COMBAT POTENTIALS OF BOEING AH-64 APACHE

Key “Echo Model!” Advancements
- Significantly Improved Aero Performance
- Enhanced collection and sharing battle space information — on and off-board
- Near real-time sensor-to-shooter
- Multi-spectral integrated sensors with extended stand-off range
- Anytime / Anywhere / Adverse weather
- Full IFR (Instrument Flight Rules) Capability

Combat overmatch through total systems integration

AH-64E Apache is a twin-engine, four-bladed, multi-mission attack helicopter - a highly integrated aerial weapons-delivery platform

AH-64 Apache – Tested and Proven
- Total U.S. Army Apache (A thru E Mode) Flight Hours: 4,483,312
- Total U.S. Army Apache (A thru E Mode) Combat Hours: 1,277,562
- Iraq / Afghanistan / Kuwait
  - Total Combat Mission Capable Rate: above 85%
- U.S. Army AH-64E Program of Record – 787 Aircraft
  - Total Aircraft Delivered: over 339 to the U.S.; 312 to other nations
  - Total U.S. Army AH-64E Hours: 392,314
  - Over 46,316 AH-64E Combat Hours
  - Total U.S. Army Combat Mission Capable Rate: above 85%
- Total aircraft (A thru E) delivered to date: 2,342

The World's Most Advanced Multi-Role Helicopter

Summary
- The AH-64E is a combat-proven combination of Lethality, Survivability, Maintainability, Interoperability, and Performance.
- Planned future Modernization will ensure the AH-64 remains Worlds Best Multi-Role Attack Helicopter to 2050 and beyond.
- All 22 Deliveries of AH-64 to IAF complete early 2020!
Multiple Usage of Kaman Verti Lifts in Combat Support Roles
Capt Robin Cherian
Director, K-Air

- K-MAX is the only helicopter designed, built, tested and certified for precision repetitive lift operations
  - Powerline construction/wire pulling – K-MAX excels in large scale infrastructure projects
    - Used to set 41 telephone poles in 5 hours
    - Can ferry and set 44 steel transmission poles in as little as 14 hours
  - Component fatigue lives based on 30 loads per hour
  - Unlimited life airframe
  - The aircraft has proven itself as a rugged, reliable machine

Unobstructed Side View
- Pilot literally sits above side window

Strategically Located Instrument Panel
- Perform procedures without removing hands and feet from controls

External Gauges
- Pilot can actively monitor performance during load operations

Ability to Withstand Extreme Conditions

27 manned K-MAX Helicopters plus 2 Unmanned K-MAX
Designed for Repetitive Vertical Lift

Key Design Features for Vertical Lift Mission:
- Counter-rotating intermeshing rotors
- Trolley mounted cargo hook
- Servo-flap control

1:1 Weight to Lift Ratio
- 6,000 lb. lift capacity
- 4,500 lb. NAVAIR CAT III flight clearance

Operates in Austere Environments
- 1-2 maintenance man hours / flight hour
- High Commercial Availability > 98%

Low Cost of Operation
- 85 gal/hr fuel consumption
- $850 /hr. commercial direct operating cost
- Unlimited airframe service life

K-MAX Drive Train

K-MAX offers the most convenient, care-free, and cost effective maintenance solution.

K-MAX Engine Data:
- Honeywell T55-17A1 Turbo shaft engine
- Take-Off Horsepower: 1000shp (745kW)
- 5 Minute Horsepower Rating: 1100shp (827kW)
- Maximum Continuous Power: 1150shp (860kW)

Experience and Reliability:
- The T55-17A1 engine has over 50,000,000 flight hours of experience worldwide.
- Honeywell has made significant improvements to this engine to increase its reliability for use in the K-MAX heavy-duty environment.

Engine is derated, ensuring long life and increase maximum cycle time.

Operational Team

- Typical Operational K-MAX Mission:
  - Crew consists of one pilot, one mechanic, and one mechanic-helper
  - Small operational footprint

- Future Unmanned K-MAX Mission:
  - Crew consists of no pilot, one mechanic, and one mechanic-helper
  - Aircraft is mostly autonomous with preprogrammed mission flight plans from a ground control laptop

Most Affordable Solution on the Market

K-MAX: The Perfect External Lift Solution

Proven in All External Lift Missions:
- Unprecedented precision placement
- Reliable airframe built to operate in austere conditions
- Cost-effective maintainability

Coming Soon NEXGEN Unmanned K-MAX

Proven in Afghanistan

NEXGEN Unmanned system in development

Can be manned or unmanned for multi purpose missions
ROLE OF CHINOOK
IN COMBAT SUPPORT

Michael M Koch
VP - Boeing Defence India

Tandem Rotorcraft
Design Advantages

- 100% of power goes to lift
- Stability in high winds
- Large center of gravity limits
- Ease of loading / unloading
- Low downwash
- High altitude operations
- Speed

