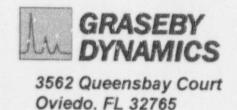
Sealed Source Safety Section Attention: 'Evaluator' Mail Stop T8FS US Nuclear Regulatory Commission Washington, D.C. 20555



October 20 1998

Dear Sir / Madam.

#### Request for Advise:

I would sincerely appreciate your advise in respect of applying for and obtaining the appropriate NRC Licensing as rapidly as possible for a Chemical Warfare Agent Monitor that we wish to sell into US 'commercial' markets.

#### 1. Introduction:

Graseby Dynamics is the world's leading designer and manufacturer of IMS (Ion Mobility Spectrometry) technology based Chemical Warfare Agent detectors. Over 60,000 of our systems have been produced and fielded world-wide to NATO customers, a vast majority to the US DOD. Graseby Dynamics' CAM (Chemical Agent Monitor), using a 10 mCi Ni-63 Sealed Source is NRC Registered and has been fielded with US DOD since 1988; following Graseby's initial delivery of near 12,000 units CAM is now manufactured in the US under License. Graseby's 'M-22 ACADA' system (Automatic Chemical Agent Detector and Alarm) is also NRC Registered and contains two of the same Ni-63 sources. ACADA is currently undergoing the process of initial user-fielding to DOD. ACADA is also the subject of a current 'Exemption' application directly from US Army who wish become its 'Exempt Distributor' within DOD.

We wish to obtain appropriate licensing for a product called CAM-2 which is an updated version of CAM, above. The CAM-2 system contains the same NRC Registered 'Sealed' Ni-63 Source of 10 mCi nominal activity, 15 mCi maximum (NRC Registration Number: NR-136-S-185-S; this is the only source we use in all our detectors).

In response to intense marketing activities in the US in support of US Govt.'s 'Domestic Preparedness' thrust, several cities and municipalities are preparing defensive protocols for potential acts of terrorism, including use of Chemical Warfare Agents (CW Agents). Graseby Dynamics, as the DOD's main supplier of

9901220034 990119 PDR RC \* PDR CW detection and warning equipment has been widely approached and asked to quote for 'commercial' sales of CW detectors across the US. In responding to these requirements we have however been made very aware by our customers of the prohibitive logistics burden that potential operators might face (e.g. local Police and Fire Departments) should we attempt to field a piece of equipment requiring local Radiation Licensing.

Research indicates that either a product distributed under 'General License', or as an 'Exempt Device' should overcome this difficulty and we would like to investigate the most expeditious route towards one of the above, preferably the Exemption, if possible.

We understand that the first step to be taken is to seek a 'Sealed Source Safety Evaluation' of the CAM-2 by NRC, however it is unclear to us to what detail the application package needs to conform as our CAM-2 differs only very slightly from DOD's current-production CAM. Might it be possible to expedite the evaluation process by appropriate reference to the existing, Registered product?

#### 2. Detail:

The CAM-2 is an updated version of US Army's CAM system, incorporating several performance and logistics related enhancements. CAM-2 is very closely related to the I-CAM (Improved-CAM) system developed by Graseby under contract to DOD, which is the version currently in volume production by Intellitec, of Deland, FL, in the US.

Graseby Dynamics Limited (GDL) is a Division of Smiths Industries, and is based in the UK. All manufacturing occurs at GDL's ISO-9001Certified main facility at:

Graseby Dynamics Limited
(Attn: Mr. Barry Langford, Sales & Marketing Director)
Park Avenue,
Bushey, Watford
Herts, WD2 2BW
England
(Tel: 01923-228566)

(Tel: 01923-228566) (Fax: 01923-240285)

GDL has a permanent US Sales & Marketing organization in the Washington area:

Graseby Dynamics Limited (Attn: Mr. Neil Bloomfield, Sales & Marketing Manager)

10640 Main Street, Suite 201 Fairfax, VA 22030

(Tel: 703-218-0380) (Fax: 703-385-6470)

I am responsible for all US technical support:

Mr. Rob Howard, Engineering Support Manager (Graseby Dynamics Limited) 3562 Queensbay Court, Oviedo, FL 32765

(Tel: 407-620-1546) (Fax: 407-359-0905)

Under our ACADA Production Contract with US DOD we are required to provide on-shore Warranty support for these systems; we also provide on-shore CLS (Contractor Logistics Support) for ACADA through a separate contract. In order to effect this work we have a developed a formal relationship with a company by the name of:

PCP, Incorporated (Attn: Dr. Martin Cohen, President) 2155 Indian Road, West Palm Beach, FL 323232323 (Tel / Fax: 561-683-0507)

PCP, Inc. holds a Radioactive Materials License from State of Florida (License Number: 1132-1) and this has been modified to incorporate maintenance of up to 400 'M-22 ACADA' systems (i.e. 800 Ni-63 sources) by Graseby personnel.

Our agreement with PCP, Inc. extends to their becoming our point of import and distribution for CAM-2. Should an NRC 'Exemption' for CAM-2 be granted then we would nominate PCP, Inc. as our 'Exempt Distributor' and proceed with an appropriate modification to their Radioactive Materials License. A recent conversation with PCP's primary point of contact within State of Florida Office of Radiation Control indicated that as Graseby manufactures CAM-2 outside the State of Florida (i.e. in the UK) then the device evaluation "probably" falls under the jurisdiction of the Federal NRC.

#### 3. Summary:

Graseby is attempting to meet the requirements of several US customers acting under Federal instruction for 'Domestic Preparedness' by rapidly providing large quantities of a military-approved Chemical Agent Detector (CAM-2) to local-government task forces with the minimum achievable NRC regulatory burden. We believe this will require either a 'General License', or preferably an 'Exemption'.

Graseby did not anticipate this rapidly developing market and therefore did not address the NRC regulatory issues until this point. We would sincerely appreciate any information or advise on how we might expedite the evaluation and licensing process to meet this need of National importance.

I attach a Company brochure for information and would very much appreciate your response at the earliest opportunity.

Sincerely,

Robert J. Howard

**Engineering Support Manager** 

Graseby Dynamics, USA

#### ROB HOWARD

ENGINEERING SUPPORT MANAGER



#### GRASEBY DYNAMICS LIMITED

3562 QUEENSBAY COURT, OVIEDO. FL 32765. TEL: (407).620.1546 FAX: (407).359.0905

EMAIL: graseby@cris.com

www.gradyn.co.uk

NUMBER SIXTY SEVEN

# Aerospace Melleli

News and Technology from Smiths Industries

, Singapore host**s** Asian Aerospace Show

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New displays for C-130

中国 航空公司

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#### Aerospace Review

NUMBER SIXTY SEVEN . SPRING 1998



Front cover: One of four Boeing 737-300s owned by China National Aviation Corporation. Of the more than 3,700 Boeing 737 aircraft built or on order, more than 500 are operated in Asia and the Middle East. This picture of the region is assembled from several remote sensing satellite images.

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#### SMITHS INDUSTRIES

Aerospace

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#### Contents

in the Asian Market	2
Product Support – The Singapore Story	4
Cutting Edge: Super Hornet and Raptor	5
Interactive Voice System	6
Navigating the Airways	8
Hawker Horizon gets Integrated Fuel System	9
A New Era for Data Processing	10
New Technologies for Aircraft Electrical Systems	12
Cockpit-21 for T-45 Upgrade	14
Displays for Civil & Military Aircraft	15
EIDS for Worldwide C-130 Hercules Market	16
Stores and Mission Management	17
Prostab Probes the Hot Spots	18
Graseby Takes the High Road - To Space!	19
Pacific Aerospace (continued from page 3)	20
Ships without Sailors	22
In the Picture	24

#### "Across the world the current forces for change have never been greater"



Every era throws up new challenges in our industry. Within each sector and across the world the current forces for change have never been greater. Consolidation among US prime manufacturers has shaken up the competitors in Europe, prompting suppliers to search for strategic partnerships. Meanwhile, shock waves from economic turmoil in the Far East have been felt in both civil and defence sectors. At Smiths Industries we consider that changes bring new opportunities. We have learned to adapt to new situations, whether inspired by industrial, political or economic activity and in recent years we have been able to grow by acquiring new skills and winning new business. Looking ahead, our continuin, success wit be based on a similar mix: responding to customer demands while anticipating future trends.

In this issue of Aerospace Review we consider the factors and developments now influencing our business operations. We observe the pace of change in the Pacific Rim which is in the spotlight at the time of Asian Aerospace in Singapore. The region is a significant marketplace for both civil and

military aircraft and whatever the economic trends, Smiths Industries remains firmly committed, through our Product Support service centre in Singapore as well as our supplier partnerships with the prime manufacturers serving those markets.

In this issue we show how we are responding to our existing customer needs while opening exciting new possibilities for the future. The company is proud to have developed the Interactive Voice Module for the Eurofighter 2000 (see pages 6 and 7), the first combat aircraft with this system. Eurofighter itself has been given stability by a commitment from participating partners to production and operational deployment early in the next decade. In another area offering great potential we are systems integrator for the digital Cockpit-21 (see page 14) now being fitted to the US Navy's T-45 training aircraft.

Within the past year Graseby Dynamics has joined Smiths Industries. A world leader in nerve agent and chemical contamination detectors, Graseby has been awarded a NASA contract for environment monitors aboard the International Space Station (see page 19). Assembly of the space station will begin this year. Looking to future possibilities, Prostab is developing video technology which could be added to our engine monitoring expertise (see page 18). We are also looking at higher levels of integration for aircraft electrical systems to improve efficiency and reliability (see pages 12 and 13), and Kelvin Hughes contemplates aerospace technology for automated ships of the future (see pages 22 and 23).

Our company continues to grow and the order books are stronger than ever. In this issue of Aerospace Review I hope we can demonstrate that investment in R & D, a strategic approach to new business and a wide product base put Smiths Industries Aerospace in a strong position to meet the future requirements of this fast changing industry.

NAmer Sarby

Norman Barber Chairman Smiths Industries Aerospace

# Pacific Aerospace

#### CHALLENGE AND CHANGE IN THE ASIAN MARKET

Across East and South-East Asia enthusiasm for aerospace investment is rife:
China is intent upon modernising her airlines, improving airports and investing in Western technology and Japan is planning high-speed commercial transport aircraft in the vanguard of a major commitment to aerospace. Smiths Industries Aerospace has also made a major commitment to the region through its Product Support facility in Singapore. We look at how the region aspires to a world-class role in air and space.

It used to be said that the health of aerospace companies revolved on the re-equipment cycle. Historically, every 20 years or so the world's airlines and fleet operators re-equip with a new generation of aircraft. In was said that, in turn, these bring advanced technology, improved seat-mile revenue and greater profits for builder and buyer alike. Indeed it seems that this is in fact the case. Notwithstanding the intervention of a World War, the major airline and operator boom of the 1930s was rapeated during the 1950s and again in the 1970s. Today – in the 1990s – a new re-equipment cycle is getting under way as the wide-body transport and long haul airliners of the 1970s are replaced with a new generation of more efficient successor types.

As a world leader in the business of producing state-of-the-art avionics, instruments and monitoring equipment Smiths Industries faces the enduring challenge of strong competition and new opportunities from growth markets. Today and for the early years of the next century the Far East will play a vital part pot only in those evolving markets but in directing the future evolution of commercial transport aircraft. To a lesser extent indigenous industries in the

Far East will steer the direction of sales and product support for military aircraft. Either way, Smiths Industries will be there as a world class leader as Far East potential expands to meet high aspirations.

It was from the Pacific rim that movement came for a new generation of high capacity long range airliner. The Boeing 747 family is no longer able to satisfy all customer needs and not even the "megatops" or super-long range Jumbos can accommodate the numbers of people Pac-rim operators want to move in a single flight. While it consolidates at home, and buys lucrative chunks of the US aerospace manufacturing sector, Boeing has shelved immediate plans for a 1,000-seat super Jumbo. So it falls to Airbus to make the running in a civil airliner market where procurement is going up – fast!

Large airliners are poised to become the vanguard of a major expansion in US aerospace business which can only do good to the European sector as well. Worldwide demand for new civil airliners will top 16,000 in the period 1996-2015 with large transport aircraft accounting for 15% of that total. In 1998 this sector will grow by 10% and during the next decade worldwide markets for almost 6,000 aircraft are reliably forecast. The boom can do nothing but good for the European manufacturing and supply industry. Two years ago European companies snatched 32% of world markets. That figure is expected

Malaysian Air Force Hawk attack and training aircraft

to reach 36% by 2005 as Far East markets expand and the US sector declines as a percentage of world aerospace trade.

Largely impervious to tremors on the Far East money markets, China alone expects to spend \$15 billion on aircraft and systems in the next five

years. For the last seven years China's air passenger traffic has grown by a phenomenal 30% per annum and in projections for the future analysts agree that it will continue to expand at twice the average Pac-rim level – which is already the highest anywhere. In the systems area, Pac-rim growth outstrips world trends with an average increase of 16% per annum in semi-conductor business for the Far East aviation market. But the writing is on the wall. Growth in Japan is expected to hit 11% at most.

At the centre of all this is the communications capital of the world - Singapore - which presides over the hub of the Far East and assumes the geographical (if not cultural) gateway between the Occident and the Orient. Competitive alliances between Singapore Airlines and Western airlines have been consummated by an agreement with Lufthansa which brings this flagship carrier closer to the Star Alliance involving United Airlines, Thai Airways, Air Canada and the Scandinavian Airline System. Through this mechanism an increasing number of Far East airlines are set to team with international partners. In an area where 76% of all Asian passengers travel inside, rather than outside the region this link to the other hemisphere can only boost business.

