NH90 - The Future All-Services Helicopter

by

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Abstract

The NH90 project formally started in September 92 when the four nations France, Germany, Italy and The Netherlands agreed on a contract with NHIndustries on the design, development and qualification of an 8 - 9 tons class helicopter which shall replace the present fleet of light transport and naval helicopters in the various military services of these states.

The NH90 comprises two versions that are based on a Weapon System Development Specification for a Tactical Transport Helicopter (TTH) and a NATO Frigate Helicopter (NFH). The design of the NH90 follows the principle to have as much as possible common basic systems and subsystems in both versions, and to utilise a high level of avionic systems integration to provide the capabilities to carry out the required tactical missions with a minimum of crew and crew workload.

Consequently, Structure, Dynamic, General Vehicle, and Flight Control Systems, Core Avionics, and Mission Equipment are principally common features for both weapon systems. The integration of two specific Mission Systems, on the other hand, provides the capabilities to employ both versions with a high rate of efficiency in their individual roles: The TTH in Tactical Transport for air forces and armies, and the NFH as a ship embarked Anti Submarine/Anti Surface Unit Warfare (ASW/ASUW) for the navies, both with the potential for a variety of other missions. The various subsystems of both Mission Systems, use most modern equipment for acquisition of mission relevant information and data, their processing, their transformation and display and provide automatic actions or advise to initiate adequate crew reactions.

Prototype Nr.1 of the NH90 had its successful maiden flight on December 18, 1995, and has since then achieved over 36 hours dedicated mostly on tests of handling qualities and general flight behaviour in altitudes up to 10.000 feet with speed of over 180 KTS. The tests are proceeding according to the plan, and the results until now are very promising.

A. Background of the NH90 programme, Operational Concept and User Needs

The beginning of the NH90 programme reaches back into the early eighties when several NATO members expressed their need to have a new ship embarked and a tactical transport helicopter. F, GE, I, NL - until May 87 also the UK - studied the feasibility of the project, worked on its predefinition and finally on the respective NATO Staff Requirement for a 8 - 9 tons Class rotorcraft in versions as a

- Tactical Transport Helicopter (TTH)
  and
- NATO Frigate Helicopter (NFH).

In September 92 the NATO Helicopter D&D, Production and Logistic Management Agency (NAHEMA), the International Project Office (of the Officials), and its industrial counterpart, N.H. Industries (NHI), subcontracting to Eurocopter France, Agusta, Eurocopter Deutschland and Fokker, signed a contract on the design, development and qualification of the NH90 which comprises the two mentioned versions.

The design of the NH90 was to be based on two major principles: Firstly, to have as much as possible common basic systems and subsystems in both versions. Secondly, to utilise a high level of avionic systems integration to be able to provide the capabilities to carry out the required tactical operations with a minimum of crew and crew workload. This performance has to allow single pilot

tactical operations at day and at night, in low level, as well as in adverse weather conditions, including maximum continuous icing, and under IFR in IMC.
With the integration of specific Mission Systems and optional equipment the NH90 can be used e.g. for

- Tactical Transport
- Heliborne Operations
- Search and Rescue
- Parachuting
- Casualties Evacuation
- Anti Submarine Warfare, (ASW)
- Anti Surface Unit Warfare, (ASUW)
- Vertical Replenishment (VERTREP)

B. Description of NH90 Common Features

The NH90 is a single main rotor helicopter with a conventional tail rotor. Power is supplied by two engines installed in a semi-pod arrangement behind the Main Gear Box (MGB) on the upper deck.

Structure

The structure consists of an carbon fibre all-composite, crashworthy fuselage with a constant cross-section centre fuselage part. The use of metals is limited to the engine section, to load introduction elements, fasteners and moderately loaded joints and particular elements. A tricycle type retractable Landing Gear is installed in the centre and - with the nose wheel - in the forward fuselage module. It can withstand vertical landing rates of descent down to 4m/s without damage, and will dampen a rate of 6m/s so that the main structure will not suffer any damage.

The cabin minimum usable height is 1.58m in the central part, and 1.53m for the rest of the cabin height. The cabin minimum usable width is 2m.

On both sides of the center fuselage there are sliding doors with a length of 1.60 m and a height of 1.50m.

The shape of the structure is compatible with the installation of a rear ramp 1.78m wide and 1,58m long.

The primary structural items incorporate materials, stress levels and configurations suitable for a damage tolerant design. Whenever damage tolerant design is not possible, safe life design shall be implemented to satisfy minimum useful lives of 10.000 FH life over 30 years in-service use.
Armoured and unarmoured crashworthy seats can be used interchangeably as the Pilot's and Copilot's seats.

Dynamic System

Two types of FADEC controlled engines will be available: The Rolls Royce/Turbomeca RTM 322 or the General Electric/Alfa Romeo GE T700-T6E. They provide around 1260 kW each for max. continuous operations. In addition to the MGB, there are two accessory gear boxes on the upper deck. One, the AGB, is mounted to the rear of the MGB, and the other, the Remote Accessory Gear Box (RAGB), to the deck in front of the MGB. On ground, an Auxilliary Power Unit (APU) drives the RAGB, to provide electrical and hydraulic power and air conditioning to the rotorcraft.

The Main Rotor of the NH90 is of the "hinged" spheriflex type with a diameter of 16,3m. Each blade is hinged in pitch, flap and drag on a single elastomeric spherical thrust bearing secured to the rotor hub. The blades, also composite type with multi-box structure and mixed glass-carbon skin, are all equipped with heating mats which can be activated when the ice protection kit is installed. A blade folding system is provided and operated automatically in the NFH and manually in the TTH.

