97464556	71284268	7361288	-472067	7833355	3380953
5	0	66420000	11070000	6642000	2191860	12091392	4987699	102337784	74848481	9777303	857255	8920047	3120551
6	0	55350000	11070000	5535000	1826550	9673114	3990159	107454673	78590905	12258768	2125879	10132889	2873229
7	0	44280000	11070000	4428000	1461240	7738491	3192127	112827407	82520451	14808956	3351344	11457612	2633322
8	0	33210000	11070000	3321000	1095930	6190793	2553702	118468777	86646473	17431304	4547952	12883352	2400002
9	0	22140000	11070000	2214000	730620	4952634	2042962	124392216	90978797	20129419	5727426	14401993	2174594
10	0	11070000	11070000	1107000	365310	3962107	1634369	130611827	95527737	22907090	6899446	16007645	1959096
11	0	0	0	0	0	3169686	1307495	137142418	100304123	36838295	11725164	25113131	2491162
12	0	0	0	0	0	2535749	1045996	143999539	105319330	38680210	12419290	26260919	2111465
13	0	0	0	0	0	2028599	836797	151199516	110585296	40614220	13126550	27487670	1791368
14	0	0	0	0	0	1622879	669438	158759492	116114561	42644931	13851913	28793018	1520922
15	5193213	0	0	0	0	1298303	535550	166697467	121920289	44777178	14599737	35370654	1514383
16	0	0	0	0	0	0	428440	0	0	0	-141385	141385	4906
17	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0
												NPV	0

REQUIRED FREIGHT RATE = 260 £/tonne

(with 80% load factor)

Table A5.24

SES157 Operating Costs - Build Cost £147.6m

VESSEL DATA	
Length	157.6
Breadth	35
Draught	7.2
Payload	1804
Power	216333
No. Containers	200
Complement	29
Annual Op. Hours	6048
No. Trips per annum	224
Fuel Load per Trip	1254
Dieso per week	648

COSTHEAD	ESCALATION RATE
Registration	0
Manning	0
Insurance	0
R & M	0
Stores	0
Victualling	0
Administration	0
Fuel Oil	0
Diesel Oil	0
Port Dues	0
Cargo Handling	0

YEAR	REGISTRATION	MANNING	INSURANCE	R & M	STORES	VICTUALING	ADMINISTRATION	FUEL OIL	DIESEL OIL	PORT DUES	CARGO HANDLING	TOTAL OPERATING COSTS
0	6000	1740000	2214000	3628800	250000	32886	147600	42134400	4665600	242458	3584000	58645744
1	6300	1827000	2324700	3810240	262500	34530	154980	44241120	4898880	254580	3763200	61578031
2	6615	1918350	2440935	4000752	275625	36257	162729	46453176	5143824	267310	3951360	64656932
3	6946	2014268	2562982	4200790	289406	38070	170865	48775835	5401015	280675	4148928	67889779
4	7293	2114981	2691131	4410829	303877	39973	179409	51214627	5671066	294709	4356374	71284268
5	7658	2220730	2825687	4631371	319070	41972	188379	53775358	5954619	309444	4574193	74848481
6	8041	2331766	2966972	4862939	335024	44070	197798	56464126	6252350	324916	4802903	78590905
7	8443	2448355	3115320	5106086	351775	46274	207688	59287332	6564968	341162	5043048	82520451
8	8865	2570772	3271086	5361390	369364	48588	218072	62251699	6893216	358220	5295200	86646473
9	9308	2699311	3434641	5629460	387832	51017	228976	65364284	7237877	376131	5559960	90978797
10	9773	2834277	3606373	5910933	407224	53568	240425	68632498	7599771	394938	5837958	95527737
11	10262	2975990	3786691	6206479	427585	56246	252446	72064123	7979759	414685	6129856	100304123
12	10775	3124790	3976026	6516803	448964	59059	265068	75667329	8378747	435419	6436349	105319330
13	11314	3281030	4174827	6842644	471412	62011	278322	79450695	8797685	457190	6758167	110585296
14	11880	3445081	4383569	7184776	494983	65112	292238	83423230	9237569	480049	7096075	116114561
15	12474	3617335	4602747	7544015	519732	68368	306850	87594391	9699447	504052	7450879	121920289
16	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0

Table A5.25
SES157 Discounted Cash Flow Analysis - Build Cost £184.5m

PROJECT LIFE: 15 PRICE: 184500000 DEBT RATIO: 0.75 LOAN YEARS: 10 INTEREST RATE: 0.1

DECLINING BAL.: 0.2

TAX RATE: 0.33 INFLATION RATE: 0.05 DISCOUNT RATE: 0.175 BASE REVENUE: 90467348

SCRAP VALUE: 6491517

YEAR	CAPITAL	LOAN OUTSTANDING	LOAN REPAYMENTS	INTEREST PAYMENTS	RELIEF ON INTEREST	CAPITAL ALLOWANCE	RELIEF ON CAPITAL	ANNUAL REVENUE	OPERATING COSTS	GROSS SURPLUS	TAX	ANNUAL CASH FLOW	DISCOUNTED CASH FLOW
0	-46125000	0	0	0	0	0	0	0	0	0	0	-46125000	-46125000
1	0	138375000	13837500	13837500	4566375	36900000	0	90467348	62197951	594397	-1310753	1905150	1544194
2	0	124537500	13837500	12453750	4109738	29520000	12177000	94990715	65307848	3391617	-4255390	7647006	5023855
3	0	110700000	13837500	11070000	3653100	23616000	9741600	99740251	68573241	6259510	-2354613	8614123	4587009
4	0	96862500	13837500	9686250	3196463	18892800	7793280	104727263	72001903	9201610	-590084	9791694	4226191
5	0	83025000	13837500	8302500	2739825	15114240	6234624	109963626	75601998	12221628	1071569	11150059	3900689
6	0	69187500	13837500	6918750	2283188	12091392	4987699	115461808	79382098	15323460	2657349	12666111	3591537
7	0	55350000	13837500	5535000	1826550	9673114	3990159	121234898	83351203	18511195	4189180	14322015	3291652
8	0	41512500	13837500	4151250	1369913	7738491	3192127	127296643	87518763	21789130	5684940	16104190	3000002
9	0	27675000	13837500	2767500	913275	6190793	2553702	133661475	91894701	25161774	7159283	18002491	2718242
10	0	13837500	13837500	1383750	456638	4952634	2042962	140344549	96489436	28633863	8624307	20009556	2448870
11	0	0	0	0	0	3962107	1634369	147361776	101313908	46047868	14656455	31391414	3113953
12	0	0	0	0	0	3169686	1307495	154729865	106379603	48350262	15524113	32826149	2639332
13	0	0	0	0	0	2535749	1045996	162466358	111698583	50767775	16408187	34359588	2239210
14	0	0	0	0	0	2028599	836797	170589676	117283513	53306164	17314891	35991273	1901152
15	6491517	0	0	0	0	1622879	669438	179119160	123147688	55971472	18249671	44213317	1892978
16	0	0	0	0	0	0	535550	0	0	0	-176732	176732	6133
17	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0
												NPV	0

REQUIRED FREIGHT RATE = 280 £/tonne

(with 80% load factor)

Table A5.26
SES157 Operating Costs - Build Cost £184.5m

VESSEL DATA		COSTHEAD	ESCALATION RATE
Length	157.6	Registration	0
Breadth	35	Manning	0
Draught	7.2	Insurance	0
Payload	1804	R & M	0
Power	216333	Stores	0
No. Containers	200	Victualling	0
Complement	29	Administration	0
Annual Op. Hours	6048	Fuel Oil	0
No. Trips per annum	224	Diesel Oil	0
Fuel Load per Trip	1254	Port Dues	0
Dieso per week	648	Cargo Handling	0

YEAR	REGISTRATION	MANNING	INSURANCE	R & M	STORES	VICTUALING	ADMINISTRATION	FUEL OIL	DIESEL OIL	PORT DUES	CARGO HANDLING	TOTAL OPERATING COSTS
0	6000	1740000	2767500	3628800	250000	32886	184500	42134400	4665600	242458	3584000	59236144
1	6300	1827000	2905875	3810240	262500	34530	193725	44241120	4898880	254580	3763200	62197951
2	6615	1918350	3051169	4000752	275625	36257	203411	46453176	5143824	267310	3951360	65307848
3	6946	2014268	3203727	4200790	289406	38070	213582	48775835	5401015	280675	4148928	68573241
4	7293	2114981	3363914	4410829	303877	39973	224261	51214627	5671066	294709	4356374	72001903
5	7658	2220730	3532109	4631371	319070	41972	235474	53775358	5954619	309444	4574193	75601998
6	8041	2331766	3708715	4862939	335024	44070	247248	56464126	6252350	324916	4802903	79382098
7	8443	2448355	3894150	5106086	351775	46274	259610	59287332	6564968	341162	5043048	83351203
8	8865	2570772	4088858	5361390	369364	48588	272591	62251699	6893216	358220	5295200	87518763
9	9308	2699311	4293301	5629460	387832	51017	286220	65364284	7237877	376131	5559960	91894701
10	9773	2834277	4507966	5910933	407224	53568	300531	68632498	7599771	394938	5837958	96489436
11	10262	2975990	4733364	6206479	427585	56246	315558	72064123	7979759	414685	6129856	101313908
12	10775	3124790	4970032	6516803	448964	59059	331335	75667329	8378747	435419	6436349	106379603
13	11314	3281030	5218534	6842644	471412	62011	347902	79450695	8797685	457190	6758167	111698583
14	11880	3445081	5479461	7184776	494983	65112	365297	83423230	9237569	480049	7096075	117283513
15	12474	3617335	5753434	7544015	519732	68368	383562	87594391	9699447	504052	7450879	123147688
16	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0

Table A5.27
SES157 Discounted Cash Flow Analysis - Fuel Price £120/tonne

PROJECT LIFE: 15 | PRICE: 123000000 | DEBT RATIO: 0.75 | LOAN YEARS: 10 | INTEREST RATE: 0.1

DECLINING BAL.: 0.2

TAX RATE: 0.33 | INFLATION RATE: 0.05 | DISCOUNT RATE: 0.175 | BASE REVENUE: 70183015

SCRAP VALUE: 4327678

YEAR	CAPITAL	LOAN OUTSTANDING	LOAN REPAYMENTS	INTEREST PAYMENTS	RELIEF ON INTEREST	CAPITAL ALLOWANCE	RELIEF ON CAPITAL	ANNUAL REVENUE	OPERATING COSTS	GROSS SURPLUS	TAX	ANNUAL CASH FLOW	DISCOUNTED CASH FLOW
0	-30750000	0	0	0	0	0	0	0	0	0	0	-30750000	-30750000
1	0	92250000	9225000	9225000	3044250	24600000	0	70183015	51336751	396265	-873835	1270100	1029463
2	0	83025000	9225000	8302500	2739825	19680000	8118000	73692166	53903588	2261078	-2836927	5098004	3349237
3	0	73800000	9225000	7380000	2435400	15744000	6494400	77376774	56598768	4173007	-1569742	5742748	3058006
4	0	64575000	9225000	6457500	2130975	12595200	5195520	81245613	59428706	6134407	-393389	6527796	2817461
5	0	55350000	9225000	5535000	1826550	10076160	4156416	85307894	62400141	8147752	714379	7433373	2600459
6	0	46125000	9225000	4612500	1522125	8060928	3325133	89573288	65520148	10215640	1771566	8444074	2394358
7	0	36900000	9225000	3690000	1217700	6448742	2660106	94051953	68796156	12340797	2792787	9548010	2194435
8	0	27675000	9225000	2767500	913275	5158994	2128085	98754550	72235964	14526087	3789960	10736127	2000001
9	0	18450000	9225000	1845000	608850	4127195	1702468	103692278	75847762	16774516	4772855	12001661	1812161
10	0	9225000	9225000	922500	304425	3301756	1361974	108876892	79640150	19089242	5749538	13339704	1632580
11	0	0	0	0	0	2641405	1089580	114320736	83622158	30698579	9770970	20927609	2075969
12	0	0	0	0	0	2113124	871664	120036773	87803265	32233508	10349409	21884099	1759554
13	0	0	0	0	0	1690499	697331	126038612	92193429	33845183	10938791	22906392	1492807
14	0	0	0	0	0	1352399	557865	132340543	96803100	35537443	11543261	23994182	1267435
15	4327678	0	0	0	0	1081919	446292	138957570	101643255	37314315	12166448	29475545	1261985
16	0	0	0	0	0	0	357033	0	0	0	-117821	117821	4089
17	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
2[illegible]	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0
												NPV	0

REQUIRED FREIGHT RATE = 217 £/tonne

(with 80% load factor)

Table A5.28
SES157 Operating Costs - Fuel Price £120/tonne

VESSEL DATA		COSTHEAD	ESCALATION RATE
Length	157.6	Registration	0
Breadth	35	Manning	0
Draught	7.2	Insurance	0
Payload	1804	R & M	0
Power	216333	Stores	0
No. Containers	200	Victualling	0
Complement	29	Administration	0
Annual Op. Hours	6048	Fuel Oil	0
No. Trips per annum	224	Diesel Oil	0
Fuel Load per Trip	1254	Port Dues	0
Dieso per week	648	Cargo Handling	0

YEAR	REGISTRATION	MANNING	INSURANCE	R & M	STORES	VICTUALING	ADMINISTRATION	FUEL OIL	DIESEL OIL	PORT DUES	CARGO HANDLING	TOTAL OPERATING COSTS
0	6000	1740000	1845000	3628800	250000	32886	123000	33707520	3732480	242458	3584000	48892144
1	6300	1827000	1937250	3810240	262500	34530	129150	35392896	3919104	254580	3763200	51336751
2	6615	1918350	2034113	4000752	275625	36257	135608	37162541	4115059	267310	3951360	53903588
3	6946	2014268	2135818	4200790	289406	38070	142388	39020668	4320812	280675	4148928	56598768
4	7293	2114981	2242609	4410829	303877	39973	149507	40971701	4536853	294709	4356374	59428706
5	7658	2220730	2354739	4631371	319070	41972	156983	43020286	4763695	309444	4574193	62400141
6	8041	2331766	2472476	4862939	335024	44070	164832	45171301	5001880	324916	4802903	65520148
7	8443	2448355	2596100	5106086	351775	46274	173073	47429866	5251974	341162	5043048	68796156
8	8865	2570772	2725905	5361390	369364	48588	181727	49801359	5514573	358220	5295200	72235964
9	9308	2699311	2862201	5629460	387832	51017	190813	52291427	5790302	376131	5559960	75847762
10	9773	2834277	3005311	5910933	407224	53568	200354	54905998	6079817	394938	5837958	79640150
11	10262	2975990	3155576	6206479	427585	56246	210372	57651298	6383807	414685	6129856	83622158
12	10775	3124790	3313355	6516803	448964	59059	220890	60533863	6702998	435419	6436349	87803265
13	11314	3281030	3479023	6842644	471412	62011	231935	63560556	7038148	457190	6758167	92193429
14	11880	3445081	3652974	7184776	494983	65112	243532	66738584	7390055	480049	7096075	96803100
15	12474	3617335	3835622	7544015	519732	68368	255708	70075513	7759558	504052	7450879	101643255
16	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0

Table A5.29

SES157 Discounted Cash Flow Analysis - Fuel Price £135/tonne

PROJECT LIFE: 15 PRICE: 123000000 DEBT RATIO: 0.75 LOAN YEARS: 10 INTEREST RATE: 0.1

DECLINING BAL.: 0.2

TAX RATE: 0.33 INFLATION RATE: 0.05 DISCOUNT RATE: 0.175 BASE REVENUE: 75097786

SCRAP VALUE: 4327678

YEAR	CAPITAL	LOAN OUTSTANDING	LOAN REPAYMENTS	INTEREST PAYMENTS	RELIEF ON INTEREST	CAPITAL ALLOWANCE	RELIEF ON CAPITAL	ANNUAL REVENUE	OPERATING COSTS	GROSS SURPLUS	TAX	ANNUAL CASH FLOW	DISCOUNTED CASH FLOW
0	-30750000	0	0	0	0	0	0	0	0	0	0	-30750000	-30750000
1	0	92250000	9225000	9225000	3044250	24600000	0	75097786	56250751	397035	-873581	1270616	1029881
2	0	83025000	9225000	8302500	2739825	19680000	8118000	78852675	59063288	2261887	-2836660	5098546	3349593
3	0	73800000	9225000	7380000	2435400	15744000	6494400	82795309	62016453	4173856	-1569461	5743318	3058309
4	0	64575000	9225000	6457500	2130975	12595200	5195520	86935074	65117275	6135299	-393095	6528394	2817719
5	0	55350000	9225000	5535000	1826550	10076160	4156416	91281828	68373139	8148689	714689	7434000	2600679
6	0	46125000	9225000	4612500	1522125	8060928	3325133	95845919	71791796	10216623	1771891	8444733	2394544
7	0	36900000	9225000	3690000	1217700	6448742	2660106	100638215	75381386	12341829	2793128	9548702	2194594
8	0	27675000	9225000	2767500	913275	5158994	2128085	105670126	79150455	14527171	3790318	10736853	2000137
9	0	18450000	9225000	1845000	608850	4127195	1702468	110953632	83107978	16775654	4773231	12002423	1812276
10	0	9225000	9225000	922500	304425	3301756	1361974	116501314	87263377	19090437	5749932	13340505	1632678
11	0	0	0	0	0	2641405	1089580	122326380	91626546	30699834	9771384	20928450	2076052
12	0	0	0	0	0	2113124	871664	128442699	96207873	32234826	10349843	21884982	1759625
13	0	0	0	0	0	1690499	697331	134864834	101018267	33846567	10939248	22907319	1492867
14	0	0	0	0	0	1352399	557865	141608075	106069180	35538895	11543740	23995155	1267486
15	4327678	0	0	0	0	1081919	446292	148688479	111372639	37315840	12166951	29476567	1262029
16	0	0	0	0	0	0	357033	0	0	0	-117821	117821	4089
17	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0
												NPV	2559

REQUIRED FREIGHT RATE = 232 £/tonne

(with 80% load factor)

Table A5.30

SES157 Operating Costs - Fuel Price £135/tonne

VESSEL DATA	
Length	157.6
Breadth	35
Draught	7.2
Payload	1804
Power	216333
No. Containers	200
Complement	29
Annual Op. Hours	6048
No. Trips per annum	224
Fuel Load per Trip	1254
Dieso per week	648

COSTHEAD	ESCALATION RATE
Registration	0
Manning	0
Insurance	0
R & M	0
Stores	0
Victualling	0
Administration	0
Fuel Oil	0
Diesel Oil	0
Port Dues	0
Cargo Handling	0

YEAR	REGISTRATION	MANNING	INSURANCE	R & M	STORES	VICTUALING	ADMINISTRATION	FUEL OIL	DIESEL OIL	PORT DUES	CARGO HANDLING	TOTAL OPERATING COSTS
0	6000	1740000	1845000	3628800	250000	32886	123000	37920960	4199040	242458	3584000	53572144
1	6300	1827000	1937250	3810240	262500	34530	129150	39817008	4408992	254580	3763200	56250751
2	6615	1918350	2034113	4000752	275625	36257	135608	41807858	4629442	267310	3951360	59063288
3	6946	2014268	2135818	4200790	289406	38070	142388	43898251	4860914	280675	4148928	62016453
4	7293	2114981	2242609	4410829	303877	39973	149507	46093164	5103959	294709	4356374	65117275
5	7658	2220730	2354739	4631371	319070	41972	156983	48397822	5359157	309444	4574193	68373139
6	8041	2331766	2472476	4862939	335024	44070	164832	50817713	5627115	324916	4802903	71791796
7	8443	2448355	2596100	5106086	351775	46274	173073	53358599	5908471	341162	5043048	75381386
8	8865	2570772	2725905	5361390	369364	48588	181727	56026529	6203895	358220	5295200	79150455
9	9308	2699311	2862201	5629460	387832	51017	190813	58827855	6514089	376131	5559960	83107978
10	9773	2834277	3005311	5910933	407224	53568	200354	61769248	6839794	394938	5837958	87263377
11	10262	2975990	3155576	6206479	427585	56246	210372	64857710	7181783	414685	6129856	91626546
12	10775	3124790	3313355	6516803	448964	59059	220890	68100596	7540873	435419	6436349	96207873
13	11314	3281030	3479023	6842644	471412	62011	231935	71505626	7917916	457190	6758167	101018267
14	11880	3445081	3652974	7184776	494983	65112	243532	75080907	8313812	480049	7096075	106069180
15	12474	3617335	3835622	7544015	519732	68368	255708	78834952	8729503	504052	7450879	111372639
16	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0

Table A5.31
SES157 Discounted Cash Flow Analysis - Fuel Price £150/tonne

PROJECT LIFE: 15 | PRICE: 123000000 | DEBT RATIO: 0.75 | LOAN YEARS: 10 | INTEREST RATE: 0.1

DECLINING BAL.: 0.2

TAX RATE: 0.33 | INFLATION RATE: 0.05 | DISCOUNT RATE: 0.175 | BASE REVENUE: 80011786

SCRAP VALUE: 4327678

YEAR	CAPITAL	LOAN OUTSTANDING	LOAN REPAYMENTS	INTEREST PAYMENTS	RELIEF ON INTEREST	CAPITAL ALLOWANCE	RELIEF ON CAPITAL	ANNUAL REVENUE	OPERATING COSTS	GROSS SURPLUS	TAX	ANNUAL CASH FLOW	DISCOUNTED CASH FLOW
0	-30750000	0	0	0	0	0	0	0	0	0	0	-30750000	-30750000
1	0	92250000	9225000	9225000	3044250	24600000	0	80011786	61164751	397035	-873581	1270616	1029881
2	0	83025000	9225000	8302500	2739825	19680000	8118000	84012375	64222988	2261887	-2836660	5098546	3349593
3	0	73800000	9225000	7380000	2435400	15744000	6494400	88212994	67434138	4173856	-1569461	5743318	3058309
4	0	64575000	9225000	6457500	2130975	12595200	5195520	92623644	70805845	6135299	-393095	6528394	2817719
5	0	55350000	9225000	5535000	1826550	10076160	4156416	97254826	74346137	8148689	714689	7434000	2600679
6	0	46125000	9225000	4612500	1522125	8060928	3325133	102117567	78063444	10216623	1771891	8444733	2394544
7	0	36900000	9225000	3690000	1217700	6448742	2660106	107223445	81966616	12341829	2793128	9548702	2194594
8	0	27675000	9225000	2767500	913275	5158994	2128085	112584618	86064947	14527171	3790318	10736853	2000137
9	0	18450000	9225000	1845000	608850	4127195	1702468	118213848	90368194	16775654	4773231	12002423	1812276
10	0	9225000	9225000	922500	304425	3301756	1361974	124124541	94886604	19090437	5749932	13340505	1632678
11	0	0	0	0	0	2641405	1089580	130330768	99630934	30699834	9771384	20928450	2076052
12	0	0	0	0	0	2113124	871664	136847306	104612481	32234826	10349843	21884982	1759625
13	0	0	0	0	0	1690499	697331	143689672	109843105	33846567	10939248	22907319	1492867
14	0	0	0	0	0	1352399	557865	150874155	115335260	35538895	11543740	23995155	1267486
15	4327678	0	0	0	0	1081919	446292	158417863	121102023	37315840	12166951	29476567	1262029
16	0	0	0	0	0	0	357033	0	0	0	-117821	117821	4089
17	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0
												NPV	2359

REQUIRED FREIGHT RATE = 248 £/tonne

(with 80% load factor)

Table A5.32
SES157 Operating Costs - Fuel Price £150/tonne

VESSEL DATA	
Length	157.6
Breadth	35
Draught	7.2
Payload	1804
Power	216333
No. Containers	200
Complement	29
Annual Op. Hours	6048
No. Trips per annum	224
Fuel Load per Trip	1254
Dieso per week	648

COSTHEAD	ESCALATION RATE
Registration	0
Manning	0
Insurance	0
R & M	0
Stores	0
Victualling	0
Administration	0
Fuel Oil	0
Diesel Oil	0
Port Dues	0
Cargo Handling	0

YEAR	REGISTRATION	MANNING	INSURANCE	R & M	STORES	VICTUALING	ADMINISTRATION	FUEL OIL	DIESEL OIL	PORT DUES	CARGO HANDLING	TOTAL OPERATING COSTS
0	6000	1740000	1845000	3628800	250000	32886	123000	42134400	4665600	242458	3584000	58252144
1	6300	1827000	1937250	3810240	262500	34530	129150	44241120	4898880	254580	3763200	61164751
2	6615	1918350	2034113	4000752	275625	36257	135608	46453176	5143824	267310	3951360	64222988
3	6946	2014268	2135818	4200790	289406	38070	142388	48775835	5401015	280675	4148928	67434138
4	7293	2114981	2242609	4410829	303877	39973	149507	51214627	5671066	294709	4356374	70805845
5	7658	2220730	2354739	4631371	319070	41972	156983	53775358	5954619	309444	4574193	74346137
6	8041	2331766	2472476	4862939	335024	44070	164832	56464126	6252350	324916	4802903	78063444
7	8443	2448355	2596100	5106086	351775	46274	173073	59287332	6564968	341162	5043048	81966616
8	8865	2570772	2725905	5361390	369364	48588	181727	62251699	6893216	358220	5295200	86064947
9	9308	2699311	2862201	5629460	387832	51017	190813	65364284	7237877	376131	5559960	90368194
10	9773	2834277	3005311	5910933	407224	53568	200354	68632498	7599771	394938	5837958	94886604
11	10262	2975990	3155576	6206479	427585	56246	210372	72064123	7979759	414685	6129856	99630934
12	10775	3124790	3313355	6516803	448964	59059	220890	75667329	8378747	435419	6436349	104612481
13	11314	3281030	3479023	6842644	471412	62011	231935	79450695	8797685	457190	6758167	109843105
14	11880	3445081	3652974	7184776	494983	65112	243532	83423230	9237569	480049	7096075	115335260
15	12474	3617335	3835622	7544015	519732	68368	255708	87594391	9699447	504052	7450879	121102023
16	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0

Table A5.33
SES157 Discounted Cash Flow Analysis - Fuel Price £165/tonne

PROJECT LIFE: 15 | PRICE: 123000000 | DEBT RATIO: 0.75 | LOAN YEARS: 10 | INTEREST RATE: 0.1

DECLINING BAL.: 0.2

TAX RATE: 0.33 | INFLATION RATE: 0.05 | DISCOUNT RATE: 0.175 | BASE REVENUE: 84925786

SCRAP VALUE: 4327678

YEAR	CAPITAL	LOAN OUTSTANDING	LOAN REPAYMENTS	INTEREST PAYMENTS	RELIEF ON INTEREST	CAPITAL ALLOWANCE	RELIEF ON CAPITAL	ANNUAL REVENUE	OPERATING COSTS	GROSS SURPLUS	TAX	ANNUAL CASH FLOW	DISCOUNTED CASH FLOW
0	-30750000	0	0	0	0	0	0	0	0	0	0	-30750000	-30750000
1	0	92250000	9225000	9225000	3044250	24600000	0	84925786	66078751	397035	-873581	1270616	1029881
2	0	83025000	9225000	8302500	2739825	19680000	8118000	89172075	69382688	2261887	-2836660	5098546	3349593
3	0	73800000	9225000	7380000	2435400	15744000	6494400	93630679	72851823	4173856	-1569461	5743318	3058309
4	0	64575000	9225000	6457500	2130975	12595200	5195520	98312213	76494414	6135299	-393095	6528394	2817719
5	0	55350000	9225000	5535000	1826550	10076160	4156416	103227823	80319135	8148689	714689	7434000	2600679
6	0	46125000	9225000	4612500	1522125	8060928	3325133	108389215	84335091	10216623	1771891	8444733	2394544
7	0	36900000	9225000	3690000	1217700	6448742	2660106	113808675	88551846	12341829	2793128	9548702	2194594
8	0	27675000	9225000	2767500	913275	5158994	2128085	119499109	92979438	14527171	3790318	10736853	2000137
9	0	18450000	9225000	1845000	608850	4127195	1702468	125474065	97628410	16775654	4773231	12002423	1812276
10	0	9225000	9225000	922500	304425	3301756	1361974	131747768	102509831	19090437	5749932	13340505	1632678
11	0	0	0	0	0	2641405	1089580	138335156	107635322	30699834	9771384	20928450	2076052
12	0	0	0	0	0	2113124	871664	145251914	113017088	32234826	10349843	21884982	1759625
13	0	0	0	0	0	1690499	697331	152514510	118667943	33846567	10939248	22907319	1492867
14	0	0	0	0	0	1352399	557865	160140235	124601340	35538895	11543740	23995155	1267486
15	4327678	0	0	0	0	1081919	446292	168147247	130831407	37315840	12166951	29476567	1262029
16	0	0	0	0	0	0	357033	0	0	0	-117821	117821	4089
17	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0
												NPV	2559

REQUIRED FREIGHT RATE = 263 £/tonne

(with 80% load factor)

Table A5.34
SES157 Operating Costs - Fuel Price £165/tonne

VESSEL DATA	
Length	157.6
Breadth	35
Draught	7.2
Payload	1804
Power	216333
No. Containers	200
Complement	29
Annual Op. Hours	6048
No. Trips per annum	224
Fuel Load per Trip	1254
Dieso per week	648

COSTHEAD	ESCALATION RATE
Registration	0
Manning	0
Insurance	0
R & M	0
Stores	0
Victualling	0
Administration	0
Fuel Oil	0
Diesel Oil	0
Port Dues	0
Cargo Handling	0

YEAR	REGISTRATION	MANNING	INSURANCE	R & M	STORES	VICTUALING	ADMINISTRATION	FUEL OIL	DIESEL OIL	PORT DUES	CARGO HANDLING	TOTAL OPERATING COSTS
0	6000	1740000	1845000	3628800	250000	32886	123000	46347840	5132160	242458	3584000	62932144
1	6300	1827000	1937250	3810240	262500	34530	129150	48665232	5388768	254580	3763200	66078751
2	6615	1918350	2034113	4000752	275625	36257	135608	51098494	5658206	267310	3951360	69382688
3	6946	2014268	2135818	4200790	289406	38070	142388	53653418	5941117	280675	4148928	72851823
4	7293	2114981	2242609	4410829	303877	39973	149507	56336089	6238173	294709	4356374	76494414
5	7658	2220730	2354739	4631371	319070	41972	156983	59152894	6550081	309444	4574193	80319135
6	8041	2331766	2472476	4862939	335024	44070	164832	62110538	6877585	324916	4802903	84335091
7	8443	2448355	2596100	5106086	351775	46274	173073	65216065	7221465	341162	5043048	88551846
8	8865	2570772	2725905	5361390	369364	48588	181727	68476869	7582538	358220	5295200	92979438
9	9308	2699311	2862201	5629460	387832	51017	190813	71900712	7961665	376131	5559960	97628410
10	9773	2834277	3005311	5910933	407224	53568	200354	75495748	8359748	394938	5837958	102509831
11	10262	2975990	3155576	6206479	427585	56246	210372	79270535	8777735	414685	6129856	107635322
12	10775	3124790	3313355	6516803	448964	59059	220890	83234062	9216622	435419	6436349	113017088
13	11314	3281030	3479023	6842644	471412	62011	231935	87395765	9677453	457190	6758167	118667943
14	11880	3445081	3652974	7184776	494983	65112	243532	91765553	10161326	480049	7096075	124601340
15	12474	3617335	3835622	7544015	519732	68368	255708	96353831	10669392	504052	7450879	130831407
16	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0

