INDIAN AEW&C SYSTEM IN THE GLOBAL PERSPECTIVE

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Abstract

An Airborne Early Warning and Control (AEW&C) System is an airborne multi-sensor system designed to detect Air-and Surface-Targets. Used at a high altitude, the system allows the operators to distinguish between friendly and hostile aircraft hundreds of kilometres away. The AEW&C aircraft is used for defensive and offensive air operations. The system is used offensively to direct fighters to locations of their targets and defensively to counter attacks. It can also be used to carry out surveillance, command and control, and battle management functions.

The paper traces the evolution of the AEW&C System in the global scenario and compares the Indian effort to tailor-make an optimal state-of-the-art system to meet specific requirements of the Indian Air Force.

Nomenclature

AAAU = Active Array Antenna Unit
AESA = Active Electronically Steered Array
AEW = Airborne Early Warning
AEW&C = Air-borne Early Warning and Control
AWACS = Air-borne Warning and Control System
BSC = Beam Steering Controller
C3 = Command, Control and Communications
CABS = Centre for Air-Borne Systems
CAEW = Conformal Air-borne Early Warning
COMINT = Communication Intelligence
CSM = Communication Support Measures
DHDS = Data Handling and Display System
DIRCM = Directed Counter Measures
DRDO = Defence Research and Development Organisation
ECCM = Electronic Counter Counter-Measures
EMI = Electro Magnetic Interference
ESA = Electronically Steered Array
ESM = Electronic Support Measures
GES = Ground Exploitation System
HF = High Frequency
HPA = High Power Amplifier
IAF = Indian Air Force
IFF = Identification Friend or Foe
IFR = In-Flight Refuelling
LNA = Low Noise Amplifier
MESA = Multi-role Electronically Steered Array
MSA = Mechanically Steered Antenna
MSC = Mission System Controller
MTOW = Max-Take-Off-Weight
OWS = Operator Work Station
PR = Primary Radar
RAAF = Royal Australian Air Force
RASP = Recognisable Air Situation Picture
RCS = Radar Cross Section
RF = Radio Frequency
SATCOM = Satellite Communication
SIGINT = Signal Intelligence
SPS = Self Protection System
SSR = Secondary Surveillance Radar
TCAS = Traffic-alert and Collision Avoidance System
T/R = Transmit-Receive
TRM = Transmit-Receive Multi-Module
U/VHF = Ultra/Very High Frequency

Introduction

In the history of military warfare, success in tactical operations has heavily depended upon the early warning that one side got on actual deployment of the enemy forces in the battleground. The fighting armies therefore scurried to take over high grounds in the theatre of war to gain information on enemy dispositions as early as possible.

In the early days of waging wars, the Chinese Army is understood to have sent up a soldier to some height on a giant kite to observe and report on enemy positions.

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With the arrival of hot air balloons towards the end of the Eighteenth Century, the French army had used tethered balloons as observation platforms to spy on the hostile Austrian army positions. The use of balloons through the 19th Century defined the operational role of an air-borne early warning platform in military conflicts.

The significant inventions of the early 20th Century, viz., the Aircraft and the RADAR, led to the clever combination of the two technologies giving birth to a distinctly identified Airborne Early Warning (AEW) system.

The prime functions of the AEW&C system are three, viz., sensing the threat scenario, providing early warning to friendly forces and enabling initiation and execution of counter-measures and counter-threats, all in real-time.

AEW&C Systems Re-Wrote Air Warfare Tactics

The AEW&C system soon proved itself to be a dominant Force Multiplier with its abilities to execute multiple functions like: Early Warning, Surveillance, Electronic Support Measures, Signal Intelligence, Command and Control and Battle Management, all from a single airborne platform. The AEW&C Systems effectively impacted the dynamics of air warfare and irreversibly changed its nature.