General Vehicle Systems

The Electrical System is designed according to the more stringent requirement of the NFH. There are three alternators, two of them driven by the MGB and one driven by the RAGB. In addition to the DC provided by the two batteries, there is a DC generator as an emergency system also driven by the RAGB.

The Hydraulic System, in particular, reflects the high standard of safety of the NH90. The redundant Flight Control (FC) hydraulic system consists of two separate and independent circuits. In addition, an independent Utility System provides hydraulic power for Landing Gear and ancillary operations. Each of the two FC circuits provides hydraulic power to perform flight control and stability functions. In case of failure one circuit can be supplied with power of an electrically driven pump, normally used as an auxiliary (back-up) hydraulic power generation unit, while the other circuit is permanently supplied in parallel by an AGB driven pump of the Utility System.

The Fuel System comprises crash resistant tank cells in the cabin floor which provide a capacity for a range of 800 km / 1.000 km (TTH/NFH). Pressure refueling port, hover-in-flight refueling and dumping capabilities provide possibilities for quick reaction in extraordinary situations.

The Ice Protection System allows the NH90 to be operated in continuous maximum icing conditions. The system comprises two elements: The fixed parts which are included in the basic vehicle, and the removable parts, grouped in a kit that can be installed when the ambient conditions ask for it.

For the main and tail rotor blades de-icing resp. anti-icing heating mats are located under the metallic erosion shield which is bonded on the blades' leading edges. These zones are energised sequentially and produce chord wise ice shedding or prevent ice accretion respectively.

The leading edge of the horizontal stabiliser is de-iced by periodical activation of a pneumatic boot which is pressurised and depressurised by an autonomous de-icer pack installed in the tail section.

The Environmental Control System provides heating of cabin and cockpit using bleed air from the engines, and cooling by cool air produced by a vapor system. Two identical, totally independent units are installed in the rotorcraft. The two condensers are located side by side on the upper deck, forward of the MGB on the left side of the rotorcraft. The two compressors are mechanically driven by the transmission. One is installed on the rear of the MGB, and the second is mounted on the RAGB.

This architecture allows the individual control of the climate in cockpit and cabin which shall lead to comfortable air conditions.

Flight Control System

The Flight Control System (FCS) of the NH90 is based on a redundant Fly-By-Wire (FBW) system with no mechanical back-up. It consists of two subsystems:

- The Primary Flight Control System (PFCS), which provides the helicopter with control and stability capabilities, and
- the Automatic Flight Control System (AFCS), which provides the appropriate modes of operation for the HANDS-OFF flight required by the mission.

To meet the stringent safety objectives, (which allows only a probability of the occurence of any catastrophic failure condition in the PFCS of less than 10^{-9}/FH) the PFCS architecture is based on the following elements:

- A digital control processing, composed of four digital channels packaged into two digital duplex computers. This digital section processes the axis control signals in normal FCS operation and provides the Handling Quality enhancement.
- An analog control processing, composed of four analog channels packaged into two duplex analog computers.

The AFCS is constituted of two duplex digital computers, located one per avionic bay. While the basic three axis attitude hold mode is performed by the PFCS, the AFCS provides full HANDS-OFF capabilities which includes operating modes from Vertical Speed Hold to Transition Down / UP, and from Go-Around to three-dimensional Navigation, to name only a few.

Core Avionic System

The Core AvionicSystem is a common system for both TTH and NFH which has to fulfill the following main functions:

- Management of the multifunction control and display units
- Management of basic (common) external and internal communications
- Management of the navigation and guidance functions
- Monitoring and check-out of avionic systems,
- Monitoring and check-out, where applicable, of vehicle systems

The Core avionic architecture is built essentially on a dual redundant digital data bus, the Core Data Bus. The Core System is designed in a way that it is not flight critical. Therefore, dedicated links are used expecially for those functions that are related to safety aspects. These dedicated links (e.g. between FCS and the Navigation System) allow the crew to fly the helicopter with the same level of safety also in case of complete failure of the Core Bus system.

The following subsystems belong to the Core System:

The Avionic Control System (ACS) is the management body of the Core System. It controls the Core Data Bus and the Core equipment using the Core Management Computer (CMC) and the Display and Keyboard Unit (DKU). The DKU is one of the major input/output devices of the avionic system. Crew commands are directly inserted and systems data are displayed.

