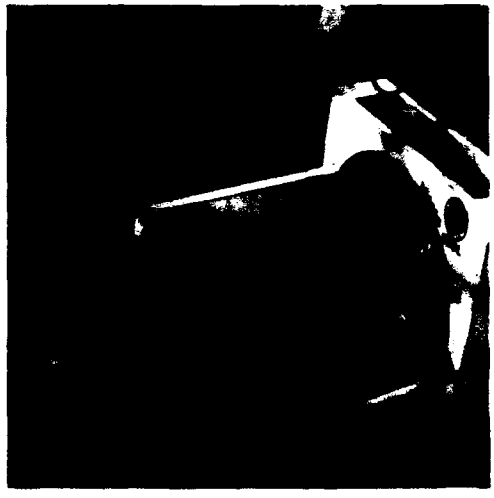
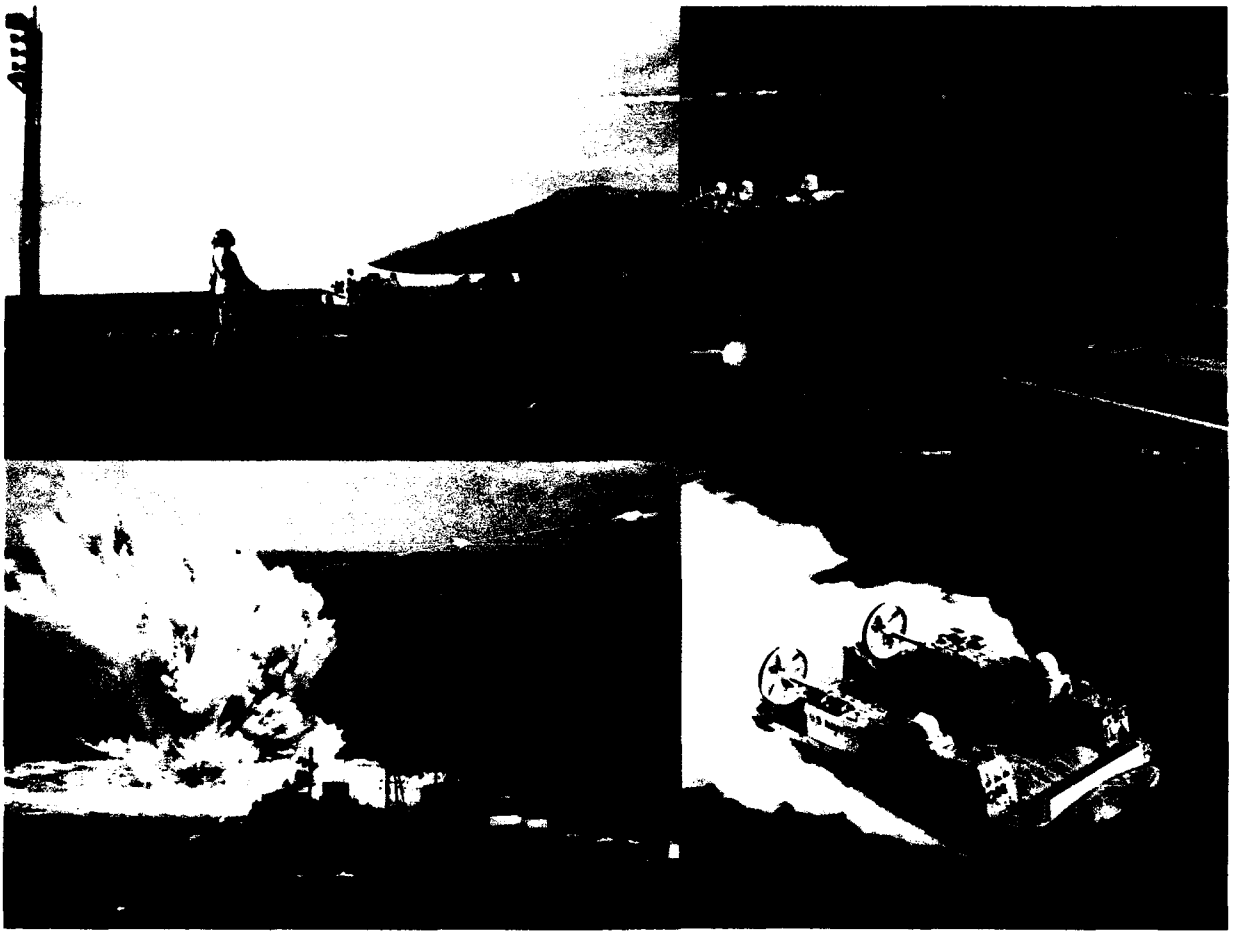
NAVAL BIODYNAMICS LABORATORY

