



HIGHLIGHTS

A NEWSLETTER PUBLISHED BY SSPA SWEDEN AB 3/2003

Contents

Decision support system for ships in danger 2

Maritime safety – both human and technical factors 4

Submarine recovery in case of flooding 6

Mauritius, tourism, natural resources – and SSPA 8

Streets clogged up? Reclaim the waterways! 10

Short comments 12

‘SWEDISH SEAMARK’
BY AUGUST STRINDBERG
PHOTO: NATIONALMUSEUM,
STOCKHOLM
(The photo has been
slightly cropped.)





Season's Greetings

Shipping has a very long tradition. It is international, and most of the business crosses borders. There is very little competition regarding long-distance heavy freight, which results in a stable and slow development pace. Along the coasts, competition with road traffic is fierce, and the best supporter of shipping is road congestion, not cost or time efficiency.

Shipping needs some new innovations to become more competitive against roads along the coast. The transportation market volume at stake in the coast zone is enormous.

Lars Afzelius



Photo montage depicting the East Indiaman in Gothenburg harbour

You can read more about the ship at www.soic.se

Decision support system for ships in danger

An officer on the bridge of a vessel carrying loaded trucks, cars and goods wagons and encountering storms and heavy seas – that means that he will be required to make critical, irreversible decisions at a significant degree of uncertainty. The situation could actually develop into a nightmare. However, support systems for decisions in situations like this will soon be reality.

A prototype of a decision support system for ships in danger has been developed, installed and tested on the Ro Ro passenger ship M/S Skåne of Scandlines. M/S Skåne has a length of 200 m and a service speed of 21 knots, and operates between Trelleborg, Sweden, and Rostock, Germany. Using the Safety & Cargo System SCS, the officers on the bridge continuously monitor the cargo and tanks, and thus the ship's stability condition. SCS collects all relevant data about cargo shifting and water intake. It calculates the future state of the ship and the available time frames for possible actions, and if there is a significant change of the predicted stability condition an alarm is sounded.

Safety & Cargo System

The decision support system Safety & Cargo System, SCS, was designed as a part of Kockum Sonics' Loadmaster system and uses a ship database, in this case describing M/S Skåne, and a digital chart of the ship's route, Trelleborg-Rostock.

SCS consists of a predictor module for calculations of the predicted ship motions and state, a wind and wave module for estimation of wind and wave conditions, and a tank module for calculation of water inflow and transfer

The project partners were:

Kockum Sonics AB (Project Manager)
SSPA Sweden AB
Chalmers Lindholmen
Department of Naval Architecture and Ocean Engineering,
Chalmers University of Technology
Rescue International AB
Scandlines AB

of water between different tanks and void spaces. SCS can also use meteorological predictions of wind and wave conditions as well as measurements of cargo positions and possible movements.

Pre-voyage calculations

In order to improve the calculation precision, the centre of gravity of the ship and cargo is determined before every voyage. One technical innovation feature is the determination of the vehicle position. The vehicle mass – cars, trucks, trailers and trains – and possible dangerous goods content are also registered. If cargo displacement occurs during the voyage an alarm is triggered and information the system registers the amount of displacement and the specific vehicle involved.

Radio position system

The radio system is used to provide an early warning indication of possible movements of any of the vehicles loaded on the ship. The information is used for ship sta-



PPrincipal particulars
of the Ro Ro Passenger ship
M/S Skåne of Scandlines
(Stena Line)

Length o. a. 200,2 [m]
Breadth incl. fender 29,6 [m]
Draught design 6,2 [m]
Displacement 23 000 [m³]
Service speed 21 [knots]
Trailer lanes 3295 [m]
Train lanes 1110 [m]

PHOTO BY COURTESY OF
SCANDLINES AB



Claes Källström, Vice President and Head of SSPA Research, received his M.Sc. degree in Electrical Engineering in 1970 and his Doctor of Engineering degree in Automatic Control in 1979, both at the Lund Institute of Technology, Lund, Sweden. Since 1979 he has been with SSPA and is today responsible for R&D. He is the author of more than 30 scientific papers presented at international conferences and in journals
 Telephone: +46 - 31 772 9050
 E-mail: claes.kallstrom@sspa.se



Peter Grundevik, Project Manager, received his PhD in physics at the University of Göteborg/Chalmers University of Technology in 1982. He then worked at Ericsson Radio Systems developing e.g. laser radar, and night vision equipment. In 1993 he became president of Dyrning Utveckling, developing video conference and communication systems. He joined SSPA in 1997 and works with telematics and navigation technologies as well as co-ordination and project management of international projects.
 Telephone: +46-31 772 9015
 E-mail: peter.grundevik@sspa.se



The car deck of M/S Skåne
 PHOTO: JOACHIM OSGÅRD, ALLSET TRACKING AB

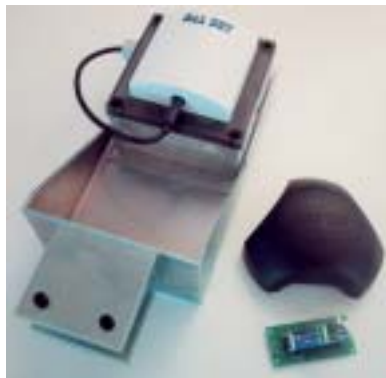
bility calculations in the same way as the registered change of fluid volumes in the different ship tanks. The radio system was originally developed to track and trace containers in transport applications and is similar to Bluetooth. The system was developed by All Set Tracking AB, Sweden.

The radio technique can also be used for logistic control of goods and electronic payment in addition to positioning (also called real-time location system).

Tag and reader system

The system consists of a tag and a reader. The tag, which contains data about the vehicle, is placed in every vehicle before it enters the ship. The tag uses wireless communication to the readers within the operational range. The information is transferred through the communication between the tag and the reader and it is forwarded to the SCS decision support system.

