RB-01-01/1/2/01

PROJECT INSTRUCTIONS

26 December 2000

NOAA Ship RONALD H. BROWN
Cruise RB-01-01
GasEx-II

30 Jan-8 Mar 2001

Chief Scientist
Richard A. Feely
Co-Chief Scientist
Wade R. McGillis

NOAA/Pacific Marine Environmental Laboratory
Ocean Climate Research Division
7600 Sand Point Way, NE
Seattle, Washington 98115

ENDORSEMENTS:

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Dr. Eddie N. Bernard
Director, Pacific Marine Environmental Laboratory
Seattle, WA 98115

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RADM Nicholas A. Prahl, NOAA
Director, Marine Center
Norfolk, VA 23510

NOAA RESEARCH CRUISE

NOAA Ship RONALD H. BROWN		**Cruise Number**	RB-01-01
Area	Eastern Equatorial Pacific	**Itinerary**	*Leg 1A Charleston-Miami d. 22 Jan a. 23 Jan*
			Leg 1B Miami-Panama a. 25 Jan d.30 Jan
			Leg 1C Panama-Honolulu (official start of GasEx01) d. 30 Jan a. 8 Mar

Participating Organizations

NOAA/PMEL	*Pacific Marine Environmental Laboratory*
NOAA/AOML	*Atlantic Oceanographic and Meteorological Laboratory*
NOAA/ETL	*Environmental Technology Laboratory*
WHOI	*Woods Hole Oceanographic Institution*
UW/APL	*University of Washington — Applied Physics Lab*
MBARI	*Monterey Bay Aquarium Research Institute*
UM	*University of Montana*
U. Miami	*University of Miami/RSMAS*
UH	*University of Heidelberg*
URI	*University of Rhode Island*
UG	*University of Groningen*
CCIW	*Canadian Centre for Inland Waters*

Cruise Description and Objectives

The GasEx-II study will take place aboard the *NOAA Ship RONALD H. BROWN (RHB)* in the Eastern Equatorial Pacific along 3°S between 125°W-140°W. The primary objective will be to use direct gas flux measurements to improve our understanding of the forcing functions on the kinetics of air-sea gas exchange. A second focus will be on the physical, chemical, and biological factors controlling pCO_2 in the surface water. The region is a CO_2 source with relatively low wind speeds offering a strong contrast with the first Gas-Ex study conducted in 1998 conducted in the North Atlantic in an area of high winds and large CO_2 sink.

The Equatorial Pacific has been a focal point for chemical and physical studies such as JGOFS and TOGA because it has a major influence on climate variability through the ENSO cycle. The questions about mesoscale CO_2 dynamics in this region relate to biological versus physical control, and remote versus local influences. Near the upwelling center it seems that the patterns in pCO_2 are dominated by physics while further off-axis biological control becomes more important. The pCO_2 in the surface water relates directly to upwelling strength, but regional fluxes are strongly influenced by remote factors such as the capping off of the upwelling system by the low salinity water advecting from the West. Diurnal heating, tropical instability waves, variations in biological productivity, and trace metal limitations on productivity may also be important.

Ship Operations

CDR Jon Rix, Chief, Operations Division, AMC
Fax Number: 757-441-6495
E-mail Address: Jon.E.Rix@noaa.gov

Scientific Operations

Lt. Carrie Hadden
206-526-4485
Pacific Marine Environmental Laboratory
7600 Sand Point Way NE
Seattle WA 98115

1.0 PERSONNEL

PERSONNEL Leg 1A CHIEF SCIENTIST Chris Fairall NOAA/ETL
Charleston-Miami

#	NAME	TITLE	Project	Institute	SEX	NAT.
1	Chris Fairall	Chief Scientist	BROWN meteorology	NOAA/ETL	M	US
2	Kara Sterling	Meteorologist	BROWN meteorology	UC	F	US
3	Andrey Grachev	Meteorologist	BROWN meteorology	NOAA/ETL	M	Russian
4	Dana Lane	Meteorologist	BROWN meteorology	NOAA/ETL	F	US
5	Catherine Russell	Meteorologist	BROWN meteorology	NOAA/ETL	F	US
6	Michelle Ryan	Meteorologist	BROWN meteorology	NOAA/ETL	F	US
7	Brian Templeman	Meteorologist	BROWN meteorology	NOAA/ETL	M	US
8	Bill Asher	Co-Chief Scientist	IR remote sensing	U. Washington	M	US
9	Andy Jessup	Physical Oceanographer	IR remote sensing	U. Washington	M	US
10	Trina Litchendorf	Physical Oceanographer	IR remote sensing	U. Washington	F	US

PERSONNEL Leg 1B CHIEF SCIENTIST Rik Wanninkhof NOAA/AOML
Miami-Panama Wade McGillis (Co-Chief Scientist) WHOI

#	NAME	TITLE	Project	Institute	SEX	NAT.
1	Rik Wanninkhof	Co-Chief Scientist	Core CO_2/Hydrography	NOAA/AOML	M	US
2	Wade McGillis	Co-Chief Scientist	CO_2	WHOI	M	US
3	Lisa Dilling	Program Manager		NOAA/OGP	F	US
4	Kristy McTaggart	Physical Oceanographer	Core CO_2/Hydrography	NOAA/PMEL	F	US
5	Marilyn Roberts	Chemist	Core CO_2/Hydrography	NOAA/PMEL	F	US
6	Pete Strutton	Biologist	Primary/New Production	MBARI	M	Australian
7	James Smith	Biologist	Primary/New Production	MBARI	M	US
8	Brian Ward	Physical Oceanographer	High Resolution Profiler	NOAA/AOML	M	Irish
9	Robert Castle	Chemist	pCO_2 variability	NOAA/AOML	M	US
10	Mike DeGrandpre	Chemist	pCO_2 variability	U. Montana	M	US
11	Nelson Frew	Marine Chemist	LADAS	WHOI	M	US
12	Robert Nelson	Marine Chemist	LADAS	WHOI	M	US
13	Erik Bock	Physical Oceanographer	LADAS	U. Heidelberg	M	US
14	Uwe Schimpf	Physical Oceanographer	LADAS	U. Heidelberg	M	German
15	Christoph Garbe	Physical Oceanographer	LADAS	U. Heidelberg	M	German
16	Tetsu Hara	Physical Oceanographer	LADAS	U. RI	M	Japanese
17	Nick Witzell	Engineer	LADAS	WHOI	M	US
18	Mike Rabozo	Marine Technician	LADAS/ASIS	U. Miami	M	US
19	Sean McKenna	Physical Oceanographer	BROWN meteorology	WHOI	M	US
20	Andy Jessup	Physical Oceanographer	IR remote sensing	U. Washington	M	US
21	Craig Neill	Chemical Oceanographer	IR remote sensing	U. Washington	M	US
22	Trina Litchendorf	Physical Oceanographer	IR remote sensing	U. Washington	F	US
23	Jon Ware	Engineer	CO_2/meteorology/SPIP/p CO_2	WHOI	M	US
24	Chris Zappa	Physical Oceanographer	Heat Flux/SPIP	WHOI	M	US
25	Will Drennan	Physical Oceanographer	ASIS	U. Miami	M	Canadian
26	Gene Terray	Physical Oceanographer	ASIS	WHOI	M	US
27	Joe Gabrielle	Engineer	ASIS	CCIW	M	Canadian
28	Jia-Zhong Zhang	Chemical Oceanographer	Nutrients	NOAA/AOML	M	US
29	George Berberian	Chemical Oceanographer	O_2	NOAA/AOML	M	US
30	Calvin Mordy	Chemical Oceanographer	Nutrients	NOAA/PMEL	M	US
31	John Dacey	Biologist	DMS/SPIP	WHOI	M	Canadian
32	Eric Hintsa	Biologist	DMS/SPIP	WHOI	M	US
33	Henk Zemmelink	Biologist	DMS/SPIP	U. Groningen	M	Dutch
34	Jenny Hanafin	Physical Oceanographer	M-AERI	U. Miami/RSMAS	F	Irish

PERSONNEL Leg 1C CHIEF SCIENTIST Richard Feely NOAA/PMEL
Panama-Honolulu Wade McGillis (Co-Chief Scientist) WHOI