In the near term Singapore will continue to be the preferred choice for aerospace companies from Western countries because the infrastructure is good for serving Malaysia, Indonesia, Thailand, Hong Kong and Taiwan. Japan is a highly industrialised money market with its own interests and China has the political will to become a central competitor to both Singapore and Japan. Development in China is unprecedented anywhere, signalled by the fact that half the cranes on construction sites around the world are at five major locations in that country. China is building an



Singapore International Airport

infrastructure to propel the country and its 1.2 billion people (20% of the world's population) into the 21st century and will assume strategic importance for the region and businesses opting for a piece of the cake.

Along with Japan, China has made a commitment to aerospace as its flagship industry for century 21. Until recently, China had a poor safety record on internal airline operations but strict government controls were applied which dramatically improved matters. The next challenge pivoted on China's airports, poorly equipped and inefficient by Western standards. Key in a five-year plan announced in 1996, China is to spend the equivalent of \$9 billion on upgrading 53 of its 132 airports. To be completed by next year, the first stage in the construction of Shanghai's new Pudong international airport is on course. When finished the 200,000 square metre terminal building will handle 18 million passenger movements and 6 million tonnes of freight each year.

Continued on pages 20-21



# PRODUCT SUPPORT The Singapore Story

An essential part of the service required by customers and provided by Smiths Industries, Product Support ensures global confidence through eight locations in five countries. Worldwide activities are controlled through Cheltenham, UK, with service centres at Clearwater and Seattle in the US, Toronto in Canada, Singapore in South East Asia, Melbourne, Australia and Heathrow, UK, With major developments in avionics and aircraft systems, advanced technology gets dated within the operating life of a single product. Product support means easing the ageing process through upgrades required by the pace of technical evolution and demanded by Smiths Industries global customers.





Krith feeding is Deployed Schoolings for the Pacific Support Courte, the For East arm of Scottic Indicateles Product Support division, and is unided in Singapore

Central to customers and clients throughout the segion, South-East Asia is served from Smiths industries FAA and CAAC approved Product Support facility in Singapore. The decision to locate the regional support centre in Singapore was taken during the early 1990s based on its good infrastructure, communications and transport facilities and easy access to other places in the area. Work to set up and equip the facility on Singapore's Loyang Industrial Estate began in April 1993 and within months the shop was in business. A formal opening book place during the Singapore Air Show of February 1994 from which date the pace and level of activity has accelerated. From this facility Smiths Industries serves customers in Singapore, Malaysia, China, indonesia, Brunei, Thailand and Bangladesh among others.

The organisation is configured to match requirements from civil and military operators alike with back-up advice and operating support across the full range of products. Modern stortshop facilities with bools and ligs to match the customer's equipment are operated by skilled and highly trained genomical quality control standards (FAA and CAAC). Maintenance and logistical support are a vital part of the sugmeering backup to provide the computer controlled maters inventory, global distribution system and itemired component lists. The computerined support network ensures operators have appropriate electronic data as well is service notes, maintenance manuals and revised information sheets and buildness.

In the last 10 years or so the Pacific Rim and Rasin segion this become an important area for Smiths Industries, which now adds a consolidated presence in the Far East to its world class market standing in Europe and North America. The Singapore facility is capable of handling a wide range of civil and military requirements throughout the region. Smiths Industries compiders China so be an important market in the area with increasing influence and vitality as the country expands its investment and dependence on serospace products, indicators agree that China will play an increasingly important role not only in the far East but on the world assumpace stage. If

# Cutting Edge

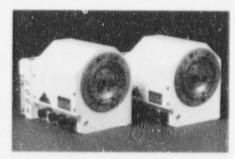
Aerospace Review is beginning a new series aimed at providing background information on exciting new projects in which Smiths Industries Aerospace is a key player helping build a new future for aerospace.

#### Seaborne Strike

In the early 1990s the US Navy faced tough decisions. Fresh from the Gulf War, the carrier fleets were already in line for a slim down. With the collapse of the Warsaw Pact and a reduced threat from former Soviet states, politicians wanted deep cuts in the defence budget. To fill operational needs vacated by reductions in unit strength aircraft were required to fly a variety of mission roles. For combined strike and interdiction the Navy chose a derivative of the McDonnell Douglas (now Boeing) F/A-18E/F Hornet.

The Hornet originated as a contender in the USAF Lightweight Fighter competition won by General Dynamics with its F-16. Now it is to get new multi-role sea legs and Smiths Industries is supplying the main electrical generators. Each is a 50/65kVA Variable Speed Constant Frequency 400Hz system with an additional triple output (2.5kW total) of regulated 28Vdc power for flight control computers. Smiths Industries 30/40kVA Cycloconverters are fitted to earlier Hornets, the F-117A, some A-4 upgrades, the Boeing/DASA X-31 and the U-2.

The F/A-18E/F carries a larger wing, greater weapons payload, up to 60% more range and better growth potential than earlier Hornets. It has better carrier suitability and survivability as well as improved avionics and cockpit displays. The Navy plans to buy between 550 and 765 Super Hornets and Smiths



Industries is assured a place on one of the bright new stars in the US Navy galaxy for the next century.

#### Century 21 - USAF Style

Owing more to the fearsome dinosaur in Jurassic Park than any airborne predator, the name Raptor has been selected for the F-22 which fighter units of the USAF will deploy from 2005. Selected as a highly manoeuvrable and stealthy successor to the F-15 Eagle, the F-22 Raptor



carries two electrical power management systems from Smiths Industries. One of these controls and distributes 270V and 28Vdc and 115Vac power while the other system comprises a battery charger and controller.

Smiths Industrics is a proud member of a select team building the US Air Force air dominance fighter, an aircraft which posses' s extraordinary agility through its twin Pratt & Whitney turbofan engines with twodimensional thrust-vectoring nozzles. The F-22 is a Mach 2-class combat aircraft designed to carry up to six air-to-air missiles internally or a combination of missiles and precision guided munitions. It is a compromise between ultimate stealth and essential mission requirements to provide for the US Air Force a fighter of unprecedented capability. Threats the F-15 will no longer be able to counter will be defeated by the lethal and survivable F-22. Currently the Air Force plans to buy 339 Raptors and Smiths Industries will be there - in every one.



# INTERACTIVE VOICE

More than 15 years of research and development, the work of several Smiths Industries engineering departments in -Britain and the United States and the combined efforts of a product qualification and "" flight evaluation team will put a unique and innovative, technology in the cockpit of Europe's latest air superlogity combat aircraft – Eurofighter. Aerospace Review talked with lan Bickerton, Head of Speech Technology at Smiths Industries, Cheltenham, to learn the background to this extraordinary piece of technology, the Interactive Voice Module:

The modern combat pilot has undertaken a steadily increasing workload over the last two decades, linked with the increasing electronic sophistication being packed into the cockpit. Human tactor engineers have feen striving to keep this workload manageable with innovative cockpit design. HOTAS (Hand On Throttle And Stick) operation is a good

example and provides avionic control while maintaining hands on the flight controls. However, cockpit designers are limited by ergonomic constraints as to how many switches they can mount on the main flight coprols. Recognising that reality, the furofunite consortium has decided to fit every production aircraft with the Interactive Voice Module (IVM) from Smiths Industries – the world's first high performance air superiority lighter to have such a system.

The Eurofighter Speech Recognition Module (SRM) is a speaker dependent,

high performance speech recognition system designed specifically for military cockpit applications. Pilots who have tried it already like it and become addicted to its advantages: reduced workload in the busy, noisy, cockpit environment; increased safety through better distribution of functional tasking; enhanced situation awareness with the pilot's attention outside the cockpit where his weapons will be targeted; and fewer reasons to take hands off the throttle and the controls. British Aerospace has two Smiths Industries

# SYSTEM

voice recognition systems on loan, one of which has been on the Eurofighter simulator for the past two years for pilot assessment and syntax design.

In the UK foundation work on speech recognition research began during the early 1970s under the Ministry of Defence at GCHQ, Cheltenham, subsequently amalgamated into the Speech Research Unit, DERA UK. This group was successful at developing core algorithms for dynamic programming - the secret of voice recognition systems. Contemporary speech recognition systems use stochastic models to provide the mathematical foundation for matching spoken word patterns: Smiths Industries uses a patented algorithm combining Markov models and neural nets for improved discrimination.

At its Grand Rapids, MI, facility in the early 1980s Lear Siegler (later to become part of Smiths Industries) pioneered an early voice input device for the F-16 Interactive Voice Programme based on Verbex commercial technology. Part of a three-phase programme to advance the concept, Smiths Industries became involved at the end of this phase in 1983 when Lear Siegler was a competitor. As the only company in all three phases of the work, Lear was invited back in to government funded research.

Algorithms and technology were advanced to the level acceptable for the avionic environment of a military cockpit. In a box about 1m long, equipment using a simple template matching technique (known as dynamic time warping) was installed in an F-16 for flight trials. These F-16 trials spanning several years proved the value of voice technology in reducing pilot workload and increasing mission capability. However, when Grand Rapids stopped their development programme in the late 1980s the extant technology was unable to offer such a system in a box small enough for cockpit installation on operational aircraft.

But Smiths Industries Research at Cheltenham would not give up and, starting from scratch, developed new algorithms specifically designed for reliable operation at the high levels of noise and speech variability characteristic of the military cockpit. The breakthrough came in 1987 when Texas Instruments produced the TMS-320-C30 digital processor capable of performing 33 million floating point instructions per second. This provided the platform for a single card implementation of the IVM. A decade later this microprocessor is still very fast by contemporary standards: the

potential vocabulary of 250 words, of which 130 are implemented in the operational unit. Memory growth to 1,000 words is in the development stage but recognition performance is (and has to be) in excess of 95% in the cockpit environment with development promising growth to greater than 98%. The IVM accepts continuous natural speech at 100-140 words/min with a 120ms response time. The voice generation side provides high quality digitised speech encoding at the rate of



AV-8B was used for tests of a demonstration voice card

TMS-320 family has since become an industry standard with 45% of the worldwide digital signal processor market.

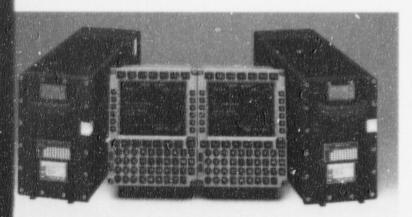
A working flight MIL-E-5400 demonstration card was produced for the US Navy AYK-14 mission computer. This was similar to a test programme designed for the AV-8B using the same algorithms built to work in difficult environments. From this Smiths Industries teamed with McDonnell Douglas, Northrop Grumman and British Aerospace bidding on the JAST (Joint Advanced Strike Technology) programme. Late in 1996 this team was dropped from the JAST contest but work through the evolutionary line from the AYK-14 to the Eurofighter award was seamless and came as a direct result of those preceding programmes.

As installed the IVM is a speaker dependent, connected word, voice recognition system with a maximum 120-160 words/min utilising a 200 word vocabulary.

The IVM is speaker dependent through voice pattern registration and each pilot must have selected words characterised at a ground support station. Beyond 130 words voice recognition patterns become difficult to assimilate but technology will eventually move the system to speaker independent operation where no voice characterisation is necessary. The Eurofighter SRM is a 140mm x 113mm doubled sided surface mount card weighing 350gm with an estimated mtbf of 25,000 hours and plugs directly into the Communications and Audio Management Unit. Potential applications for the near future include battlefield and naval use in busy, high noise level, environments. Future civil uses may be applied to similar environments in manufacturing, processing and power industries.

# NAVIGATING the AIRWAYS AIRWAYS UNITED STATES OF AMERICA

Today's crowded skies and the increasing demand for air travel and freight services means safety assumes greater importance. Increased demand on air traffic control systems and flight networks bring unprecedented loads on optimised route planning and safety standards. Moreover, the expectations of operators and owners frequently compromise technical and flight planning criteria to the detriment of each segment in this jigsaw. Flight management systems embrace a computer driven flight control capability selectable for specific modes of operation. As such they are becoming an essential feature of improved, and enhanced, flight and air traffic control systems. Smiths Industries recognises the challenges and has successfully tackled these problems to equip the VC-25 fleet with a new Flight Management System (FMS) which modifies the Boeing 747s used by the President of the United States.



In the United States a major effort is underway to incorporate new capabilities into flight and air traffic management and the Department of Defense has implemented a programme to generate a Global Air Traffic Management (GATM) system for operation in the worldwide air space environment. Global Air Traffic Management (GATM) is the term coined by the US Air Force to designate the military requirements of the Future Air Navigation System in the Communication Navigation Surveillance/Air Traffic Management (CNS/ATM) environment.

The Smiths Industries Flight Management System on the VC-25 (Boeing 747) Presidential aircraft fleet includes three Multifunction Control Display Units (MCDUs) which are to be built by Smiths Industries Malvern, PA., and three Flight Management Computers (FMCs) built by Smiths Industries Grand Rapids, MI. The MCDU consists of a large colour Active Matrix Liquid Crystal Display and the unit is typical of those currently flying on Boeing 737 series aircraft. These units offer high reliability with reduced weight and power demand. Off the shelf, the FMS has full ARINC 702A/739A compatibility and will be compliant with the Future Air Navigation System incorporating satellite systems for position-fixing, communications and surveillance.

Smiths Industries is developing technologies for Flight Management Systems to meet demanding criteria and specifications for both the military and civil aviation procurement market. Military transport avionics to satisfy the GATM requirements are currently less capable than their civilian counterparts. The exacting requirements of GATM make military FMS on air transport fleets essential for safe and efficient flight and route management. The selection of Smiths Industries to upgrade the Presidential Boeing 747 is a lead in that direction.