Every reader has a unique identity and its position on the cargo deck is known. When the vehicle drives on board the first reader detects it. The position determination is carried out using both tag-reader positioning and logics. The logic is based on known facts such as the extension of the vehicle, restricted placement of the vehicle, and the existing cell division defined by the installation of readers. The positioning cannot be based on measurements alone but requires additional knowledge because:



Readers and tag of the radio position system
 PHOTO: ERIC SANDBERG, ALLSET TRACKING AB

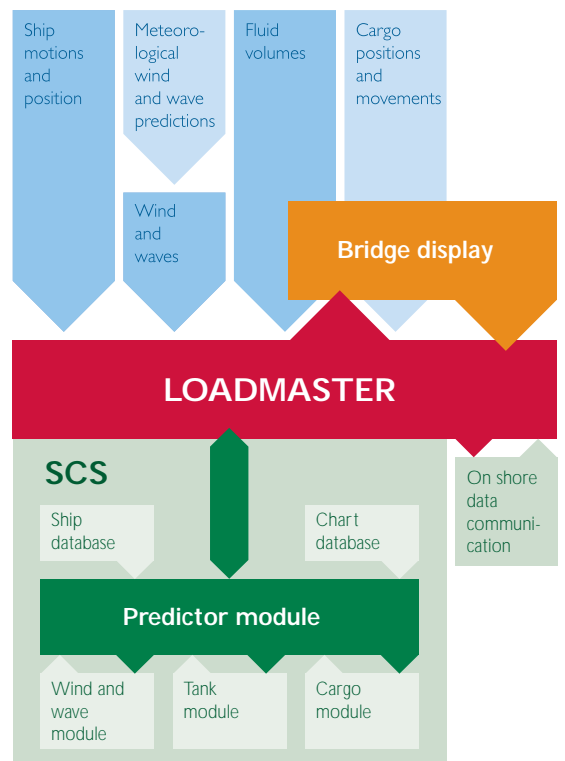
- the radio environment is difficult as the radio signal is reflected by the ship's steel construction;
- the exact position of the tag in the vehicle may vary;
- the vehicles are not all oriented in the same direction on the cargo deck.

A positive feature is that it is not necessary to know the exact positions of the vehicles, since a starting scenario defines a reference. However, it is important to register a relative movement compared with this starting point. The radio system detects cargo displacement during ship transit through the registration of signal levels from all the readers, and a new stability calculation is carried out in real time. Another advantage is that when the vehicle is identified so is the cargo, and the crew may more safely manage vehicles with dangerous goods.

A promising contribution

During the development work simulations and simulator testing were extensively used at SSPA. The SCS prototype was tested on board M/S Skåne in May, 2003, and it was obvious that the functions of the SCS prototype were operating in a satisfactory way. Remaining development activities include some additional work on integration between SCS and the radio position system and some improvements in the SCS user interface on the bridge. What we have seen is a promising contribution to safety at sea.

Claes Källström / Peter Grundevik



Pincipal design of Safety & Cargo System SCS

Maritime safety – both human and technical factors



Per Stefenson, M.Sc., Project Manager at SSPA. He received his master's degree in Naval Architecture at Chalmers University of Technology in 1981 and his Marine Engineer's diploma at the Royal Navy Academy in 1982. After slightly more than ten years in the Swedish shipbuilding industry he joined the Swedish Maritime Administration (SMA) as a project manager for new-buildings and later as head of research. In 2000 he joined SSPA as a project manager for marine operation projects. Telephone: +46 - 31 772 9111 E-mail: per.stefenson@sspa.se



Jianbo Hua, M. Sc and PhD Project Manager at SSPA. He received his master's degree in 1984 and doctor's degree in 1995 in Naval Architecture at the Royal Institute of Technology, Stockholm. In June 2001, he joined SSPA as a project manager at the Research Division. He was a member of the ISSC Loads Committee during 1991-1994 and is now a member of the ITTC Seakeeping Committee. Telephone: +46 - 31 772 9054 E-mail: jianbo.hua@sspa.se

It is rare to have only one underlying cause of an accident, but we often have a tendency to focus on one specific factor or issue that is easier to investigate rather than analyse the whole picture.

The immediate EU response to the Prestige accident was that it would not have happened if the ship had been a modern double-hull ship. A new directive had just been approved by the European Commission to speed up the IMO timetable for the conversion to double hull, in the aftermath of the Erica accident. This new catastrophe appeared to justify the EU action, but would a double-hull ship have survived better?

The material stress level in a double-hull ship is the same as in a single-hull ship, if the safety margins for these types of failures are not changed. The maintenance of a double-hull ship is, however, much more demanding than for a single skin, which has fewer compartments. In addition the cargo in a single-hull ship helps to provide corrosion protection. A badly maintained double hull may be much more dangerous than its single hull sister due to risk for explosion in the empty tanks.

Thus it is obvious that the time for simple solutions is over, and we are facing a much more complex world, where management, responsibility, safe technology, and operational factors all have to be considered together in order to maintain safety. In other words, we need to establish a good safety culture.

Thematic network on maritime safety

SSPA participates in the THEMES Thematic Network, funded by the European Community. This network includes stakeholders such as classification societies, ship owners, shipyards, authorities, universities and companies that are involved in the Maritime Industry, like SSPA. The overall goal of THEMES is to improve industrial

safety and environmental protection in shipping, through support and development of a pro-active safety culture. The project aims at establishing a common knowledge base and a comprehensive framework of safety assessment and safety management for waterborne transport. The experience from past accidents and incidents offers important information to identify hazards as well as material to build risk analysis models.

The human factor

It has been estimated that the human factor is one of the main causes in 60 to 90 per cent of accidents, depending on the type of accident (e.g. grounding, collision, fire and explosion, etc.). Although addressed in several projects, a common framework for including this aspect in risk assessment has still not been established.

IMO has introduced the International Safety Management Code (ISM). The intention is to improve safety levels through establishing a safety culture on board and among ship owners. ISM requires procedures for safety monitoring that may give valuable data from actual experiences, but there is still a long way to go before 'best practices' for a good safety culture is established.

Despite all these 'soft' issues we still have to build safe ships. The final, optimal solution is of course not designed yet, and it never will be. We are facing new challenges all the time. If the THEMES project represents the broad safety aspects in SSPA's work, then the analysis of dynamic stability of a modern passenger or RoRo ship represents the in depth research needed to establish know-how about modern ship behaviour.

Prestige, a tanker carrying 60 000 tons of heavy fuel oil, broke apart in heavy weather outside the Spanish Atlantic coast. Would a double hull ship have survived better?

