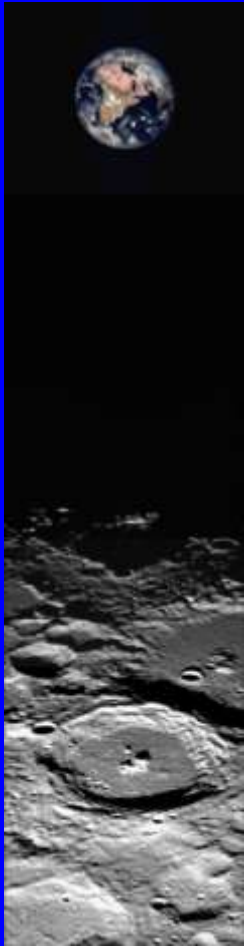

THE HISTORY AND CAPABILITIES OF DEEP ROVs

Robert L. Wernli

First Centurion Enterprises

IN THE BEGINNING...

...THE HEAVEN AND THE EARTH
WAS CREATED...

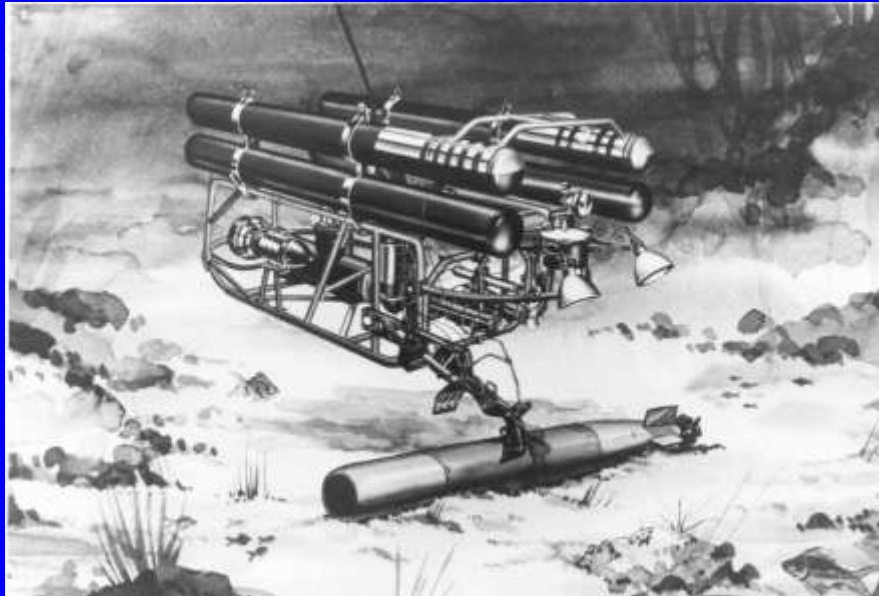


23 April 2007

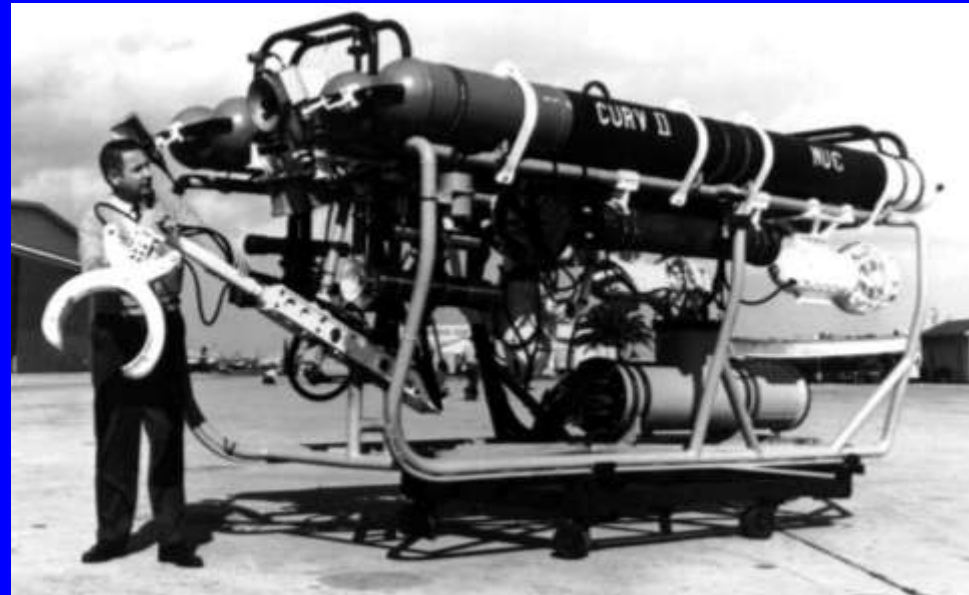


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...IN 1961...