Smiths Industries Flight Management System

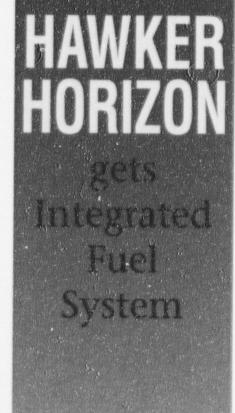
In a strategic move that consolidates Smiths Industries in the business and regional jet market Smiths Industries Aerospace, Malvern, PA., has won a contract to provide the integrated fuel system for the new Raytheon Aircraft Company Hawker Horizon business jet. Building on years of fuel gauging and component experience, which includes such diverse aircraft as the Boeing 777, Learjet 60, Dornier 328 and CH-47, this latest success represents new milestones for the company.

With a fibre-composite fuselage the Hawker Horizon is Raytheon's new addition to its top-of-the-range series. This executive aircraft has a price of \$14.6 million and a 3100 nm range at 0.82 Mach. Raytheon Aircraft's Hawker Horizon offers capabilities not found in other mid-sized jets. First flight is planned for late 1999 followed by FAA certification in 2001 with customer deliveries beginning shortly thereafter.

When Raytheon went shopping for the supplier to provide a fuel system package for the Hawker Horizon they looked for a company that could manufacture. Smiths Industries will manufacture all fuel quantity indication components. Fuel control functions will reside in modules as part of the aircraft electrical control subsystem. The circulation subsystem components will include ac boost pumps, motive flow pumps, single point fuelling adaptors and an array of special valves, manifolds and sensors.

Smiths Industries has established an on-site design team in Wichita to support system definition activities. Other programme tasks will include overseeing the simulated wing tests and providing fuel system certification support. The wing test programme is a two part effort being conducted at Fuji Heavy Industries at Utsunomiya, Japan, and at Raytheon's Wichita facility. Fuji is producing the aircraft's wing and will supply all assemblies for installation at Wichita.

The integrated fuel system for the Hawker Horizon builds on a successful relationship with the Wichita based company which includes Smiths Industries instruments on Beechjet T-1A Jayhawk, Hawker 800 and 1000, King Air and the new T-6A trainer for the US Air Force and the US Navy. The new integrated fuel system is designed for growth and can easily be adapted for derivative business jet aircraft in this growing market segment.





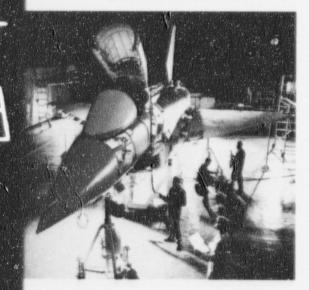
# NEWE PROCESSING

At Smiths Industries, data control and processing is considered a vital part of making aircraft operate better, more efficiently and with greater margin of safety than ever before. The company is working on several enabling technologies that promise revolutionary approaches to the way information is obtained, handled and processed. Traditionally, the military aircraft is seen as the sharp end of combat operations but in reality it is the enabling vehicle for a predefined mission. The aircraft has no meaning without the mission and too many pilots, even now, have failed to understand the impending age of the 'mission manager' role. In time aircraft will fly themselves and only receive commands from a pilot via interactive voice systems or through stores and mission management systems (see page 17). These technologies free pilots to concentrate on the mission. In the last 50 years they have been overburdened with electronic boxes and in-cockpit tasks which sap time and attention on the target.

It is hard to come up through military pilot training and convert the individual to the operational imperative that mission operations drive the purpose of the pilot's job. Advances in data processing forced by increased capabilities through advances in technology and the increased demands of flight planners leave the pilot in overload. Increasing demands for safety, driven at least as much by civil air operators, enhance the capabilities of automated and 'managed' flight systems. In turn these negate many of the historic requirements put upon a pilot, the hands-on-stick feeling that some say is a tradition rather than a requirement.

At the core of all this is data processing and the associated suite of data collection equipment in an environment where, historically, the trend has been to increased investment and dependence (in and out of the cockpit) on avionics. The dictionary definition of 'avionics' is that it pertains to all the systems in an aircraft working to electronic principles. Broad, but true. In that all-embracing context the trend, if not exponential, is staggering.

Sixty years ago avionics – in those days electrical systems – accounted for around 4% of the aircraft's flyaway cost. With the introduction of the jet age, picking up on associated technology development, that figure increased to around 12%, typified by the Hawker Hunter. When the Tornado came along in the early 1970s, avionics accounted for 35% of



the unit cost while associated 'electronics' in the Eurofighter top 42%. Now the F-22 Raptor swings the pendulum further vet, across the percentage divide, with an avionics bill fully 56% of the total cost of each aircraft. Increasing complexity of aircraft systems over the last 50 years pushed up the Maintenance Man-Hours/Flight Hour figure, going from around 15 hrs for a frontline RAF fighter in World War II to about 45 hrs for a late 1960s high performance combat aircraft. Avionics and systems design has contributed to a reduction in that value - back to 15 hrs for the F-22 and down to 10 hrs for the Eurofighter.

Major gains in size and weight reduction commensurate with dramatically expanded capabilities and possibilities, have driven up weight attributable to avionics. Avionics now account for around 4% of aircraft



takeoff weight compared with almost 3% during the 1950s. Surely an astonishingly good value-for-weight ratio in a period during which electronics and avionics have immeasurably advanced beyond anything conceived then. Moreover, in fixed terms when corrected for inflation, the cost of a modern high-performance fighter has increased 100-fold since the halcyon days of World War II increasing the sensitivity of the operator to even a single loss.

The value of each aircraft has become integral with the air vehicle's ability to perform its assigned mission and survive. Consequently, when driving toward that, safety involves many factors other than saving the life of the crew; it is ensuring that each modern combat aircraft performs its mission so that others of the same type do not have to repeat a sortie and risk (perhaps lose) other lives. Sum these absolutes (cost, capability, efficiency) and enhanced processing ensues. A typical example of the increased attention being given to enhanced safety through survivability and greater reliability is the Health & Usage Monitoring System designed to monitor nearly 200 parameters on RAF HC Mk.2 (CH-47D) helicopters. Through that, applied technology creates a synergy between the requirements of the operator and the safety of the system - across the board - which in turn leads to greater efficiency and better value for money.

#### Data Recorders Aid Safety

By understanding the nature of inflight failures safety is enhanced through a better characterisation of the aircraft's problem. A positive step toward achieving that has been taken by the US Army with the introduction of Smiths Industries solid state Voice and Data Recorders (VADR®) as part of the Digital Source Collector programme on selected AH-64 Apaches, OH-58 Kiowa Warriors and CH-47 Chinooks. Production and deliveries are currently being made from Grand Rapids, MI, with order backlogs for this and other military programmes ensuring work through the year 2003. The VADR® is being used to provide data in support of US Army maintenance, training and flight safety activities and is one in a family of rugged data recording packages produced by Smiths Industries.

Smiths Industries was recently selected to provide the VADR® for the first eight flight test aircraft for Britain's Longbow Apache, the WAH-64. Products can be configured as a high capacity Flight Data Recorder (FDR), a Cockpit Voice Recorder (CVR), or combined CVR/FDR. They are designed to meet both FAA TSO and European EUROCAE requirements for both flight and cockpit voice recorder equipment. Solid-state voice and data recorder systems have wide application with many air forces and civil air operators throughout the world.

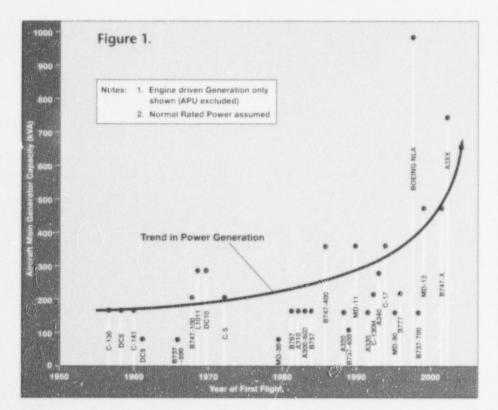


# Generating New Ideas In Electrical Power Systems

Civil aircraft electrical power system demands have increased steadily over the past 40 years and the trend is accelerating as aircraft increase in size. Conventional Constant Frequency 400Hz aircraft power systems have been the common solution over this period using relatively expensive Integrated Drive Generators. Ian Moir, Business Development Manager for Power Generation and Power Management at Smiths Industries, Civil Systems – UK says that new advances now offer more attractive alternatives providing more advanced load management, more efficient use of available power and an integrated system running electrical and hydraulic systems together.

The general trend in the evolution of aircraft electrical systems since the 1950s has been for a steady increase in electrical power demand. In part this has arisen in civil aircraft due to the increases in size and the number of passengers that can be carried. It also

reflects a steady increase in some of the main electric power users: power demand from food galleys has grown due to increased aircraft range and the desire of airlines to offer more exotic meals and in-flight entertainment (IFE) has brought additional passenger





demand; in present systems IFE demand is approaching 100 watts/seat. Figure 1 gives an overview of these escalating demands since 1950.

In the past the most popular and successful method of generating aircraft electrical power has been through a Constant Speed Drive CSD) together with a generator to provide 115Vac, 3-phase power at a constant 400Hz. More recently the CSD and generator have often been combined into one unit called an Integrated Drive Generator (IDG). This Constant Frequency (CF) option has been the norm for many years but it is expensive to procure and maintain. Some systems employ electronically produced constant frequency power by means of Variable Speed Constant Frequency (VSCF) dc-link (DCL) technology but these are not necessarily optimum for all future applications. Variable Frequency (VF) and cycloconverter systems are now alternative options.

Cheaper than any other system, VF provides 115Vac, 3-phase power at a frequency directly proportional to the variation in engine speed, usually 2:1 for a turbofan aircraft. However, due to the wide range of frequency variation, power conditioning would be needed in most cases and the cost of attendant motor controllers mitigate against the very low cost of power generation. On the other hand the VSCF/cycloconverter offers great potential for the civil market. The cycloconverter has been used for primary electrical power on the F/A-18C/D and E/F Hornet, the F-117A and the U-2: over 4,000 VSCF systems



have been delivered by Smiths Industries, Leland Electrosystems division. While VF may be the cheapest, because of the need for a large number of high power motor controllers it may not be the lowest risk solution for power levels in excess of 120kVA per channel. In those cases a combination of VF and VSCF cycloconverter may be the best option.

When it comes to power generation, cost of procurement and cost of maintenance are powerful factors in selection. For initial procurement, VSCF/DCL and VSCF/cycloconverters carry almost the same price as an Integrated Drive Generator but the VF system is little more than half that. In terms of maintenance, VSCF-DCL is less than half the cost of an IDG system whereas the VSCF-cyclo and VF systems are minimal. Since maintenance costs affect direct operating costs the former is a powerful tool in selection. Reliability of the VSCF/cyclo system is up to four times that of the CF or VSCF/DCL system while Variable Frequency system reliability is twice that again.

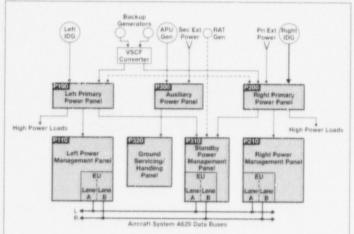
The Boeing 777 Electrical Load Management System (ELMS), now also to be fitted to the Boeing 767, sets new standards for industry and represents the first integrated electrical power distribution and load management system for a civil aircraft. The system comprises seven power panels, three of which are for primary power distribution and four for secondary. Load management and utilities systems control is exercised by means of Electronic Units which interface

with the left and right aircraft system ARINC 629 digital data bus with dual redundant architecture. ELMS provides by far the most advanced system in airline use today. Approximately 17-19 Electrical Load Control Units (ELCUs) supply high power directly for the main ac busses, power which can be switched off by an intelligence within the ELMS should a power source fail. Loads may be reinstated following restoration of source to ensure effective use of power.

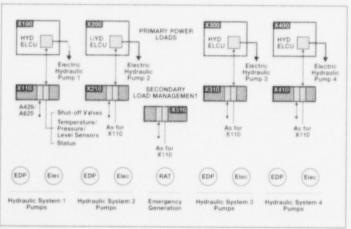
This system can be simplified or it can be increased to meet the demands from large capacity aircraft of the future, such as the A3XX where 50-60 ELCUs with 150-180kVA per channel could be required. On the Boeing 777, which has completed more than 300,000 flying hours in airline service, ELCU mtbf is in excess of 140,000 hours. This reliability, when coupled to control aspects of ELMS, provides a high level of confidence in a total system integrating major hydraulic power generation through existing ELMS technology for a very large aircraft. Design criteria for ELMS was

such that following a failure the equipment had to continue to function for 10 days with a 99% confidence level that a further failure would not occur. This equates to about 110 flying hours or more than 160 operating hours at Boeing 777 utilisation rates. At the time of writing, one particular module used in twelve ELMS locations had amassed a total 3.6 million module flying hours, an excess of 5 million operating hours.

Systems integration presents a logical evolution of existing technology in airline service today. Using open architectures, hosting modules from more than one vendor, successful and cost effective development of highly integrated systems become possible. One of the effects of controlling the operation of major components of fuel, hydraulic and air systems within a modern aircraft is to effectively integrate those functions more closely with the electrical system. The message coming from the Boeing 777 is that these systems can be very reliable and highly effective in helping airlines respond to customer demand.