PHOTO: AFP, PRESENS BILD



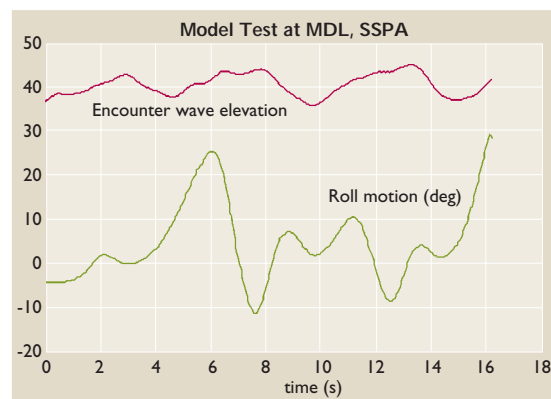
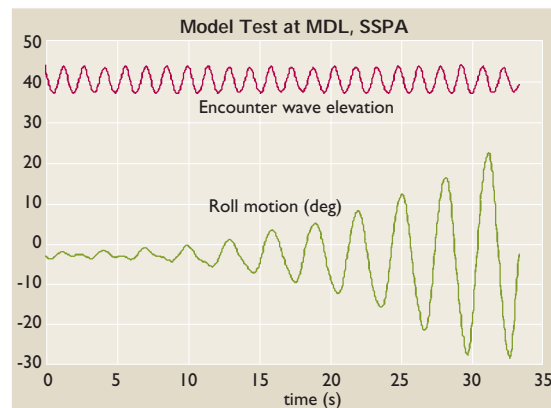


The main features of this kind of ship are the large cargo space available and the roll on and roll off concept for cargo handling. Usually, the ratio of ship beam to draught is about four or even greater, which allows a high centre of gravitation without violating the stability criteria. A fine hull form with large flare at bow and stern is thus required to obtain low resistance.

PHOTO: CONNY WICKBERG

Demonstration of the parametric roll motion of a RoRo ship at low speed in a following regular wave. As seen, the roll amplitude increases successively with time and approaches 30 degrees. Some accident investigations have shown that this kind of roll motion has caused cargo shifting on board with heavy damage and also capsizing.

Large roll motion in a quartering wave. The model was run at a speed in terms of Froude number equal to 0.3. The wave incident angle was 30 degrees. The test was stopped, as the large roll angle exceeded 30 degrees. The wave amplitude was actually small: about 1.6% of the ship length and 2% of the wave-length respectively. This test case can be considered to be equivalent to the real situation of a RoRo ship running in quartering swell.



Wave-induced dynamic stability problems on modern ships

RoRo and RoRo/passenger-ships have proved to be a means of efficient transport of unit cargo and passengers. However, this kind of ship is vulnerable to the dynamic problem of so-called parametric roll when she runs in head or following waves at low speed, due to the construction concept.

Due to the market demand and with improved propulsion technology, some design projects are under way to develop large RoRo ships with a service speed of 30 knots or higher. As a matter of fact, the increase in speed can lead to more dynamic problems, particularly in following and quartering waves. These ships can be subjected to large roll motion, loss of stability and course keeping problems, etc.

Obviously, it is important to make adequate assessment of these dynamic problems during the design procedure. Technically, it is possible to reduce the risk of the dynamic problems as a consequence of increased speed by proper design of the hull form and ship construction. Under service operation, these dynamic problems can be avoided by setting proper speed or/and course with regard to the wave condition. However, it is necessary to firstly identify the parameters and service conditions that affect the occurrence and severity of these dynamic problems. Computer simulation has become an important tool for analysis of ship dynamics in waves, but the trustworthiness of the result is to a large degree related to the accuracy of the numerical modelling of the associated hydrodynamics. Model testing is still a reliable method for observation and analysis. Nevertheless, model testing in combination with computer simulation is considered to be the most cost-efficient way to carry out a comprehensive assessment.

Jianbo Hua / Per Stefenson

Submarine recovery in case of flooding



Lennart Byström graduated from the Royal Institute of Technology in Stockholm (Eng. Phys.) in 1970. After working with traffic control systems at the Swedish Air Force he joined SSPA in 1974. He is working as a project manager for seakeeping and manoeuvring testing of merchant and naval ships. He is also working with simulation models of various dynamic systems.

Telephone: +46 - 31 772 9086
E-mail: lennart.bystrom@ssp.a.se

Some people have experienced it, many more have seen it on movies and most of us could rather easily imagine it – the horror of being inside a submarine, discovering that water is flooding into it. To enhance the preparedness for handling such a terrible situation, and increase the possibility of surviving such a situation, SSPA has, in co-operation with Kockums AB, carried out simulations of what actually happens.

Investigations of the behaviour of a flooded submarine after damage require development of sophisticated numerical tools. Two phenomena may be identified as taking place during the flooding procedure: the water ingress/egress mechanism and the internal motion of the accumulated water, including its interaction with the motion of the vessel. The free surface of the flooded water inside a compartment has a complicated wavy pattern that is influenced by the geometry, filling rate, frequency and amplitude of the motion of the compartment. However, to satisfactorily determine the coupled motions of the system, it is sufficient to assume that the free surface of the flooded water always remains horizontal, but moves freely inside the compartment.

Water ingress into a submarine

A probable initiating event in a flooding scenario could be damage to a seawater pipe, seawater cooler or similar equipment at a certain location can be a probable flooding scenario. After a certain reaction time one or more of the following measures may be taken:

- Closing the emergency shut-off valves.
- Emergency blowing of the ballast tanks is started.
- Increasing speed unless the propulsion motor is affected by flooding.
- Controlling the trim to reach the surface and to gain propulsion and lifting force from buoyancy and attack angle.

For the simulation of water ingress the submarine is divided into representative sections separated by watertight bulkheads. Each section is divided into compartments. Each compartment is assumed to have a cylindrical cross section with a possible footboard and with certain permeability (amount of water per cubic metre).

Water may penetrate into the submarine through a hole, which is defined by location, area of the hole and a contraction coefficient.

The flow Q through the hole is then obtained according to:

$$Q = C_n \cdot A \cdot \sqrt{2gh} \quad [\text{m}^3/\text{sec}]$$

where C_n is the contraction coefficient [-]
 A is the area of the hole [m^2]
and h is the water column ($=z_1 - z_2$) [m]

When the water begins penetrating the hole it will initially collect in the compartment where the hole is located. When the water level in a compartment is higher than

Ballast tank data

Tank No	Net volume [m^3]	Long. location rel. AP [m]	Volume of bottle [m^3]	Initial pressure in bottle [bar]
1	40	53.0	2.16	250
2	20	51	1.08	250
3	20	29.5	1.08	250
4	40	9	2.16	250

the walls of that particular compartment, it begins to flow over to the adjacent compartment.

