

FACTUAL REPORT - ATTACHMENT 4

Functional Hazard Assessment & System Safety Assessment

AIRWORTHINESS

ERA21FA233

**FUNCTIONAL HAZARD ASSESSMENT
AND
SYSTEM SAFETY ASSESSMENT
FOR THE
INTERNAL WATER TANK AND SNORKEL
ON THE
BLACKHAWK MISSION EQUIPMENT, LLC
UH-60 & S-70 SERIES ROTORCRAFT
DOCUMENT NUMBER: BHI-214-101
FAA STC PROJECT NUMBER: ST7314DE-R**

**PREPARED FOR:
FEDERAL AVIATION ADMINISTRATION**

Aircraft Certification Office (ACO)
Technical Operations Center (TCO)
26805 East 68th Avenue, Room 214
Denver, Colorado

**REVISION: A
DATE: FEBRUARY 3, 2020**

FAA ACTION	
DENVER AIRCRAFT CERTIFICATION OFFICE	
☒ APPROVED	☐ Concur
☐ Accepts	☐ Reject
FAA Project Number: ST7314DE-R	
Comments: System Safety Assessment BHI-214-101, Rev A	
FAA Safety Engineer Signature	Date
	3/19/2020

BLACKHAWK MISSION EQUIPMENT, LLC	BME WATERTANK & SNORKEL	Doc No. BHI-214-101
320 Main Street, Suite 200	FHA / SSA	Revision: A
Carbondale, CO 81623	UH-60 & S-70 Series ROTORCRAFT	Rev Date: 02/03/2020
Prepared By: Richard B Sands	Approved By: Frankie Marrero	Page: 2 of 47

RECORD OF REVISIONS

RECORD OF REVISIONS				
REV	DESCRIPTION	ECO#	DATE	APPROVED
IR	Initial Release	-	01/16/2020	
A	Added water tank leakage failure to FHA Table 2 and FHA Failure Classification Assessment Table 3. Added Figures 2, 3, 4, and 5. Added snorkel hose test report document as Attachment "A" and TSO Lead Acid Battery Spec as Attachment "B. Revised cover page and page 4. Updated Tables 2 and 3. Revised paragraph 6.1. Updated Table of Contents and List of Figures accordingly.	-	02/03/2020	

BLACKHAWK MISSION EQUIPMENT, LLC	BME WATERTANK & SNORKEL	Doc No. BHI-214-101
320 Main Street, Suite 200	FHA / SSA	Revision: A
Carbondale, CO 81623	UH-60 & S-70 Series ROTORCRAFT	Rev Date: 02/03/2020
Prepared By: Richard B Sands	Approved By: Frankie Marrero	Page: 3 of 47

TABLE OF CONTENTS

1. INTRODUCTION	4
1.1. Purpose	4
1.2. Scope.....	4
1.3. Reference Documents	4
1.4. Acronyms and Abbreviations	5
2. DESCRIPTION.....	6
2.1. System Description.....	6
2.2. Water Tank Key Operational Components.....	9
2.3. E-dump installation.....	9
3. FUNCTIONAL HAZARD ASSESSMENT.....	10
3.1. Assessment Methodology	10
3.2. Failure Conditions.....	10
4. FHA DEPTH OF ANALYSIS FLOWCHART	19
5. SYSTEM SAFETY ASSESSMENT.....	20
5.1. Assessment Methodology	20
6. FHA FAILURE CLASSIFICATION AND SAFETY ASSESSMENT.....	21
6.1. FHA / SSA Summary and Conclusion.....	25
7. ATTACHMENT A – SNORKEL HOSE TEST REPORT	29
8. ATTACHMENT B – LEAD ACID BATTERY SPECIFICATION AND TSO AUTHORIZATION.....	45

List of Tables

Table 1 Failure Condition Severity as Related to Probability Objectives and Assurance Levels	12
Table 2 Functional Hazard Assessment Table	13
Table 3 FHA Failure Classification and Safety Assessment.....	21

List of Figures

Figure 1 Simplified Block Diagram.....	7
Figure 2 Water Tank Control Switch Panel	7
Figure 3 Message Interface Display	8
Figure 4 Center Console with Message Interface Display and Switch Panel	8
Figure 5 Emergency Dump (Edump) Handle Installation.....	9
Figure 6 Depth of Analysis Flow Chart.....	19

BLACKHAWK MISSION EQUIPMENT, LLC	BME WATERTANK & SNORKEL	Doc No. BHI-214-101
320 Main Street, Suite 200	FHA / SSA	Revision: A
Carbondale, CO 81623	UH-60 & S-70 Series ROTORCRAFT •	Rev Date: 02/03/2020
Prepared By: Richard B Sands	Approved By: Frankie Marrero	Page: 4 of 47

1. INTRODUCTION

1.1. Purpose

The purpose of this Functional Hazard Assessment (FHA) / System Safety Assessment (SSA) document is to show compliance with 14 CFR 29.1309 (a)(b)(2)(c)(d)(g)(h) Amdt 29-24.

1.2. Scope

The FHA/SSA document details the most likely failure conditions and mitigation for the BME water tank and snorkel installation. It also details their severity and the effects on the rotorcraft and crew. The output of the FHA will be used in the development of the System Safety Assessment (SSA) which will describe how the failure conditions identified in the FHA are mitigated by either design, or procedures.