...THE US NAVY CREATED
THE CURV



THESE ARE NOT ULTRA DEEP ROVs

ULTRA DEEP = 3K METERS+



THE U.S. NAVY HAD A NEED



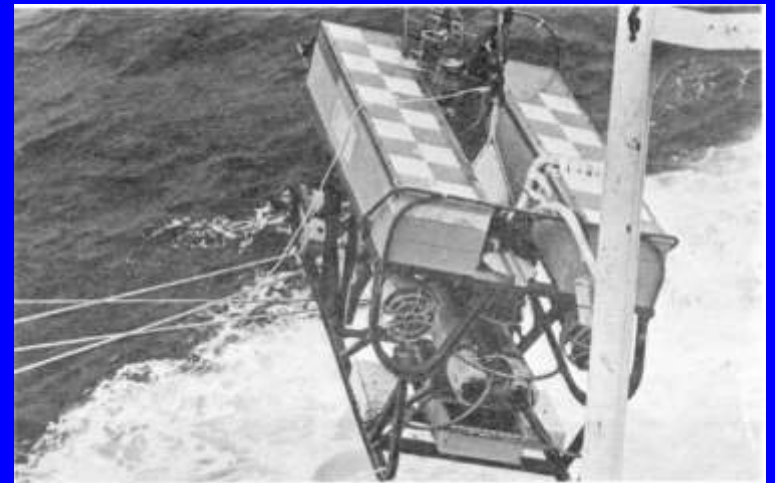
**ATOMIC BOMB RECOVERY
OFF PALOMARES SPAIN IN
1966 AT 869 METERS**



CURV III WAS “FLY AWAY”



***PISCES III OFF
CORK IRELAND
IN 480 METERS***



***CURV* TRANSFERRED TO INDUSTRY**



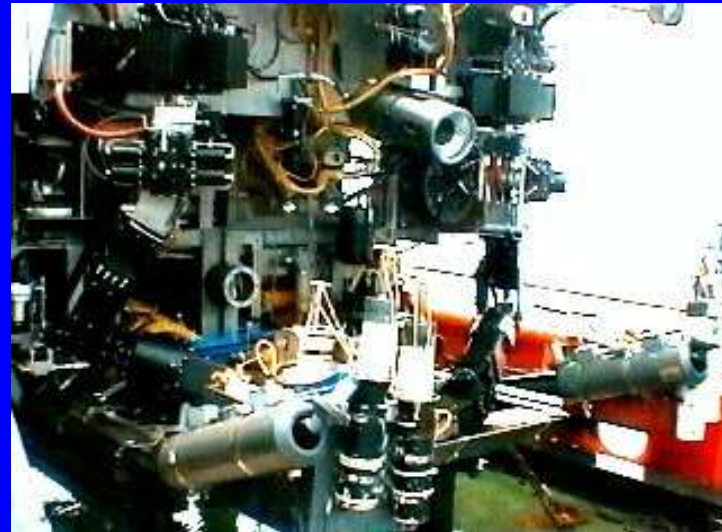
- 1990 – *CURV*, OPERATED BY EASTPORT INTERNATIONAL, BREAKS THE 20K BARRIER WITH A RECORD DIVE TO 20,105 FEET
- 29 YEARS IN THE MAKING!