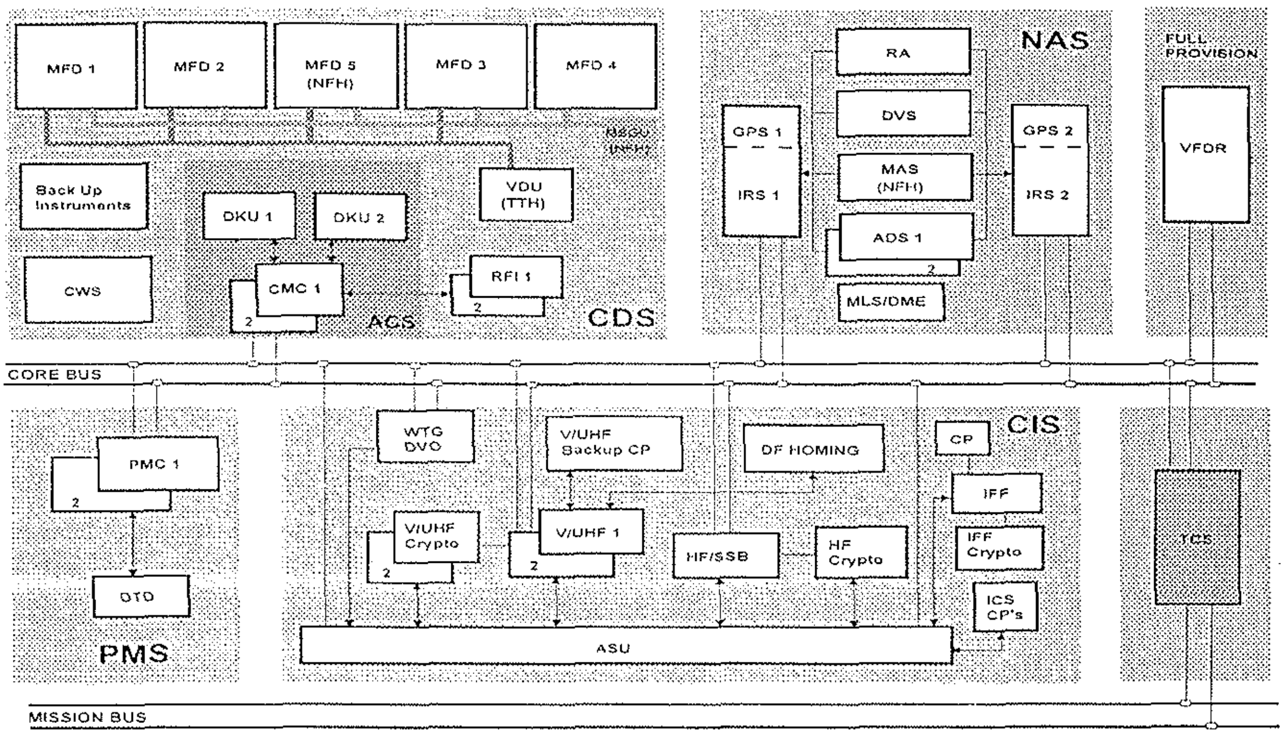
The Control and Display System (CDS) allows to display information and to receive commands from the crew. Information are received from the FCS, the Core and the Mission System. All Core video formats are generated by the displays themselves which are equipped with their own symbol generator. The NVG compatible CDS consists of:

- 4 (5 for NFH) Multifunction Displays (MFD) including symbol generators; size 8" x 8" useful area,
- 1 Central Warning System (CWS) including a Warning Management Computer (WMC),
- 2 Remote Frequency Indicators (RFI),
- 1 set of (conventional) back-up instruments.

The Communication and Identification System (CIS) allows simultaneous communication in clear and secure voice and gives acoustic warning and identification tones to the crew. In detail it consists of :

- An Intercommunication System (ICS) with a Direct Voice Output (DVO) and a Warning Tone Generator (WTG).
- An External Communication System with
  - 2 V/UHF radios;
  - 1 V/UHF Direction Finder/Homer;
  - 1 HF/SSB;
  - 1 IFF Transponder plus mode S.

CORE AVIONIC SYSTEM



The main capabilities include:

- Access of all air crew members to External Communication
- Distribution of audio signals to air crew members generated by avionic equipment and mission sensors
- Generation and distribution of audio voice messages and warning tones
- DF/Homing capability provided by the V/UHF transceivers
- Automatic radio relay
- ECCM Capabilities

The Navigation System (NAS) generates guidance and navigation data using autonomous and radio navigation equipment. The NAS data are available for display, for the FCS and for the Mission System.

The NAS shall consist of :

- Inertial Reference System (IRS) including Global Positioning System(GPS),
- Doppler Velocity Sensor (DVS),
- Radar Altimeter (R/A),
- Air Data System (ADS),
- Microwave Landing System (MLS),
- Distance Measuring Equipment (DME-P).

The NAS includes the following functions:

- Initialization and management of the navigation and guidance capabilities
- Computing of navigation data parameters
- Basic navigation data performance
- Alignment capabilities
- Updating capabilities
- Low air speed capabilities
- Guidance computation
- Flight plan management

The incorporation of the GPS will improve the relative position and accuracy. During periods when GPS fixes are not available the necessary navigation data will be provided by the autonomous navigation subsystem.

The Plant Management System (PMS) interfaces the helicopter's plant sensors and the Avionic System to acquire, format and process vehicle and avionics data.

The PMS consists of

- two Plant Management Computers (PMCs) and
- one Maintenance Data Transfer Device (DTD).

The two PMCs are connected as remote terminals to the Core Data Bus, and linked together by means of dedicated serial links. The Maintenance DTD can also be used for tactical operation in case of failure of the "Mission DTD".

The PMS provides the following main functions:

- Management of vehicle systems alarms;
- Monitoring and diagnostic functions;
- Maintenance Data Base management;
- Helicopter performance computation;
- Flight Report management;
- Check list management;
- Information display;
- Provision of data for VFDR.

The Helicopter Performance Computation function provides the crew with the information of how the helicopter is operating or it can predict how the helicopter may operate in a given situation. The goal of this function is to replace the performance flight manual with a computerized means in order to reduce crew workload and support the crew in mission-oriented decision making.

Hence, there will be made available

- Cruise Capability,
- Cruise Performance,
- Hover Capability,
- Hover Performance,
- Climb Capability,
- OEI Cruise Performance,
- OEI Hover Performance,
- Safe Heights and Fly Away Performance.

The Flight Report Management comprises the establishment of a flight report after each flight. This report, initiated by crew command will be sent to the CDS for display. The crew will have the possibility to add comments to the report, using the DKU keyboard. The complete flight report will then be sent back from the CMC to the PMC to be stored there.

Monitoring and Diagnostic Functions

The NH90 Monitoring and Diagnostic System (MDS) is an integrated capability provided at helicopter level, which is based on the interface with the various monitored equipment and subsystems of vehicle and avionic system including Core and Mission System.