A unique configuration, delivering unique capabilities

Advantages of Tandems

The CH-47 Chinook
Unmatched Capabilities

Traditional Roles
- Combat Support / Combat Service
- Long Haul Point-to-Point Logistics Support
- Combat Search and Rescue
- Humanitarian Aid
- Civil Support (Fire Fighting, Flood Assistance, Hurricane, Earthquakes
and Tsunami Relief, Mountain Rescue)

New Roles
- Intermittent / Continuous
- Deep Combat Assaults
- Homeland Defense Force
- Homeland Security / WMD
- Operations in austere / high altitude / limited visibility environments

H-47 Mission Capabilities

One Aircraft, Multi-Mission Capability

CH-47F India Overview

Fleet size IMPROVES efficiencies, REDUCES operator cost

India Deliveries begin 1Q 2019!

900+
Chinooks
20
Countries

Vertical Lift / Cargo Helicopters

H-47 Lifting the World

ROTOR INDIA - Q4 31 DECEMBER - 2018

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One AIRCRAFT. Many MISSIONS. National ASSET.

SUMMARY

• 55 years of service and innovation, another 50 ahead
• Unmatched heavy lift...and multi-mission versatility
• Lower support cost
• ARRIVING in 2019!

DCS H-47F Chinook ER
Extended Range Configuration

• Integrated Avionics CAAS Cockpit
• Navigation
  - EGI, VOR, TACAN, ADF, RDALT
• Communication Suite
  - Multiband Radio
  - HF Radio
  - SATCOM
• Mission Features
  - Enhanced Aircraft Survivability:
    - Radar Warning
    - Missile Warning
    - Chaff and Flare Dispensing
    - Counter Ballistic Protection
    - Laser Warning
  - Advanced Aircraft Capabilities:
  - Advanced Air Transceiver
  - Machined Frame, extended nose
  - 24,000 lb (10,495 kg) of additional fuel

• Long Range Fuel System
• Air to Air Refueling + Probe
• Digital Automatic Flight Control System (DAFCS)
• Rotor Brake System
• Next Generation Electrical System
  - Two 45-kVA main generators
  - Two 45-kVA-Regulated TRs
  - One 240-kVA-Regulated TR
  - One 35-kVA KVU generator
  - 35-kVA Battery Capacity

Cargo and Troop Capacity Comparison

Promises MADE. Promises DELIVERED.

DELIVERIES (2012–2017)

272 Aircraft
4 Unique configurations
53 DAYS ahead of contract delivery

First Flight of CH-47I

Chinook can carry two vehicles plus troops if required
Challenges faced in Manufacturing Helicopter Systems

Air Cmde Pramod Puranik
Vice President Defense
Bharat Forge

PROSPECTS OF HELICOPTER MANUFACTURING IN INDIA

HAL Snapshot

- History:
  - Since 1964 – 16 Production & 9 R&D Centres
  - 12 types of Aircrafts manufactured with in-house R&D
  - 14 types of aircrafts manufactured under Licence
  - Total 3,500 + aircrafts and 3,600 + engines manufactured

- Success Stories:
  - Dhruv (ALH)
  - Tejas (LCA)
  - JIT
  - Other upgrades

- Present Order book:
  - 332 Helicopters

- Yearly Production capacity:
  - 25-30 Aircrafts

- Huge gap in Demand and Supply

- Need to Augment HAL production facility / Infrastructure / Supply Chain

Essentials of Helicopter Industrial Base

Market Opportunity
  - Is it real and very large?

Technology
  - R&D
  - Innovation
  - Disruptive technologies

Manufacturing Ecosystem
  - Manufacturing Competence
  - Manufacturing Capability
  - Manufacturing Capacity
  - Collaborative Approach
  - Synergy of stakeholders

MSMEs: Engines of Growth

Manufacturing Ecosystem

Airbus Helicopter Delivery 2017 - Bharat Forge

Demand driven by growth

Importance of today's helicopters will remain in service 20 years from now
Projected growth in units: ≈37,000

Rotor India - QE 31 December - 2018
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Material, Process and Technology - Centers Of Excellence

Fuselage -
- Materials: Al, Ti, Steel, Composites
- Process: Metal Forming, Machining, Bonding and Curing
- Technology: Autoclave, Rubber Press, Stretch Press, CNC Machining, Riveting, Welding, Brazing
- Surface Treatment: Anodizing, Phosphating, Zinc Plating

Gear Box -
- Materials: Magnesium Casting, Case Hardening Steel, High Strength Forgings
- Process: Gleason Gear Generation, Grinding, Super Finishing, 5-axis machining center, Precision CNC Grinding, GMM, etc.
- Gear Hobbing, Gear Shaping, Gear Honing, Gear Grinding, Gear Testing
- Surface Treatment: Sealed Quench Furnace Carburizing, Case Hardening
- Testing: Back to back Regenerative Test Rig