#	NAME	TITLE	Project	Institute	SEX	NAT.
1	Richard Feely	Co-Chief Scientist	Core CO_2/Hydrography	NOAA/PMEL	M	US
2	Wade McGillis	Co-Chief Scientist	CO_2	WHOI	M	US
3	Chris Sabine	Chemist	Core CO_2/Hydrography	NOAA/PMEL	M	US
4	Kristy McTaggart	Physical Oceanographer	Core CO_2/Hydrography	NOAA/PMEL	F	US
5	Marilyn Roberts	Chemist	Core CO_2/Hydrography	NOAA/PMEL	F	US
6	Dana Greeley	Chemist	Core CO_2/Hydrography	NOAA/PMEL	M	US
7	Pete Strutton	Biologist	Primary/New Production	MBARI	M	Australian
8	James Smith	Biologist	Primary/New Production	MBARI	M	US
9	Brian Ward	Physical Oceanographer	High Resolution Profiler	NOAA/AOML	M	Irish
10	Robert Castle	Chemist	pCO_2 variability	NOAA/AOML	M	US
11	Mike DeGrandpre	Chemist	pCO_2 variability	U. Montana	M	US
12	Nelson Frew	Marine Chemist	LADAS	WHOI	M	US
13	Robert Nelson	Marine Chemist	LADAS	WHOI	M	US
14	Erik Bock	Physical Oceanographer	LADAS	U. Heidelberg	M	US
15	Uwe Schimpf	Physical Oceanographer	LADAS	U. Heidelberg	M	German
16	Christoph Garbe	Physical Oceanographer	LADAS	U. Heidelberg	M	German
17	Tetsu Hara	Physical Oceanographer	LADAS	U. RI	M	Japanese
18	Nick Witzell	Engineer	LADAS	WHOI	M	US
19	Mike Rabozo	Marine Technician	LADAS/ASIS	U. Miami	M	US
20	Jeff Hare	Meteorologist	BROWN meteorology	NOAA/ETL	M	US
21	Sean McKenna	Physical Oceanographer	BROWN meteorology	WHOI	M	US
22	Craig Neill	Chemical Oceanographer	IR remote sensing	U. Washington	M	US
23	Trina Litchendorf	Physical Oceanographer	IR remote sensing	U. Washington	F	US
24	Jon Ware	Engineer	CO_2/meteorology/SPIP/p CO_2	WHOI	M	US
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31	Calvin Mordy	Chemical Oceanographer	Nutrients	NOAA/PMEL	M	US
32	John Dacey	Biologist	DMS/SPIP	WHOI	M	Canadian
33	Henk Zemmelink	Biologist	DMS/SPIP	U. Groningen	M	Dutch
34	Jenny Hanafin	Physical Oceanographer	M-AERI	U. Miami/RSMAS	F	Irish

Affiliation Addresses:
NOAA/PMEL: 7600 Sandpoint Way NE, Seattle, WA 98115
NOAA/AOML: 4301 Rickenbacker Cswy., Miami, FL 33149
NOAA/ETL: 325 Broadway, Boulder, CO 80303
MBARI: PO Box 628, 7700 Sandholdt Road, Moss Landing, CA 95039
U. Miami/RSMAS: 4600 Rickenbacker Cswy., Miami, FL 33149
U.Washington/APL: 1013 NE 40th St. Seattle, WA 98105
U. Montana: Missoula, MT 59812
U. Groningen: Kerklaan 30, Postbus 14, 9750 AA Haren, The Netherlands.
CCIW: Canadian Centre for Inland Waters
U. Heidelberg: ICSC, Im Neuenheimer Feld 368, 69120 Heidelberg, Germany
WHOI: Woods Hole, MA 02543

Explanation of abbreviations:

ASIS — Air-Sea Interaction Spar Buoy
DMS — Dimethylsulfide
SPIP — Surface Processes Instrument Platform
LADAS — Air-Sea Interaction Catamaran
SMS — Surface Microlayer Sampler
SPMR — Satlantic 13 Channel Profiling Radiometer
FRRF — Fast Repetition Rate Fluorometer
FSTP- Fine-Scale Temperature Profiler

The Chief Scientists are authorized to alter the scientific portion of this cruise plan with the concurrence of the Commanding Officer, provided that the proposed changes will not: (1) jeopardize the safety of personnel or the ship; (2) exceed the time allotted for the cruise; (3) result in undue additional expense; or (4) change the general intent of the cruise.

2.0 OPERATIONS

Leg 1A is a 1-1/2 day transit between Charleston and Miami, and will be used as training for both ETL and UW personnel. ETL personnel will arrive in Charleston a few days before departure to bring the air-sea flux system back to operational status and to work with the WHOI group in meshing atmospheric gas flux measurements. ETL will also take advantage of this short time at sea to train several of their personnel in the operation of the flux system and several of the *RHB s* atmospheric observing systems, as well as the data archiving operations of these systems. The *RHB* systems of interest are the C-band Doppler radar, the 915 MHz Doppler wind profiler, and the Seaspace satellite receiver. Extra operational demands or interference with the ship during transit are not anticipated. It is requested that the ship data system be operating and the normal ETL message be transmitted to our workstations. It is also requested that the C-band, wind profiler, and satellite receiver be operational. Most Leg1A scientists will disembark in Miami.

Leg 1B will begin in Miami and end in Panama; most scientists participating in the GasEx01 cruise will embark in Miami for the duration of the cruise to Honolulu; however, several scientists will be aboard for testing and training purposes and will disembark in Panama. This five-day transit will provide additional days for training and testing prototype equipment which has never been thoroughly tested at sea.

Leg 1C will begin in Panama and is the official beginning of GasEx01. Several scientists will embark there. This in-port will be regarded as a touch-and-go. Any other disembarking scientists leaving the ship must go through customs.

The operations during the GasEx01 cruise will be multi-faceted with high demands on ship s operations and integrity. A wide range of intensive over-the-side measurements will be performed. These measurements require over-the-side operations, such as the LADAS catamaran, the ASIS platform, CARIOCA/SAMI buoy, and FSTP buoys, zodiac SMS/SPIP operations, CTD operations, underway seawater surface measurements and SPMR biological profiler operations. In addition, atmospheric measurements will be made using equipment mounted on the bow tower, which is aft of the jackstaff; additional atmospheric measurements will also be made from a bow boom.

A description of each ocean and atmospheric measurement follows:

2.1 Over-the-side Operations

One or two test CTD s will be conducted during the transit to 3°S /125°W. Upon arrival at that site, we will deploy the ASIS/ CARIOCA buoys, and will sail LADAS and SPIP. We will then begin CTD s commencing with 24-hr intensive study at 3°S /125°W; after completion, we will do a series of CTD s in a butterfly pattern around the site, taking stations within 100km in both latitude and longitude. As we begin transit westerly along 3°S, the timing of some of these operations may change due to the location that ASIS may have drifted to, and the possible need to recover and redeploy it; additionally, the CARIOCA buoy as well as the temperature profiling buoy may have to be repositioned occasionally to be near ASIS. A second 24-hr intensive study will be conducted around 3¡S/130¡W. If time permits, a second butterfly pattern will be done at this location. At the end of the 3°S line (~3°S /140°W) we will recover all over-the-side instruments, and then begin a series of 500m CTD s in direct line to Honolulu between 3°S -5°N; this will include one 24-hr intensive at 0/143°20.3 W.

2.1.1 LADAS (Surface Films and Sea Surface Roughness)

The air-sea interaction catamaran, LADAS, is a remotely operated platform instrumented with a scanning laser slope gauge, a wave-wire array, a surface microlayer skimmer and fluorometry system, and a passive infrared imager.

Ship Operational Requirements: LADAS is a near-autonomous research catamaran, requiring about 1 hour each for deployment and recovery with the ship s crane. Near daily deployment of LADAS will be performed, each lasting 4-6 hours, and occasionally 2 deployments/day will be made. Target deployment times for LADAS will be ~1500L. If a second daily deployment is required, the timing will be ~0300L. LADAS is sailed remotely by a pilot that operates it near the *RHB* s bridge. It is sailed into the wind at about 1 kt., with the ship steaming about 300 meters behind LADAS.

2.1.2 SPIP/SMS Operations

The Surface Processes Instrument Platform (SPIP) and the Surface Microlayer Sampler (SMS) are independent platforms and deployed separately. SPIP is a Hobie catamaran instrumented with near surface atmospheric and oceanographic sensors. Measurements will include atmospheric profiles of water vapor, carbon dioxide, temperature, and wind speed. Subsurface shear, turbulence, salinity, and temperature will also be performed. After RIB deployment, the SPIP will be deployed, and then tethered to the RIB. The SPIP/RIB system deployments will last 4 hours. The SMS resembles a small sled and will be deployed with a zodiac (to be supplied by the science party). The SMS will be deployed from the zodiac and connected by an aluminum boom. The SMS/zodiac system deployments will last 3-4 hours.

Ship Operational Requirements: Zodiac operations will be performed for sea-surface sampling intensives, and are deployed by the *RHB* s crane with the SPIP and SMS package. The zodiac will survey near the drifters and does not require any additional ship time. The zodiac coxswain will be in contact with the ship s crew by radio. NOTE: Zodiac operations will not be performed at night.

2.1.3 Drifting buoys: ASIS, CARIOCA/SAMI, FSTP (Surface Processes and CO_2 Fluxes)

Surface process variability and surface wave state will be measured from the autonomous air-sea interaction spar buoy ASIS. In addition, autonomous pCO_2 sensors will be operated on *RHB*, on ASIS and SPIP, and on the CARIOCA/SAMI buoy. There will be two Fine-Scale Temperature Profiler (FSTP) buoys, one tethered to the CARIOCA/SAMI buoy and the other will be free-floating.

Ship Operational Requirements: ASIS will be deployed and drift; it will be recovered/redeployed once/week unless there are system malfunctions, in which case emergency recovery will be performed. *RHB* should sail downwind of ASIS, into the wind. The CARIOCA/SAMI and tethered FSTP buoy-drifting systems will be placed near the drifting ASIS buoy at deployment, and their positions will be periodically monitored via visuals of the flashing strobe light and with a VHF transmitter. Ship time may be needed to conduct daily recoveries to reposition the small buoys near the ASIS platform. The FSTP tethered to the CARIOCA/SAMI buoy will have to be recovered every four days for recharging of batteries and data downloads. The second FSTP will be deployed by scientific personnel with a zodiac or with a ship davit depending on time and seastate. This will take place right after the LADAS is launched and recovered 4 hours later when LADAS is brought on board.