The MDS coverage of the avionics uses the inherent monitoring and diagnostic capabilities provided by each avionic equipment or sub-system as part of its own Built-In-Test capabilities. These information will be processed to provide wherever possible diagnosis and prognosis information.
The main objectives of the MDS are to increase availability, minimise costs and logistic support, enhance flight safety and avoid failures as far as feasible.

For that aim the system has to provide failure detection, failure isolation data, crew alerting and advice, and storage of data into the Maintenance Data Base (MDB) and the Data Insertion Device (DID).

This will be achieved by applying wherever feasible pre-flight tests, in-flight monitoring and diagnostic, and supports post-flight diagnostic, and where feasible prognosis.

The PMS is the key element of the MDS architecture:

- It provides the interfaces with the vehicle plants and systems as well as the avionic system, including signal conditioning for discrete, analog and digital inputs.
- It provides the acquisition of the MDS relevant data which are:
  - Pre-processed to be made available for crew presentation by means of the CDS,
  - pre-processed and stored in a format suitable for maintenance purpose and post-flight analysis.
- It interfaces the CDS for the presentation to the crew of MDS data and entry/editing of MDS relevant parameters,
- it interfaces the WTG and the DVO to provide the crew with MDS relevant aural alarms and messages,
- it provides up/down-loading of the MDS data (which are acquired and stored in the PMCs) via the maintenance DTD (or Mission DTD in case of failure of the maintenance DTD) and/or the maintenance ports provided in the PMCs.

Mission Equipment

The Mission Equipment, usable in TTH and/or in NFH comprises:

- up to 20 light weight, side facing, crashworthy troop seats,
- up to 12 stretchers,
- a Rescue Hoist,
- a Cargo Hook,
- two Heavy Store Carrier for external loads like missiles, fuel tanks, and a
- Parachuting kit,
- Floatation gear,
- Harpoon (NFH only).

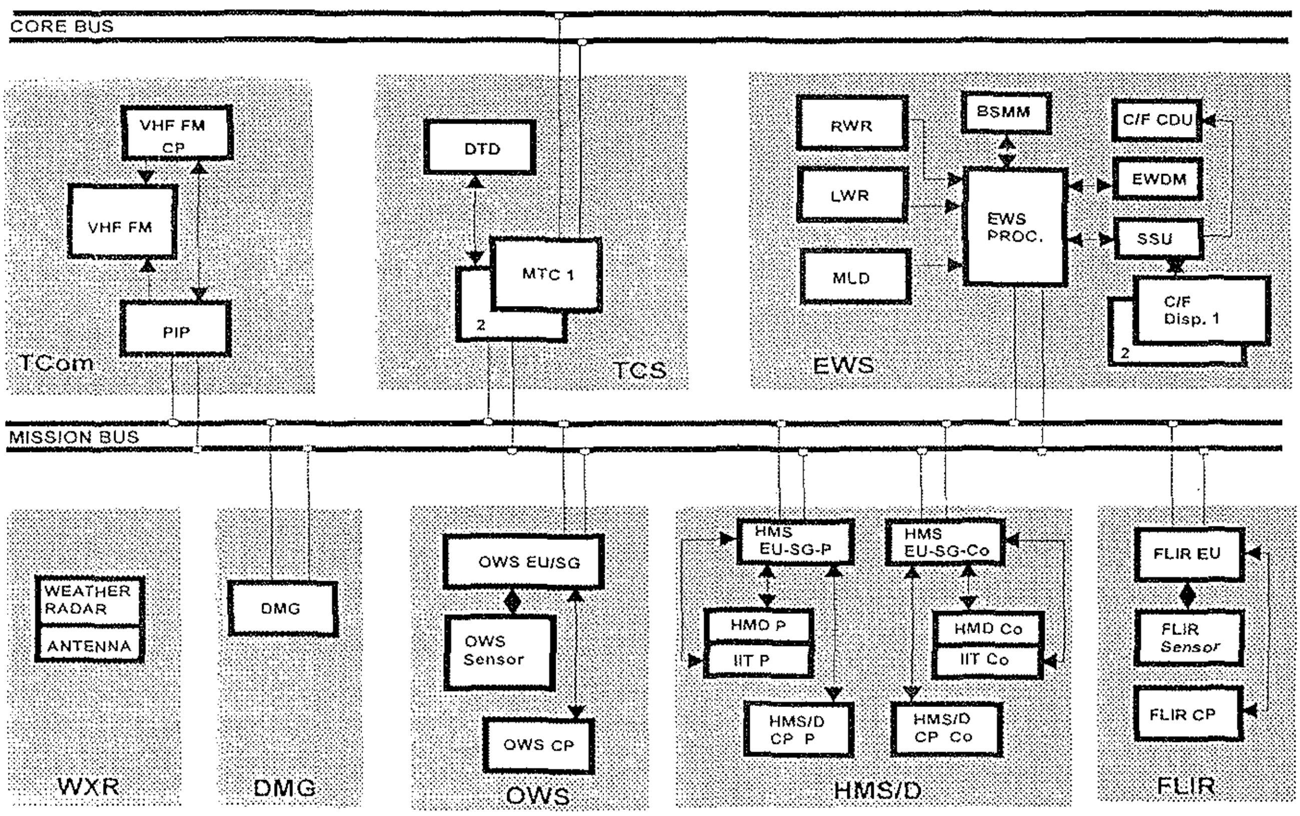
C. TTH Mission System

The primary mission of the TTH requires the helicopter to perform tactical transport of troops and material at day and at night, in low level down to a Nap-of-the-Earth (NOE) profile, also in adverse weather conditions and close to the FEBA. With special equipment additional missions like Search and Rescue (SAR), casualties evacuation, parachuting and others can be performed. The TTH Mission System (TMS) described in the following shall provide the crew with the means to execute these missions successfully.