NEW ORLEANS, LOUISIANA

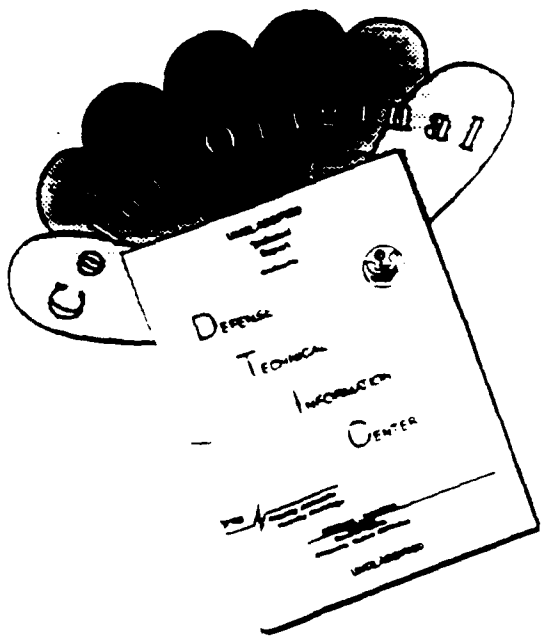


Mission of the Naval Biodynamics Laboratory

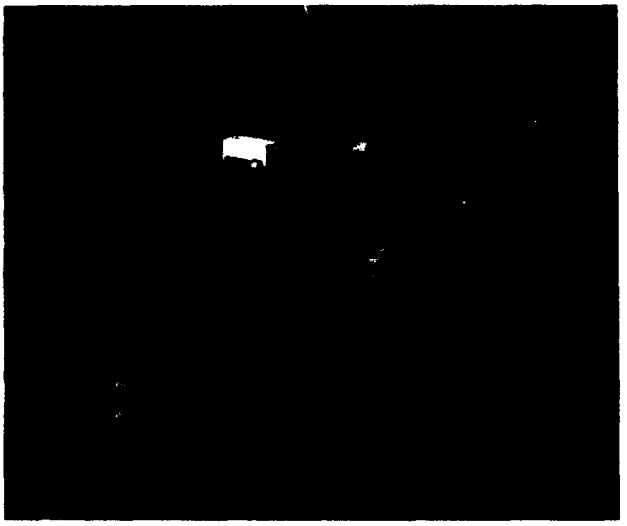
To enhance the performance of and prevent injury to the men and women of the United States Navy and Marine Corps by conducting biomedical research on the effects of mechanical forces encountered by crew members in Navy/Marine Corps aircraft and ships, establishing human tolerance limits to these forces, and developing approaches to minimize their adverse effects.