LESS THAN A WEEK LATER



**THE ADVANCED TETHERED
VEHICLE BREAKS RECORD
AGAIN, REACHING A DEPTH
OF 20,600 FEET**

**ATV, DEVELOPED BY THE
US NAVY (“NOSC”), NOW
OPERATED BY SCRIPPS
INSTITUTION OF
OCEANOGRAPHY**



MARIANA TRENCH

24 MARCH 1995



**KAIKO REACHES
A DEPTH OF
10,911.4 METERS**

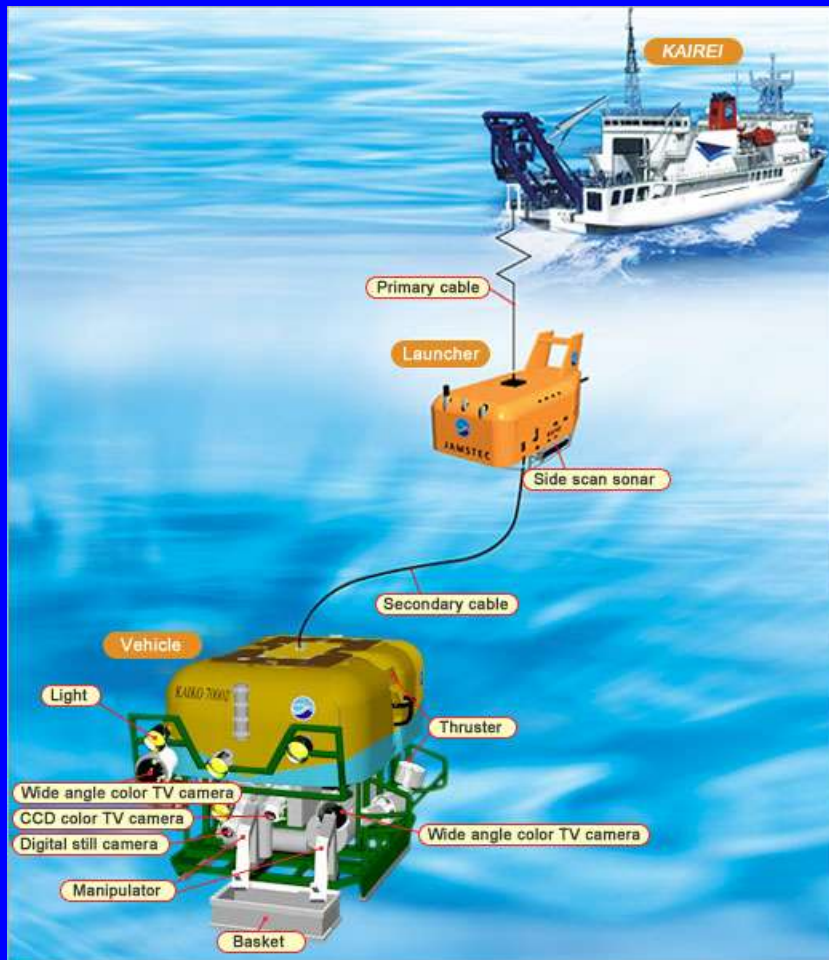


THE KEY POINTS ARE

- **WE ARE NOT LIMITED BY TECHNOLOGY**
- **HOWEVER, WE ARE LIMITED BY MONEY**
- **AND WE ARE FOREVER CONSTRAINED BY “MURPHY’S LAWS”**

KAIKO LOST!

- MAY 2003 ON 296TH DIVE AT DEPTH OF 4,675 M
- *UROV 7K* INTERIM FIX AS *KAIKO 7000*



ANOTHER NEW JAMSTEC WORK HORSE



HYPER DOLPHIN

- 3K METER
- HI-DEF COLOR
- 2 MANIPS
- 75 HP

WHY THE DEEP OCEAN?

- **US NAVY REQUIREMENT**
- **DEEP SEARCH AND RECOVERY**
- **20,000 FEET = 98% OF OCEAN FLOOR**
- **DEVELOPED THE TECHNOLOGY**
- **TRANSFERRED IT TO INDUSTRY**

EFFICIENT SEARCH IS...