The TMS comprises

- ❑ Tactical Control System (TCS)
- ❑ Electronic Warfare System (EWS)
- ❑ Dedicated Mission Flight Aids (MFA)
- ❑ Tactical Communication (TCom)

TTH MISSION SYSTEM



The TMS communicates with the Core System via the CORE Bus, video lines, and dedicated lines.

The crew has access to the TMS via DKU and MFD selections of the Core System and via dedicated and specific control panels allocated to the TTH Mission System. The main displays of the TMS are the MFDs, the DKUs and the HMDs. Certain information for TMS shall also be available on dedicated TMS Control Panels.

Tactical Control System

The Tactical Control System of the TTH consists of two Mission Tactical Computers (MTC), a TTH DTD and a TTH DID, and a dual redundant TTH Mission Bus.

The main functions of the subsystem are to manage the overall Mission System e.g. Mission Bus control, frequency management, initialisation/reinitialisation) interface with the Core System, generate the tactical situation (e.g. flight plan management, feasibility calculation), and record and up/down-load tactical/mission data.

Electronic Warfare System

The Electronic Warfare System consists of radar sensor, laser sensor , missile launch detector, one EWS processor with a threat library, a blanking management module, and a Chaff/Flares Dispenser unit with two cartridge dispenser modules and a cockpit control unit.

The EWS shall detect, identify and classify radar transmitters, laser transmitters and missile launches and their related weapon systems. Threats will be displayed, warnings are generated and appropriate countermeasures will be activated.

The EWS shall determine the priorities of threat information (radar, laser or MLD) in accordance with the priority levels stored in the library. Furthermore, for acoustic warning of the air crew a discrete signal which corresponds to the specific type of threat will be generated by the EWS.

The appropriate counter-measures are contained in the threat library. Upon identification of a threat, the EWS processor shall provide the counter-measure program to the C/F-Dispenser Unit which can be activated manually, semi-automatically and automatically. In the automatic mode countermeasures are initiated by the EW processor and executed by the C/F D unit without operator interaction. The flight crew is informed via MFD indication and warning management.

Mission Flight Aids

The TTH Mission Flight Aids in particular, provide sensors and navigational support to perform the tactical mission by day and night and in case of reduced visibility.

The MFA comprise the Vertical Situation Aids which are the Helmet Mounted Sight and Display (HMS/D) for Pilot and Copilot, combined with an Image Intensifier Tube (IIT) included within an integrated helmet system, the Forward Looking Infrared (FLIR), and the Obstacle Warning System (OWS), and the Horizontal Situation Aids which include the Digital Map System (DMS), and the Weather Radar (WXR).

The Helmet Mounted Sight and Display consists of HMS sensing and receiving devices for the Pilot and Copilot, two binocular helmet displays, two HMD EUs including symbol generators, and dedicated control panels. The system will provide pilot and copilot with visual aids for missions during day and night and/or reduced visibility.

The two HMS/D sets operate independently from each other. The display is integrated in the pilot's/copilot's helmet which enables the presentation of an image generated by two Cathode Ray Tubes (CRT) and an image generated by the two IITs at night. The CRTs present the FLIR image and/or the symbology. The symbology will be superimposed onto the FLIR image during day or night or the symbology is displayed only during the day. To calculate the symbology parameters the symbol generators use navigational data (like those of the MFD Primary Flight Display (PFD) via the MTC. In addition, they generate - independent from each other - also flight and warning symbology. Pilot and Copilot will be able to select for presentation on their HMD the different symbologies, the FLIR image, the IIT image, and a combination of all images.

The Forward Looking Infrared is an electro-optical sensor installed in the nose of the TTH. It consists of FLIR camera/electronics, a FLIR platform, and FLIR Control Panel.

The FLIR camera-sensor detects terrain IR radiation and generates an electronic FLIR image. This FLIR image video is sent to the HMD/SG for display on the HMD and to the VDU for display on the MFD, depending on selection by the air crew.

The FLIR platform carries the FLIR sensor and slaves it to the directions commanded by the HMS Line-of-Sight calculation, by manual steering inputs or in a fixed position. No roll angle compensation is foreseen. The platform shall also allow look into turn capability.

The Obstacle Warning System shall detect obstacles in front of the helicopter which otherwise cannot be seen with visual means of the crew, i.e. eyes or eyes armed with NVG or FLIR optronics. It shall be based on the RADAR or LASER principle.

The OWS may consist of the a sensor head, a platform with associated electronics, an electronic unit for sensor and processing and the OWS control panel.

The transmitting device shall allow emitting electromagnetic power (radio frequency or laser) to beam on obstacles (including wires) especially such that protrude into the flight path. The transmitting device shall scan the terrain in front of the h/c. For turn coordination a flight vector oriented calculation shall be provided which shall be based on data received from the NAS.

The receiving device shall detect the obstacles. It shall process the signals to determine the slant range, bearing and elevation of the obstacle in relation to the helicopter's longitudinal datum or its course. The OWS shall provide to the HMD parameters suitable to display a vertical situation.

At this point it is to note, that according to the results of the tendering process we are, for the moment, not in a position to definitely select of the systems offered due to the fact that some aspects of our requirements could not be fulfilled by potential suppliers.

The Digital Map System comprises two digital raster and vector map generators (DMG) to provide the display of topographic information also combined with aeronautical and selected tactical overlays. Each of the DMGs shall generate independently the above map images. These images are NVG compatible. For storage of digital map and mission data base a common map data storage device will be provided for both DMGs.

The functions of the DMGs include the generation of raster/vector maps, the generation of mission related overlays, the generation of aeronautical (IFR/VFR-enroute, approach and departure) charts, and the possibility to edit prepared/preplanned mission related overlays.