Emergency blowing

When flooding is detected, the first action must be to close all the shut-off valves in the flooded compartment. After that it is necessary to compensate for the increased weight by using of the emergency blowing system. A safety philosophy often exists, and this is the basis for safety analysis of the submarine's total rescue system. Such a philosophy may be:

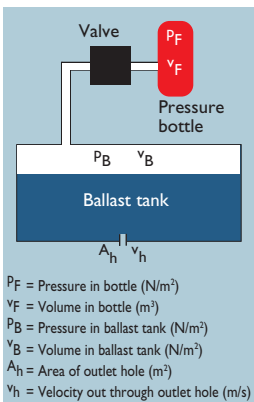
- ballast tank blowing should be performed at the latest a fixed time period after damage
- damaged main cooling pipes are closed by hull valves at the latest a fixed time period after damage
- there may exist smaller leaks that cannot be stopped

The designated time period is rather short, a few tenths of a second, and chosen to be long enough for a trained crew to perform necessary actions but short enough to ensure that the capacity of the ballast blowing installation is reasonable.

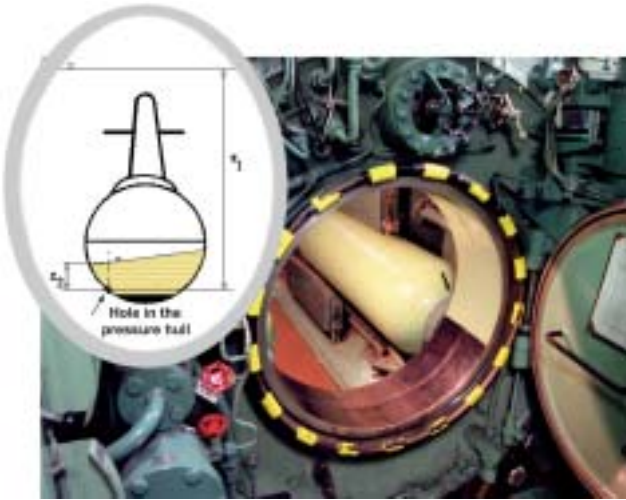
Mathematical modelling of an emergency blowing system

Blowing the ballast tanks is accomplished by rapidly discharging air from high-pressure air bottles to the ballast

The U.S. submarine *Greenville* is seen underway off Pearl Harbour. PHOTO: JEFF GEBHARD, PRESSENS BILD

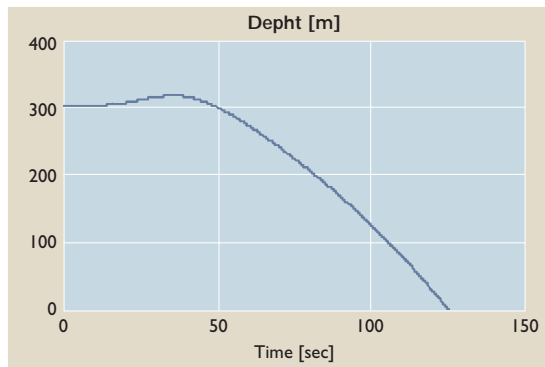
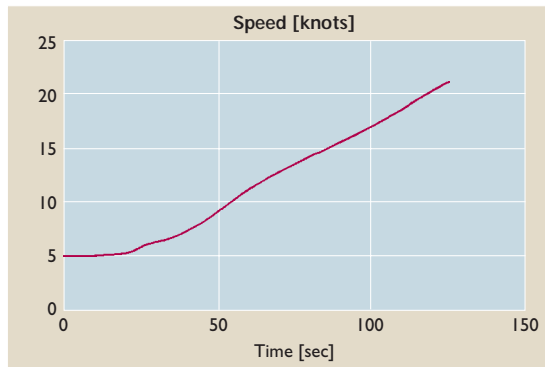
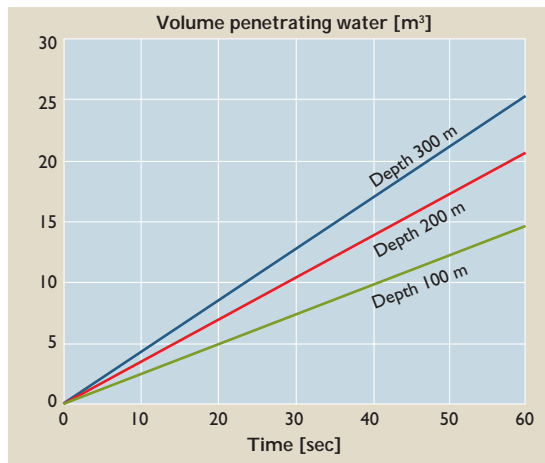


Emergency blowing system)



Water may penetrate into the submarine through a hole, which is defined by location, area of the hole and a contraction coefficient. The pressure in the hole is obtained from the height of the local water column to the still water surface minus the height of the inside water column.

Amount of penetrating water through a 100 mm hole. Even if a hole in the pressure hull is small, the water flow through it can be quite large at a large water depth. The diagram illustrates the water flow versus time for a 100mm hole with the contraction coefficient $C_n = 0.7$ for different constant depths.



Flooding in the forward section at depth 300 m. Hole diameter: 0.15 m. Total volume of bottles: 6.48 m³. After 40 sec the water flow through the hole is stopped, the propeller is set to 120 rpm and at the same time emergency blowing is started.

tanks. Due to the rapid process, air and water are mixed in the ballast tanks. Since the energy in water is much higher than that in air, the air will adopt the water temperature. This means that the process is isothermal.

In the air bottles the pressure will drop very rapidly. Heat exchange with the material of the bottles will then make the temperature increase in the bottle. However, this is a slow process and if this heat transmission is neglected, the process in the bottles can be considered to be adiabatic. With these assumptions, the heat quantity in the bottles is underestimated, while it may be overestimated in the ballast tanks.

During the early phase of the Kockums Australian Project real tests were performed to verify these assumptions. Pressure and air temperature were measured inside a compressed air container during discharge of the air to a water tank. Pressure, air temperature, and mass flowout of the tank were measured simultaneously. For the first 20-30 seconds the pressure and air temperature showed the process to be almost perfectly adiabatic. In the water tank a slight pressure increase was detected, and the temperature was almost constant during the whole process.