The Boeing 777 ELMS sets new standards for the industry, representing the first integrated electrical power distribution and load management system for a civil aircraft.



An existing system using ELMS technology could integrate the major hydraulic generation system for future large airliners, undertaking control and indication functions for a fourchannel system with four engine-driven pumps, four electrically-driven hydraulic pumps and a single emergency channel.

# Pilot Information &

# Cockpit-21 for T-45 Upgrade

Equipped with a new digital cockpit known as Cockpit-21, the first production T-45C Goshawk jet trainer for the US Navy was rolled out at the Boeing company, St. Louis, on October 31, 1997 Central to cockpit-21 has been the re-design of the avionics system developed to full DoD 2167a standard by Smiths Industries Aerospace. developed to replace existing analogue displays Cockpit-21 more closely matches digital displays used in operational F/A-18 aircraft and other US Navy aircraft for which pilots train on the T-45. Developed initially from the BAe Hawk 60 to a US Navy VXTS requirement for replacing T-2C Buckeye and TA-4J Skyhawk trainers, the T-45A first flew in April 1988 and entered service at the end of 1990. A year later the type was cleared for carrier landings and the first US Navy student went solo on the type on

March 23, 1994.



Smiths Industries supplies the Head-Up Display for the T-45C, and has performed the full systems integration on Cockpit-21, which comprises a Display Processor Unit, Pilot Display Unit and Data Entry Panel (DEP). The DEP drives five display surfaces including the Pilots Display Unit and four raster Head-Down Displays. The new cockpit provides navigation, weapons delivery, aircraft performance and communication data to both stations in the two-place cockpit. Smiths Industries will provide Boeing with 103 new digital Cockpit-21 assemblies by 2004 and Boeing are planning to retro-fit an additional 84 T-45As with the new digital layout.

# Display Systems

# Displays for Civil & Military Aircraft

Advanced information processing and AMLCD technology is revolutionising the modern cockpit, replacing liquid crystal displays in an increasing number of aircraft. Smiths industries has been developing these new systems to produce a range of AMLCD products for application with civil and military customers.

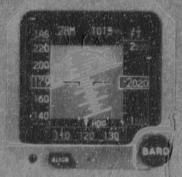


#### **B777 Para Visual Display**

This multi-function AMLCD giaresticald display is installed on the cockpit counting of the Roeing 777 as a Para Visual Display to provide ground direction information by means of a notating barber-pole format or to provide azimuth guidance information on takeoff when visibility falls below acceptability.

#### N-22 Standiny Flight Display

Developed for the Boeing V-22, the AMLCD standby flight display provides engine instrumentation data, fuel system data, by draulic system failure information, flap and raccile angle data.

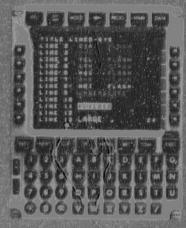


#### MD-90 Flight Display

The integrated Standby Instrument System is now being fitted to the MD-90 as a fully integrated single-box solution replacing at least three existing cockpic displays.

#### Military Head Down Display

Selected for Royal Australian Air Force Hawks and fine new F/A-188/F Hornets the five-inch colour sould function AMLCD is a line replacement unit for video, text or graphics.



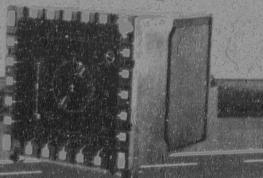
#### Multi-function Control Display Unit

Designed for growth and new applications, the flat panel AMI CD is ARING, 739/429 compatible providing control/display functions for the global positioning system, ACARS, flight management system, performance advisory system or SATCOM.



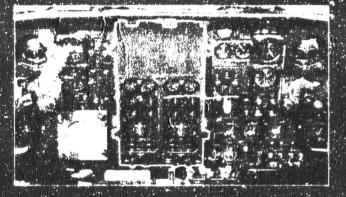
#### **Datalink Control Display Unit**

Two full colour Databak Control Display Units are fitted to Airbus A330/340 series aircraft now in service as part of the Future Air Navigation System.



for Worldwide C-13 Hercules Market

Patting new life into the Lackheed Hercules military transport aircraft, Smiths Industries in conjunction with the RAF has developed a new Engine Instrumentation Display System. (fADS) using light emitting diode technology. for the C-130K. It has already been ordered by the South African Air Force, the Danish Air Force and the Belgian Air Force and although the RAI has yet to make a commitment considerable market interest has been expressed by C-130 users in the US and around the world.



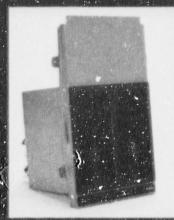
The LIDS is a direct replacement for the existing electromechanical instruments litted to existing C-130 providing significant benefits in terms of weight, power consumption, ighability and cost of ownership. Additionally, retro-fit of the LHDS releases valuable panel space for potential display upgrade requirements. The FIDS aliquas presents primary parameters in a pointer/counter format with secondary parameters in a digital format providing one easily read display that requires minimum crew difference training. Elias provides system reliability at least 20 times better than existing indicutors. It is a COTS design based on more than 2,000 systems with over 10 million hours in service on commercial addiners.

Smiths Industries Acrospace began work on new displays for C-130 when Lockheed Martin ivas evaluating the option of offering retro-fits and apprades to the entire existing fleet or producing a new version, the C-130J. When Lockheed opted to produce the C-130J the upgrade programme evaporated until the RAF talked with Marshall Aerospace about upgrades to its own fleet of C-130s. Smiths Industries designed the new 11125 panels under a contract from the Masistry of Defence

worth almost \$1 million to apply existing commercial displays carried by Boeing 737 and MD-80 types to the C-130. Three sets were made for the RAF and Smiths Industries worked with Marshall Aerospace to carry out rightests on 156 engines at RAF Lyneham, followed later by tests with engines on the wing. Flight trials in the form of a risk reduction programmé began in September 1996.

In paraflel applications, 156 engined Lockheed P-3 Orlon maritime patrol aircraft are an ideal market for 400%. in :

addition, Electronic Flight Display Systems (FFDS) are as atlatile for PEA/B aircraft while the Plight Director Indicators are applicable to the VEC/CP-140. MTBF on the LIDS is an estimated 22,000 hrs compared with 292 hrs for attitude indicators on existing P-3s. EIDS provides an mith of 3,500 hrs compared with 72 hrs for the five instruments it replaces. Currently several hundred TFS6 powered C-130 and P-3 aircraft worldwide are carolidates for the cost effective retro-fit affording greater information operability and efficiency with lower cost and maintenance.



# STORES AND MISSION MANAGEMENT

#### Added Life for Engines

Data processing is at the core of function and responsibility. But not everything is designed to enhance the mission role of the pilot. Increased emphasis on evaluating the potential life of the aircraft has become an integral part of the equation. Vital for efficient and cost effective management of aircraft and engine systems, life monitoring through the use of computers capable of measuring age-critical parameters helps extend the operational flight time and cut operating costs. Traditionally, engines get serviced at predetermined intervals according to hours flown. This takes no account of the degree of wear and tear through usage or the way the engine has been treated; engines on Hawks flown by the Red Arrows, for instance, have a much tougher working environment than average and tend to age faster.

Because Rolls-Royce is required to provide guarantees on engine reliability life monitoring has become essential for supplier and customer alike. The latest, potentially high demand, application for data processing is the Engine Life Computer (ELC) now fitted by Smiths Industries to a number of RAF Hawk trainers. Civil and military operators



alike have much to benefit from the use of ELC systems and life computer applications with ship, gas turbine or power generation operators are obvious. Ultimately, onboard circraft engine monitoring beyond the measurement of essential performance-related parameters will underpin the future of unmanned air combat vehicle technology. That will lead to integrated architecture, about which more in the next issue, and to driverless ships proposed by Dr Andy Norris from Kelvin Hughes on page 22.

#### Stores Management for the Maritime Mission

Be it on RAF Nimrod or US Marine Corps AV-8B Harrier attack aircraft, Smiths Industries mission and weapons management systems are leading the field into the next century. Carrying the maritime surveillance role well beyond the year 2000, Smiths Industries will equip 21 British Aerospace Nimrod MR Mk.2P aircraft with the Utilities System Management System, the Navigation and Flight Management System and the Stores Management System (SMS) together with associated



ground equipment. Now more than 30 years old, the Nimrod will make use of 2 SMS derived from the F/A-18 system to keep RAF aircraft of this type on target for at least the next 25 years.

In 1997 Smiths Industries, Florham Park was awarded a \$14 million development contract from Boeing for updates to the existing Weapons Management and Control System on the AV-8B Harrier. Known as the Open Systems Core Avionics Requirement programme (OSCAR) this will include hardware and software updates to the aircraft's Warfare Management Computer. The development will continue through 1998 and include software development, test equipment and the delivery of both engineering and production readiness aircraft hardware.

## Prostab Probes the Hot Spots

Photo: Rally-Royce

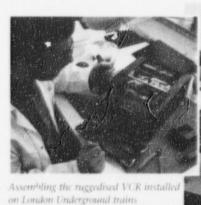
Founded in 1972 to provide systems consultancy in television applications, Prostab International has developed specialised camera, monitoring and surveillance systems with potential for revolutionising the way aircraft engine performance and component life is measured. Smiths Industries added Prostab's complementary technologies to its range of systems in mid-1997, bringing specialised skills and expertise to all aspects of video monitoring and specialised products. Paradoxically, the company breathed life into lateral thinking about systems engineering as it related to the design and manufacture of specialised video products and the supply of tailored video systems. Far from the aerospace world, it existed to create interactive synergies between interdisciplinary technologies and Prostab achieved success in designing to a specific, or unique, requirement where no existing package could be found.

Prostab's applications include remotely controlled, mechanically shuttered, tv cameras for use by the Defence Research Agency on their electro-optical tracking system. When the DRA developed robot video links Prostab supplied various multiplexing and de-multiplexing systems. The RAF uses a Prostab mobile digital angulation measurement system on weapon ranges using triangulation to measure the location of weapon impact positions. Elsewhere, rugged Prostab colour monitors designed and built to a demanding military specification are used in helicopters and a remote vision system has been developed for vehicle manufacturers.

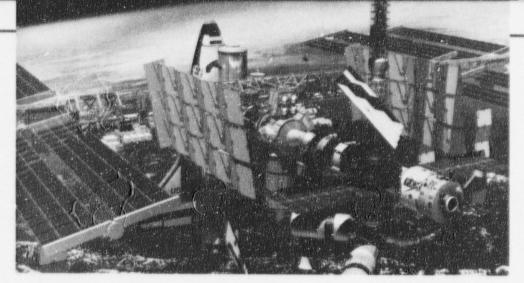
Prostab equipment now offered by Smiths Industries includes hardened video recorders, LCD monitors and camera equipment to survive shock, heat, vibration, electrical noise and dirt. London Underground is using Prostab to provide a Videorail monitoring system now coming into service on the Northern Line. The system has wide applications not only in other route systems with London Underground but in overground rail networks operating in harsh and challenging climates. Prostab is

actively developing a Videorail recorder replacing tape with a hard-disk capability on an open loop system. Technical requirements are high for an operating environment with high dc voltage which greatly exceeds that faced by the aircraft industry. As such, Prostab equipment has potential applications in difficult places such as furnaces. The company is already developing a video based bomb scoring system using software solutions for computing accuracy and performance.

Perhaps the greatest application to the aerospace industry is one in which miniaturised camera and video links located in critical engine hot spots record visible images of materials reacting to high stress operating conditions. Coupled to Engine Life Computers and systems management technology the synergy between operators, engine manufacturers and technologies from this unique world of highly stressed video systems design bodes well for innovative developments in this area.







# GRASEBY TAKES THE HIGH ROAD - TO SPACE!

When Coalition troops went to war against Saddam Hussein in 1991 they carried detectors built by Graseby Dynamics to warn them of nerve and blister agents many feared would be widely used by Iraq's military forces. Now Graseby is heading for space to map toxic contaminants aboard the International Space Station and warn astronauts of danger to health or life. In many ways the two environments are similar: harmful contaminants can be released with little or no warning and personnel must sit tight and ride out the threat far from home in safe-suits that stand between life and death. The challenge is immense.

For more than 50 years Graseby has been tackling such challenges and having joined Smiths Industries in an agreed acquisition towards the end of 1997 has now extended the company's influence to NASA's Shuttle and the vacuum of space. Graseby's involvement began during the Second World War when the company supplied SONAR and ASDIC equipment to the Royal Navy and fuses and sensor heads for weapons. Adapting to a more peacetime role Graseby responded when the British

government looked for a means of detecting hidden explosives, a requirement urged on by troubles in Northern Ireland during the 1970s. This in turn resulted in a technology to detect and measure chemical warfare agents, nerve agents and blister agents. To achieve this Graseby resurrected the principle of ion mobility spectroscopy and produced the Chemical Agent Monitor (CAM), the first real-time monitor to see worldwide use.

Produced by Graseby Dynamics and weighing 1.7kg, the CAM can be attached to the main battle tank, armoured personnel carrier or handheld. Air is drawn into the unit and ionised by a weak radioactive source. Molecules of certain agent vapours are characterised by their ability to form low-mobility ionic clusters and these are classified according to a known vapour source. Whether at isolated ground locations or in the atmosphere very small quantities of toxic agents can be monitored. Graseby licensed the CAM and to date more than



50,000 units have been put into use worldwide, mostly with NATO forces. CAM successfully detected the use of chemical weapons during the Iran/Iraq war of the 1980s and saw wide use during the 1991 war with Iraq. Deployed in hospitals, vehicles, ships



and with ground troops, the CAM was also used on Scud missile debris.