DISCLAIMER NOTICE

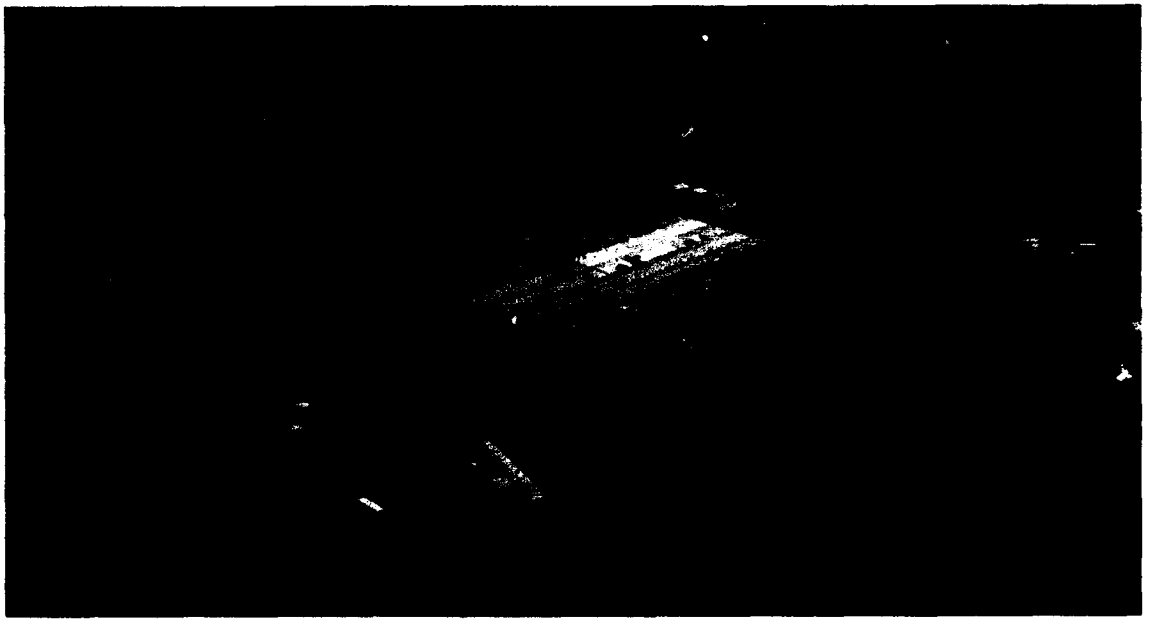


THIS DOCUMENT IS BEST QUALITY AVAILABLE. THE COPY FURNISHED TO DTIC CONTAINED A SIGNIFICANT NUMBER OF COLOR PAGES WHICH DO NOT REPRODUCE LEGIBLY ON BLACK AND WHITE MICROFICHE.



Naval Biodynamics Laboratory
New Orleans, Louisiana

The Naval Biodynamics Laboratory (NBDL), located on the National Aeronautics and Space Administration's Michoud Assembly Facility in New Orleans, Louisiana, was established in 1971. Since then, it has grown from a detachment of the Naval Aerospace Medical Research Laboratory in Pensacola, Florida to a separate command under the Naval Medical Research and Development Command in Bethesda, Maryland. The staff includes military and civilian scientists, engineers, technicians, and a cadre of sailors who have volunteered to be experimental subjects in the command's research programs.