- NOT USING A TOWED SYSTEM
- USING AN AUV IS!
- C&C TECHNOLOGIES' *C-SURVEYOR* – 82K+ KM



RECOVERY UNDER NAVY CONTRACT



**PHOENIX
INTERNATIONAL
THRU 2011**



23 April 2007

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PHOENIX REMORA



MEDITERRANEAN SEA

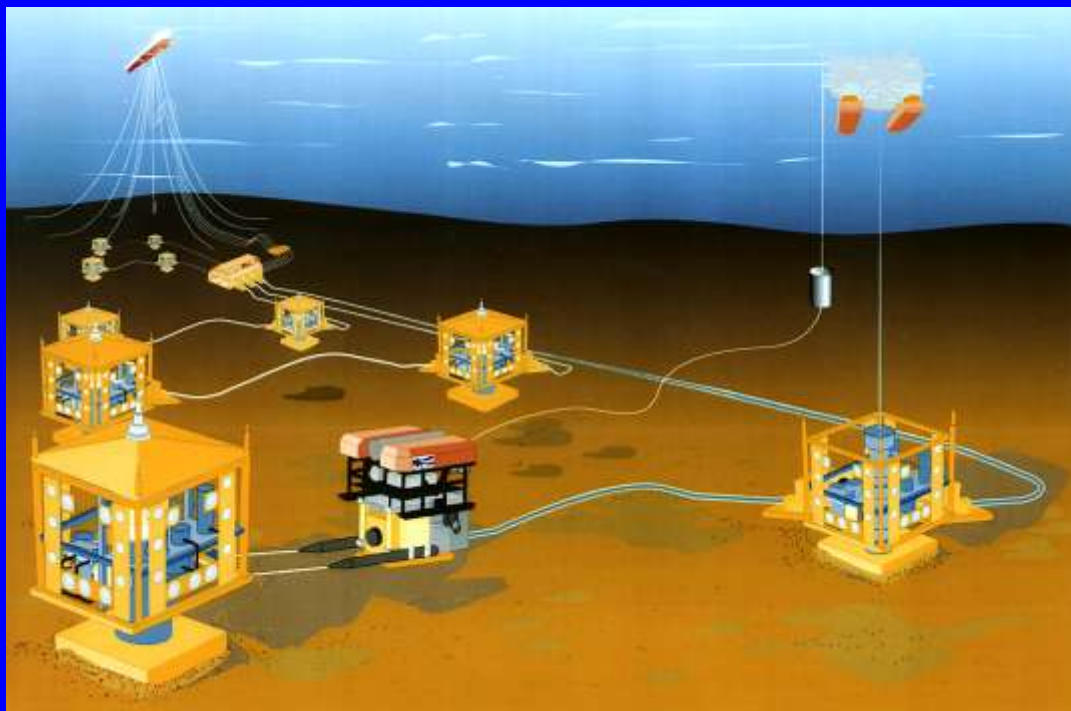
- 1999 – DAKAR SUBMARINE
- 2000 – F-16D AIRCRAFT

- 6,000 M CAPABILITY
- FLY AWAY



COMMERCIAL APPLICATIONS

\$



**GAS AND OIL FIELDS
GOING BEYOND THE 3,000
METER DEPTH**

**OFFSHORE
INTERVENTION IS
THE DRIVER**



DESIGNS ARE NOW FOR REMOTE INTERVENTION



WORK CLASS ROV SYSTEMS OPERATING WORLDWIDE*

Company and History	Systems in Service
Oceaneering International, Inc.	200>
Subsea 7 (ex Halliburton/Subsea)	120
Sonsub (Division of Saipem)	59
Fugro (ex Thales/Racal)	36
Technip (Coflexip/Stena)	35
Canyon (Division of Cal Dive)	27
Stolt (Stolt/Comex/Seaway)	19
Others	75
	TOTAL 571

Source – Drew Michel interviewing Contractors – Some have not been contacted recently and new contractors are entering the market, so these estimates could be low by as many as 30 systems

