Society of U. S. Naval Flight Surgeons

Naval Aerospace Medical Institute, Code 32
Naval Air Station, Pensacola. FL 32508-5600

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PRESIDENT'S COLUMN

Hopefully, most of you have returned from your deployments in support of Desert Shield/Storm and Operation Provide Comfort and will be reading this in more comfortable surroundings. Unfortunately, if you read any news stories or watched television coverage of “The War,” you saw how the Air Force won the war. There was little coverage of the Navy/Marine Corps contributions. The August 1991 Naval Institute Proceedings has several excellent articles addressing the lack of coverage of our part in the conflict, and I highly recommend that all of you read this issue. It is very enlightening! When discussing the Gulf War with colleagues from other services or with friends who are curious about where we were during the war, I’d like to point out a few of our accomplishments which you can relate to them.

* The Navy was the first military force to respond, controlling the seas around Iraq and projecting air power (and is still there performing maritime interdiction).

* Maritime preposition ships responded by 15 August establishing a fully equipped, combat-ready 15,000 man Marine Expeditionary Brigade ashore.

* We had 6 carriers in the war with as many as 4 in the Persian Gulf at one time (the first time we have deployed this many carriers at war since WWII).

* For the first time since Korea we had 2 battleships deployed together in support of the war.

* The Gulf War saw the first combat use of the Tomahawk, SLAM, F/A-18, AV-8B, Aegis Cruiser and RPV, all of which performed superbly.

* The Navy-Marine air team flew over 25% of all air missions.

* Over 9 million tons of military supplies and equipment were brought in theater by the largest sea lift since WWII.

I’m sure those of you who were there can add to this list of accomplishments. Which leads me to my next topic (pretty smooth, huh?).

A major emphasis of the Problems Course (Oct. 22-25) this year will be experiences/lessons learned from Desert Shield/Storm. All of you who have input are welcome to participate and let the rest of us know what it was like. There will also be a host of other topics pertinent to aviation medicine. Plus it is an excellent opportunity to renew old friendships, check into future assignments, exchange information, swap stories, etc. Please make plans to attend. And as a reminder, remember that membership in AsMA is a prerequisite for SUSNFS membership. If you have somehow become a SUSNFS member without joining AsMA, please join ASAP. Your support is crucial to our societies’ well-being.

CAPT R.A. WEAVER
MC, USN

SECRETARY-TREASURER'S NOTES

Hey howdy! How y’all doin?! This is the second Newsletter of our fiscal year 1991-1992 and it’s nice to continue to see dues trickle in, but there are alot of people with ’90 (dues were due April 1990) still next to their names. By April 1992, these individuals will be 2 years in arrears and will be subsequently scratched from the rolls. Please take a quick look at the date behind your name on the address label. If it’s ’92 and above, you are current. If it’s ’91 or below, you owe. We’d liketo keep as many members as possible, but we can’t do it without your support through dues. Don’t forget now, as I mentioned in the July issue, dues will be going up the first of the year. As of 1 January 1992:

Annual Dues for Membership/Subscription - $15
Lifetime Membership (20 years prepaid dues) - $300

Again, a great savings if you buy a Lifetime Membership now, which is still $200.

We also have something new and important in the works. We received a large donation from an Internationally known Private Jet Club. They received some onsight demonstrations and training in our new Physiology Building and were very impressed with our professionalism and dedication in the field of Aerospace Medicine. They were well acquainted with CAPT Sonny Carter (Navy Flight Surgeon and Shuttle Astronaut) who died in a plane crash early in the summer. We all agreed it wou.ld be nice to remember “Sonny” with something special. A 12" Bronze Relief of CAPT Carter mounted on a large cherry board with a bronze plated inscription underneath is currently in the works. We hope to dedicate this in one of the new physiology classrooms in 1992. We thank them forthe wonderful donation that will make this remembrance possible.