Table A5.35
SES157 Discounted Cash Flow Analysis - Fuel Price £180/tonne

PROJECT LIFE: 15 | PRICE: 123000000 | DEBT RATIO: 0.75 | LOAN YEARS: 10 | INTEREST RATE: 0.1

DECLINING BAL.: 0.2

TAX RATE: 0.33 | INFLATION RATE: 0.05 | DISCOUNT RATE: 0.175 | BASE REVENUE: 89839786

SCRAP VALUE: 4327678

YEAR	CAPITAL	LOAN OUTSTANDING	LOAN REPAYMENTS	INTEREST PAYMENTS	RELIEF ON INTEREST	CAPITAL ALLOWANCE	RELIEF ON CAPITAL	ANNUAL REVENUE	OPERATING COSTS	GROSS SURPLUS	TAX	ANNUAL CASH FLOW	DISCOUNTED CASH FLOW
0	-30750000	0	0	0	0	0	0	0	0	0	0	-30750000	-30750000
1	0	92250000	9225000	9225000	3044250	24600000	0	89839786	70992751	397035	-873581	1270616	1029881
2	0	83025000	9225000	8302500	2739825	19680000	8118000	94331775	74542388	2261887	-2836660	5098546	3349593
3	0	73800000	9225000	7380000	2435400	15744000	6494400	99048364	78269508	4173856	-1569461	5743318	3058309
4	0	64575000	9225000	6457500	2130975	12595200	5195520	104000782	82182983	6135299	-393095	6528394	2817719
5	0	55350000	9225000	5535000	1826550	10076160	4156416	109200821	86292132	8148689	714689	7434000	2600679
6	0	46125000	9225000	4612500	1522125	8060928	3325133	114660862	90606739	10216623	1771891	8444733	2394544
7	0	36900000	9225000	3690000	1217700	6448742	2660106	120393905	95137076	12341829	2793128	9548702	2194594
8	0	27675000	9225000	2767500	913275	5158994	2128085	126413601	99893930	14527171	3790318	10736853	2000137
9	0	18450000	9225000	1845000	608850	4127195	1702468	132734281	104888626	16775654	4773231	12002423	1812276
10	0	9225000	9225000	922500	304425	3301756	1361974	139370995	110133057	19090437	5749932	13340505	1632678
11	0	0	0	0	0	2641405	1089580	146339544	115639710	30699834	9771384	20928450	2076052
12	0	0	0	0	0	2113124	871664	153656522	121421696	32234826	10349843	21884982	1759625
13	0	0	0	0	0	1690499	697331	161339348	127492781	33846567	10939248	22907319	1492867
14	0	0	0	0	0	1352399	557865	169406315	133867420	35538895	11543740	23995155	1267486
15	4327678	0	0	0	0	1081919	446292	177876631	140560791	37315840	12166951	29476567	1262029
16	0	0	0	0	0	0	357033	0	0	0	-117821	117821	4089
17	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0
												NPV	2559

REQUIRED FREIGHT RATE = 278 £/tonne

(with 80% load factor)

Table A5.36
SES157 Operating Costs - Fuel Price £180/tonne

VESSEL DATA	
Length	157.6
Breadth	35
Draught	7.2
Payload	1804
Power	216333
No. Containers	200
Complement	29
Annual Op. Hours	6048
No. Trips per annum	224
Fuel Load per Trip	1254
Dieso per week	648

COSTHEAD	ESCALATION RATE
Registration	0
Manning	0
Insurance	0
R & M	0
Stores	0
Victualling	0
Administration	0
Fuel Oil	0
Diesel Oil	0
Port Dues	0
Cargo Handling	0

YEAR	REGISTRATION	MANNING	INSURANCE	R & M	STORES	VICTUALING	ADMINISTRATION	FUEL OIL	DIESEL OIL	PORT DUES	CARGO HANDLING	TOTAL OPERATING COSTS
0	6000	1740000	1845000	3628800	250000	32886	123000	50561280	5598720	242458	3584000	67612144
1	6300	1827000	1937250	3810240	262500	34530	129150	53089344	5878656	254580	3763200	70992751
2	6615	1918350	2034113	4000752	275625	36257	135608	55743811	6172589	267310	3951360	74542388
3	6946	2014268	2135818	4200790	289406	38070	142388	58531002	6481218	280675	4148928	78269508
4	7293	2114981	2242609	4410829	303877	39973	149507	61457552	6805279	294709	4356374	82182983
5	7658	2220730	2354739	4631371	319070	41972	156983	64530429	7145543	309444	4574193	86292132
6	8041	2331766	2472476	4862939	335024	44070	164832	67756951	7502820	324916	4802903	90606739
7	8443	2448355	2596100	5106086	351775	46274	173073	71144798	7877961	341162	5043048	95137076
8	8865	2570772	2725905	5361390	369364	48588	181727	74702038	8271859	358220	5295200	99893930
9	9308	2699311	2862201	5629460	387832	51017	190813	78437140	8685452	376131	5559960	104888626
10	9773	2834277	3005311	5910933	407224	53568	200354	82358997	9119725	394938	5837958	110133057
11	10262	2975990	3155576	6206479	427585	56246	210372	86476947	9575711	414685	6129856	115639710
12	10775	3124790	3313355	6516803	448964	59059	220890	90800795	10054497	435419	6436349	121421696
13	11314	3281030	3479023	6842644	471412	62011	231935	95340834	10557222	457190	6758167	127492781
14	11880	3445081	3652974	7184776	494983	65112	243532	100107876	11085083	480049	7096075	133867420
15	12474	3617335	3835622	7544015	519732	68368	255708	105113270	11639337	504052	7450879	140560791
16	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0

Table A5.37

SES157 Discounted Cash Flow Analysis - Fuel Price £225/tonne

PROJECT LIFE: 15 PRICE: 123000000 DEBT RATIO: 0.75 LOAN YEARS: 10 INTEREST RATE: 0.1

DECLINING BAL.: 0.2

TAX RATE: 0.33 INFLATION RATE: 0.05 DISCOUNT RATE: 0.175 BASE REVENUE: 104581786

SCRAP VALUE: 4327678

YEAR	CAPITAL	LOAN OUTSTANDING	LOAN REPAYMENTS	INTEREST PAYMENTS	RELIEF ON INTEREST	CAPITAL ALLOWANCE	RELIEF ON CAPITAL	ANNUAL REVENUE	OPERATING COSTS	GROSS SURPLUS	TAX	ANNUAL CASH FLOW	DISCOUNTED CASH FLOW
0	-30750000	0	0	0	0	0	0	0	0	0	0	-30750000	-30750000
1	0	92250000	9225000	9225000	3044250	24600000	0	104581786	85734751	397035	-873581	1270616	1029881
2	0	83025000	9225000	8302500	2739825	19680000	8118000	109810875	90021488	2261887	-2836660	5098546	3349593
3	0	73800000	9225000	7380000	2435400	15744000	6494400	115301419	94522563	4173856	-1569461	5743318	3058309
4	0	64575000	9225000	6457500	2130975	12595200	5195520	121066490	99248691	6135299	-393095	6528394	2817719
5	0	55350000	9225000	5535000	1826550	10076160	4156416	127119814	104211125	8148689	714689	7434000	2600679
6	0	46125000	9225000	4612500	1522125	8060928	3325133	133475805	109421682	10216623	1771891	8444733	2394544
7	0	36900000	9225000	3690000	1217700	6448742	2660106	140149595	114892766	12341829	2793128	9548702	2194594
8	0	27675000	9225000	2767500	913275	5158994	2128085	147157075	120637404	14527171	3790318	10736853	2000137
9	0	18450000	9225000	1845000	608850	4127195	1702468	154514929	126669274	16775654	4773231	12002423	1812276
10	0	9225000	9225000	922500	304425	3301756	1361974	162240675	133002738	19090437	5749932	13340505	1632678
11	0	0	0	0	0	2641405	1089580	170352709	139652875	30699834	9771384	20928450	2076052
12	0	0	0	0	0	2113124	871664	178870344	146635519	32234826	10349843	21884982	1759625
13	0	0	0	0	0	1690499	697331	187813862	153967295	33846567	10939248	22907319	1492867
14	0	0	0	0	0	1352399	557865	197204555	161665659	35538895	11543740	23995155	1267486
15	4327678	0	0	0	0	1081919	446292	207064782	169748942	37315840	12166951	29476567	1262029
16	0	0	0	0	0	0	357033	0	0	0	-117821	117821	4089
17	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0
												NPV	2259

REQUIRED FREIGHT RATE = 324 £/tonne

(with 80% load factor)

Table A5.38
SES157 Operating Costs - Fuel Price £200/tonne

VESSEL DATA	
Length	157.6
Breadth	35
Draught	7.2
Payload	1804
Power	216333
No. Containers	200
Complement	29
Annual Op. Hours	6048
No. Trips per annum	224
Fuel Load per Trip	1254
Dieso per week	648

COSTHEAD	ESCALATION RATE
Registration	0
Manning	0
Insurance	0
R & M	0
Stores	0
Victualling	0
Administration	0
Fuel Oil	0
Diesel Oil	0
Port Dues	0
Cargo Handling	0

YEAR	REGISTRATION	MANNING	INSURANCE	R & M	STORES	VICTUALING	ADMINISTRATION	FUEL OIL	DIESEL OIL	PORT DUES	CARGO HANDLING	TOTAL OPERATING COSTS
0	6000	1740000	1845000	3628800	250000	32886	123000	63201600	6998400	242458	3584000	81652144
1	6300	1827000	1937250	3810240	262500	34530	129150	66361680	7348320	254580	3763200	85734751
2	6615	1918350	2034113	4000752	275625	36257	135608	69679764	7715736	267310	3951360	90021488
3	6946	2014268	2135818	4200790	289406	38070	142388	73163752	8101523	280675	4148928	94522563
4	7293	2114981	2242609	4410829	303877	39973	149507	76821940	8506599	294709	4356374	99248691
5	7658	2220730	2354739	4631371	319070	41972	156983	80663037	8931929	309444	4574193	104211125
6	8041	2331766	2472476	4862939	335024	44070	164832	84696189	9378525	324916	4802903	109421682
7	8443	2448355	2596100	5106086	351775	46274	173073	88930998	9847452	341162	5043048	114892766
8	8865	2570772	2725905	5361390	369364	48588	181727	93377548	10339824	358220	5295200	120637404
9	9308	2699311	2862201	5629460	387832	51017	190813	98046425	10856815	376131	5559960	126669274
10	9773	2834277	3005311	5910933	407224	53568	200354	102948747	11399656	394938	5837958	133002738
11	10262	2975990	3155576	6206479	427585	56246	210372	108096184	11969639	414685	6129856	139652875
12	10775	3124790	3313355	6516803	448964	59059	220890	113500993	12568121	435419	6436349	146635519
13	11314	3281030	3479023	6842644	471412	62011	231935	119176043	13196527	457190	6758167	153967295
14	11880	3445081	3652974	7184776	494983	65112	243532	125134845	13856353	480049	7096075	161665659
15	12474	3617335	3835622	7544015	519732	68368	255708	131391587	14549171	504052	7450879	169748942
16	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0

Table A5.39
SES157 Discounted Cash Flow Analysis - Tax Rate 25%

PROJECT LIFE: 15 | PRICE: 123000000 | DEBT RATIO: 0.75 | LOAN YEARS: 10 | INTEREST RATE: 0.1

DECLINING BAL.: 0.2

TAX RATE: 0.25 | INFLATION RATE: 0.05 | DISCOUNT RATE: 0.175 | BASE REVENUE: 80156578

SCRAP VALUE: 4327678

YEAR	CAPITAL	LOAN OUTSTANDING	LOAN REPAYMENTS	INTEREST PAYMENTS	RELIEF ON INTEREST	CAPITAL ALLOWANCE	RELIEF ON CAPITAL	ANNUAL REVENUE	OPERATING COSTS	GROSS SURPLUS	TAX	ANNUAL CASH FLOW	DISCOUNTED CASH FLOW
0	-30750000	0	0	0	0	0	0	0	0	0	0	-30750000	-30750000
1	0	92250000	9225000	9225000	2306250	24600000	0	80156578	61164751	541827	-441106	982933	796704
2	0	83025000	9225000	8302500	2075625	19680000	6150000	84164407	64222988	2413919	-1452927	3866845	2540402
3	0	73800000	9225000	7380000	1845000	15744000	4920000	88372627	67434138	4333490	-607878	4941367	2631271
4	0	64575000	9225000	6457500	1614375	12595200	3936000	92791259	70805845	6302914	188135	6114779	2639199
5	0	55350000	9225000	5535000	1383750	10076160	3148800	97430822	74346137	8324685	948034	7376651	2580616
6	0	46125000	9225000	4612500	1153125	8060928	2519040	102302363	78063444	10401419	1682314	8719106	2472344
7	0	36900000	9225000	3690000	922500	6448742	2015232	107417481	81966616	12535865	2399533	10136332	2329650
8	0	27675000	9225000	2767500	691875	5158994	1612186	112788355	86064947	14730908	3106712	11624196	2165437
9	0	18450000	9225000	1845000	461250	4127195	1289748	118427773	90368194	16989579	3809645	13179934	1990072
10	0	9225000	9225000	922500	230625	3301756	1031799	124349161	94886604	19315058	4513158	14801899	1811531
11	0	0	0	0	0	2641405	825439	130566619	99630934	30935685	7527562	23408124	2322030
12	0	0	0	0	0	2113124	660351	137094950	104612481	32482470	7955530	24526940	1972048
13	0	0	0	0	0	1690499	528281	143949698	109843105	34106593	8394578	25712015	1675649
14	0	0	0	0	0	1352399	422625	151147183	115335260	35811923	8847325	26964598	1424340
15	4327678	0	0	0	0	1081919	338100	158704542	121102023	37602519	9316105	32614092	1396361
16	0	0	0	0	0	0	270480	0	0	0	-67620	67620	2347
17	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0
												NPV	0

REQUIRED FREIGHT RATE = 248 £/tonne

(with 80% load factor)

Table A5.41
SES157 Discounted Cash Flow Analysis - Tax Rate 30%

PROJECT LIFE: 15 PRICE: 123000000 DEBT RATIO: 0.75 LOAN YEARS: 10 INTEREST RATE: 0.1

DECLINING BAL.: 0.2

TAX RATE: 0.3 INFLATION RATE: 0.05 DISCOUNT RATE: 0.175 BASE REVENUE: 80099993

SCRAP VALUE: 4327678

YEAR	CAPITAL	LOAN OUTSTANDING	LOAN REPAYMENTS	INTEREST PAYMENTS	RELIEF ON INTEREST	CAPITAL ALLOWANCE	RELIEF ON CAPITAL	ANNUAL REVENUE	OPERATING COSTS	GROSS SURPLUS	TAX	ANNUAL CASH FLOW	DISCOUNTED CASH FLOW
0	-30750000	0	0	0	0	0	0	0	0	0	0	-30750000	-30750000
1	0	92250000	9225000	9225000	2767500	24600000	0	80099993	61164751	485242	-684677	1169919	948263
2	0	83025000	9225000	8302500	2490750	19680000	7380000	84104992	64222988	2354504	-2254874	4609378	3028224
3	0	73800000	9225000	7380000	2214000	15744000	5904000	88310242	67434138	4271104	-1154069	5425173	2888897
4	0	64575000	9225000	6457500	1937250	12595200	4723200	92725754	70805845	6237409	-126912	6364322	2746904
5	0	55350000	9225000	5535000	1660500	10076160	3778560	97362042	74346137	8255905	845053	7410851	2592581
6	0	46125000	9225000	4612500	1383750	8060928	3022848	102230144	78063444	10329200	1776781	8552420	2425080
7	0	36900000	9225000	3690000	1107000	6448742	2418278	107341651	81966616	12460035	2680427	9779608	2247664
8	0	27675000	9225000	2767500	830250	5158994	1934623	112708734	86064947	14651287	3565924	11085363	2065060
9	0	18450000	9225000	1845000	553500	4127195	1547698	118344170	90368194	16905976	4441433	12464543	1882053
10	0	9225000	9225000	922500	276750	3301756	1238159	124261379	94886604	19227275	5313710	13913565	1702812
11	0	0	0	0	0	2641405	990527	130474448	99630934	30843514	8955896	21887618	2171199
12	0	0	0	0	0	2113124	792421	136998170	104612481	32385690	9477980	22907709	1841856
13	0	0	0	0	0	1690499	633937	143848079	109843105	34004974	10011311	23993663	1563664
14	0	0	0	0	0	1352399	507150	151040483	115335260	35705223	10559422	25145801	1328266
15	4327678	0	0	0	0	1081919	405720	158592507	121102023	37490484	11125429	30692732	1314099
16	0	0	0	0	0	0	324576	0	0	0	-97373	97373	3379
17	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0
												NPV	0

REQUIRED FREIGHT RATE = 248 £/tonne

(with 80% load factor)

SES157 Operating Costs - Tax Rate 30%

VESSEL DATA	
Length	157.6
Breadth	35
Draught	7.2
Payload	1804
Power	216333
No. Containers	200
Complement	29
Annual Op. Hours	6048
No. Trips per annum	224
Fuel Load per Trip	1254
Dieso per week	648

COSTHEAD	ESCALATION RATE
Registration	0
Manning	0
Insurance	0
R & M	0
Stores	0
Victualling	0
Administration	0
Fuel Oil	0
Diesel Oil	0
Port Dues	0
Cargo Handling	0

YEAR	REGISTRATION	MANNING	INSURANCE	R & M	STORES	VICTUALING	ADMINISTRATION	FUEL OIL	DIESEL OIL	PORT DUES	CARGO HANDLING	TOTAL OPERATING COSTS
0	6000	1740000	1845000	3628800	250000	32886	123000	42134400	4665600	242458	3584000	58252144
1	6300	1827000	1937250	3810240	262500	34530	129150	44241120	4898880	254580	3763200	61164751
2	6615	1918350	2034113	4000752	275625	36257	135608	46453176	5143824	267310	3951360	64222988
3	6946	2014268	2135818	4200790	289406	38070	142388	48775835	5401015	280675	4148928	67434138
4	7293	2114981	2242609	4410829	303877	39973	149507	51214627	5671066	294709	4356374	70805845
5	7658	2220730	2354739	4631371	319070	41972	156983	53775358	5954619	309444	4574193	74346137
6	8041	2331766	2472476	4862939	335024	44070	164832	56464126	6252350	324916	4802903	78063444
7	8443	2448355	2596100	5106086	351775	46274	173073	59287332	6564968	341162	5043048	81966616
8	8865	2570772	2725905	5361390	369364	48588	181727	62251699	6893216	358220	5295200	86064947
9	9308	2699311	2862201	5629460	387832	51017	190813	65364284	7237877	376131	5559960	90368194
10	9773	2834277	3005311	5910933	407224	53568	200354	68632498	7599771	394938	5837958	94886604
11	10262	2975990	3155576	6206479	427585	56246	210372	72064123	7979759	414685	6129856	99630934
12	10775	3124790	3313355	6516803	448964	59059	220890	75667329	8378747	435419	6436349	104612481
13	11314	3281030	3479023	6842644	471412	62011	231935	79450695	8797685	457190	6758167	109843105
14	11880	3445081	3652974	7184776	494983	65112	243532	83423230	9237569	480049	7096075	115335260
15	12474	3617335	3835622	7544015	519732	68368	255708	87594391	9699447	504052	7450879	121102023
16	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0

Table A5.43
SES157 Discounted Cash Flow Analysis - Tax Rate 35%

PROJECT LIFE: 15 | PRICE: 123000000 | DEBT RATIO: 0.75 | LOAN YEARS: 10 | INTEREST RATE: 0.1

DECLINING BAL.: 0.2

TAX RATE: 0.35 | INFLATION RATE: 0.05 | DISCOUNT RATE: 0.175 | BASE REVENUE: 79925242

SCRAP VALUE: 4327678

YEAR	CAPITAL	LOAN OUTSTANDING	LOAN REPAYMENTS	INTEREST PAYMENTS	RELIEF ON INTEREST	CAPITAL ALLOWANCE	RELIEF ON CAPITAL	ANNUAL REVENUE	OPERATING COSTS	GROSS SURPLUS	TAX	ANNUAL CASH FLOW	DISCOUNTED CASH FLOW
0	-30750000	0	0	0	0	0	0	0	0	0	0	-30750000	-30750000
1	0	92250000	9225000	9225000	3228750	24600000	0	79925242	61164751	310491	-1021391	1331882	1079539
2	0	83025000	9225000	8302500	2905875	19680000	8610000	83921504	64222988	2171016	-3270701	5441717	3575046
3	0	73800000	9225000	7380000	2583000	15744000	6888000	88117579	67434138	4078442	-1887395	5965837	3176800
4	0	64575000	9225000	6457500	2260125	12595200	5510400	92523458	70805845	6035114	-607394	6642508	2866972
5	0	55350000	9225000	5535000	1937250	10076160	4408320	97149631	74346137	8043494	594274	7449221	2606004
6	0	46125000	9225000	4612500	1614375	8060928	3526656	102007113	78063444	10106169	1737798	8368371	2372892
7	0	36900000	9225000	3690000	1291500	6448742	2821325	107107468	81966616	12225853	2839560	9386293	2157267
8	0	27675000	9225000	2767500	968625	5158994	2257060	112462842	86064947	14405395	3912899	10492497	1954616
9	0	18450000	9225000	1845000	645750	4127195	1805648	118085984	90368194	16647790	4968737	11679053	1763450
10	0	9225000	9225000	922500	322875	3301756	1444518	123990283	94886604	18956179	6016075	12940104	1583675
11	0	0	0	0	0	2641405	1155615	130189797	99630934	30558863	10291137	20267726	2010510
12	0	0	0	0	0	2113124	924492	136699287	104612481	32086807	10906810	21179996	1702942
13	0	0	0	0	0	1690499	739593	143534252	109843105	33691147	11533044	22158103	1444041
14	0	0	0	0	0	1352399	591675	150710964	115335260	35375704	12174410	23201294	1225552
15	4327678	0	0	0	0	1081919	473340	158246512	121102023	37144490	12834902	28637265	1226095
16	0	0	0	0	0	0	378672	0	0	0	-132535	132535	4599
17	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0
												NPV	0

REQUIRED FREIGHT RATE = 247 £/tonne

(with 80% load factor)

SES157 Operating Costs - Tax Rate 35%

VESSEL DATA		COSTHEAD	ESCALATION RATE
Length	157.6	Registration	0
Breadth	35	Manning	0
Draught	7.2	Insurance	0
Payload	1804	R & M	0
Power	216333	Stores	0
No. Containers	200	Victualling	0
Complement	29	Administration	0
Annual Op. Hours	6048	Fuel Oil	0
No. Trips per annum	224	Diesel Oil	0
Fuel Load per Trip	1254	Port Dues	0
Dieso per week	648	Cargo Handling	0

YEAR	REGISTRATION	MANNING	INSURANCE	R & M	STORES	VICTUALING	ADMINISTRATION	FUEL OIL	DIESEL OIL	PORT DUES	CARGO HANDLING	TOTAL OPERATING COSTS
0	6000	1740000	1845000	3628800	250000	32886	123000	42134400	4665600	242458	3584000	58252144
1	6300	1827000	1937250	3810240	262500	34530	129150	44241120	4898880	254580	3763200	61164751
2	6615	1918350	2034113	4000752	275625	36257	135608	46453176	5143824	267310	3951360	64222988
3	6946	2014268	2135818	4200790	289406	38070	142388	48775835	5401015	280675	4148928	67434138
4	7293	2114981	2242609	4410829	303877	39973	149507	51214627	5671066	294709	4356374	70805845
5	7658	2220730	2354739	4631371	319070	41972	156983	53775358	5954619	309444	4574193	74346137
6	8041	2331766	2472476	4862939	335024	44070	164832	56464126	6252350	324916	4802903	78063444
7	8443	2448355	2596100	5106086	351775	46274	173073	59287332	6564968	341162	5043048	81966616
8	8865	2570772	2725905	5361390	369364	48588	181727	62251699	6893216	358220	5295200	86064947
9	9308	2699311	2862201	5629460	387832	51017	190813	65364284	7237877	376131	5559960	90368194
10	9773	2834277	3005311	5910933	407224	53568	200354	68632498	7599771	394938	5837958	94886604
11	10262	2975990	3155576	6206479	427585	56246	210372	72064123	7979759	414685	6129856	99630934
12	10775	3124790	3313355	6516803	448964	59059	220890	75667329	8378747	435419	6436349	104612481
13	11314	3281030	3479023	6842644	471412	62011	231935	79450695	8797685	457190	6758167	109843105
14	11880	3445081	3652974	7184776	494983	65112	243532	83423230	9237569	480049	7096075	115335260
15	12474	3617335	3835622	7544015	519732	68368	255708	87594391	9699447	504052	7450879	121102023
16	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0

Table A5.45
SES157 Discounted Cash Flow Analysis - Tax Rate 40%

PROJECT LIFE: 15 **PRICE:** 123000000 **DEBT RATIO:** 0.75 **LOAN YEARS:** 10 **INTEREST RATE:** 0.1

DECLINING BAL.: 0.2

TAX RATE: 0.4 **INFLATION RATE:** 0.05 **DISCOUNT RATE:** 0.175 **BASE REVENUE:** 79602785

SCRAP VALUE: 4327678

YEAR	CAPITAL	LOAN OUTSTANDING	LOAN REPAYMENTS	INTEREST PAYMENTS	RELIEF ON INTEREST	CAPITAL ALLOWANCE	RELIEF ON CAPITAL	ANNUAL REVENUE	OPERATING COSTS	GROSS SURPLUS	TAX	ANNUAL CASH FLOW	DISCOUNTED CASH FLOW
0	-30750000	0	0	0	0	0	0	0	0	0	0	-30750000	-30750000
1	0	92250000	9225000	9225000	3690000	24600000	0	79602785	61164751	-11966	1480786	1468821	1190533
2	0	83025000	9225000	8302500	3321000	19680000	9840000	83582924	64222988	1832436	-4531426	6363862	4180867
3	0	73800000	9225000	7380000	2952000	15744000	7872000	87762071	67434138	3722933	-2840427	6563360	3494980
4	0	64575000	9225000	6457500	2583000	12595200	6297600	92150174	70805845	5661829	1287508	6949338	2999403
5	0	55350000	9225000	5535000	2214000	10076160	5038080	96757683	74346137	7651546	159786	7491760	2620885
6	0	46125000	9225000	4612500	1845000	8060928	4030464	101595567	78063444	9694623	1527664	8166960	2315781
7	0	36900000	9225000	3690000	1476000	6448742	3224371	106675345	81966616	11793729	2837343	8956386	2058461
8	0	27675000	9225000	2767500	1107000	5158994	2579497	112009112	86064947	13951666	4106068	9845598	1834107
9	0	18450000	9225000	1845000	738000	4127195	2063598	117609568	90368194	16171374	5347911	10823463	1634262
10	0	9225000	9225000	922500	369000	3301756	1650878	123490047	94886604	18455943	6574426	11881517	1454120
11	0	0	0	0	0	2641405	1320702	129664549	99630934	30033615	11485165	18548450	1839962
12	0	0	0	0	0	2113124	1056562	136147776	104612481	31535296	12191494	19343802	1555306
13	0	0	0	0	0	1690499	845250	142955165	109843105	33112060	12906724	20205336	1316779
14	0	0	0	0	0	1352399	676200	150102923	115335260	34767664	13636586	21131078	1116198
15	4327678	0	0	0	0	1081919	540960	157608070	121102023	36506047	14386035	26447690	1132349
16	0	0	0	0	0	0	432768	0	0	0	-173107	173107	6007
17	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0
												NPV	1

REQUIRED FREIGHT RATE = ***246 £/tonne***

(with 80% load factor)

Table A5.46

SES157 Operating Costs - Tax Rate 40%

VESSEL DATA	
Length	157.6
Breadth	35
Draught	7.2
Payload	1804
Power	216333
No. Containers	200
Complement	29
Annual Op. Hours	6048
No. Trips per annum	224
Fuel Load per Trip	1254
Dieso per week	648

COSTHEAD	ESCALATION RATE
Registration	0
Manning	0
Insurance	0
R & M	0
Stores	0
Victualling	0
Administration	0
Fuel Oil	0
Diesel Oil	0
Port Dues	0
Cargo Handling	0

YEAR	REGISTRATION	MANNING	INSURANCE	R & M	STORES	VICTUALING	ADMINISTRATION	FUEL OIL	DIESEL OIL	PORT DUES	CARGO HANDLING	TOTAL OPERATING COSTS
0	6000	1740000	1845000	3628800	250000	32886	123000	42134400	4665600	242458	3584000	58252144
1	6300	1827000	1937250	3810240	262500	34530	129150	44241120	4898880	254580	3763200	61161751
2	6615	1918350	2034113	4000752	275625	36257	135608	46453176	5143824	267310	3951360	64222988
3	6946	2014268	2135818	4200790	289406	38070	142388	48775835	5401015	280675	4148928	67434138
4	7293	2114981	2242609	4410829	303877	39973	149507	51214627	5671066	294709	4356374	70805845
5	7658	2220730	2354739	4631371	319070	41972	156983	53775358	5954619	309444	4574193	74346137
6	8041	2331766	2472476	4862939	335024	44070	164832	56464126	6252350	324916	4802903	78063444
7	8443	2448355	2596100	5106086	351775	46274	173073	59287332	6564968	341162	5043048	81966616
8	8865	2570772	2725905	5361390	369364	48588	181727	62251699	6893216	358220	5295200	86064947
9	9308	2699311	2862201	5629460	387832	51017	190813	65364284	7237877	376131	5559960	90368194
10	9773	2834277	3005311	5910933	407224	53568	200354	68632498	7599771	394938	5837958	94886604
11	10262	2975990	3155576	6206479	427585	56246	210372	72064123	7979759	414685	6129856	99630934
12	10775	3124790	3313355	6516803	448964	59059	220890	75667329	8378747	435419	6436349	104612481
13	11314	3281030	3479023	6842644	471412	62011	231935	79450695	8797685	457190	6758167	109843105
14	11880	3445081	3652974	7184776	494983	65112	243532	83423230	9237569	480049	7096075	115335260
15	12474	3617335	3835622	7544015	519732	68368	255708	87594391	9699447	504052	7450879	121102023
16	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0