The roles that the two dominant AEW&C systems, viz., the E-2C Hawkeye and the E-3 AWACS played during the Gulf War (1991) amply illustrate the potential of these systems. During Operation Desert Shield and Desert Storm, the AEW&C Aircraft helped overcome surveillance deficiencies and conduct successful air operations. They assisted the fighter fleet by providing early threat detection and building up situational awareness that led to 39 out of 41 air-to-air engagements being successful.

E-2 Hawkeye

The Grumman E-2 Hawkeye (Fig.1) is an American all-weather, aircraft-carrier-based tactical Airborne Early Warning (AEW) aircraft. The twin Turboprop Aircraft was designed and developed in the 1950s by Grumman for the United States Navy. The E-2Cs, operating with their ‘S’-Band radar, provided the command and control for successful operations directing both land attack and combat air patrol missions over Iraq and providing control for the shoot-down of two Iraqi MiG-21 aircraft by F/A-18s in the early days of the war. During Operation Enduring Freedom in Afghanistan and ‘Operation Iraqi Freedom’ in the Gulf, Hawkeye squadrons flew overland sorties and provided critical battle management for attack of enemy ground targets, close-air-support coordination, combat search and rescue control, airspace management, as well as data link and communication relay for both land and naval forces. Over 100 E-2C Hawkeyes have been operating in a number of countries around the world.

E-3 AWACS

The E-3 AWACS (Fig.2) is a modified Boeing 707/320 commercial airframe with a rotating radar dome. The E-3 AWACS’ look-down radar operating in ‘S’-Band, has a 360° view of the horizon, and at operating altitudes has a range of more than 320km. The radar can detect and track air and sea targets simultaneously. In a tactical role, the E-3 can detect and track hostile aircraft operating at low altitudes over any terrain, and can identify and control friendly aircraft in the same airspace. In the strategic defence role, the E-3 provides the means to detect, identify, track and intercept airborne threats.

The E-3 AWACS can carry out airborne surveillance and command, control and communications (C3) functions for both tactical and air defence forces. The aircraft is equipped with 14 command and control consoles fitted with high-resolution colour displays. Over 72 of the E-3 AWACS are known to be in operation with various Air Forces of the world including USAF and the NATO.

In later years, when B-707 aircraft went out of production, the B-767-based version of the E-3 AWACS came into being.

Arrival of the Active Electronically-Steered Array (AESA) Radar

Both E-2C Hawkeye and E-3 AWACS aircraft carried Mechanically Steered Antenna (MSA) in rotodomes of size that was appropriate to the aircrafts geometry and all-up weight. The 23.4-tonne E-2C carried a 7.3m dia rotating dome that housed the MSA antenna. The 147.43-tonne E-3 AWACS carried a 9.1m dia rotating dome containing the main radar, Identification Friend or Foe (IFF) and data-link fighter-control antennae.

In the case of single radiator / antenna radar, such as the ones in the E-2C Hawkeye and the E-3 AWACS, the antenna had to be mechanically rotated for the radar beam to scan the air space. With the advent of the Electronically Steered Array (ESA), it became possible to scan electronically without any mechanical rotation of the antenna. The ESA is mounted in a fixed position on the aircraft structure and the beam is steered by individually controlling the phase of the radio waves transmitted and received by each of the multiple radiating elements in the antenna. With ESA, the revolutionary Inertia-less Scanning had arrived with multifarious advantages.

The Active ESA Radar

The Active ESA Radar (Fig.3 and 4) has distributed within it, both the transmitter power-amplifier function and the receiver front-end functions. A tiny dedicated Transmit-Receive (T/R) Module is placed directly behind each of the radiating elements. The centralized Transmitter, Duplexer and Front-End Receiving Elements are thereby eliminated. The T/R Module, which is a block of electronics with a transmitter (amplifier), receiver and a common phase shifter, has become the basic building block of the AESA radar.