Looking forward to seeing you at the Navy Problems Course, 22-25 October. I will have on sale, the Newsletters and Binder for $35; Flight Surgeon Handbook for $20; Mess Dress Gold Wings with Diamond Chip for $130; and a new item, Navy Blue Polysilk ties with miniature gold Flight Surgeon Wings for $20. Keep your aviators on the “center line!”

LCDR DAVE SHIVELEY
MC, USN
NAMI (Code 32R)

SPATIAL DISORIENTATION IN AVIATION -- A REVIEW

Aircraft mishap reports are full of unexplained tragedies: The aircraft which takes off on a moonless night and silently plunges into the ocean less than a mile from the end of the runway. The F-4 which departs formation flight, exhibits erratic maneuvers, and plunges into the ocean under full power. A fatally late pullout from a practice bombing run. The sudden loss of controlled flight at the 90. One of the leading factors cited in incidents like these is spatial disorientation.

The ordinarily fine balance among the organs which allow us to maintain equilibrium and balance can be disrupted by the unusual attitudes and accelerative forces encountered in naval aviation. Although the medical community uses the term **vertigo** only to describe the sensation of spinning (either the person or the environment appearing to spin), aviators describe nearly **any** type of disorientation as vertigo - including directional confusion. Since the term vertigo can be misleading, we should try to restrict references to vertigo to those circumstances which result in a spinning sensation.

Pilots are most susceptible to disorientation when busy. anxious, unusually stressed or fatigued, hypoxic, or under temperature or emotional stress. Medications and G stresses can also impair the pilot’s ability to resist disorienting sensations. Critical times are when transiting from VMC (visual meterological conditions) to IMC (instrument meterologic conditions), night flight, in unusual or rapidly changing weather conditions, entering or recovering from unusual attitudes, and during formation flying. Pilots with less instrument time are also more susceptible to disorientation.

Spatial orientation is provided by input from the inner ear (called the vestibular system and inludes the simicircular canals), vision, and other body position sensors called proprioceptors. The inner ear has two components which are stimulated by either rotory or linear acceleration. Approximately 20-30 seconds after a constant velocity is established, as in a constant rate of turn, these organs become accustomed to the new orientation and register it as the new norm - reset to receive new input. In addition, there is a threshold for stimulation of these organs, and accelerations below a threshold value will not be registered. Proprioception is a term used to describe an appreciation of position based on the relative forces sensed by body surfaces and joint movements. This input can be deceiving in aviation since force vectors are modified by acceleration and gravity vectors.

The following is a summary of the most common types of spatial disorientations encountered in military craft:

THE LEANS is the most common flight illusion and is caused by reversal of a flight attitude to which the pilot has become accustomed. That is, if one were to maintain a constant 300 angle of bank turn in the opposite direction (a 300 deviation from the new norm). If the pilot has no visual or instrument cues to guide him, he may follow the natural tendency to reassume what the vestibular system thinks is a normal attitude: the original 30° angle of bank turn. Even with visual or instrument references, the pilot will feel as if he should lean in the direction of the original turn. A variation on this theme occurs when a pilot initiates a turn which is imperceptible to the vestibular system because the roll rate is insufficient to cause vestibular stimulation (less than threshold). If the pilot then corrects with a more rapid roll in the opposite direction, since the original turn was too slow to register, the perception will be that there was ony one turn - the rapid one - and the pilot will tend to lean in the direction of the original (slow) roll which is perceived as level flight.

THE GRAVEYARD SPIN is another variation of the leans in which the pilot enters a spin which lasts longer than 20-30 seconds. Initially, the fluid in the semicircular canals accelerates, giving the correct input of spin direction and speed. After a few seconds, the fluid movement reaches a new equilibrium and the spinning sensation is replaced by a feeling of no movement even though the spin continues. If the spin is then corrected and level flight is resumed, a reversal of the semicircular canal fluid movement will (falsely) tell the pilot that he has entered an equal but opposite spin. The natural reaction is for the pilot to attempt to correct by putting the aircraft back into the original spin.