Rotor Blade -
- Materials: Fibre Cloth and Pre-peg of Glass Carbon and other Composite Materials,
  Phenolic and Epoxy Resins, Honey Comb Core from Metal / Non-Metal,
- Process: Autoclave Bonding, Hydraulic Press Bonding, Insitu Bonding,
- Spl. Machines: Water Jet and Laser Cutting, C-Scan, CT-Scan, Ultrasonic, Clean Rooms
- Testing: Static and Dynamic Balancing

**Approximate Cost Matrix**
New Tactical Radio System RT7000

Mr. Jim Jackalone
Director Business Development
Cobham

RT-7000
Airborne Communications System
Communications Without Limitations

Technology Has Evolved
Radios … Not Just for ATC Communications Anymore

Introducing RT-7000
AIRBORNE COMMUNICATIONS
SYSTEM

RT-7000
Revolutionizing Airborne Communications

Key Features:
• Fully Integrated Panel Mount Design (only 4.5kg)
• Software Defined Radio (SDR) – FM / AM / Digital Trunking
  – Embedded Relay and Simulcast Functionality
• Integrated Modular Architecture
  – 1 to 5 transceivers
  – 3 independent internal transceiver modules
  – 2 externally attachable radio connections
• Land Mobile Radio (LMR)
• MIL-SPEC handheld
• Cellular and LTE
• Sat Phone
• Color touch screen with full function button and knob interface
• Intuitive, easy to use, Man-Machine Interface (MMI)

RT-7000 Can Grow Easily as Your Missions Do

Module Option #1 – Wideband Transceiver
• Cobham SDR Wideband Transceiver Module
  – 29.7 MHz - 960 MHz
  – FM / AM Across “The Wideband Spectrum”
• Military FM – 50 MHz – 88 MHz
• Military AM – 225 MHz – 400 MHz
• Extended range ATC, AM – 118 MHz – 156 MHz
  – 25 kHz & 8.33 kHz spacing
• Land mobile FM
  – 30 MHz – 50 MHz (VHF Low Band)
  – 136 MHz – 174 MHz (VHF High Band)
  – 380 MHz – 520 MHz (UHF)
  – 764 MHz – 870 MHz (700/800)
  – 896 MHz – 940 MHz (900 MHz)
• P-25 digital conventional
• FIPS 140-2 AES Digital and P25 DES Digital Encryption
• P25 Over-The-Air-Rekey (OTAR)

Covers All Tactical Voice and ATC Needs

Module Option #2 – Motorola P25 Digital Trunking
• Motorola APX-8000 based module
  – Every module can cover:
    • 136 MHz – 174 MHz VHF
    • 380 MHz – 520 MHz UHF
    • 764 MHz – 870 MHz UHF
  – User desired features
    • P25 Phase II trunking
    • P25 Phase 1, SmartZone & SmartNet trunking
    • ADP, AES, DES, DES-XL, DES-OFB, DVP-XL analog and digital encryption
    • Over-the-air rekey (OTAR) and multikey encryption
    • VoteScan multi-cast voting scan
    • Other Motorola features as requested

Leverages the Latest Motorola User Experience

ROTOR INDIA - QE 31 DECEMBER - 2018
Module Option #3 – GUARD/SAR Receiver

- GUARD/SAR Module
  - Global Maritime Distress and Safety System (GMDSS) compliant RT-7000 receiver module
  - Simultaneously monitors:
    - 121.5 MHz AM (Civil Air Distress)
    - 243.0 MHz AM (Military Air Distress)
    - 156.8 MHz FM (Channel 16 – Marine Distress)
    - 156.525 MHz PSK (DSC, Channel 70)
  - MIL-STD-3009 NVG compliant
  - Works with current NVG goggles
  - 1000 nit (Cd/m2) color display
  - Direct sunlight readable
  - Compatible with all flight gloves
  - 170° viewing angle
    - +85° to -85° from center both vertical and horizontal allows for more mounting options

Industry Leading Display & Man-Machine Interface

RCDU Remote Control Display Unit
Secondary Control Flexibility

Never Miss a Call for Help

GUARD/SAR Module GUI

Configurable for Mission Flexibility

Connect External Devices for On-the-Fly Interoperability

Intuitive Man-Machine Interface - Control & Display

- Operator choice of man-machine interface
  - Color touch screen and/or button and knob
  - Intuitive operation, quick access guides are not required
  - Customizable GUI for special mission needs
- Manage 5 user defined radios (including “interoperability portables”)
  - Relay
  - Simulcast
  - Relay/Simulcast (with no latency or delay)
- Activated by the push a single illuminated button
  - Engineering degree not required

Contact Info

Anand Subbedar
Director of Business Development
Aerospace Communications
Cobham India Private Ltd.
T: +91-11-3044-6521, M: +91-97-3116-616
anand.subbedar@cobham.com, www.cobham.com

Jim Jackalone
Director of Sales & Marketing
Cobham Aerospace Connectivity
6400 Wilkinson Drive, Prescott AZ 86301 USA
Jim.Jackalone@cobham.com
First to improve safety, we need to determine what we are doing wrong:

- What are the leading causes in Helicopter Air Ambulance (HAA) accidents?
- Mechanical Failures
- Mechanical Issues—Pilot induced LOC
- Night Issues
- Mid-Air Collision
- Most HAA accidents go back to "Human Factors" and are preventable.
- Let's look at each issue separately.