The Transmit-Receive (T/R) Module

The T/R Module (Fig.5) contains a multi-stage High Power Amplifier (HPA), a Duplexer (Circulator), a protection circuit to block any leakage of the transmitted pulses through the duplexer into the receiving channel, and a Low-Noise Amplifier (LNA) for the received signals. The RF input and output are passed through a variable gain amplifier and a variable phase shifter, which typically are time-shared between transmission and reception. These, and the associated switches, are controlled by a logic circuit in accordance with commands received from the Beam Steering Controller (BSC). In order to minimize the cost of the T/R Modules and to make them small enough to fit behind the closely spaced radiators, the modules are implemented with integrated circuits and miniaturized.

Design and development of the Transmit-Receive Module has been undertaken indigenously by DRDO to meet the needs of the Indian AEW&C System under development. A unique feature of the indigenous T/R Module design is that eight Transmit-Receive Modules are combined compactly to form a single Transmit-Receive Multi-Module (TRMM) (Fig.6), thus facilitating high-density installation of a few hundreds of them in the Active Array Antenna Unit (AAAU) to power the Primary Surveillance Radar.

The AESA Advantage

The inherent advantage of the AESA radar is its impudence to perform even with some T/R module failures, unlike the single transmitter case, where the entire radar system will shut down with the transmitter failure. AESA radar goes through a graceful degradation with cumulative failures in its battery of T/R modules. The AESA Radar has three key advantages that have proved increasingly important in military applications. This revolutionary technology helps build substantially more compact radar systems resulting in low weight, minimal aerodynamic drag and relatively smaller Radar Cross Section (RCS), all of which are operationally of vital importance for the platform aircraft. Besides, the AESA radar provides enhanced beam agility with higher reliability. The latest AESA sensor further helps track air-and sea-targets simultaneously as well as tracks continuously the high-performance aircraft, while maintaining the routine scan over the operational area.

The New Breed of AEW&C Systems with AESA Radar

Both the E-2 Hawkeye and the E-3 AWACS deployed successfully during the Gulf War had the Mechanically Steered Antenna radar. In the early 1990s, a more versatile breed of AEW&C systems with Electronically Steered Array radar started making their appearance progressively.

Saab-340 AEW&C

The first of the AEW&C systems to sport AESA radar was the Swedish Saab-340 AEW&C aircraft (Fig.7). The Saab-340 is a twin-engine Turboprop Aircraft. An AEW version with phased-array radar, Erieye, in a rectangular pod on top of the fuselage was delivered in 1994. The Swedish Air Force ordered for six units of the aircraft. Some numbers are used by Japan as Search-and-Rescue aircraft. A recent variant of Saab-340 AEW&C, designated Saab-2000 AEW&C, using the same Erieye AESA radar, has been ordered by Pakistan.

The Ericsson PS-890 Erieye radar uses an active array with 200 solid state modules. The range of the ‘S’-band side-looking radar is 300 km. The antenna is housed in a 9m long box radome mounted atop the fuselage. Utilizing adaptive side lobe suppression, the look angle on each side of the radome is about 120 degrees in the azimuth. Against a fighter-sized target of $2m^2$ RCS, the effective range of the radar is approximately 300 km. Seaborne targets can be detected at longer ranges, though this is a function of the aircraft's cruising height.

The electronically scanned antenna can scan sectors of interest frequently while others are monitored; and a single sector can be scanned in different modes at the same time. The aircraft functions as an airborne radar integrated with the total air defence network.

EMB-145 AEW&C

Brazil saw the virtue of the Ericsson Erieye radar of the Saab-340 AEW&C and chose to mount the same on its bigger and faster twin-engine regional jet aircraft, EMB-145.

M/s Embraer of Brazil built the EMB-145 AEW&C aircraft (Fig.8) for Air Forces of Brazil, Mexico and Greece with the Erieye radar and other subsystems opted by those Nations.