Each DMG will generate map images in different scales betweeen 1/1.000.000 and 1/50.000.

It is possible to zoom the maps and to move to an area outside the actual area overflown. The presentation on the maps is calculated in two or three dimensional and polychromatic cartographic representation.

In addition, the DMGs are able to generate maps showing the h/c present position in different orientations which are e.g.

-fixed h/c present position in the center of the display and a moving map,
-fixed h/c present position in the bottom of the display and a moving map,
-map orientation with north in the center or bottom up direction of the display,
-map orientation with track in the center or bottom up direction of the display,
-fixed map in north up orientation and a moving h/c symbol.

The DMGs shall allow the insertion of symbols for mission overlays, to superimpose these symbols to the pure map and to generate a combined output. In addition, depending on selected IFR/VFR data the DMGs shall allow the presentation of aeronautical charts without map and overlay incorporation. It shall be possible to edit each preplanned/prepared overlay by using the map as background information.

The Weather Radar subsystem consisting of an antenna/antenna drive unit and a transmitter / receiver / electronics unit, shall provide the functions

- Weather Avoidance Mode,
- Ground Mapping/Search Mode,
- Beacon Mode.

In the weather avoidance mode the WXR detects radar transmitter reflections from weather characteristics for

- rain cloud formations and qualitative rain intensity ,
- detection of atmospheric disturbances and zones of calm and stormy weather,
- detection of areas of icing conditions.

The Ground Mapping/Search Mode on the WXR provides the capability to detect and display surface characteristics. The search mode permits ground mapping or search for topographical features like prominent landmarks and waters, natural and man made landmarks, islands, higher bridges etc..

The Beacon Mode on the WXR provides the capability to interrogate, detect and decode pulses from beacon transponders. Beacon symbols are presented on the display at the appropriate range and bearing and scaled to the selected range scale.

VHF/FM Tactical Radio

For tactical communication with ground forces the TTH is also equipped with a dedicated VHF/FM Tactical Radio.

The radio is integrated in the TTH Mission System. Management of frequency and channel plans as well as tactical information like predefined radio silence periods etc. are performed by the MTC.

The transceiver covers the 30 - 88 MHz band. For security this tactical radio provides frequency hopping and secure voice functions. A separate control panel allows the operation in stand-by mode on battery power.

D. NFH Mission System

The NFH Mission System (NMS) has been designed to meet the stringent requirement to perform ASW and ASUW missions using a crew constituted by only three crew members: One Pilot, one TACCO and one SENSO. The large variety of sensors on board and consequently the large amount of information to be managed by the crew are imposing the use of key design features to reduce the crew workload as much as possible.

General Architecture

The NMS is the result of a high level of integration between mission avionics, mission sensors and armament, as required to provide mission effectiveness and high probability of mission success.

The NMS consists of the following subsystems and equipment:

- Tactical Control System (TCS)
- Data Link-11 System
- Naval RADAR
- IFF Interrogator
- SONICS System
- Magnetic Anomaly Detector (MAD)
- Electronic Warfare System (EWS)
- Tactical FLIR
- Stores Management System (SMS)
- Data Recording System
- Stores and weapons

The NMS avionic architecture is also built essentially on a dual redundant digital data bus (Mission Data Bus). It assures at the same time a high level of functional integration and an adequate flexibility to follow the progressive development of the NMS, its possible future upgrades and/or customisations.
The interface between the Mission Bus and the Core Bus is provided through the Mission Tactical Computer (MTC) which is connected to the Mission Bus as Bus Controller (BC) and to the Core bus as Remote Terminal (RT).

Tactical Control System (TCS)

The TCS is the heart of the NFH mission system. It integrates all mission sensors, communication & navigation data and air-vehicle information which are necessary to compile the tactical situation and to perform the assigned mission.

The TCS provides:

• Operator Interface Management, which is characterised by:

- Maximum level of functional integration so to minimise the number of operations which are requested from the crew to perform a specific task.
This has been achieved by using automatic procedure, an extensive use of graphic aids and direct interactions on the tactical presentation.

- Simplified management of controls and presettings and easy access to information.

- Use of advanced man-to-machine interaction concepts such as Interactive Dialogue Window (IDW) (possibility to have direct access to items' information selected on a graphical tactical situation presentation) and Summary Tables (ST) (possibility to summarise the status of one or more sensors or equipment involved in a specific function).

The TCS will manage the MFD presentation which can be graphical, totes, summary tables and sensors presentations.