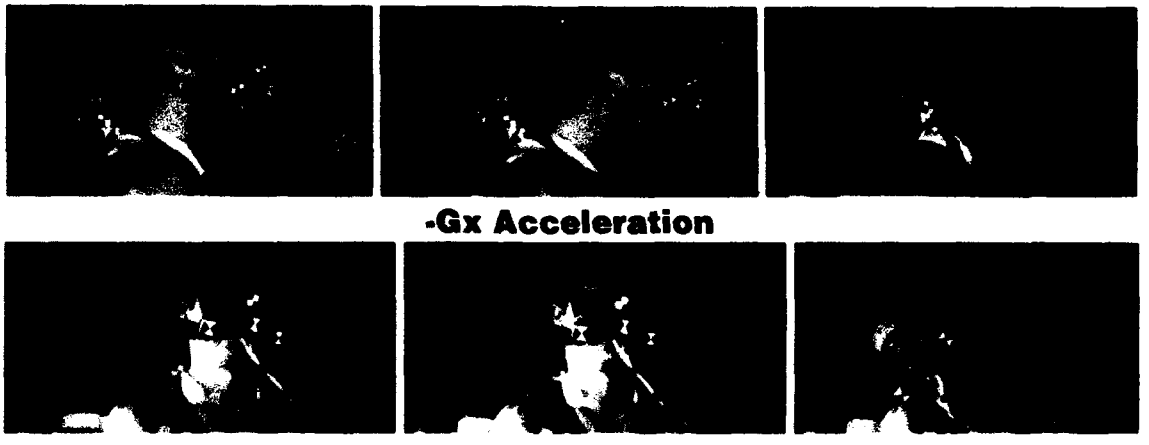


NASA Michoud Assembly Facility
New Orleans, Louisiana

IMPACT ACCELERATION RESEARCH

The Naval Biodynamics Laboratory's Impact Acceleration Research Program is designed to investigate the effects of indirect impact forces on the head and neck, and their potential for producing injury. NBDL studies human response to impact using nitrogen-powered Horizontal and Vertical Accelerators. These propel a restrained human subject or manikin on an instrumented sled along a 700 foot track or a 36 foot tower. The human subjects are initially exposed to low levels of acceleration which are increased in increments of a single g within a well-established safety range. Before, during, and after each test, a data acquisition system is used to collect and analyze inertial and physiological measurements and to medically monitor and provide information concerning human response to impact. The Vertical Accelerator simulates aircrew ejections, while the Horizontal Accelerator is used to obtain data for human response to simulated crashes.

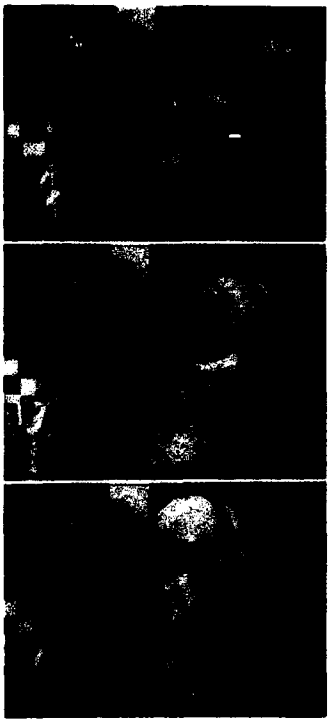
An environmentally controlled building houses the 700 foot Horizontal Accelerator Test Track that has been in operation since 1972.



Time series showing response of an unrestrained head and neck during a -Gx and +Gy acceleration.

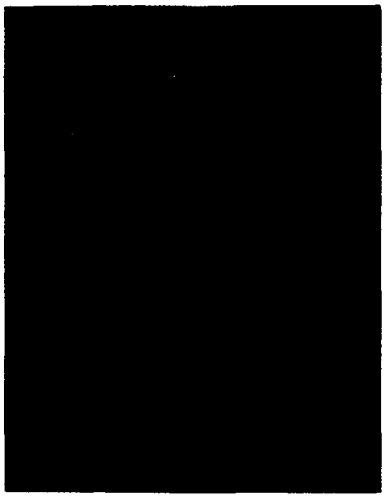
These data are used for studying the effects of biomechanical forces on aircrew, and are also used as the international standard to validate the fidelity of the head and neck response of crash test manikins. Additionally, NBDL researchers use somatosensory evoked potentials (SEPs) to assess the integrity of the central nervous system of humans undergoing impact acceleration. SEPs are electric impulses measured from brain waves produced by stimulation of the skin. One objective of this research is to establish impact injury thresholds for properly restrained personnel. These thresholds will enable engineers to design safer cockpits, emergency egress devices, and recovery systems.

The nitrogen powered Vertical Accelerator propels a restrained HRV or manikin on an instrumented carriage along a 36 foot vertical rail.



Time series showing response of an unrestrained head and neck during a +Gz acceleration.

Although numerous +Gz (or axial impact) experiments have been conducted on supine human research volunteers (HRVs) using the Horizontal Accelerator, the Vertical Accelerator allows a more realistic investigation of the biomechanical effects of forces similar to those produced by an aircraft ejection seat. The Vertical Accelerator has also been used to simulate forces encountered on board Navy ships during underwater explosions.



An Electrohydraulic Shaker is used for studying the effects of shipboard or helicopter vibration.

Subject-mounted accelerometers, aligned along the x, y, and z axes, measure the three components of linear acceleration directly.

HUMAN FACTORS RESEARCH

The Human Factors Research Program investigates the interactions between human operators and weapon platforms, equipment, and machinery within military operational environments. The Human Factors Division is responsible for examining, developing, and validating techniques to reduce the adverse effects of motion on humans in military settings.