When NASA wanted detectors to monitor potentially hazardous environments Graseby responded with a detector that has already flown on several Shuttle missions. A useful propellant for satellites and spacecraft, hydrazine is a toxic carcinogen that will endanger life if introduced to the inside of a habitable space vehicle. Concern about the possible toxicity of outgassing on board space stations had been suspected as the cause of general poor health among Soviet cosmonauts returned from long stays aboard Mir. As lead agency in the International Space Station NASA has contracted Graseby to provide chemical monitors to characterise the space station environment over long periods, putting Smiths Industries firmly into space.



#### Pacific Aerospace

Continued from page 3

China is now one of the world's largest markets for new civil transport aircraft and that trend is predicted to grow. Having acquired Hong Kong's new Chek Lap Kok international airport China is beefing up the mainland infrastructure to massively expand internal services. The successful move to improve safety has worked without the need to close a single operator and prepares the way for major fleet procurement and product support from many Western companies. In 1996 Air China ordered 33 Airbus aircraft and is now in the process of buying 29 Boeing aircraft while McDonnell Douglas is working up a plan for licence production of MD-90 airliners in Shanghai.

As for Japan, recent money market wobbles have shaken confidence in that country and it may take most of 1998 for the consequences to level out. Challenges from China, while small at present, concern Japanese industry bosses and banking experts linked to Japan's aerospace aspirations. After making the nation a world supplier of motorcycles and cars, and controlling global demand for semiconductors and electrical goods, aerospace is next on Japan's

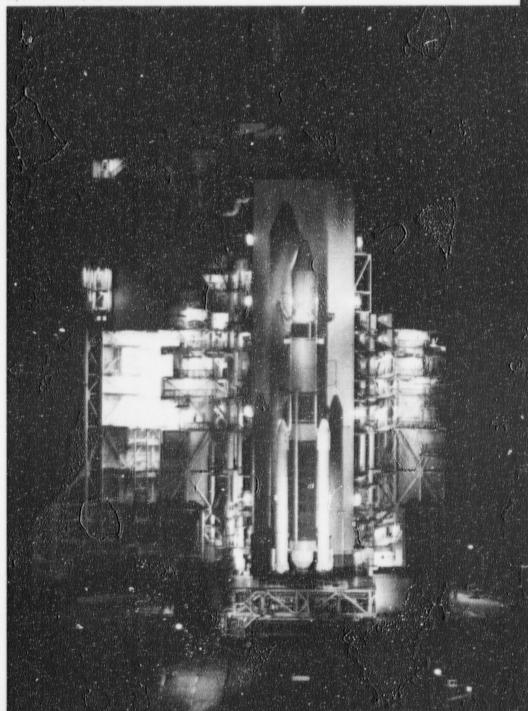
hit list. Here too links with Western companies are an essential prerequisite for success on the global stage. Never shy about projecting its capabilities, Japanese industry is already convinced that it alone can match the West.

Japan's government has invested more than any other single country outside the US and Russia in advanced space technology as a cornerstone of its aerospace initiative. With its own range of satellite launchers and a major programme aimed at consolidating national needs around an in-orbit infrastructure, Japan is servicing the





Right now, Aviation Industries of China and a European consortium including Airbus are refining a deal to build a 100 seat regional airliner, first in a series of new commercial aircraft aimed at Far East markets. China believes by teaming with proven builders and operators in the West it can attract deals like that struck between Singapore Airlines and Lufthansa and wants to boost expansion of its indigenous aerospace industry. At present a mere 0.02% of all internal journeys are made by air, compared with 2.5% in North America. Yet predictions speak of a doubling in China's commercial air traffic within two years. There is no place on earth where expansion is more vibrant than China and no region outside the Far East where opportunities are greater.



Far East with data on weather. climate, natural resources, deforestation, water quality, fishing areas and a host of other concerns related to the natural environment. Following deregulation in the 1980s, Japan's burgeoning telecommunications industry is replete with communications, broadcast and direct-to-home satellite tv. New and more powerful launch vehicles could compete with rockets from the US, Europe and Russia on a global basis. As measured through product and budget Japan's space programme is already as big as the whole European Space Agency.

As described elsewhere, Smiths Industries is in space courtesy of Graseby. Japan is planning to stay there in a big way and its astronauts will breathe pure air because of Graseby air quality monitoring equipment. Chemical constituents of artificial atmospheres are crucial to the health and safety of astronauts. Beginning this year assembly of the International Space Station (ISS) will get under way. Through a series of more than 40 flights over five years the ISS will come together as a major research laboratory in space. Along with the US, ESA and Russia, Japan will provide a space station module for science experiments in a pressurised environment conducted by international crews.

So far Japan has refrained from putting its space programme on the global marketplace for satellite launches and production line buys from other countries in the Far East. Japan is slowly converting its domestic space programme into a potential order-board for foreign participation. China has observed this and, after years of running spy satellite projects, is now accelerating plans for its own civilian space programme with products it can market to the rest of Asia. Communications and directbroadcast (satellite) tv employs technology closely related to aircraft and their systems.

It was from the aviation industry that the world's space programmes were spawned. Over time they became separate industries using common technologies and inventions. Japan is



Hypersonic airliner powered by hydrogen burning scramjet

uniting those two once again, as is the United States, with plans for aerospace vehicles that look more like futuristic aircraft than spacecraft. Several companies in the Far East are cooperating on nascent plans for hypersonic people-movers and transatmospheric vehicles. Using hydrogen fuelled scramjets to power these vehicles at speeds in the Mach 10-15 region they would be designed for high speed hemispiacric transport linking Pac-rim countries with the United States and Europe.

Japan is following a successtar precedent set by Boeing in the early 1950s when it delayed final design of its jet powered Model 367 airliner and built it to a specification optimised for transatlantic routes. When it emerged as the Boeing 707 it was four years behind the British Comet but with a winning advantage: it could cross the Atlantic with a full load of passengers. Japan sees in hypersonic transport the same solution to the world market need for a high speed passenger carrier: make it cross the Pacific Ocean with a full load of passengers in less time than any Concorde replacement could ever manage. Japan's ambition is to be a lead player in an international consortium to develop the next generation of high speed airliner. One based on novel methods of propulsion, environmentally clean and with no significant overpressure (sonic boom) to deter flights over land.

Just as the Americans got the jump on the Europeans in the first 30 years of jet air transport so could Japan seize the initiative for a world lead in the next major expansion of civil air transport. One driven by the requirements of the Pacific rim. From small regional feeder routes to trans-Pacific traffic the Asian aerospace world is poised for change on a colossal scale. Singapore is currently the showplace for that market but across the region, from Shanghai to Sydney and from Malaysia to Melanesia, the next growth in world aerospace markets has begun.



#### Dr Andy Norris of Kelvin Hughes Ltd predicts the marriage of aerospace and marine engineering and a new general predicts the marriage of aerospace and marine engineering and a new generation of driverless ships. WITHOUT SAILORS

My basic premise behind the assertion that one day soon fully automated ships will be a reality is increasing demand for improvements in technology to add safety and lower operating costs. This, plus new technology, particularly computing power, permits this option within a few years. The computing power available for a fixed cost has doubled every eighteen months and as yet there is no limit to that trend. Strong influences come from international legislation and from the ever increasing fear of crippling litigation should the vessel become involved in human or environmental damage.

Most accidents at sea are caused by human error. Analysts claim that accidents. Because ship's electronic and mechanical systems continue to improve in reliability the proportion is likely to rise. But is it right to express concern over the ratio of human error to other errors? Better training and better technology must surely go hand in hand to reduce accidents. Yet the very technology needed to help the human element become infallible tends to reduce the need for human intervention.

For at least 40 years there have been studies and experiments on

humans cause up to 96% of all marine of accidents attributed to human error

automated ships and many visionaries before this have speculated on future possibilities. Coming from a company whose prime area is navigation I am interested in developments with the space-based Global Positioning System (GPS). Typically, GPS is accurate to 50-100 metres more than 95% of the time but, even ignoring what can happen 5% of the time, an accuracy of 50 metres is nowhere near the level required for driverless ships in harbours and rivers. If US authorities permitted use of the military, P-code, GPS channels accuracy would improve to 5 metres or better while differential P-code signals could reduce the error to 1 metre. In short, the technology exists for position location and navigation with ships under way without human intervention.

A potential problem for GPS use is the possibility of an undetected fault in the transmitted satellite signals. The US Department of Defense has a comprehensive checking system to detect such faults but the civil aviation authorities decided some time ago that GPS receivers on aircraft should have an additional facility known as RAIM (Receiver Autonomous Integrity Monitoring). RAIM has special statistical algorithms continuously running within the receiver to check for inconsistencies in navigation solutions. By using more satellites than is strictly necessary for a standard navigation solution problems are brought to the attention of the user. Such techniques are now being used by good quality maritime GPS receivers.

To provide integrity for position fixing in the driverless vessel it would be essential for two or more separate satellite systems to be used so that RAIM techniques could eliminate the erroneous system. The Russian Glonass system, already operational, is a potential candidate for that



second set of navigation satellites. In the next few years operators including Inmarsat will put into service a large number of low orbit satellites which could carry additional navigation data. Within 5-7 years the infrastructure for high integrity, high accuracy, position fixes for driverless vesseis will be common.

Currently, transferring position information from a GPS receiver to a paper chart is a tedious operation prone to error but the automatic plotting of GPS positions on to an electronic chart is accurate and painless. International organisations have finalised requirements for electronic chart equipment, a system known as ECDIS (Electronic Chart Display and Information System) with data referred to as ENC (Electronic Navigational Chart). Hydrographic offices around the



1964. A BAe Trident with Smiths Industries Autoland touches down in fog

world use data, known as \$57, to this format although it will take many years to obtain good global coverage. The ENC uses a data format which the ECDis equipment can display.

An essential requirement for driverless vessels is precise position location and speed calibration. Large merchant vessels now have to carry ARPA (Automatic Radar Plotting Aid) equipment capable of simultaneously tracking 20 targets but many systems can now handle up to 50 or more. Auto-initiation of tracks can be set relative to the host vessel with calculations made concerning distance, time of closest approach etc. Parallel improvements in marine radar include automated gain and clutter adjustments whose control capabilities exceed the capabilities of many human operators. While there is doubt that even these systems

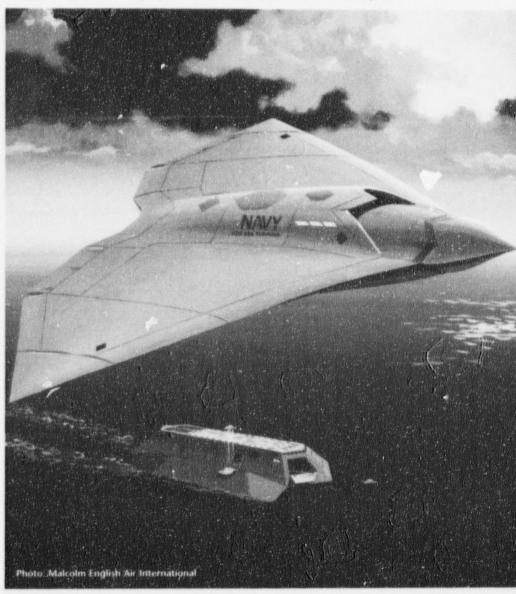
could ever be sufficiently accurate or reliable for safe operation on driverless ships a new navigation aid known as AIS (Automatic Identification System) would be.

Essential for a driverless vessel is a predefined route and the ability to avoid collisions with other vessels. For a number of years Kelvin Hughes has been jointly researching with Liverpool John Moores University a concept known as CAAS (Collision Avoidance Advice System). CAAS accepts target information from an ARPA, or in the future a combined ARPA/AIS, and calculates whether any other vessel will enter a predefined safety domain. If it does the system assesses which vessel has to stand to and which has to manoeuvre. Domain parameters are assigned to the host ship by the

operator. CAAS is currently being evaluated by the Danish Maritime Institute on one of their ship simulators as part of a European Union funded programme.

In future ships should follow the development of failure-proof electronic equipment pioneered by fly-by-wire systems used, for instance, on the Boeing 777 and Airbus aircraft. Utilising triple redundant systems and ultra high reliability with non-stressed designs coupled to prognostic maintenance such as that now used on aircraft engines technologies will emerge to bring forward the age of the driverless vessel, improving safety, increasing reliability and enhancing operating efficiency.

2020? An unmanned combat aircraft overflies an unmanned stealth warship



#### In the Picture

#### Civil Systems VP

Paul Edwards has been appointed Vice President Business Development for the Civil Systems division where he is responsible for worldwide marketing activity for civil products. Paul began his career as an Undergraduate

Apprentice with British Aerospace (Military Aircraft) Ltd in 1982. After progressing through a number of engineering positions, Paul moved to marketing in 1990 and eventually became Head of Strategy and Business Analysis for British Aerospace Defence Ltd. He joined Smiths Industries in 1994 as Strategic Planning Executive based in Cheltenham and in 1995 he became a Director and moved to Clearwater. Florida. Paul holds an MBA



from the Cranfield School of Management and a BSc (Hons) in Computer Science from the University of Manchester Institute of Science and Technology.

#### **Award-Winning Apprentices**

In recognition of their work in information technology, Cheltenham trainees Leom Holley and Sandra Jemmott received regional awards in a national competition to find the UK 'Modern Apprentice of the Year'. Leom, currently on a three year training programme at the Product Support division, won a special award for devising a system to keep track of holidays for the division's 400 employees. His new database replaces a paper-based system which was prone to error and dispute. Sandra, an engineering apprentice with the Defence Systems division, received a merit certificate and was praised for her work in helping to identify errors in computer software.