Table A5.47
SES157 Discounted Cash Flow Analysis - Tax Rate 45%

PROJECT LIFE: 15 | **PRICE:** 123000000 | **DEBT RATIO:** 0.75 | **LOAN YEARS:** 10 | **INTEREST RATE:** 0.1

DECLINING BAL.: 0.2

TAX RATE: 0.45 | **INFLATION RATE:** 0.05 | **DISCOUNT RATE:** 0.175 | **BASE REVENUE:** 79092341

SCRAP VALUE: 4327678

YEAR	CAPITAL	LOAN OUTSTANDING	LOAN REPAYMENTS	INTEREST PAYMENTS	RELIEF ON INTEREST	CAPITAL ALLOWANCE	RELIEF ON CAPITAL	ANNUAL REVENUE	OPERATING COSTS	GROSS SURPLUS	TAX	ANNUAL CASH FLOW	DISCOUNTED CASH FLOW
0	-30750000	0	0	0	0	0	0	0	0	0	0	30750000	-30750000
1	0	92250000	9225000	9225000	4151250	24600000	0	79092341	61164751	-522410	2103147	1580737	1281246
2	0	83025000	9225000	8302500	3736125	19680000	11070000	83046958	64222988	1296469	-6079345	7375814	4845690
3	0	73800000	9225000	7380000	3321000	15744000	8856000	87199306	67434138	3160168	-4057574	7217742	3843438
4	0	64575000	9225000	6457500	2905875	12595200	7084800	91559271	70805845	5070926	2213887	7284613	3144197
5	0	55350000	9225000	5535000	2490750	10076160	5667840	96137235	74346137	7031098	-507372	7538469	2637226
6	0	46125000	9225000	4612500	2075625	8060928	4534272	100944096	78063444	9043153	1094965	7948188	2253747
7	0	36900000	9225000	3690000	1660500	6448742	3627418	105991301	81966616	11109685	2619795	8489890	1951245
8	0	27675000	9225000	2767500	1245375	5158994	2901934	111290866	86064947	13233419	4088750	9144670	1703534
9	0	18450000	9225000	1845000	830250	4127195	2321547	116855409	90368194	15417215	5519438	9897777	1494491
10	0	9225000	9225000	922500	415125	3301756	1857238	122698180	94886604	17664076	6926271	10737805	1314147
11	0	0	0	0	0	2641405	1485790	128833089	99630934	29202155	12472364	16729791	1659555
12	0	0	0	0	0	2113124	1188632	135274743	104612481	30662263	13263134	17399129	1398948
13	0	0	0	0	0	1690499	950906	142038481	109843105	32195376	14060012	18135364	1181879
14	0	0	0	0	0	1352399	760725	149140405	115335260	33805145	14869989	18935156	1000204
15	4327678	0	0	0	0	1081919	608580	156597425	121102023	35495402	15699070	24124010	1032861
16	0	0	0	0	0	0	486864	0	0	0	-219089	219089	7603
17	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0
												NPV	11

REQUIRED FREIGHT RATE = 245 £/tonne

(with 80% load factor)

Table A5.48
SES157 Operating Costs - Tax Rate 45%

VESSEL DATA	
Length	157.6
Breadth	35
Draught	7.2
Payload	1804
Power	216333
No. Containers	200
Complement	29
Annual Op. Hours	6048
No. Trips per annum	224
Fuel Load per Trip	1254
Dieso per week	648

COSTHEAD	ESCALATION RATE
Registration	0
Manning	0
Insurance	0
R & M	0
Stores	0
Victualling	0
Administration	0
Fuel Oil	0
Diesel Oil	0
Port Dues	0
Cargo Handling	0

YEAR	REGISTRATION	MANNING	INSURANCE	R & M	STORES	VICTUALING	ADMINISTRATION	FUEL OIL	DIESEL OIL	PORT DUES	CARGO HANDLING	TOTAL OPERATING COSTS
0	6000	1740000	1845000	3628800	250000	32886	123000	42134400	4665600	242458	3584000	58252144
1	6300	1827000	1937250	3810240	262500	34530	129150	44241120	4898880	254580	3763200	61161751
2	6615	1918350	2034113	4000752	275625	36257	135608	46453176	5143824	267310	3951360	64222988
3	6946	2014268	2135818	4200790	289406	38070	142388	48775835	5401015	280675	4148928	67434138
4	7293	2114981	2242609	4410829	303877	39973	149507	51214627	5671066	294709	4356374	70805845
5	7658	2220730	2354739	4631371	319070	41972	156983	53775358	5954619	309444	4574193	74346137
6	8041	2331766	2472476	4862939	335024	44070	164832	56464126	6252350	324916	4802903	78063444
7	8443	2448355	2596100	5106086	351775	46274	173073	59287332	6564968	341162	5043048	81966616
8	8865	2570772	2725905	5361390	369364	48588	181727	62251699	6893216	358220	5295200	86064947
9	9308	2699311	2862201	5629460	387832	51017	190813	65364284	7237877	376131	5559960	90368194
10	9773	2834277	3005311	5910933	407224	53568	200354	68632498	7599771	394938	5837958	94886604
11	10262	2975990	3155576	6206479	427585	56246	210372	72064123	7979759	414685	6129856	99630934
12	10775	3124790	3313355	6516803	448964	59059	220890	75667329	8378747	435419	6436349	104612481
13	11314	3281030	3479023	6842644	471412	62011	231935	79450695	8797685	457190	6758167	109843105
14	11880	3445081	3652974	7184776	494983	65112	243532	83423230	9237569	480049	7096075	115335260
15	12474	3617335	3835622	7544015	519732	68368	255708	87594391	9699447	504052	7450879	121102023
16	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0

Table A5.49
SES157 Discounted Cash Flow Analysis - Fuel Escalation 2.5%

PROJECT LIFE: 15 | PRICE: 123000000 | DEBT RATIO: 0.75 | LOAN YEARS: 10 | INTEREST RATE: 0.1

DECLINING BAL.: 0.2

TAX RATE: 0.45 | INFLATION RATE: 0.05 | DISCOUNT RATE: 0.175 | BASE REVENUE: 86141694

SCRAP VALUE: 4327678

YEAR	CAPITAL	LOAN OUTSTANDING	LOAN REPAYMENTS	INTEREST PAYMENTS	RELIEF ON INTEREST	CAPITAL ALLOWANCE	RELIEF ON CAPITAL	ANNUAL REVENUE	OPERATING COSTS	GROSS SURPLUS	TAX	ANNUAL CASH FLOW	DISCOUNTED CASH FLOW
0	-30750000	0	0	0	0	0	0	0	0	0	0	-30750000	-30750000
1	0	92250000	9225000	9225000	4151250	24600000	0	86141694	62393251	5298443	516237	4782206	3876155
2	0	83025000	9225000	8302500	3736125	19680000	11070000	90448778	66835086	6086192	-3923970	10010162	6576378
3	0	73800000	9225000	7380000	3321000	15744000	8856000	94971217	71599830	6766388	-2434776	9201163	4899607
4	0	64575000	9225000	6457500	2905875	12595200	7084800	99719778	76711313	7325965	-1199119	8525085	3679510
5	0	55350000	9225000	5535000	2490750	10076160	5667840	104705767	82195146	7750621	-183586	7934207	2775669
6	0	46125000	9225000	4612500	2075625	8060928	4534272	109941055	88078852	8024703	636663	7388040	2094914
7	0	36900000	9225000	3690000	1660500	6448742	3627418	115438108	94392007	8131102	1279433	6851669	1574730
8	0	27675000	9225000	2767500	1245375	5158994	2901934	121210014	101166396	8051117	1756714	6294404	1172566
9	0	18450000	9225000	1845000	830250	4127195	2321547	127270514	108436183	7764331	2075640	5688691	858950
10	0	9225000	9225000	922500	415125	3301756	1857238	133634040	116238084	7248456	2239242	5009214	613053
11	0	0	0	0	0	2641405	1485790	140315742	124611561	15704181	6398276	9305905	923123
12	0	0	0	0	0	2113124	1188632	147331529	133599033	13732496	5644739	8087757	650283
13	0	0	0	0	0	1690499	950906	154698106	143246091	11452015	4725499	6726516	438366
14	0	0	0	0	0	1352399	760725	162433011	153601744	8831267	3631744	5199523	274652
15	4327678	0	0	0	0	1081919	608580	170554661	164718672	5835989	2352334	7811333	334440
16	0	0	0	0	0	0	486864	0	0	0	-219089	219089	7603
17	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0
												NPV	0

REQUIRED FREIGHT RATE = 266 £/tonne

(with 80% load factor)

Table A5.50

SES157 Operating Costs - Fuel Escalation 2.5%

VESSEL DATA		COSTHEAD	ESCALATION RATE
Length	157.6	Registration	0
Breadth	35	Manning	0
Draught	7.2	Insurance	0
Payload	1804	R & M	0
Power	216333	Stores	0
No. Containers	200	Victualling	0
Complement	29	Administration	0
Annual Op. Hours	6048	Fuel Oil	0.025
No. Trips per annum	224	Diesel Oil	0.025
Fuel Load per Trip	1254	Port Dues	0
Dieso per week	648	Cargo Handling	0

YEAR	REGISTRATION	MANNING	INSURANCE	R & M	STORES	VICTUALING	ADMINISTRATION	FUEL OIL	DIESEL OIL	PORT DUES	CARGO HANDLING	TOTAL OPERATING COSTS
0	6000	1740000	1845000	3628800	250000	32886	123000	42134400	4665600	242458	3584000	58252144
1	6300	1827000	1937250	3810240	262500	34530	129150	45347148	5021352	254580	3763200	62393251
2	6615	1918350	2034113	4000752	275625	36257	135608	48804868	5404230	267310	3951360	66835086
3	6946	2014268	2135818	4200790	289406	38070	142388	52526239	5816303	280675	4148928	71599830
4	7293	2114981	2242609	4410829	303877	39973	149507	56531365	6259796	294709	4356374	76711313
5	7658	2220730	2354739	4631371	319070	41972	156983	60841882	6737105	309444	4574193	82195146
6	8041	2331766	2472476	4862939	335024	44070	164832	65481075	7250809	324916	4802903	88078852
7	8443	2448355	2596100	5106086	351775	46274	173073	70474007	7803684	341162	5043048	94392007
8	8865	2570772	2725905	5361390	369364	48588	181727	75847650	8398714	358220	5295200	101166396
9	9308	2699311	2862201	5629460	387832	51017	190813	81631033	9039116	376131	5559960	108436183
10	9773	2834277	3005311	5910933	407224	53568	200354	87855400	9728349	394938	5837958	116238084
11	10262	2975990	3155576	6206479	427585	56246	210372	94554374	10470136	414685	6129856	124611561
12	10775	3124790	3313355	6516803	448964	59059	220890	101764145	11268484	435419	6436349	133599033
13	11314	3281030	3479023	6842644	471412	62011	231935	109523661	12127705	457190	6758167	143246091
14	11880	3445081	3652974	7184776	494983	65112	243532	117874840	13052443	480049	7096075	153601744
15	12474	3617335	3835622	7544015	519732	68368	255708	126862797	14047692	504052	7450879	164718672
16	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0

Table A5.51

SES157 Discounted Cash Flow Analysis - Fuel Escalation 5%

PROJECT LIFE: 15 | **PRICE: 123000000** | **DEBT RATIO: 0.75** | **LOAN YEARS: 10** | **INTEREST RATE: 0.1**

DECLINING BAL.: 0.2

TAX RATE: 0.45 | **INFLATION RATE: 0.05** | **DISCOUNT RATE: 0.175** | **BASE REVENUE: 94573257**

SCRAP VALUE: 4327678

YEAR	CAPITAL	LOAN OUTSTANDING	LOAN REPAYMENTS	INTEREST PAYMENTS	RELIEF ON INTEREST	CAPITAL ALLOWANCE	RELIEF ON CAPITAL	ANNUAL REVENUE	OPERATING COSTS	GROSS SURPLUS	TAX	ANNUAL CASH FLOW	DISCOUNTED CASH FLOW
0	-30750000	0	0	0	0	0	0	0	0	0	0	-30750000	-30750000
1	0	92250000	9225000	9225000	4151250	24600000	0	94573257	63621751	12501507	3757615	8743891	7087247
2	0	83025000	9225000	8302500	3736125	19680000	11070000	99301920	69511681	12262739	-1144524	13407263	8808172
3	0	73800000	9225000	7380000	3321000	15744000	8856000	104267016	75973764	11688252	-219936	11908189	6341094
4	0	64575000	9225000	6457500	2905875	12595200	7084800	109480367	83065067	10732800	333956	10398844	4488243
5	0	55350000	9225000	5535000	2490750	10076160	5667840	114954385	90848428	9345957	534315	8811642	3082627
6	0	46125000	9225000	4612500	2075625	8060928	4534272	120702105	99393044	7471561	387749	7083812	2008649
7	0	36900000	9225000	3690000	1660500	6448742	3627418	126737210	108775115	5047095	-108370	5155465	1184889
8	0	27675000	9225000	2767500	1245375	5158994	2901934	133074070	119078563	2003008	-964936	2967943	552889
9	0	18450000	9225000	1845000	830250	4127195	2321547	139727774	130395814	-1738040	-2200427	462387	69817
10	0	9225000	9225000	922500	415125	3301756	1857238	146714163	142828668	-6262005	-3840466	-2421540	-296360
11	0	0	0	0	0	2641405	1485790	154049871	156489254	-2439383	-1766328	-673055	-66765
12	0	0	0	0	0	2113124	1188632	161752364	171501082	-9748718	-4921807	-4826910	-388100
13	0	0	0	0	0	1690499	950906	169839982	188000207	-18160224	-8600008	-9560216	-623038
14	0	0	0	0	0	1352399	760725	178331982	206136505	-27804523	-12854361	-14950162	-789706
15	4327678	0	0	0	0	1081919	608580	187248581	226075087	-38826507	-17745789	-16753040	-717276
16	0	0	0	0	0	0	486864	0	0	0	-219089	219089	7603
17	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0
												NPV	-14

REQUIRED FREIGHT RATE = 293 £/tonne

(with 80% load factor)

Table A5.52

SES157 Operating Costs - Fuel Escalation 5%

VESSEL DATA		COSTHEAD	ESCALATION RATE
Length	157.6	Registration	0
Breadth	35	Manning	0
Draught	7.2	Insurance	0
Payload	1804	R & M	0
Power	216333	Stores	0
No. Containers	200	Victualling	0
Complement	29	Administration	0
Annual Op. Hours	6048	Fuel Oil	0.05
No. Trips per annum	224	Diesel Oil	0.05
Fuel Load per Trip	1254	Port Dues	0
Dieso per week	648	Cargo Handling	0

YEAR	REGISTRATION	MANNING	INSURANCE	R & M	STORES	VICTUALING	ADMINISTRATION	FUEL OIL	DIESEL OIL	PORT DUES	CARGO HANDLING	TOTAL OPERATING COSTS
0	6000	1740000	1845000	3628800	250000	32886	123000	42134400	4665600	242458	3584000	58252144
1	6300	1827000	1937250	3810240	262500	34530	129150	46453176	5143824	254580	3763200	63621751
2	6615	1918350	2034113	4000752	275625	36257	135608	51214627	5671066	267310	3951360	69511681
3	6946	2014268	2135818	4200790	289406	38070	142388	56464126	6252350	280675	4148928	75973764
4	7293	2114981	2242609	4410829	303877	39973	149507	62251699	6893216	294709	4356374	83065067
5	7658	2220730	2354739	4631371	319070	41972	156983	68632498	7599771	309444	4574193	90848428
6	8041	2331766	2472476	4862939	335024	44070	164832	75667329	8378747	324916	4802903	99393044
7	8443	2448355	2596100	5106086	351775	46274	173073	83423230	9237569	341162	5043048	108775115
8	8865	2570772	2725905	5361390	369364	48588	181727	91974111	10184420	358220	5295200	119078563
9	9308	2699311	2862201	5629460	387832	51017	190813	101401457	11228323	376131	5559960	130395814
10	9773	2834277	3005311	5910933	407224	53568	200354	111795107	12379226	394938	5837958	142828668
11	10262	2975990	3155576	6206479	427585	56246	210372	123254105	13648096	414685	6129856	156489254
12	10775	3124790	3313355	6516803	448964	59059	220890	135887651	15047026	435419	6436349	171501082
13	11314	3281030	3479023	6842644	471412	62011	231935	149816135	16589346	457190	6758167	188000207
14	11880	3445081	3652974	7184776	494983	65112	243532	165172289	18289755	480049	7096075	206136505
15	12474	3617335	3835622	7544015	519732	68368	255708	182102449	20164454	504052	7450879	226075087
16	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0

Table A5.53
SES157 Discounted Cash Flow Analysis - Fuel Escalation 7.5%

PROJECT LIFE: 15 | PRICE: 123000000 | DEBT RATIO: 0.75 | LOAN YEARS: 10 | INTEREST RATE: 0.1

DECLINING BAL.: 0.2

TAX RATE: 0.45 | INFLATION RATE: 0.05 | DISCOUNT RATE: 0.175 | BASE REVENUE: 104703740

SCRAP VALUE: 4327678

YEAR	CAPITAL	LOAN OUTSTANDING	LOAN REPAYMENTS	INTEREST PAYMENTS	RELIEF ON INTEREST	CAPITAL ALLOWANCE	RELIEF ON CAPITAL	ANNUAL REVENUE	OPERATING COSTS	GROSS SURPLUS	TAX	ANNUAL CASH FLOW	DISCOUNTED CASH FLOW
0	-30750000	0	0	0	0	0	0	0	0	0	0	-30750000	-30750000
1	0	92250000	9225000	9225000	4151250	24600000	0	104703740	64850251	21403490	7763508	13639982	11055710
2	0	83025000	9225000	8302500	3736125	19680000	11070000	109938927	72252771	20158656	2408639	17750017	11661232
3	0	73800000	9225000	7380000	3321000	15744000	8856000	115435874	80561019	18269855	2741785	15528070	8268676
4	0	64575000	9225000	6457500	2905875	12595200	7084800	121207668	89889239	15635929	2540364	13095564	5652174
5	0	55350000	9225000	5535000	2490750	10076160	5667840	127268051	100366267	12141784	1792437	10349347	3620571
6	0	46125000	9225000	4612500	2075625	8060928	4534272	133631453	112137401	7656553	470995	7185558	2037499
7	0	36900000	9225000	3690000	1660500	6448742	3627418	140313026	125366517	2031509	-1465384	3496893	803697
8	0	27675000	9225000	2767500	1245375	5158994	2901934	147328677	140238454	-4902277	-4072314	-829963	-154611
9	0	18450000	9225000	1845000	830250	4127195	2321547	154695111	156961703	-13336591	-7419775	-5916816	-893395
10	0	9225000	9225000	922500	415125	3301756	1857238	162429867	175771447	-23489080	-11592649	-11896431	-1455945
11	0	0	0	0	0	2641405	1485790	170551360	196932992	-26381631	-12540340	-13841292	-1373023
12	0	0	0	0	0	2113124	1188632	179078928	220745634	-41666706	-19284902	-22381804	-1799571
13	0	0	0	0	0	1690499	950906	188032875	247547030	-59514155	-27209277	-32304878	-2105305
14	0	0	0	0	0	1352399	760725	197434518	277718125	-80283607	-36469949	-43813658	-2314351
15	4327678	0	0	0	0	1081919	608580	207306244	311688720	-104382476	-47245975	-52808823	-2260992
16	0	0	0	0	0	0	486864	0	0	0	-219089	219089	7603
17	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0
												NPV	-30

REQUIRED FREIGHT RATE = 324 £/tonne

(with 80% load factor)

Table A5.54
SES157 Operating Costs - Fuel Escalation 7.5%

VESSEL DATA		COSTHEAD	ESCALATION RATE
Length	157.6	Registration	0
Breadth	35	Manning	0
Draught	7.2	Insurance	0
Payload	1804	R & M	0
Power	216333	Stores	0
No. Containers	200	Victualling	0
Complement	29	Administration	0
Annual Op. Hours	6048	Fuel Oil	0.075
No. Trips per annum	224	Diesel Oil	0.075
Fuel Load per Trip	1254	Port Dues	0
Dieso per week	648	Cargo Handling	0

YEAR	REGISTRATION	MANNING	INSURANCE	R & M	STORES	VICTUALING	ADMINISTRATION	FUEL OIL	DIESEL OIL	PORT DUES	CARGO HANDLING	TOTAL OPERATING COSTS
0	6000	1740000	1845000	3628800	250000	32886	123000	42134400	4665600	242458	3584000	58252144
1	6300	1827000	1937250	3810240	262500	34530	129150	47559204	5266296	254580	3763200	64850251
2	6615	1918350	2034113	4000752	275625	36257	135608	53682452	5944332	267310	3951360	72252771
3	6946	2014268	2135818	4200790	289406	38070	142388	60594067	6709664	280675	4148928	80561019
4	7293	2114981	2242609	4410829	303877	39973	149507	68395553	7573534	294709	4356374	89889239
5	7658	2220730	2354739	4631371	319070	41972	156983	77201481	8548626	309444	4574193	100366267
6	8041	2331766	2472476	4862939	335024	44070	164832	87141171	9649262	324916	4802903	112137401
7	8443	2448355	2596100	5106086	351775	46274	173073	98360597	10891604	341162	5043048	125366517
8	8865	2570772	2725905	5361390	369364	48588	181727	111024524	12293898	358220	5295200	140238454
9	9308	2699311	2862201	5629460	387832	51017	190813	125318932	13876737	376131	5559960	156961703
10	9773	2834277	3005311	5910933	407224	53568	200354	141453744	15663367	394938	5837958	175771447
11	10262	2975990	3155576	6206479	427585	56246	210372	159665914	17680026	414685	6129856	196932992
12	10775	3124790	3313355	6516803	448964	59059	220890	180222900	19956329	435419	6436349	220745634
13	11314	3281030	3479023	6842644	471412	62011	231935	203426598	22525707	457190	6758167	247547030
14	11880	3445081	3652974	7184776	494983	65112	243532	229617773	25425891	480049	7096075	277718125
15	12474	3617335	3835622	7544015	519732	68368	255708	259181061	28699475	504052	7450879	311688720
16	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0

Table A5.55

SES157 Discounted Cash Flow Analysis - Fuel Escalation 10%

PROJECT LIFE: 15 PRICE: 123000000 DEBT RATIO: 0.75 LOAN YEARS: 10 INTEREST RATE: 0.1

DECLINING BAL.: 0.2

TAX RATE: 0.45 INFLATION RATE: 0.05 DISCOUNT RATE: 0.175 BASE REVENUE: 116924557

SCRAP VALUE: 4327678

YEAR	CAPITAL	LOAN OUTSTANDING	LOAN REPAYMENTS	INTEREST PAYMENTS	RELIEF ON INTEREST	CAPITAL ALLOWANCE	RELIEF ON CAPITAL	ANNUAL REVENUE	OPERATING COSTS	GROSS SURPLUS	TAX	ANNUAL CASH FLOW	DISCOUNTED CASH FLOW
0	-30750000	0	0	0	0	0	0	0	0	0	0	-30750000	-30750000
1	0	92250000	9225000	9225000	4151250	24600000	0	116924557	66078751	32395806	12710050	19685756	15956033
2	0	83025000	9225000	8302500	3736125	19680000	11070000	122770785	75058358	30184926	6920461	23264466	15284061
3	0	73800000	9225000	7380000	3321000	15744000	8856000	128909324	85366675	26937649	6642292	20295357	10807250
4	0	64575000	9225000	6457500	2905875	12595200	7084800	135354790	97206495	22465796	5613804	16851991	7273485
5	0	55350000	9225000	5535000	2490750	10076160	5667840	142122530	110811885	16550645	3776425	12774220	4468879
6	0	46125000	9225000	4612500	2075625	8060928	4534272	149228656	126453031	8938126	1047703	7890423	2237367
7	0	36900000	9225000	3690000	1660500	6448742	3627418	156690089	144441819	-666730	-2679591	2012862	462619
8	0	27675000	9225000	2767500	1245375	5158994	2901934	164524593	165138297	-12606204	-7539081	-5067123	-943939
9	0	18450000	9225000	1845000	830250	4127195	2321547	172750823	188958130	-27277307	-13693097	-13584210	-2051114
10	0	9225000	9225000	922500	415125	3301756	1857238	181388364	216381207	-45140343	-21335717	-23804625	-2913330
11	0	0	0	0	0	2641405	1485790	190457782	247961589	-57503806	-26545318	-30958488	-3071008
12	0	0	0	0	0	2113124	1188632	199980672	284338995	-84358323	-38496130	-45862193	-3687473
13	0	0	0	0	0	1690499	950906	209979705	326252066	-116272361	-52750470	-63521891	-4139713
14	0	0	0	0	0	1352399	760725	220478690	374553690	-154075000	-69676076	-84398924	-4458170
15	4327678	0	0	0	0	1081919	608580	231502625	430228694	-198726069	-89700592	-104697799	-4482601
16	0	0	0	0	0	0	486864	0	0	0	-219089	219089	7603
17	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0
												NPV	-51

REQUIRED FREIGHT RATE = 362 £/tonne

(with 80% load factor)

Table A5.56
SES157 Operating Costs - Fuel Escalation 10%

VESSEL DATA		COSTHEAD	ESCALATION RATE
Length	157.6	Registration	0
Breadth	35	Manning	0
Draught	7.2	Insurance	0
Payload	1804	R & M	0
Power	216333	Stores	0
No. Containers	200	Victualling	0
Complement	29	Administration	0
Annual Op. Hours	6048	Fuel Oil	0.1
No. Trips per annum	224	Diesel Oil	0.1
Fuel Load per Trip	1254	Port Dues	0
Dieso per week	648	Cargo Handling	0

YEAR	REGISTRATION	MANNING	INSURANCE	R & M	STORES	VICTUALING	ADMINISTRATION	FUEL OIL	DIESEL OIL	PORT DUES	CARGO HANDLING	TOTAL OPERATING COSTS
0	6000	1740000	1845000	3628800	250000	32886	123000	42134400	4665600	242458	3584000	58252144
1	6300	1827000	1937250	3810240	262500	34530	129150	48665232	5388768	254580	3763200	66078751
2	6615	1918350	2034113	4000752	275625	36257	135608	56208343	6224027	267310	3951360	75058358
3	6946	2014268	2135818	4200790	289406	38070	142388	64920636	7188751	280675	4148928	85366675
4	7293	2114981	2242609	4410829	303877	39973	149507	74983335	8303008	294709	4356374	97206495
5	7658	2220730	2354739	4631371	319070	41972	156983	86605752	9589974	309444	4574193	110811885
6	8041	2331766	2472476	4862939	335024	44070	164832	100029643	11076420	324916	4802903	126453031
7	8443	2448355	2596100	5106086	351775	46274	173073	115534238	12793265	341162	5043048	144441819
8	8865	2570772	2725905	5361390	369364	48588	181727	133442045	14776221	358220	5295200	165138297
9	9308	2699311	2862201	5629460	387832	51017	190813	154125562	17066535	376131	5559960	188958130
10	9773	2834277	3005311	5910933	407224	53568	200354	178015024	19711848	394938	5837958	216381207
11	10262	2975990	3155576	6206479	427585	56246	210372	205607352	22767185	414685	6129856	247961589
12	10775	3124790	3313355	6516803	448964	59059	220890	237476492	26296098	435419	6436349	284338995
13	11314	3281030	3479023	6842644	471412	62011	231935	274285348	30371993	457190	6758167	326252066
14	11880	3445081	3652974	7184776	494983	65112	243532	316799577	35079652	480049	7096075	374553690
15	12474	3617335	3835622	7544015	519732	68368	255708	365903511	40516999	504052	7450879	430228694
16	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0

Table A5.57
SES157 Discounted Cash Flow Analysis - R&M Escalation 2.5%

PROJECT LIFE: 15 PRICE: 123000000 DEBT RATIO: 0.75 LOAN YEARS: 10 INTEREST RATE: 0.1

DECLINING BAL.: 0.2

TAX RATE: 0.45 INFLATION RATE: 0.05 DISCOUNT RATE: 0.175 BASE REVENUE: 79638937

SCRAP VALUE: 4327678

YEAR	CAPITAL	LOAN OUTSTANDING	LOAN REPAYMENTS	INTEREST PAYMENTS	RELIEF ON INTEREST	CAPITAL ALLOWANCE	RELIEF ON CAPITAL	ANNUAL REVENUE	OPERATING COSTS	GROSS SURPLUS	TAX	ANNUAL CASH FLOW	DISCOUNTED CASH FLOW
0	-30750000	0	0	0	0	0	0	0	0	0	0	-30750000	-30750000
1	0	92250000	9225000	9225000	4151250	24600000	0	79638937	61260007	-71070	-1900044	1828974	1482451
2	0	83025000	9225000	8302500	3736125	19680000	11070000	83620884	64425526	1667857	-5912221	7580078	4979885
3	0	73800000	9225000	7380000	3321000	15744000	8856000	87801928	67757139	3439789	-3931745	7371534	3925332
4	0	64575000	9225000	6457500	2905875	12595200	7084800	92192024	71263746	5245779	-2135203	7380982	3185704
5	0	55350000	9225000	5535000	2490750	10076160	5667840	96801625	74954737	7086888	-482266	7569154	2647961
6	0	46125000	9225000	4612500	2075625	8060928	4534272	101641707	78840023	8964184	1059429	7904755	2241431
7	0	36900000	9225000	3690000	1660500	6448742	3627418	106723792	82930062	10878730	2515866	8362865	1922051
8	0	27675000	9225000	2767500	1245375	5158994	2901934	112059982	87235890	12831592	3907927	8923665	1662363
9	0	18450000	9225000	1845000	830250	4127195	2321547	117662981	91769158	14823823	5252411	9571411	1445212
10	0	9225000	9225000	922500	415125	3301756	1857238	123546130	96542165	16856465	6562846	10293619	1259785
11	0	0	0	0	0	2641405	1485790	129723436	101567893	28155543	12001389	16154154	1602453
12	0	0	0	0	0	2113124	1188632	136209608	106860053	29349555	12672415	16677140	1340897
13	0	0	0	0	0	1690499	950906	143020088	112433121	30586968	13336228	17250740	1124228
14	0	0	0	0	0	1352399	760725	150171093	118302384	31868709	13998593	17870116	943946
15	4327678	0	0	0	0	1081919	608580	157679647	124483991	33195657	14664185	22859150	978707
16	0	0	0	0	0	0	486864	0	0	0	-219089	219089	7603
17	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0
												NPV	10

REQUIRED FREIGHT RATE = 246 £/tonne

(with 80% load factor)