The effects of heavy sea state conditions and biodynamic stresses on cognitive and psychomotor performance on board naval vessels is of special interest for designing techniques to reduce the adverse effects of motion.

Ongoing investigations develop and test methods to enhance crew performance in operational naval environments, both at sea and in the air.

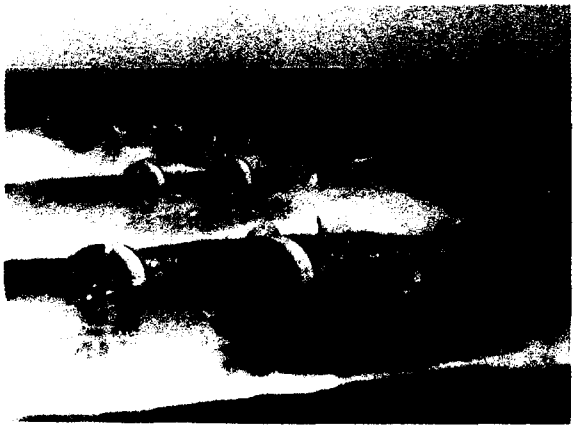
Full scale mock-ups are built at the Laboratory to determine human factors deficiencies and optimal arrangement and configuration of equipment displays and controls.

The Naval Biodynamics Laboratory houses the Navy's only Ship Motion Simulator (SMS), which is capable of simulating ship motion in conditions up to Sea State 5 with three degrees of freedom: heave, pitch, and roll. The SMS and a tri-axial tilt/ rotation chair with a visual effects device are used to study the effects of motion on human physical and mental performance.

The SMS can be configured and programmed to produce motion that accurately matches motion characteristics of Navy vessels.

A Cognitive-Behavioral Anti-Motion Sickness Training Program has been developed for use by the fleet and other customers.

The Human Factors Division also provides human factors engineering consultation for various agencies, including the U.S. Coast Guard Research and Development Center, Naval Sea Systems Command, NATO, and other Department of Defense components.



NBDL provides human factors engineering consultations for various agencies.

FACILITIES

The Naval Biodynamics Laboratory houses several unique "man-rated" devices and facilities to support varied research programs.

Horizontal Accelerator

Maximum acceleration	140g
Maximum payload	5000 lbs
Maximum velocity	150 ft/sec
Power stroke	9.84 ft
Pulse shape	half-sine, modified square trapezoidal
Pulse duration	.200 sec
Track length	700 ft
Sled dimensions	12 ft X 4 ft
Data acquisition systems	16 channel FM (telemetry), 28 channel digital

Vertical Accelerator

Maximum acceleration	75g
Maximum payload	1500 lbs
Maximum velocity	65 ft/sec
Power stroke	3.5 ft
Pulse shape	half-sine, triangular trapezoidal
Pulse duration	.200 sec
Height	36 ft
Carriage dimensions	2.5 ft X 6 ft
Data acquisition system	16 channel FM (telemetry), 28 channel digital

Ship Motion Simulator

Degrees of freedom	3 (heave, pitch, roll)
Heave stroke length	22 ft
Heave frequency response	0.04 to 4.0 Hz
Angular displacement	30°, pitch and roll
Angular velocity	25°/sec, pitch and roll

Tri-Axial Tilt Rotation Chair

Rotation	Variable up to 20 RPM, clockwise or counterclockwise
Pitch and roll	Total range of 80° (±40°)

Electrohydraulic Shaker

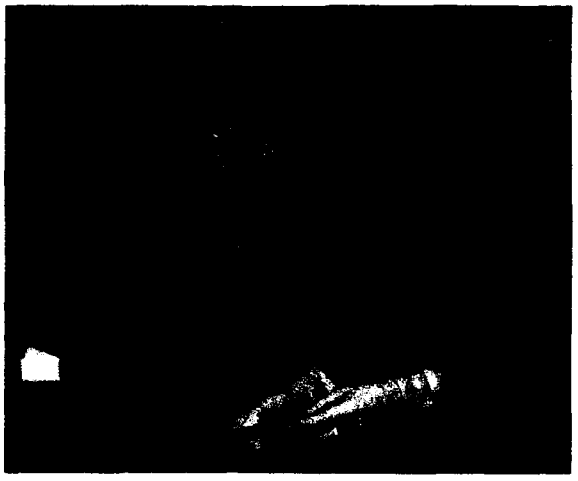
Frequency response	1 to 500 Hz
Stroke length	12 in
Payload capacity	500 lbs