#### **Technology Director**

Phil Collins has been appointed Director of Technology of Smiths Industries Aerospace. This is in addition to his current responsibilities as Engineering Director, Civil Systems – UK. Phil joined Smiths Industries in 1961 as a student apprentice and obtained a BSc in Electrical Engineering in 1966. He then worked as a Systems Engineer where, among other achievements, he was responsible for control law design, flight test, and certification of the company's first digital autopilot. Appointed Engineering Manager in the mid 80s and Chief Engineer in 1992, Phil became Engineering Director, Civil Systems – UK in 1994. He is an Associate of the City & Guilds Institute and a Fellow of the Royal Aeronautical Society. In 1996 he was awarded the MBE in recognition of his services to engineering.

# John Shepherd moves to Graseby

John Shepherd, formerly of Micro Circuit Engineering, has taken up a new appointment as Managing Director

of Graseby Dynamics based at Watford, Hertfordshire. John came to Smiths Industries in 1990 as Design Engineering Manager, Avionic Control Systems after some 15 years with British Aerospace. Later appointed Head of Programs and then Programs Executive, Civil Systems - UK, he became General Manager of MCE, Cheltenham early in 1997. John has a BSc in Electrical and Electronic Engineering.



## In the Picture

## Computer for Kenya

When Jotham Konaka, a teacher at a Kenyan school for the physically handicapped, appealed for help from local industry, staff from Defence Systems Cheltenham raised the money to buy a computer scheduled for replacement in an upgrading programme and donated it to the school. The computer will be specially adapted for use by children who are unable to write because of their disabilities. Pictured here with some of the employees who contributed, Jotham expressed his thanks and said that the computer will help to make a huge change in the lives of children at the school.



#### ELMS deliveries approach 150

When Ron Woodard, President of the Boeing Commercial Airplane Company opened the new Civil Systems building at Cheltenham in June last year, Production Manager John Mayne (left) presented him with the delivery note for the 100th Electrical Load Management System (ELMS) ship set supplied for the B777 aircraft. Production has since continued apace with a total of more than 145 systems now delivered. A fully integrated system designed to control, distribute and protect the supply of electrical power, Smiths Industries ELMS is standard fit on the B777 where it reduces aircraft wiring, saves both weight and volume and reduces build time.



#### Civil Systems Appointment

Eddie Hinkley has joined Civil Systems - UK as Head of Business Development responsible for winning new business and expanding the product base. Initially a Student Apprentice in Mechanical Engineering with Triplex Safety Glass, Eddie later moved to Pilkington Aerospace where he worked as a Draughtsman, Design Engineer and Technical Manager. He then moved to Business Development, eventually heading up the Sales and Marketing Department where he was instrumental in winning major contracts with leading international aerospace companies.



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Robert J Howard

Engineering Support Manager
Graseby Dynamics Limited

3562 Queensbay Court

Oviedo, FL 32765

December xx, 1998

Dear Mr. Howard,

This is a response to your letter requesting information dated October 20, 1998, for the process in getting a sealed source device registered and obtaining a license for the commercial distribution of the sealed source device CAM-2. Since the purpose of the device is to protect life and property from airborne hazards, and may meet the safety requirements of 10 CFR 32.27, it may be distributed to persons exempt from licensing.

An applicant wishing to distribute or initially transfer products ontaining byproduct material, such as the CAM-2, to persons exempt from licensing, must also obtain an exempt distribution license. The contents required for an NRC license required for the exempt distribution of the imported CAM-2 devices begin in 10 CFR 32.26 "Gas and aerosol detectors containing byproduct material: Requirements for license to manufacture, process, produce, or initially transfer". A license issued under 10 CFR 32.26 permits you to distribute the CAM-2 to persons exempt from licensing in accordance with 10 CFR 30.20.

In order to possess and use byproduct material, you must first satisfy the general requirements of 10 CFR 30.33. Therefore you must apply for and obtain a specific license authorizing the possession and use of byproduct material.

Prior to licensing the the CAM-2 for distribtion, it will be necessary for a Sealed Source Safety

98-97.wpd

**KVA DRAFT** 

Staff to to perform a device review pursuant to the issuance of a device registration sheet. The product information to be submitted for a distribution license and a device registration is outlined in 10 CFR 32.26, 32.27, and 32.29(c), and in Regulatory Guide 6.9 and NUREG's 1562 and 1556 Vol 3. While it is not necessary that you provide a sample of the device, you will need to submit detailed drawings of the device and an example of the point-of-sale package.

In the Sealed Source and Device application, specific details regarding prototype testing to demonstrate containment, shielding, and other safety features under normal and severe conditions of handling, storage and use. Since the CAM-2 appears to be substantially similiar to the "M-22 ACADA" used by the military (here and abroad) past performance history of those devices may be used in lieu of prototype testing. When using historical data, include pertinent items such as the number of units distributed, typical service length, incidents and problems encountered with the devices, etc.

According your letter, the CAM-2 will be produced in England then imported into the United States. Since you have an established office in the state of Florida, and have a distributor in the state of Florida as well for an existing device, you are under the jurisdiction of the state of Florida which is an Agreement State. Therefore your license applications are to be applied through the state of Florida, and you need to apply the Florida equivalents of the above mentioned regulations.

Sincerely,

XXXX



#### MOUSTRY PROFILE

# BRASEBY DEFENCE TECHNOLOGY PROVES ITS WORK

Reprinted with the permission of ASIAN DEFENCE JOURNAL, October 1994 issue

INDUSTRY PROFILE

# GRASEBY DEFENCE TECHNOLOGY PROVES ITS WORTH



A GRASEBY IONICS Ammonia Monitor—for water and final effluent analysis. An outstanding result of GRASEBY's pioneering work in Ion Mobility Spectrometry (IMS) for the defence industry that has major beneficial impact on the civilian sector.

It is easy for politicians and financial executives to forget that support for the defence industry frequently has a major beneficial impact through spin-off developments within the civilian sector. While Western nations reshuffle their priorities following the end of the Cold War, a deaf ear should not be turned towards the investment needs of defence companies, particularly those skilled in creating new technologies. Many provide the means necessary to win a modern conflict situations, including terrorism and drug-related crime. Many are also the companies with employees skilled, and having the insights necessary, to apply new technologies to complex civilian and commercial problems. GRASEBY Plc is a case in point.

#### J.V. Haase Ewin "

**D**uring late August, GRASEBY Plc, the international electronics group, reported increased pre-tax profits in the half year to June 30, 1994, on reduced sales figures. Some financial experts suggested that things might

have been better, had it not been for the end of the Cold War. Reduced sales for the defence related technology division of the company were largely to blame for overall weak financial figures, despite improved sales in the medical, environmental and product monitoring divisions of the company. The language of the company's report seemed

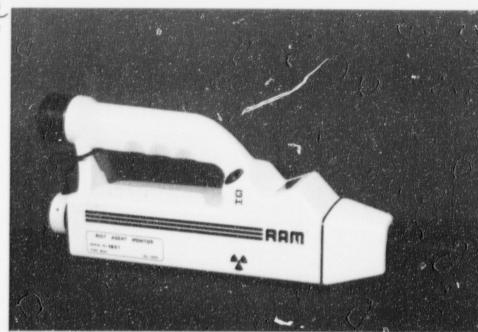
somewhat apologetic that the company was involved in producing war-related equipment. And, to read the news reports in major UK papers following the earnings announcement, one could miss the fact that GRASEBY makes some of the best NBC defence products available anywhere in the world. In this reporter's opinion, that is a pity.

#### GRASEBY DEFENCE TECHNOLOGY PROVES ITS WORTH

GRASEBY's pioneering work in Ion Mobility Spectrometry (IMS) is at the heart of its Chemical Agent Monitoring equipment, and has been the foundation for the company's development of products useful in environmental heath and safety, and medical care.

Ion Mobility Spectrometry (IMS) is a highly versatile means of identifying and measuring minute quantities of substances in air or other gas. The IMS technology is based on vaporising substances in a closed chamber and subjecting them to an electrical field, under controlled conditions. Depending on their size and other characteristics. ionised molecules of the substances under investigation travel from one side of the chamber to the other. Measuring the speed and size of a mass of ions flowing at a specific speed across the electrical field in a predetermined environment permits precise identification of a substance and its concentration in a mixture with other substances. Accuracy limits are set in Parts Per Billion (PPB). The technology is so sensitive, medical scientists have been able to identify medications taken by measuring their presence in vapours emitted through a patient's skin.

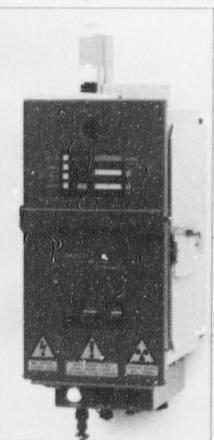
The best known application of GRASEBY's IMS technology is CAM, the chemical agent monitoring equip-



With this RAM (Riot Agent Monitor) unit, GRASEBY has provided security forces with this efficient portable tool to detect unwarranted dispersal of riot agents such as CN, CS and BBC chemical spray employed during civil unrest.

ment respected by military forces around the world. CAM was designed to meet United Kingdom Ministry of Defence requirements, and was adopted into service in 1985. Since then, it has been adopted by a number of civil and military defence organisations in the developed world and, ac-

cording to the company's estimates, there are now between 54 and 56 thousand CAM units in service in 26 countries worldwide. Both NATO and the United Nations have employed the CAM technology; for example, over the past decade the UN has used CAM as a standard item of equipment during its



■ The GRASEBY's GID-2 chemical attack monitor for ships, designed for release in 1995 but advanced for use in the 1990 Gulf War by the Royal Navy. Now in place also with the French and Belgian navies (GID-2A model) and under review by NATO and United States.

b In view of discerning battlefield needs for land forces, this GID3 monitor was developed for fighting vehicles and static installations; notably field hospitals and air defence sites.



investigations in Iraq concerning both its use of chemical agents and the verification of the destruction of its chemical agent stockpiles.

To keep pace with changing strategic needs, the application of IMS technology has gone through a number of modifications, although the basic concepts remain similar. Sometimes a new product is still fresh from the testing laboratory when it is pressed into service. To aid in the detection of chemica! attacks against naval warships and troops stationed in bunker installations, GRASEBY IONICS designed the GID-2 for release in 1995. However, during the emergency created by the Gulf War in 1990, the equipment was released to support of the specific requirements of the Royal Navy. Now, GID-2 is also used by the Belgian and French navies, and is under review by NATO, the US and others. It is reported that no warship or naval auxiliary vessel of the Royal Navy will go into an area where chemical warfare agents are a threat without being fitted with the GID-2

GRASEBY developed the GID-3 for use on armoured and light fighting vehicles and around more static installations, including hospitals, air defence sites and supply facilities. Important characteristics of the GID-3 are: its ability to simultaneously detect a number of chemical agents, including blister, blood, choking and mustard agents, its high resistance to interference from external interference; and, its portability due to its light weight and compact design.

Comparability in design and use is a major advantage in GRASEBY's IMS products. Skills learned on one type of equipment is quickly transferable to another. To assist in training needs, GRASEBY developed the SIM-CAM system to complement its CAM Chemical Agent Monitor. The SIM-CAM has both financial and strategic advantages. Financially, the 5.14-CAM offers considerable savings because training can be done without expensive chemical warfare simulants, and students do not need to use the expensive CAM units themselves thus saving wear and tear on necessary defence equipment. And, according to its manufacturers, SIM-CAM used consumables at a substantially lower rate than the actual CAM equipment.

Training must be as realistic as possible to insure proper use of sensitive equipment under high-stress conditions. To provide a range of training experiences, the SIM-CAM system has two parts: small 'detection' units used by one or more trainees, and a remotecontrol unit for the instructor. Using radio frequencies, the instructor can cause the SIM-CAM detectors to register the presence, in varying concentrations, of one or more chemical agents. Trainees then practice the correct monitoring and decontamination procedures. By practising detection and decontamination under a number of simulated conditions, trainees can be prepared for a number of battlefield scenarios and strategic situations.

IMS technology has far broader application within the civilian sector, however. Chemical accidents and terrorist attacks are realities today. The possibilities were made evident when, in June of this year, Hugo Gurdon, a Tokyo-based correspondent for the London Daily Telegraph, reported that seven people died and 58 were treated in hospital after a part of Matsumoto city was covered by a cloud of poison gas. While the exact details of the incident are vague, it is known that the poisoning was caused by an organophosphate substance, and that a man was arrested after police found a supply of suspect chemicals in his home.

Both civil defence and military personnel will profit from GRASEBY's new GI-MINI. This sensitive chemical agent detector weighs about a pound and is powered by a 9-volt PP3 battery. According to the manufacturers, it is easy to operate, simple to maintain and requires little training. Compact enough to be carried in a pocket, this miniature version of CAM (185mm x 60mm x 35mm) gives both a visible and audible alarm when chemical agents are detected.

Riot agents, such as CN, CS and BBC agents, are used by security forces during periods of civil unrest. These hazardous substances can put both innocent civilians and security personnel at risk. To minimise the danger from these agents, GRASEBY has developed RAM (Riot Agent Monitor), which measures the concentration of substances down to the lowest concentration that would be harmful to personnel. This equipment can be used to monitor leakage within riot agent storage facilities, detect unsafe levels of agents in civilian areas, and test for the presence of the ingress of agents through air filtration systems.