2.1.4 CTD Operations

Upon arrival at 3°S /125°W a 24-hr CTD intensive will occur. After the intensive study is completed, a series of CTD s to 500m will occur in a butterfly pattern around the site. After the completion of the extensive survey, we will begin a westerly transit along 3°S following ASIS, and CTD s will be performed daily to 500m. A second 24-hr intensive study will occur near 3°S /130¡W, along with a second butterfly pattern. Discrete CTD samples will be drawn for the measurements of dissolved oxygen, pCO_2, DIC, nutrients, DOC, salinity, chlorophyll, ^{14}C, ^{15}N and POC. The FRRF biological profiler will be mounted on the CTD rosette and will replace one Niskin bottle slot. This will be deployed on all casts of 500m. At the end of the 3°S line (~3°S /140°W) we will begin a series of 500m CTD s in direct line with Honolulu between 3°S -5°N; this will include one 24-hr intensive study at the equator.

Ship Operational Requirements: The ship will provide a winch operator for each cast, and log keeping will be handled by the OOD. Scientific personnel and Chief Survey Technician (CST) will stand alternate 12-hr CTD watches during the three intensive study stations as well as the 500m stations during the butterfly pattern around 3°S /125°W. CST assistance with Niskin bottle sampling will be provided while on watch as other duties permit.

After the westerly transit begins along 3°S the 500-m CTD deployments will be conducted generally once/day around noon requiring ~1hr. of shiptime. CST will provide assistance for CTD readiness, and deployment and recovery of the package during hours of 0800-1630. Any casts between 1630 and 0800 will be supported by the scientific party. The exception will be the 24-hr intensive study stations, at which time the CST will stand an alternate 12-hr CTD watch with scientific personnel.

Efforts will be made to keep the ship s bow into the wind during the CTD operations. The CTD will be lowered at a speed of 30 meters/minute for the first 200 meters and then at 60 meters/minute. The CTD will be retrieved at 60 meters/minute unless otherwise specified by the Chief Scientists. The time and position of the CTD are to be recorded by bridge watch personnel when the package enters and leaves the water, as well as when at depth. Both primary and secondary winches must contain at least 5000m of CTD conducting cable in good condition. Adequate spare parts must be available to assure that this equipment is maintained in good working order by the ship s ET. The ship s ET must be skilled in CTD wire terminations, and will terminate, as necessary. Adequate supplies of materials for CTD wire re-terminations must be available.

Many of the chemical measurements are sensitive to contamination from soot, oils, solvents, spray cleaners, lubricants, paints, hydraulic fluid, and other toxic substances. The Chief Scientists must be notified prior to the use of these substances on the fantail, as well as near the CTD area. Care must be taken to avoid contamination of the rosette system with these substances.

Discharges from holding tanks must be secured 20 minutes before arriving on station. Due to the short time frame of the hydrocasts, discharge will be secured while on station until the CTD package is recovered. The bridge must inform the ship s engineers in advance when discharges are to be secured.

2.1.5 High Resolution Profiler

High resolution profiles of temperature, salinity, dissolved oxygen, pCO_2, DIC, and nutrients will be done using an internally recording CTD approximately 4 times during the cruise. The information gathered from this study will be used to study diurnal stratification in surface waters. We will characterize the small-scale vertical variability in the upper 20 m by performing a series of high resolution (~1-2 m) casts over 24-hour periods. Casts will be conducted on the following schedule: just before dawn, mid-morning (~1000), mid afternoon (~1500), and just after sunset. The pressure, temperature and salinity measurements will be made using in-situ instruments on a low-profile CTD package to allow sampling within 1 m of the surface. The remaining parameters will be measured using discrete samples collected from a water pumping system attached to the CTD package.

Ship Operational Requirements: We will use *RHB* s boom crane and winch, or line and capstan system. *RHB* will need to maintain station for ~1 hour per cast.

2.1.6 Sea Surface Measurements

Underway surface water measurements are an important component of the cruise. Water flows from the bow must be maintained at 50 L/min or above at all times. The Chief Scientists should be notified immediately if there are problems with the water delivery system. Spare parts and spare pumps should be available for immediate installation if failure occurs. At the discretion of the Chief Scientists the progress of the ship will be halted until water flow is restored. Incubators will be positioned in the appropriate unshaded location port side beside the A-frame and should be operated in a continuous mode as well. During transit to and from the study site, the CARIOCA/ SAMI buoy will be operated and calibrated on deck. Water will be supplied continuously to the buoy using a header tank supplied by flow from the underway seawater line.

<u>Ship Operational Requirements</u>: Assistance by CST will be requested once/watch to draw calibrating oxygen and salinities from the underway seawater system.

The ship s TSG will run continuously; we request assistance by CST whenever possible to check data quality. Quality control shall include logging and comparison of TSG data with the CTD signal when the CTD is at the surface (nominally 3-6m depth).

A ship-mounted ADCP system will be used to continuously measure the currents in the upper ocean along the trackline. At a minimum, data from the ADCP will be logged from the start of the transit once clear of the Miami port and continue until secured just prior to the pier in Honolulu. For calibration purposes it is essential that bottom tracking be activated at the start and end of a cruise when in water depths shallower then 500m. The ship's ET will be in charge of data storage (hard drive to disks and/or CD s as necessary). The ADCP will be interfaced to the ship s GPS receiver and will receive data at one-second intervals. The clock on the ADCP IBM computer will NOT be reset while underway. ADCP operating parameters will not be changed without the permission of the Chief Scientists; in consultation with Dr Eric Firing and after informing the Chief Scientists of the intended parameter change. ADCP data will be sent to Dr. Eric Firing at the University of Hawaii.

Accurate ship navigation is essential for valid ADCP current measurements. The ship will provide a fully operational GPS receiver and Seapath 200 system for navigation input. Ship s ET will select proper GPS codes to enable ADCP navigation data collection. The ADCP will be interfaced with the ship's gyro so that accurate heading information is available to the ADCP. A manual comparison of the ADCP heading/gyro reading will be logged by the Electronics Technician while the ship is dockside, at the beginning of a cruise and checked periodically throughout the cruise. For calibration purposes, Bottom Tracking should be activated whenever the ship is transiting water shallower than 500m.

Due to compatibility problems, the ADCP is not interfaced to SCS, so GPS navigation and gyro inputs must be connected directly to the ADCP system. If the ADCP becomes interfaced to the SCS, then the ADCP data will be recorded on both the ADCP recording system and the SCS. Bernoulli drives (or other storage systems) will be connected to the ADCP system for ADCP data collection. The ADCP data recorded on the IBM has course and speed information from the navigation data which is exactly time coincident with the ADCP ensembles.

The ADCP system will be operated by ship personnel and will continuously log data to the ADCP zip storage disks during the entire cruise. If necessary, the ADCP data disks will be changed when full. Full disks will be labeled and backed up. An ADCP log will be maintained by the ship s ET and a check of the ADCP recording of heading, time, velocity and navigation information will be done periodically to ensure that the system is operating properly. Any inconsistencies, such as heading, time, and/or navigation input not in agreement with actual/expected, will be noted in the log and reported to the Commanding Officer and Chief Scientists.

2.2 Chemical Analyses: CTD casts/HR Profiler/Underway seawater system

Samples drawn for salinity, oxygen, DIC, DOM, pCO_2, chlorophyll, C14, N15 and nutrients will be analyzed on board ship by members of the scientific party. Nutrient measurements will be made using an AlpKem RFA system. Refrigerator/freezer space will be required for sample storage.

Analyses of ^{14}C will be conducted by a NRC licensed operator (Pete Strutton) in a self-contained van located on the Main Deck/Fantail (details in Appendix E).

Measurements to be made from the bow intake system will include temperature and salinity (TSG), chlorophyll, oxygen, and partial pressure of pCO_2, DIC, DMS, and nutrients. In addition, a SAMI autonomous CO_2 sensor and a liquicel based IR system will be installed at the seachest. Five to ten L/minute of water will be shunted from a flange forward of the seachest and returned to the main line in the seachest. A small impeller pump will be used to pump the water through the two instruments. Both systems can withstand pressures of at least 30 psi.

Ship Operational Requirements: All chemical analyses will be done by the scientific party; however, assistance may be requested to CST for analyses of salinities during the intensive butterfly pattern sampling around at 3°S /125°W as well as at 3¡S/130¡W as time permits.

2.3 SPMR (Satlantic13 channel profiling radiometer)

Near daily profiles will be conducted using the SPMR, which provides an index of phytoplankton health and can also be used to estimate primary production. Daily water collection at the ASIS drifter site will also be done, and the samples incubated on deck in seawater-cooled system after inoculation with the ^{14}C label.

Ship Operational Requirements: Near daily SPMR profiles will be conducted requiring 1 hour of ship time. These deployments will coincide with the SeaWIFS pass. During profiling, the ship will be steered into the predominant wind direction. The ship will stop daily at the ASIS site for the collection of surface water samples. This operation requires less than 15 minutes of ship time. However, this operation can be performed during CTD casts or profiling.