Mechanical failures without pilot input resulted in 6 accidents with 17 fatalities.

There is not much we can do about this as pilots, other than insure that we do a good preflight.

As managers, we can insure that all maintenance is performed “By the book”.

- Mechanical issues — pilot induced included 2 accidents with 2 fatalities and 2 serious injuries.
- These could have been prevented by insisting that we follow S.O.P.s and checklists as published.
- Pilot induced loss of control issues caused 8 accidents with 13 fatalities and 8 serious injuries.
- These included issues such as Settling with power (Vortex Ring State, L.T.E. and Brownout during landing).
- These issues should be discussed during all training and checking events to insure that our pilots can recognize and correct for these issues prior to an accident.
- Night issues caused 40 accidents with 108 fatalities and 12 serious injuries.
- Most of these accidents were continued flight VMC into IMC weather, without recognizing the issues and a subsequent CFIT accident. As you can see, the survival rate in an IMC/CFIT accident is not very good.
- Our industry fixed a great deal of these accidents with the introduction on Night Vision Goggle technology and training.
- More about training at the end.

- The last category was a mid-air collision in Flagstaff, AZ over a hospital helipad in the daytime between 2 VFR Bell 407 aircraft from 2 different companies, with no survivors.
- We addressed this issue with a coalition of all Operators in the area getting together and coming up with best practices and procedures for enforcing those procedures without assistance from any outside entities.
- More about training.
- How many of you are familiar with the FAA's 5 Hazardous Attitudes for Helicopter Pilots?
- The 5 Hazardous Attitudes for Helicopter Pilots
  - Macho
  - Anti-authority
  - Invulnerability
  - Impulsivity
  - Resignation

These can be found in the FAA Advisory Circular 60-22, and I would encourage everyone to read and apply these principles.

- A word about complacency.
- In a word maybe it is desensitized.
- Let me explain
- Basically any Safety Management System is all about people.
- Without a safety “Culture” in your organization, safety is just something on a poster.
- How many of you have heard of “Just Culture”?
- This is something that has to start at the top, but has to be reinforced at every level. It is vital to all of us, because what “that other guy” does directly affects me and my family, so it is vital that I speak up.
- Be your brother’s keeper.
- If you have any questions about any of this information, please feel free to call or email me at anytime. My contact information is: 
  James Wisecup  
  james.wisecup@rotor.org  
  01.801.915.0197

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**Jim Wisecup**
Chairman HAI

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_Rotor India - QE 31 December - 2018_
Safety in Commercial Helicopter Operation in Bangladesh

NIM Firdaus Hossain
Group Captain (Retd)
Senior Flight Operations Inspector
CAAB

Sequence

• Background of Commercial Helicopter Operation
  • Types of Helicopter Operation
  • Number and types of Helicopter
• Role of CAAB
  • Issuance of AOC
• Assessment of Safety in Flying
  • Safety in Flying
  • Safety in Maintenance
  • Safety in Training
  • Brief Record of Accident/ Incident
• Challenges in Safety Compliance

Background

• Bangladesh airspace is jointly used by Civil and Military aircraft in complete harmony.
• Government has vested the overall regulatory control to the Civil Aviation Authority of Bangladesh (CAAB).
• The hybrid mix of aircraft starting from small general aviation aircraft to today’s modern wide bodied aircraft in a small airspace is a challenging task both for the operators and the regulators.
• Amidst this backdrop, the ever-growing Helicopter Operation has created extra burden on the regulators keeping the Flight Safety issues in mind.
• Journey of Commercial Helicopter in Bangladesh started in 1999
• Today the helicopter fleets has about 30 commercial helicopters
• Initially helicopters were expected to act like one more vehicle in the lot and to support the commercial/business requirements
• In last about 20 years, CAAB had to infuse safety initiatives, culture and discipline as a priority in the minds of the investors & operators.