Further protection of civilians is provided by GRASEBY's explosive vapour detectors. The GVD6 is based on the most advanced IMS technology, and is both highly sensitive and selective in the explosives it can identify. Designed to fit into an executive briefcase, the equipment is easy to carry and non-offensive in its appearance.

PLASTEC is GRASEBY's high technology counter to the terrorist threat of modern plastic explosives and TNT. Only a few 5 micro particles of its target substances will trigger a visual and/or audible alarm. Particles can be collected on a 'wipe' or cotton glove, making sampling complex objects practical.

Ammonia is another hazard GRASEBY's IMS technology has been adapted to identify. Very low levels of this gas in water is both difficult to detect and dangerous. GRASEBY's ammonia monitor was design for use in the continuous monitoring of drinking water, the detection of ammonia in the final effluent from sewage treatment facilities, and in certain food and pharmaceutical processes in which ammonia may appear as a contaminant.

GRASEBY has made a firm commitment to enhance the quality of life through a safer and better environment, through minimum waste and the conservation of scarce resources. and the elimination and control of pollutants wherever possible. The company has also committed itself to improving the safety of food and pharmaceuticals, and improved standards of medical care through the application of technology. Anvone reading GRASEBY's latest annual report will quickly see how far they have come in meeting these goals through the application of IMS and other technologies.

GRASEBY's expertise in IMS grew from its investment in defence technology, and that should not be forgotten. A tendency among its executives to play down GRASEBY's defence role is both discernable and understandable; no one wants to be seen to support, in any way, the human misery of war and armed conflict. At the same time, however, the value of GRASEBY's contributions to modern military and civilian defence systems should be a matter of pride. The NBC detection equipment and the IMS development activities of the technology division help provide the tools needed during times of both peace and war in an increasing dangerous world.

# AGADA

# **Automatic Chemical Agent Alarm**

The Graseby Dynamics ACADA is the most advanced chemical warfare detector to be fielded by the US Armed Forces.

The ACADA simultaneously detects the most common nerve and blister agents in real time. The system is designed to be used by all services as a point detector, installed in vehicles or deployed around fixed sites as a perimeter defense system. The ACADA is extremely user friendly, reliable, rugged, accurate and suitable for integration into larger networks.

The ACADA evolved from Graseby's commercial GID-3 detector to meet the demanding ACADA specification. Graseby worked closely with the Soldier and Biological, Chemical Command (SBCCOM) at Aberdeen Proving Ground to ensure the detector has optimum performance.

## **Operational Roles:**

### As a man-portable system:

- · Point detection
- Capable of driving multiple remote alarms at a range of 1200 ft.
- Integrates into network which displays a warning at a central console

## In armored fighting vehicles:

- Detects threat outside vehicle via sampling system
- · Monitors crew compartment
- · Confirms operation of filter system

#### In reconnaissance role:

- Samples external atmosphere
- Provides alarm and displays threat in the vehicle and remotely



Graseby Dynamics ACADA



a SMITHS INDUSTRIES Company

# GRASEBY DYNAMICS:

On a SUS-V in Ft. Greely, Alaska in temperatures down to -49°F.



ACADA can be installed on various vehicles.





ACADA can be networked around strategic facilities

### **ACADA Description**

The ACADA is a rugged, self-contained unit which is powered by a battery clipped to its base. In this configuration the ACADA can be deployed up-wind of a position to provide early warning of a gas attack. This warning can be given by a local visual alarm, a local audio/visual alarm or a remote audio/visual alarm using the M42 Remote Alarm module.

The ACADA system has been developed complete with vehicle mount. This can provide protection for the detector in the harshest vehicle environment and facilitate the use of the vehicle electrical supply to power the unit.

The system also includes a 115/220v main power supply. This allows the unit to be run continuously when used for perimeter or strategic facility protection.

The ACADA uses an advanced form of the Ion Mobility Spectrometry (IMS) technology which is well proven in the CAM™ chemical agent monitor and the GID-2A™. It responds simultaneously to nerve and blister agents in real time and is capable of being reprogrammed to meet future threats.

# ACADA

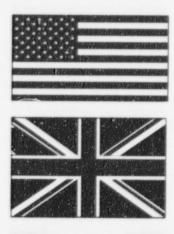
# The Choice of Military Forces Worldwide

### **International Programs**

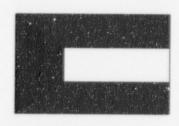
Several military forces around the world have purchased the commercial version of the ACADA, the GID-3. The Canadian Army has installed the detector on their Light Armored Vehicle (LAV) reconnaissance variant. The British Army has installed the detector on the FOX NBC reconnaissance vehicle. The Kuwaiti Ministry of Defense is fitting their M1A2 tanks and Warrior Armored Personnel Carriers (APCs) with the system. The Malaysian Ministry of Defense has also purchased GID-3 for use on ships and to protect land based facilities. Several other NATO countries are currently considering purchasing this equipment.

## **Product Improvements**

Different customers have their own unique demands from the equipment and need a system that is subject to continuous improvement. For these reasons Graseby is investing major technical resources in ACADA product improvement programs. Such programs are designed to reduce life cycle costs, enhance user interface and extend the range and sensitivity of the agents detected.











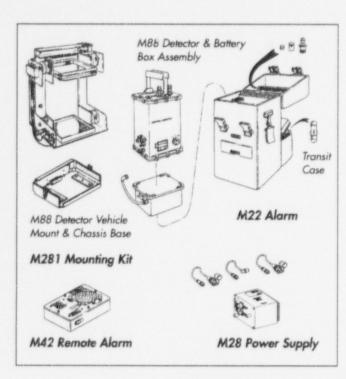
The ACADA mounted on a Bradley at Yuma, Arizona and tested in temperatures of up to 120°F.

### GRASEBY DYNAMICS

Telephone: (703) 218-0380 Fax: (703) 385-6470 Email: nbloom@gradyn.com



# **ACADA Specifications**



## Graseby Dynamics ACADA



Photo: Soldier and Biological, Chemical Command (SBCCOM)



10640 Main Street, Suite 204 Fairfax, Virginia 22030

Telephone: (703) 218-0380

Fax: (703) 385-6470

Email: nbloom@gradyn.com

#### Detection

ACADA detects the most common nerve and blister agents and can be programmed to detect other agents such as blood, choking and chlorine gas.

Size	Dimensions (in)	Wt. (lb)
Detector	$6.5 \times 7.0 \times 10.8$	10.6
Battery & box	$6.0 \times 7.0 \times 3.0$	3.5
Vehicle mount	7.9 x 12.9 x 16.1	16.5

#### Powe

- · 24 vDC lithium battery
- DC vehicle power supply
- · 115 to 220 vAC M28 power supply

#### **Operating Environment**

- -22°F to +140°F
- · -40°F to +158°F (storage)
- . Driving rain, dust or sand resistant
- Vibration and shock proofed to appropriate military requirements

#### Reliability

- Long operating life units continue to perform after thousands of hours of use
- Repair by interchangeable modules (no special tools required)

#### Interferent Rejection (tested)

- High interferent rejection 1/5 of previous IMS systems
- · Low false positives

#### **Data Communications**

- MICAD compatible RS 232 data port
- · Embedded flexibility for network integration

#### Training

- · User friendly
- · Commonality to CAM
- Training literature, video, and interactive CD-ROM available to US military

# DETECTION EQUIPMENT FOR CHEMICAL AGENT VAPOURS

Graseby Dynamics Limited, specialises in the research and development of highly sophisticated analytical instrumentation, and has a world-lead in chemical vapour monitoring equipment for military, environmental and civil defence purposes.

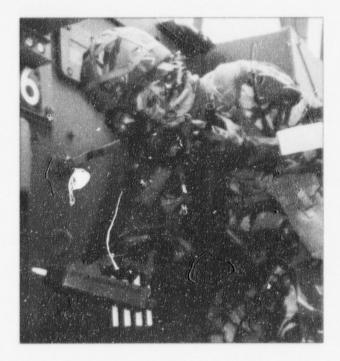
#### CAMP CHEMICAL AGENT MONITOR

Graseby designed, developed and manufactures the CAM monitor, which is a portable hand-held instrument programmed to respond to the presence of nerve and blister agent vapours. It works in real time and over 55,000 units are now in service in over 30 countries world wide.

The principal uses of CAM are:

- To confirm that a chemical attack has taken place
- To confirm when the threat has passed and to enable the commander to order troops to take off respirators
- To delineate areas of ground which have been contaminated
- To establish the extent of contamination of stores, vehicles, aircraft and personnel
- To confirm the effectiveness of decontamination procedures
- To establish that personnel entering collective protection areas are 'clean'
- To check battlefield casualties for contamination
- To confirm the effectiveness of training procedures by using simulant

CAM has been tested in such extremes of climate as the humid jungles of Panama, the deserts of Arizona and the cold of the Arctic. It was used by four



United Nations investigative missions sent to Iran and Iraq in 1986, 1987 and 1988 and confirmed the allegations of chemical weapons use.

CAM was extensively used by the Allied Forces during the gulf War and was deployed to check debris for possible chemical agent contamination after Scud missile attacks in Saudi Arabia. CAM has also been deployed by the UN Special Commission teams in Iraq to inspect some of the 125.000 munitions, including 46,000 chemical-filled bombs, shells and warheads, which were discovered after the war.

#### FAM™ FIELD ALARM MODULE

To address the need for a local sentry alarm, enabling the CAM monitor to be used in a detection role, Graseby has developed the FAM Field Alarm Module. FAM offers a remote display/alarm feature and automatically switches CAM between the nerve and blister agent modes

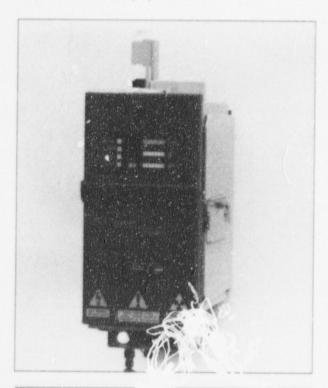
GRASEBY

# GID-2ATM FIXED CHEMICAL AGENT DETECTOR

Operating continuously throughout a chemical attack, the GID-2A can be networked to give information on the rise or fall of threat levels. It is already in service with the UK Royal Navy and was available on warships in the Gulf War. It is in service with several other navies.

The GID-2A can be configured and integrated across a wide range of deployment requirements to meet specific needs. These include monitoring of interior and exterior atmospheres and the integrity of filtration systems in:

- ships, aircraft and vehicle NBC system
- military bases, headquarters and building protection systems
- · airfield security systems



## GID-314 CHEMIC AGENT DETECTOR

Has been configured for use in small ships, armoured fighting vehicles (AFV<sub>2</sub>), fultration systems and as a detector for use by dismounted thits. It was selected for use in the UK Vanicle Electronics Research Defence initiative (VERDI, programme as the equipment to detect the chemical warfare threat

outside the AFV (Armoured Fighting Vehicle), monitor the collective protection of the crew compartment and confirm the filter system's efficiency, the GID-3 has also been successfully integrated with the Marconi Centaur Weapon Control System. GID-3 has been selected for the Canadian LAV Recce vehicle as the on board chemical detector and on the Kuwait Desert Warrior, GID-3 has been selected as the on board chemical detector on AS90 and on the Recce Warrior developed by GKN.



#### OFM™ OTTO FUEL MONITOR

The OFM monitors the vapour from Otto fuel when used in torpedoes. It has been supplied to the UK and other NATO Navies for use in hunter-killer submarines, surface vessels and armament depots.

NATO STOCK NUMBERS: All Graseby products are backed by a comprehensive list of NATO stock numbers

Contacts:

Tim Otter Senior Sales and Marketing Executive Neil Bloomfield Sales and Marketing Executive

CAM, FAM, GID are trad marks of Graseby Ionic









Air Sampling for Safety and Security

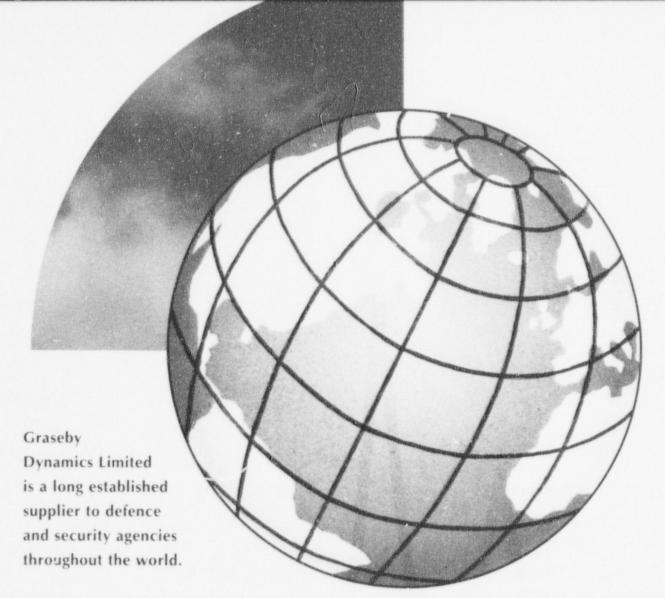




SMITHS IN RECORD

Aerospace





The company's battlefield-proven IMS (Ion Mobility Spectrometry) technology, originally developed to detect and identify chemical warfare agents, continues to be refined for the protection of defence forces, while its use is fast expanding into commercial, law enforcement and scientific applications in international markets.