1.3. Reference Documents

1.3.1. Advisory Circulars

AC 29 -2C	Certification of Normal Category Rotorcraft
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1.3.2. Industry Guidance Documentation

SAE ARP4761	Guidelines and Methods for Conducting the Safety Assessment Process on Civil Airborne Systems and Equipment
5925-0085	BH60, Harness Installation Drawing
PS-0210	Trotter Controls Wire and Identification Log
BME-007-201	UH-60A/S-70 Internal Water Tank & Snorkel System Electrical Wiring Diagram
BME-007-203	BME Water Tank System and Control Wiring Diagram
ER-0312	BH60 – Electrical Loads for Firefighting Missions
TM1-1520-237-23&P	UH-60 Maintenance Manual
BHI-210-109	RFMS For UH-60 And S-70 Series Helicopters for Internal Water Tanks and Snorkel Installation
BHI-212-222	EMI/EMC Test Plan/Report
BHI-212-115	Structural Analysis Report
RKG 5074	Hose Test for Project ST7314DE-R.

BLACKHAWK MISSION EQUIPMENT, LLC	BME WATERTANK & SNORKEL	Doc No. BHI-214-101
320 Main Street, Suite 200	FHA / SSA	Revision: A
Carbondale, CO 81623	UH-60 & S-70 Series ROTORCRAFT	Rev Date: 02/03/2020
Prepared By: Richard B Sands	Approved By: Frankie Marrero	Page: 5 of 47

1.4. Acronyms and Abbreviations

AC	Advisory Circular
ACO	Aircraft Certification Office
APU	Auxiliary Power Unit
BME	Blackhawk Mission Equipment
DAR	Designated Airworthiness Representative
DER	Designated Engineering Representative
DV	Data Vault
ELA	Electrical Load Analysis
FHA	Functional Hazard Assessment
FTP	Flight Test Plan
GCU	Generator Control Unit
GTP	Ground Test Plan
IAW	In Accordance With
ICA	Instructions for Continued Airworthiness
LRU	Line Replaceable Unit
N/A	Not Applicable
PSCP	Project Specific Certification Plan
RCCB	Remote Control Circuit Breaker
RFMS	Rotorcraft Flight Manual Supplement
RG	Recombinant Gas
SSA	System Safety Assessment
VAC	Volts Alternating Current
VDC	Volts Direct Current
VRLA	Valve Regulated Lead Acid

BLACKHAWK MISSION EQUIPMENT, LLC	BME WATERTANK & SNORKEL	Doc No. BHI-214-101
320 Main Street, Suite 200	FHA / SSA	Revision: A
Carbondale, CO 81623	UH-60 & S-70 Series ROTORCRAFT	Rev Date: 02/03/2020
Prepared By: Richard B Sands	Approved By: Frankie Marrero	Page: 6 of 47

2. DESCRIPTION

2.1. System Description

This modification installs a 925-gallon water tank, controls and snorkel system in the main cabin area of the rotorcraft. The tank has an angled sub-floor for a gravity fed water drop, and a triple redundancy means for dropping water. The water tank has a fifteen (15) foot long external snorkel hose equipped with a 7.5 horsepower pump for filling the tank while hovering above a water source. The pump fills the tank to capacity in 55 seconds. The tank can also be filled on the ground thru a 3" diameter water hose nozzle.

The water tank has an electric geared gate doors, powered by an independent, 24 volt dc sealed lead acid TSO aircraft battery located underneath the water tank. The battery is recharged via a trickle charge circuit connected to the No. 2 DC primary buss located at the right-side pilot's circuit breaker panel in the cockpit. Power for the snorkel pump is via the No. 2 AC primary buss located at the pilot's circuit breaker panel right-side in the cockpit. The water tank installation includes an upper and lower restraint system in order to secure the water tank assembly to aircraft structure.

The internal water tank installation is controlled via message interface and switch panel located in the center console. Additional equipment includes: a motor controller located underneath the water tank, a data vault / telemetry box located in the nose compartment, and an external Iridium antenna installed on the fwd-upper-cockpit section of the rotorcraft in support of the telemetry box. A block diagram of the system is shown in Figure 1 below. The switch panel and message interface display are shown in Figures 2 and 3 respectively. Their location in the center console is shown in Figure 3.

BLACKHAWK MISSION EQUIPMENT, LLC	BME WATERTANK & SNORKEL	Doc No. BHI-214-101
320 Main Street, Suite 200	FHA / SSA	Revision: A
Carbondale, CO 81623	UH-60 & S-70 Series ROTORCRAFT	Rev Date: 02/03/2020
Prepared By: Richard B Sands	Approved By: Frankie Marrero	Page: 7 of 47