Simulation of a flooding scenario

A suitable mathematical model accounting for the submarine motion in the presence of flooded water has been developed by SSPA and implemented in the computer code SUBMO. It provides an efficient way to investigate the motions of the coupled system consisting of the submarine and a flooded water mass. The model is truly non-linear, allowing for consideration of large amplitude motions of the submarine.

The diagrams to the left show an example of a simulation of a recovery manoeuvre. There are a total of four ballast tanks modelled in the depicted simulation. In the mathematical model each tank system represents the tank itself (with an outlet hole), a pressure bottle and a valve for controlling the blowing procedure. Thus each tank is specified by longitudinal location, volume, size of bottle and an initial pressure of the bottle, see the table.

The simulations are conducted as follows:

1. Initial speed is chosen to be 5 knots. At the start of the simulation the depth is the same as the point depth set, 300 m. The submarine is allowed a certain time (20 sec) to obtain steady state conditions.
2. After 20 sec a flooding hole with the diameter 0.15 m is opened in the forward section. The contraction coefficient, C_n , is = 0.7
3. After another 20 sec (at $t = 40$ sec), the point trim set is changed to 25°, at the same time emergency blowing is started and the propeller rate is changed to 120 rpm

Lennart Byström

Mauritius, tourism, natural resources – and SSPA



Per Danielsson, Project Manager at SSPA. He graduated in Civil Engineering (M.Sc. in Engineering Geology), in 1989. He has been working at SSPA since 1994 in the areas of sustainable development, integrated coastal management and environmental management.

Telephone: +46 -31 772 9035
Email: per.danielsson@sspa.se



Örjan Mohlund, M.Sc. in Architecture and Physical Planning, 1962. He runs a consulting business and is a member of SSPA's network of experts. He has been working in the areas of institutional development, regional, rural and urban planning and integrated coastal planning and management in Sweden and abroad, mainly in Africa, South East Asia and the West Indies.
Telephone: +46 - 8 500 330 90
E-mail: orjan.mohlund@sspa.se

Deep blue water, beautiful white sand beaches, swaying palm trees and colourful coral reefs are resources that we want to preserve for the next generation to enjoy and explore. These natural resources are very fragile and must be managed very carefully, in order to maintain their high quality and ensure they remain accessible to the public. However, rapid development all around the world places a heavy pressure on coastal areas and severely threatens sustainability.

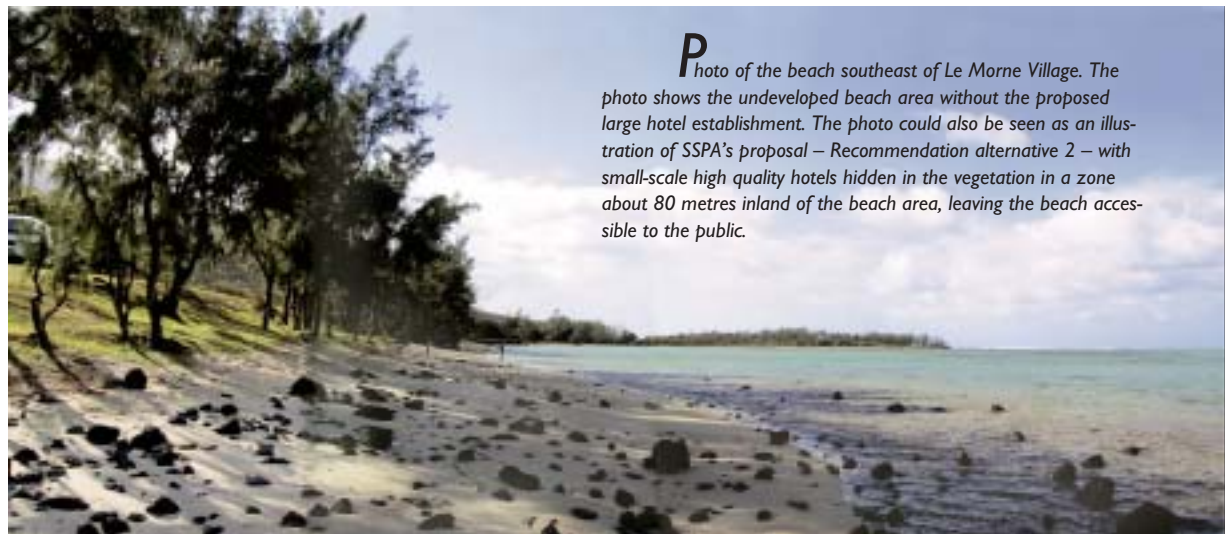
In 2001, the Government of Mauritius was approached by a developer with a request to dredge 1 500 000 m³ of sand from a lagoon on the south coast of the country. If this amount of sand was piled up on a football field, the pile would be 250 m high, or as high as a 70-storey skyscraper. The request also included the construction of a five-star hotel with 250 rooms, to be located on the beach of the lagoon. The Government decided to engage an independent firm to carry out an in-depth investigation of the likely impacts and consequences of the intervention on the marine and terrestrial environment and the local socio-economy.

A task for SSPA

After an international tendering process, SSPA Sweden AB was commissioned the investigation by the Ministry of Economic Development, Financial Services and Corporate

Project Components:

- Analysis of the consequences on natural resources.
- Analysis of consequences on cost and benefits to the Mauritius community at large.
- Analysis of consequences on socio-economy and quality of life
- Critical assessment of EIA prepared by local consultants
- Protective environmental measures
- Alternative operational systems
- Management and market value
- Environmental & socio-economic impact



Affairs (MEDFSCA), Mauritius. The task was specified as a feasibility study and an environmental impact assessment of the proposed large-scale sand extraction and the establishment of the beach hotel

The proposed development was expected to impact on a wide range of social, economic and environmental conditions, as well as on issues of national significance. In order to handle such a volume of both complementing and conflicting interests, it was extremely important to apply a comprehensive and integrated working methodology.

Impact assessment – both local and regional

A number of baseline studies were carried out in and around the lagoon to collect data and assess both local and regional impacts. The assessment covered primary, multiple and secondary effects. The studies included wave pattern, bathymetry, tidal currents, sediment transport, sediment geology, marine and terrestrial ecology, socio-economy, legal matters, community development and land uses. The work was carried out in both the winter and in the summer seasons so that the consequences could be assessed for both the normal season and the cyclone season. All data were then processed and analysed, aiming at a comprehensive final assessment of the impacts on the lagoon and surrounding inter-linked marine and terrestrial areas. The analysis formed the basis for formulating appropriate recommendations to be considered by the client.