Table A5.58
SES157 Operating Costs - R&M 2.5%

VESSEL DATA		COSTHEAD	ESCALATION RATE
Length	157.6	Registration	0
Breadth	35	Manning	0
Draught	7.2	Insurance	0
Payload	1804	R & M	0.025
Power	216333	Stores	0
No. Containers	200	Victualling	0
Complement	29	Administration	0
Annual Op. Hours	6048	Fuel Oil	0
No. Trips per annum	224	Diesel Oil	0
Fuel Load per Trip	1254	Port Dues	0
Dieso per week	648	Cargo Handling	0

YEAR	REGISTRATION	MANNING	INSURANCE	R & M	STORES	VICTUALING	ADMINISTRATION	FUEL OIL	DIESEL OIL	PORT DUES	CARGO HANDLING	TOTAL OPERATING COSTS
0	6000	1740000	1845000	3628800	250000	32886	123000	42134400	4665600	242458	3584000	58252144
1	6300	1827000	1937250	3905496	262500	34530	129150	44241120	4898880	254580	3763200	61260007
2	6615	1918350	2034113	4203290	275625	36257	135608	46453176	5143824	267310	3951360	64425526
3	6946	2014268	2135818	4523791	289406	38070	142388	48775835	5401015	280675	4148928	67757139
4	7293	2114981	2242609	4868730	303877	39973	149507	51214627	5671066	294709	4356374	71263746
5	7658	2220730	2354739	5239971	319070	41972	156983	53775358	5954619	309444	4574193	74954737
6	8041	2331766	2472476	5639518	335024	44070	164832	56464126	6252350	324916	4802903	78840023
7	8443	2448355	2596100	6069532	351775	46274	173073	59287332	6564968	341162	5043048	82930062
8	8865	2570772	2725905	6532333	369364	48588	181727	62251699	6893216	358220	5295200	87235890
9	9308	2699311	2862201	7030424	387832	51017	190813	65364284	7237877	376131	5559960	91769158
10	9773	2834277	3005311	7566494	407224	53568	200354	68632498	7599771	394938	5837958	96542165
11	10262	2975990	3155576	8143439	427585	56246	210372	72064123	7979759	414685	6129856	101567893
12	10775	3124790	3313355	8764376	448964	59059	220890	75667329	8378747	435419	6436349	106860053
13	11314	3281030	3479023	9432660	471412	62011	231935	79450695	8797685	457190	6758167	112433121
14	11880	3445081	3652974	10151900	494983	65112	243532	83423230	9237569	480049	7096075	118302384
15	12474	3617335	3835622	10925982	519732	68368	255708	87594391	9699447	504052	7450879	124483991
16	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0

Table A5.59
SES157 Discounted Cash Flow Analysis - R&M Escalation 5%

PROJECT LIFE: 15 | PRICE: 123000000 | DEBT RATIO: 0.75 | LOAN YEARS: 10 | INTEREST RATE: 0.1

DECLINING BAL.: 0.2

TAX RATE: 0.45 | INFLATION RATE: 0.05 | DISCOUNT RATE: 0.175 | BASE REVENUE: 80292707

SCRAP VALUE: 4327678

YEAR	CAPITAL	LOAN OUTSTANDING	LOAN REPAYMENTS	INTEREST PAYMENTS	RELIEF ON INTEREST	CAPITAL ALLOWANCE	RELIEF ON CAPITAL	ANNUAL REVENUE	OPERATING COSTS	GROSS SURPLUS	TAX	ANNUAL CASH FLOW	DISCOUNTED CASH FLOW
0	-30750000	0	0	0	0	0	0	0	0	0	0	-30750000	-30750000
1	0	92250000	9225000	9225000	4151250	24600000	0	80292707	61355263	487444	-1648713	2136157	1731434
2	0	83025000	9225000	8302500	3736125	19680000	11070000	84307343	64633065	2146777	-5696707	7843484	5152935
3	0	73800000	9225000	7380000	3321000	15744000	8856000	88522710	68096287	3821423	-3760010	7581432	4037102
4	0	64575000	9225000	6457500	2905875	12595200	7084800	92948845	71756406	5509939	-2016331	7526270	3248412
5	0	55350000	9225000	5535000	2490750	10076160	5667840	97596287	75625699	7210588	-426601	7637189	2671762
6	0	46125000	9225000	4612500	2075625	8060928	4534272	102476102	79717308	8921294	1040129	7881165	2234742
7	0	36900000	9225000	3690000	1660500	6448742	3627418	107599907	84045306	10639601	2408258	8231344	1891823
8	0	27675000	9225000	2767500	1245375	5158994	2901934	112979902	88624772	12362631	3696895	8665736	1614314
9	0	18450000	9225000	1845000	830250	4127195	2321547	118628897	93471874	14087023	4920852	9166172	1384024
10	0	9225000	9225000	922500	415125	3301756	1857238	124560342	98603958	15808885	6091435	9717450	1189271
11	0	0	0	0	0	2641405	1485790	130788359	104039641	26748719	11368318	15380401	1525699
12	0	0	0	0	0	2113124	1188632	137327777	109798920	27528857	11853101	15675756	1260383
13	0	0	0	0	0	1690499	950906	144194166	115903286	28290880	12302988	15987892	1041929
14	0	0	0	0	0	1352399	760725	151403875	122375849	29028026	12720286	16307740	861417
15	.4327678	0	0	0	0	1081919	608580	158974068	129241473	29732595	13105807	20954466	897158
16	0	0	0	0	0	0	486864	0	0	0	-219089	219089	7603
17	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0
												NPV	9

REQUIRED FREIGHT RATE = 248 £/tonne

(with 80% load factor)

Table A5.60
SES157 Operating Costs - R&M 5%

VESSEL DATA	
Length	157.6
Breadth	35
Draught	7.2
Payload	1804
Power	216333
No. Containers	200
Complement	29
Annual Op. Hours	6048
No. Trips per annum	224
Fuel Load per Trip	1254
Dieso per week	648

COSTHEAD	ESCALATION RATE
Registration	0
Manning	0
Insurance	0
R & M	0.05
Stores	0
Victualling	0
Administration	0
Fuel Oil	0
Diesel Oil	0
Port Dues	0
Cargo Handling	0

YEAR	REGISTRATION	MANNING	INSURANCE	R & M	STORES	VICTUALING	ADMINISTRATION	FUEL OIL	DIESEL OIL	PORT DUES	CARGO HANDLING	TOTAL OPERATING COSTS
0	6000	1740000	1845000	3628800	250000	32886	123000	42134400	4665600	242458	3584000	58252144
1	6300	1827000	1937250	4000752	262500	34530	129150	44241120	4898880	254580	3763200	61355263
2	6615	1918350	2034113	4410829	275625	36257	135608	46453176	5143824	267310	3951360	64633065
3	6946	2014268	2135818	4862939	289406	38070	142388	48775835	5401015	280675	4148928	68096287
4	7293	2114981	2242609	5361390	303877	39973	149507	51214627	5671066	294709	4356374	71756406
5	7658	2220730	2354739	5910933	319070	41972	156983	53775358	5954619	309444	4574193	75625699
6	8041	2331766	2472476	6516803	335024	44070	164832	56464126	6252350	324916	4802903	79717308
7	8443	2448355	2596100	7184776	351775	46274	173073	59287332	6564968	341162	5043048	84045306
8	8865	2570772	2725905	7921215	369364	48588	181727	62251699	6893216	358220	5295200	88624772
9	9308	2699311	2862201	8733140	387832	51017	190813	65364284	7237877	376131	5559960	93471874
10	9773	2834277	3005311	9628287	407224	53568	200354	68632498	7599771	394938	5837958	98603958
11	10262	2975990	3155576	10615186	427585	56246	210372	72064123	7979759	414685	6129856	104039641
12	10775	3124790	3313355	11703243	448964	59059	220890	75667329	8378747	435419	6436349	109798920
13	11314	3281030	3479023	12902825	471412	62011	231935	79150695	8797685	457190	6758167	115903286
14	11880	3445081	3652974	14225365	494983	65112	243532	83423230	9237569	480049	7096075	122375849
15	12474	3617335	3835622	15683464	519732	68368	255708	87594391	9699447	504052	7450879	129241473
16	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0

Table A5.61

SES157 Discounted Cash Flow Analysis - R&M Escalation 7.5%

PROJECT LIFE: 15 PRICE: 123000000 DEBT RATIO: 0.75 LOAN YEARS: 10 INTEREST RATE: 0.1

DECLINING BAL.: 0.2

TAX RATE: 0.45 INFLATION RATE: 0.05 DISCOUNT RATE: 0.175 BASE REVENUE: 81078209

SCRAP VALUE: 4327678

YEAR	CAPITAL	LOAN OUTSTANDING	LOAN REPAYMENTS	INTEREST PAYMENTS	RELIEF ON INTEREST	CAPITAL ALLOWANCE	RELIEF ON CAPITAL	ANNUAL REVENUE	OPERATING COSTS	GROSS SURPLUS	TAX	ANNUAL CASH FLOW	DISCOUNTED CASH FLOW
0	-30750000	0	0	0	0	0	0	0	0	0	0	-30750000	-30750000
1	0	92250000	9225000	9225000	4151250	24600000	0	81078209	61450519	1177691	-1338102	2515792	2039143
2	0	83025000	9225000	8302500	3736125	19680000	11070000	85132120	64845605	2759014	-5421200	8180214	5374157
3	0	73800000	9225000	7380000	3321000	15744000	8856000	89388726	68451976	4331750	-3530363	7862112	4186564
4	0	64575000	9225000	6457500	2905875	12595200	7084800	93858162	72285542	5890120	-1845250	7735370	3338662
5	0	55350000	9225000	5535000	2490750	10076160	5667840	98551070	76363698	7427372	-329048	7756420	2713473
6	0	46125000	9225000	4612500	2075625	8060928	4534272	103478624	80705486	8935638	1046583	7889054	2236979
7	0	36900000	9225000	3690000	1660500	6448742	3627418	108652555	85331777	10405777	2303037	8102740	1862266
8	0	27675000	9225000	2767500	1245375	5158994	2901934	114085183	90265477	11827205	3455953	8371252	1559456
9	0	18450000	9225000	1845000	830250	4127195	2321547	119789442	95531752	13187689	4516151	8671538	1309338
10	0	9225000	9225000	922500	415125	3301756	1857238	125778914	101158290	14473124	5490342	8982781	1099358
11	0	0	0	0	0	2641405	1485790	132067859	107175586	24892274	10532918	14359356	1424414
12	0	0	0	0	0	2113124	1188632	138671252	113617267	25053986	10739409	14314577	1150940
13	0	0	0	0	0	1690499	950906	145604815	120520455	25084360	10860054	14224306	926996
14	0	0	0	0	0	1352399	760725	152885056	127926177	24958878	10889169	14069709	743198
15	4327678	0	0	0	0	1081919	608580	160529309	135879822	24649486	10818408	18158756	777461
16	0	0	0	0	0	0	486864	0	0	0	-219089	219089	7603
17	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0
												NPV	8

REQUIRED FREIGHT RATE = 251 £/tonne

(with 80% load factor)

Table A5.62

SES157 Operating Costs - R&M 7.5%

VESSEL DATA		COSTHEAD	ESCALATION RATE
Length	157.6	Registration	0
Breadth	35	Manning	0
Draught	7.2	Insurance	0
Payload	1804	R & M	0.075
Power	216333	Stores	0
No. Containers	200	Victualling	0
Complement	29	Administration	0
Annual Op. Hours	6048	Fuel Oil	0
No. Trips per annum	224	Diesel Oil	0
Fuel Load per Trip	1254	Port Dues	0
Dieso per week	648	Cargo Handling	0

YEAR	REGISTRATION	MANNING	INSURANCE	R & M	STORES	VICTUALING	ADMINISTRATION	FUEL OIL	DIESEL OIL	PORT DUES	CARGO HANDLING	TOTAL OPERATING COSTS
0	6000	1740000	1845000	3628800	250000	32886	123000	42134400	4665600	242458	3584000	58252144
1	6300	1827000	1937250	4096008	262500	34530	129150	44241120	4898880	254580	3763200	61450519
2	6615	1918350	2034113	4623369	275625	36257	135608	46453176	5143824	267310	3951360	64845605
3	6946	2014268	2135818	5218628	289406	38070	142388	48775835	5401015	280675	4148928	68451976
4	7293	2114981	2242609	5890526	303877	39973	149507	51214627	5671066	294709	4356374	72285542
5	7658	2220730	2354739	6648931	319070	41972	156983	53775358	5954619	309444	4574193	76363698
6	8041	2331766	2472476	7504981	335024	44070	164832	56464126	6252350	324916	4802903	80705486
7	8443	2448355	2596100	8471248	351775	46274	173073	59287332	6564968	341162	5043048	85331777
8	8865	2570772	2725905	9561921	369364	48588	181727	62251699	6893216	358220	5295200	90265477
9	9308	2699311	2862201	10793018	387832	51017	190813	65364284	7237877	376131	5559960	95531752
10	9773	2834277	3005311	12182619	407224	53568	200354	68632498	7599771	394938	5837958	101158290
11	10262	2975990	3155576	13751131	427585	56246	210372	72064123	7979759	414685	6129856	107175586
12	10775	3124790	3313355	15521589	448964	59059	220890	75667329	8378747	435419	6436349	113617267
13	11314	3281030	3479023	17519994	471412	62011	231935	79450695	8797685	457190	6758167	120520455
14	11880	3445081	3652974	19775693	494983	65112	243532	83423230	9237569	480049	7096075	127926177
15	12474	3617335	3835622	22321814	519732	68368	255708	87594391	9699447	504052	7450879	135879822
16	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0

Table A5.63

SES157 Discounted Cash Flow Analysis - R&M Escalation 10%

PROJECT LIFE: 15 PRICE: 123000000 DEBT RATIO: 0.75 LOAN YEARS: 10 INTEREST RATE: 0.1

DECLINING BAL.: 0.2

TAX RATE: 0.45 INFLATION RATE: 0.05 DISCOUNT RATE: 0.175 BASE REVENUE: 82025793

SCRAP VALUE: 4327678

YEAR	CAPITAL	LOAN OUTSTANDING	LOAN REPAYMENTS	INTEREST PAYMENTS	RELIEF ON INTEREST	CAPITAL ALLOWANCE	RELIEF ON CAPITAL	ANNUAL REVENUE	OPERATING COSTS	GROSS SURPLUS	TAX	ANNUAL CASH FLOW	DISCOUNTED CASH FLOW
0	-30750000	0	0	0	0	0	0	0	0	0	0	-30750000	-30750000
1	0	92250000	9225000	9225000	4151250	24600000	0	82025793	61545775	2030018	-954554	2984572	2419106
2	0	83025000	9225000	8302500	3736125	19680000	11070000	86127082	65063146	3536436	-5071360	8607796	5655065
3	0	73800000	9225000	7380000	3321000	15744000	8856000	90433436	68824599	5003837	-3227923	8231760	4383401
4	0	64575000	9225000	6457500	2905875	12595200	7084800	94955108	72852910	6419698	-1606940	8026638	3464376
5	0	55350000	9225000	5535000	2490750	10076160	5667840	99702864	77173635	7769229	-175213	7944441	2779249
6	0	46125000	9225000	4612500	2075625	8060928	4534272	104688007	81815498	9035009	1091300	7943709	2252477
7	0	36900000	9225000	3690000	1660500	6448742	3627418	109922407	86810847	10196560	2208889	7987671	1835820
8	0	27675000	9225000	2767500	1245375	5158994	2901934	115418527	92196173	11229855	3187146	8042709	1498253
9	0	18450000	9225000	1845000	830250	4127195	2321547	121189454	98012706	12106748	4029728	8077020	1219570
10	0	9225000	9225000	922500	415125	3301756	1857238	127248927	104307108	12794318	4734880	8059438	986355
11	0	0	0	0	0	2641405	1485790	133611373	111132265	22479108	9446993	13032115	1292755
12	0	0	0	0	0	2113124	1188632	140291941	118548198	21743743	9249800	12493943	1004555
13	0	0	0	0	0	1690499	950306	147306539	126623123	20683416	8879630	11803786	769251
14	0	0	0	0	0	1352399	760725	154671865	135434658	19237207	8314417	10922790	576970
15	4327678	0	0	0	0	1081919	608580	162405459	145071229	17334229	7526542	14135365	605201
16	0	0	0	0	0	0	486864	0	0	0	-219089	219089	7603
17	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0
												NPV	6

REQUIRED FREIGHT RATE = 254 £/tonne

(with 80% load factor)

Table A5.64
SES157 Operating Costs - R&M 10%

VESSEL DATA	
Length	157.6
Breadth	35
Draught	7.2
Payload	1804
Power	216333
No. Containers	200
Complement	29
Annual Op. Hours	6048
No. Trips per annum	224
Fuel Load per Trip	1254
Dieso per week	648

COSTHEAD	ESCALATION RATE
Registration	0
Manning	0
Insurance	0
R & M	0.1
Stores	0
Victualling	0
Administration	0
Fuel Oil	0
Diesel Oil	0
Port Dues	0
Cargo Handling	0

YEAR	REGISTRATION	MANNING	INSURANCE	R & M	STORES	VICTUALING	ADMINISTRATION	FUEL OIL	DIESEL OIL	PORT DUES	CARGO HANDLING	TOTAL OPERATING COSTS
0	6000	1740000	1845000	3628800	250000	32886	123000	42134400	4665600	242458	3584000	58252144
1	6300	1827000	1937250	4191264	262500	34530	129150	44241120	4898880	254580	3763200	61545775
2	6615	1918350	2034113	4840910	275625	36257	135608	46453176	5143824	267310	3951360	65063146
3	6946	2014268	2135818	5591251	289406	38070	142388	48775835	5401015	280675	4148928	68824599
4	7293	2114981	2242609	6457895	303877	39973	149507	51214627	5671066	294709	4356374	72852910
5	7658	2220730	2354739	7458869	319070	41972	156983	53775358	5954619	309444	4574193	77173635
6	8041	2331766	2472476	8614993	335024	44070	164832	56464126	6252350	324916	4802903	81815498
7	8443	2448355	2596100	9950317	351775	46274	173073	59287332	6564968	341162	5043048	86810847
8	8865	2570772	2725905	11492616	369364	48588	181727	62251699	6893216	358220	5295200	92196173
9	9308	2699311	2862201	13273972	387832	51017	190813	65364284	7237877	376131	5559960	98012706
10	9773	2834277	3005311	15331437	407224	53568	200354	68632498	7599771	394938	5837958	104307108
11	10262	2975990	3155576	17707810	427585	56246	210372	72064123	7979759	414685	6129856	111132265
12	10775	3124790	3313355	20452521	448964	59059	220890	75667329	8378747	435419	6436349	118548198
13	11314	3281030	3479023	23622662	471412	62011	231935	79450695	8797685	457190	6758167	126623123
14	11880	3445081	3652974	27284174	494983	65112	243532	83423230	9237569	480049	7096075	135434658
15	12474	3617335	3835622	31513221	519732	68368	255708	87594391	9699447	504052	7450879	145071229
16	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0

Appendix 6

SES Best/Worst Operating Costs

Table A6.1
SES194 Best Operating Costs

VESSEL DATA		COSTHEAD	ESCALATION RATE
Length	194.1	Registration	0
Breadth	38.8	Manning	0
Draught	6.8	Insurance	0
Payload	1314	R & M	0
Power	291670	Stores	0
No. Containers	150	Victualling	0
Complement	38	Administration	0
Annual Op. Hours	5280	Fuel Oil	0
No. Trips per annum	96	Diesel Oil	0
Fuel Load per Trip	3256	Port Dues	0
Dieso per week	85	Cargo Handling	0

YEAR	REGISTRATION	MANNING	INSURANCE	R & M	STORES	VICTUALING	ADMINISTRATION	FUEL OIL	DIESEL OIL	PORT DUES	CARGO HANDLING	TOTAL OPERATING COSTS
0	7500	2052000	1606500	3564000	300000	37620	142800	40634880	530400	68118	921600	49865418
1	7875	2154600	1686825	3742200	315000	39501	149940	42666624	556920	71524	967680	52358689
2	8269	2262330	1771166	3929310	330750	41476	157437	44799955	584766	75100	1016064	54976623
3	8682	2375447	1859725	4125776	347288	43550	165309	47039953	614004	78855	1066867	57725454
4	9116	2494219	1952711	4332064	364652	45727	173574	49391951	644705	82798	1120211	60611727
5	9572	2618930	2050346	4548667	382884	48014	182253	51861548	676940	86937	1176221	63642313
6	10051	2749876	2152864	4776101	402029	50414	191366	54454626	710787	91284	1235032	66824429
7	10553	2887370	2260507	5014906	422130	52935	200934	57177357	746326	95849	1296784	70165650
8	11081	3031739	2373532	5265651	443237	55582	210981	60036225	783642	100641	1361623	73673933
9	11635	3183325	2492209	5528934	465398	58361	221530	63038036	822824	105673	1429704	77357630
10	12217	3342492	2616819	5805380	488668	61279	232606	66189938	863966	110957	1501189	81225511
11	12828	3509616	2747660	6095649	513102	64343	244236	69499435	907164	116504	1576249	85286787
12	13469	3685097	2885043	6400432	538757	67560	256448	72974406	952522	122330	1655061	89551126
13	14142	3869352	3029295	6720454	565695	70938	269271	76623127	1000148	128446	1737814	94028682
14	14849	4062820	3180760	7056476	593979	74485	282734	80454283	1050156	134869	1824705	98730116
15	15592	4265961	3339798	7409300	623678	78209	296871	84476997	1102664	141612	1915940	103666622
16	16372	4479259	3506788	7779765	654862	82120	311714	88700847	1157797	148693	2011737	108849953
17	17190	4703222	3682127	8168753	687605	86226	327300	93135889	1215687	156127	2112324	114292451
18	18050	4938383	3866234	8577191	721986	90537	343665	97792684	1276471	163934	2217940	120007073
19	18952	5185302	4059545	9006050	758085	95064	360848	102682318	1340294	172130	2328837	126007427
20	19900	5444567	4262523	9456353	795989	99817	378891	107816434	1407309	180737	2445279	132307799
21	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0

Table A6.2
SES194 Worst Operating Costs

VESSEL DATA	
Length	194.1
Breadth	38.8
Draught	6.8
Payload	1314
Power	291670
No. Containers	150
Complement	38
Annual Op. Hours	5280
No. Trips per annum	96
Fuel Load per Trip	3256
Dieso per week	85

COSTHEAD	ESCALATION RATE
Registration	0
Manning	0
Insurance	0
R & M	0
Stores	0
Victualling	0
Administration	0
Fuel Oil	0
Diesel Oil	0
Port Dues	0
Cargo Handling	0

YEAR	REGISTRATION	MANNING	INSURANCE	R & M	STORES	VICTUALING	ADMINISTRATION	FUEL OIL	DIESEL OIL	PORT DUES	CARGO HANDLING	TOTAL OPERATING COSTS
0	7500	2508000	3622500	4356000	300000	37620	193200	53137920	693600	83255	1382400	66321995
1	7875	2633400	3803625	4573800	315000	39501	202860	55794816	728280	87418	1451520	69638095
2	8269	2765070	3993806	4802490	330750	41476	213003	58584557	764694	91789	1524096	73120000
3	8682	2903324	4193497	5042615	347288	43550	223653	61513785	802929	96378	1600301	76776000
4	9116	3048490	4403171	5294745	364652	45727	234836	64589474	843075	101197	1680316	80614799
5	9572	3200914	4623330	5559482	382884	48014	246578	67818948	885229	106257	1764332	84645539
6	10051	3360960	4854496	5837457	402029	50414	258906	71209895	929490	111570	1852548	88877816
7	10553	3529008	5097221	6129329	422130	52935	271852	74770390	975965	117148	1945176	93321707
8	11081	3705458	5352082	6435796	443237	55582	285444	78508909	1024763	123006	2042434	97987793
9	11635	3890731	5619686	6757586	465398	58361	299717	82434355	1076001	129156	2144556	102887182
10	12217	4085268	5900671	7095465	488668	61279	314702	86556072	1129801	135614	2251784	108031541
11	12828	4289531	6195704	7450238	513102	64343	330438	90883876	1186291	142394	2364373	113433118
12	13469	4504008	6505490	7822750	538757	67560	346959	95428070	1245606	149514	2482592	119104774
13	0	0	0	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0

Table A6.3
SES157 Best Operating Costs

VESSEL DATA		COSTHEAD	ESCALATION RATE
Length	157.6	Registration	0
Breadth	35	Manning	0
Draught	7.2	Insurance	0
Payload	1804	R & M	0
Power	216333	Stores	0
No. Containers	200	Victualling	0
Complement	29	Administration	0
Annual Op. Hours	6048	Fuel Oil	0
No. Trips per annum	224	Diesel Oil	0
Fuel Load per Trip	1254	Port Dues	0
Dieso per week	648	Cargo Handling	0

YEAR	REGISTRATION	MANNING	INSURANCE	R & M	STORES	VICTUALING	ADMINISTRATION	FUEL OIL	DIESEL OIL	PORT DUES	CARGO HANDLING	TOTAL OPERATING COSTS
0	6000	1566000	1176188	3265920	250000	32886	104550	36516480	4043520	218212	2867200	50046955
1	6300	1644300	1234997	3429216	262500	34530	109778	38342304	4245696	229122	3010560	52549303
2	6615	1726515	1296747	3600677	275625	36257	115266	40259419	4457981	240579	3161088	55176768
3	6946	1812841	1361584	3780711	289406	38070	121030	42272390	4680880	252607	3319142	57935607
4	7293	1903483	1429663	3969746	303877	39973	127081	44386010	4914924	265238	3485100	60832387
5	7658	1998657	1501146	4168233	319070	41972	133435	46605310	5160670	278500	3659354	63874006
6	8041	2098590	1576204	4376645	335024	44070	140107	48935576	5418704	292425	3842322	67067707
7	8443	2203519	1655014	4595477	351775	46274	147112	51382354	5689639	307046	4034438	70421092
8	8865	2313695	1737765	4825251	369364	48588	154468	53951472	5974121	322398	4236160	73942147
9	9308	2429380	1824653	5066514	387832	51017	162191	56649046	6272827	338518	4447968	77639254
10	9773	2550849	1915885	5319840	407224	53568	170301	59481498	6586468	355444	4670367	81521217
11	10262	2678391	2011680	5585832	427585	56246	178816	62455573	6915791	373216	4903885	85597277
12	10775	2812311	2112264	5865123	448964	59059	187757	65578352	7261581	391877	5149079	89877141
13	11314	2952927	2217877	6158379	471412	62011	197145	68857269	7624660	411471	5406533	94370998
14	11880	3100573	2328771	6466298	494983	65112	207002	72300133	8005893	432045	5676860	99089548
15	12474	3255602	2445209	6789613	519732	68368	217352	75915139	8406188	453647	5960703	104044026
16	13097	3418382	2567470	7129094	545719	71786	228220	79710896	8826497	476329	6258738	109246227
17	13752	3589301	2695843	7485548	573005	75375	239631	83696441	9267822	500146	6571675	114708538
18	14440	3768766	2830635	7859826	601655	79144	251612	87881263	9731213	525153	6900259	120443965
19	15162	3957204	2972167	8252817	631738	83101	264193	92275326	10217774	551410	7245272	126466164
20	15920	4155064	3120776	8665458	663324	87256	277402	96889093	10728662	578981	7607535	132789472
21	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0

Table A6.4
SES157 Worst Operating Costs

VESSEL DATA		COSTHEAD	ESCALATION RATE
Length	157.6	Registration	0
Breadth	35	Manning	0
Draught	7.2	Insurance	0
Payload	1804	R & M	0
Power	216333	Stores	0
No. Containers	200	Victualling	0
Complement	29	Administration	0
Annual Op. Hours	6048	Fuel Oil	0
No. Trips per annum	224	Diesel Oil	0
Fuel Load per Trip	1254	Port Dues	0
Dieso per week	648	Cargo Handling	0

YEAR	REGISTRATION	MANNING	INSURANCE	R & M	STORES	VICTUALING	ADMINISTRATION	FUEL OIL	DIESEL OIL	PORT DUES	CARGO HANDLING	TOTAL OPERATING COSTS
0	6000	1914000	2652188	3991680	250000	32886	141450	47752320	5287680	266703	4300800	66595707
1	6300	2009700	2784797	4191264	262500	34530	148523	50139936	5552064	280039	4515840	69925492
2	6615	2110185	2924037	4400827	275625	36257	155949	52646933	5829667	294040	4741632	73421767
3	6946	2215694	3070239	4620869	289406	38070	163746	55279279	6121151	308742	4978714	77092855
4	7293	2326479	3223750	4851912	303877	39973	171933	58043243	6427208	324180	5227649	80947498
5	7658	2442803	3384938	5094508	319070	41972	180530	60945406	6748568	340389	5489032	84994873
6	8041	2564943	3554185	5349233	335024	44070	189557	63992676	7085997	357408	5763483	89244616
7	8443	2693190	3731894	5616695	351775	46274	199034	67192310	7440297	375278	6051657	93706847
8	8865	2827850	3918489	5897529	369364	48588	208986	70551925	7812312	394042	6354240	98392190
9	9308	2969242	4114413	6192406	387832	51017	219435	74079521	8202927	413744	6671952	103311799
10	9773	3117704	4320134	6502026	407224	53568	230407	77783497	8613074	434432	7005550	108477389
11	10262	3273590	4536141	6827127	427585	56246	241928	81672672	9043727	456153	7355828	113901259
12	10775	3437269	4762948	7168484	448964	59059	254024	85756306	9495914	478961	7723619	119596321
13	0	0	0	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0

Table A6.5
SES125 Best Operating Costs

VESSEL DATA	
Length	125.1
Breadth	31.3
Draught	7.3
Payload (max)	1261
Power	152726
No. Containers	150
Complement	24
Annual Op. Hours	6384
No. Trips per annum	336
Fuel Load per Trip	631
Dieso per week	84

COSTHEAD	ESCALATION RATE
Registration	0
Manning	0
Insurance	0
R & M	0
Stores	0
Victualling	0
Administration	0
Fuel Oil	0
Diesel Oil	0
Port Dues	0
Cargo Handling	0

