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## Operation Popeye Project Popeye

Weather modification was a technology once embraced by the US military as a tool to help both wartime and peacetime missions. However, interest in the ability to modify weather waned following the end of the conflict in Vietnam and became virtually non-existent after the passage of the Environmental Modification (ENMOD) Treaty in 1977, which prohibited offensive weather modification from occurring over a large area.

With the onset of conflict in Southeast Asia, operational interest in modifying weather to support combat operations increased. The goal of such a program would be to flood supply routes used by the North Vietnamese into South Vietnam by seeding clouds in the area. Between 1949 and 1978 China Lake developed concepts, techniques, and hardware that were successfully used in hurricane abatement, fog control, and drought relief.

The use of weather modification as a tool of warfare was very much a by-product of developments to use weather modification techniques for peacetime missions. One method that was tried, but later abandoned by the military was the use of aircraft dry ice seeding to dissipate cold fog. In the late 1960s and early 1970s, specially configured WC-130 aircraft were equipped with a dry ice crusher and dispenser. On a typical mission such aircraft would fly a seeding pattern consisting of between 5 and 30 parallel lines, each 5-6 miles long and 0.5 to 1.5 miles apart. This pattern would be flown just above the fog at a distance between 45 and 60 minutes upwind of the area where clearing was desired, with the machine generally dispensing 15 pounds of crushed dry ice per minute. The hole then, would hopefully drift over the desired area at the desired time. The return on the investment in these operations was significant. During the winter of 1969-70 for instance, fog dispersal operations in the United States via this method cost \$80,000 but saved \$900,000. As weather modification became discredited in the mid-1970s, however, this method was abandoned.

A weather modification program for selected areas of Laos, which subsequently known as Project Popeye (also referred to as Operation Popeye), was proposed by the Joint Chiefs of Staff on 10 August 1966. The Command of US Military Assistance Command, Vietnam (COMUSMACV) and the Commander in Chief of US Pacific Command (CINCPAC) concurred in the proposal and recommended that it be carried out in selected areas of the Tiger Hound area of operation in Laos. The Joint Chiefs of Staff granted approval on 1 September 1966 and the execute order was issued on 17 September 1966.

The Joint Chiefs of Staff approved the project to extend the rainy season by cloud seeding in Laos, as a means of denying the enemy vehicular lines of communication. According to intelligence sources at the time, there was a significant movement of enemy supplies and personnel through the Se Kong watershed and the peripheral mountainous areas. Vehicular traffic was a frequently used method of transportation, but it was considerably hampered by poor road conditions caused by inclement weather. It was hoped that the cloud seeding project would cause further deterioration of the infiltration route.

The prime objective of Project Popeye was to tailor the cloud seeding techniques developed by the Naval Ordnance Test Station, China Lake, California to the unique meteorological, terrain, and operational conditions that existed in the particular area, and then conduct an operational evaluation of the concept. It was estimated that the initial portion, Phase IA, would take 10 days, consisting of preliminary reconnaissance flights over operational areas, and some trial cloud

seedings conducted for training and proof testing of operations techniques and aircraft. The next phase, Phase IB, would last approximately 35 days and would consist of 50 case samples of randomly selected but controlled cloud seeding operations.

Phase IB of Project Popeye commenced on 29 September 1966 and ended on 28 October 1966. A 56-case sample was evaluated and more than 85 percent reacted in accordance with the project theory. There was also evidence of broader applications of weather modification, such as cloud rain-out over the ocean to reduce precipitation of friendly forces, cloud dissipation by overseeding to improve visibility of friendly forces, and other applications based on tactical operations. In view of the success of Project Popeye, COMUSMACV recommended immediate full-scale implementation of the Popeye technique, to include these broader aspects.

Based on experience gained during the test, Seventh Air Force wrote a Popeye plan for utilizing the technique as an adjunct to the weapons systems then being employed in the theater. The operations plan, based on Air Force control and execution of the entire operation, was approved by COMUSMACV and by the Joint Chiefs of Staff, who forwarded it to higher authority on 5 December 1966, with approval to implement the project expected in early 1967.

The Air Force continued its attempts at weather modification after the initial Popeye tests, flying rain-making missions during 6 southwest monsoon seasons before the project ended on 5 July 1972. Initially, 3 WC-130A aircraft were used in the Popeye missions. These aircraft had been converted to a weather reconnaissance configuration featuring the AN/AMR-1 system, capable of receiving information from dropsondes. The aircraft, however, were not configured for atmospheric sampling like the WC-130Bs and WC-130Es in service at the time. By 1970, the WC-130As had been returned to the standard C-130A configuration and replaced by WC-130Bs and WC-130Es on a rotational basis. Aircraft dropped photoflash cartridges inside certain clouds, relying on the release of silver iodide or lead iodide in the updraft to trigger the release of moisture. The annual cost of the effort was roughly \$3.6 million, including the operation and maintenance of 3 Lockheed WC-130s and 20 McDonnell Douglas RF-4Cs, purchase of seeding materials, and pay for the people involved.

In the end, however, it proved impossible to determine the amount of additional rainfall caused by cloud-seeding rather than other factors, and thus justify the recurring outlay. The Defense Intelligence Agency estimated that seeding increased rainfall "in limited areas up to 30 percent above that predicted for the existing conditions," but this figure admittedly was the result of "empirical and theoretical techniques based on units expended and the physical properties of the air mass seeded"-in short, a scientific guess. Sensor data showed only that the enemy consistently experienced difficulty keeping traffic moving through the monsoon rains, a normal problem for that time of year.

From time to time, especially during 1971, tropical storms either intensified the downpour associated with the southwest monsoon or extended the rainy season beyond its anticipated close. Atmospheric conditions over either the Indian Ocean or the South China Sea, rather than cloud seeding over southern Laos, spawned these typhoons. Ironically, typhoon-induced rains interfered with cloud seeding, cooling the earth and preventing the updrafts of heated air that were essential to the project.

When this effort was exposed, however, the military endured tremendous pressure and criticism, especially from Congress. Within 5 years of the negative publicity, US military weather modification research had ceased.