Hotel and sand dredging – or not?

The Lagoon at La Prairie and the surrounding areas represent some of the very few coastal areas that still remain rather undeveloped. The results of the study of currents, wave patterns and sediment transport indicated that the proposed dredging would not affect the present situation in a significant way. A study of the lagoon's marine flora and fauna showed, however, that the marine life would

Photo of the beach southeast of Le Morne Village. The photo shows the undeveloped beach area without the proposed large hotel establishment. The photo could also be seen as an illustration of SSPA's proposal – Recommendation alternative 2 – with small-scale high quality hotels hidden in the vegetation in a zone about 80 metres inland of the beach area, leaving the beach accessible to the public.

The beauty of a tropical island is a major natural resource that is fragile and important for the development of an island.



generally be jeopardised by the sand dredging and hotel development, and in certain areas also be totally destroyed.

A large socio-economic study was carried out to depict the situation in the Le Morne Village and surrounding villages. The result of the study showed that the local communities were largely dependent on the fishing resources of the lagoon and that the proposed dredging would significantly reduce the volume of the annual catch. The hotel establishment would certainly create new job opportunities. However, very few villagers would be able to meet the hotel's requirements for skilled labour.

Recommendations

The study resulted in two alternative recommendations:

Alternative 1

Due to the importance of the lagoon from a national point of view, the decision on the use of the lagoon at La Prairie should be deferred until additional information required at a national level would be available from the ongoing work on the National Physical Development Plan 2002 (NPDP) and the Integrated Coastal Zone Planning and Management project.



Alternative 2

If the above recommendation could not be realised, the following measures should be taken:

- approving the establishment of one or two 'high-quality, small-scale' hotels, located more than 80 metres inland from the high water mark;
- reducing the sand dredging so that only a restricted water area near the shore is deepened;
- developing the beach area to a high-quality Public Beach with provision of good service; and
- providing attractive opportunities for local business to be engaged in the economic activities generated by the hotel – provision of services and supplies, commercial activities, etc.

The tourist industry is one of the largest industries in the world. 500 billion euro were spent within the tourist industry in 2002. It is essential for nations like Mauritius and other small island states to develop the tourist industry in a sustainable way. Deep blue water, beautiful white sand beaches, swaying palm trees and colourful coral reefs are resources that the country and the people will benefit from in the future.

Per Danielsson/Örjan Mohlund

Sustainable development is recognised as the key for safeguarding the environment and securing natural resources for future generations. This issue has been addressed at several United Nations Conferences, starting with the Stockholm Declaration 1972, followed by the Rio Declaration 1992 with Agenda 21 and at the World Summit 2002 in Johannesburg.



Illustration of the proposed 250-room hotel on the beach southeast of Le Morne Village. The sketch illustrates the impact of the proposed large-scale hotel development on the land and seascape, as well as the significantly reduced public access to the beach.

Streets clogged up? Reclaim the waterways!



Björn Forsman, Project Manager, M. Sc. in Mechanical Engineering, graduated from Chalmers University of Technology in 1979. In 1980 he joined SSPA where he has worked with oil spill management, model testing and simulation of ship manoeuvring, and has been responsible for leading and co-ordinating commercial projects in the area of marine environment. He also has a wide experience of international projects.
Telephone: +46 - 31 772 9059
E-mail: bjorn.forsman@sspa.se



Kurt Dyhr, Project Manager, Licentiate Degree in Chemical Engineering, graduated from Luleå Technical University in 1998. In 2001 he joined SSPA where he has worked with risk assessments and risk investigations. He has worked with development of educational material for handling LPG accidents, and environmental investigations and development of tools for environmental management and accounting.
Telephone: +46 8 702 04 81
E-mail: kurt.dyhr@backmans.verkstader.se

During the first 50 years of the 20th century, regular ferryboats served an important role for public transportation along our coasts and in the archipelago. During the last 50 years of the 20th century the asphalt and car boom drove the ferryboats out of competition. Today when more and more of our cities are facing serious congestion and capacity problems with public transportation systems, the ferries are returning to favour. In order to become successful the new generation of ferries must be prepared to adopt new technologies and management policies to match buses and underground from efficiency and environmental point of view.

Like in most European capitals and other large cities, the citizen of Stockholm spends more and more time in traffic queues or in underground trains commuting from distant suburbs. The expansion possibilities for streets and public transportation networks are being fully exploited, and there is no more money to spend on construction to cut the peaks of the morning and afternoon rush hours.

Stockholm – a city of islands and waterways

From the perspective of traffic congestion and Stockholm's topography – mostly islands – a number of new ferry lines are now being planned in order to increase the traffic capacity, in particular to connect the southern and northern halves of the city. The capacity of today's bridges is not enough during rush hours, and most of them are located in the city centre. The new ferry lines, located outside the city centre, also offer safer routes for hazardous cargo, and road tankers and other heavy lorries do not have to traverse the city streets to reach the harbour.

Although there is a lot of experience of ferry operations in Sweden – the Swedish National Road Administration (SNRA) operates 37 different lines with 61 vessels and a passenger turnover of 25 million per year – there are a number of technological and environmental challenges to consider when using the waterways as an effective complement and alternative to land-based traffic infrastructures.

A well-known profile of Stockholm city's waterways – the fleet has a passenger turnover of 2.5 million per year.