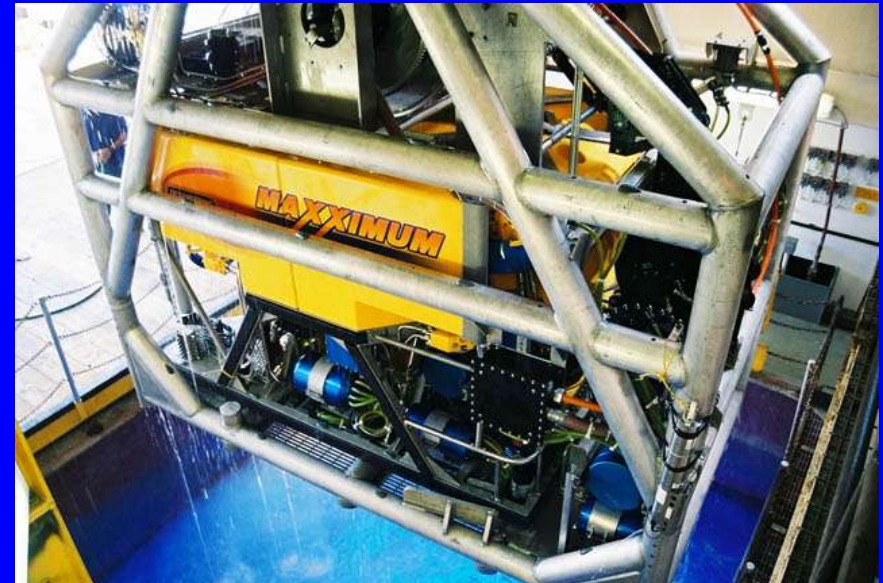
*NOT ALL OF THE ABOVE ROVS ARE 3,000 METER CAPABLE, BUT CAN DO HEAVY WORK