G-550 CAEW

In June 2005, the Israeli Air Force ordered a new Conformal Airborne Early Warning aircraft based on the Gulfstream G-550, ultra-long-range business jet, and developed by Israeli Aircraft Industries' ELTA Systems Group. The new platform, called the G-550 CAEW(Fig.9), includes phased array radar, phased array IFF, Signal Intelligence (SIGINT), and a communications system. The communications system includes a data-link and satellite communication (SATCOM) system for secure high-speed connectivity with ground stations. The G-550 CAEW aircraft was designed to operate in network-centric environment.

The ELTA radar conformally built on the sides of the fuselage works on the 'L'-Band and provides a detection range of 400 km on the LH and RH sides, in the extended mode. In the forward and aft directions, independent radars mounted on the nose and tail work on the 'S'-Band and provide a range of 280 km, in the extended mode. The 'nose radar' is placed in the location of the Weather radar.

The G-550 CAEW is on order for Israel and Singapore.

B-737 AEW&C, Wedgetail

The Boeing Company is building for the Royal Australian Air Force (RAAF) an AEW&C system designated B-737 AEW&C, Wedgetail (Fig.10). The Boeing AEW&C Solution combines the new Boeing 737-700 aircraft with the Northrop Grumman Multi-role Electronically Scanned Array (MESA) radar. Included in the platform are an Identification Friend or Foe (IFF) system; an expanded, passive electronic surveillance system; and an effective self-defence capability.

Northrop Grumman's MESA radar is mounted in a rectangular 'T'-structure atop the fuselage providing 360-degree coverage in the 'L'-Band with a range of 360 km. The cabin houses six Mission Operator Consoles. The radar can track air and sea targets simultaneously and can help the operator track high-performance aircraft while continuously scanning the operational area.

The 737 AEW&C platform, with its interoperability with the E-3 and B-767 Airborne Warning and Control System (AWACS) aircraft, is designed to fill the airborne-surveillance needs of Australia. The first of the six planes ordered by the RAAF is due to be delivered in 2010. Turkey has also ordered for a few numbers of the B-737 AEW&C.

IL-76 AWACS

India, Israel and Russia are developing an AWACS system with true 360° azimuth coverage radar built into the Russian Briev IL-76 aircraft (Fig.11) platform.

This system is built around an ELTA EL/M-2075 AESA L-band radar, and adds electronic and communications intelligence gathering (ELINT and COMINT) capabilities. The system is interoperable with other air and ground stations, and uses sensor fusion to provide a complete picture of the battle space.

India's IL-76 AWACS will use a conventional circular radome mounted on top of its fuselage, rather than the front and side structural modifications made in the case of the Gulfstream G-550 CAEW system. The radome will, however, be fixed and not rotating. The ELTA radar, with a set of three phased-arrays housed in a triangular configuration inside the radome, will operate in L-Band and scan 360 degrees in the azimuth with a range of 370 km (Fig.12).

Delivery of the IL-76 AWACS systems to Indian Air Force is slated to complete by the year 2012.

The Indian AEW&C System

The Defence Research and Development Organisation (DRDO) have launched the Indian AEW&C programme that is focussed on the needs of the Indian Air Force. The Centre for Air-Borne Systems (CABS) of the DRDO is tasked with the development of the system and the centre is pursuing the programme with participation of multiple work-centres from within DRDO as well as Indian Industries in the Public and Private Sector.

The Capabilities

The Indian AEW&C system will detect, identify and classify threats present in the surveillance area and act as a Command and Control Centre to support Air Defence operations (Fig.13). The system, with its multiple Communication and Data Links, can alert and direct fighters against threats while providing 'Recognizable Air Situation Picture' (RASP) to commanders at the Ground Exploitation Stations (GES) that are strategically located. The AEW&C system can thus support Air Force in offensive strike missions and assist Forces in the tactical battle area. Besides, the Electronic and Communication Support Measures of the system can intercept and counter unfriendly radar transmissions and communication signals.