Talented technicians and engineers working in well-equipped photography, electronic, machine, and fiberglass/wood shops design and fabricate a wide variety of items in support of NBDL's research.

HUMAN RESEARCH VOLUNTEERS (HRVs)

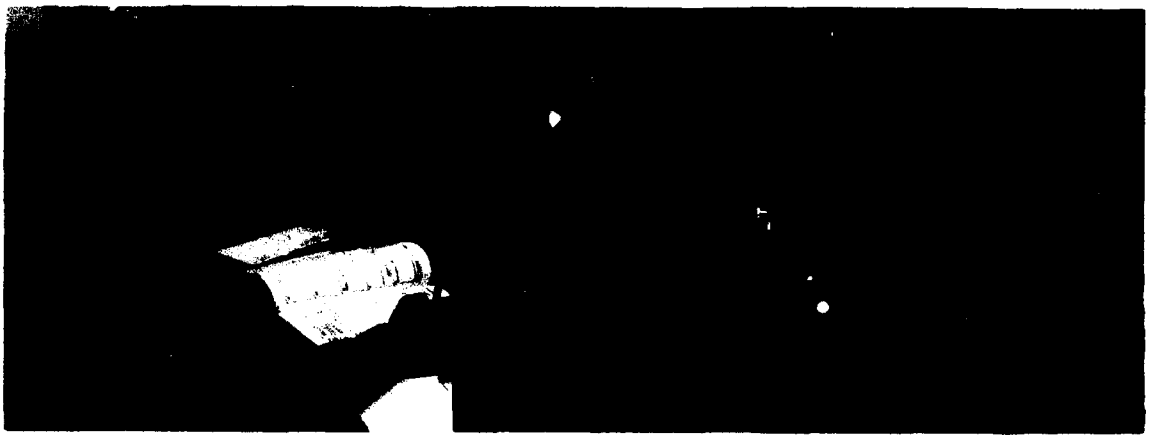
NBDL has several junior enlisted personnel who have volunteered to serve as dedicated HRVs for the command's experimental research programs. These HRVs are recuited from the Recruit Training Command in Orlando, Florida.

HRVs must meet rigorous mental and physical standards in order to qualify.



During experiments, HRVs are carefully monitored by a highly experienced and capable in-house medical staff.

The HRVs are medically evaluated on a long term follow-up basis to determine if there are lasting performance, physiological, or medical effects due to experimental exposures to impact acceleration. This research is conducted as a case study using the protocol established for the command's Air Crew Impact Injury Prevention Program.

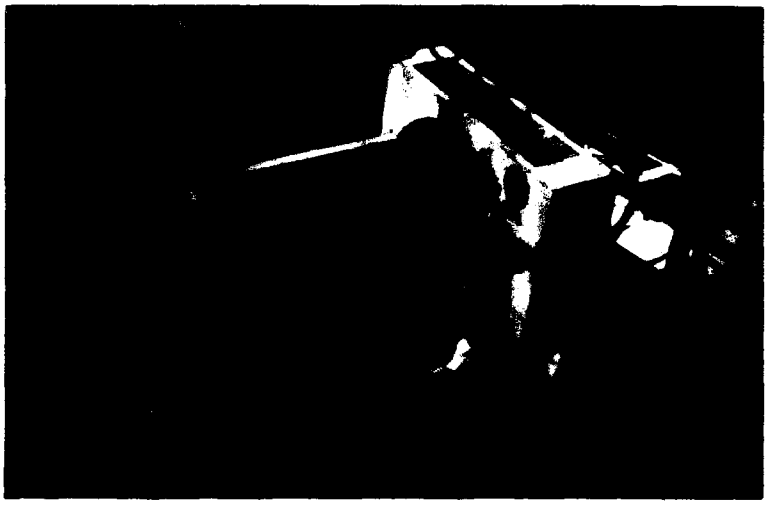


When not participating as subjects in experiments, HRVs work in all command departments.