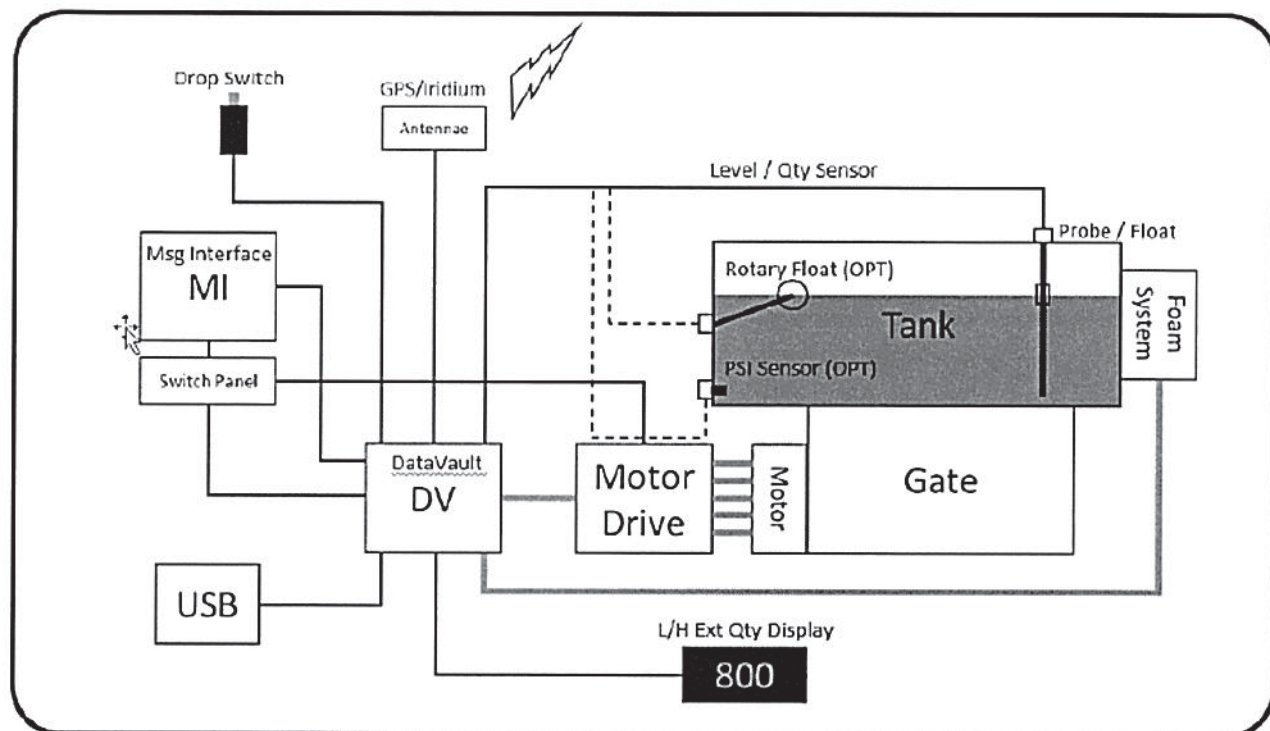


Figure 1 Simplified Block Diagram

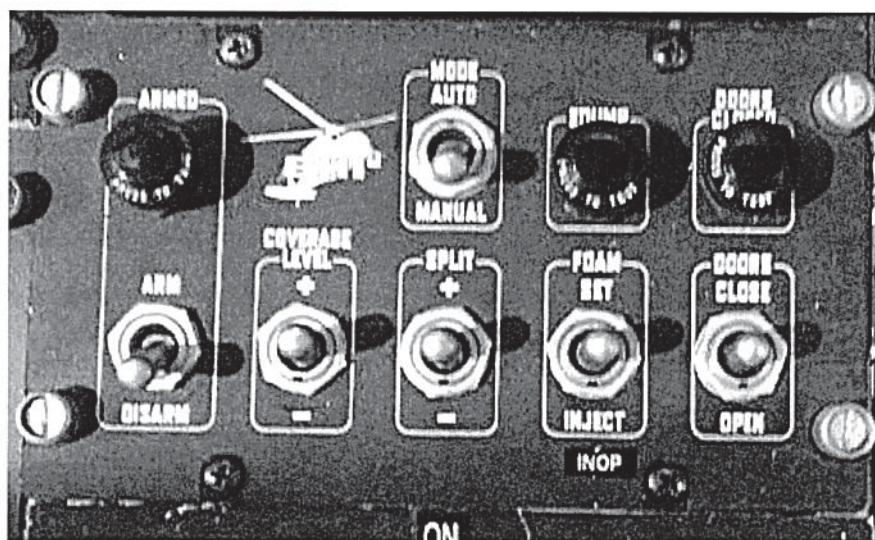


Figure 2 Water Tank Control Switch Panel

BLACKHAWK MISSION EQUIPMENT, LLC	BME WATERTANK & SNORKEL	Doc No. BHI-214-101
320 Main Street, Suite 200	FHA / SSA	Revision: A
Carbondale, CO 81623	UH-60 & S-70 Series ROTORCRAFT	Rev Date: 02/03/2020
Prepared By: Richard B Sands	Approved By: Frankie Marrero	Page: 8 of 47