Environmentally friendly water bound passenger traffic

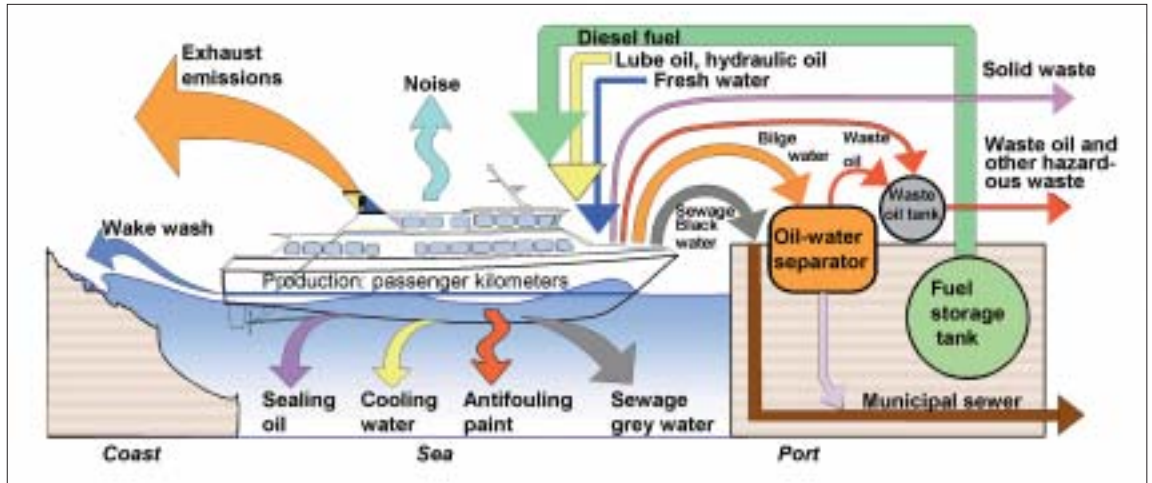
In Stockholm city and in the archipelago there is a long history of passenger traffic transported by ferryboats, and the operator Waxholms Ångfartygs AB, commonly known as Waxholmsbolaget, has been operating since 1896. The company owns 18 ferryboats that serve the archipelago and 6 harbour ferries, commonly known as the Djurgården ferries. To manage the traffic demand in the archipelago, the company co-operates with privately owned independent boat operators. The total number of boats in the company's different fleets is 59. The Djurgården ferries serve Stockholm's inner harbour and have an annual passenger total of about 2.5 million. The archipelago ferryboats carry approximately 1.8 million passengers per year.

The utilisation of former harbour and dock areas for housing developments also contributes to the renaissance for waterborne public transport solutions and an increasing interest in new technologies. For the short routes connecting the inner parts of the city it is particularly important to find environmentally friendly solutions for the propulsion machinery and alternatives such as fuel cells and biogas fuel are being discussed in various development projects.

Tools for environmental management and accounting

In 1998 SSPA Sweden and Waxholmsbolaget initiated a co-operation project in order to facilitate environmental management in the company and to develop tools for prediction and quantification of the exhaust emissions associated with the operation of the fleet. The tool developed calculates the exhaust emissions of NO_x, SO₂, CO₂, CO, hydrogen carbons and soot particles from each vessel. The calculation algorithms in the data program are based on unique data for every individual vessel such as records of vessel operation patterns and specific engine data. The environmental software tool calculates the emissions for single boats and different fleet segments of the company. The results are presented in the company's

The basis for the environmental management and accounting tool can be illustrated by this schematic flow and mass balance of the resources consumed, production output and environmental impact associated with ship operations of Waxholmsbolaget.



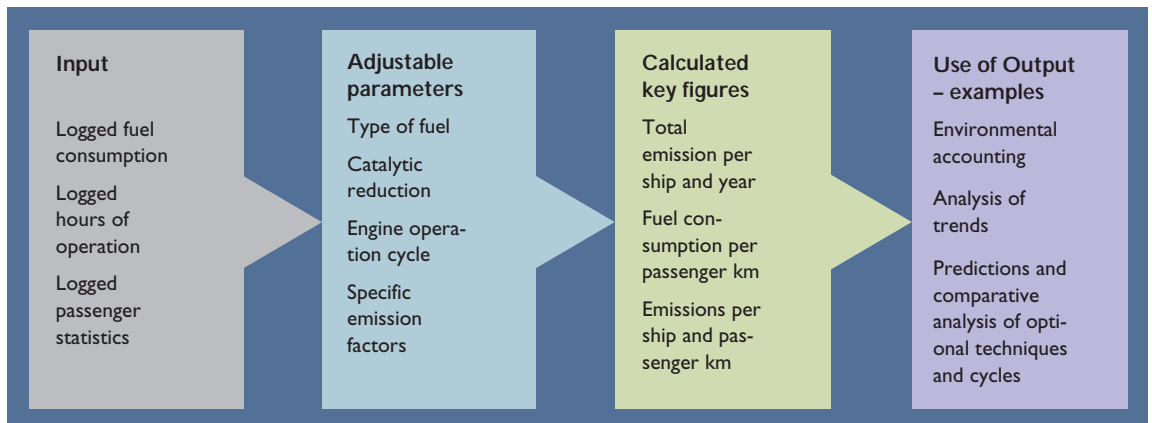
Typical environmental impact from substances in exhaust gases

Substances	Abbreviation	Environmental impact
Nitrogen oxide, NO and NO ₂ .	NO _x	Eutrophication, acidification, danger to health
Sulphur oxides, SO and SO ₂ .	SO _x	Acidification
Unincinerated hydrocarbon compounds	HC _x	Danger to health, climate change
Carbon dioxide, CO ₂	CO ₂	Climate change
Carbon monoxide	CO	Danger to health
Soot particles	PM	Danger to health



The frequent port stops with retardation/acceleration cycles emphasise the importance of operational practices.

The computation of emission data is illustrated by the box chart to the right.



annual environmental report.

One objective of the company's environmental policy is to reduce the exhaust emissions and pollution from boats. To reduce the emissions of acidic sulphur dioxide (SO₂) all Djurgården ferries have changed fuel, from Gasoil 10 with a sulphur content of 0.05 % by weight to sulphur free marine diesel. In addition, a project has been initiated to reduce the fuel consumption by adjusting timetables and applying fuel-efficient driving practices.

The emissions software tool has recently been upgraded, and the output from this also demonstrates that measures such as replacement and upgrading of the engines have resulted in a significant drop in the total emissions. The new version of the tool is also prepared to include modules for prediction and quantification routines for other environmental aspects associated with the operation of a fleet of ferryboats or other ships.

SSPA's engagement in this project is a good example on how our environmental competence can be combined with SSPA's extensive experience on ship design and operational aspects of safe marine passenger transport systems. We are looking forward to meeting new challenges within the development of the next generation of green, safe and effective waterborne public transportation systems.