OCEANEERING'S LATEST



- 2,200 LBS THRUST
- 2,900 LBS LIFT

- 10,000 FT DEPTH
- 300 HP (2-110 + 80 CAGE)
- DUAL MANIPULATOR



SCHILLING ROBOTICS MAKING A MOVE



UHD – ULTRAHEAVY-DUTY ROV

- 3,000 – 6,500 MSW
- 100 – 200 HP
- 2,315 – 2,535 LBF THRUST

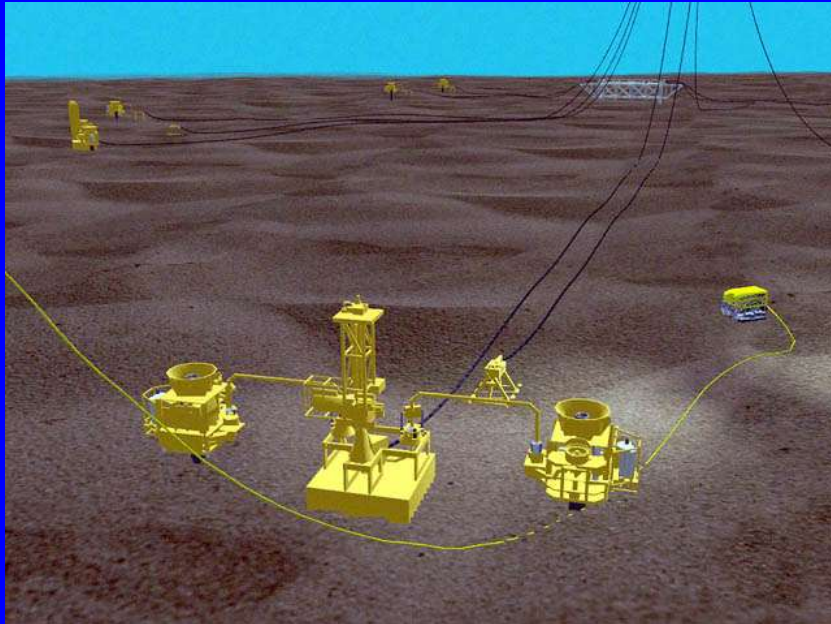


SCHILLING VEHICLES

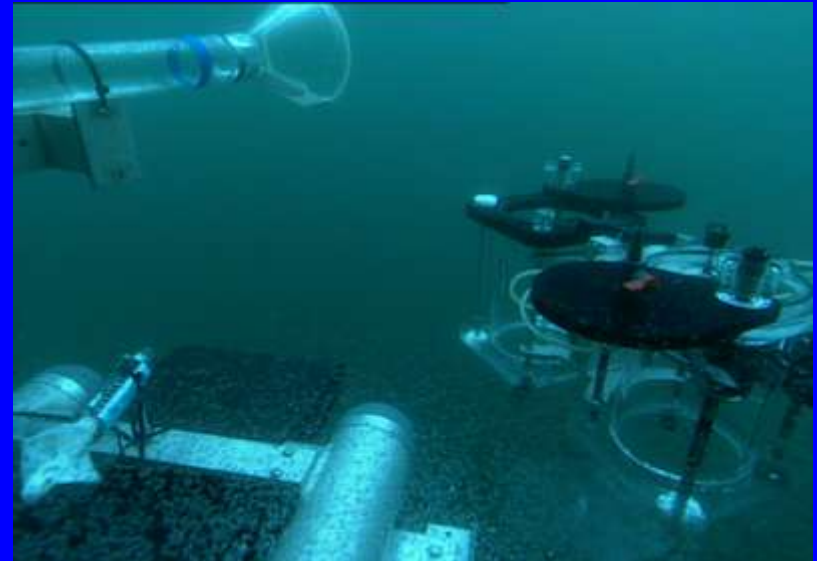
Client	No. of Systems	Depth Rating (m)	Propulsion Type	HP
Delivered				
Canyon	4	3000	Electric	100 equivalent
Marum/University of Bremen	1	4000	Electric	100 equivalent
Geoconsult	4	4000	Hydraulic	150
Phoenix International	2	3500	Hydraulic	200
Acergy Group	2	3000	Hydraulic	150
Delivery Pending, 2007 & 2008				
Marine Technologies	1	4000	Hydraulic	200
Marine Technologies	2	3000	Hydraulic	150
Acergy Group	5	3000	Hydraulic	150
Phoenix International	3	4000	Hydraulic	200
Allseas	4	4000	Hydraulic	150
Geoconsult	2	4000	Hydraulic	150
Geomar	1	6000	Electric	100 equivalent

SIMULATORS

- OCEANEERING'S MIMIC
- OFFSHORE COSTS NEARING \$1M PER DAY



WHAT ABOUT RESEARCH?



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ULTRA-DEEP ROVs

CIRCA 1998*

<u>Ultra-Deep ROVs</u>							
Manufacturer	Name	Size LxWxH-m	Depth-m	Power-hp	Wt.-kg	Payload-kg	Thru Frame
SubSea International	Hammerhead	2.99x2.54x2.18	5000	150	4536	907	n/a
Oceaneering	Magellan 725	2.4x1.5x1.4	7000	25	2041	544	n/a
	Millennium	3.0x1.5x1.7	>3000	150	1932	341	n/a
	Magellan 825	3.2x1.4x2.0	8000	25	3000	n/a	500 kg
MBARI	Tiburón	2.7x2.2x2.0	4000	20	3090	100	n/a
	Ventana	2.54x1.48x1.68	4000	30	2338	170	n/a
ISE	Hysub 5000	2.54x1.48x1.68	5000	30	1986	91	n/a
lfremer	ROV 6000	3.15x2.15x1.8	6000	20	3700	170	n/a
	Victor 6000	3.1x2.1x2.8	6000	n/a	4200	600	n/a
Woods Hole Oceanographic Inst.	Jason	2.2x1.1x1.2	6000	n/a	1200	50	n/a
Mitsui	Kaiko	3.1x2.0x2.3	11000	n/a	5600	150	n/a
Okeangeofizika	RTM 6000	1.4x1.2x0.7	6000	n/a	400	7	n/a