VERSATILITY

Using its multi-faceted capabilities, NBDL is uniquely positioned to conduct experimental research for other military organizations, governmental agencies, universities, and private industry.

NBDL's unique technical capabilities allow the Laboratory to conduct a wide spectrum of research.



Productive professional collaborations with other agencies augment NBDL's scientific capability.

NBDL has also expanded its research efforts by establishing formal collaborative agreements with researchers and engineers at several universities. Under these agreements, university researchers and graduate students augment the Laboratory staff while conducting research projects furthering the command's mission. This collaboration provides a unique opportunity for university and government professionals to work together to solve Navy problems, while enhancing the stature of the Navy in the local community. Contributing their expertise to the national and international scientific community, NBDL staff serve as members or advisers on many renowned organizations, boards, committees, and working groups. These include the NATO Information Exchange Subgroup on Seakeeping; Tri-Service Aeromedical Research Panel; Scientific Program Committee, Aerospace Medical Association; IEEE Committee on Health Care and Engineering Practices; and ISO Technical Sub-Committee on Human Exposure to Mechanical Vibration and Shock.

NAVAL BIODYNAMICS LABORATORY

BOX 29407
NEW ORLEANS, LA 70189-0407
Commercial: (504) 257-3919 DSN: 485-2296
Tele FAX: (504) 257-5456

TELEPHONE DIRECTORY

			DSN: 485-
CDR ROBERT RENDIN	*COMMANDING OFFICER*	*257-3917*	*2297*
CDR LAWRENCE SCHOENBERG	*EXECUTIVE OFFICER*	*257-3922*	*2395*
YNCS STEPHEN ROGAN	*COMMAND SENIOR CHIEF*	*257-0150*	

RESEARCH DEPARTMENT

MARC WEISS, PhD	*CHIEF SCIENTIST*	*257-3979*	*2293*
SALVADORE GUCCIONE, PhD	*HEAD, MATH. SCIENCES DIV.*	*257-3975*	
LCDR F. DOUGLAS HOLCOMBE	*HEAD, HUMAN FACTORS DIV.*	*257-3947*	*2394*
MR. GARY JUPITER	*HEAD, DATA SYSTEMS DIV.*	*257-3938*	