Major Sub-systems

The Indian AEW&C system thus comprises a number of major sub-systems (Fig.14), viz., Primary Radar (PR), Secondary Surveillance Radar SSR (or, Identification Friend or Foe - IFF), Electronic Support Measures (ESM), Communication Support Measures (CSM), Mission Communication System (MCS) that includes the 'C'-Band and 'Ku'-Band SATCOM Data Links (DL) and the U/VHF Voice and Data Link, Self-Protection System (SPS), Data Handling and Display System (DHDS) and Mission System Controller (MSC).

The platform aircraft is also augmented with Dual Auxiliary Power Units, Cabin Cooling System, Additional Cabin Fuel Tanks and In-Flight Refueling System to cater to satisfactory performance of the AEW&C Mission System and ensure adequate flight performance compatible with operational requirements.

Primary Surveillance Radar

The primary sensor for the AEW&C will be the indigenous AESA "S"-Band radar with detection range of 300 km against a target RCS of the fighter class of aircraft. Two radiating planar arrays, assembled back-to-back and mounted on top of the fuselage in an Active Antenna Array Unit (AAAU) (Fig.15), will provide nearly 150 coverage on either side of the AAAU. The important modes of operation of the system are the surface surveillance and the air surveillance.

The sensor has the abilities to search, track-while-scan, priority tracking, high performance tracking, etc. In priority tracking, the targets will be placed in full track mode even if they cross the primary surveillance area. In high performance tracking, additional measurements will be made to improve the tracking accuracies. Utilising the active aperture technology, the radar provides a fast-beam agile system that can operate in several modes concurrently. Interoperability with AWACS, other AEW&C aircraft, fighters and Ground Exploitation Stations (GES) is ensured using data-links with voice and data channels.

The cabin houses five Operator Work Stations (OWS). The In-Flight Refuelling (IFR) system enables extended operations over 11 hours. For efficient operation, sufficient rest crew seats are provided.

The Evolving Design Norms

The major AEW&C programmes undertaken with AESA radar by world countries have been detailed in Table-1 placed at Appendix-A. While every design is customised to meet specific military perceptions and budgetary constraints of the user Nation, a general design philosophy is seen to evolve from patterns observed with recent and on-going programmes. A few of those aspects are briefly discussed in the following paragraphs.

'L'-Band Vs 'S'-Band

The dominant AEW&C systems in operation, or under development, have chosen either S-Band or L-Band Radar in an attempt to optimise on range and other functional characteristics. Both the radars are capable of giving a detection range of 300-400km depending on the radiating power provided.

The 'S'-Band solution is compact and relatively lightweight and provides high definition radar picture. This also allows simultaneous operation of both IFF/TCAS and radar. Also, being away from the communication spectrum, the problem of interference is minimised.

Over 120 AWACS aircraft operating in 'S'-Band have participated in military conflicts of recent years and have been highly instrumental in deciding the victory in battles. The 'S'-Band is thus battle-proven to an ample measure.

The Myth of 360°-Azimuth-Scan Capability

The gains of AESA radar (Fig.16) arise essentially from its ability to be fixed on the airframe either conformally on the sides of the fuselage as in G-550 Phalcon configuration, or, externally in a streamlined 'podded' arrangement as in Saab-340 Erieye / B-737 Wedgetail systems. Such a 'low-drag' design brings in considerable gains in operating costs of the platform and exploits fully the 'non-rotating' nature of the AESA radar. (The 'non-rotating' roto-dome of the IL-76 AWACS Phalcon with an AESA radar is an exception in this case and had been adopted from considerations of commonality with the earlier version of IL-76 / A-50 Mainstay with a rotating MSA radar.)

The essentially 'side-looking' AESA radar configurations cover 120-150 degrees on each of the LH and RH sides of the aircraft with the desired full range. The gaps of 30-60 degrees in the forward and aft directions tend to get covered by additional radars in the nose and tail of the aircraft to the extent of only 70% of the design range due to size-restrictions on the arrays in the fwd and aft orientations. When the system is being used essentially as a side-looking surveillance sensor, it offers no operational disadvantages. On occasions, like when the radar is used for support missions like for 'Combat Air Patrol', this aspect of the essentially 'side-looking' AESA radar should be had in mind and suitable manoeuvre tactics employed to overcome the shortfall in the fwd and aft directions.