YEAR	REGISTRATION	MANNING	INSURANCE	R & M	STORES	VICTUALING	ADMINISTRATION	FUEL OIL	DIESEL OIL	PORT DUES	CARGO HANDLING	TOTAL OPERATING COSTS
0	5000	1296000	812813	2872800	200000	28728	72250	27562080	524160	228796	3225600	36828226
1	5250	1360800	853453	3016440	210000	30164	75863	28940184	550368	240236	3386880	38669638
2	5513	1428840	896126	3167262	220500	31673	79656	30387193	577886	252247	3556224	40603120
3	5788	1500282	940932	3325625	231525	33256	83638	31906553	606781	264860	3734035	42633276
4	6078	1575296	987979	3491906	243101	34919	87820	33501881	637120	278103	3920737	44764939
5	6381	1654061	1037378	3666502	255256	36665	92211	35176975	668976	292008	4116774	47003186
6	6700	1736764	1089246	3849827	268019	38498	96822	36935823	702425	306608	4322612	49353346
7	7036	1823602	1143709	4042318	281420	40423	101663	38782614	737546	321939	4538743	51821013
8	7387	1914782	1200894	4244434	295491	42444	106746	40721745	774423	338036	4765680	54412063
9	7757	2010521	1260939	4456656	310266	44567	112083	42757832	813144	354937	5003964	57132667
10	8144	2111047	1323986	4679488	325779	46795	117688	44895724	853801	372684	5254163	59989300
11	8552	2216600	1390185	4913463	342068	49135	123572	47140510	896491	391319	5516871	62988765
12	8979	2327430	1459694	5159136	359171	51591	129751	49497536	941316	410884	5792714	66138203
13	9428	2443801	1532679	5417093	377130	54171	136238	51972413	988382	431429	6082350	69445113
14	9900	2565991	1609313	5687947	395986	56879	143050	54571033	1037801	453000	6386467	72917369
15	10395	2694291	1689779	5972345	415786	59723	150203	57299585	1089691	475650	6705791	76563238
16	10914	2829005	1774268	6270962	436575	62710	157713	60164564	1144176	499433	7041080	80391399
17	11460	2970456	1862981	6584510	458404	65845	165598	63172792	1201384	524404	7393134	84410969
18	12033	3118979	1956130	6913736	481324	69137	173878	66331432	1261454	550624	7762791	88631518
19	12635	3274927	2053937	7259423	505390	72594	182572	69648003	1324526	578156	8150931	93063094
20	13266	3438674	2156634	7622394	530660	76224	191701	73130404	1390753	607063	8558477	97716248
21	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0

Table A6.6
SES125 Worst Operating Costs

VESSEL DATA	
Length	125.1
Breadth	31.3
Draught	7.3
Payload (max)	1261
Power	152726
No. Containers	150
Complement	24
Annual Op. Hours	6384
No. Trips per annum	336
Fuel Load per Trip	631
Dieso per week	84

COSTHEAD	ESCALATION RATE
Registration	0
Manning	0
Insurance	0
R & M	0
Stores	0
Victualling	0
Administration	0
Fuel Oil	0
Diesel Oil	0
Port Dues	0
Cargo Handling	0

YEAR	REGISTRATION	MANNING	INSURANCE	R & M	STORES	VICTUALING	ADMINISTRATION	FUEL OIL	DIESEL OIL	PORT DUES	CARGO HANDLING	TOTAL OPERATING COSTS
0	5000	1584000	1875000	3511200	200000	28728	100000	36042720	685440	279639	4838400	49150127
1	5250	1663200	1968750	3686760	210000	30164	105000	37844856	719712	293621	5080320	51607634
2	5513	1746360	2067188	3871098	220500	31673	110250	39737099	755698	308302	5334336	54188015
3	5788	1833678	2170547	4064653	231525	33256	115763	41723954	793482	323718	5601053	56897416
4	6078	1925362	2279074	4267886	243101	34919	121551	43810151	833157	339903	5881105	59742287
5	6381	2021630	2393028	4481280	255256	36665	127628	46000659	874814	356899	6175161	62729401
6	6700	2122711	2512679	4705344	268019	38498	134010	48300692	918555	374743	6483919	65865871
7	7036	2228847	2638313	4940611	281420	40423	140710	50715727	964483	393481	6808115	69159165
8	7387	2340289	2770229	5187642	295491	42444	147746	53251513	1012707	413155	7148520	72617123
9	7757	2457304	2908740	5447024	310266	44567	155133	55914089	1063342	433812	7505946	76247979
10	8144	2580169	3054177	5719375	325779	46795	162889	58709793	1116510	455503	7881244	80060378
11	8552	2709178	3206886	6005344	342068	49135	171034	61645283	1172335	478278	8275306	84063397
12	8979	2844636	3367231	6305611	359171	51591	179586	64727547	1230952	502192	8689071	88266567
13	0	0	0	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0

Appendix 7

SES Economic Potential: Discounted Cash Flows and Operating Costs

Table A7.1
SES194 Discounted Cash Flow Analysis - dwt/Disp=0.55

PROJECT LIFE: 15 | PRICE: 252000000 | DEBT RATIO: 0.75 | LOAN YEARS: 10 | INTEREST RATE: 0.1

DECLINING BAL.: 0.2

TAX RATE: 0.33 | INFLATION RATE: 0.05 | DISCOUNT RATE: 0.175 | BASE REVENUE: 103514217

SCRAP VALUE: 8866462

YEAR	CAPITAL	LOAN OUTSTANDING	LOAN REPAYMENTS	INTEREST PAYMENTS	RELIEF ON INTEREST	CAPITAL ALLOWANCE	RELIEF ON CAPITAL	ANNUAL REVENUE	OPERATING COSTS	GROSS SURPLUS	TAX	ANNUAL CASH FLOW	DISCOUNTED CASH FLOW
0	-63000000	0	0	0	0	0	0	0	0	0	0	-63000000	-63000000
1	0	189000000	18900000	18900000	6237000	50400000	0	103514217	64902358	811859	-1790296	2602156	2109143
2	0	170100000	18900000	17010000	5613300	40320000	16632000	108689928	68147476	4632452	-5812240	10444692	6861851
3	0	151200000	18900000	15120000	4989600	32256000	13305600	114124424	71554850	8549575	-3216056	11765631	6265183
4	0	132300000	18900000	13230000	4365900	25804800	10644480	119830646	75132592	12568053	-805968	13374021	5772359
5	0	113400000	18900000	11340000	3742200	20643840	8515584	125822178	78889222	16692956	1463607	15229349	5327771
6	0	94500000	18900000	9450000	3118500	16515072	6812467	132113287	82833683	20929604	3629550	17300054	4905513
7	0	75600000	18900000	7560000	2494800	13212058	5449974	138718951	86975367	25283584	5721807	19561777	4495915
8	0	56700000	18900000	5670000	1871100	10569646	4359979	145654899	91324135	29760763	7764796	21995967	4097564
9	0	37800000	18900000	3780000	1247400	8455717	3487983	152937644	95890342	34367301	9778533	24588768	3712721
10	0	18900000	18900000	1890000	623700	6764573	2790387	160584526	100684859	39109667	11779541	27330125	3344799
11	0	0	0	0	0	5411659	2232309	168613752	105719102	62894650	20018572	42876077	4253204
12	0	0	0	0	0	4329327	1785847	177044440	111005057	66039382	21203667	44835716	3604941
13	0	0	0	0	0	3463462	1428678	185896662	116555310	69341351	22411182	46930169	3058433
14	0	0	0	0	0	2770769	1142942	195191495	122383076	72808419	23649607	49158812	2596696
15	8866462	0	0	0	0	2216615	914354	204951070	128502230	76448840	24926380	60388921	2585531
16	0	0	0	0	0	0	731483	0	0	0	-241389	241389	8377
17	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0
												NPV	1

REQUIRED FREIGHT RATE = 323 £/tonne

(with 80% load factor)

Table A7.2

SES194 Operating Costs - dwt/Disp=0.55

VESSEL DATA

Length	194.1
Breadth	38.8
Draught	6.8
Payload	4171
Power	291670
No. Containers	450
Complement	38
Annual Op. Hours	5280
No. Trips per annum	96
Fuel Load per Trip	3256
Dieso per week	85

COSTHEAD	ESCALATION RATE
Registration	0
Manning	0
Insurance	0
R & M	0
Stores	0
Victualling	0
Administration	0
Fuel Oil	0
Diesel Oil	0
Port Dues	0
Cargo Handling	0

YEAR	REGISTRATION	MANNING	INSURANCE	R & M	STORES	VICTUALING	ADMINISTRATION	FUEL OIL	DIESEL OIL	PORT DUES	CARGO HANDLING	TOTAL OPERATING COSTS
0	7500	2280000	3780000	3960000	300000	37620	252000	46886400	612000	240250	3456000	61811770
1	7875	2394000	3969000	4158000	315000	39501	264600	49230720	642600	252262	3628800	64902358
2	8269	2513700	4167450	4365900	330750	41476	277830	51692256	674730	264875	3810240	68147476
3	8682	2639385	4375823	4584195	347288	43550	291722	54276869	708467	278119	4000752	71554850
4	9116	2771354	4594614	4813405	364652	45727	306308	56990712	743890	292025	4200790	75132592
5	9572	2909922	4824344	5054075	382884	48014	321623	59840248	781084	306626	4410829	78889222
6	10051	3055418	5065562	5306779	402029	50414	337704	62832260	820139	321957	4631371	82833683
7	10553	3208189	5318840	5572118	422130	52935	354589	65973873	861145	338055	4862939	86975367
8	11081	3368598	5584782	5850724	443237	55582	372319	69272567	904203	354958	5106086	91324135
9	11635	3537028	5864021	6143260	465398	58361	390935	72736195	949413	372706	5361390	95890342
10	12217	3713880	6157222	6450423	488668	61279	410481	76373005	996884	391341	5629460	100684859
11	12828	3899574	6465083	6772944	513102	64343	431006	80191655	1046728	410908	5910933	105719102
12	13469	4094552	6788337	7111591	538757	67560	452556	84201238	1099064	431454	6206479	111005057
13	14142	4299280	7127754	7467171	565695	70938	475184	88411300	1154017	453026	6516803	116555310
14	14849	4514244	7484141	7840529	593979	74485	498943	92831865	1211718	475678	6842644	122383076
15	15592	4739956	7858349	8232556	623678	78209	523890	97473458	1272304	499462	7184776	128502230
16	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0

Table A7.3
SES157 Discounted Cash Flow Analysis - dwt/Disp=0.55

PROJECT LIFE: 15 | PRICE: 184500000 | DEBT RATIO: 0.75 | LOAN YEARS: 10 | INTEREST RATE: 0.1

DECLINING BAL.: 0.2

TAX RATE: 0.33 | INFLATION RATE: 0.05 | DISCOUNT RATE: 0.175 | BASE REVENUE: 94492607

SCRAP VALUE: 6491517

YEAR	CAPITAL	LOAN OUTSTANDING	LOAN REPAYMENTS	INTEREST PAYMENTS	RELIEF ON INTEREST	CAPITAL ALLOWANCE	RELIEF ON CAPITAL	ANNUAL REVENUE	OPERATING COSTS	GROSS SURPLUS	TAX	ANNUAL CASH FLOW	DISCOUNTED CASH FLOW
0	-46125000	0	0	0	0	0	0	0	0	0	0	-46125000	-46125000
1	0	138375000	13837500	13837500	4566375	36900000	0	94492607	66223211	594397	-1310753	1905150	1544194
2	0	124537500	13837500	12453750	4109738	29520000	12177000	99217238	69534371	3391617	-4255390	7647007	5023855
3	0	110700000	13837500	11070000	3653100	23616000	9741600	104178100	73011090	6259510	-2354613	8614123	4587009
4	0	96862500	13837500	9686250	3196463	18892800	7793280	109387005	76661644	9201611	-590084	9791694	4226192
5	0	83025000	13837500	8302500	2739825	15114240	6234624	114856355	80494726	12221629	1071569	11150059	3900689
6	0	69187500	13837500	6918750	2283188	12091392	4987699	120599173	84519463	15323460	2657349	12666111	3591537
7	0	55350000	13837500	5535000	1826550	9673114	3990159	126629131	88745436	18511196	4189180	14322015	3291652
8	0	41512500	13837500	4151250	1369913	7738491	3192127	132960588	93182708	21789130	5684940	16104190	3000002
9	0	27675000	13837500	2767500	913275	6190793	2553702	139608617	97841843	25161774	7159283	18002491	2718242
10	0	13837500	13837500	1383750	456638	4952634	2042962	146589048	102733935	28633863	8624307	20009556	2448870
11	0	0	0	0	0	3962107	1634369	153918501	107870632	46047869	14656455	31391414	3113953
12	0	0	0	0	0	3169686	1307495	161614426	113264164	48350262	15524113	32826149	2639332
13	0	0	0	0	0	2535749	1045996	169695147	118927372	50767775	16408187	34359588	2239210
14	0	0	0	0	0	2028599	836797	178179904	124873740	53306164	17314891	35991273	1901152
15	6491517	0	0	0	0	1622879	669438	187088899	131117427	55971472	18249671	44213317	1892978
16	0	0	0	0	0	0	535550	0	0	0	-176732	176732	6133
17	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0
												NPV	0

REQUIRED FREIGHT RATE = 144 £/tonne

(with 80% load factor)

Table A7.4
SES157 Operating Costs - dwt/Disp=0.55

VESSEL DATA		COSTHEAD	ESCALATION RATE
Length	157.6	Registration	0
Breadth	35	Manning	0
Draught	7.2	Insurance	0
Payload	3661	R & M	0
Power	216333	Stores	0
No. Containers	400	Victualling	0
Complement	29	Administration	0
Annual Op. Hours	6048	Fuel Oil	0
No. Trips per annum	224	Diesel Oil	0
Fuel Load per Trip	1254	Port Dues	0
Dieso per week	648	Cargo Handling	0

YEAR	REGISTRATION	MANNING	INSURANCE	R & M	STORES	VICTUALING	ADMINISTRATION	FUEL OIL	DIESEL OIL	PORT DUES	CARGO HANDLING	TOTAL OPERATING COSTS
0	6000	1740000	2767500	3628800	250000	32886	184500	42134400	4665600	492038	7168000	63069724
1	6300	1827000	2905875	3810240	262500	34530	193725	44241120	4898880	516640	7526400	66223211
2	6615	1918350	3051169	4000752	275625	36257	203411	46453176	5143824	542472	7902720	69534371
3	6946	2014268	3203727	4200790	289406	38070	213582	48775835	5401015	569596	8297856	73011090
4	7293	2114981	3363914	4410829	303877	39973	224261	51214627	5671066	598076	8712749	76661644
5	7658	2220730	3532109	4631371	319070	41972	235474	53775358	5954619	627980	9148386	80494726
6	8041	2331766	3708715	4862939	335024	44070	247248	56464126	6252350	659379	9605806	84519463
7	8443	2448355	3894150	5106086	351775	46274	259610	59287332	6564968	692347	10086096	88745436
8	8865	2570772	4088858	5361390	369364	48588	272591	62251699	6893216	726965	10590401	93182708
9	9308	2699311	4293301	5629460	387832	51017	286220	65364284	7237877	763313	11119921	97841843
10	9773	2834277	4507966	5910933	407224	53568	300531	68632498	7599771	801479	11675917	102733935
11	10262	2975990	4733364	6206479	427585	56246	315558	72064123	7979759	841553	12259713	107870632
12	10775	3124790	4970032	6516803	448964	59059	331335	75667329	8378747	883630	12872698	113264164
13	11314	3281030	5218534	6842644	471412	62011	347902	79450695	8797685	927812	13516333	118927372
14	11880	3445081	5479461	7184776	494983	65112	365297	83423230	9237569	974202	14192150	124873740
15	12474	3617335	5753434	7544015	519732	68368	383562	87594391	9699447	1022912	14901757	131117427
16	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0

Table A7.5
SES125 Discounted Cash Flow Analysis - dwt/Disp=0.55

PROJECT LIFE: 15 | PRICE: 127500000 | DEBT RATIO: 0.75 | LOAN YEARS: 10 | INTEREST RATE: 0.1

DECLINING BAL.: 0.2

TAX RATE: 0.33 | INFLATION RATE: 0.05 | DISCOUNT RATE: 0.175 | BASE REVENUE: 68379215

SCRAP VALUE: 4486007

YEAR	CAPITAL	LOAN OUTSTANDING	LOAN REPAYMENTS	INTEREST PAYMENTS	RELIEF ON INTEREST	CAPITAL ALLOWANCE	RELIEF ON CAPITAL	ANNUAL REVENUE	OPERATING COSTS	GROSS SURPLUS	TAX	ANNUAL CASH FLOW	DISCOUNTED CASH FLOW
0	-31875000	0	0	0	0	0	0	0	0	0	0	-31875000	-31875000
1	0	95625000	9562500	9562500	3155625	25500000	0	68379215	48843453	410762	-905805	1316567	1067126
2	0	86062500	9562500	8606250	2840063	20400000	8415000	71798176	51285626	2343800	-2940717	5284517	3471770
3	0	76500000	9562500	7650000	2524500	16320000	6732000	75388085	53849907	4325678	-1627171	5952849	3169884
4	0	66937500	9562500	6693750	2208938	13056000	5385600	79157489	56542402	6358837	-407781	6766618	2920539
5	0	57375000	9562500	5737500	1893375	10444800	4308480	83115363	59369523	8445841	740515	7705326	2695598
6	0	47812500	9562500	4781250	1577813	8355840	3446784	87271132	62337999	10589383	1836380	8753003	2481956
7	0	38250000	9562500	3825000	1262250	6684672	2757427	91634688	65454899	12792290	2894962	9897327	2274719
8	0	28687500	9562500	2868750	946688	5347738	2205942	96216423	68727644	15057529	3928617	11128912	2073172
9	0	19125000	9562500	1912500	631125	4278190	1764753	101027244	72164026	17388218	4947472	12440746	1878460
10	0	9562500	9562500	956250	315563	3422552	1411803	106078606	75772227	19787629	5959887	13827742	1692309
11	0	0	0	0	0	2738042	1129442	111382536	79560838	31821698	10128444	21693253	2151919
12	0	0	0	0	0	2190433	903554	116951663	83538880	33412783	10728046	22684737	1823928
13	0	0	0	0	0	1752347	722843	122799246	87715824	35083422	11338991	23744431	1547421
14	0	0	0	0	0	1401877	578274	128939208	92101615	36837593	11965575	24872018	1313804
15	4486007	0	0	0	0	1121502	462620	135386169	96706696	38679473	12611562	30553919	1308156
16	0	0	0	0	0	0	370096	0	0	0	-122132	122132	4238
17	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0
												NPV	0

REQUIRED FREIGHT RATE = 106 £/tonne

(with 80% load factor)

Table A7.6
SES125 Operating Costs - dwt/Disp=0.55

VESSEL DATA	
Length	125.1
Breadth	31.3
Draught	7.3
Payload (max)	2404
Power	152726
No. Containers	250
Complement	24
Annual Op. Hours	6384
No. Trips per annum	336
Fuel Load per Trip	631
Dieso per week	84

COSTHEAD	ESCALATION RATE
Registration	0
Manning	0
Insurance	0
R & M	0
Stores	0
Victualling	0
Administration	0
Fuel Oil	0
Diesel Oil	0
Port Dues	0
Cargo Handling	0

YEAR	REGISTRATION	MANNING	INSURANCE	R & M	STORES	VICTUALING	ADMINISTRATION	FUEL OIL	DIESEL OIL	PORT DUES	CARGO HANDLING	TOTAL OPERATING COSTS
0	5000	1440000	1912500	3192000	200000	28728	127500	31802400	604800	484646	6720000	46517574
1	5250	1512000	2008125	3351600	210000	30164	133875	33392520	635040	508879	7056000	48843453
2	5513	1587600	2108531	3519180	220500	31673	140569	35062146	666792	534323	7408800	51285626
3	5788	1666980	2213958	3695139	231525	33256	147597	36815253	700132	561039	7779240	53849907
4	6078	1750329	2324656	3879896	243101	34919	154977	38656016	735138	589091	8168202	56542402
5	6381	1837845	2440888	4073891	255256	36665	162726	40588817	771895	618545	8576612	59369523
6	6700	1929738	2562933	4277585	268019	38498	170862	42618258	810490	649473	9005443	62337999
7	7036	2026225	2691080	4491465	281420	40423	179405	44749170	851014	681946	9455715	65454899
8	7387	2127536	2825634	4716038	295491	42444	188376	46986629	893565	716043	9928501	68727644
9	7757	2233913	2966915	4951840	310266	44567	197794	49335960	938243	751846	10424926	72164026
10	8144	2345608	3115261	5199432	325779	46795	207684	51802758	985155	789438	10946172	75772227
11	8552	2462889	3271024	5459403	342068	49135	218068	54392896	1034413	828910	11493480	79560838
12	8979	2586033	3434575	5732373	359171	51591	228972	57112541	1086134	870355	12068155	83538880
13	9428	2715335	3606304	6018992	377130	54171	240420	59968168	1140441	913873	12671562	87715824
14	9900	2851102	3786619	6319942	395986	56879	252441	62966577	1197463	959567	13305140	92101615
15	10395	2993657	3975950	6635939	415786	59723	265063	66114906	1257336	1007545	13970397	96706696
16	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0

Table A7.7
SES108 Discounted Cash Flow Analysis - dwt/Disp=0.55

PROJECT LIFE: 15 | PRICE: 84000000 | DEBT RATIO: 0.75 | LOAN YEARS: 10 | INTEREST RATE: 0.1

DECLINING BAL.: 0.2

TAX RATE: 0.33 | INFLATION RATE: 0.05 | DISCOUNT RATE: 0.175 | BASE REVENUE: 47165579

SCRAP VALUE: 2955487

YEAR	CAPITAL	LOAN OUTSTANDING	LOAN REPAYMENTS	INTEREST PAYMENTS	RELIEF ON INTEREST	CAPITAL ALLOWANCE	RELIEF ON CAPITAL	ANNUAL REVENUE	OPERATING COSTS	GROSS SURPLUS	TAX	ANNUAL CASH FLOW	DISCOUNTED CASH FLOW
0	-21000000	0	0	0	0	0	0	0	0	0	0	-21000000	-21000000
1	0	63000000	6300000	6300000	2079000	16800000	0	47165579	34294959	270620	-596765	867385	703048
2	0	56700000	6300000	5670000	1871100	13440000	5544000	49523858	36009707	1544151	-1937413	3481564	2287284
3	0	50400000	6300000	5040000	1663200	10752000	4435200	52000050	37810192	2849858	-1072019	3921877	2088394
4	0	44100000	6300000	4410000	1455300	8601600	3548160	54600053	39700702	4189351	-268656	4458007	1924120
5	0	37800000	6300000	3780000	1247400	6881280	2838528	57330056	41685737	5564319	487869	5076450	1775924
6	0	31500000	6300000	3150000	1039500	5505024	2270822	60196558	43770024	6976535	1209850	5766685	1635171
7	0	25200000	6300000	2520000	831600	4404019	1816658	63206386	45958525	8427861	1907269	6520592	1498638
8	0	18900000	6300000	1890000	623700	3523215	1453326	66366706	48256451	9920254	2588265	7331989	1365855
9	0	12600000	6300000	1260000	415800	2818572	1162661	69685041	50669274	11455767	3259511	8196256	1237574
10	0	6300000	6300000	630000	207900	2254858	930129	73169293	53202737	13036556	3926514	9110042	1114933
11	0	0	0	0	0	1803886	744103	76827758	55862874	20964883	6672857	14292026	1417735
12	0	0	0	0	0	1443109	595282	80669145	58656018	22013127	7067889	14945239	1201647
13	0	0	0	0	0	1154487	476226	84702603	61588819	23113784	7470394	15643390	1019478
14	0	0	0	0	0	923590	380981	88937733	64668260	24269473	7883202	16386271	865565
15	2955487	0	0	0	0	738872	304785	93384619	67901673	25482947	8308793	20129640	861844
16	0	0	0	0	0	0	243828	0	0	0	-80463	80463	2792
17	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0
												NPV	0

REQUIRED FREIGHT RATE = 120 £/tonne

(with 80% load factor)

Table A7.8
SES108 Operating Costs - dwt/Disp=0.55

VESSEL DATA	
Length	108
Breadth	27
Draught	6.3
Payload (max)	1461
Power	104000
No. Containers	150
Complement	24
Annual Op. Hours	6384
No. Trips per annum	336
Fuel Load per Trip	427
Dieso per week	84

COSTHEAD	ESCALATION RATE
Registration	0
Manning	0
Insurance	0
R & M	0
Stores	0
Victualling	0
Administration	0
Fuel Oil	0
Diesel Oil	0
Port Dues	0
Cargo Handling	0

YEAR	REGISTRATION	MANNING	INSURANCE	R & M	STORES	VICTUALING	ADMINISTRATION	FUEL OIL	DIESEL OIL	PORT DUES	CARGO HANDLING	TOTAL OPERATING COSTS
0	5000	1440000	1260000	3192000	200000	28728	84000	21520800	604800	294538	4032000	32661866
1	5250	1512000	1323000	3351600	210000	30164	88200	22596840	635040	309264	4233600	34294959
2	5513	1587600	1389150	3519180	220500	31673	92610	23726682	666792	324728	4445280	36009707
3	5788	1666980	1458608	3695139	231525	33256	97241	24913016	700132	340964	4667544	37810192
4	6078	1750329	1531538	3879896	243101	34919	102103	26158667	735138	358012	4900921	39700702
5	6381	1837845	1608115	4073891	255256	36665	107208	27466600	771895	375913	5145967	41685737
6	6700	1929738	1688521	4277585	268019	38498	112568	28839930	810490	394709	5403266	43770024
7	7036	2026225	1772947	4491465	281420	40423	118196	30281927	851014	414444	5673429	45958525
8	7387	2127536	1861594	4716038	295491	42444	124106	31796023	893565	435166	5957100	48256451
9	7757	2233913	1954674	4951840	310266	44567	130312	33385824	938243	456924	6254955	50669274
10	8144	2345608	2052407	5199432	325779	46795	136827	35055115	985155	479771	6567703	53202737
11	8552	2462889	2155028	5459403	342068	49135	143669	36807871	1034413	503759	6896088	55862874
12	8979	2586033	2262779	5732373	359171	51591	150852	38648265	1086134	528947	7240893	58656018
13	9428	2715335	2375918	6018992	377130	54171	158395	40580678	1140441	555395	7602937	61588819
14	9900	2851102	2494714	6319942	395986	56879	166314	42609712	1197463	583164	7983084	64668260
15	10395	2993657	2619450	6635939	415786	59723	174630	44740198	1257336	612323	8382238	67901673
16	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0

Table A7.9

SES194 Discounted Cash Flow Analysis - Mid-Journey Refuelling

PROJECT LIFE: 15 | PRICE: 168000000 | DEBT RATIO: 0.75 | LOAN YEARS: 10 | INTEREST RATE: 0.1

DECLINING BAL.: 0.2

TAX RATE: 0.33 | INFLATION RATE: 0.05 | DISCOUNT RATE: 0.175 | BASE REVENUE: 105108433

SCRAP VALUE: 5910975

YEAR	CAPITAL	LOAN OUTSTANDING	LOAN REPAYMENTS	INTEREST PAYMENTS	RELIEF ON INTEREST	CAPITAL ALLOWANCE	RELIEF ON CAPITAL	ANNUAL REVENUE	OPERATING COSTS	GROSS SURPLUS	TAX	ANNUAL CASH FLOW	DISCOUNTED CASH FLOW
0	-42000000	0	0	0	0	0	0	0	0	0	0	-42000000	-42000000
1	0	126000000	12600000	12600000	4158000	33600000	0	105108433	79367193	541239	-1193531	1734770	1406096
2	0	113400000	12600000	11340000	3742200	26880000	11088000	110363854	83335553	3088301	-3874827	6963128	4574568
3	0	100800000	12600000	10080000	3326400	21504000	8870400	115882047	87502331	5699716	-2144038	7843754	4176788
4	0	88200000	12600000	8820000	2910600	17203200	7096320	121676149	91877447	8378702	-537312	8916014	3848239
5	0	75600000	12600000	7560000	2494800	13762560	5677056	127759957	96471320	11128637	975738	10152900	3551847
6	0	63000000	12600000	6300000	2079000	11010048	4541645	134147955	101294886	13953069	2419700	11533369	3270342
7	0	50400000	12600000	5040000	1663200	8808038	3633316	140855353	106359630	16855723	3814538	13041184	2997277
8	0	37800000	12600000	3780000	1247400	7046431	2906653	147898120	111677611	19840509	5176531	14663978	2731709
9	0	25200000	12600000	2520000	831600	5637145	2325322	155293026	117261492	22911534	6519022	16392512	2475147
10	0	12600000	12600000	1260000	415800	4509716	1860258	163057678	123124566	26073111	7853028	18220083	2229866
11	0	0	0	0	0	3607773	1488206	171210561	129280795	41929767	13345715	28584052	2835469
12	0	0	0	0	0	2886218	1190565	179771089	135744835	44026255	14135778	29890477	2403294
13	0	0	0	0	0	2308974	952452	188759644	142532076	46227568	14940788	31286779	2038955
14	0	0	0	0	0	1847180	761962	198197626	149658680	48538946	15766405	32772541	1731130
15	5910975	0	0	0	0	1477744	609569	208107507	157141614	50965893	16617587	40259281	1723687
16	0	0	0	0	0	0	487655	0	0	0	-160926	160926	5585
17	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0
												NPV	0

REQUIRED FREIGHT RATE = 488 £/tonne

(with 80% load factor)

Table A7.10
SES194 Operating Costs - Mid-Journey Refuelling

VESSEL DATA		COSTHEAD	ESCALATION RATE
Length	194.1	Registration	0
Breadth	38.8	Manning	0
Draught	6.8	Insurance	0
Payload	2807	R & M	0
Power	291670	Stores	0
No. Containers	250	Victualling	0
Complement	38	Administration	0
Annual Op. Hours	5280	Fuel Oil	0
No. Trips per annum	96	Diesel Oil	0
Fuel Load per Trip	3526	Port Dues	0
Dieso per week	85	Cargo Handling	0

YEAR	REGISTRATION	MANNING	INSURANCE	R & M	STORES	VICTUALING	ADMINISTRATION	FUEL OIL	DIESEL OIL	PORT DUES	CARGO HANDLING	TOTAL OPERATING COSTS
0	7500	2280000	2520000	3960000	300000	37620	168000	63468000	765000	161683	1920000	75587803
1	7875	2394000	2646000	4158000	315000	39501	176400	66641400	803250	169767	2016000	79367193
2	8269	2513700	2778300	4365900	330750	41476	185220	69973470	843413	178256	2116800	83335553
3	8682	2639385	2917215	4584195	347288	43550	194481	73472144	885583	187169	2222640	87502331
4	9116	2771354	3063076	4813405	364652	45727	204205	77145751	929862	196527	2333772	91877447
5	9572	2909922	3216230	5054075	382884	48014	214415	81003038	976355	206353	2450461	96471320
6	10051	3055418	3377041	5306779	402029	50414	225136	85053190	1025173	216671	2572984	101294886
7	10553	3208189	3545893	5572118	422130	52935	236393	89305850	1076432	227504	2701633	106359630
8	11081	3368598	3723188	5850724	443237	55582	248213	93771142	1130253	238880	2836714	111677611
9	11635	3537028	3909347	6143260	465398	58361	260623	98459699	1186766	250824	2978550	117261492
10	12217	3713880	4104814	6450423	488668	61279	273654	103382684	1246104	263365	3127478	123124566
11	12828	3899574	4310055	6772944	513102	64343	287337	108551818	1308410	276533	3283852	129280795
12	13469	4094552	4525558	7111591	538757	67560	301704	113979409	1373830	290360	3448044	135744835
13	14142	4299280	4751836	7467171	565695	70938	316789	119678380	1442522	304878	3620446	142532076
14	14849	4514244	4989428	7840529	593979	74485	332629	125662299	1514648	320122	3801469	149658680
15	15592	4739956	5238899	8232556	623678	78209	349260	131945414	1590380	336128	3991542	157141614
16	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0

