"Take Charge and Move Out" !

TACAMO Submarine communication systems

The Indian Navy is well regarded as perhaps the pioneer among the Services in strategic thinking and has long anticipated its value as a potential key component of India's emerging, albeit closely guarded, nuclear-doctrine. It was apparent from the outset that nuclear-powered ballistic missile armed submarines (SSBNs) would constitute the most reliable element among assured retaliatory nuclear-strike platforms, for their inherent "stealth" attributes, for being mobile, submerged and out of reach of most electromagnetic frequency bands for detection. A similar view was forcefully held by the legendary Russian Admiral of the Fleet Sergey Georgyevich Gorshkov, and knowing his personal influence on the Indian Navy's strategic thinking and formulation, this was hardly surprising.

Decades later, not only has an Indian Navy SSBN in the shape of INS *Arihant* initiated operational patrol, the strategic punch is being incorporated in conventional hunter-killer submarines (SSK) in the form of specific BrahMos supersonic cruise missiles. The potential is also inherent in possible Indo-Israeli developments in missile technology, especially in areas of Inertial Navigation Systems (INS) and terminal guidance. Yet to be really effective in the strategic sense, the submarines in the area of situational awareness remain inherently handicapped because of their "isolationist nature" and need to be contacted and commanded by National Command Authority (NCA), to issue launch orders, the absence of which cripples the formidable strategic platform and renders it virtually impotent.

Thus little wonder the Indian Navy attached high priority to submarine communications even decades ago and subsequently anticipated the importance of Very Low Frequency (VLF) underwater transmissions. As part of an ambitious naval modernisation programme during the mid-1980s the Indian Navy had constructed a VLF broadcasting station in Tamil Nadu. Although not publicly declared, it was reported that the United States, the undisputed leader of submarine communications actively collaborated in the project, which was completed in September 1986. This facility needs to be viewed as an "initial step" in the quest of development of underwater Very Low Frequency/ Extremely Low Frequency (VLF/ELF) and laser communications for effective coordination of the submarines with the India's NCA. News reports indicate commissioning of INS *Kattabomman* VLF/ ELF station in 2014. However it remains unclear whether it is a new facility or a modernised existing type.

A US Navy Boeing E-6B Mercury TACAMO aircraft (photo: Jason Grant)

The operational VLF facility is used by the Indian Navy to communicate with its SSK fleet of Russian *Kilo* Class and German Class Type 209 with trailing communication buoys at periscope depth of 10 to 20 metres. After the nuclear-powered INS *Arihant* became operational, the VLF facility permits India's NCA to issue launch orders to the submerged submarines at periscope depth. VLF waves propagate to almost a quarter of the globe away and are generally immune to atmospheric disturbances caused by nuclear detonations. Extremely Low Frequency (ELF) waves on the other hand can penetrate to depths of 100 metres but a huge overland infrastructure needs to be built up with at least 80 km long antennae. In this context, as far back as 1986, researchers from the Defence Electronics Applications Laboratory, Dehra Dun, after reviewing the effects of nuclear radiation and EMP on VLF/ELF communication systems, concluded that "ELF radio communication was the only reliable means which could withstand the effects of a nuclear holocaust and was least disturbed by the EMP generated by nuclear explosion". Subsequently classified research and development in these areas was carried out by the National Institute of Oceanography, Goa, Indian Institutes of Technology (IITs) Madras and Bangalore, and Defence Electronics Applications Laboratory, Dehra Dun, although the system in principle relies on fixed terrestrial infrastructure and thus vulnerable to enemy strikes. However on the negative side, the small bandwidth of VLF transmission limits the rate of transmission of data, usually allowing only the operation of slow Teletype messages. Moreover the large terrestrial and static VLF/ELF facility would be vulnerable to enemy strikes as even if the facilities are shifted deep underground in "hardened" shelters, the vital and critical communication antennae would have to be located above ground and would remain vulnerable.

Thus Indian Navy is left with no other option but to develop, ideally with United States assistance, an airborne VLF transmitter similar to the United States Navy (USN) "Take Charge & Move Out" (TACAMO) to ensure survivability of its VLF facility and thus retaining the critical sub-surface nuclear punch. For TACAMO missions the USN initially utilised EC-130A/Q Hercules platforms with a powerful 200 KW transmitter providing the VLF transmissions through a 10 km long trailing wire antennae with a drogue parachute at the end. During transmission the aircraft maintained a flight-profile in a continuous tight circle, which resulted in over 70% of the wire hanging straight down and acting as a relatively efficient vertical antenna.