THE GRAVEYARD SPIRAL is very similar to the graveyard spin except that the pilot unknowingly assumes a descending turn rather than a stalled spin and his vestibular system becomes accustomed to the turn. When the pilot notices a loss of altitude and either pulls back on the stick or adds power without first correcting the nose-down attitude, the spiral will tighten and the rate of descent will increase. Once the spiral is established, the vestibular system will become accustomed to the spiral as the new norm and, when the pilot returns to level flight, he will suffer the illusion of turning in the opposite direction and may compensate by re-entering the spiral.

THE CORIOLIS EFFECT is another illusion caused by the vestibular system becoming accustomed to turning. During a prolonged coordinated turn, the fluid in the semicircular canals which are initially stimulated attains a constant speed and the sensation of motion ceases. If the pilot then moves his head so that he places the semicircular canals in a different orientation, he will sense rotation or movement in a different spatial plane. This effect of combined turning sensations can be overwhelming and result in unpredictable maneuvers to correct what is perceived as uncontrolled rolling, turning, or spinning. Since the Coriolis effect can be overwhelming and most often occurs close to the ground (when looking at one's kneeboard in break or turn to final, for example), it is one of the most dangerous illusions.

THE OCUIOGRAVIC ILLUSION usually occurs during level forward acceleration and is the false sensation of a nose-up attitude. The horizontal acceleration vector is shifted by the vertical gravitational vector so that the net seat-of-the-pants feeling is slightly nose-up rather than directly forward. This illusion can be dangerous when taking off in conditions of low visibility (a moonless night without a good horizon, for example) and has accounted for many accidents within a mile after take off as the pilot attempts to correct for the feeling of a nose-up attitude by pushing the nose over. Another variation of this illusion is created during a pushover from a climb to level flight. The resultant vectors create the feeling of backward rotation and the natural tendency is to push the nose further over to stop the perceived backward motion, thereby increasing the vectors and intensifying the illusion.

THE ELEVATOR ILLUSION is interesting because it results from one of the body's normal compensatory mechanisms. During unexpected upward accelerations (as in an updraft), the vestibular organs tilt the eye with a compensatory downward tracking movement designed to follow objects as the body rises. Because the instrument panel remains fixed in front of the pilot, the tracking reflex causes the illusion of the panel rising. The pilot then feels that a nose-down correction is appropriate.

FALSE VERTICAL AND HORIZONTAL CUES often cause problems when flying over a sloping cloud cover or gently sloping terrain. The pilot may feel compelled to adjust his wing attitude to match the sloping horizon. A similar reaction occurs in northern regions when slanting aurora borealis lights give the pilot a false sense of the vertical plane.

BLENDING OF THE EARTH AND SKY often occurs on especially dark nights when lights from the stars are indistinguishable from those of the earth or on overcast nights when there are no ground lights (over ocean, for example) to help gain a horizontal orientation.

RELATIVE MOTION is a common illusion in formation flying and is similar to the feeling of motion produced by an adjacent car creeping forward at a stop light. This illusion is even more pronounced in aviation since there are few stable external reference points.

AUTOKINESIS, the false perception that a small stationary, steady light is moving, is another illusion which can cause problems in formation flying. This effect can be diminished by occasionally redirecting one's gaze or looking at a reference object, increasing the size, brilliance, or number of lights, or by changing from a steady to a blinking light.

FLICKER VERTIGO (not true vertigo) has been reported by many helicopter and fixed wing propeller aircraft pilots. The flickering of the anti-collision lights or direct sunlight through helicopter blades or slowly rotating propeller blades during taxiing can cause disorientation and, in rare cases, seizures.

ROTOR DOWNWASH in a low hover over water can give the impression that the helicopter is rising.Inattent tion to instrument input might lead the pilot to succumb to the natural tendency to compensate by inappropriately descending.

TARGET FASCINATION, although not strictly an illusion, is a form of disorientation since the pilot's attention is diverted to task performance unrelated to flying — occasionally to his detriment. The low altitude bombing run is the classic example: the pilot concentrates on the target so long that his pull up is initiated too late to clear obstacles.