Figure 3 Message Interface Display

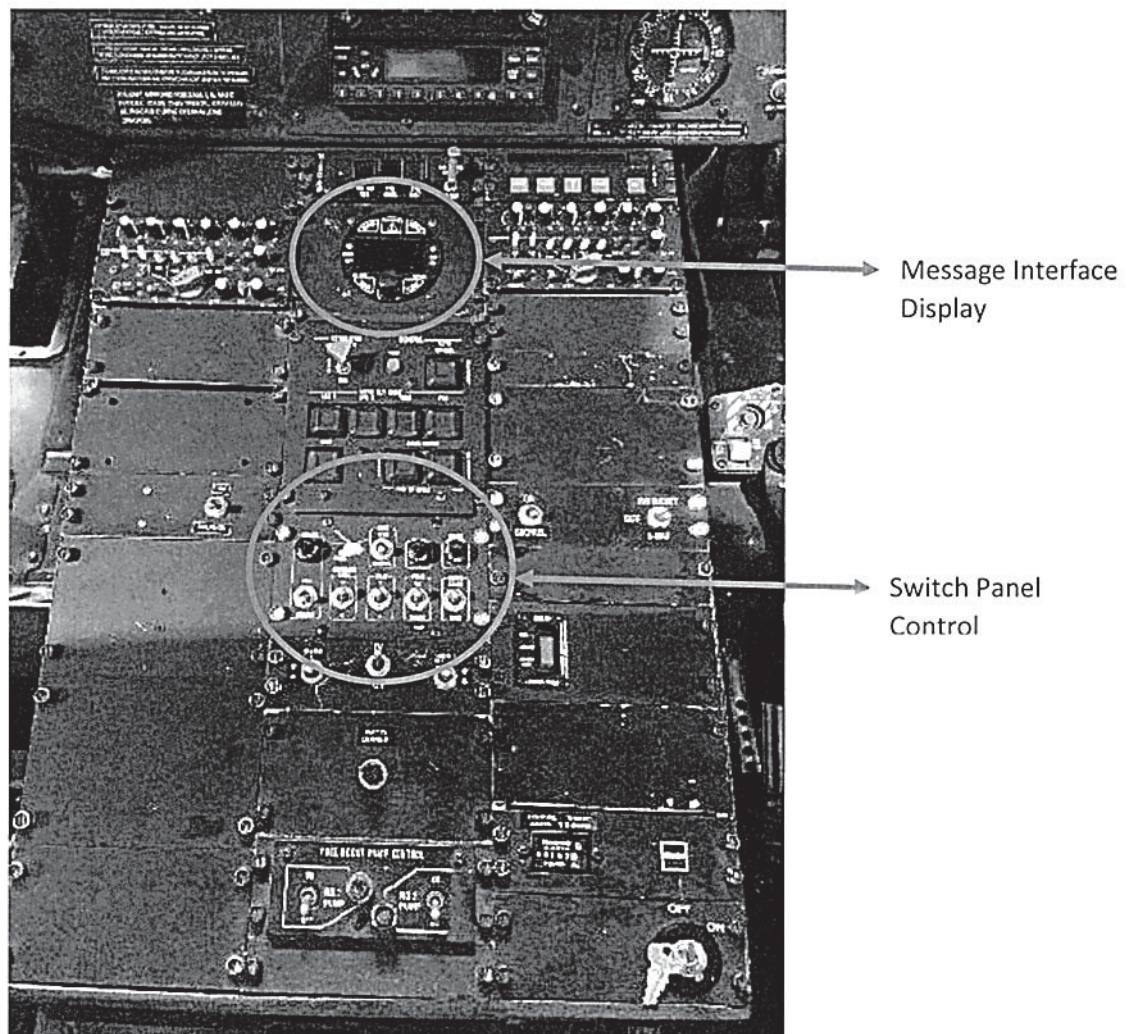


Figure 4 Center Console with Message Interface Display and Switch Panel

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320 Main Street, Suite 200	FHA / SSA	Revision: A
Carbondale, CO 81623	UH-60 & S-70 Series ROTORCRAFT	Rev Date: 02/03/2020
Prepared By: Richard B Sands	Approved By: Frankie Marrero	Page: 9 of 47

2.2. Water Tank Key Operational Components

- a. Data Vault - The Data Vault provides all control and telemetry functions for the system. It manages the communications devices, displays and sensors.
- b. Pilot Interface - The pilot interfaces are comprised of a message interface (MI) and switch panel. The switch panel is mounted in the center console. The message interface is a standard instrument/gauge sized device.

2.3. E-dump installation

Although the aircraft can land with a water tank full of water, the system is designed with triple redundancy. The E-dump installation consist of mechanical components that involves the pulling of a cable handle that connects to a gas spring strut. In the rare case the two other electrical means of dumping water fail, the pilot can pull the Edump as the third means to dump water from the tank.