Conformal-mounting Vs Pod-mounting

In the case of conformal-mounting of the arrays, the large number of T/R modules requires to be accommodated in the aircraft's cabin and the signals taken through low-loss and high-shielding cables to the antenna arrays mounted on the exterior. This arrangement has the inherent disadvantage of large Electro Magnetic Interference (EMI) created due to power leakage from the large number of cables in the cabin. Besides, the hundreds of cables connecting the T/R modules to the appropriate antenna arrays are, on an average, of 3m length resulting in considerable loss of the radiating power. The heat generated by the T/R modules is proportionate to their radiating power and the quantum of heat dissipated into the cabin can also be considerable. An independent cooling system will thus become necessary to keep the battery of T/R modules, as well as other cabin-mounted equipment, within permissible limits of temperature for reliable operation.

In contrast, in the case of pod-mounted installation of the AESA antenna, the problems of EMI, loss of radiation power, requirement for special cooling provisions, etc., that, in effect, add to the power and weight requirements of the system, are drastically minimized, if not totally eliminated. The cooling of the battery of T/R modules in this case is conveniently achieved using the ram-air tapped from the free stream of atmosphere.

Elevation Scan Helps Retain RASP During Turns

Providing some Elevation-Scan capability, like ±10°-17°, to the AESA radar has been found to be useful to automatically stabilise the RASP during mild roll-oscillations of the aircraft as well as during shallow turns. Even on occasions like a quick 180°- turn, when the bank angle of the aircraft had to exceed the built-in ±10°-17° elevation-scan capability, it helps to reduce the duration of loss of the RASP and in its quick recovery.

Incidentally, an analytical study has proved that the duration of loss of RASP during steep turns is about the same for AESA radar irrespective of it being a '300° Side-Looking' type or with a '360° all-around vision'. This breaks the myth of the radar with '360° vision' being superior to the Side-Looking radar with '300° vision.

Conclusion

Considerable thought has gone into arriving at the configuration design of the Indian EMB-145 AEW&C system to make the EMB-145 platform aircraft and the AEW&C Mission System a win-win combination to realise a compact and optimal surveillance system that fulfills the Air Force's requirements fully and cost-effectively.

Appendix-'A'

Table-1: AEW&C systems with AESA radar

Sl. No.	Parameter	Saab-340 AEW&C, *Argus*, Sweden	EMB-145 AEW&C, Brazil,	Gulfstream G-550 CAEW, Israel	B-737 AEW&C, *Wedgetail*, Australia	IL-76 *Phalcon* AWACS, India	Indian EMB-145 AEW&C, India
							
PLATFORM CHARACTERISTICS							
1	**Prime Contractor for Platform / Mission System**	Saab Scania, Sweden /Ericsson, Sweden	Embraer, Brazil / Ericsson, Sweden	Gulfstream Aerospace, USA; ELTA, Israel	Boeing, USA / Northrop Grumman, USA	Briev aircraft Co., Russia / ELTA, Israel	Embraer, Brazil / Defence R&D Organisation, India
2	**User Countries (Number Delivered, or, Ordered)**	Sweden (6) Japan, Pakistan (6)	Brazil, Mexico, Greece,	Israel, Singapore	Australia (4+2), Turkey (4), Korea	India (3+3)	India (3+3)
3	**Platform Aircraft Type**	Twin-engine Turbo-prop Cityliner	Twin-engine Regional Jet	Twin-engine Long Range Executive Jet	Twin-engine Medium Range Business Jet	Four-engine Strategic Jet Transpot	Twin-engine Regional Jet
4	**Max Take-Off Weight, (Tonnes)**	13.2	24.0	41.3	79.0	170.0	24.0
5	**Operational Cruising Speed, (M No. / KTAS)**	- / 160	0.8 / -	- / 488	0.78 / 453	- / 432	0.8 / -
6	**Endurance (hr)**	5-7	> 5	9	> 9	7.7 (Extendable with In-Flight Refuelling)	5 (Extendable up to 11 with single In-Flight Refuelling)
7	**Service Ceiling (ft AMSL)**	25,000	35,000	51,000	41,000	42,700	35,000

