"MISSILE SAFETY -- THE UNSUNG EFFORT BEHIND THE SPACE PROGRAM"

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Anyone who has watched a newsreel of the count-down and launching of a missile has no doubt been amazed at the intricate details and precautions involved. This is evidenced by the warning horns, lights, loudspeakers blaring to clear personnel from the area, blockhouse activity, and the continuous checking by the launch control officer. These are visual indications of a vast safety program continuously operating behind the scenes to protect the missile teams and their equipment as well as the general public.

During the missile era infancy the safety program was integrated into the Air Force's already existing aggressive flight safety program. However, as large missiles such as Thor and Atlas became operational it was apparent that the flight safety approach alone would not be sufficient. In manned aircraft equipment malfunctions are compensated for by the skill of the pilot. Consequently the aircraft can be landed, repaired, and placed back into service. This is not true in missile operations where the malfunction of a small component may destroy an expensive missile vehicle.

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The whole idea of missile operations is to prepare a weapon for launch, then let it remain in a ready condition until needed. If it is ever required to fire, all components must work perfectly the first time in order to accomplish the mission. Because of this wide difference in concept between aircraft and missiles and the higher potential explosive yields contained in missile and nuclear warheads, it was necessary for the Air Force to expand and strengthen its whole accident prevention program.

A decision was made to consolidate all Air Force safety functions under a single jurisdiction with increased emphasis on missile and nuclear safety. As a result, the Pentagon-level Office of the Deputy Inspector General for Safety was established with headquarters first in Washington, D.C., then later at Norton AFB, San Bernardino, California. Commanded by Major General Perry B. Griffith, this office is divided into four major directorates responsible for all Air Force missile, flight, ground, and nuclear safety programs. These directorates are complemented by Assistants for Life Sciences, Education and Training, and Records and Statistics. Colonel George T. Buck, Director of Missile Safety, is in charge of implementing, guiding, and monitoring the worldwide missile safety program.

As pointed out by Colonel Buck, the missile safety program goes far deeper than the airborne missile itself. Nearly 85 per cent of the operation--and nearly that much of the cost--involves aerospace ground equipment (AGE). AGE is all the handling, testing, checking, and monitoring equipment required to prepare and launch a missile vehicle. Because personnel are predominantly working with AGE, the majority of missile accidents originate in this area. With the limited operational time, malfunctions and failures must be identified and prevented before they occur even once.

Missile safety men must continually ask themselves questions to identify the problems and deficiencies associated with AGE and decisions concerning the best course of corrective action must be made. An example of this was a need for more information by missile safety and operating personnel in field activities about high energy pneumatic and fluid systems involving pressures greater than 5,000 psi. To search out the information, personnel from the Directorate of Missile Safety initiated the establishment of an Air Force Steering Committee and Working Group on Integrated Pressure Systems and Components. Information was gathered, tests conducted, evaluations made, and a Technical Order was published which contained the needed information. There are many other examples involving cleaning fluids, valves, electrical relays, and components on which effective corrective action was taken following identification of the problem.

The above example highlights the importance of Colonel Buck's philosophy and drive to orientate the whole missile safety program back to basic design and prevention. One tiny mistake on the drawing board--or in basic concept planning--not only may be extremely costly, but also disastrous if allowed to pass unnoticed. Engineering changes often require equipment modification, technical data revisions, and retrofit programs affecting maintenance and operation schedules. In the case of large ICBM's and their complicated construction schedules, a small change may delay an operational ready date by weeks. An example of this is where a minor breakdown of a transporter carrying a missile to a given site, which took approximately three hours to fix, affected the maintenance and operations program of a certain base for the next eight days.

Safety, like every other phase of the missile operation, is a team effort. At the blockhouse, which contains the launch control equipment and consoles, the safety man must make a physical inspection of the building and equipment prior to a launch. He checks for the proper functioning of blast doors, escape hatches, and ventilation systems. In case of missile malfunction, these items are very important to the launch crew. If a missile should blow up on the pad, personnel must be protected from the blast and ensuing fire. Escape routes must be carefully checked in advance.

The safety man not only has to solve present problems, but keep an eye on the future as well. Safety procedures must be constantly revised to keep pace with new and stronger metals, changes in fuels, increased pressures, electronic component improvements, etc. What was a safe practice one day may become a hazardous operation the next day. Take the case of using asphalt to pave the missile launch sites for example. When liquid oxygen (LOX) was introduced as a primary oxidizer, a potential hazard developed. If LOX were to leak or be inadvertently spilled on asphalt, it would immediately combine with the oil and form an extremely explosive gel. This gel is so "impact sensitive" that a scuff of a man's shoe might blow off his leg! Fortunately, the hazard was discovered early in the missile program and very few areas had to be repaved with concrete.

Cryogenic fuels and oxidizers such as LOX and liquid hydrogen have created problems because both must be stored and handled at unusually low minimum temperatures to prevent "boil-off." LOX, for example, cannot be permitted to rise above minus 430°F which is just 30° above absolute zero. If it does, it will expand from a liquid to a vapor state, usually with a disastrous explosion.

Another cryogenic fuel, liquid fluorine, is so inflammable that it will ignite or react violently upon combination with almost any substance, even with water or asbestos because of the contaminants contained in these normally "fire-proof" substances.

Among the special problems confronting the missile safety expert is the handling of toxic propellants and chemicals. Liquid propellant fuels and oxidizers are, in general, highly reactible chemicals and all of the ingredients for a disaster are present when handling them. Therefore, the missile propellant handlers must be provided with skillfully designed protective equipment. Certain missile operating activities present potential hazards that are difficult to eliminate or adequately safeguard. As an example, in the event of a nitric acid (HNO_3, oxidizer) propellant leak the propellant handlers' lives depend on protective clothing. Naturally, the type of equipment or protective garments will depend upon the nature of hazards involved.

What type of protective equipment is commonly used in missile propellant operations? This equipment includes toxic vapor sensors (the nose is not reliable), vapor concentration analyzers, fire detectors, emergency breathing apparatus, chemical and fire resistant protective suits, etc. Perhaps no piece of personnel safety equipment has been subject to greater research efforts than the propellant handlers' suits. One can literally state that current protective suits will save a man's skin. These suits have the following characteristics: (1) will withstand the corrosive effects of the most reactive propellants; (2) prevent the penetrating effects of fuels or oxidizers; (3) are fire retardant; and (4) are reasonably flexible even in the coldest weather.

How about communications once a propellant handler is literally sealed in a protective suit? A compact two-way radio is installed in the suit so he can communicate with companion missileers. The cost of one of these protective suits is equivalent to two white sable fur coats!

Air Force safety men are learning from past experience and anticipating what will be needed in the future. Professional training for missile safety personnel includes a special eight-week course at the University of Southern California. The aim is for every missile unit in the Air Force to have a trained, fully qualified Missile Safety Officer.

General Griffith, in summing up the safety program, said, "I am pleased with the Air Force's integrated approach to its safety mission. Our people are dedicating themselves wholeheartedly in their labors to save lives, dollars, and machinery. I think the program has proved to be a dollar saver for the taxpayer, a special boon to our defense program, and a preserver of our nation's combat potential."