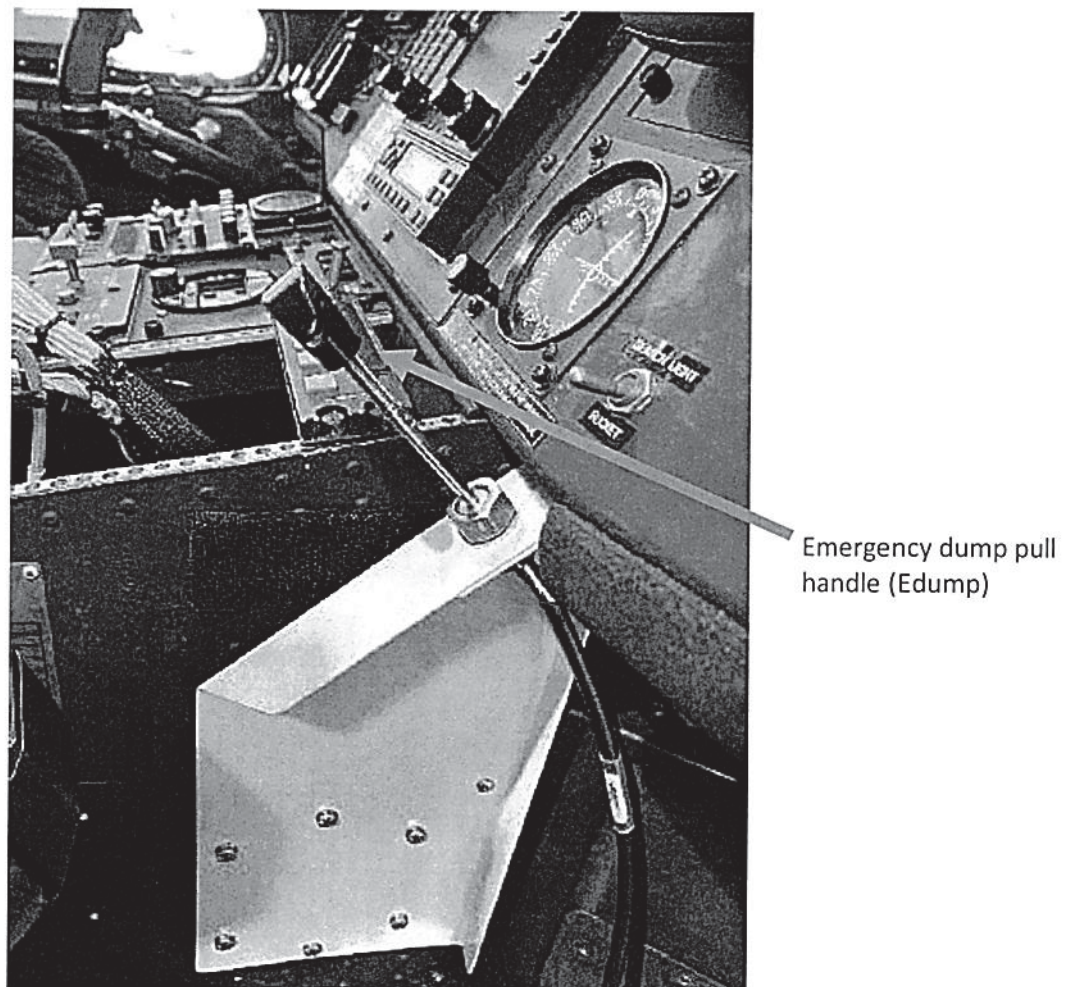


Figure 5 Emergency Dump (Edump) Handle Installation

BLACKHAWK MISSION EQUIPMENT, LLC	BME WATERTANK & SNORKEL	Doc No. BHI-214-101
320 Main Street, Suite 200	FHA / SSA	Revision: A
Carbondale, CO 81623	UH-60 & S-70 Series ROTORCRAFT	Rev Date: 02/03/2020
Prepared By: Richard B Sands	Approved By: Frankie Marrero	Page: 10 of 47

3. FUNCTIONAL HAZARD ASSESSMENT

3.1. Assessment Methodology

The Functional Hazard Assessment (FHA) will identify and classify the failure condition(s) associated with the water tank, controls and snorkel system. The goal is to clearly identify each failure condition its severity and effect on rotorcraft and crew, along with the rationale for its classification. This FHA will use a top-level analysis of the functions performed by the water tank, controls and snorkel system installed as part of this STC and the risk presented by these functions following failure or misuse. The hazards identified by the FHA will be assigned a hazard classification based on FAA guidance. These classifications are then assigned a probability in accordance with The Failure Condition Severity Classifications in Table 1 below.

3.2. Failure Conditions

A condition having an effect on either the rotorcraft or its occupants, or both, either direct or consequential, which is caused or contributed to by one or more failures or errors considering flight phase and relevant adverse operational or environmental conditions or external events. Failure conditions may be classified according to their severity as follows:

3.2.1. **Catastrophic** – Failure condition which would prevent continued safe flight operations and landings.

3.2.2. **Hazardous** – Failure conditions that would reduce the capability of the aircraft or the ability of the crew to cope with adverse operating conditions to the extent the following would be possible:

- A large reduction in safety margins or functional capabilities
- Physical distress or higher workload such that the flight crew cannot be relied upon to perform their tasks accurately or completely
- Serious or fatal injury to an occupant other than the flight crew

3.2.3. **Major** – Failure conditions that would reduce the capability of the aircraft or the ability of the crew to cope with adverse operating conditions to the extent that there would be a significant reduction in safety margins or functional capabilities. In addition, the failure condition has a significant increase in crew workload or in conditions impairing crew efficiency.

BLACKHAWK MISSION EQUIPMENT, LLC	BME WATERTANK & SNORKEL	Doc No. BHI-214-101
320 Main Street, Suite 200	FHA / SSA	Revision: A
Carbondale, CO 81623	UH-60 & S-70 Series ROTORCRAFT	Rev Date: 02/03/2020
Prepared By: Richard B Sands	Approved By: Frankie Marrero	Page: 11 of 47

3.2.4. **Minor** – Failure conditions that would not significantly reduce airplane safety and involve crew actions that are within their capabilities. Minor failure conditions may include a slight reduction in safety margins or functional capabilities, a slight increase in crew workload (such as routine flight plan changes), or some physical discomfort to passengers or cabin crew.

3.2.5. **No Safety Effect** - Failure conditions that would have no effect on safety (that is, failure conditions that would not affect the operational capability of the airplane or increase crew workload).

BLACKHAWK MISSION EQUIPMENT, LLC	BME WATERTANK & SNORKEL	Doc No. BHI-214-101
320 Main Street, Suite 200	FHA / SSA	Revision: A
Carbondale, CO 81623	UH-60 & S-70 Series ROTORCRAFT	Rev Date: 02/03/2020
Prepared By: Richard B Sands	Approved By: Frankie Marrero	Page: 12 of 47