Current Market Outlook

• Transportation of passengers (Charter/Corporate)
  • Business clients
  • VIP & CIP
  • Celebration & Air Tour
• Medical Evacuation/ Air Ambulance
• Aerial Survey/ Recce
• Advertisement/ Film Making

Current Market Outlook
(Number and types of Helicopter)

<table>
<thead>
<tr>
<th>Types</th>
<th>No</th>
<th>Engine</th>
</tr>
</thead>
<tbody>
<tr>
<td>R-44</td>
<td>02</td>
<td>Single (Piston)</td>
</tr>
<tr>
<td>R-66</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>Bell-407</td>
<td>04</td>
<td>Single (Turbine)</td>
</tr>
<tr>
<td>EC-130</td>
<td>04</td>
<td></td>
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<tr>
<td>AW-139</td>
<td>02</td>
<td></td>
</tr>
<tr>
<td>Bell-433</td>
<td>01</td>
<td>Twin (Turbine)</td>
</tr>
<tr>
<td>Bell-429</td>
<td>02</td>
<td></td>
</tr>
</tbody>
</table>

# Inclusion of 1XAW-119, 2XAW-109, 1XBell-429, 1XBell-505 underway

Role of CAAB

Contribute in Change of the overall
BEHAVIOUR & MIND-SET
of Investors/ operators

Role of CAAB in Issuance of AOC (AOC Pamphlet)

• Air Operator certification (AOC) is issued to new applicants and holders of AOC.
• AOC Pamphlet comprises four Parts providing information to applicants and holders and a procedure for issue/renewal of AOC in order to infuse more of safety awareness in the minds of the investors.

For Parts are:

• Part-I : Regulatory Information
• Part-II : Operational Information
• Part-III : Airworthiness Information
• Part-IV : Guidelines, Checklists and Reference Documents
Part-I, Regulatory Information:
- This Part of the document provides information related to ICAO Annexes, the Regulatory Rules, Air Navigation Orders and other requirements of CAA Bangladesh.
- Category A: Schedule and/or non-schedule passenger and/or cargo, both in international and domestic sectors.
- Category B: Schedule and/or non-schedule passenger and/or cargo in domestic sectors.
- Category C: Schedule and/or non-schedule passenger and/or cargo both in domestic and international sectors by Helicopter.
- Category D: Schedule and/or non-schedule cargo both in international and domestic sectors.

Part-II, Operational Information:
- The procedures, practices and methods carried out (operations manual, air operator maintenance control manual, training manuals, etc.) of the prospective operators, in conjunction with any relevant portion of CAR 84, ANOs, Directives, Circulars etc.

Part-III, Airworthiness Information:
- Includes basic infra structural and workforce availability

Part-IV: Guidelines, Checklists and Reference Documents
- CAR 84, ANO, ICAO annexes

Safety in Helicopter Operation
Safety in Flying

Convenience
- Types of operation- Simple
- Terrain- mostly flat, low lands
- Availability of landing place- both pre-planned & precautionary/emergency
- No night operation

Threats/ Hazards
- Congested airspace- in & around airfield
- Weather- mostly hot & humid with pre & post monsoon roughness
- Single piloted & no compulsion on having auto-pilot
- Crowd control at outstation

Safety in Helicopter Operation
Safety in Maintenance

Convenience
- Availability of technicians

Inconvenience
- Acute shortage of AME specially on rotorcraft

Safety in Helicopter Operation
Safety in Training & Evaluation

Convenience
- Availability of qualified/ experienced aircrew
- Ground examination for pilots are web based and can be availed round the year

Inconvenience
- No dedicated helicopter pilot training school

Safety in Helicopter Operation
Record of last 4 years
- Total 4 Major accidents
- 3 relating to Human (Pilot) factor and 1 technical factor
- Average Yearly flying 8000-10000 hours

Challenges
- All commercial helicopter operates from the busiest commercial airport VGHS that also hosts:
  - Fighter and transport ac units of military
  - All major international airlines (passenger & cargo)
  - All domestic fixed wing operators
  - Helicopter operation clearance procedure- not speedy and efficient enough
  - Oversight on outstation helipads is fully on pilot discretion
  - Standard departure and rejoin procedure from main operating base (VGHS) - yet to be formulated

ARE THEY REALLY SAFETY CONCERN

How long do I sleep at night?

- Flight Cadets

☑ 85% were found sleep less than 6 hour

INFUSING SAFETY CULTURE

- Reward and Punishment
- Changing Attitude and Behaviours
- Training and Briefing
- Encourage to Report
- Knowledge Review Session
- Promotional Strategies (Posters, Billboards)
- Addressing Stress and Fatigue
- Setting the Right Examples in front of them
- Discuss all emergencies

CONCLUSION

Safety Culture Framework
Helicopter Safety Performance Initiatives

Mr. Chewang Gyeltshen
CEO, Royal Bhutan Helicopter Services Pvt. Ltd.

OUTLINE
• BHUTAN ON THE WORLD MAP
• rhlsh: VISION & MISSION
• DAILY OPERATION(S)
• CHALLENGES
• SAFETY INITIATIVES

DAILY OPERATIONS
• Activation & Dispatch of Aircraft:
  • Flight dispatch will receive an activation call
  • Planning, WX updates, W&B (Duty Pilot + Flight Dispatch)
  • Reference tools; Google earth
  • Company Data on V2 Tracker
  • Point of Contact for Local WX update via What app, imo etc...
  • Go — No Go decision by the Duty Pilot

SAFETY TOOLS ON BOARD
• v2 Track
• Vision 1000
• WIRE CUTTERS
• ELT

CHALLENGES
• No accurate weather app
• High operating altitudes
• Pay load issue with high altitude customers.
• Not many options for forced landing
• Limited fuel station
• No proper landing pad
• FODs

SAFETY POLICY
rhlsh’s safety policy applies to all the employees in the company and includes all areas and aspects of the company’s helicopter operations. The management of safety is a primary responsibility of all the managers and employees. rhlsh’s primary objective is to ensure all operations are ‘Safely conducted with zero Incidence and Accidents’.