Prevention of disorientation must be a conscious effort; early transition to instruments when visibility diminishes, not relying on the seat-of-the-pants sensory input, not mixing instrument flying with external visual cues, avoiding head movements which can cause disorientation (especially during turns), being particularly vigilant during high risk conditions such as darkness and low visibility, maintaining instrument proficiency, and not flying with an upper respiratory infection, when under medication, or when emotionally stressed. Overcoming disorientation requires concentration, composure, and intellectual command of the aircraft despite the distractions. Persistent minor disorientation (the leans, for example) may be quelled by redirecting one's attention. More compelling disorientation requires greater concentration and dependence on instruments, maintaining proper scan, and not mixing visual with instrument references. Head movements should be minimized and, in multi-seat aircraft, the copilot should assume control if he is unaffected. Lastly, the aircraft should be abandoned if control and orientation cannot be regained.

REMEMBER - All of these effects are normal body responses to confusing sensory input and, under the right conditions, can be experienced by anyone with any experience level.

CDR D. ARTHUR
MC, USN
NAMI (Code 32)

CODE 42 SPEAKS

I would like to encourage all of you to take the time to sit down and read through the new MMD Chapter 15 and compare it with the old Chap. 15. There are a number of changes which will affect the way you do business. One change which we have thus far been letting slip through is depth perception testing. The AFVT is no longer an acceptable method for testing depth perception in candidates and in Class I personnel. The only acceptable method is the Verhoeff for these individuals. We will pink slip candidate and Class I physicals which don't have Verhoeff depth perceptions.

There are a number of other changes which hopefully will make your life easier. For instance, Seasonal Allergic Rhinnitis before age 12, and since age 12 if requiring less than 21 days of medication/year is no longer considered disqualifying (SAR has been the second most common disqualifying defect in the past so this should decrease your waiver work load). Weight has been eliminated as a standard for designated Naval personnel (note the "designated" and "Naval" in this sentence - Marines must still meet weight/body fat standards as per MCO 6100.10 as must candidates for all aviation programs). Weight has been the third most common disqualifying defect so this should further reduce your paperwork (although rumor has it that OPNAV may be writing a weight standard into NATOPS).

Waiver submissions should become simpler with the institution of the Tiered Waiver System. Many waivered conditions no longer require annual submission. Some require submission tri-annually and some will have no routine submission requirement after the initial waiver is granted. The new Flight Surgeon's Quick Reference Guide (FSQR) will include a table outlining submission requirements for various cond itions. If a cond ition is not addressed in the table, assume annual submission is required. Which leads me to my next topic (another smooth transition ala the "President's Column" above).

The FSQR revision has been completed and is being massaged into a publishable format. I hope to have it ready for distribution at the Problems Course, but if not, I will hand out Xerox (actually Ricoh) copies of it at the course with the smooth version to follow. It has undergone extensive review and correction, but I'm sure a number of "glaring" errors/omissions will rear their ugly heads under your close scrutiny. I welcome any input to make this a better product. If you find any errors or have any suggestions as to how to improve the FSQR, please let me know. And as always, keep those cards and letters coming.

CAPT R.A. WEAVER
MC, USN
NAMI (Code 42)

FROM THE FLEET

INFLIGHT SPONTANEOUS PNEUMOTHORAX: A CASE REPORT

INITIAL PRESENTATION:

A 38 year old Naval Aviator, with 15 years of aviation experience and 2100 flight hours as a designated B/N, presented to the acute care clinic following a high altitude flight, with the complaint of right sided chest pain and dyspnea. The pain was located just underneath the shoulder, and was positional depending on the patient being upright or recumbent. The patient noticed the pain on initial descent from an altitude of 40,000 feet with an internal cabin pressure of 18,000 feet. The pain began as a mild ache, but slowly progressed in intensity throughout the remainder of the flight. On examination, the patient was in mild distress, tachypneic, with a regular heart rate. He was noted to have an occasional nonproductive cough, with somewhat decreased breath sounds in the right lower lung fields. The patient complained of tenderness to palpation over the right anterior and lower chest. There was no evidence of a deviated trachea, distended neck veins, or muffled heart sounds. Radiographic evaluation revealed a 10-15 percent pneumothorax, with a non-displaced mediastinum, and without pleural effusion.