Table A7.11
SES157 Discounted Cash Flow Analysis - Mid-Journey Refuelling

PROJECT LIFE: 15 | PRICE: 123000000 | DEBT RATIO: 0.75 | LOAN YEARS: 10 | INTEREST RATE: 0.1

DECLINING BAL.: 0.2

TAX RATE: 0.33 | INFLATION RATE: 0.05 | DISCOUNT RATE: 0.175 | BASE REVENUE: 96435206

SCRAP VALUE: 4327678

YEAR	CAPITAL	LOAN OUTSTANDING	LOAN REPAYMENTS	INTEREST PAYMENTS	RELIEF ON INTEREST	CAPITAL ALLOWANCE	RELIEF ON CAPITAL	ANNUAL REVENUE	OPERATING COSTS	GROSS SURPLUS	TAX	ANNUAL CASH FLOW	DISCOUNTED CASH FLOW
0	-30750000	0	0	0	0	0	0	0	0	0	0	-30750000	-30750000
1	0	92250000	9225000	9225000	3044250	24600000	0	96435206	77588942	396265	-873835	1270100	1029463
2	0	83025000	9225000	8302500	2739825	19680000	8118000	101256966	81468389	2261078	-2836927	5098004	3349237
3	0	73800000	9225000	7380000	2435400	15744000	6494400	106319815	85541808	4173007	-1569742	5742748	3058006
4	0	64575000	9225000	6457500	2130975	12595200	5195520	111635805	89818898	6134407	-393389	6527796	2817461
5	0	55350000	9225000	5535000	1826550	10076160	4156416	117217596	94309843	8147752	714380	7433373	2600459
6	0	46125000	9225000	4612500	1522125	8060928	3325133	123078475	99025335	10215640	1771566	8444074	2394358
7	0	36900000	9225000	3690000	1217700	6448742	2660106	129232399	103976602	12340797	2792787	9548010	2194435
8	0	27675000	9225000	2767500	913275	5158994	2128085	135694019	109175432	14526087	3789960	10736127	2000001
9	0	18450000	9225000	1845000	608850	4127195	1702468	142478720	114634204	16774516	4772855	12001661	1812161
10	0	9225000	9225000	922500	304425	3301756	1361974	149602656	120365914	19089242	5749538	13339704	1632580
11	0	0	0	0	0	2641405	1089580	157082789	126384210	30698579	9770970	20927609	2075969
12	0	0	0	0	0	2113124	871664	164936928	132703420	32233508	10349409	21884099	1759554
13	0	0	0	0	0	1690499	697331	173183775	139338591	33845183	10938791	22906392	1492807
14	0	0	0	0	0	1352399	557865	181842964	146305521	35537443	11543261	23994182	1267435
15	4327678	0	0	0	0	1081919	446292	190935112	153620797	37314315	12166448	29475545	1261985
16	0	0	0	0	0	0	357033	0	0	0	-117821	117821	4089
17	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0
												NPV	0

REQUIRED FREIGHT RATE = 226 £/tonne

(with 80% load factor)

Table A7.12
SES157 Operating Costs - Mid-Journey Refuelling

VESSEL DATA		COSTHEAD	ESCALATION RATE
Length	157.6	Registration	0
Breadth	35	Manning	0
Draught	7.2	Insurance	0
Payload	2385	R & M	0
Power	216333	Stores	0
No. Containers	200	Victualling	0
Complement	29	Administration	0
Annual Op. Hours	6048	Fuel Oil	0
No. Trips per annum	224	Diesel Oil	0
Fuel Load per Trip	1346	Port Dues	0
Dieso per week	648	Cargo Handling	0

YEAR	REGISTRATION	MANNING	INSURANCE	R & M	STORES	VICTUALING	ADMINISTRATION	FUEL OIL	DIESEL OIL	PORT DUES	CARGO HANDLING	TOTAL OPERATING COSTS
0	6000	1740000	1845000	3628800	250000	32886	123000	56532000	5832000	320544	3584000	73894230
1	6300	1827000	1937250	3810240	262500	34530	129150	59358600	6123600	336571	3763200	77588942
2	6615	1918350	2034113	4000752	275625	36257	135608	62326530	6429780	353400	3951360	81468389
3	6946	2014268	2135818	4200790	289406	38070	142388	65442857	6751269	371070	4148928	85541808
4	7293	2114981	2242609	4410829	303877	39973	149507	68714999	7088832	389623	4356374	89818898
5	7658	2220730	2354739	4631371	319070	41972	156983	72150749	7443274	409104	4574193	94309843
6	8041	2331766	2472476	4862939	335024	44070	164832	75758287	7815438	429560	4802903	99025335
7	8443	2441355	2596100	5106086	351775	46274	173073	79546201	8206210	451038	5043048	103976602
8	8865	2570772	2725905	5361390	369364	48588	181727	83523511	8616520	473589	5295200	109175432
9	9308	2699311	2862201	5629460	387832	51017	190813	87699687	9047346	497269	5559960	114634204
10	9773	2834277	3005311	5910933	407224	53568	200354	92084671	9499713	522132	5837958	120365914
11	10262	2975990	3155576	6206479	427585	56246	210372	96688905	9974699	548239	6129856	126384210
12	10775	3124790	3313355	6516803	448964	59059	220890	101523350	10473434	575651	6436349	132703420
13	11314	3281030	3479023	6842644	471412	62011	231935	106599517	10997106	604434	6758167	139338591
14	11880	3445081	3652974	7184776	494983	65112	243532	111929493	11546961	634655	7096075	146305521
15	12474	3617335	3835622	7544015	519732	68368	255708	117525968	12124309	666388	7450879	153620797
16	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0

Table A7.13
SES125 Discounted Cash Flow Analysis - Mid-Journey Refuelling

PROJECT LIFE: 15 PRICE: 85000000 DEBT RATIO: 0.75 LOAN YEARS: 10 INTEREST RATE: 0.1

DECLINING BAL.: 0.2

TAX RATE: 0.33 INFLATION RATE: 0.05 DISCOUNT RATE: 0.175 BASE REVENUE: 70030871

SCRAP VALUE: 2990672

YEAR	CAPITAL	LOAN OUTSTANDING	LOAN REPAYMENTS	INTEREST PAYMENTS	RELIEF ON INTEREST	CAPITAL ALLOWANCE	RELIEF ON CAPITAL	ANNUAL REVENUE	OPERATING COSTS	GROSS SURPLUS	TAX	ANNUAL CASH FLOW	DISCOUNTED CASH FLOW
0	-21250000	0	0	0	0	0	0	0	0	0	0	-21250000	-21250000
1	0	63750000	6375000	6375000	2103750	17000000	0	70030871	57007030	273841	-603870	877711	711417
2	0	57375000	6375000	5737500	1893375	13600000	5610000	73532415	59857382	1562533	-1960478	3523011	2314513
3	0	51000000	6375000	5100000	1683000	10880000	4488000	77209036	62850251	2883785	-1084781	3968566	2113256
4	0	44625000	6375000	4462500	1472625	8704000	3590400	81069488	65992763	4239224	-271854	4511079	1947026
5	0	38250000	6375000	3825000	1262250	6963200	2872320	85122962	69292401	5630561	493677	5136884	1797065
6	0	31875000	6375000	3187500	1051875	5570560	2297856	89379110	72757021	7059589	1224253	5835336	1654637
7	0	25500000	6375000	2550000	841500	4456448	1838285	93848066	76394872	8528193	1929975	6598218	1516479
8	0	19125000	6375000	1912500	631125	3565158	1470628	98540469	80214616	10038353	2619078	7419275	1382115
9	0	12750000	6375000	1275000	420750	2852127	1176502	103467492	84225347	11592145	3298315	8293831	1252307
10	0	6375000	6375000	637500	210375	2281701	941202	108640867	88436614	13191753	3973258	9218495	1128206
11	0	0	0	0	0	1825361	752961	114072910	92858445	21214465	6752296	14462169	1434612
12	0	0	0	0	0	1460289	602369	119776556	97501367	22275188	7152030	15123158	1215952
13	0	0	0	0	0	1168231	481895	125765384	102376436	23388948	7559327	15829621	1031614
14	0	0	0	0	0	934585	385516	132053653	107495257	24558395	7977050	16581345	875870
15	2990672	0	0	0	0	747668	308413	138656335	112870020	25786315	8407708	20369279	872104
16	0	0	0	0	0	0	246730	0	0	0	-81421	81421	2826
17	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0
												NPV	0

REQUIRED FREIGHT RATE = 168 £/tonne

(with 80% load factor)

Table A7.14
SES125 Operating Costs - Mid-Journey Refuelling

VESSEL DATA

Length	125.1
Breadth	31.3
Draught	7.3
Payload (max)	1551
Power	152726
No. Containers	150
Complement	24
Annual Op. Hours	6384
No. Trips per annum	336
Fuel Load per Trip	682
Dieso per week	84

COSTHEAD	ESCALATION RATE
Registration	0
Manning	0
Insurance	0
R & M	0
Stores	0
Victualling	0
Administration	0
Fuel Oil	0
Diesel Oil	0
Port Dues	0
Cargo Handling	0

YEAR	REGISTRATION	MANNING	INSURANCE	R & M	STORES	VICTUALING	ADMINISTRATION	FUEL OIL	DIESEL OIL	PORT DUES	CARGO HANDLING	TOTAL OPERATING COSTS
0	5000	1440000	1275000	3192000	200000	28728	85000	42966000	756000	312682	4032000	54292410
1	5250	1512000	1338750	3351600	210000	30164	89250	45114300	793800	328316	4233600	57007030
2	5513	1587600	1405688	3519180	220500	31673	93713	47370015	833490	344731	4445280	59857382
3	5788	1666980	1475972	3695139	231525	33256	98398	49738516	875165	361968	4667544	62850251
4	6078	1750329	1549770	3879896	243101	34919	103318	52225442	918923	380066	4900921	65992763
5	6381	1837845	1627259	4073891	255256	36665	108484	54836714	964869	399070	5145967	69292401
6	6700	1929738	1708622	4277585	268019	38498	113908	57578549	1013112	419023	5403266	72757021
7	7036	2026225	1794053	4491465	281420	40423	119604	60457477	1063768	439974	5673429	76394872
8	7387	2127536	1883756	4716038	295491	42444	125584	63480351	1116956	461973	5957100	80214616
9	7757	2233913	1977943	4951840	310266	44567	131863	66654368	1172804	485072	6254955	84225347
10	8144	2345608	2076841	5199432	325779	46795	138456	69987087	1231444	509325	6567703	88436614
11	8552	2462889	2180683	5459403	342068	49135	145379	73486441	1293017	534792	6896088	92858445
12	8979	2586033	2289717	5732373	359171	51591	152648	77160763	1357667	561531	7240893	97501367
13	9428	2715335	2404203	6018992	377130	54171	160280	81018801	1425551	589608	7602937	102376436
14	9900	2851102	2524413	6319942	395986	56879	168294	85069741	1496828	619088	7983084	107495257
15	10395	2993657	2650633	6635939	415786	59723	176709	89323228	1571670	650043	8382238	112870020
16	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0

Table A7.15

SES194 Discounted Cash Flow Analysis - Specific Power = 18.4 kW/t

PROJECT LIFE: 15 | PRICE: 164800000 | DEBT RATIO: 0.75 | LOAN YEARS: 10 | INTEREST RATE: 0.1

DECLINING BAL.: 0.2

TAX RATE: 0.33 | INFLATION RATE: 0.05 | DISCOUNT RATE: 0.175 | BASE REVENUE: 81774255

SCRAP VALUE: 5798385

YEAR	CAPITAL	LOAN OUTSTANDING	LOAN REPAYMENTS	INTEREST PAYMENTS	RELIEF ON INTEREST	CAPITAL ALLOWANCE	RELIEF ON CAPITAL	ANNUAL REVENUE	OPERATING COSTS	GROSS SURPLUS	TAX	ANNUAL CASH FLOW	DISCOUNTED CASH FLOW
0	-41200000	0	0	0	0	0	0	0	0	0	0	-41200000	-41200000
1	0	123600000	12360000	12360000	4078800	32960000	0	81774255	56523324	530930	-1170797	1701727	1379313
2	0	111240000	12360000	11124000	3670920	26368000	10876800	85862967	59349491	3029477	-3801020	6830497	4487433
3	0	98880000	12360000	9888000	3263040	21094400	8701440	90156116	62316965	5591150	-2103199	7694349	4097230
4	0	86520000	12360000	8652000	2855160	16875520	6961152	94663921	65432814	8219108	-527077	8746185	3774940
5	0	74160000	12360000	7416000	2447280	13500416	5568922	99397118	68704454	10916663	957152	9959511	3484193
6	0	61800000	12360000	6180000	2039400	10800333	4455137	104366973	72139677	13687297	2373611	11313686	3208050
7	0	49440000	12360000	4944000	1631520	8640266	3564110	109585322	75746661	16534661	3741880	12792781	2940186
8	0	37080000	12360000	3708000	1223640	6912213	2851288	115064588	79533994	19462594	5077930	14384664	2679677
9	0	24720000	12360000	2472000	815760	5529770	2281030	120817818	83510693	22475124	6394850	16080274	2428002
10	0	12360000	12360000	1236000	407880	4423816	1824824	126858708	87686228	25576480	7703446	17873034	2187392
11	0	0	0	0	0	3539053	1459859	133201644	92070540	41131104	13091511	28039594	2781460
12	0	0	0	0	0	2831242	1167888	139861726	96674067	43187660	13866525	29321135	2357517
13	0	0	0	0	0	2264994	934310	146854812	101507770	45347043	14656202	30690841	2000118
14	0	0	0	0	0	1811995	747448	154197553	106583158	47614395	15466092	32148302	1698157
15	5798385	0	0	0	0	1449596	597958	161907431	111912316	49995114	16301061	39492437	1690855
16	0	0	0	0	0	0	478367	0	0	0	-157861	157861	5478
17	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0
												NPV	0

REQUIRED FREIGHT RATE = 665 £/tonne

(with 80% load factor)

Table A7.16
SES194 Operating Costs - Specific Power = 18.4 kW/t

VESSEL DATA		COSTHEAD	ESCALATION RATE
Length	194.1	Registration	0
Breadth	38.8	Manning	0
Draught	6.8	Insurance	0
Payload	1601	R & M	0
Power	262548	Stores	0
No. Containers	150	Victualling	0
Complement	38	Administration	0
Annual Op. Hours	5280	Fuel Oil	0
No. Trips per annum	96	Diesel Oil	0
Fuel Load per Trip	2969	Port Dues	0
Dieso per week	85	Cargo Handling	0

YEAR	REGISTRATION	MANNING	INSURANCE	R & M	STORES	VICTUALING	ADMINISTRATION	FUEL OIL	DIESEL OIL	PORT DUES	CARGO HANDLING	TOTAL OPERATING COSTS
0	7500	2280000	2472000	3960000	300000	37620	164800	42753600	612000	92218	1152000	53831738
1	7875	2394000	2595600	4158000	315000	39501	173040	44891280	642600	96828	1209600	56523324
2	8269	2513700	2725380	4365900	330750	41476	181692	47135844	674730	101670	1270080	59349491
3	8682	2639385	2861649	4584195	347288	43550	190777	49492636	708467	106753	1333584	62316965
4	9116	2771354	3004731	4813405	364652	45727	200315	51967268	743890	112091	1400263	65432814
5	9572	2909922	3154968	5054075	382884	48014	210331	54565631	781084	117696	1470276	68704454
6	10051	3055418	3312716	5306779	402029	50414	220848	57293913	820139	123580	1543790	72139677
7	10553	3208189	3478352	5572118	422130	52935	231890	60158609	861145	129759	1620980	75746661
8	11081	3368598	3652270	5850724	443237	55582	243485	63166539	904203	136247	1702029	79533994
9	11635	3537028	3834883	6143260	465398	58361	255659	66324866	949413	143060	1787130	83510693
10	12217	3713880	4026628	6450423	488668	61279	268442	69641109	996884	150213	1876487	87686228
11	12828	3899574	4227959	6772944	513102	64343	281864	73123165	1046728	157723	1970311	92070540
12	13469	4094552	4439357	7111591	538757	67560	295957	76779323	1099064	165610	2068826	96674067
13	14142	4299280	4661325	7467171	565695	70938	310755	80618289	1154017	173890	2172268	101507770
14	14849	4514244	4894391	7840529	593979	74485	326293	84649204	1211718	182585	2280881	106583158
15	15592	4739956	5139110	8232556	623678	78209	342607	88881664	1272304	191714	2394925	111912316
16	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0

Table A7.17
SES194 Discounted Cash Flow Analysis - Specific Power = 16.3 kW/t

PROJECT LIFE: 15 PRICE: 161590000 DEBT RATIO: 0.75 LOAN YEARS: 10 INTEREST RATE: 0.1

DECLINING BAL.: 0.2

TAX RATE: 0.33 INFLATION RATE: 0.05 DISCOUNT RATE: 0.175 BASE REVENUE: 76755808

SCRAP VALUE: 5685443

YEAR	CAPITAL	LOAN OUTSTANDING	LOAN REPAYMENTS	INTEREST PAYMENTS	RELIEF ON INTEREST	CAPITAL ALLOWANCE	RELIEF ON CAPITAL	ANNUAL REVENUE	OPERATING COSTS	GROSS SURPLUS	TAX	ANNUAL CASH FLOW	DISCOUNTED CASH FLOW
0	-40397500	0	0	0	0	0	0	0	0	0	0	-40397500	-40397500
1	0	121192500	12119250	12119250	3999353	32318000	0	76755808	51996719	520589	-1147992	1668581	1352446
2	0	109073250	12119250	10907325	3599417	25854400	10664940	80593598	54596555	2970468	-3726983	6697451	4400026
3	0	96954000	12119250	9695400	3199482	20683520	8531952	84623278	57326383	5482245	-2062232	7544477	4017424
4	0	84834750	12119250	8483475	2799547	16546816	6825562	88854442	60192702	8059015	-516811	8575826	3701411
5	0	72715500	12119250	7271550	2399612	13237453	5460449	93297164	63202337	10704027	938509	9765518	3416327
6	0	60596250	12119250	6059625	1999676	10589962	4368359	97962022	66362454	13420693	2327377	11093316	3145563
7	0	48477000	12119250	4847700	1599741	8471970	3494688	102860123	69680577	16212597	3668995	12543601	2882917
8	0	36357750	12119250	3635775	1199806	6777576	2795750	108003129	73164605	19083499	4979021	14104478	2627482
9	0	24238500	12119250	2423850	799871	5422061	2236600	113403286	76822836	22037350	6270290	15767060	2380709
10	0	12119250	12119250	1211925	399935	4337649	1789280	119073450	80663977	25078298	7553397	17524900	2144786
11	0	0	0	0	0	3470119	1431424	125027123	84697176	40329946	12836512	27493434	2727283
12	0	0	0	0	0	2776095	1145139	131278479	88932035	42346444	13596430	28750013	2311597
13	0	0	0	0	0	2220876	916111	137842403	93378637	44463766	14370726	30093040	1961159
14	0	0	0	0	0	1776701	732889	144734523	98047569	46686954	15164841	31522113	1665080
15	5685443	0	0	0	0	1421361	586311	151971249	102949947	49021302	15983547	38723198	1657921
16	0	0	0	0	0	0	469049	0	0	0	-154786	154786	5372
17	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0
												NPV	0

REQUIRED FREIGHT RATE = 527 £/tonne

(with 80% load factor)

Table A7.18
SES194 Operating Costs - Specific Power = 16.3 kW/t

VESSEL DATA	
Length	194.1
Breadth	38.8
Draught	6.8
Payload	1898
Power	233376
No. Containers	150
Complement	38
Annual Op. Hours	5280
No. Trips per annum	96
Fuel Load per Trip	2672
Dieso per week	85

COSTHEAD	ESCALATION RATE
Registration	0
Manning	0
Insurance	0
R & M	0
Stores	0
Victualling	0
Administration	0
Fuel Oil	0
Diesel Oil	0
Port Dues	0
Cargo Handling	0

YEAR	REGISTRATION	MANNING	INSURANCE	R & M	STORES	VICTUALING	ADMINISTRATION	FUEL OIL	DIESEL OIL	PORT DUES	CARGO HANDLING	TOTAL OPERATING COSTS
0	7500	2280000	2423850	3960000	300000	37620	161590	38476800	612000	109325	1152000	49520685
1	7875	2394000	2545043	4158000	315000	39501	169670	40400640	642600	114791	1209600	51996719
2	8269	2513700	2672295	4365900	330750	41476	178153	42420672	674730	120531	1270080	54596555
3	8682	2639385	2805909	4584195	347288	43550	187061	44541706	708467	126557	1333584	57326383
4	9116	2771354	2946205	4813405	364652	45727	196414	46768791	743890	132885	1400263	60192702
5	9572	2909922	3093515	5054075	382884	48014	206234	49107230	781084	139529	1470276	63202337
6	10051	3055418	3248191	5306779	402029	50414	216546	51562592	820139	146506	1543790	66362454
7	10553	3208189	3410600	5572118	422130	52935	227373	54140722	861145	153831	1620980	69680577
8	11081	3368598	3581130	5850724	443237	55582	238742	56847758	904203	161523	1702029	73164605
9	11635	3537028	3760187	6143260	465398	58361	250679	59690146	949413	169599	1787130	76822836
10	12217	3713880	3948196	6450423	488668	61279	263213	62674653	996884	178079	1876487	80663977
11	12828	3899574	4145606	6772944	513102	64343	276374	65808385	1046728	186983	1970311	84697176
12	13469	4094552	4352886	7111591	538757	67560	290192	69098805	1099064	196332	2068826	88932035
13	14142	4299280	4570531	7467171	565695	70938	304702	72553745	1154017	206148	2172268	93378637
14	14849	4514244	4799057	7840529	593979	74485	319937	76181432	1211718	216456	2280881	98047569
15	15592	4739956	5039010	8232556	623678	78209	335934	79990504	1272304	227278	2394925	102949947
16	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0

Table A7.19

SES157 Discounted Cash Flow Analysis - Specific Power = 20.97 kW/t

PROJECT LIFE: 15 | PRICE: 120300000 | DEBT RATIO: 0.75 | LOAN YEARS: 10 | INTEREST RATE: 0.1

DECLINING BAL.: 0.2

TAX RATE: 0.33 | INFLATION RATE: 0.05 | DISCOUNT RATE: 0.175 | BASE REVENUE: 75405569

SCRAP VALUE: 4232680

YEAR	CAPITAL	LOAN OUTSTANDING	LOAN REPAYMENTS	INTEREST PAYMENTS	RELIEF ON INTEREST	CAPITAL ALLOWANCE	RELIEF ON CAPITAL	ANNUAL REVENUE	OPERATING COSTS	GROSS SURPLUS	TAX	ANNUAL CASH FLOW	DISCOUNTED CASH FLOW
0	-30075000	0	0	0	0	0	0	0	0	0	0	-30075000	-30075000
1	0	90225000	9022500	9022500	2977425	24060000	0	75405569	56973003	387566	-854653	1242220	1006865
2	0	81202500	9022500	8120250	2679683	19248000	7939800	79175847	59821653	2211444	-2774653	4986097	3275717
3	0	72180000	9022500	7218000	2381940	15398400	6351840	83134640	62812736	4081404	-1535284	5616688	2990879
4	0	63157500	9022500	6315750	2084198	12318720	5081472	87291372	65953373	5999749	-384754	6384503	2755614
5	0	54135000	9022500	5413500	1786455	9854976	4065178	91655940	69251041	7968899	698698	7270201	2543376
6	0	45112500	9022500	4511250	1488713	7883981	3252142	96238737	72713593	9991394	1732678	8258716	2341799
7	0	36090000	9022500	3609000	1190970	6307185	2601714	101050674	76349273	12069901	2731482	9338420	2146264
8	0	27067500	9022500	2706750	893228	5045748	2081371	106103208	80166737	14207222	3706766	10500456	1956099
9	0	18045000	9022500	1804500	595485	4036598	1665097	111408368	84175073	16406295	4668085	11738210	1772382
10	0	9022500	9022500	902250	297743	3229279	1332077	116978787	88383827	18670210	5623329	13046881	1596743
11	0	0	0	0	0	2583423	1065662	122827726	92803018	30024708	9556485	20468223	2030399
12	0	0	0	0	0	2066738	852530	128969113	97443169	31525943	10122227	21403717	1720930
13	0	0	0	0	0	1653391	682024	135417568	102315328	33102240	10698672	22403569	1460038
14	0	0	0	0	0	1322712	545619	142188447	107431094	34757352	11289872	23467480	1239613
15	4232680	0	0	0	0	1058170	436495	149297869	112802649	36495220	11899379	28828521	1234283
16	0	0	0	0	0	0	349196	0	0	0	-115235	115235	3999
17	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0
												NPV	0

REQUIRED FREIGHT RATE = 219 £/tonne

(with 80% load factor)

Table A7.20
SES157 Operating Costs - Specific Power = 20.97 kW/t

VESSEL DATA		COSTHEAD	ESCALATION RATE
Length	157.6	Registration	0
Breadth	35	Manning	0
Draught	7.2	Insurance	0
Payload	1922	R & M	0
Power	194727	Stores	0
No. Containers	200	Victualling	0
Complement	29	Administration	0
Annual Op. Hours	6048	Fuel Oil	0
No. Trips per annum	224	Diesel Oil	0
Fuel Load per Trip	1136	Port Dues	0
Dieso per week	648	Cargo Handling	0

YEAR	REGISTRATION	MANNING	INSURANCE	R & M	STORES	VICTUALING	ADMINISTRATION	FUEL OIL	DIESEL OIL	PORT DUES	CARGO HANDLING	TOTAL OPERATING COSTS
0	6000	1740000	1804500	3628800	250000	32886	120300	38169600	4665600	258317	3584000	54260003
1	6300	1827000	1894725	3810240	262500	34530	126315	40078080	4898880	271233	3763200	56973003
2	6615	1918350	1989461	4000752	275625	36257	132631	42081984	5143824	284794	3951360	59821653
3	6946	2014268	2088934	4200790	289406	38070	139262	44186083	5401015	299034	4148928	62812736
4	7293	2114981	2193381	4410829	303877	39973	146225	46395387	5671066	313986	4356374	65953373
5	7658	2220730	2303050	4631371	319070	41972	153537	48715157	5954619	329685	4574193	69251041
6	8041	2331766	2418203	4862939	335024	44070	161214	51150915	6252350	346169	4802903	72713593
7	8443	2448355	2539113	5106086	351775	46274	169274	53708460	6564968	363478	5043048	76349273
8	8865	2570772	2666068	5361390	369364	48588	177738	56393883	6893216	381652	5295200	80166737
9	9308	2699311	2799372	5629460	387832	51017	186625	59213577	7237877	400734	5559960	84175073
10	9773	2834277	2939340	5910933	407224	53568	195956	62174256	7599771	420771	5837958	88383827
11	10262	2975990	3086307	6206479	427585	56246	205754	65282969	7979759	441809	6129856	92803018
12	10775	3124790	3240623	6516803	448964	59059	216042	68547118	8378747	463900	6436349	97443169
13	11314	3281030	3402654	6842644	471412	62011	226844	71974474	8797685	487095	6758167	102315328
14	11880	3445081	3572787	7184776	494983	65112	238186	75573197	9237569	511450	7096075	107431094
15	12474	3617335	3751426	7544015	519732	68368	250095	79351857	9699447	537022	7450879	112802649
16	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0

Table A7.21
SES157 Discounted Cash Flow Analysis - Specific Power = 18.64 kW/t

PROJECT LIFE: 15 | PRICE: 117600000 | DEBT RATIO: 0.75 | LOAN YEARS: 10 | INTEREST RATE: 0.1

DECLINING BAL.: 0.2

TAX RATE: 0.33 | INFLATION RATE: 0.05 | DISCOUNT RATE: 0.175 | BASE REVENUE: 70764984

SCRAP VALUE: 4137682

YEAR	CAPITAL	LOAN OUTSTANDING	LOAN REPAYMENTS	INTEREST PAYMENTS	RELIEF ON INTEREST	CAPITAL ALLOWANCE	RELIEF ON CAPITAL	ANNUAL REVENUE	OPERATING COSTS	GROSS SURPLUS	TAX	ANNUAL CASH FLOW	DISCOUNTED CASH FLOW
0	-29400000	0	0	0	0	0	0	0	0	0	0	-29400000	-29400000
1	0	88200000	8820000	8820000	2910600	23520000	0	70764984	52746116	378868	-835472	1214339	984267
2	0	79380000	8820000	7938000	2619540	18816000	7761600	74303233	55383422	2161811	-2712379	4874190	3202197
3	0	70560000	8820000	7056000	2328480	15052800	6209280	78018395	58152593	3989802	-1500826	5490628	2923752
4	0	61740000	8820000	6174000	2037420	12042240	4967424	81919314	61060223	5865092	376118	6241210	2693768
5	0	52920000	8820000	5292000	1746360	9633792	3973939	86015280	64113234	7790046	683017	7107030	2486293
6	0	44100000	8820000	4410000	1455300	7707034	3179151	90316044	67318896	9767148	1693790	8073358	2289240
7	0	35280000	8820000	3528000	1164240	6165627	2543321	94831846	70684840	11799006	2670177	9128829	2098094
8	0	26460000	8820000	2646000	873180	4932502	2034657	99573439	74219082	13888356	3623571	10264785	1912197
9	0	17640000	8820000	1764000	582120	3946001	1627725	104552111	77930037	16038074	4563315	11474759	1732603
10	0	8820000	8820000	882000	291060	3156801	1302180	109779716	81826538	18251178	5497119	12754058	1560906
11	0	0	0	0	0	2525441	1041744	115268702	85917865	29350837	9342000	20008836	1984829
12	0	0	0	0	0	2020353	833395	121032137	90213759	30818378	9895044	20923334	1682306
13	0	0	0	0	0	1616282	666716	127083744	94724446	32359297	10458552	21900746	1427269
14	0	0	0	0	0	1293026	533373	133437931	99460669	33977262	11036483	22940779	1211791
15	4137682	0	0	0	0	1034421	426698	140109828	104433702	35676125	11632311	28181497	1206581
16	0	0	0	0	0	0	341359	0	0	0	-112648	112648	3909
17	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0
												NPV	0