3.2.6. Failure Condition Severity Classification

PROBABILITY (QUANTITATIVE)	PER FLIGHT HOURS				
	≤ 1.0	$\leq 1.0E-3$	$\leq 1.0E-5$	$\leq 1.0E-7$	$\leq 1.0E-9$
PROBABILITY (DESCRIPTIVE)	FAA	PROBABLE		IMPROBABLE	
	JAA	FREQUENT	REASONABLY PROPABLE	REMOTE	EXTREMELY REMOTE
FAILURE CONDITION SEVERITY CLASSIFICATION	FAA	MINOR		MAJOR	SEVERE MAJOR
	JAA	MINOR		MAJOR	HAZARDOUS
FAILURE CONDITION EFFECT	FAA & JAA	• SIGHT REDUCTION IN SAFETY MARGINS • SLIGHT INCREASE IN CREW WORKLOAD • SLIGHT INCONVENIENCE TO OCCUPANTS		• SIGNIFICANT REDUCTION IN SAFETY MARGINS OR FUNCTIONAL CAPABILITIES • SIGNIFICANT INCREASE IN CREW WORKLOAD OR CONDITIONS IMPAIRING CREW EFFICIENCY • SOME DISCOMFORT TO OCCUPANTS	• LARGE REDUCTION IN SAFETY MARGINS OR FUNCTIONAL CAPABILITIES • HIGHER WORKLOAD OR PHYSICAL DISTRESS SUCH THAT THE CREW COULD NOT BE RELIED UPON TO PERFORM TASK ACCURATELY OR COMPLETELY • ADVERSE EFFECTS ON OCCUPANTS
DEVELOPMENT ASSURANCE LEVEL	ARP 4754	LEVEL D		LEVEL C	LEVEL B
					LEVEL A

Table 1 Failure Condition Severity as Related to Probability Objectives and Assurance Levels

BLACKHAWK MISSION EQUIPMENT, LLC	BME WATERTANK & SNORKEL	Doc No. BHI-214-101
320 Main Street, Suite 200	FHA / SSA	Revision: A
Carbondale, CO 81623	UH-60 & S-70 Series ROTORCRAFT	Rev Date: 02/03/2020
Prepared By: Richard B Sands	Approved By: Frankie Marrero	Page: 13 of 47

3.2.7. Functional Hazard Assessment

Table 2 Functional Hazard Assessment Table

FUNCTIONAL HAZARD ASSESSMENT TABLE							
ITEM	FUNCTION	FAILURE CONDITION (HAZARD DESCRIPTION)	FLIGHT PHASE	EFFECT OF FAILURE CONDITION ON ROTORCRAFT / CREW	CLASSIFICATION	SUPPORTING MATERIAL REFERENCE	VERIFICATION
1	The ability to fill water tank via snorkel assembly and pump control	Unable to fill water tank	ALL	No reduction in aircraft safety margins. No increase in crew workload.	No Safety Effect	AC 29-2C ARP 4761	Qualitative Analysis
2	The ability to release water when commanded via Trotter controller or EDUMP	Unable to dump water	ALL	No reduction in aircraft safety margins. Slight increase in crew workload. Mission aborted	Minor Failure Condition	AC 29-2C ARP 4761	Qualitative Analysis
3	Water tank secured in helicopter bay	Water tank attachments becomes unsecure in-flight	ALL	Significant reduction in aircraft safety margins. Significant increase in flight crew workload as flight crew becomes aware of tank's condition and focuses on maintain flight until able to land. Water tank attachment malfunction will be assessed on ground.	Major Failure Condition	AC 29-2C ARP 4761 See structures Analysis report BHI-212-115	Qualitative Analysis
4	Normal NAV and COMM functions	Water tank electronics EMI affects aircraft COMM and NAV systems	ALL	Slight reduction in aircraft safety margins. Slight increase in flight crew workload as pilot	Minor Failure Condition	AC 29-2C ARP 4761	Qualitative Analysis

BLACKHAWK MISSION EQUIPMENT, LLC	BME WATERTANK & SNORKEL	Doc No. BHI-214-101
320 Main Street, Suite 200	FHA / SSA	Revision: A
Carbondale, CO 81623	UH-60 & S-70 Series ROTORCRAFT	Rev Date: 02/03/2020
Prepared By: Richard B Sands	Approved By: Frankie Marrero	Page: 14 of 47

FUNCTIONAL HAZARD ASSESSMENT TABLE							
ITEM	FUNCTION	FAILURE CONDITION (HAZARD DESCRIPTION)	FLIGHT PHASE	EFFECT OF FAILURE CONDITION ON ROTORCRAFT / CREW	CLASSIFICATION	SUPPORTING MATERIAL REFERENCE	VERIFICATION
				assesses the effect of the interference on COMM and NAV systems. Pilot selects best COMM/NAV systems for communication, navigation and if required flies VFR until able to land. (Ref. EMI/EMC Test Report No. BHI-212-222R)		EMI/EMC Test Report No. BHI-212-222R	
5	Water tank system and controls power available	Water tank system and controls sustain power failure	ALL	No reduction in aircraft safety margins. Slight increase in crew workload. Water tank system and control power failure will be assessed on ground. Mission Aborted	Minor Failure Condition	AC 29-2C ARP 4761	Qualitative Analysis
6	Normal telemetry, GPS and communication function	Telemetry system failure	ALL	No reduction in aircraft safety margins. No increase in crew workload as telemetry system is transparent to flight crew (no interaction). Telemetry	No Safety Effect	AC 29-2C ARP 4761	Qualitative Analysis

BLACKHAWK MISSION EQUIPMENT, LLC	BME WATERTANK & SNORKEL	Doc No. BHI-214-101
320 Main Street, Suite 200	FHA / SSA	Revision: A
Carbondale, CO 81623	UH-60 & S-70 Series ROTORCRAFT	Rev Date: 02/03/2020
Prepared By: Richard B Sands	Approved By: Frankie Marrero	Page: 15 of 47