2.4 Atmospheric Measurments

2.4.1 Bulk meteorology and turbulent fluxes

Bulk meteorology and turbulent fluxes will include wind speed, wind stress, latent and sensible heat fluxes, radiation fluxes, and air-sea CO_2 fluxes. These instruments will be mounted on the bow jack staff and the bow tower. It is requested that ship personnel visually inspect the integrity of the towers and determine the tension of the guidewires every couple of days while at sea.

Ship Operational Requirements: *RHB* should sail into the wind whenever possible. During LADAS deployments this speed will be dictated by the speed of LADAS. During CTD and diurnal operations the ship will hold station into the wind. When LADAS is not in the water and there are no other over-the-side operations the speed will be 2-3 kts.

2.4.2 Infrared Remote Sensing

Infrared Remote Sensing will measure the fraction of surface area which the thermal boundary layer is disrupted by microbreaking waves. This is obtained by thresholding the IR image using a passive IR imager. These instruments will be mounted on the bow tower.

Ship Operational Requirements: *RHB* should sail into the wind at 6kts whenever possible. Note, this seems contradictory to the 2-3 km listed above.

2.4.3 Shipboard CO_2/H_2O/DMS flux measurements

Shipboard CO_2/H_2O/DMS flux measurements will be made with atmospheric profiles from a mast on the boom that extends approximately 10m off the bow. A sensor container 1m x 1m x 1.5 m will be mounted on the bow next to the bow tower.

2.4.4 Radiosonde launches

Manual launches will be done from the staging bay 2 times a day.

Ship Operational Requirements: CST will assist when possible. Note: I d discourage this. It takes too much time away from other CST duties.

2.4.5 Navigational Control

P Code GPS will be the primary navigational control during this cruise. GPS positions at the highest accuracy available will be recorded by the SCS. Nominally, positions at the beginning and end of all operations and as required elsewhere in these instructions are to be recorded.

2.4.6 Log keeping

Ship Operational Requirements: Log keeping maintained by the ship includes: a MOA in addition to the official Deck Log, the official weather log, and the synoptic weather reports. We request continued support of operational log keeping used successfully to date recorded in the MOA, with any notable operations (such as balloon launches, CTD deployed/at depth/on deck, over-the-side operations, survey lines begun/ended) or course/speed changes (course change >10 deg., speed change >50 RPM) logged accordingly. Minor course/speed changes associated with coming on station need not be logged. The SCS data will be checked and made available during the cruise, and will include a date/time stamp GPS position, course/speed over the ground, and gyro heading. Several groups will require the data in real time and assistance of the ET is requested to accomplish interfacing with the scientists computers

3.0 FACILITIES

3.1 Equipment and Capabilities Provided by the Ship

Sufficient consumables, backup units, and on-site spares and technical support must be in place to assure that operational interruptions are minimal. All measurement instruments (i.e. Autosals) are expected to have current calibrations, and all pertinent calibration information shall be included in the data package. The following systems and their associated support services are essential to the cruise:

(a) Log keeping (see Section 2.2.6).
(b) Two (2) Autosal salinometers calibrated within the last 12 months with calibration records
(c) Surface seawater thermosalinograph (in bow) calibrated within the last 6 months to 0.05…C and 0.01ppt with calibration records

(d) Meteorological sensors, including relative humidity, temperature and wind, calibrated within the last 6 months
(e) Bow continuous water sampling system with minimum flow of 50 L/min, with feed to the Hydro, Bio, Main, and Wet Labs at a flow rate of 25 to 50 L/min, with backup pump.
(f) Global Positioning System via the Scientific Computer System.
(g) Starboard side deep-sea winch with at least 5000 m of .322" conducting wire, sliprings, and connection to computer room.
(h) 480 volt, 3-phase AC power for project vans on forward and aft decks.
(i) Phone lines and water service to vans listed in Section 3.2.2.
(j) A ship hull mounted Narrow band 150 KHz ADCP. The ADCP will be run continuously to measure currents in the upper ocean along the track. A working gyrocompass interface to the ADCP will be available; the ship's gyrocompass shall be maintained to provide the most accurate heading information possible.
(k) SCS display in the Electronics Lab and main Oceanographic Lab;
(l) Backup Sea Bird 9/11 Plus CTD system, carousel sampler; 2 TC sensor pairs, 2 pumps, plumbing, cable spares, termination kits and spares, 12-bottle frame, and 12-10L bottles (bottles are on loan from PMEL).
(m) Designated PC with Zip drive for CTD data acquisition and preliminary processing networked to a color printer and VCR for real time data archive.
(n) The ship is requested to provide technical expertise and assistance if unexpected problems arise.
(o) Laboratory and storage space for up to 30,000 pounds of equipment.

3.2 Equipment and Capabilities Provided by the Scientific Party

The scientific party will provide the following items and will be responsible for their maintenance support:

(a) Two complete CTD systems including SeaBird 9/11 plus, CTD module sensors and deck unit, 24 position carousel sampler, stand, termination kits and spares, and 36-10L bottles.
(b) Spare electrical and mechanical termination kits.
(c) Compressed gases: approximately 18 tanks of various gases, to be secured on Main-deck laboratories and 02 deck forward where required. Approximate weight of individual tank is100 lbs.
(d) 288 salinity bottles.
(e) Instrumentation for Hydro, Computer, Bio and Main Laboratories, and vans forward and aft
(f) LADAS catamaran
(g) ASIS buoy
(h) CARIOCA/SAMI buoy
(i) SPIP
(j) SMS
(k) Zodiac
(l) FSTP buoys (2x)
(m) MQ system
(n) Bow tower
(o) Bow boom
(p) CO_2 laser
(q) Sky camera
(r) Portable radiation package
(s) Radiosondes/Balloons
(t) Hard-hat
(u) IR imager
(v) Sulfur Chemiluminescense Detetector
(w) Consumables, i.e., data storage media, printer supplies, paper, etc.

Total weight is approximately 12000 pounds and power requirements are on the order of 40 kW (115VAC/60Hz), respectively. Several outlets must have 20A rating. Space will be required near the uncontaminated seawater discharge point in Hydrolab for a Turner-Designs fluorometer, underway pCO_2

analyzer, underway DIC analyzer, and a GC. Space will also be required near the uncontaminated seawater discharge point in the Bio-Lab for an underway nitrate analyzer.

Portable Vans: (See App. B and C)

Name	Dimensions (LWH)*	Weight (lbs.)	Power	Serv.**	Location
DIC Van (Roberts)	20 x8 x8	13000	480/60/3	P,C,S	Main Port
ASIS Van (Drennan)	20 x8 x8	7000	480/60/3		Level 01 Port
C14 Van (SIO)	13 x7 x7	5500	480/60/1	P	Main Port
Van (Bates/Asher)	20 x8 x8	13000	480/60/3	P,C,S	02 Deck Forward
Van (McGillis)	20 x8 x8	13000	480/60/3	P,C,S	02 Deck Forward

*not including protrusions (air conditioners, etc)
**C=potable water, P=phone, S=SCS readout

Additional large equipment items:

Name	Dimensions (LWH)*	Weight (lbs.)	Power	Location
LADAS	22'X10'	5000	N/A	Main (by A-frame)
ASIS	36 (w/mast)	700	Battery supplied	Main Stbrd
CARIOCA/SAMI	6 x6		N/A	Main Port
M-AERI	3 x4 x6	400	N/A	02 Level Forward
Sky camera	6 x3 x3	25	500w	Flying Bridge
Weather pack			N/A	01 level Bow
Profiler launcher	5'x5'	200	110	Main Aft
Bow Boom	30 x1		N/A	01 level Bow
Bow Tower	18 x6 x29	1580	N/A	01 level Bow
SPIP	13 x8		N/A	Faintail
Incubators	10'x8'x2'	400	N/A	Main Port Aft
SPMR	4 x1	270	N/A	Main
SMS	2.5 x3		N/A	Main

4.0 DISPOSITION OF DATA AND REPORTS

4.1 Data Responsibilities

The Chief Scientists will be responsible for the disposition, feedback on data quality, and archiving of data and specimens collected on board the ship for the primary project. As representative of the program manager (Director, PMEL), the Chief Scientists will also be responsible for the dissemination of copies of these data to participants in the cruise, to any other requesters, and to NESDIS in accordance with NDM 16-11 (ROSCOP within 3 months of cruise completion). The ship may assist in copying data and reports insofar as facilities allow.

The Chief Scientists will receive all original data gathered by the ship for the primary project, and this data transfer will be documented on NOAA Form 61-29 "Letter Transmitting Data". The Chief Scientists in turn will furnish the ship a complete inventory listing all data gathered by the scientific party detailing types and quantities of data.

Individuals in charge of piggyback projects conducted during the cruise have the same responsibilities for their project's data as the Chief Scientists have for primary project data. All requests for data should be made through the Chief Scientists.

The Commanding Officer is responsible for all data collected for ancillary projects until those data have been transferred to the project's principal investigators or their designees. Data transfers will be documented on NOAA Form 61-29. Copies of ancillary project data will be provided to the Chief Scientists when requested. Reporting and sending copies of ancillary project data to NESDIS (ROSCOP) is the responsibility of the program office sponsoring those projects.