CLINICAL COURSE:

The patient was admitted to a naval hospital, where a chest tube was placed in the right thorax with complete resolution of the pneumothorax. The chest tube was removed 3 days later, and the patient was discharged to convalescent leave without symptoms or complaints. The patient returned to the acute care clinic 16 days later with a five day history of worsening dyspnea and chest pain, which he had attributed to the prior thoracostomy. Radiographic evaluation at this time revealed a completely collapsed right lung, without a midline shift or effusion. The patient was again admitted to a naval hospital, and the following day underwent a right thoracotomy with pleurodesis and a bleb resection of his right lung. The patient did well post-operatively, and two months following his surgery, the patient was released from care by his thoracic surgeon. The patient is currently pain free, with normal physical exam, chest X-ray, and pulmonary function tests. The patient had a low pressure chamber run to 18,000 feet which was uneventful, and following a local board of flight surgeons, he was given an upchit. His waiver package is currently pending NAMI approval.

TREATMENT AND AEROMEDICAL DISPOSITION:

This case represents a somewhat atypical presentation, as in only 12 percent of spontaneous pneumothoraces does the pneumothorax occur while flying.[1] Generally, the activity level at the time of the occurrence does not seem to affect the incidence. Seventy-five percent of spontaneous penumothoraces occur during light activity or while the individual is asleep. In most cases there is no underlying pulmonary disease, but occasionally sarcoidosis, infection, neoplasm or pulmonary blebs may be present. This patient did present with the typical symptoms of pneumothorax, with a sudden onset of chest pain, nonproductive cough, and dyspnea. Similarly, the physical exam was typical in noting decreased breath sounds and hyperresonance to percussion in the involved lung. Occasionally, (10%) these patients may experience life threatening symptoms with severe respiratory and/or cardiac insufficiency. Conversely, in 7 percent of cases, the patient may be asymptomatic or have only mild symptoms, which may be mistaken for an upper respiratory infection.[2] With small pneumothoraces, it is sometimes necessary to obtain exhalation radiographs to visualize a 10 to 15 percent pneumothorax.

The treatment of spontaneous pneumothorax remains a topic of considerable discussion, compounded additionally by the aeromedical considerations involved. Conservative therapy consists of bed rest, needle aspiration or chest tube placement, whereas surgical treatment may include chemical or mechanical pleurodesis, bleb resection, or parietal pleurectomy. In student naval aviators or candidates, a spontaneous pneumothorax is disqualifying if it has occurred within the previous three years. Standard naval guidelines for the treatment of designated aircrew require chest tube placement for the first occurence of a moderate pneumothorax, while a definitive surgical procedure is necessary in cases of tension pneumothorax, unresolved or recurrent pneumothorax. Various authors have suggested aggressive treatment of involved aircrew because of the 30-40 percent chance of recurrence, involving either the ipsilateral or contralateral lung.[1234] This aggressive approach is especially warranted in pilots, who can not afford the risk of a recurrence while flying. In all instances, the flight surgeon must consider each case individually and, along with the patient, decide on the optimum choice of therapy, considering the patient's well being and aeromedical status. Whether the patient undergoes conservative or surgical therapy, in order for him to be returned to a flying status, he must have a normal physical exam, normal pulmonary function tests, a normal chest x-ray, and an uneventful low pressure chamber run at an aviation physiology unit.