Appendix-A

AEW&C MISSION SYSTEM CAPABILITIES							
8	**Primary Radar**	Ericsson *'Erieye'*	Ericsson *'Erieye'*	ELTA Conformal Airborne Early Warning (CAEW)	Multi-Role Electronically-Steered Array (MESA)	ELTA *'Phalcon'* Phased Array, All-weather, Day & Night,	DRDO Active Electronically-Steered Array (AESA)
9	**Frequency Band**	'S'-Band	'S'-Band	'L'-Band on the sides and 'S'-Band in the 'fwd' & 'aft' directions	'L'-Band	'L'-Band	'S'-Band
10	**Radar Coverage in Azimuth (Degrees)**	240°	240° plus limited coverage for 60°	240° plus limited coverage for 120°	240° plus limited coverage for 120°	360°	240° plus limited coverage for 60°
11	**Mission Operator Work Stations (Number)**	3	5	5	6	8	5
12	**Other Sub-systems**	IFF, ESM,	IFF, ESM,	IFF, ESM, U/VHF & HF, SATCOM, SPS,	IFF, ESM, SPS, CSM, SATCOM, Data Link	IFF, ESM, CSM, U/VHF & HF, SPS,	IFF, ESM, CSM, U/VHF & HF, 'C'-Band Data Link , 'Ku'-Band SATCOM, SPS,
13	**AEW&C Mission System Crew Seats (Number)**	3 Reserve Seats: NIL	5 Reserve Seats: 3	5 Reserve Seats: NIL	6 Reserve Seats: 10	8 Reserve Seats: 12	5 Reserve Seats: 7

Fig.2 E-3 AWACS

Fig.1 E-2 Hawkeye

Fig.6

Fig.3

Fig.7 Saab-340 AEW&C, Sweden

Fig.4

Fig.8 EMB-145 AEW&C, Brazil

Fig.5

Fig.9 G-550 CAEW, Israel

Fig.10 B-737 AEW&C, Wedgetail, Australia

Fig.11 IL-76 AWACS, India

Fig.12

Fig.13 Indian EMB-145 AEW&C, India

Fig.14

Fig.15

Fig.16

MRF ENTERS AVIATION SECTOR

MRF, the largest Tyre manufacturer in the Country, has decided to enter in the sophisticated area of developing and manufacture of aviation tyres. This sector requires advanced technology and huge investment in development, testing and production.

MRF was encouraged by the approval given by Centre for Military Airworthiness Certification (CEMI-LAC) and Regional Centre for Military Airworthiness (RCMA) for supply of tyres for Chetak Helicopters manufactured by Hindustan Aeronautics Limited (HAL). Production of these aviation tyres will be established at MRF's Medak Facility located in Andhra Pradesh.

The product, branded as (**Aero Muscle**), had been tested rigorously under International Standards and norms set by authorised Government Agencies.

The type size os 355 x 150 4 ply tyre is an outcome of MRF's in-house development through the MRF R&D facility based in Chennai. The critical raw materials are sourced from overseas suppliers.

The test tyres were subjected to ground tests initially to meet with the various mandatory safety and performance parameters established by the Government Agencies and the Certifying authorities. After the successful completion of the ground trials, the tyres were cleared for flight trials. On successful completion of the flight trials the governing body/certifying authorities have issued a prototype along with the provisional certificate for the commercial production of these tyres.

Besides HAL, the other prospective customers for these tyres are the Indian Defence Service - Air Force, Navy, Coast Guard etc. This product will also be marketed to the private sector in the Indian and International markets. Preliminary enquiries have ben received from International Companies in the Aviation Sector.

(See Advt : Page No.)