4.2 Data Requirements

The ship s SCS system should log the following parameters:

PCODE_TIME (HHMMSS)
PCODE_LAT (DEGMIN)
PCODE_LON (DEGMIN)
PCODE_QUALITY (1=std)
PCODE_COG (Degrees)
PCODE_SOG (Knots)
LRing-Gyro (Degrees)
PCODE-SOG-msec (M/SEC)
TSG_Unit_Temp (Degrees_C)
TSG_Conductivity (Mega_Mhos)
TSG_Salinity (PPT)
Barometer (MB)
Precip9-trwlhs (mm/hr)
Imet-Rain (mm)
Imet-Rel_Hum (Percent)
Imet-Temp (Degrees_C)
Fluoro-Value (PPM)
ADCP temperature
Imet-TWind1-Speed-MSEC (M/SEC)
Imet-Twind2-Speed-MSEC (M/SEC) ???
Imet-Twind1-Dir (Degrees)
Imet-TWind2-Dir (Degrees)
Bottom Depth (meters)

The Chief Survey Technician will translate the data from thermosalinograph to ASCII and plot the data on a daily basis for distribution by the Chief Scientists.

The following data products will be produced by the ship and, if requested, will be given to the Chief Scientists at the end of the cruise:

(a) navigational log sheets (MOAs) or current equivalent;
(b) photocopies of SEAS log sheets and hourly weather log;
(c) SCS data on CD ROM.

4.3 Ship Operations Evaluation Report
A Ship Operations Evaluation Report will be completed by the Chief Scientists and given to the Director, PMEL, for review and then forwarded to NC3.

5.0 ADDITIONAL INVESTIGATIONS AND PROJECTS
Any additional work will be subordinate to the primary project and will be accomplished only with the concurrence of the Commanding Officer and the Chief Scientist(s).

5.1 Ancillary Projects
The following projects will be conducted by ship's personnel in accordance with the general instructions contained in the PMC OPORDER, and conducted on a not-to-interfere basis with the primary project:

(a)	SEAS Data Collection and Transmission	(PMC OPORDER 1.2.1)
(b)	Marine Mammal Reporting	(PMC OPORDER 1.2.2)
(c)	Bathymetric Trackline	(PMC OPORDER 1.2.5)
(d)	Nautical Charting	(PMC OPORDER 1.2.6)
(e)	Central Pacific Weather Reporting	(PMC OPORDER 1.2.7)
(f)	Sea Turtle Observations	(SP-PMC-2-94

6.0 HAZARDOUS MATERIALS (See App. D for detailed listing of Hazmats)

RHB will operate in full compliance with all environmental compliance requirements imposed by NOAA. **All hazardous materials/substances needed to carry out the objectives of the embarked science mission, including ancillary tasks, are the direct responsibility of the embarked designated Chief Scientists, whether or not that Chief Scientists are using them directly.** *RHB s* Environmental Compliance Officer will work with the Chief Scientists to ensure that this management policy is properly executed, and that any problems are brought promptly to the attention of the Commanding Officer.

6.1 Material Safety Data Sheet (MSDS)

All hazardous materials require a Material Safety Data Sheet (MSDS). Copies of all MSDS s shall be forwarded to the ship at least two weeks prior to sailing. The Chief Scientists shall have copies of each MSDS available when the hazardous materials are loaded aboard. **Hazardous material for which the MSDS is not provided will not be loaded aboard.**

6.2 HAZMAT Inventory

The Chief Scientists will complete a local inventory form, provided by the Commanding Officer, indicating the amount of each material brought onboard, and for which the Chief Scientists are responsible. This inventory shall be updated at departure, accounting for the amount of material being removed, as well as the amount consumed in science operations and the amount being removed in the form of waste.

6.3 HAZMAT Locker

The ship s dedicated HAZMAT Locker contains two 45-gallon capacity flammable cabinets and one 22-gallon capacity flammable cabinet, plus some available storage on the deck. Unless there are dedicated storage lockers (meeting OSHA/NFPA standards) in each van, all HAZMAT, except small amounts for ready use, must be stored in the HAZMAT Locker.

6.4 HAZMAT Spill Response

The scientific party, under the supervision of the Chief Scientists, shall be prepared to respond fully to emergencies involving spills of any mission HAZMAT. This includes providing properly-trained personnel for response, as well as the necessary neutralizing chemicals and clean-up materials. Ship s personnel are not first responders and will act in a support role only, in the event of a spill.

6.5 Responsibilities

The Chief Scientists are directly responsible for the proper handling, both administrative and physical, of all scientific party hazardous wastes. **No liquid wastes shall be introduced into the ship s drainage system. No solid waste material shall be placed in the ship s garbage.**

7.0 RADIOACTIVE ISOTOPE POLICY (See App. E for protocols)

Each scientist working with these materials will be required to wear a lab coat and disposable booties to reduce the likelihood of tracking the substance out of the specified working area.

It will be the responsibility of the investigator to conduct pre-cruise (for background) and post-cruise wipe tests (regardless of whether a spill occurred or not). Wipe tests should also be conducted in the event of a spill, as well as periodically while underway.

A detailed procedural methodology describing the use of these materials should be provided to the Environmental Compliance Officer (ECO) for review at least one month prior to bringing them aboard. A spill contingency plan should also be provided at the same time. Please note that ship’s personnel are not first responders in the event of a spill.

A log detailing the type and amount of materials brought aboard and removed from of the ship shall be maintained, along with a record of any spills that occurred.

All radioisotope work will be conducted by NRC or State licensed investigators only, and copies of these licenses shall be provided to the ECO at least one month prior to bringing any materials on board.

8.0 MISCELLANEOUS

Some scientific equipment is sensitive to radio frequency interference. If interference with this or other equipment occurs, it may be necessary for the Chief Scientists and the Commanding Officer to adjust operations and transmission times or take other steps to electronically isolate the equipment.

All SCUBA diving, if conducted, shall be in accordance with NOAA, OMAO, and MOC directives.

There will be no charge for meals. Commissioned officers who are participating as scientific personnel will be charged at commissioned officer's rate in accordance with Title 37, U.S.S. Section 302 based upon the established monthly Basic Allowance for Subsistence (BAS).

8.1 Small Boat Operations

Small boat operations are weather dependent and at the Command's discretion. They will be limited to daylight hours except in cases of emergency.

8.2 Pre and Post Cruise Meetings

A pre-cruise meeting between the Commanding Officer and the Chief Scientists will be conducted either on the day before or the day of departure, with the express purpose of identifying day-to-day project requirements, in order to best use shipboard resources and identify overtime needs.

8.3 Scientific Berthing

The Chief Scientists are responsible for assigning berthing for the scientific party within the spaces approved as dedicated scientific berthing. The ship will send stateroom diagrams to the Chief Scientists showing authorized berthing spaces. Post cruise, the Chief Scientists are responsible for returning the scientific berthing spaces to the condition in which they were received; for stripping bedding and for linen return; and for the return of any room keys which were issued.

The Chief Scientists are also responsible for the cleanliness of the laboratory spaces and storage areas used by the science party, both during the cruise and at its conclusion prior to departing the ship.

In accordance with NC Instruction 5255.0, Controlled Substances Aboard NOAA Vessels, dated 06 August 1985, all persons boarding NOAA vessels give implied consent to comply with all safety and security policies and regulations which are administered by the Commanding Officer. All spaces and equipment on the vessel are subject to inspection or search at any time.

8.4 Medical Forms & Emergency Contacts

The NOAA Health Services Questionnaire must be completed in advance by each participating scientist. It is required to reach the ship no later than 4 weeks prior to the cruise (i.e., 12/22/00). This will allow time to medically clear the individual and to request additional information if needed. We ask that all personnel bring any prescription medication they may need and any over-the-counter medicine that is taken routinely (e.g. an aspirin per day, etc.). The ship maintains a stock of medications aboard, but supplies are limited and chances to restock are few.

Prior to departure, the Chief Scientists will provide a listing of emergency contacts to the Executive Officer for all members of the scientific party, with the following information: name, address, relationship to member, and telephone number. These can be combined with the NOAA Health Services Questionnaire.

8.5 Shipboard Safety

A discussion of shipboard safety policies is in the "Science User's Guide" which is available on *RHB* and is the responsibility of the scientific party to read. This information is also available on the ship's web page: http://www.moc.noaa.gov/rb/science/welcome.htm. A meeting with the Operations Officer will be held for the scientific party at the beginning of the cruise which will include a safety briefing. Wearing open-toed footwear (such as sandals) outside of private berthing areas is unsafe and is not permitted. All members of the scientific party are expected to be aware of shipboard safety regulations and to comply with them.

All personnel (including scientists) involved in suspended load operations on deck or in recovering the CTD will be required to wear steel-toed safety shoes. Elsewhere in the ship, normal close-toed are adequate.