As world leader in the detection and analysis of minute quantities of hazardous materials, the company's expertise and substantial resources support growth activities in four main areas:

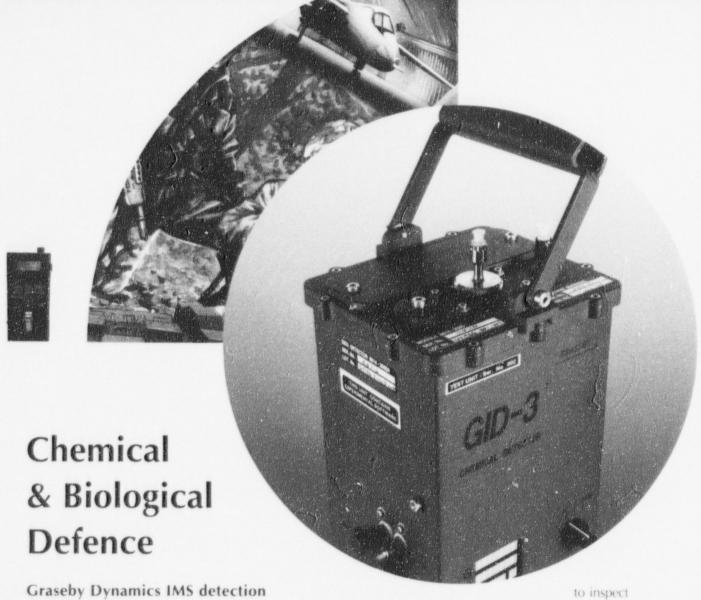
- Chemical & biological defence
- · Air quality monitoring
- Law enforcement
- Research & development

#### Corporate Profile

The company employ some 250 people with manufacturing, research facilities and also direct sales and service staff located in the United Kingdom and North America. Graseby Dynamics maintain a network of agents world-wide who are dedicated to customer support.

#### **Smiths Industries**

The parent organisation, Smiths Industries a world leader in advanced avionics, medical systems and specialised industrial products. It has achieved a strong record of growth through investment in research and development, new manufacturing technology and closely focused marketing. While generating a healthy cash-flow, the company has created shareholder value by continuing to build the existing businesses and making complementary acquisitions. Almost three-quarters of Smiths Industries' sales are made to customers outside the United Kingdom, with the United States as its largest single market.



Graseby Dynamics IMS detection technology, originally developed to alert troops to the dangers arising from chemical attack, now safeguards complete installations integrated within NBC warning systems.

The highly successful CAM<sup>TM</sup> chemical agent monitor designed and manufactured by Graseby

Dynamics is in service with the armed forces of 30 countries, with over 50,000 units deployed world-wide, and is used by the UN Special

Commission teams

chemical munitions in Iraq following the Gulf War. IMS technology is at the heart of this rugged hand-held instrument, its sensitive and selective detection of chemical warfare nerve and blister agent vapours reliably alerts troops to don protective clothing and checks potential hazard levels around equipment and installations.

Graseby Dynamics supply CAM<sup>™</sup> chemical agent monitors, accessories, training in their use and maintenance. System upgrades ensure that the best protection possible is available as requirements develop.

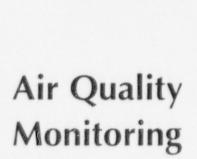
The Mini is Graseby Dynamics new miniaturised, hand held chemical agent detector which can be programmed to detect a wide range of hazardous air borne vapours.

A further product, Graseby Dynamics GID-3<sup>nd</sup> chemical agent detector, is configured for useful small ships, armotifed lighting vehicles (AFVs), filtration systems, including those for datic installations such as bunkers, and for disnounced troops. The supremacy of this technology is confirmed by the selection of GID-3<sup>nd</sup> for the UK's Vehicle Electronics Research Defence Initiative (VERDI) programme to detect chemical warfare

threats outside the AFV and to monitor the protection of the crow compariment.

GID-3<sup>IM</sup> is also successfully integrated in Nuclear, Biological, Chemical (NBC) warning networks and has been selected by the United States DoD for their Automated Chemical Agent Detector and Alarm (ACADA) requirement.

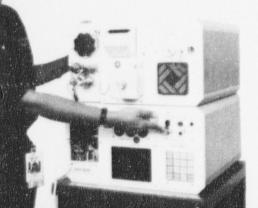




Crew members in enclosed vehicles on land, in space or underwater, need a safe environment which is preserved from the threat of hazardous chemicals.

Space equipment demands the utmost in reliability, combined with severe restraints concerning the size, weight and power requirements of any payload.

IMS technology offers exceptional performance while satisfying these constraints and Graseby Dynamics, as a leading authority on the technology, undertakes projects on behalf of NASA,



and its prime contractors, projects which further the company's expertise and prowess in the vapour detection field.

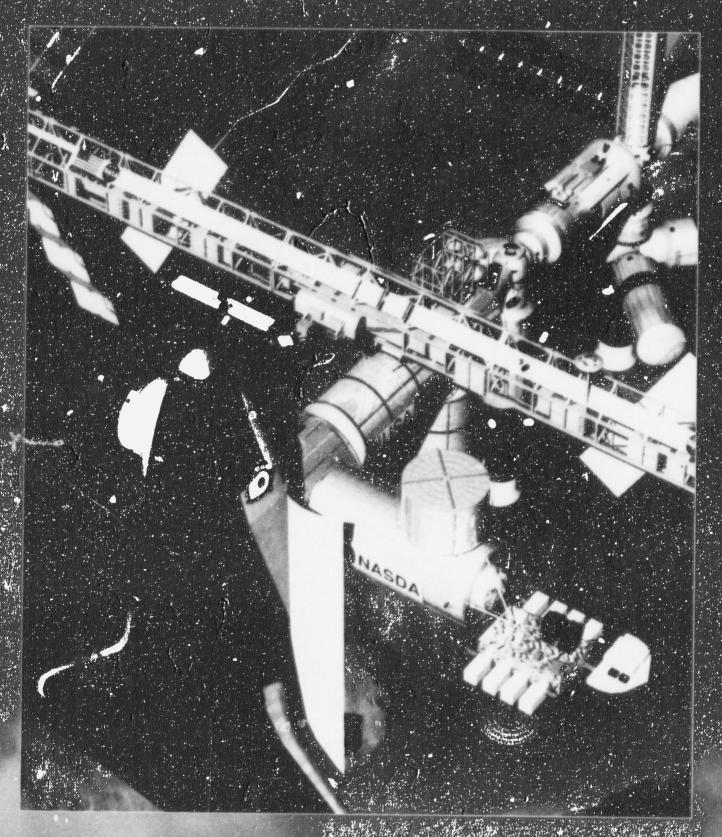
One such project is an instrument, based upon Graseby Dynamics CAM<sup>IM</sup> chemical agent monitor, to measure the possible contamination of astronauts' suits with hydrazine fuel, a highly toxic substance, following extra vehicular activity.

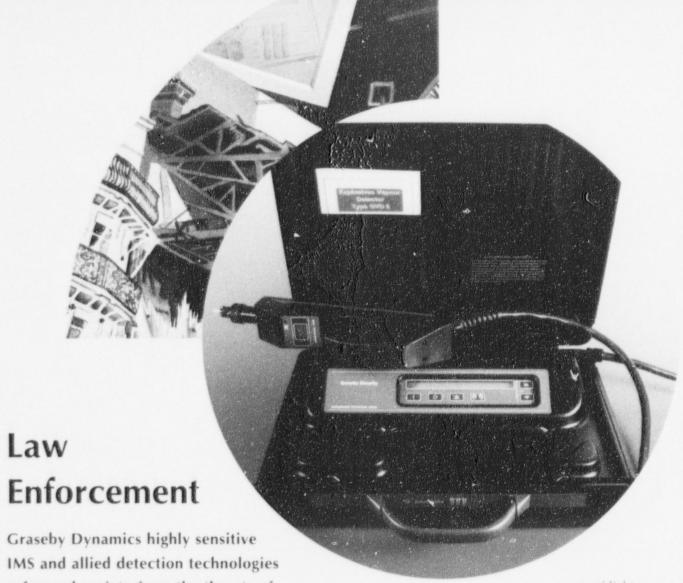
A further instrument analyses the internal atmosphere within the International Space Station (ISS). This Volatile Organic Analyser (VOA) uses a combination of gas chromatography and IMS technology designed and developed by Graseby Dynamics. The instrument alerts the ISS and ground control of any build up of hazardous vapours within the habitable sections of the station.

Illustration (left/right) courtesy of NASA

Grassby Dynamics is also developing an quality monitoring equipment for use in subspicines, utilizing modified versions of its military proven chamical defection systems.

These specialised projects extend the esperise of the company, and enable it to maintain a substantial team of highly competent scientists and engineers who are world leaders in the research, design and development of chemical monitoring and detection equipment.





Graseby Dynamics highly sensitive IMS and allied detection technologies safeguard society from the threats of terrorist explosives and the international traffic in illegal drugs.

Personnel charged with the responsibility of screening public places for either hazardous or controlled materials need equipment that is sensitive, easy to use and dependable with minimal disruptive false alarms.

Many of today's explosives detectors supplied by Graseby Dynamics stem from pioneering work undertaken for the British Army which resulted in a revolutionary back-pack portable instrument first

deployed in Northern Ireland. Continued research and further refinement of that detection technology has produced the present range of lightweight, hand-portable, vapour-detection equipment sold by the company to military and professional customers world-wide.

The increased use of plastic explosives has led to the development of an instrument capable of identifying particles of explosives. PLASTEC™ is based on the company's highly sensitive IMS technology and compresses a dedicated forensic laboratory into a compact portable battery powered instrument. PLASTEC™ is rapidly being

deployed to enhance the security of mass transit systems.



NARCOTECT extends Graseby Dynamics IMS particle-identifying experience, by successfully applying the technology to detect minute quantities of heroin, cocaine and other controlled drugs. Not only does the technology increase the incidence of detection, but by placing a portable laboratory at the scene of the crime, traceability of evidence

is heightened, thereby increasing the level of successful prosecutions.

Graseby Dynamics expertise will undoubledly extend the use of IMS technology into further civilian sectors in the future.





Intensive research and development supports all the company's products. This unrivalled resource is also available directly to customers on a contract, collaborative or joint venture basis.

Graseby Dynamics continually maintain a substantial investment in R&D, ensuring that its products remain second to none in world markets. The R&D team's multi-disciplinary skills span the design and development of electronic, electrochemical and electro-mechanical systems and, uniquely, are combined with extensive applications

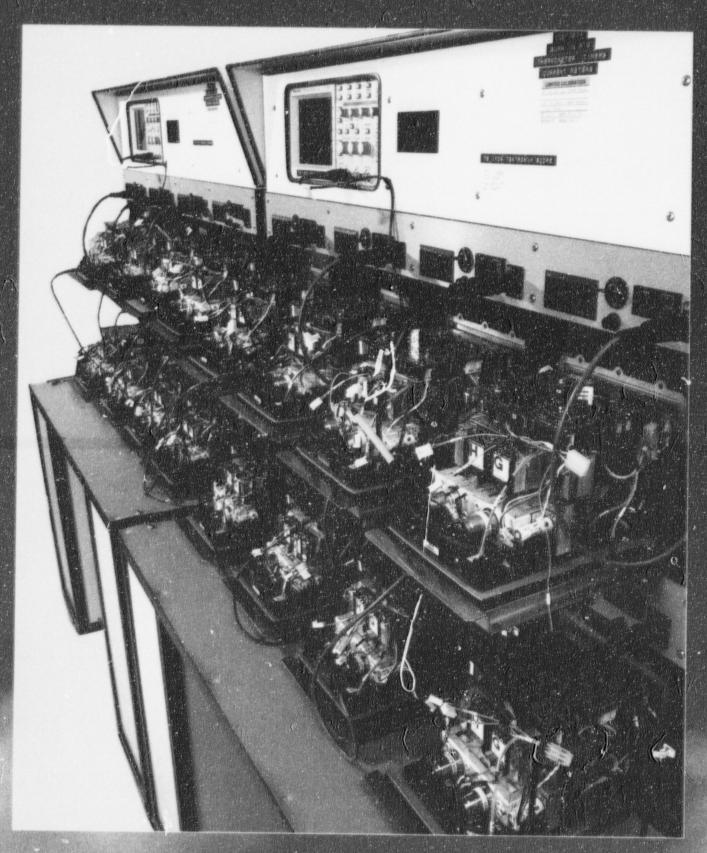
and supporting experience in detection and analysis of gases and vapours at ultra-low concentrations within atmospheres and liquids.

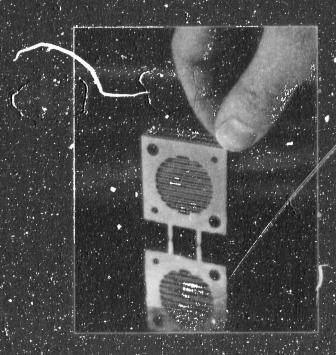
The company's specialist skills and services include:

- Ion Mobility Spectrometry
- Trace atmospheric vapour detection
- Integrated Biosensor systems
- Combined analytical techniques
- Design of small, low power and rugged instruments
- Advanced waveform processing techniques
- Generation, Calibration and sampling of vapour levels
- Independent NAMAS accredited environmental test laboratory

The work of the R&D team ranges from computer modelling and simulation of physical systems, thibugh feasibility experiments to the design and construction of prototypes followed by system evaluation.

Programmes are under John behalf of the UK MoD, the Canadian Department of National Defence, the US DoD, NASA, the UK DTI and the US Drug Enforcement Agency, as well as for companies within the private sector.





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