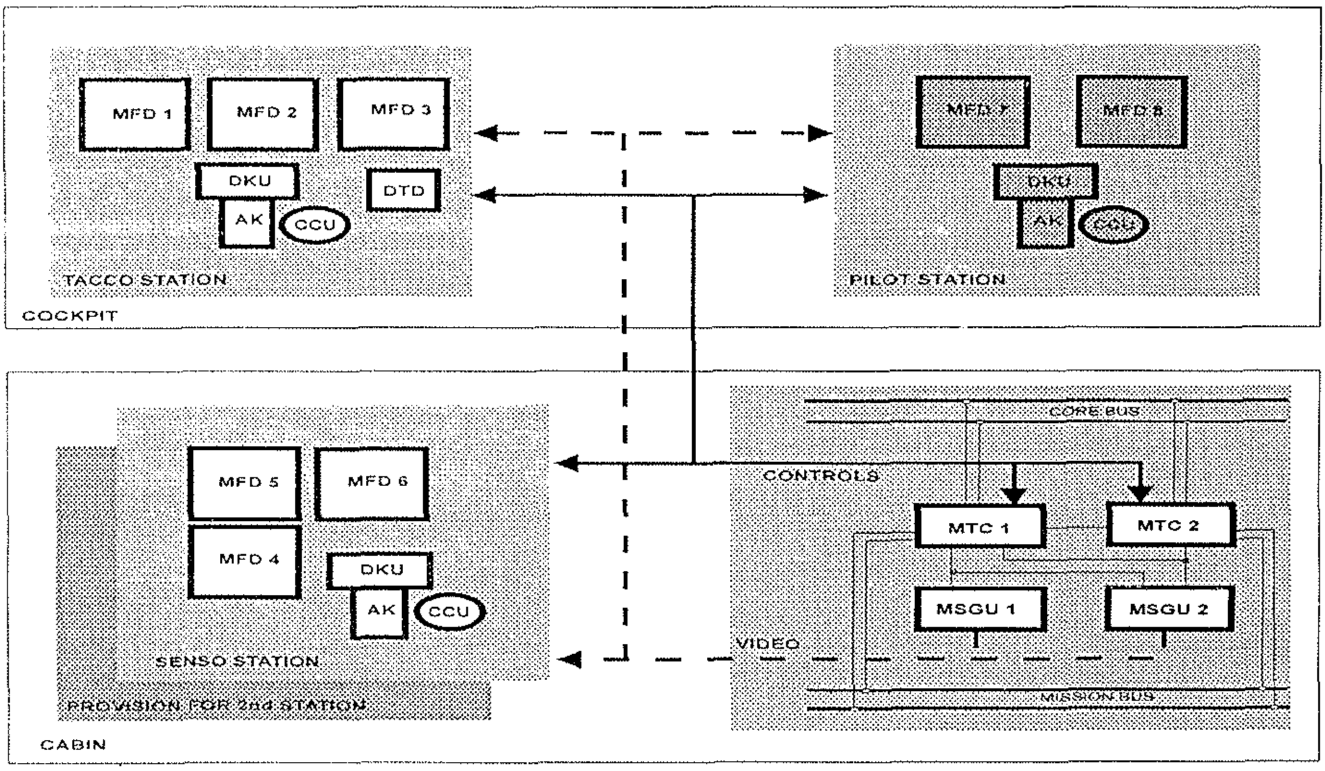
• Tactical Communication Management

For this purpose the TCS supports the crew in managing the EMission CONtrol (EMCON) and COMmunication PLAN (COMPLAN), pre-defined and downloaded via Mission DID.

• Tactical Navigation Management

For this purpose the TCS supports the crew in managing tactical flight plans.

NFH TACTICAL CONTROL SYSTEM



• Tactical Situation Compilation

The compilation and the management of the tactical situation is the key element to keep the crew in tactical situation awareness condition and is also the main function of the TCS.

Information coming from the on board sensors, from Link 11 and from the intelligence shall be correlated and managed to build the so called "tactical situation".

To reduce the operator workload the TCS supports the crew by providing:

- Point Tracks management;
- ESM Bearings and Fixes management;
- Acoustic Bearing and Fixes management;
- Tactical library management;
- Dead Reckoning of tracks;

• Tactical Data Base (TDB) Management

• Mission Feasibility

The TCS supports the crew (mainly TACCO) to estimate the feasibility of an assigned mission, in term of residual time and fuel autonomy. This capability is provided to reduce the crew workload and not to substitute the crew's decision making process since the uncertainty of the parameters involved in the calculation makes it limited in reliability.

When the result from the calculation is a non feasibility condition then the system tries to propose to the operator flight plan modifications necessary to accomplish the mission.

• Attack Phase Management

The TCS supports the crew to perform the attack phase of the mission which can be a direct attack or an indirect attack (Over The Horizon Targeting execution).

• Mission Recording Capability

The NFH mission system provides an in flight mission data recording and retrieval capability.
A post flight data retrieval is also provided for mission debriefing and training purpose.

Mission Sensors

The NFH is equipped with a Tactical RADAR allowing surface surveillance, fire & forget missile launching, navigation and weather surveillance.
The RADAR provides a 360° azimuth coverage, a Track While Scan (TWS) processing and (desirable) a target recognition capability (radar silhouette - ISAR).

The EW System (EWS) is used for passive surface surveillance and self protection. It consists of Electronic Support Measurement (ESM) and Chaff & Flares countemeasures.

The ESM provides detection, localisation, tracking, identification and classification of RF emissions;

The Tactical FLIR supports the crew to detect, locate and identify targets at night and in limited visibility conditions, at ranges that would otherwise be impossible when using other sensors or visual surveillance without the risk of exposing the own presence.

The Sonics System is used for subsurface surveillance: underwater active and passive targets detection, localisation, classification and tracking.
It consists of two major functional elements: the Dipping Sonar and the Sonobuoys systems.