* Operational Effectiveness of Unmanned Underwater Systems, R.L. Wernli, 1998

WHOI'S *JASON*/MEDEA

- 6,500 METER CAPABILITY
- 6 DC THRUSTERS
- 2 HYDRAULIC MANIPS



MBARI'S *VENTANA*

HYDRAULIC *HYSUB* ATP-40



MBARI'S *TIBURON*

- 4K METER DEPTH
- ALL ELECTRIC
- HYDRAULIC TOOL-
SLED OPTIONAL



IFREMER'S *VICTOR*



23 April 2007

- 6,000 METER DEPTH
- 2 MANIPULATORS
- 8 CAMERAS
- VARIOUS TOOL SLEDS



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SCHILLING'S *QUEST*

- ALL ELECTRIC
- 3K – 6K M DEPTH
- 7 RING THRUSTERS



KORDI'S *HEMIRE*



- 6K METER DEPTH
- DUAL MANIPS
- TESTED TO 5,775 METERS IN NOV 06

Hemire

CHINA



- SHANGHAI JIAO TONG UNIVERSITY
- 3,500 M DEEP SAMPLING ROV
- EXPERIENCED CABLE FAILURE SIMILAR TO *KAIKO*

TODAY'S DEEP ROV FLEET

PART I

MANUFACTURER	VEHICLE	NUMBER BUILT	DEPTH (M)
HEAVY DUTY ROVS - 3K+ METERS			
ACERGY	SCV 3000 BLOCK 1A	4	3K
ACERGY (FORMERLY STOLT)	SCV 3000	22	3K
US NAVY	ATV	1	6K
DEEP SEA SYSTEMS INT.	MAX ROVER MK3 GLOBAL EXPLORER	1	3K
DEEP SEA SYSTEMS INT.	OMNI MAX ROVER	2	3K
ECA SA	VICTOR 6000	1	6K
FUGRO SURVEY (FORMERLY THALES)	SEALION 3000	6	3K
ISE	HYSUB ATP 5000	4	5K
JAMSTEC	UROV 7K	1	7K
JAMSTEC	HYPER DOLPHIN	1	3K
MALM ORSTAD AS	SCV SOLO MK2	1	3K
MBARI	TIBURON	1	4K
MITSUI	DOLPHIN 3K	1	3K
MITSUI	KAIKO	1	11K
MTQ SUBSEA TECHNOLOGY	PHOENIX	2	3K
OCEANEERING	MAGNUM 100	90	3K
OCEANEERING	MAGUNUM 120	10	3K
OCEANEERING	MAXXIMUM	3	3K
OCEANEERING	MILLENNIUM	19	3K
OCEANEERING	MILLENNIUM PLUS	15	3K
OCEANEERING	MAGELLAN 825	1	7.5K
OCEANEERING	OCEAN DISCOVERY	1	6K

TODAY'S DEEP ROV FLEET

PART II

PERRY SLINGSBY SYSTEMS	TRITON MRV	7	3K
PERRY SLINGSBY SYSTEMS	TRITON SP	9	3K
PERRY SLINGSBY SYSTEMS	TRITON XLS	20	3K
PHOENIX INTERNATIONAL	REMORA 6000	2	6K
SCHILLING ROBOTICS	QUEST	5	3-6.5K
SCHILLING ROBOTICS	UHD	8	3-6.5K
SCRIPPS INSTITUTION OF OCEANOGRAPHY	ADVANCED TETHERED VEHICLE	1	6K
SEAEYE MARINE	SEAEYE COUGAR	5	2-6K
SMD HYDROVISION	DEMON	12	3K
SMD HYDROVISION	QUANTUM	2	3-4K
SMD HYDROVISION	QUASAR	?	3-4K
SMD HYDROVISION	VENOM	3	3K
SMD HYRDOVISION	QUARK	1	3-4K
SONSUB	INNOVATOR	12	4K
SUBSEA 7	CLANSMAN	1	3K
SUBSEA 7	HERCULES	13	3K
SUBSEA 7	HAMMERHEAD	2	5K
TOTAL MARINE TECH	NOMAD	?	1-3.5K
WHOI	ISIS	1	6.5K
WHOI	JASON II	1	6.5K
		293	
SMALL VEHICLES			
OCEANEERING TECHNOLOGIES	SPIDERBOT	5	6K
PHOENIX INTERNATIONAL	X-BOT II	1	7K
*Information Based Largely on ROVs Of the World, 7th Ed.			

HYBRIDS



CYBERNETIX'S SWIMMER

- HYBRID ROV/AUV
- AUV DOCKS W / TARGET
- LINK TO OPERATOR
- POWER CONNECTED
- ROV LAUNCHED
- WORK PERFORMED
- RECOVER AND TRANSIT

DON'T FORGET THE SMALL GUYS

6K M CAPABLE

OCEANEERING

PHOENIX INT.



XIE XIE