All the employees are responsible to:
• Operate in compliance with the applicable requirements, regulations, company policy and procedures;
• Take preventative action to mitigate accidents and incidents;
• Report any safety hazards or events;
• Collaborate with management on developing systems and processes for ensuring compliance.

rhlsh will continuously strive to:
• Provide sufficiently skilled and trained human resources to implement safety strategies and processes;
• Establish and manage our safety performances against realistic performances;
• Ensure externally supplied systems and services to support our operations are delivered to meet our performance standards.

Safety is a core value within rhlsh and we believe in providing our employees and customers with a safe and healthy working environment.

SAFETY INITIATIVES
1. Safety Management System (SMS)
• Approved on 08/01/2018

2. Royal Bhutan Helicopter Safety Team (rHST)
• A committee which considers strategic safety function
• Effectiveness of the SMS
• Study accidents to determine corrective actions that can be taken to prevent recurrence.
• Effectiveness of safety oversight of sub-contracted organizations
• Conduct regular inspections to detect hazardous conditions and unsafe work practices and recommend corrective actions.
• Provide appropriate resources to achieve the established safety performances.

3. Emergency Response Planning
• As per Bhutan Civil Aviation Authority for the approval of Ground Handling Agent.
• All employees aware of their responsibilities
• Mock drill once a year

No. of Flights

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Service Type</th>
<th>No. of Flights</th>
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<tbody>
<tr>
<td>1</td>
<td>MedEvac</td>
<td>404</td>
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<tr>
<td>2</td>
<td>Tourist Charter</td>
<td>297</td>
</tr>
<tr>
<td>3</td>
<td>Local Charter</td>
<td>475</td>
</tr>
<tr>
<td>4</td>
<td>Fire Fighting</td>
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</tbody>
</table>

As of August 2018

COMPANY OVERVIEW
• First helicopter company established by RGoB on 8th July 2015
  (PROVIDE EMERGENCY SERVICES)
• OPERATING BASE: Paro International Airport, Old Hangar, Elev. 7350’
• HELICOPTER FLEET: Two E130 (EC 130 T2)
• TOTAL EMPLOYEES: 36
• TOTAL FLYING HOURS: 1386 FHs + 1093 FHs = 2479 FHs (AS OF SEPTEMBER 2018)

rhlsh: VISION “To be a leader in rotary aviation services - Nationally, Regionally, and Globally.”

rhlsh’s Mission
• Providing a SAFE and faster mode of transport;
• SAVING lives through swift medical evacuations;
• RESPONDING to and combating disasters rapidly and efficiently;
• Ensuring SUSTAINABLE development, and;
• Ensuring CUSTOMER satisfaction.

TYPE OF SERVICES
• Medical Evacuation
• Medical Evacuation
• Cargo/Freight Transport
• Passenger Transport
Improving Helicopter Safety and Operational Efficiency

Giorgio Dossena
LH Accident & Incident Investigation Manager

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Helicopter Safety and Operational Efficiency

Operative mainly include:
- Spatial disorientation / Loss of situational awareness / Inadvertent entry in IMC
- Poor Flight Planning (Weather, Fuel Management, Performance calculation)
- Induced or self-induced pressure
- Fixed obstacles: vertical (Power Lines) or horizontal (wires, etc.)
- Mobile obstacles (other aircraft, drones, etc.)

Maintenance causes include:
- Improper Maintenance
- Improper ground handling

What to do?

Improve safety and operational efficiency
- Helicopter Design
- Helicopter Flight Operations
- Maintenance
- Training
- Learning by experience (e.g. Event Investigation, FDR and FDM data analysis)

By Design

Sharing a C (Common Cockpit Concept) approach means:
- Same cockpit look and feel
- Same Instrumentation and Tools
- Common philosophy for Alert System
- Standardised symbology

Other Benefits:
Typical Pilots Conversion Time: ~50% less time

- Improved situational awareness through the installation and integration of systems/functionalities such as:
  - Synthetic Vision System (SVS);
  - Digital Map;
  - Weather radar;
  - EGPWS/HTAWS;
  - TCAS/TCAS II;
  - ADS-B Out (1090 MHz);

- Improved External Threat Recognition through the installation of dedicated systems such as:
  - Obstacle Proximity Lidar System (OPLS) - Certified for AW139, AW189 and AW169 for hovering in confined spaces, it informs the pilots about the distance to the closest surrounding obstacles (e.g. rig structure, rocks, trees and buildings).