8.6 Wage Marine Day-Worker Working Hours and Rest Periods

Chief Scientists shall be cognizant of the reduced capability of *RHB*'s operating crew to support 24-hour mission activities with a high tempo of deck operations at all hours. Wage marine employees are subject to negotiated work rules contained in the applicable collective bargaining agreement. Day-workers' hours of duty are a continuous eight-hour period, beginning no earlier than 0600 and ending no later than 1800. It is not permissible to separate such an employee's workday into several short work periods with interspersed non work periods. Day-workers called out to work between the hours of 0000 and 0600 are entitled to a rest period of one hour for each such hour worked. Such rest periods begin at 0800 and will result in no day-workers being available to support science operations until the rest period has been observed. All wage marine employees are supervised and assigned work only by the Commanding Officer or designee. The Chief Scientists and the Commanding Officer shall consult regularly to ensure that the shipboard resources available to support the embarked mission are utilized safely, efficiently and with due economy.

8.7 Communications

The Chief Scientists or designated representative will have access to ship's telecommunications systems on a cost-reimbursable basis. Where possible, it is requested that direct payment (e.g. by credit card) be used as opposed to after-the-fact reimbursement. Ship's systems include:

8.7.1 INMARSAT-A

INMARSAT-A, for high speed data transmission, including FTP, and high quality voice telephone communications. Costs is $11.25 per minute for voice, $5.55 per minute for Fax, and may be charged to credit card (preferable) or otherwise reimbursed. Phone numbers for ship's INMARSAT-A are: ###-154-2643 voice and ###-154-2644 fax. (### = Ocean Code).

8.7.2 INMARSAT-M

INMARSAT-M, for voice telephone communications and 2400 baud data transfer, about $3 per minute to the US. Phone number for ship's INMARSAT-M system is ###-761-266-581. INMARSAT-M may be charged to credit card, collect, or otherwise reimbursed. (### = Ocean Code).

NOTE: For RB-01-01 cruise, the ship will be operating in range of the Pacific Ocean Satellite, with ocean code = 872 or Atlantic Ocean Satellite (West) with ocean code = 874. The switch from Atlantic Ocean Satellite (West) to Pacific Ocean Satellite will occur at roughly 100°W longitude.

8.7.3 E-Mail

An account on Lotus cc:Mail for each embarked personnel will be established by the shipboard electronics staff. The general format is:

Firstname_Lastname%BROWN@ccmail.rdc.noaa.gov

Due to the escalating volume of e-mail and its associated transmission costs, each member of the ship's complement (crew and scientist) will be authorized to send/receive up to 15 KB of data per day ($1.50/day or $45/month) at no cost. E-mail costs accrued in excess of this amount must be reimbursed by the individual. At or near the end of each leg, the Commanding Officer will provide the Chief Scientists with a detailed billing statement for all personnel in his party. Prior to their departure, the chief scientists will be responsible for obtaining reimbursement from any member of the party whose e-mail costs exceed the complimentary entitlement.

8.7.4 Contacts

Important phone numbers, fax numbers and e-mail addresses:

PMEL/OCRD Fax: 206-526-6744
PMEL/ADMIN Fax: 206-526-6815

RONALD H. BROWN

- INMARSAT "M" VOICE:	761-266-581, -580	(approx $2.99/min)
- INMARSAT "M" FAX:	761-266-582	
- INMARSAT VOICE:	154-2643	(approx $11.25/min)
- INMARSAT FAX:	154-2644	(approx $5.55/min)
- CELLULAR:	757-635-0678	
- CO CELLULAR:	206-910-8152	

INMARSAT Ocean Codes: 872 Pacific or 874 W. Atlantic (for E. Pacific)

Chief Scientist:	Richard A. Feely (feely@pmel.noaa.gov)	206-526-6214
Co-Chief Scientist:	Wade McGillis (wmcgillis@whoi.edu)	508-289-3325

8.8 Port Agent Services/Billing

Contractual agreements exist between the port agents and the commanding officer for services provided to *NOAA Ship RHB*. The costs or required reimbursements for any services arranged through the ship's agents by the scientific program, which are considered to be outside the scope of the agent/ship support agreement, will be the responsibility of that program. Where possible, it is requested that direct payment be arranged between the science party and port agent, as opposed to after-the-fact reimbursement to the ship's accounts.

8.9 U. S. Navy Clearance

AMC Operations (AMC1x3) will contact US Navy activities SUBRON9 and COMSUBPAC and inform them of cruise activities in advance to determine if there are restrictions on planned cruise operations. AMC1x3 will alert the Chief Scientists and *RONALD H BROWN* if ship operations need to be adjusted due to Navy restrictions.

8.10 Recent Ship Modification

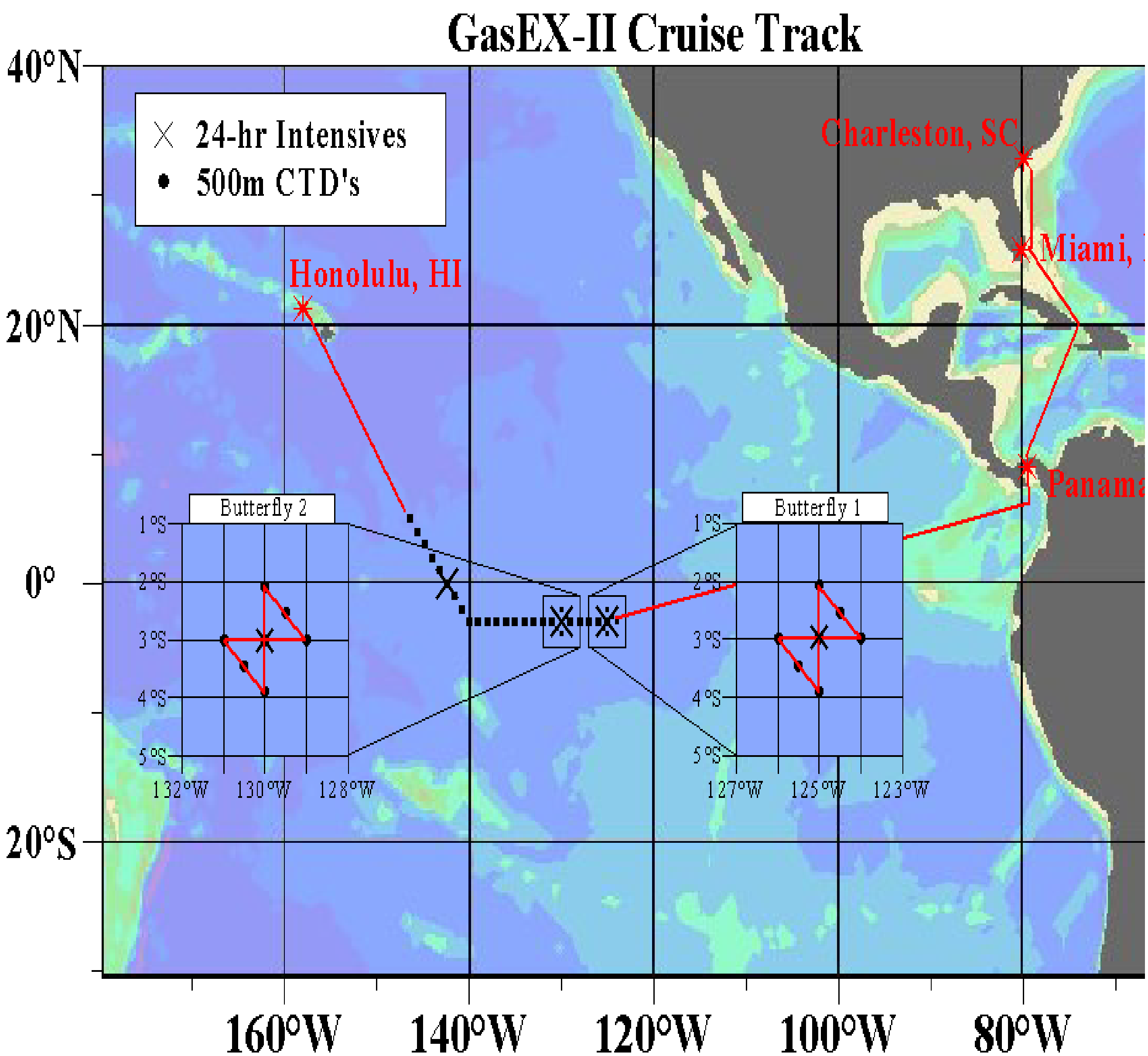
Projects using the bow and lab spaces should note new deck penetrators were installed in fwd Main lab and Bio Lab. However, these have special requirements for meeting ABS standards for fire/watertight seals. If projects wish to use these hull penetrators, please specify number of cables and/or sampling tubes, their diameters, whether connectors can be removed for stuffing, etc. Ship has a limited supply of packing/potting materials that are required for using these penetrators. Otherwise, stuffing tubes in aft lab bulkheads (Main lab, Hydro lab, and Wet lab) remain available.