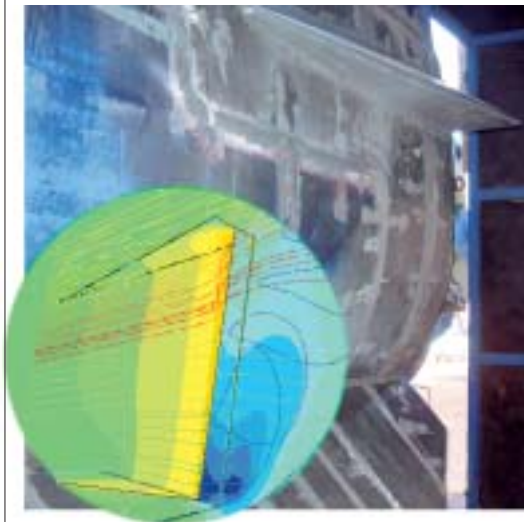
Björn Forsman/Kurt Dyhr

Short comments

Improvement of the STENA HSS interceptor pressure

The interceptors on the STENA HSS ferries have recently been improved by use of RANS computations at SSPA. In order to improve the manoeuvring efficiency, the fins

above and below the interceptor have been modified to contain the streamlines better. The volume near the fins and interceptors has been modelled. SHIPFLOW calculations were used to obtain a reasonable inlet boundary layer to the RANS solution. *Michael Leer-Andersen*



FLUENT computation (pressure contour and path lines) applied to a photo of the new fin on the STENA CARISMA

118' Wally Power – Milestone in yacht design

The increasing demand for high speed at sea in recent years has created a challenge for the boat designers. We want to select the best possible technical options while keeping costs at a reasonably acceptable level, so a good compromise is often needed. During the design process for its new 118' Power motor yacht, Wally was searching for appropriate solutions to ensure that the technical aspects of the project would be compatible with the requirement for extremely innovative styling.

To enhance the reliability of this very high-speed boat, extensive analyses and testing were conducted in the fields of naval architecture, composite materials and construction technology. The goal of this work was to ensure that the boat

will be capable of reliable long-term operation in moderate to severe environmental conditions, and will smoothly pass through the waves at high speeds, with reduced motions and accelerations.

The mass properties such as the CG position, combined with the chosen hull form, minimize the hydrodynamic resistance at about 60 knots. For all speeds it has been observed during the model tests and sea trials that the bow wave is well deflected and no air is found in the water flowing under the bottom area between the keel and the spray rails, the latter being a fundamental prerequisite for optimum performance of the three water jets.

A great achievement of the project is the stability of the boat in

Predictions based on model tests were fully proven at sea trials.



Papers 2003

- Allenström, B., Hallander J.: 'Peak Performance in SSPA's Large Cavitation Tunnel.' SprechTag Kavitation, Schiffbautechnische Gesellschaft e.V., Hamburg, Germany, January 30, 2003.
- Kurimo, R., Byström, L.: 'Manoeuvring with pods: Model test results and sea trial experience of M/S Costa Atlantica.' 8th International Marine Design Conference: IMDC 2003, Athens, Greece, May 5–8, 2003
- Harries, S., Janson C. E., Leer-Andersen, M., Marzi, J., Maisonneuve, J. J., Raven, H., Valdenazzi, F.: 'The FANTASTIC roro: CFD optimisation of the forebody and experimental verification.' International Conference on Ship and Shipping Research, Palermo, Italy June 24–27, 2003.
- Li, D.-Q., Ottosson, P., Trägårdh, P.: 'Prediction of bank effects by model tests and mathematical models.' International Conf. on Marine Simulations and Ship Maneuverability, MARSIM 03, Kanazawa, Japan, August 25–28, 2003.
- Trägårdh, P.: 'Roll motion of manoeuvring ships.' International Conf. on Marine Simulations and Ship Maneuverability, MARSIM 03, Kanazawa, Japan, August 25–28, 2003.

- Hua, J., Lundbäck, O.: 'Issues on mathematical modelling of wave-induced forces in following seas.' 8th International Conf. on Stability of Ships and Ocean Vehicles, STAB 2003, Madrid, Spain, September 15–19, 2003.
- Hua, J.: 'Model test for validation of calculated wave-induced excitations on a ship in following and quartering waves.' 8th International Conf. on Stability of Ships and Ocean Vehicles, STAB 2003, Madrid, Spain, September 15–19, 2003.
- Allenström, B., Liljenberg, H., Tuudem, U.: 'Concept development and model testing – new generation Air Assisted Vessels (AAV) with water jet propulsion.' 7th International Conference on Fast Sea Transportation, FAST 2003, Ischia, Italy, October 7–10, 2003.
- Lundbäck, O., Hua, J.: 'Model trials for studying hydrodynamic force components in following seas.' 7th International Conference on Fast Sea Transportation, FAST 2003, Ischia, Italy, October 7–10, 2003.
- Allenström, B., Andreasson, H., Leer-Andersen, M., Li, D.-Q.: 'Amplification of ship generated wake wash due to coastal effects.' SNAME– World Maritime Technology Conference and Exposition, San Fransisco, USA, October 17–20, 2003
- Grundevik, P.: 'Optimise the high speed craft/port interface with respect to efficiency, safety and environmental effects.' E-MAR Conference, Nice/Sophia-Antipolis, France, June 5, 2003

Naval architecture

Wally with Intermarine Italy
Hydrodynamic predictions:

Wally, Intermarine,
SSPA Sweden AB

Builder:

Rodriquez Intermarine, Italy

General characteristics

Length O.A.: 36.00 m
Displacement (half load): 95 tons
Construction Type:
Advanced Composites
Propulsive Power:
3 x 5,600 HP Turbines
Water jets:
KaMeWa 2 x 63 + 1 x 50
Speed: max 65 Knots

pitch and roll at all speeds. The boat has exceptionally good performance in all working conditions. This was predicted from model test results and confirmed by the sea trials carried out in calm and rough seas. The running trim can be adjusted by a system of 'interceptors' installed on the transom, making it possible to reduce the resistance at the desired speed. The Wally Power reacts well to external forces when running at maximum speed as well as during manoeuvring, showing that it is able to easily control the 14,000 kW propulsive power.

Sten A. Hellström

Please visit our website!
www.sspa.se

SSPA HIGHLIGHTS 1/2004 will be distributed in April 2004.



SSPA HIGHLIGHTS IS PUBLISHED BY
SSPA SWEDEN AB.
P.O. BOX 24 001
SE-40022 GÖTEBORG, SWEDEN
PHONE INT. + 46 -31 772 9000
TELEFAX + 46 -31 772 9124
E-MAIL postmaster@sspa.se
WEB SITE www.sspa.se
EDITOR: LI FREDRIKSON
PRODUCTION: NILS LINDSKOUG
GRAPHIC DESIGN: WERNER SCHMIDT
PHOTO: SVEN WESSLING
PRINTED IN SWEDEN
ISSN 1401-3711