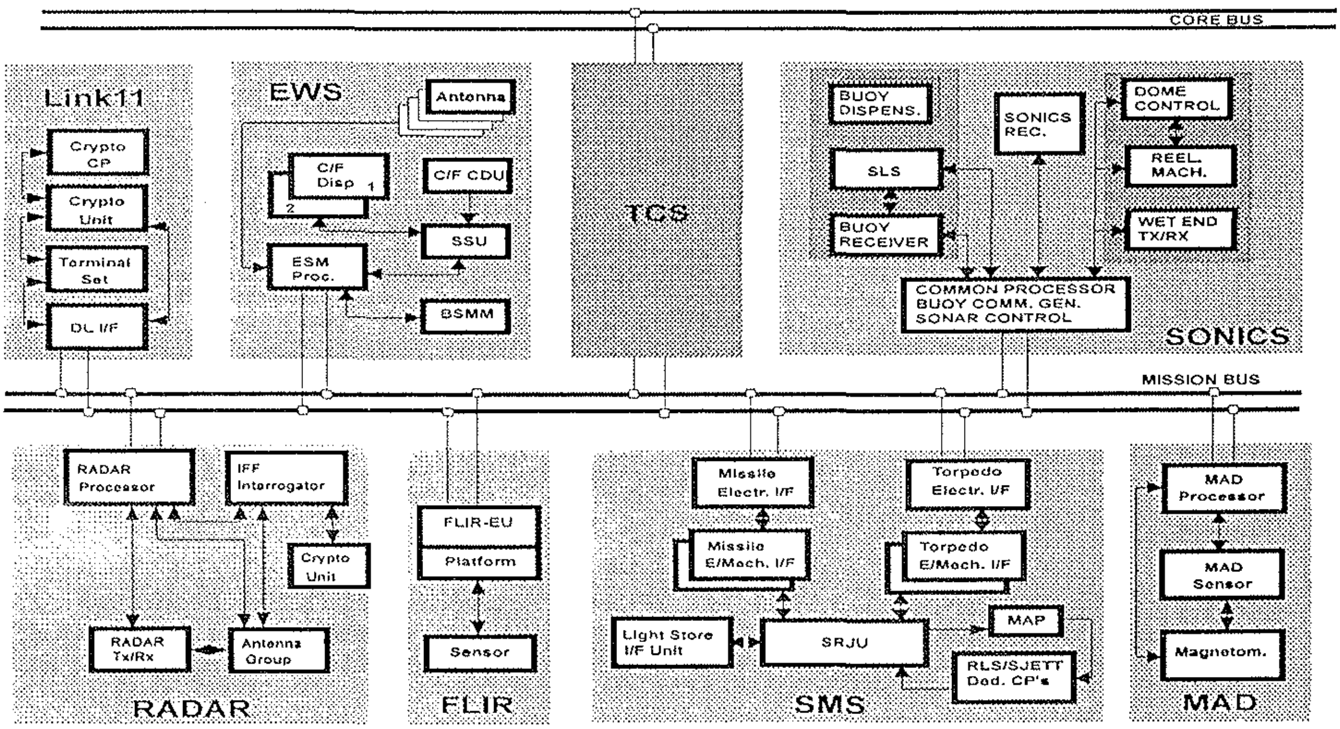
• The Dipping SONAR provides the following main features:

- Detection, localisation, tracking and identification of submerged submarines targets;
- Omni-directional search and localisation with both active and passive operation capabilities;
- Stereo audio outputs to the operator.
- Simultaneous processing and automatic alerting for the acoustic signals as required to aid the operator during target detection and classification;
- Automatic tracking of multiple targets with manual track initialisation;
- Acoustic libraries management;
- High fidelity recording of all intercepted sonar data.

• The Sonobuoy System provides the following main features:

- various types by passive and active buoys, selectable by the operator;
- Automatic alert for not displayed buoys;
- Sonobuoy Location System capability (SLS);
- Manual setting for life, RF and body depth of the buoy; automatic setting (through the TCS) is desirable;
- Automatic/manual dropping of the buoy;
- capability to control passive/active sonobuoy display parameters;
- Processing and generation of command tones to be transmitted via the UHF radio(s);
- High fidelity recording of all intercepted sonobuoy data.

NFH MISSION SYSTEM



An inboard MAD System is integrated to support passive re-localisation of a submerged submarine target, confirm its presence and identify it as a submarine vessel.

The MAD information are presented on the MFDs.

Stores and Weapons

MU90 Torpedo and MARTE Missile are foreseen according to the present contract.

In addition a complete provision for external Fuel Tank integration and a mechanical provision for installation of heavy missiles (e.g. Exocet) is being prepared.

NFH Video Distribution Network

A dedicated video network is used within the NMS architecture to distribute the information generated, in video format, by NMS sensors or by the TCS itself to all cockpit and cabin Multi-Function Displays (MFD).

In this context, it shall be noted that the cockpit MFD are major features used by the TCS, since (especially in the NFH three crew concept) the whole cockpit crew has an active role in the tactical management of the mission.

All available information generated by any of the NMS sensors, or by the TCS itself, are accessible to all crew members in all crew stations.

The NFH Mission Symbol Generator Units (MSGUs) are the key components of the NFH video distribution network. Two redundant MSGU are included in the TCS.

Each MSGU can generate up to six independent video presentations which can be superimposed to any of the sensors video formats.

NFH Audio Distribution Network

The NFH features a complex audio distribution network which can be considered as composed by two networks which share the helicopter Intercommunication System (ICS) as a common part.

One of these two networks is used to distribute voice messages (including those generated by the Direct Voice Output (DVO) device) and warning tones, while the other is used to distribute the audio information (Data Link 11 messages).

Specific mission related audio features are the following:

- Telebriefing which allows voice communication between the NFH crew and the tactical control officer when the helicopter is on the flight deck of the parent ship.

- Underwater communication (UQC) for voice communication between co-operating units.

- Distribution of the audio signals generated by the NFH Mission systems (e.g SONICS).

- The Data Umbilical Link; a special feature which allows the connection of the helicopter to the parent ship (on deck) for the transfer of the Link11 information from the ship to the NFH.

E. Status of the Programme

Prototype 1 of the NH90 has performed its maiden flight according to the D&D plan on December 18, 1995. Since then over thirty six hours of flight testing have been booked. The tests were mostly dedicated to a step by step opening of the flight envelope, investigations of general flight characteristics and handling qualities in altitudes up to 10.000 feet and speeds over 180 kts.

Up to now the general results are very promising which was also confirmed by crews of the official services. The next goal is to get Protoype 2 in the air which is planned just one year after PT1 in December this year.