REQUIRED FREIGHT RATE = 193 £/tonne

(with 80% load factor)

Table A7.22
SES157 Operating Costs - Specific Power = 18.64 kW/t

VESSEL DATA		COSTHEAD	ESCALATION RATE
Length	157.6	Registration	0
Breadth	35	Manning	0
Draught	7.2	Insurance	0
Payload	2041	R & M	0
Power	173091	Stores	0
No. Containers	200	Victualling	0
Complement	29	Administration	0
Annual Op. Hours	6048	Fuel Oil	0
No. Trips per annum	224	Diesel Oil	0
Fuel Load per Trip	1017	Port Dues	0
Dieso per week	648	Cargo Handling	0

YEAR	REGISTRATION	MANNING	INSURANCE	R & M	STORES	VICTUALING	ADMINISTRATION	FUEL OIL	DIESEL OIL	PORT DUES	CARGO HANDLING	TOTAL OPERATING COSTS
0	6000	1740000	1764000	3628800	250000	32886	117600	34171200	4665600	274310	3584000	50234396
1	6300	1827000	1852200	3810240	262500	34530	123480	35879760	4898880	288026	3763200	52746116
2	6615	1918350	1944810	4000752	275625	36257	129654	37673748	5143824	302427	3951360	55383422
3	6946	2014268	2012051	4200790	289406	38070	136137	39557435	5401015	317549	4148928	58152593
4	7293	2114981	2144153	4410829	303877	39973	142944	41535307	5671066	333426	4356374	61060223
5	7658	2220730	2251361	4631371	319070	41972	150091	43612073	5954619	350097	4574193	64113234
6	8041	2331766	2363929	4862939	335024	44070	157595	45792676	6252350	367602	4802903	67318896
7	8443	2448355	2482125	5106086	351775	46274	165475	48082310	6564968	385982	5043048	70684840
8	8865	2570772	2606231	5361390	369364	48588	173749	50486425	6893216	405281	5295200	74219082
9	9308	2699311	2736543	5629460	387832	51017	182436	53010747	7237877	425545	5559960	77930037
10	9773	2834277	2873370	5910933	407224	53568	191558	55661284	7599771	446823	5837958	81826538
11	10262	2975990	3017039	6206479	427585	56246	201136	58444348	7979759	469164	6129856	85917865
12	10775	3124790	3167891	6516803	448964	59059	211193	61366566	8378747	492622	6436349	90213759
13	11314	3281030	3326285	6842644	471412	62011	221752	64434894	8797685	517253	6758167	94724446
14	11880	3445081	3492599	7184776	494983	65112	232840	67656639	9237569	543116	7096075	99460669
15	12474	3617335	3667229	7544015	519732	68368	244482	71039471	9699447	570272	7450879	104433702
16	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0

Table A7.23
SES125 Discounted Cash Flow Analysis - Specific Power = 24.06 kW/t

PROJECT LIFE: 15 | PRICE: 82940000 | DEBT RATIO: 0.75 | LOAN YEARS: 10 | INTEREST RATE: 0.1

DECLINING BAL.: 0.2

TAX RATE: 0.33 | INFLATION RATE: 0.05 | DISCOUNT RATE: 0.175 | BASE REVENUE: 54628909

SCRAP VALUE: 2918192

YEAR	CAPITAL	LOAN OUTSTANDING	LOAN REPAYMENTS	INTEREST PAYMENTS	RELIEF ON INTEREST	CAPITAL ALLOWANCE	RELIEF ON CAPITAL	ANNUAL REVENUE	OPERATING COSTS	GROSS SURPLUS	TAX	ANNUAL CASH FLOW	DISCOUNTED CASH FLOW
0	-20735000	0	0	0	0	0	0	0	0	0	0	-20735000	-20735000
1	0	62205000	6220500	6220500	2052765	16588000	0	54628909	41920704	267205	-589235	856440	694176
2	0	55984500	6220500	5598450	1847489	13270400	5474040	57360354	44016739	1524665	-1912965	3437630	2258420
3	0	49764000	6220500	4976400	1642212	10616320	4379232	60228372	46217576	2813896	-1058491	3872387	2062041
4	0	43543500	6220500	4354350	1436936	8493056	3503386	63239790	48528455	4136486	-265266	4401751	1899839
5	0	37323000	6220500	3732300	1231659	6794445	2802708	66401780	50954878	5494102	481712	5012390	1753513
6	0	31102500	6220500	3110250	1026383	5435556	2242167	69721869	53502622	6888497	1194583	5693915	1614537
7	0	24882000	6220500	2488200	821106	4348445	1793733	73207962	56177753	8321510	1883201	6438309	1479727
8	0	18661500	6220500	1866150	615830	3478756	1434987	76868361	58986640	9795070	2555604	7239466	1348619
9	0	12441000	6220500	1244100	410553	2783005	1147989	80711779	61935972	11311206	3218379	8092827	1221957
10	0	6220500	6220500	622050	205277	2226404	918392	84747368	65032771	12872047	3876965	8995082	1100863
11	0	0	0	0	0	1781123	734713	88984736	68284409	20700326	6588652	14111674	1399844
12	0	0	0	0	0	1424898	587771	93433973	71698630	21735343	6978699	14756644	1186483
13	0	0	0	0	0	1139919	470216	98105671	75283561	22822110	7376125	15445985	1006613
14	0	0	0	0	0	911935	376173	103010955	79047740	23963215	7783724	16179491	854643
15	2918192	0	0	0	0	729548	300939	108161503	83000127	25161376	8203944	19875624	850968
16	0	0	0	0	0	0	240751	0	0	0	-79448	79448	2757
17	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0
												NPV	0

REQUIRED FREIGHT RATE = 154 £/tonne

(with 80% load factor)

Table A7.24

SES125 Operating Costs - Specific Power = 24.06 kW/t

VESSEL DATA		COSTHEAD	ESCALATION RATE
Length	125.1	Registration	0
Breadth	31.3	Manning	0
Draught	7.3	Insurance	0
Payload (max)	1320	R & M	0
Power	137462	Stores	0
No. Containers	150	Victualling	0
Complement	24	Administration	0
Annual Op. Hours	6384	Fuel Oil	0
No. Trips per annum	336	Diesel Oil	0
Fuel Load per Trip	572	Port Dues	0
Dieso per week	84	Cargo Handling	0

YEAR	REGISTRATION	MANNING	INSURANCE	R & M	STORES	VICTUALING	ADMINISTRATION	FUEL OIL	DIESEL OIL	PORT DUES	CARGO HANDLING	TOTAL OPERATING COSTS
0	5000	1440000	1244100	3192000	200000	28728	82940	28828800	604800	266112	4032000	39924480
1	5250	1512000	1306305	3351600	210000	30164	87087	30270240	635040	279418	4233600	41920704
2	5513	1587600	1371620	3519180	220500	31673	91441	31783752	666792	293388	4445280	44016739
3	5788	1666980	1440201	3695139	231525	33256	96013	33372940	700132	308058	4667544	46217576
4	6078	1750329	1512211	3879896	243101	34919	100814	35041587	735138	323461	4900921	48528455
5	6381	1837845	1587822	4073891	255256	36665	105855	36793666	771895	339634	5145967	50954878
6	6700	1929738	1667213	4277585	268019	38498	111148	38633349	810490	356616	5403266	53502622
7	7036	2026225	1750574	4491465	281420	40423	116705	40565017	851014	374446	5673429	56177753
8	7387	2127536	1838102	4716038	295491	42444	122540	42593267	893565	393169	5957100	58986640
9	7757	2233913	1930007	4951840	310266	44567	128667	44722931	938243	412827	6254955	61935972
10	8144	2345608	2026508	5199432	325779	46795	135101	46959077	985155	433468	6567703	65032771
11	8552	2462889	2127833	5459403	342068	49135	141856	49307031	1034413	455142	6896088	68284409
12	8979	2586033	2234225	5732373	359171	51591	148948	51772383	1086134	477899	7240893	71698630
13	9428	2715335	2345936	6018992	377130	54171	156396	54361002	1140441	501794	7602937	75283561
14	9900	2851102	2463233	6319942	395986	56879	164216	57079052	1197463	526884	7983084	79047740
15	10395	2993657	2586395	6635939	415786	59723	172426	59933005	1257336	553228	8382238	83000127
16	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0

Table A7.25
SES125 Discounted Cash Flow Analysis - Specific Power = 21.38 kW/t

PROJECT LIFE: 15   PRICE: 80880000   DEBT RATIO: 0.75   LOAN YEARS: 10   INTEREST RATE: 0.1

DECLINING BAL.: 0.2

TAX RATE: 0.33   INFLATION RATE: 0.05   DISCOUNT RATE: 0.175   BASE REVENUE: 51063457

SCRAP VALUE: 2845712

YEAR	CAPITAL	LOAN OUTSTANDING	LOAN REPAYMENTS	INTEREST PAYMENTS	RELIEF ON INTEREST	CAPITAL ALLOWANCE	RELIEF ON CAPITAL	ANNUAL REVENUE	OPERATING COSTS	GROSS SURPLUS	TAX	ANNUAL CASH FLOW	DISCOUNTED CASH FLOW
0	-20220000	0	0	0	0	0	0	0	0	0	0	-20220000	-20220000
1	0	60660000	6066000	6066000	2001780	16176000	0	51063457	38670888	260568	-574600	835168	676935
2	0	54594000	6066000	5459400	1801602	12940800	5338080	53616629	40604433	1486797	-1865452	3352249	2202328
3	0	48528000	6066000	4852800	1601424	10352640	4270464	56297461	42634655	2744006	-1032201	3776207	2010825
4	0	42462000	6066000	4246200	1401246	8282112	3416371	59112334	44766387	4033747	-258677	4292424	1852652
5	0	36396000	6066000	3639600	1201068	6625690	2733097	62067951	47004707	5357644	469748	4887896	1709961
6	0	30330000	6066000	3033000	1000890	5300552	2186478	65171348	49354942	6717406	1164913	5552493	1574436
7	0	24264000	6066000	2426400	800712	4240441	1749182	68429916	51822689	8114827	1836428	6278399	1442975
8	0	18198000	6066000	1819800	600534	3392353	1399346	71851411	54413824	9551788	2492130	7059658	1315123
9	0	12132000	6066000	1213200	400356	2713882	1119477	75443982	57134515	11030267	3138443	7891824	1191607
10	0	6066000	6066000	606600	200178	2171106	895581	79216181	59991240	12552341	3780672	8771669	1073521
11	0	0	0	0	0	1736885	716465	83176990	62990802	20186188	6425008	13761179	1365076
12	0	0	0	0	0	1389508	573172	87335840	66140343	21195497	6805367	14390130	1157014
13	0	0	0	0	0	1111606	458538	91702632	69447360	22255272	7192922	15062350	981611
14	0	0	0	0	0	889285	366830	96287763	72919728	23368035	7590398	15777638	833416
15	2845712	0	0	0	0	711428	293464	101102151	76565714	24536437	8000181	19381968	829832
16	0	0	0	0	0	0	234771	0	0	0	-77475	77475	2689
17	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0
												NPV	0

REQUIRED FREIGHT RATE = 138 £/tonne

(with 80% load factor)

Table A7.26
SES125 Operating Costs - Specific Power = 21.38 kW/t

VESSEL DATA		COSTHEAD	ESCALATION RATE
Length	125.1	Registration	0
Breadth	31.3	Manning	0
Draught	7.3	Insurance	0
Payload (max)	1381	R & M	0
Power	122188	Stores	0
No. Containers	150	Victualling	0
Complement	24	Administration	0
Annual Op. Hours	6384	Fuel Oil	0
No. Trips per annum	336	Diesel Oil	0
Fuel Load per Trip	511	Port Dues	0
Dieso per week	84	Cargo Handling	0

YEAR	REGISTRATION	MANNING	INSURANCE	R & M	STORES	VICTUALING	ADMINISTRATION	FUEL OIL	DIESEL OIL	PORT DUES	CARGO HANDLING	TOTAL OPERATING COSTS
0	5000	1440000	1213200	3192000	200000	28728	80880	25754400	604800	278410	4032000	36829418
1	5250	1512000	1273860	3351600	210000	30164	84924	27042120	635040	292330	4233600	38670888
2	5513	1587600	1337553	3519180	220500	31673	89170	28394226	666792	306947	4445280	40604433
3	5788	1666980	1404431	3695139	231525	33256	93629	29813937	700132	322294	4667544	42634655
4	6078	1750329	1474652	3879896	243101	34919	98310	31304634	735138	338409	4900921	44766387
5	6381	1837845	1548385	4073891	255256	36665	103226	32869866	771895	355329	5145967	47004707
6	6700	1929738	1625804	4277585	268019	38498	108387	34513359	810490	373095	5403266	49354942
7	7036	2026225	1707094	4491465	281420	40423	113806	36239027	851014	391750	5673429	51822689
8	7387	2127536	1792449	4716038	295491	42444	119497	38050978	893565	411338	5957100	54413824
9	7757	2233913	1882071	4951840	310266	44567	125471	39953527	938243	431905	6254955	57134515
10	8144	2345608	1976175	5199432	325779	46795	131745	41951204	985155	453500	6567703	59991240
11	8552	2462889	2074984	5459403	342068	49135	138332	44048764	1034413	476175	6896088	62990802
12	8979	2586033	2178733	5732373	359171	51591	145249	46251202	1086134	499984	7240893	66140343
13	9428	2715335	2287670	6018992	377130	54171	152511	48563762	1140441	524983	7602937	69447360
14	9900	2851102	2402053	6319942	395986	56879	160137	50991950	1197463	551232	7983084	72919728
15	10395	2993657	2522156	6635939	415786	59723	168144	53541548	1257336	578794	8382238	76565714
16	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0

Table A7.27
SES194 Discounted Cash Flow Analysis - SFC = 200g/kWhr

PROJECT LIFE: 15 | PRICE: 168000000 | DEBT RATIO: 0.75 | LOAN YEARS: 10 | INTEREST RATE: 0.1

DECLINING BAL.: 0.2

TAX RATE: 0.33 | INFLATION RATE: 0.05 | DISCOUNT RATE: 0.175 | BASE REVENUE: 80932848

SCRAP VALUE: 5910975

YEAR	CAPITAL	LOAN OUTSTANDING	LOAN REPAYMENTS	INTEREST PAYMENTS	RELIEF ON INTEREST	CAPITAL ALLOWANCE	RELIEF ON CAPITAL	ANNUAL REVENUE	OPERATING COSTS	GROSS SURPLUS	TAX	ANNUAL CASH FLOW	DISCOUNTED CASH FLOW
0	-42000000	0	0	0	0	0	0	0	0	0	0	-42000000	-42000000
1	0	126000000	12600000	12600000	4158000	33600000	0	80932848	55191609	541239	-1193531	1734770	1406096
2	0	113400000	12600000	11340000	3742200	26880000	11088000	84979490	57951189	3088301	-3874827	6963128	4574568
3	0	100800000	12600000	10080000	3326400	21504000	8870400	89228465	60848749	5699716	-2144038	7843754	4176788
4	0	88200000	12600000	8820000	2910600	17203200	7056320	93689888	63891186	8378702	-537312	8916014	3848239
5	0	75600000	12600000	7560000	2494800	13762560	5677056	98374383	67085745	11128637	975738	10152900	3551847
6	0	63000000	12600000	6300000	2079000	11010048	4541645	103293102	70440033	13953069	2419700	11533369	3270342
7	0	50400000	12600000	5040000	1663200	8808038	3633316	108457757	73962034	16855723	3814538	13041184	2997277
8	0	37800000	12600000	3780000	1247400	7046431	2906653	113880645	77660136	19840509	5176531	14663978	2731709
9	0	25200000	12600000	2520000	831600	5637145	2325322	119574677	81543143	22911534	6519022	16392512	2475147
10	0	12600000	12600000	1260000	415800	4509716	1860258	125553411	85620300	26073111	7853028	18220083	2229866
11	0	0	0	0	0	3607773	1488206	131831081	89901315	41929767	13345715	28584052	2835469
12	0	0	0	0	0	2886218	1190565	138422635	94396380	44026255	14135778	29890477	2403294
13	0	0	0	0	0	2308974	952452	145343767	99116200	46227568	14940788	31286779	2038955
14	0	0	0	0	0	1847180	761962	152610956	104072009	48538946	15766405	32772541	1731130
15	5910975	0	0	0	0	1477744	609569	160241503	109275610	50965893	16617587	40259281	1723687
16	0	0	0	0	0	0	487655	0	0	0	-160926	160926	5585
17	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0
												NPV	0

REQUIRED FREIGHT RATE = 622 £/tonne

(with 80% load factor)

Table A7.28
SES194 Operating Costs - SFC = 200g/kWhr

VESSEL DATA		COSTHEAD	ESCALATION RATE
Length	194.1	Registration	0
Breadth	38.8	Manning	0
Draught	6.8	Insurance	0
Payload	1693	R & M	0
Power	291670	Stores	0
No. Containers	150	Victualling	0
Complement	38	Administration	0
Annual Op. Hours	5280	Fuel Oil	0
No. Trips per annum	96	Diesel Oil	0
Fuel Load per Trip	2877	Port Dues	0
Dieso per week	85	Cargo Handling	0

YEAR	REGISTRATION	MANNING	INSURANCE	R & M	STORES	VICTUALING	ADMINISTRATION	FUEL OIL	DIESEL OIL	PORT DUES	CARGO HANDLING	TOTAL OPERATING COSTS
0	7500	2280000	2520000	3960000	300000	37620	168000	41428800	612000	97517	1152000	52563437
1	7875	2394000	2646000	4158000	315000	39501	176400	43500240	642600	102393	1209600	55191609
2	8269	2513700	2778300	4365900	330750	41476	185220	45675252	674730	107512	1270080	57951189
3	8682	2639385	2917215	4584195	347288	43550	194481	47959015	708467	112888	1333584	60848749
4	9116	2771354	3063076	4813405	364652	45727	204205	50356965	743890	118532	1400263	63891186
5	9572	2909922	3216230	5054075	382884	48014	214415	52874814	781084	124459	1470276	67085745
6	10051	3055418	3377041	5306779	402029	50414	225136	55518554	820139	130682	1543790	70440033
7	10553	3208189	3545893	5572118	422130	52935	236393	58294482	861145	137216	1620980	73962034
8	11081	3368598	3723188	5850724	443237	55582	248213	61209206	904203	144077	1702029	77660136
9	11635	3537028	3909347	6143260	465398	58361	260623	64269666	949413	151281	1787130	81543143
10	12217	3713880	4104814	6450423	488668	61279	273654	67483150	996884	158845	1876487	85620300
11	12828	3899574	4310055	6772944	513102	64343	287337	70857307	1046728	166787	1970311	89901315
12	13469	4094552	4525558	7111591	538757	67560	301704	74400173	1099064	175126	2068826	94396380
13	14142	4299280	4751836	7467171	565695	70938	316789	78120181	1154017	183882	2172268	99116200
14	14849	4514244	4989428	7840529	593979	74485	332629	82026190	1211718	193077	2280881	104072009
15	15592	4739956	5238899	8232556	623678	78209	349260	86127500	1272304	202730	2394925	109275610
16	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0

Table A7.29

SES194 Discounted Cash Flow Analysis - SFC = 180g/kWhr

PROJECT LIFE: 15 | PRICE: 168000000 | DEBT RATIO: 0.75 | LOAN YEARS: 10 | INTEREST RATE: 0.1

DECLINING BAL.: 0.2

TAX RATE: 0.33 | INFLATION RATE: 0.05 | DISCOUNT RATE: 0.175 | BASE REVENUE: 77017373

SCRAP VALUE: 5910975

YEAR	CAPITAL	LOAN OUTSTANDING	LOAN REPAYMENTS	INTEREST PAYMENTS	RELIEF ON INTEREST	CAPITAL ALLOWANCE	RELIEF ON CAPITAL	ANNUAL REVENUE	OPERATING COSTS	GROSS SURPLUS	TAX	ANNUAL CASH FLOW	DISCOUNTED CASH FLOW
0	-42000000	0	0	0	0	0	0	0	0	0	0	-42000000	-42000000
1	0	126000000	12600000	12600000	4158000	33600000	0	77017373	51276133	541239	-1193531	1734770	1406096
2	0	113400000	12600000	11340000	3742200	26880000	11088000	80868242	53839940	3088301	-3874827	6963128	4574568
3	0	100800000	12600000	10080000	3326400	21504000	8870400	84911654	56531937	5699716	-2144038	7843754	4176788
4	0	88200000	12600000	8820000	2910600	17203200	7096320	89157236	59358534	8378702	-537312	8916014	3848239
5	0	75600000	12600000	7560000	2494800	13762560	5677056	93615098	62326461	11128637	975738	10152900	3551847
6	0	63000000	12600000	6300000	2079000	11010048	4541645	98295853	65442784	13953069	2419700	11533369	3270342
7	0	50400000	12600000	5040000	1663200	8808038	3633316	103210646	68714923	16855723	3814538	13041184	2997277
8	0	37800000	12600000	3780000	1247400	7046431	2906653	108371178	72150669	19840509	5176531	14663978	2731709
9	0	25200000	12600000	2520000	831600	5637145	2325322	113789737	75758202	22911534	6519022	16392512	2475147
10	0	12600000	12600000	1260000	415800	4509716	1860258	119479224	79546113	26073111	7853028	18220083	2229866
11	0	0	0	0	0	3607773	1488206	125453185	83523418	41929767	13345715	28584052	2835469
12	0	0	0	0	0	2886218	1190565	131725844	87699589	44026255	14135778	29890477	2403294
13	0	0	0	0	0	2308974	952452	138312136	92084569	46227568	14940788	31286779	2038955
14	0	0	0	0	0	1847180	761962	145227743	96688797	48538946	15766405	32772541	1731130
15	5910975	0	0	0	0	1477744	609569	152489130	101523237	50965893	16617587	40259281	1723687
16	0	0	0	0	0	0	487655	0	0	0	-160926	160926	5585
17	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0
												= NPV	0

REQUIRED FREIGHT RATE = 513 £/tonne

(with 80% load factor)

Table A7.30
SES194 Operating Costs - SFC = 180g/kWhr

VESSEL DATA		COSTHEAD	ESCALATION RATE
Length	194.1	Registration	0
Breadth	38.8	Manning	0
Draught	6.8	Insurance	0
Payload	1953	R & M	0
Power	291670	Stores	0
No. Containers	150	Victualling	0
Complement	38	Administration	0
Annual Op. Hours	5280	Fuel Oil	0
No. Trips per annum	96	Diesel Oil	0
Fuel Load per Trip	2617	Port Dues	0
Dieso per week	85	Cargo Handling	0

YEAR	REGISTRATION	MANNING	INSURANCE	R & M	STORES	VICTUALING	ADMINISTRATION	FUEL OIL	DIESEL OIL	PORT DUES	CARGO HANDLING	TOTAL OPERATING COSTS
0	7500	2280000	2520000	3960000	300000	37620	168000	37684800	612000	112493	1152000	48834413
1	7875	2394000	2646000	4158000	315000	39501	176400	39569040	642600	118117	1209600	51276133
2	8269	2513700	2778300	4365900	330750	41476	185220	41547492	674730	124023	1270080	53839940
3	8682	2639385	2917215	4584195	347288	43550	194481	43624867	708467	130224	1333584	56531937
4	9116	2771354	3063076	4813405	364652	45727	204205	45806110	743890	136736	1400263	59358534
5	9572	2909922	3216230	5054075	382884	48014	214415	48096415	781084	143572	1470276	62326461
6	10051	3055418	3377041	5306779	402029	50414	225136	50501236	820139	150751	1543790	65442784
7	10553	3208189	3545893	5572118	422130	52935	236393	53026298	861145	158289	1620980	68714923
8	11081	3368598	3723188	5850724	443237	55582	248213	55677613	904203	166203	1702029	72150669
9	11635	3537028	3909347	6143260	465398	58361	260623	58461494	949413	174513	1787130	75758202
10	12217	3713880	4104814	6450423	488668	61279	273654	61384568	996884	183239	1876487	79546113
11	12828	3899574	4310055	6772944	513102	64343	287337	64453797	1046728	192401	1970311	83523418
12	13469	4094552	4525558	7111591	538757	67560	301704	67676486	1099064	202021	2068826	87699589
13	14142	4299280	4751836	7467171	565695	70938	316789	71060311	1154017	212122	2172268	92084569
14	14849	4514244	4989428	7840529	593979	74485	332629	74613326	1211718	222728	2280881	96688797
15	15592	4739956	5238899	8232556	623678	78209	349260	78343993	1272304	233864	2394925	101523237
16	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0

Table A7.31
SES157 Discounted Cash Flow Analysis - SFC = 200g/kWhr

PROJECT LIFE: 15 PRICE: 123000000 DEBT RATIO: 0.75 LOAN YEARS: 10 INTEREST RATE: 0.1

DECLINING BAL.: 0.2

TAX RATE: 0.33 INFLATION RATE: 0.05 DISCOUNT RATE: 0.175 BASE REVENUE: 74599628

SCRAP VALUE: 4327678

YEAR	CAPITAL	LOAN OUTSTANDING	LOAN REPAYMENTS	INTEREST PAYMENTS	RELIEF ON INTEREST	CAPITAL ALLOWANCE	RELIEF ON CAPITAL	ANNUAL REVENUE	OPERATING COSTS	GROSS SURPLUS	TAX	ANNUAL CASH FLOW	DISCOUNTED CASH FLOW
0	-30750000	0	0	0	0	0	0	0	0	0	0	-30750000	-30750000
1	0	92250000	9225000	9225000	3044250	24600000	0	74599628	55753363	396265	-873835	1270100	1029463
2	0	83025000	9225000	8302500	2739825	19680000	8118000	78329609	58541031	2261078	-2836927	5098004	3349237
3	0	73800000	9225000	7380000	2435400	15744000	6494400	82246090	61468083	4173007	-1569742	5742748	3058006
4	0	64575000	9225000	6457500	2130975	12595200	5195520	86358394	64541487	6134407	-393389	6527796	2817461
5	0	55350000	9225000	5535000	1826550	10076160	4156416	90676314	67768562	8147752	714380	7433373	2600459
6	0	46125000	9225000	4612500	1522125	8060928	3325133	95210130	71156990	10215640	1771566	8444074	2394358
7	0	36900000	9225000	3690000	1217700	6448742	2660106	99970636	74714839	12340797	2792787	9548010	2194435
8	0	27675000	9225000	2767500	913275	5158994	2128085	104969168	78450581	14526087	3789960	10736127	2000001
9	0	18450000	9225000	1845000	608850	4127195	1702468	110217626	82373110	16774516	4772855	12001661	1812161
10	0	9225000	9225000	922500	304425	3301756	1361974	115728508	86491766	19089242	5749538	13339704	1632580
11	0	0	0	0	0	2641405	1089580	121514933	90816354	30698579	9770970	20927609	2075969
12	0	0	0	0	0	2113124	871664	127590680	95357172	32233508	10349409	21884099	1759554
13	0	0	0	0	0	1690499	697331	133970214	100125030	33845183	10938791	22906392	1492807
14	0	0	0	0	0	1352399	557865	140668724	105131282	35537443	11543261	23994182	1267435
15	4327678	0	0	0	0	1081919	446292	147702160	110387846	37314315	12166448	29475545	1261985
16	0	0	0	0	0	0	357033	0	0	0	-117821	117821	4089
17	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0
												NPV	0

REQUIRED FREIGHT RATE = 213 £/tonne

(with 80% load factor)

Table A7.32
SES157 Operating Costs - SFC = 200g/kWhr

VESSEL DATA		COSTHEAD	ESCALATION RATE
Length	157.6	Registration	0
Breadth	35	Manning	0
Draught	7.2	Insurance	0
Payload	1958	R & M	0
Power	216333	Stores	0
No. Containers	200	Victualling	0
Complement	29	Administration	0
Annual Op. Hours	6048	Fuel Oil	0
No. Trips per annum	224	Diesel Oil	0
Fuel Load per Trip	1100	Port Dues	0
Dieso per week	648	Cargo Handling	0

YEAR	REGISTRATION	MANNING	INSURANCE	R & M	STORES	VICTUALING	ADMINISTRATION	FUEL OIL	DIESEL OIL	PORT DUES	CARGO HANDLING	TOTAL OPERATING COSTS
0	6000	1740000	1845000	3628800	250000	32886	123000	36960000	4665600	263155	3584000	53098441
1	6300	1827000	1937250	3810240	262500	34530	129150	38808000	4898880	276313	3763200	55753363
2	6615	1918350	2034113	4000752	275625	36257	135608	40748400	5143824	290129	3951360	58541031
3	6946	2014268	2135818	4200790	289406	38070	142388	42785820	5401015	304635	4148928	61468083
4	7293	2114981	2242609	4410829	303877	39973	149507	44925111	5671066	319867	4356374	64541487
5	7658	2220730	2354739	4631371	319070	41972	156983	47171367	5954619	335860	4574193	67768562
6	8041	2331766	2472476	4862939	335024	44070	164832	49529935	6252350	352653	4802903	71156990
7	8443	2448355	2596100	5106086	351775	46274	173073	52006432	6564968	370286	5043048	74714839
8	8865	2570772	2725905	5361390	369364	48588	181727	54606753	6893216	388800	5295200	78450581
9	9308	2699311	2862201	5629460	387832	51017	190813	57337091	7237877	408240	5559960	82373110
10	9773	2834277	3005311	5910933	407224	53568	200354	60203945	7599771	428652	5837958	86491766
11	10262	2975990	3155576	6206479	427585	56246	210372	63214143	7979759	450085	6129856	90816354
12	10775	3124790	3313355	6516803	448964	59059	220890	66374850	8378747	472589	6436349	95357172
13	11314	3281030	3479023	6842644	471412	62011	231935	69693592	8797685	496218	6758167	100125030
14	11880	3445081	3652974	7184776	494983	65112	243532	73178272	9237569	521029	7096075	105131282
15	12474	3617335	3835622	7544015	519732	68368	255708	76837186	9699447	547081	7450879	110387846
16	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0