CONCLUSION:

The occurrence of spontaneous pneumothorax in the United States is relatively uncommon, but is more often seen in young males ranging in age from 20 to 40 years. The incidence rate ranges from 2-46 per 100,000 individuals and is felt to be increasing.[1] The incidence has been found to be higher in the military population, and among Naval Aviators, 89 cases have been reported over the previous 4 years. It has been hypothesized, that the repeated exposure to significant changes in atmospheric pressure, inherent in operational flights, might be a considerable factor in the rupture of otherwise asymptomatic pulmonary blebs.[6] Additional factors which may be of significance are exposure to sustained G forces, the restrictive nature of flight equipment, and the positive pressure ventilation of Navy regulators.[3 5] There is little research material in the literature concerning this problem signaling perhaps that a thorough scientific study would be warranted to determine if aviators are indeed at increased risk, and if so, how this can be corrected.

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L T STEPHEN G. SEIFERT
MC. USNR
CARRIER AIRWING 7

RAMs CORNER

NAVY RADIATION HEALTH PROGRAMS

NAMI spends a good deal of time educating its students on the physiological effects of radiation. However, their expertise in the actual administration of radiation health programs is acquired during that critical first operational tour. Rather than waiting for an inspection to illustrate this for you, take a few minutes from your busy day to read this. Hopefully, itwill take away some of the mystery.

First, let's talk about the players in this game. All ionizing radiation programs fall under the purview of the Naval Sea Systems Command (NAVSEA). NAVSEA divides this into two broad categories: (1) radiation health related to nuclear propulsion, and (2) radiation health related to special weapons. Non-ionizing radiation health relating to lasers, microwave emiters, magnetic fields, etc. is regulated by the Bureau of Medicine (BUMED) and the Office of Naval Occupational Safety and Health (NAVOSH). Your commanding officer is responsible for enforcing the guidelines promulgated by these instructions. You and the Radiation Health Officer (RHO) are accountable for administrating the programs.

Ionizing radiation health programs are described in three very important documents. Radiation related to nuclear propulsion programs is covered by NAVSEA 389-0153, more commonly referred to as the "0153." You should familiarize yourself with Articles 106,107,108, 223,224,405,406, and Appendices A, E, J, K, and M. This publication is classified CONFIDENTIAL and can usually be found in Engineering's secure spaces. This document covers everything you need to know regarding specific forms relating to exposure limits, visitors, emergencies, etc. Should you have further questions about this program, it is regulated by NAVSEA-08. They can be reached at (703) 602-3887.

The second document is NAVSEA TW-120-AA-PRO-010, commonly referred to as the "PRO-010." This instruction covers the management of ionizing radiation exposure related to special weapons programs. It too is classified CONFIDENTIAL and can be found in the Nuclear Safety Officer's secure spaces. You should be familiar with Articles 105. 106, 107,201-208,302-306, 401-404, and Appendices A and B. This program is regulated by NAVSEA-O6GN. Their phone number is (703) 602-0417.

The last of the three critical documents is probably the most important for Flight Surgeons to be aware of. It is the NAVMED P-5055. This manual covers the entire scope of radiation health physicals, exposure limits, and radiation health care administration. It has a sample of each standard form required, as well as a complete description (block by block) of how to fill them out properly. This document is a must for your desk reference file. If your command does not have one, you can write to BUMED fora copy. For more specific questions, you can call BUMED at Autovon 294-1182.

The Flight Surgeon should also be familiar with radiation dosimetry devices and RADIAC equipment. There are three commonly used personal dosimeters. Table One has a detailed description of which categories of personnel receive specific devices.