FUNCTIONAL HAZARD ASSESSMENT TABLE							
ITEM	FUNCTION	FAILURE CONDITION (HAZARD DESCRIPTION)	FLIGHT PHASE	EFFECT OF FAILURE CONDITION ON ROTORCRAFT / CREW	CLASSIFICATION	SUPPORTING MATERIAL REFERENCE	VERIFICATION
				system failure will be assessed on ground. Mission aborted			
7	Normal flight operations	Snorkel pump becomes snagged on ground obstacle or object (in-flight/landing)	FLIGHT	Significant reduction in aircraft safety margins. Significant increase in flight crew workload as flight crew becomes aware of snorkel snag. Pilot focuses on maintaining flight. Pilot pulls up on collective in order to detach snorkel hose assembly from aircraft. The snorkel pump assembly will detached from the aircraft/hose assembly if 2,500 lbs. of force is exerted on snorkel assembly. Damage to water tank, snorkel pump, hose assembly and aircraft will be assessed on ground.	Major Failure Condition	AC 29-2C ARP 4761 RKG5074	Qualitative Analysis

BLACKHAWK MISSION EQUIPMENT, LLC	BME WATERTANK & SNORKEL	Doc No. BHI-214-101
320 Main Street, Suite 200	FHA / SSA	Revision: A
Carbondale, CO 81623	UH-60 & S-70 Series ROTORCRAFT	Rev Date: 02/03/2020
Prepared By: Richard B Sands	Approved By: Frankie Marrero	Page: 16 of 47

FUNCTIONAL HAZARD ASSESSMENT TABLE							
ITEM	FUNCTION	FAILURE CONDITION (HAZARD DESCRIPTION)	FLIGHT PHASE	EFFECT OF FAILURE CONDITION ON ROTORCRAFT / CREW	CLASSIFICATION	SUPPORTING MATERIAL REFERENCE	VERIFICATION
8	Normal flight operations	Snorkel hits or gets entangled in aircraft (other than tail or main rotator)	ALL	Slight reduction in aircraft safety margins. Slight increase in flight crew workload as flight crew becomes aware of snorkel entanglement and focuses on maintaining flight. Damage to aircraft will be assessed on ground.	Minor Failure Condition	AC 29-2C ARP 4761	Qualitative Analysis
9	Normal flight operations	Lightning strikes aircraft and exits through snorkel pump assembly	FLIGHT	Slight reduction in aircraft safety margins. Slight increase in flight crew workload as flight crew becomes aware of strike and focuses on maintaining flight as the system is designed and installed to ensure protection against lightning as well as the aircraft is certified for lightning strikes. Damage, if any, will be assessed on ground.	Minor Failure Condition	AC 29-2C ARP 4761	Qualitative Analysis

BLACKHAWK MISSION EQUIPMENT, LLC	BME WATERTANK & SNORKEL	Doc No. BHI-214-101
320 Main Street, Suite 200	FHA / SSA	Revision: A
Carbondale, CO 81623	UH-60 & S-70 Series ROTORCRAFT	Rev Date: 02/03/2020
Prepared By: Richard B Sands	Approved By: Frankie Marrero	Page: 17 of 47

FUNCTIONAL HAZARD ASSESSMENT TABLE

ITEM	FUNCTION	FAILURE CONDITION (HAZARD DESCRIPTION)	FLIGHT PHASE	EFFECT OF FAILURE CONDITION ON ROTORCRAFT / CREW	CLASSIFICATION	SUPPORTING MATERIAL REFERENCE	VERIFICATION
10	Normal flight operations	Lightning strikes snorkel pump and exits through aircraft surface	FLIGHT	Slight reduction in aircraft safety margins. Slight increase in flight crew workload as flight crew becomes aware of strike and focuses on maintaining flight as the system is designed and installed to ensure protection against lightning as well as the aircraft is certified for lightning strikes. Damage, if any, will be assessed on ground.	Minor Failure Condition	AC 29-2C ARP 4761	Qualitative Analysis
11	Normal Tank Operation	Water tank leaks water in main cabin	FLIGHT	No reduction in aircraft safety margins. Slight increase in crew workload as tank leaks water in main cabin. Crew becomes aware of tank leakage and dumps the remaining water in the tank via Trotter controller or EDUMP. Leakage from	Minor Failure Condition	AC 29-2C ARP 4761	Qualitative Analysis

BLACKHAWK MISSION EQUIPMENT, LLC	BME WATERTANK & SNORKEL	Doc No. BHI-214-101
320 Main Street, Suite 200	FHA / SSA	Revision: A
Carbondale, CO 81623	UH-60 & S-70 Series ROTORCRAFT	Rev Date: 02/03/2020
Prepared By: Richard B Sands	Approved By: Frankie Marrero	Page: 18 of 47

FUNCTIONAL HAZARD ASSESSMENT TABLE							
ITEM	FUNCTION	FAILURE CONDITION (HAZARD DESCRIPTION)	FLIGHT PHASE	EFFECT OF FAILURE CONDITION ON ROTORCRAFT / CREW	CLASSIFICATION	SUPPORTING MATERIAL REFERENCE	VERIFICATION
				water tank exists out main cabin doors. Water tank leakage will be assessed on ground.			
12	Normal snorkel pump operation	During pumping snorkel pump overheats	ALL	No reduction in aircraft safety margins. No increase in crew workload as thermal mechanism in pump shuts down the snorkel pump. Crew becomes aware that pumping has ceased and continues flight if airborne. Damage to snorkel pump is assessed on ground.	No safety Effect	AC 29-2C ARP 4761	Qualitative Analysis

BLACKHAWK MISSION EQUIPMENT, LLC	BME WATERTANK & SNORKEL	Doc No. BHI-214-101
320 Main Street, Suite 200	FHA / SSA	Revision: A
Carbondale, CO 81623	UH-60 & S-70 Series ROTORCRAFT	Rev Date: 02/03/2020
Prepared By: Richard B Sands	Approved By: Frankie Marrero	Page: 19 of 47

4. FHA DEPTH OF ANALYSIS FLOWCHART

From the flow chart below (ref. AC 29-2C) it was determined that the analysis of the failure conditions could be qualitative for the following reasons:

The failure conditions are not hazardous or catastrophic, the dominant failure condition was major with the majority of failure conditions being either minor or having no safety effect. The water tank system and snorkel hose assembly are not complex systems, and the system and installation are similar to previous designs.