9.0 APPENDICES

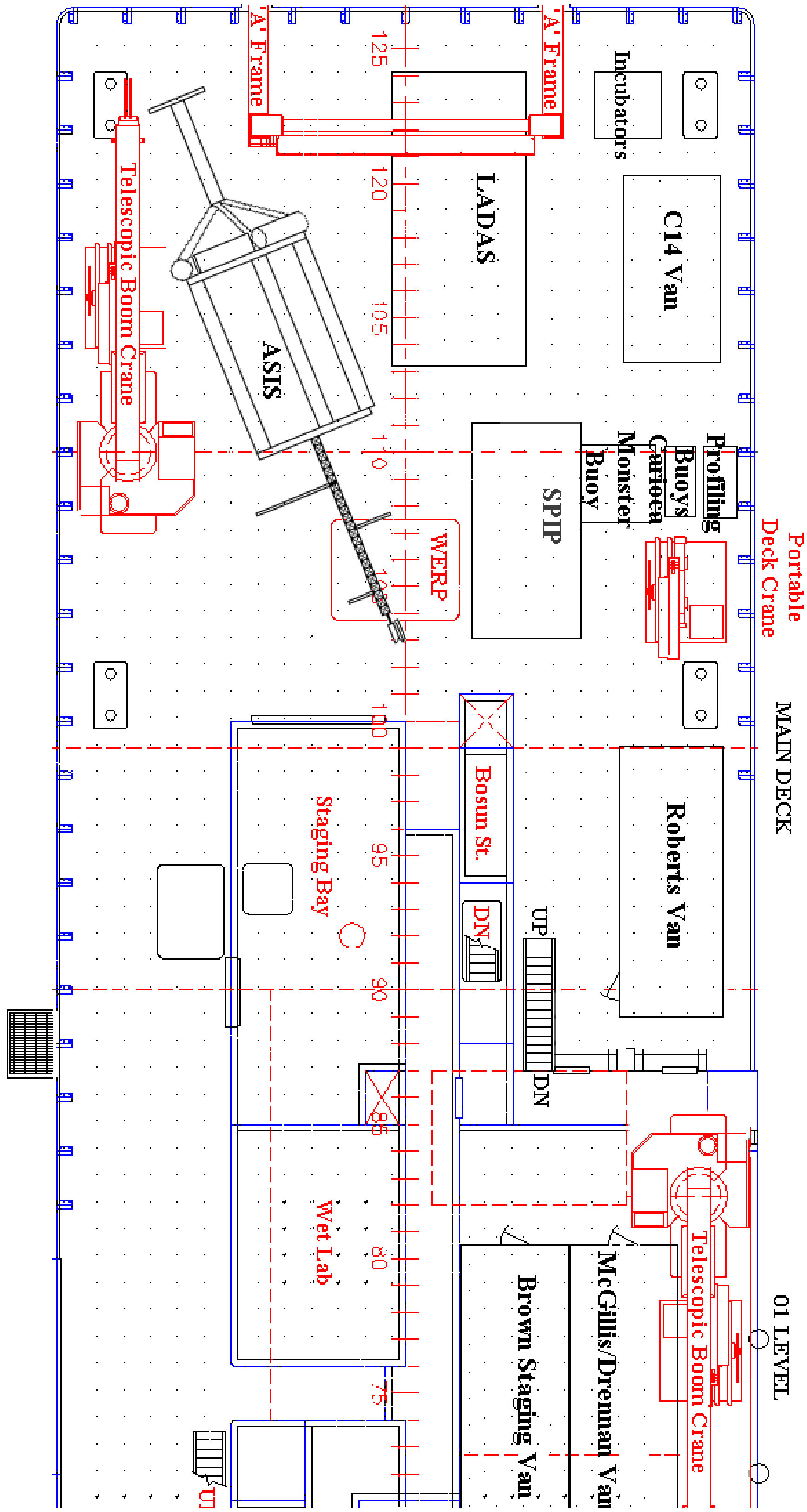
A. Working area/CTD locations
B. Diagram of Equipment Layout — Fantail
C. Diagram of Equipment Layout - Bow
D. Hazardous Materials
E. MBARI protocols for ^{14}C

Appendix A.

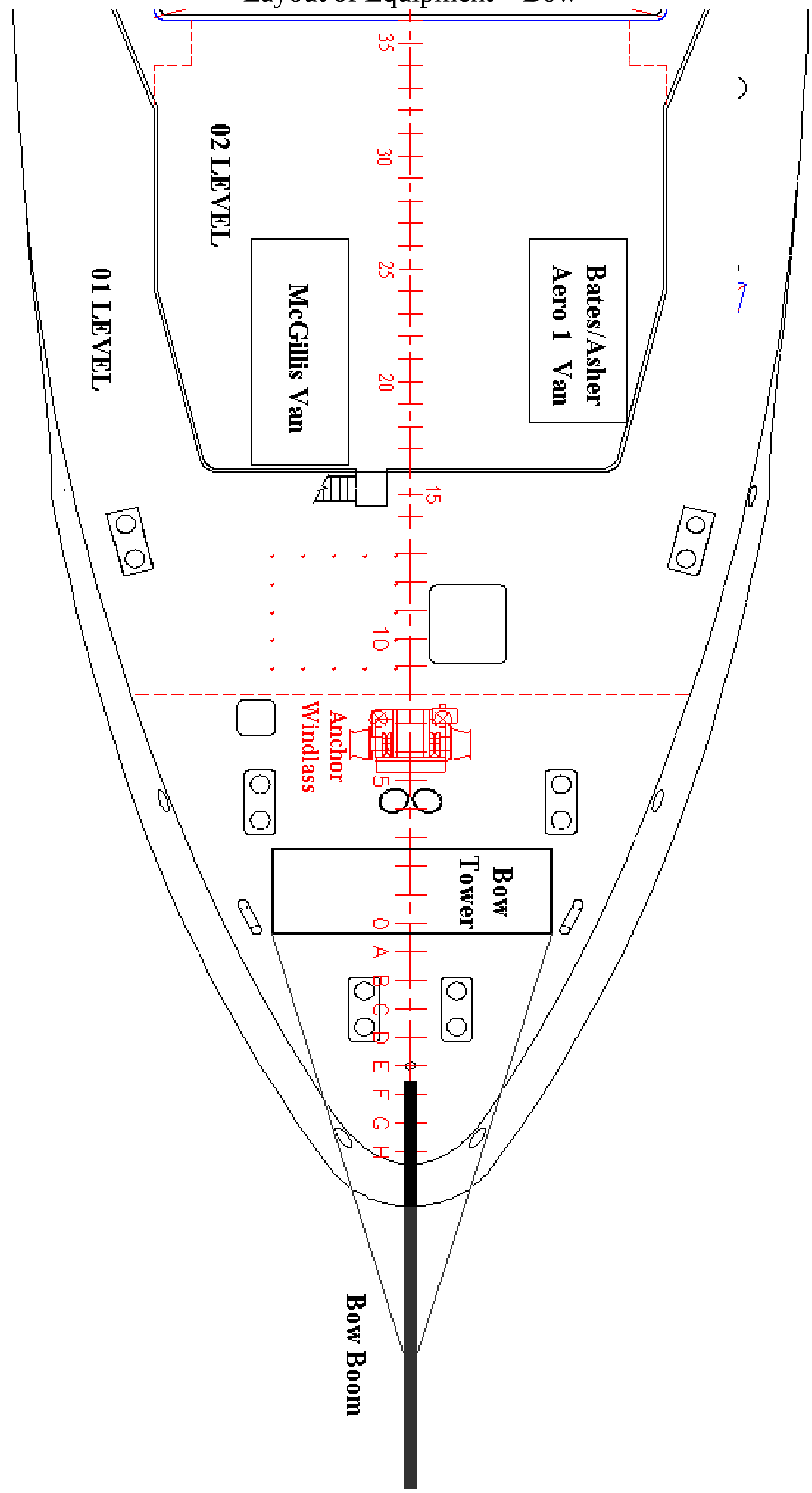
Working Area/CTD locations



Appendix B.
Layout of Equipment – Fantail



Appendix C.
Layout of Equipment – Bow



Appendix D.
Hazardous Materials

NOAA (Nutrients):
Acetone
Ammonium Molybdate
Antimony Potassium Tartrate
Ascorbic Acid
Brij
Cadmium Granules
Cupric Sulfate
Dowfax
Ethyl Alcohol
Hydrochloric Acid (36%)
Hydrochloric Acid (6 N)
Imidazole
N-(1-Naphthyl)ethylenediamine
Dihydrochloride
Nitric Acid (20%)
Oxalic acid
Potassium Chloride
Potassium Nitrate
Potassium Phosphate
Sodium Bicarbonate
Sodium Chloride
Sodium Fluorosilicate
Sodium Hydroxide (1N)
Sodium Nitrite

NOAA (DIC/pCO2):
Magnesium perchlorate 4 x 500G Bottles
Phosphoric acid 1 x 1gal
Mercuric chloride 500G Bottle
Malcosorb 4 x 500G Bottles
Cathode solution 5 x 1 gal
Anode solution 5 pint bottles
Potassium iodide 1000G
Acetone 1 x 1 gal
Isopropyl alcohol 2x 0.5 gal
Apiezon grease 5 x 75 G tubes
Aquasorb 2 x 500 G
Thermometers (Mercury) 5
UHP Nitrogen (5)
CO2/Nitrogen Mix (10)
CO2 Standard - Lecture size (4)