Table 1: Dosimetry by Work Category

TYPE OF WORK	BADGE TYPE
Nuclear Propulsion Worker	CaF
Non-nuclear Trained Worker ("A" Gang)	LiF
Special Weapons Worker	LiF
Non-occupational Worker Occasionally Requiring Entry Into Radiation Spaces or Adjacent Spaces	
Submariners	LiF
Surface Ships	CaF
Shore Facilities	CaF
Radiation Calibration Lab Worker	LiF
RADIOGRAPHERS	
X-ray/gamma Device> 250 KVP (command choice)	CaF or LiF
X-ray/gamma Device < 250 KVP	LiF
If Worker Must Enter High Radiation Area	CaF
Medical Personnel (X-ray/Nuclear Med)	LiF
New Construction/Shipyard Personnel (command choice)	CaF or LiF
Navy Divers/E.O.D./S.E.A.L.'s	CaF (LiF where req.)
VISITORS	
Special weapons maintenance or stowage areas (Marines)	LiF
All Others	CaF

The first type is the Calcium Fluoride dosimeter (DT-526/PD). It is a small, cylindrical, black plastic device designed to measure gamma and x-ray (above 250 KVP) exposure. It has a range of 1 mrem to 5000 rem. It is NOT designed to measure neutron exposure; although, it does have a sulfur pellet in the cap to function as a neutron accident dosimeter. All reactor workers are required to wear this device. It is read daily for those working in high radiation areas, monthly for occupational workers doing routine work, and quarterly for non-occupational workers. It should be calibrated every 12 months.

The second dosimetric device is the Lithium Fluoride badge (DT -648/PD). This is a small, black, square, plastic device with four chips inside it. It is designed to detect gamma, x-ray (below 250 KVP), beta, and neutron exposure. It is issued to all weapons workers, x-ray technicians, workers in radiation calibration laboratories, and crew members of ballistic missile submarines. The badge should be read ever 6 to 7 weeks for non-FBM personnel. FBM personnel have their badges read at the end of each patrol cycle.

The third dosimeter is the pocket dosimeter (IM-9). It is a small, black, pen-like device designed to measure radiation exposures in the 0 to 200 mrm range. If dropped, it can give you a false reading. The important thing to know about the device is that any time you have an off-scale reading you must leave the radiation area immediately even if you think it might be a spurrious reading.

Radiacs commonly seen in the Fleet are designed to detect alpha, beta, gamma, and neutron radiation. Beta/Gamma Detectors include the AN/PDR-27, RAM 3400, RM-3C, and E-140N. The AN/PDR-56 is designed to detect alpha emissions. The AN/PDR-72 is the only portable device the Navy has for the detection of neutrons. All reactor workers are given a baseline evaluation for body burdons of Co 60 using either the PRM-5 or the Canberra-35N prior to entering nuclear propulsion programs. I would encourage you to look at these devices with someone familiar with them for a more complete discussion of their applications.

Lastly, the possibility for radiation contamination exists whenever you handle or work with sources. There are numerous books and publications available regarding nuclear contingencies. Each facility should have at least one good reference concerning accident preparedness. Two textbooks that can help you plan effectively for radiation related problems are: (1) Military Radiobiology by J.J. Conklin and R.I. Walker (ISBN 0-12-184050-6), and (2) Radiobiologyforthe Radiologist (3rd Edition) by E.J. Hall (ISBN 0-397-50848-4).

You should be aware that not all radiation problems can be solved with squadron or shipboard assets. Consultation can be made locally through the nearest shipyard, tender, or submarine base. The Naval Nuclear Power School in Orlando, the Naval Undersea Medical Institute in Groton, the Air Force Occupational Health Laboratory in San Antonio (Autovon 240-2061), and Oak Ridge National Laboratories are also invaluable sources of information.

LCDR RICHARD E. OSWALD
MC, USN
RESIDENT AEROSPACE MEDICINE
NAMI (Code 32R)
(Now assigned to Naval Post Graduate School,
Monterrey)

-- EDITORIAL POLICY--

The views expressed are those of the individual authors and not necessarily those of the Society of U.S. Naval Flight Surgeons.

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Correspondence should be addressed to:

CAPT CONRAD DALTON, MC, USN
Editor, SUSNFS Newsletter
Naval Aerospace Medical Institute,
Code 32
NAS Pensacola, FL 32508

ADDRESS CHANGE

NAME ____ RANK ______________________________________

STREET ____

CITY ___________________________________ STATE __________________________ ZIP ______________________