BIOMEDICAL SUPPORT DEPARTMENT

CDR THOMAS ANDERSON	*DEPARTMENT HEAD*	*257-3953*	*2394*

TECHNOLOGY DEPARTMENT

MR. GIL WILLEMS	*DEPARTMENT HEAD*	*257-3892*	*2295*
MR. MARK LOTZ	*HEAD, BIOINSTRUMENT. DIV.*	*257-3900*	

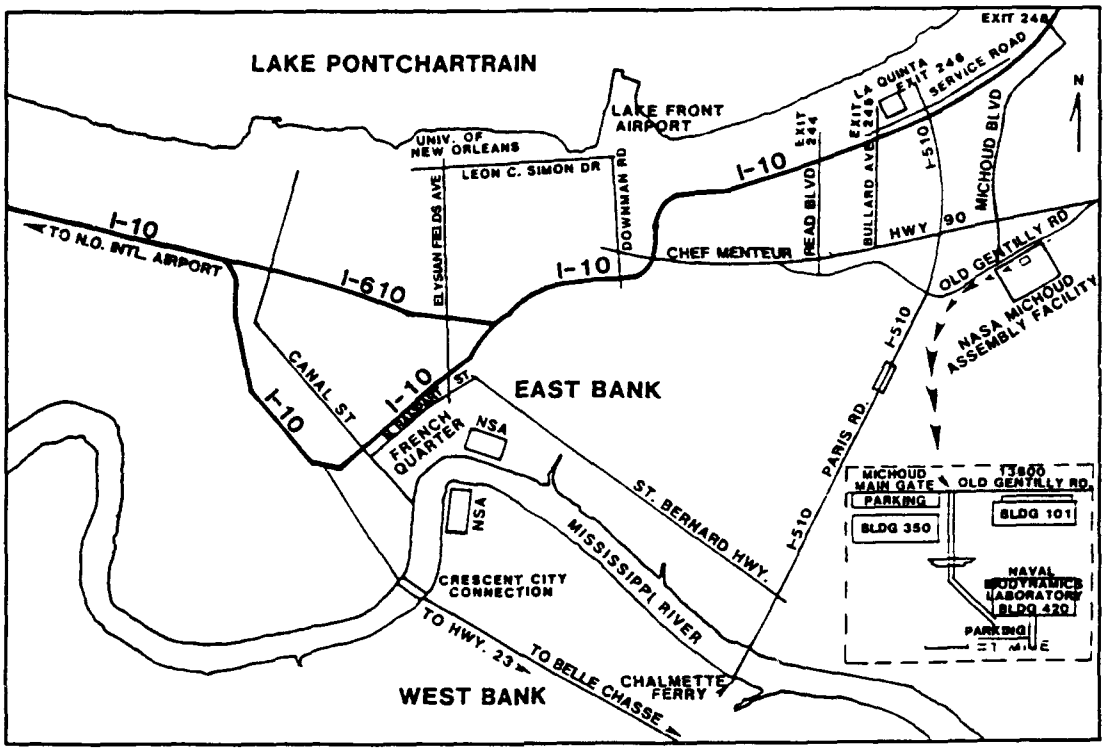
RESEARCH SUPPORT DEPARTMENT

LT KEVIN RICE	*DEPARTMENT HEAD/AO*	*257-3920*	*2296*
SK2 ANTHONY GEORGE	*HEAD, ADMIN. SUPPORT DIV.*	*257-3921*	

FISCAL DEPARTMENT

MS. SEVERINA GARCIA	*DEPARTMENT HEAD*	*257-0030*	*2294*

MAP OF MICHOUD AND NBDL



NAVAL BIODYNAMICS LABORATORY
BOX 29407
NEW ORLEANS, LA 70189-0407
COMMERCIAL: (504) 257-3919 DSN: 485-2292

NBDL MISSION

OUR MISSION is to enhance the performance of and prevent injury to the men and women of the United States Navy and Marine Corps.

WE WILL ACCOMPLISH this by conducting biomedical research on the effects of mechanical forces encountered by crew members in Navy/Marine Corps aircraft and ships, establishing human tolerance limits to these forces, and developing approaches to minimize their adverse effects.

WE WILL STRIVE CONTINUALLY to conduct the highest quality research to improve the safe and effective performance of Sailors and Marines.

NBDL VISION

WE ARE COMMITTED to providing a research facility dedicated to excellence in which:

THE NAVY AND MARINE CORPS consider NBDL the first source of scientific information relating to impact acceleration and the effects of ship motion on human performance.

BIOMEDICAL RESEARCH ORGANIZATIONS respect the Naval Biodynamics Laboratory as a world leader in conducting biodynamics research.

OUR LABORATORY PROFESSIONALS view the Naval Biodynamics Laboratory as a superior environment for realizing their professional growth and satisfaction.

OUR HIGHER ECHELON COMMAND regards the Naval Biodynamics Laboratory as the model command supporting the Navy Medical Department's strategic goals and objectives.

OUR PEOPLE view themselves as empowered members of one of the world's finest biodynamics research teams.

NBDL GUIDING PRINCIPLES

WE EXIST to ensure the best performance from and prevent injury to our Sailors and Marines.

WE WILL: Support the combat readiness of the Navy and Marine Corps.

Maintain pride and quality in all our work.

Earn the trust and confidence of our customers by enthusiastically providing prompt responses to their operational research requirements.

Share the results of our research with the international scientific community.

Be responsible members of our civilian community providing civic support whenever possible.

WE CARE about each other just as we care about our work. This is the basis of the mutual trust and respect that must exist for us to succeed.