NOAA(ACE/ASIA):
CO2 (Neph) 2 tanks PMEL
Helium (IC) 6 tanks PMEL
Breathing air (DMS) 3 tanks PMEL
H2 (OC/EC) 2 tanks PMEL
O2 10% bal He (OC/EC) 2 tanks PMEL
CH4 10% bal He (OC/EC) 2 tanks PMEL
He (OC/EC) 2 tanks PMEL
Breathing air (OC/EC) 2 tanks PMEL
He (CO) 2 tanks PMEL
He 40 tanks PMEL
H2 (OC/EC) 2 tanks RU
O2 10% bal He (OC/EC) 2 tanks RU
CH4 10% bal He (OC/EC) 2 tanks RU
He (OC/EC) 3 tanks RU
Breathing air (OC/EC) 8 tanks RU
N2 2 tanks AS
H2 2 tanks AS
He 2 tanks AS

WHOI (LADAS):
Acetic Acid 1-5LB
Acetone 2 cases - 4L
Ammonium Hydroxide 1-5LB
Chloroform 2 cases — 4L
Formic Acid 1-500g
Hexane 2 cases — 4L
Hydrochloric Acid 1-2.6Quart
Mercuric Chloride 1-25g
Methanol 2 cases — 4 L
Methylene Chloride 2 cases — 4 L
Phosphoric Acid 1-2L
Quinine Sulfate 1-25g
Sulfuric Acid 1-2.5L
UHP Nitrogen T Tank (~5 tanks)
UHP Helium T Tank (1 tank)
Sulfanilamide
Sulfuric Acid

RSMAS (M-AERI):
Acetone — 1L
Ethanol — 1L
Nitric acid (5%) — 1L
Helium (12)

MBARI (C-14):
Carbon 14 isotope (as NaH[14]CO3) — 100ml
(total activity 10 milliCuries)
Hydrochloric Acid (HCl, concentrated) - 10 L
Acetone - 10 L
Liquid nitrogen - 20 L

Appendix E.
MBARI protocols for ^{14}C

Isotope usage
The isotope usage aboard the *NOAA Ship RHB* will not exceed 20 mCi of carbon 14. The maximum usage in one day will be 1.0 mCi. Each day we will use 100 uCi (0.1 mCi) per incubation at a maximum of 10 incubations per day, but usually approximately 3 incubations per day (0.3 mCi per day).

The carbon 14 stock will be transported directly from the MBARI to the boat in liquid form, already diluted to the working concentration. This eliminates the need to mix diluted working solutions from concentrated solutions on board. All carbon 14 will be stored within the refrigerator of the Scripps Photobiology Group van.

All isotope work will occur only within the isotope section of the Scripps Photobiology Group van. While performing isotope work, personnel will wear lab coats, gloves, and disposable protective footwear. The back 1/3 of the van is considered the isotope section. This section of the van contains the hood and the refrigerator. The floor is sealed and there is a dam on the floor separating the isotope section from the remainder of the van. The isotope section of the van had been checked by Environmental Health and Safety at UCSD and is approved for isotope work.

No stock solutions or waste will be removed from the isotope section of the van until the end of GasEx in Honolulu. There, all ^{14}C will be removed and disposed of at the University of Hawaii s facility at Snug Harbor, as per previous cruises that MBARI has undertaken on the NOAA Ship *Ka imimoana*. The logistics for this desposal will be discussed with the UH RSO and oceanography departments in the months prior to GasEx.

Note that the 24hr incubation protocol requires that an incubator (footprint ~1.5m × 1.5m) be secured somewhere on the ship s deck in full sunlight, with underway seawater running through it. This means that 8 inoculated sample bottles will be outside of the lab van for 24hrs per experiment. During that time they will be in tightly sealed bottles, with no chance of radiation spillage barring a breach of protocol as described below.

The work will be performed under MBARI s *Radioactive Materials License, number 5128-27*. Pete Strutton is an authorized user on the above-mentioned license, and will be in charge of all ^{14}C work at sea.

Wipes will be done at the beginning and end of the cruise, and processed using an on board scintillation counter. Results of these wipe tests will be provided to the Chief Scientists and the ship s command. In addition, a hand-held counter will be on board, to be used for surveying contamination in the event of a spill.

Waste
The following samples/waste will be disposed of in Hawaii
Samples — a maximum of 2400 scintillation vials with a combined activity of 20 uCi

Dry waste — 4 to 5 1-gallon ziploc bags of dry waste (gloves, tips etc) with trace amounts of radioactivity

Liquid waste - approximately 250 liters of liquid waste with less than 20 mCi of activity

Remaining stock - less than 10 mCi

All waste/samples will be transported in secondary, radiation-approved containers.

During the acidification process of the protocol described below, radioactive carbon will be released from the fume hood while the ship is underway. This carbon dioxide will be released in accordance with NRC regulations limiting the exposure of the general public to radioactive materials.

Procedure for Dealing with Spills and Personnel Contamination Spills

1. Notify individuals in the area of the spill's occurrence, location, size and nature.

2. Wash your hands if they have become contaminated as part of the spill incident.

3. Put on personal protective equipment including gloves, labcoat and eyewear to prevent contamination of the hands, body, and street clothes, if these are not already being worn.

4. Define and confine the spill zone. Mark off the spill area with chalk, markers, tape, etc. and restrict traffic to that area.

5. Individuals in the spill zone must stay within the zone until monitored for contamination, then decontaminated and/or established as free of contamination. Individuals initially within the spill zone should move to the area of lowest exposure.

6. If the spill was of dry material, dampen the spill slightly. This will avoid the spill's spread due to air currents or wind. Be careful not to spread the spill area unnecessarily. If the spill was of liquid material, cover the liquid with absorbent material (such as paper towels or Dessicant) to limit the spread of contamination.

7. Shut off fans or air circulation devices. Direct exhaust ventilation should be left operating.

8. Notify the captain, resident marine technician, operations officer, chief scientists or other designated individual(s).

9. Once the spill zone is controlled, then emphasis shifts to decontamination procedures. Begin decontamination procedures as soon as possible. Cleaning agents normally used in the laboratory environment should be adequate. SIO radioisotope isolation vans are equipped with spill kits containing the necessary materials. In addition, RadCon surface cleaner is very effective in removing radioactivity from difficult to clean surfaces. Start at the periphery of the contaminated area and work inward. Systematically reduce the contaminated area. Avoid using large circular cleaning motions, as this practice will increase the spill's surface area. Mitigation of liquid bicarbonate carbon-14 spills can be enhanced by rinsing the area with acid (e.g. 10% HCL), releasing the C14 as C14O2. This should be done only in a well ventilated area.

10. Put all contaminated, disposable materials into plastic bags for appropriate disposal later. Contaminated laboratory equipment should be bagged or set aside in dishpans for later decontamination.

11. Survey meter and/or wipe tests will be used to monitor the progress of the decontamination.

Personnel Decontamination

1. Administer first aid if necessary.

2. Be aware of personal and ethnic privacy issues when decontaminating personnel.

3. Define the area of contamination. Note the quantity of contamination, size and location.

4. Begin decontamination procedures with the mildest form of cleansing. Skin should be decontaminated using mild soap and water. The decontamination should progress to using soap with a mild abrasive, soft brush and water, then to a mild organic acid (citric acid, vinegar). Nails or hair may need to be trimmed to complete the decontamination. Decontamination procedures should not break the skin.

5. Survey meter and/or wipe tests will be used to monitor the progress of the decontamination.

6. Record the size, location, and degree of contamination. Give this information to the captain, resident marine technician, operations officer, chief scientists or other designated individual(s).

7. Put all contaminated, disposable materials into plastic bags for appropriate disposal later.

8. Clothing may need to be removed or changed. Contaminated clothing may be bagged and retained for decay or disposal.

<u>Protocol for 24hr incubation experiments</u>

1. Rinse three times and fill 280ml bottles from trace-metal clean CTD bottles corresponding to 100%, 50%, 30%, 15%, 5%, 1% and 0.1% light depths. Fill the SF and To100% bottles from the surface (100%) CTD bottle. Fill the To 0.1% bottle from the 0.1% light depth bottle.

2. Bring the bottles into the lab, put on gloves, lab coat and booties. Draw isotope into the eppendorf repeater pipette a little more than halfway. Dispense 2 shots back into the isotope bottle to make sure the pipette is dispensing correctly. Dispense one shot into each of the 280 ml incubation bottles. Return unused isotope to isotope bottle. Cap bottles **securely** and invert twice to mix isotope.

3. Filter the two **To** bottles immediately through regular GFFs. Place the GFFs in separate labeled vials, cover with 1 ml of 0.5N HCl, and place in fume hood.

4. Take the remaining eight bottles to the incubator and place in appropriate tubes, except the 100% and SF bottles which remain uncovered.

5. After 24hrs, remove bottles. Remove 1 ml from the 100% and 0.1% bottles using the 1 ml pipette, dispense into scintillation vial and add 20 ml of cytoscint - these are the **totals.** Cap and place in fume hood.

6. Filter the individual light level bottles through regular GFFs, place in labeled scintillation vials, cover with 1 ml of 0.5N HCl and place in fume hood. Filter 100 ml each of the SF sample through a 1 m and 5 m membrane filter respectively, place filter in scintillation vial, cover with 1 ml of 0.5N HCl and fume.

7. After a minimum of 24hrs, remove the vials from the fume hood, add 10 mls of Cytoscint ES scintillation fluid and shake vigorously. Read in scintillation counter.