  - More comprehensive Warning, Caution and Advisories messages to better manage, by providing the required information to the flight crew in a timely manner, the potential emergency condition;

  - Improved flight path control, Navigation Improvements with reduced pilot workload through integrated FMS (Flight Management System), SBAS GPS for LPV approaches, etc;

  - Full time 4-axis autopilot with automatic safety features easy to use and clear to understand.

WiFi Technology in Data Transfer
WiFi technology for data transfer from helicopter to "ground stations", computers and laptops.

Displays with Multiple Video Entry
Camera in tail fin can be displayed in the MFDs and PFDs, allowing pilots to have full situational awareness during ground operations and flight.
Design and Simulation Tools enhance the capability to analyse and optimise the system performance thus increasing the safety of the helicopters. Example is given by the design and certification process for our “Low stress gearboxes” (Dry-run capability of Main Gear Boxes), where the airflow in the transmission bay has been deeply analysed to improve ventilation.

By Helicopter Flight Ops.

- Performance Based Navigation (PBN): It sets clear performance requirements for flight operations. PBN involves a major shift from conventional ground-based navigation and procedures to satellite-based navigation (NAVSTAR, EGNOS, Galileo) and area navigation procedures.
- Improves Safety
  - Reduces CPT
  - Consistent predictable flight paths
  - Stabilized approach paths
- Improves Operating Returns (Reduces fuel costs, Reduces investment in ground based systems, Reduces time in flight through more direct routes)
- Increases Airspace Capacity (More efficient direct routes, Reduces airspace conflicts)
- Is Environmentally Friendly

By Maintenance

Interactive Electronic Technical Publication (IETP) is available through the AW Customer Portal Leonardo.

89-A-ACCP-00-X Corrosion Control Publication 2014-05-07
89-A-AMDI-00-X Material Data Information 2014-07-30
89-A-ASRP-00-X Structural Repair Publication 2014-07-30
89-A-AWDP-00-X Wiring Data Publication 2014-07-30
89-A-CRAF-00-X Component Repair & Overhaul Publication 2014-07-30
89-A-IDP-00-X Illustrated Part Data Publication 2014-07-30
89-A-ITEP-00-X Illustrated Tools and Equipment Publication 2014-07-30
AW189-MMEL (EASA) Master Minimum Equipment List (EASA) 2014-05-08

IETP is also available on all portable devices.

By Training

Helicopters simulators were used previously to practice emergencies listed in the flight manual.

With improved technologies in the visuals displays we can now train the flight crew to multiple scenarios and put the crew in situations where we can reproduce a complex operation challenge.

- Virtual Interactive Procedural Trainer (VIPT)
- Virtual Maintenance Trainer (VMT)
- Maintenance Training System

Enhanced Training Device is a high fidelity training device which embodies an affordable design approach providing the required Fidelity/Safety level guaranteed by the usage of OEM data.

By “Learning by experience” (FDR / FDM Analysis)

Conclusion
How can we get helicopter operators to follow the IHST recommendations – HAL VIEW

D.S.D. Prasad Rao
Additional General Manager (Design)

IHST RECOMMENDATIONS
IHST recommended the following four areas to prevent helicopter accidents:

1. Safety Management Systems (SMS)
2. Structured programs for initial and recurrent training
3. Mission-specific systems and equipment, including:
   - Health & usage monitoring systems (HUUMS)
   - Flight data monitoring (FDM) programs
   - Night vision goggles
   - Wire strike protection
4. Structured programs to fully comply with manufacturers’ recommended maintenance practices

SAFETY BY DESIGN
All HAL products are designed to international airworthiness standards like DERSTAN 00-970 and FAR/CS 29/27 which incorporates margins and redundancies ensuring safety.

DHRUV
Designed and developed as a state-of-the-art, multi-role, multi-mission helicopter to operate day or night, all weather in:-

- High altitude extreme cold and hot weather conditions
- Hot & desert conditions
- Saline atmosphere/off-shore environment

ADVANCED TECHNOLOGY FEATURES

Safety in Performance
- CAT A operations: (upto 10,600 ft)

Safety in Structural Design
- Adequate static and fatigue margins
- Consideration of worst case environments of humidity and temperature
- Fail safe structural design
- Demonstration of damage tolerance
- Crash worthiness:
  - Seats
  - Fuel tanks
  - Bottom structure and
  - Landing gear

Skid Landing Gear Drop test

Breakaway Fuselage

ALH DESIGN FEATURES
- Redundancy in flight critical systems such as
  - Full Authority Digital Engine Control (FADEC)
  - Automatic Flight Control System (AFCS)
  - Hydraulic System
  - Fuel System
  - Electrical system
- Two engines widely spaced
- Gear Box with dual lubrication system
- Duplicated Flying controls
Safety in System Design:

- Redundancy in:
  - Electrical System
    - 2 DC Generators + 2 Alternators + 1 Static inverters + 2 Batteries
  - Communication & Navigation System
    - 2 VHF + 1 HF
    - 2 VOR/DME + 1 GPS + 1 ADF + 2 AHIRS + 1 Magnetic Compass
  - Automatic Flight Control System
    - Dual/Dual Architecture
  - FADEC
  - Hydraulic System
    - 2 Control Hydraulics + 1 Utility Hydraulics
    - 2 Lane FADEC

Failure Condition Categories

<table>
<thead>
<tr>
<th>Failure Condition Categories</th>
<th>Probability Definitions</th>
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<tbody>
<tr>
<td>Event or incident</td>
<td>Described in functional equivalence or safety margins</td>
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</tbody>
</table>

System Safety Cell

- Instituted at complex level for catering to flight safety occurrences of HAL operated aircrafts.
- Standing Committee for investigation of flying incidents of HAL operated aircrafts.
- Analyze significant flight and ground snags occurring in flight hangar
- Establishes cause of failure and recommends suitable remedial measures
- For accidents. SSC supports the investigating agency, DGCA for Civil and CEMILAC for Military, in tandem with designers and manufacturers
- Preservation of important evidence, in case of accidents

Safety Management System @ HAL

SMS is a coordinated set of processes designed to provide an organized and practical method for controlling risks and hazards.

RWR & DC, HAL, Bengaluru is committed to establish a Safety Management System agreed with DGCA

SMS – KEY COMPONENTS
SAFETY POLICY
A safety policy outlines the principles, processes and methods of the organization’s SMS to achieve the desired safety. The policy establishes management’s commitment to incorporate and continually improve safety in all aspects of its activities.

Safety policy statements typically include:
- The overall safety objectives of the organization
- The commitment of senior management to provide the resources necessary for effective safety management
- A statement about responsibility and accountability for safety at all levels of the organization
- Management’s explicit support of a ‘positive safety culture’, as part of the overall safety culture of the organization

SAFETY GOAL
As an organization progresses through its SMS development, the desired goal is to be more predictive versus simply reactive.

HELIÇTOR PERFORMANCE LIMITATIONS
Most performance related accidents (engine may not be performing as expected, unexpected hull or shift in the wind, the air temperature at the landing site might be higher than anticipated because of surface heating etc.) can be prevented, provided that the pilot maintains a good situational awareness, knows the performance limitations of the helicopter, and apply basic performance calculations, if necessary the results may be validated with a power check at the actual landing or take-off site.

HUMAN ERRORS AND TRAINING NEEDS
- Humans, by their very nature, make mistakes; therefore, it should come as no surprise that human error has been implicated in a variety of occupational accidents, including 70% to 80% of those in civil and military aviation.
- Interventions aimed at reducing the occurrence or consequences of human error have not been effective. Clearly, if accidents are to be reduced further, more emphasis must be placed on the genesis of human error as it relates to accident causation.
- Training will reduce the human errors as practice makes men perfect. All post holders, certifying/support staff, auditors are given an induction training for a period of 5 days. Refresher training is imparted with the latest amendments taken place for the last 2 years.

FLIGHT SAFETY

FLIGHT DATA MONITORING
- Flight Data Monitoring (FDM) programs provide a proactive and prognostic capabilities to help identify risks before accidents occur.
- With the ability to routinely collect flight data, operators can gain objective insight into the risk factors/hazards affecting daily operations. Once analyzed this data can be used to drive safety strategy and facilitate sound decision making.
- While post-accident/incident investigation is a valuable use for FDM the greatest value comes from utilizing this data within the organization’s SMS for Hazard Identification, Continuous Improvement or Safety Assurance processes in an aggregate format.

SMS FOR MAINTENANCE
- With the advance in technology, accidents due to helicopter maintenance has come down.
- Even here, statistical data shows that 80 percent of all aviation accidents are caused by human factors
- Unless proactive steps are taken to reduce Human Factor, huge cost penalty will be seen during operations of the helicopter.
- Human Factor tools (Dirty Dozen, MEDA, SHELL) help in identifying those factors that contribute to existing error, and avoiding future errors.
- An organization’s maintenance leadership is an essential part of the team for the successful implementation of an SMS.

SAFETY ASSURANCE
The users are safety audited two times in a year to assure Safety
Auditing is carried out in the following areas
- Organisation and management systems
- Operations Manual, SMS
- Training Programs
- Flight and Ground Operations
- Maintenance
- Operational Security etc.

Benefits of Safety Audit
- By questioning, observing and reviewing internal processes, additional deficiencies and undetected operational risks can be discovered and corrected.
- Risks can be mitigated to an acceptable level before an event occurs
- Shed light on what is working and what is not
- Promotes operational efficiencies
- Involving the entire team in every aspect of the process leads to an improved “safety culture” and understanding of the benefits

HAL SAFETY PROMOTION
HAL will continue to follow SAFETY CULTURE and promotes Safety which assures SAFETY ASSURANCE to the users.