Table A7.33
SES157 Discounted Cash Flow Analysis - SFC = 180g/kWhr

PROJECT LIFE: 15 **PRICE:** 123000000 **DEBT RATIO:** 0.75 **LOAN YEARS:** 10 **INTEREST RATE:** 0.1

DECLINING BAL.: 0.2

TAX RATE: 0.33 **INFLATION RATE:** 0.05 **DISCOUNT RATE:** 0.175 **BASE REVENUE:** 70945184

SCRAP VALUE: 4327678

YEAR	CAPITAL	LOAN OUTSTANDING	LOAN REPAYMENTS	INTEREST PAYMENTS	RELIEF ON INTEREST	CAPITAL ALLOWANCE	RELIEF ON CAPITAL	ANNUAL REVENUE	OPERATING COSTS	GROSS SURPLUS	TAX	ANNUAL CASH FLOW	DISCOUNTED CASH FLOW
0	-30750000	0	0	0	0	0	0	0	0	0	0	-30750000	-30750000
1	0	92250000	9225000	9225000	3044250	24600000	0	70945184	52098920	396265	-873835	1270100	1029463
2	0	83025000	9225000	8302500	2739825	19680000	8118000	74492444	54703866	2261078	-2836927	5098004	3349237
3	0	73800000	9225000	7380000	2435400	15744000	6494400	78217066	57439059	4173007	-1569742	5742748	3058006
4	0	64575000	9225000	6457500	2130975	12595200	5195520	82127919	60311012	6134407	-393389	6527796	2817461
5	0	55350000	9225000	5535000	1826550	10076160	4156416	86234315	63326563	8147752	714380	7433373	2600459
6	0	46125000	9225000	4612500	1522125	8060928	3325133	90546031	66492891	10215640	1771566	8444074	2394358
7	0	36900000	9225000	3690000	1217700	6448742	2660106	95073332	69817535	12340797	2792787	9548010	2194435
8	0	27675000	9225000	2767500	913275	5158994	2128085	99826999	73308412	14526087	3789960	10736127	2000001
9	0	18450000	9225000	1845000	608850	4127195	1702468	101818349	76973833	16774516	4772855	12001661	1812161
10	0	9225000	9225000	922500	304425	3301756	1361974	110059266	80822524	19089242	5749538	13339704	1632580
11	0	0	0	0	0	2641405	1089580	115562230	84863650	30698579	9770970	20927609	2075969
12	0	0	0	0	0	2113124	871664	121340341	89106833	32233508	10349409	21884099	1759554
13	0	0	0	0	0	1690499	697331	127407358	93562175	33845183	10938791	22906392	1492807
14	0	0	0	0	0	1352399	557865	133777726	98240283	35537443	11543261	23994182	1267435
15	4327678	0	0	0	0	1081919	446292	140466612	103152297	37314315	12166448	29475545	1261985
16	0	0	0	0	0	0	357033	0	0	0	-117821	117821	4089
17	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0
												NPV	0

REQUIRED FREIGHT RATE = 192 £/tonne

(with 80% load factor)

Table A7.34
SES157 Operating Costs - SFC = 180g/kWhr

VESSEL DATA		COSTHEAD	ESCALATION RATE
Length	157.6	Registration	0
Breadth	35	Manning	0
Draught	7.2	Insurance	0
Payload	2062	R & M	0
Power	216333	Stores	0
No. Containers	200	Victualling	0
Complement	29	Administration	0
Annual Op. Hours	6048	Fuel Oil	0
No. Trips per annum	224	Diesel Oil	0
Fuel Load per Trip	996	Port Dues	0
Dieso per week	648	Cargo Handling	0

YEAR	REGISTRATION	MANNING	INSURANCE	R & M	STORES	VICTUALING	ADMINISTRATION	FUEL OIL	DIESEL OIL	PORT DUES	CARGO HANDLING	TOTAL OPERATING COSTS
0	6000	1740000	1845000	3628800	250000	32886	123000	33465600	4665600	277133	3584000	49618019
1	6300	1827000	1937250	3810240	262500	34530	129150	35138880	4898880	290989	3763200	52098920
2	6615	1918350	2034113	4000752	275625	36257	135608	36895824	5143824	305539	3951360	54703866
3	6946	2014268	2135818	4200790	289406	38070	142388	38740615	5401015	320816	4148928	57439059
4	7293	2114981	2242609	4410829	303877	39973	149507	40677646	5671066	336857	4356374	60311012
5	7658	2220730	2354739	4631371	319070	41972	156983	42711528	5954619	353699	4574193	63326563
6	8041	2331766	2472476	4862939	335024	44070	164832	44847105	6252350	371384	4802903	66492891
7	8443	2448355	2596100	5106086	351775	46274	173073	47089460	6564968	389954	5043048	69817535
8	8865	2570772	2725905	5361390	369364	48588	181727	49443933	6893216	409451	5295200	73308412
9	9308	2699311	2862201	5629460	387832	51017	190813	51916130	7237877	429924	5559960	76973833
10	9773	2834277	3005311	5910933	407224	53568	200354	54511936	7599771	451420	5837958	80822524
11	10262	2975990	3155576	6206479	427585	56246	210372	57237533	7979759	473991	6129856	84863650
12	10775	3124790	3313355	6516803	448964	59059	220890	60099409	8378747	497691	6436349	89106833
13	11314	3281030	3479023	6842644	471412	62011	231935	63104380	8797685	522575	6758167	93562175
14	11880	3445081	3652974	7184776	494983	65112	243532	66259599	9237569	548704	7096075	98240283
15	12474	3617335	3835622	7544015	519732	68368	255708	69572579	9699447	576139	7450879	103152297
16	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0

Table A7.35
SES125 Discounted Cash Flow Analysis - SFC = 200g/kWhr

PROJECT LIFE: 15 | PRICE: 85000000 | DEBT RATIO: 0.75 | LOAN YEARS: 10 | INTEREST RATE: 0.1

DECLINING BAL.: 0.2

TAX RATE: 0.33 | INFLATION RATE: 0.05 | DISCOUNT RATE: 0.175 | BASE REVENUE: 53977695

SCRAP VALUE: 2990672

YEAR	CAPITAL	LOAN OUTSTANDING	LOAN REPAYMENTS	INTEREST PAYMENTS	RELIEF ON INTEREST	CAPITAL ALLOWANCE	RELIEF ON CAPITAL	ANNUAL REVENUE	OPERATING COSTS	GROSS SURPLUS	TAX	ANNUAL CASH FLOW	DISCOUNTED CASH FLOW
0	-21250000	0	0	0	0	0	0	0	0	0	0	-21250000	-21250000
1	0	63750000	6375000	6375000	2103750	17000000	0	53977695	40953854	273841	-603870	877711	711417
2	0	57375000	6375000	5737500	1893375	13600000	5610000	56676580	43001547	1562533	-1960478	3523011	2314513
3	0	51000000	6375000	5100000	1683000	10880000	4488000	59510409	45151624	2883785	-1084781	3968566	2113256
4	0	44625000	6375000	4462500	1472625	8704000	3590400	62485930	47409205	4239224	-271854	4511079	1947026
5	0	38250000	6375000	3825000	1262250	6963200	2872320	65610226	49779665	5630561	493677	5136884	1797065
6	0	31875000	6375000	3187500	1051875	5570560	2297856	68890737	52268649	7059589	1224253	5835336	1654637
7	0	25500000	6375000	2550000	841500	4456448	1838285	72335274	54882081	8528193	1929975	6598218	1516479
8	0	19125000	6375000	1912500	631125	3565158	1470628	75952038	57626185	10038353	2619078	7419275	1382115
9	0	12750000	6375000	1275000	420750	2852127	1176502	79749640	60507494	11592145	3298315	8293831	1252307
10	0	6375000	6375000	637500	210375	2281701	941202	83737122	63532869	13191753	3973258	9218495	1128206
11	0	0	0	0	0	1825361	752961	87923978	66709513	21214465	6752296	14462169	1434612
12	0	0	0	0	0	1460289	602369	92320177	70044988	22275188	7152030	15123158	1215952
13	0	0	0	0	0	1168231	481895	96936186	73547238	23388948	7559327	15829621	1031614
14	0	0	0	0	0	934585	385516	101782995	77224600	24558395	7977050	16581345	875870
15	2990672	0	0	0	0	747668	308413	106872145	81085829	25786315	8407708	20369279	872104
16	0	0	0	0	0	0	246730	0	0	0	-81421	81421	2826
17	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0
												NPV	0

REQUIRED FREIGHT RATE = 150 £/tonne

(with 80% load factor)

Table A7.36
SES125 Operating Costs - SFC = 200g/kWhr

VESSEL DATA		COSTHEAD	ESCALATION RATE
Length	125.1	Registration	0
Breadth	31.3	Manning	0
Draught	7.3	Insurance	0
Payload (max)	1339	R & M	0
Power	152726	Stores	0
No. Containers	150	Victualling	0
Complement	24	Administration	0
Annual Op. Hours	6384	Fuel Oil	0
No. Trips per annum	336	Diesel Oil	0
Fuel Load per Trip	553	Port Dues	0
Dieso per week	84	Cargo Handling	0

YEAR	REGISTRATION	MANNING	INSURANCE	R & M	STORES	VICTUALING	ADMINISTRATION	FUEL OIL	DIESEL OIL	PORT DUES	CARGO HANDLING	TOTAL OPERATING COSTS
0	5000	1440000	1275000	3192000	200000	28728	85000	27871200	604800	269942	4032000	39003670
1	5250	1512000	1338750	3351600	210000	30164	89250	29264760	635040	283440	4233600	40953854
2	5513	1587600	1405688	3519180	220500	31673	93713	30727998	666792	297611	4445280	43001547
3	5788	1666980	1475972	3695139	231525	33256	98398	32264398	700132	312492	4667544	45151624
4	6078	1750329	1549770	3879896	243101	34919	103318	33877618	735138	328117	4900921	47409205
5	6381	1837845	1627259	4073891	255256	36665	108484	35571499	771895	344523	5145967	49779665
6	6700	1929738	1708622	4277585	268019	38498	113908	37350074	810490	361749	5403266	52268649
7	7036	2026225	1794053	4491465	281420	40423	119604	39217577	851014	379836	5673429	54882081
8	7387	2127536	1883756	4716038	295491	42444	125584	41178456	893565	398828	5957100	57626185
9	7757	2233913	1977943	4951840	310266	44567	131863	43237379	938243	418769	6254955	60507494
10	8144	2345608	2076841	5199432	325779	46795	138456	45399248	985155	439708	6567703	63532869
11	8552	2462889	2180683	5459403	342068	49135	145379	47669210	1034413	461693	6896088	66709513
12	8979	2586033	2289717	5732373	359171	51591	152648	50052671	1086134	484778	7240893	70044988
13	9428	2715335	2404203	6018992	377130	54171	160280	52555304	1140441	509017	7602937	73547238
14	9900	2851102	2524413	6319942	395986	56879	168294	55183070	1197463	534467	7983084	77224600
15	10395	2993657	2650633	6635939	415786	59723	176709	57942223	1257336	561191	8382238	81085829
16	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0

Table A7.37
SES125 Discounted Cash Flow Analysis - SFC = 180g/kWhr

PROJECT LIFE: 15 PRICE: 85000000 DEBT RATIO: 0.75 LOAN YEARS: 10 INTEREST RATE: 0.1

DECLINING BAL.: 0.2

TAX RATE: 0.33 INFLATION RATE: 0.05 DISCOUNT RATE: 0.175 BASE REVENUE: 51184154

SCRAP VALUE: 2990672

YEAR	CAPITAL	LOAN OUTSTANDING	LOAN REPAYMENTS	INTEREST PAYMENTS	RELIEF ON INTEREST	CAPITAL ALLOWANCE	RELIEF ON CAPITAL	ANNUAL REVENUE	OPERATING COSTS	GROSS SURPLUS	TAX	ANNUAL CASH FLOW	DISCOUNTED CASH FLOW
0	-21250000	0	0	0	0	0	0	0	0	0	0	-21250000	-21250000
1	0	63750000	6375000	6375000	2103750	17000000	0	51184154	38160313	273841	-603870	877711	711417
2	0	57375000	6375000	5737500	1893375	13600000	5610000	53743362	40068329	1562533	-1960478	3523011	2314513
3	0	51000000	6375000	5100000	1683000	10880000	4488000	56430530	42071745	2883785	-1084781	3968566	2113256
4	0	44625000	6375000	4462500	1472625	8704000	3590400	59252057	44175332	4239224	-271854	4511079	1947026
5	0	38250000	6375000	3825000	1262250	6963200	2872320	62214659	46384099	5630561	493677	5136884	1797065
6	0	31875000	6375000	3187500	1051875	5570560	2297856	65325392	48703304	7059589	1224253	5835336	1654637
7	0	25500000	6375000	2550000	841500	4456448	1838285	68591662	51138469	8528193	1929975	6598218	1516479
8	0	19125000	6375000	1912500	631125	3565158	1470628	72021245	53695392	10038353	2619078	7419275	1382115
9	0	12750000	6375000	1275000	420750	2852127	1176502	75622307	56380162	11592145	3298315	8293831	1252307
10	0	6375000	6375000	637500	210375	2281701	941202	79403423	59199170	13191753	3973258	9218495	1128206
11	0	0	0	0	0	1825361	752961	83373594	62159129	21214465	6752296	14462169	1434612
12	0	0	0	0	0	1460289	602369	87542274	65267085	22275188	7152030	15123158	1215952
13	0	0	0	0	0	1168231	481895	91919387	68530439	23388948	7559327	15829621	1031614
14	0	0	0	0	0	934585	385516	96515357	71956961	24558395	7977050	16581345	875870
15	2990672	0	0	0	0	747668	308413	101341125	75554809	25786315	8407708	20369279	872104
16	0	0	0	0	0	0	246730	0	0	0	-81421	81421	2826
17	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0
												NPV	0

REQUIRED FREIGHT RATE = 137 £/tonne

(with 80% load factor)

Table A7.38
SES125 Operating Costs - SFC = 180g/kWhr

VESSEL DATA		COSTHEAD	ESCALATION RATE
Length	125.1	Registration	0
Breadth	31.3	Manning	0
Draught	7.3	Insurance	0
Payload (max)	1392	R & M	0
Power	152726	Stores	0
No. Containers	150	Victualling	0
Complement	24	Administration	0
Annual Op. Hours	6384	Fuel Oil	0
No. Trips per annum	336	Diesel Oil	0
Fuel Load per Trip	500	Port Dues	0
Dieso per week	84	Cargo Handling	0

YEAR	REGISTRATION	MANNING	INSURANCE	R & M	STORES	VICTUALING	ADMINISTRATION	FUEL OIL	DIESEL OIL	PORT DUES	CARGO HANDLING	TOTAL OPERATING COSTS
0	5000	1440000	1275000	3192000	200000	28728	85000	25200000	604800	280627	4032000	36343155
1	5250	1512000	1338750	3351600	210000	30164	89250	26460000	635040	294659	4233600	38160313
2	5513	1587600	1405688	3519180	220500	31673	93713	27783000	666792	309391	4445280	40068329
3	5788	1666980	1475972	3695139	231525	33256	98398	29172150	700132	324861	4667544	42071745
4	6078	1750329	1549770	3879896	243101	34919	103318	30630758	735138	341104	4900921	44175332
5	6381	1837845	1627259	4073891	255256	36665	108484	32162295	771895	358159	5145967	46384099
6	6700	1929738	1708622	4277585	268019	38498	113908	33770410	810490	376067	5403266	48703304
7	7036	2026225	1794053	4491465	281420	40423	119604	35458931	851014	394871	5673429	51138469
8	7387	2127536	1883756	4716038	295491	42444	125584	37231877	893565	414614	5957100	53695392
9	7757	2233913	1977943	4951840	310266	44567	131863	39093471	938243	435345	6254955	56380162
10	8144	2345608	2076841	5199432	325779	46795	138456	41048145	985155	457112	6567703	59199170
11	8552	2462889	2180683	5459403	342068	49135	145379	43100552	1034413	479968	6896088	62159129
12	8979	2586033	2289717	5732373	359171	51591	152648	45255579	1086134	503966	7240893	65267085
13	9428	2715335	2404203	6018992	377130	54171	160280	47518358	1140441	529164	7602937	68530439
14	9900	2851102	2524413	6319942	395986	56879	168294	49894276	1197463	555623	7983084	71956961
15	10395	2993657	2650633	6635939	415786	59723	176709	52388990	1257336	583404	8382238	75554809
16	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0

Appendix 8

SES Combined Economic Potential: Operating Costs

Table A8.1
SES194a Operating Costs

VESSEL DATA		COSTHEAD	ESCALATION RATE
Length	194.1	Registration	0
Breadth	38.8	Manning	0
Draught	6.8	Insurance	0
Payload	4600	R & M	0
Power	262548	Stores	0
No. Containers	450	Victualling	0
Complement	38	Administration	0
Annual Op. Hours	5280	Fuel Oil	0
No. Trips per annum	96	Diesel Oil	0
Fuel Load per Trip	2800	Port Dues	0
Dieso per week	85	Cargo Handling	0

YEAR	REGISTRATION	MANNING	INSURANCE	R & M	STORES	VICTUALING	ADMINISTRATION	FUEL OIL	DIESEL OIL	PORT DUES	CARGO HANDLING	TOTAL OPERATING COSTS
0	7500	2280000	3708000	3960000	300000	37620	247200	50400000	765000	264960	3456000	65426280
1	7875	2394000	3893400	4158000	315000	39501	259560	52920000	803250	278208	3628800	68697594
2	8269	2513700	4088070	4365900	330750	41476	272538	55566000	843413	292118	3810240	72132474
3	8682	2639385	4292474	4584195	347288	43550	286165	58344300	885583	306724	4000752	75739097
4	9116	2771354	4507097	4813405	364652	45727	300473	61261515	929862	322061	4200790	79526052
5	9572	2909922	4732452	5054075	382884	48014	315497	64324591	976355	338164	4410829	83502355
6	10051	3055418	4969075	5306779	402029	50414	331272	67540820	1025173	355072	4631371	87677473
7	10553	3208189	5217528	5572118	422130	52935	347835	70917861	1076432	372825	4862939	92061346
8	11081	3368598	5478405	5850724	443237	55582	365227	74463754	1130253	391467	5106086	96664414
9	11635	3537028	5752325	6143260	465398	58361	383488	78186942	1186766	411040	5361390	101497634
10	12217	3713880	6039941	6450423	488668	61279	402663	82096289	1246104	431592	5629460	106572516
11	12828	3899574	6341938	6772944	513102	64343	422796	86201104	1308410	453172	5910933	111901142
12	13469	4094552	6659035	7111591	538757	67560	443936	90511159	1373830	475830	6206479	117496199
13	14142	4299280	6991987	7467171	565695	70938	466132	95036717	1442522	499622	6516803	123371009
14	14849	4514244	7341586	7840529	593979	74485	489439	99788553	1514648	524603	6842644	129539559
15	15592	4739956	7708666	8232556	623678	78209	513911	104777980	1590380	550833	7184776	136016537
16	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0

Table A8.2
SES194b Operating Costs

VESSEL DATA	
Length	194.1
Breadth	38.8
Draught	6.8
Payload	6297
Power	233376
No. Containers	600
Complement	38
Annual Op. Hours	5280
No. Trips per annum	96
Fuel Load per Trip	2262
Dieso per week	85

COSTHEAD	ESCALATION RATE
Registration	0
Manning	0
Insurance	0
R & M	0
Stores	0
Victualling	0
Administration	0
Fuel Oil	0
Diesel Oil	0
Port Dues	0
Cargo Handling	0

YEAR	REGISTRATION	MANNING	INSURANCE	R & M	STORES	VICTUALING	ADMINISTRATION	FUEL OIL	DIESEL OIL	PORT DUES	CARGO HANDLING	TOTAL OPERATING COSTS
0	7500	2280000	3635775	3960000	300000	37620	242385	40716000	765000	362707	4608000	56914987
1	7875	2394000	3817564	4158000	315000	39501	254504	42751800	803250	380843	4838400	59760737
2	8269	2513700	4008442	4365900	330750	41476	267229	44889390	843413	399885	5080320	62748773
3	8682	2639385	4208864	4584195	347288	43550	280591	47133860	885583	419879	5334336	65886212
4	9116	2771354	4419307	4813405	364152	45727	294620	49490552	929862	440873	5601053	69180523
5	9572	2909922	4640273	5054075	382884	48014	309352	51965080	976355	462917	5881105	72639549
6	10051	3055418	4872286	5306779	402029	50414	324819	54563334	1025173	486062	6175161	76271526
7	10553	3208189	5115901	5572118	422130	52935	341060	57291501	1076432	510365	6483919	80085103
8	11081	3368598	5371696	5850724	443237	55582	358113	60156076	1130253	535884	6808115	84089358
9	11635	3537028	5640280	6143260	465398	58361	376019	63163880	1186766	562678	7148520	88293826
10	12217	3713880	5922294	6450423	488668	61279	394820	66322074	1246104	590812	7505946	92708517
11	12828	3899574	6218409	6772944	513102	64343	414561	69638177	1308410	620352	7881244	97343943
12	13469	4094552	6529330	7111591	538757	67560	435289	73120086	1373830	651370	8275306	102211140
13	14142	4299280	6855796	7467171	565695	70938	457053	76776090	1442522	683939	8689071	107321697
14	14849	4514244	7198586	7840529	593979	74485	479906	80614895	1514648	718135	9123525	112687782
15	15592	4739956	7558515	8232556	623678	78209	503901	84645640	1590380	754042	9579701	118322171
16	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0

Table A8.3
SES157a Operating Costs

VESSEL DATA		COSTHEAD	ESCALATION RATE
Length	157.6	Registration	0
Breadth	35	Manning	0
Draught	7.2	Insurance	0
Payload	3456	R & M	0
Power	194727	Stores	0
No. Containers	350	Victualling	0
Complement	29	Administration	0
Annual Op. Hours	6048	Fuel Oil	0
No. Trips per annum	224	Diesel Oil	0
Fuel Load per Trip	1062	Port Dues	0
Dieso per week	648	Cargo Handling	0

YEAR	REGISTRATION	MANNING	INSURANCE	R & M	STORES	VICTUALING	ADMINISTRATION	FUEL OIL	DIESEL OIL	PORT DUES	CARGO HANDLING	TOTAL OPERATING COSTS
0	6000	1740000	2706750	3628800	250000	32886	180450	44604000	5832000	464486	6272000	65717372
1	6300	1827000	2842088	3810240	262500	34530	189473	46834200	6123600	487711	6585600	69003241
2	6615	1918350	2984192	4000752	275625	36257	198946	49175910	6429780	512096	6914880	72453403
3	6946	2014268	3133401	4200790	289406	38070	208893	51634706	6751269	537701	7260624	76076073
4	7293	2114981	3290072	4410829	303877	39973	219338	54216441	7088832	564586	7623655	79879877
5	7658	2220730	3454575	4631371	319070	41972	230305	56927263	7443274	592815	8004838	83873871
6	8041	2331766	3627304	4862939	335024	44070	241820	59773626	7815438	622456	8405080	88067564
7	8443	2448355	3808669	5106086	351775	46274	253911	62762307	8206210	653579	8825334	92470942
8	8865	2570772	3999103	5361390	369364	48588	266607	65900423	8616520	686258	9266601	97094490
9	9308	2699311	4199058	5629460	387832	51017	279937	69195444	9047346	720571	9729931	101949214
10	9773	2834277	4409011	5910933	407224	53568	293934	72655216	9499713	756599	10216427	107046675
11	10262	2975990	4629461	6206479	427585	56246	308631	76287977	9974699	794429	10727248	112399009
12	10775	3124790	4860934	6516803	448964	59059	324062	80102376	10473434	834151	11263611	118018959
13	11314	3281030	5103981	6842644	471412	62011	340265	84107494	10997106	875858	11826791	123919907
14	11880	3445081	5359180	7184776	494983	65112	357279	88312869	11546961	919651	12418131	130115902
15	12474	3617335	5627139	7544015	519732	68368	375143	92728513	12124309	965634	13039038	136621697
16	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0

Table A8.4
SES157b Operating Costs

VESSEL DATA		COSTHEAD	ESCALATION RATE
Length	157.6	Registration	0
Breadth	35	Manning	0
Draught	7.2	Insurance	0
Payload	4488	R & M	0
Power	173091	Stores	0
No. Containers	450	Victualling	0
Complement	29	Administration	0
Annual Op. Hours	6048	Fuel Oil	0
No. Trips per annum	224	Diesel Oil	0
Fuel Load per Trip	854	Port Dues	0
Dieso per week	648	Cargo Handling	0

YEAR	REGISTRATION	MANNING	INSURANCE	R & M	STORES	VICTUALING	ADMINISTRATION	FUEL OIL	DIESEL OIL	PORT DUES	CARGO HANDLING	TOTAL OPERATING COSTS
0	6000	1740000	2646000	3628800	250000	32886	176400	35868000	5832000	603187	8064000	58847273
1	6300	1827000	2778300	3810240	262500	34530	185220	37661400	6123600	633347	8467200	61789637
2	6615	1918350	2917215	4000752	275625	36257	194481	39544470	6429780	665014	8890560	64879119
3	6946	2014268	3063076	4200790	289406	38070	204205	41521694	6751269	698265	9335088	68123075
4	7293	2114981	3216230	4410829	303877	39973	214415	43597778	7088832	733178	9801842	71529228
5	7658	2220730	3377041	4631371	319070	41972	225136	45777667	7443274	769837	10291935	75105690
6	8041	2331766	3545893	4862939	335024	44070	236393	48066550	7815438	808329	10806531	78860974
7	8443	2448355	3723188	5106086	351775	46274	248213	50469878	8206210	848745	11346858	82804023
8	8865	2570772	3909347	5361390	369364	48588	260623	52993372	8616520	891182	11914201	86944224
9	9308	2699311	4104814	5629460	387832	51017	273654	55643040	9047346	935741	12509911	91291435
10	9773	2834277	4310055	5910933	407224	53568	287337	58425192	9499713	982528	13135406	95856007
11	10262	2975990	4525558	6206479	427585	56246	301704	61346452	9974699	1031655	13792177	100648807
12	10775	3124790	4751836	6516803	448964	59059	316789	64413775	10473434	1083238	14481785	105681248
13	11314	3281030	4989428	6842644	471412	62011	332629	67634463	10997106	1137399	15205875	110965310
14	11880	3445081	5238899	7184776	494983	65112	349260	71016187	11546961	1194269	15966168	116513576
15	12474	3617335	5500844	7544015	519732	68368	366723	74566996	12124309	1253983	16764477	122339255
16	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0

Table A8.5
SES125a Operating Costs

VESSEL DATA		COSTHEAD	ESCALATION RATE
Length	125.1	Registration	0
Breadth	31.3	Manning	0
Draught	7.3	Insurance	0
Payload (max)	2194	R & M	0
Power	137462	Stores	0
No. Containers	200	Victualling	0
Complement	24	Administration	0
Annual Op. Hours	6384	Fuel Oil	0
No. Trips per annum	336	Diesel Oil	0
Fuel Load per Trip	538	Port Dues	0
Dieso per week	84	Cargo Handling	0

YEAR	REGISTRATION	MANNING	INSURANCE	R & M	STORES	VICTUALING	ADMINISTRATION	FUEL OIL	DIESEL OIL	PORT DUES	CARGO HANDLING	TOTAL OPERATING COSTS
0	5000	1440000	1866150	3192000	200000	28728	124410	33894000	756000	442310	5376000	47324598
1	5250	1512000	1959458	3351600	210000	30164	130631	35588700	793800	464426	5644800	49690828
2	5513	1587600	2057430	3519180	220500	31673	137162	37368135	833490	487647	5927040	52175370
3	5788	1666980	2160302	3695139	231525	33256	144020	39236542	875165	512030	6223392	54784138
4	6078	1750329	2268317	3879896	243101	34919	151221	41198369	918923	537631	6534562	57523345
5	6381	1837845	2381733	4073891	255256	36665	158782	43258287	964869	564513	6861290	60399512
6	6700	1929738	2500819	4277585	268019	38498	166721	45421202	1013112	592738	7204354	63419488
7	7036	2026225	2625860	4491465	281420	40423	175057	47692262	1063768	622375	7564572	66590462
8	7387	2127536	2757153	4716038	295491	42444	183810	50076875	1116956	653494	7942800	69919986
9	7757	2233913	2895011	4951840	310266	44567	193001	52580719	1172804	686169	8339940	73415985
10	8144	2345608	3039762	5199432	325779	46795	202651	55209754	1231444	720477	8756938	77086784
11	8552	2462889	3191750	5459403	342068	49135	212783	57970242	1293017	756501	9194784	80941123
12	8979	2586033	3351337	5732373	359171	51591	223422	60868754	1357667	794326	9654524	84988179
13	9428	2715335	3518904	6018992	377130	54171	234594	63912192	1425551	834042	10137250	89237588
14	9900	2851102	3694849	6319942	395986	56879	246323	67107802	1496828	875744	10644112	93699468
15	10395	2993657	3879592	6635939	415786	59723	258639	70463192	1571670	919532	11176318	98384441
16	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0

Table A8.6
SES125b Operating Costs

VESSEL DATA	
Length	125.1
Breadth	31.3
Draught	7.3
Payload (max)	2819
Power	122188
No. Containers	300
Complement	24
Annual Op. Hours	6384
No. Trips per annum	336
Fuel Load per Trip	432
Dieso per week	84

COSTHEAD	ESCALATION RATE
Registration	0
Manning	0
Insurance	0
R & M	0
Stores	0
Victualling	0
Administration	0
Fuel Oil	0
Diesel Oil	0
Port Dues	0
Cargo Handling	0

YEAR	REGISTRATION	MANNING	INSURANCE	R & M	STORES	VICTUALING	ADMINISTRATION	FUEL OIL	DIESEL OIL	PORT DUES	CARGO HANDLING	TOTAL OPERATING COSTS
0	5000	1440000	1819800	3192000	200000	28728	121320	27216000	756000	568310	8064000	43411158
1	5250	1512000	1910790	3351600	210000	30164	127386	28576800	793800	596726	8467200	45581716
2	5513	1587600	2006330	3519180	220500	31673	133755	30005640	833490	626562	8890560	47860802
3	5788	1666980	2106646	3695139	231525	33256	140443	31505922	875165	657890	9335088	50253842
4	6078	1750329	2211978	3879896	243101	34919	147465	33081218	918923	690785	9801842	52766534
5	6381	1837845	2322577	4073891	255256	36665	154838	34735279	964869	725324	10291935	55404861
6	6700	1929738	2438706	4277585	268019	38498	162580	36472043	1013112	761590	10806531	58175104
7	7036	2026225	2560641	4491465	281420	40423	170709	38295645	1063768	799670	11346858	61083859
8	7387	2127536	2688673	4716038	295491	42444	179245	40210427	1116956	839653	11914201	64138052
9	7757	2233913	2823107	4951840	310266	44567	188207	42220949	1172804	881636	12509911	67344955
10	8144	2345608	2964262	5199432	325779	46795	197617	44331996	1231444	925718	13135406	70712203
11	8552	2462889	3112476	5459403	342068	49135	207498	46548596	1293017	972004	13792177	74247813
12	8979	2586033	3268099	5732373	359171	51591	217873	48876026	1357667	1020604	14481785	77960203
13	9428	2715335	3431504	6018992	377130	54171	228767	51319827	1425551	1071634	15205875	81858214
14	9900	2851102	3603080	6319942	395986	56879	240205	53885818	1496828	1125216	15966168	85951124
15	10395	2993657	3783234	6635939	415786	59723	252216	56580109	1571670	1181477	16764477	90248680
16	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0