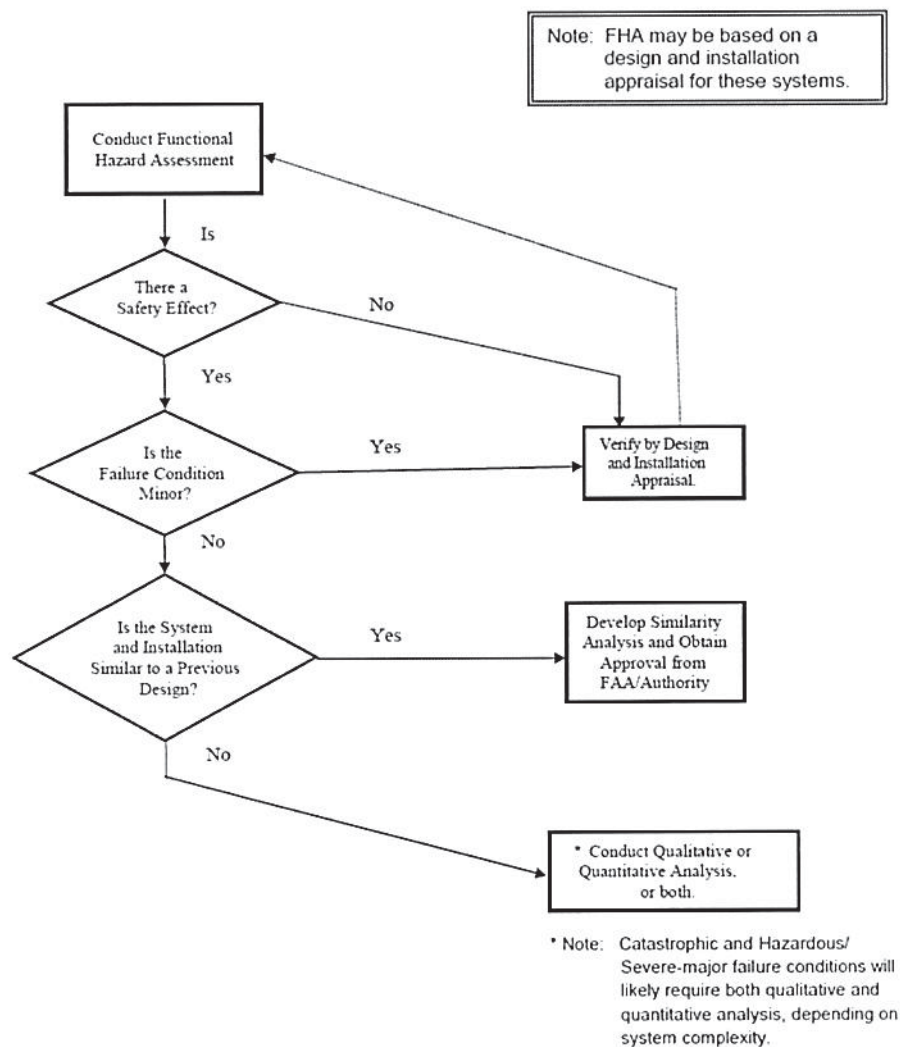


Figure 6 Depth of Analysis Flow Chart

BLACKHAWK MISSION EQUIPMENT, LLC	BME WATERTANK & SNORKEL	Doc No. BHI-214-101
320 Main Street, Suite 200	FHA / SSA	Revision: A
Carbondale, CO 81623	UH-60 & S-70 Series ROTORCRAFT	Rev Date: 02/03/2020
Prepared By: Richard B Sands	Approved By: Frankie Marrero	Page: 20 of 47

5. SYSTEM SAFETY ASSESSMENT

5.1. Assessment Methodology

The safety assessment process begins with the FHA and ends with verification that the design meets the safety requirements and regulatory standards. The safety assessment process can be either qualitative, quantitative or both.

- Qualitative - Those analytical processes that assess system and aircraft safety in an objective non-numerical manner. A qualitative assessment is based on engineering judgment.
- Quantitative - Those analytical processes that apply mathematical methods to assess the system and aircraft safety.

From the flow chart in Figure 2 above, it was determined that a qualitative analysis would be appropriate because the failure conditions identified in the FHA were not hazardous or catastrophic, the dominant failure condition was Major, with the majority of failure conditions either minor or having no safety effect. The water tank system and snorkel assembly are not complex, and the system and installation is similar to a previous design.

BLACKHAWK MISSION EQUIPMENT, LLC	BME WATERTANK & SNORKEL	Doc No. BHI-214-101
320 Main Street, Suite 200	FHA / SSA	Revision: A
Carbondale, CO 81623	UH-60 & S-70 Series ROTORCRAFT	Rev Date: 02/03/2020
Prepared By: Richard B Sands	Approved By: Frankie Marrero	Page: 21 of 47

6. FHA FAILURE CLASSIFICATION AND SAFETY ASSESSMENT

Table 3 FHA Failure Classification and Safety Assessment

FHA Failure Classifications and Safety Assessment			
No.	Failure Condition	Hazard Classification	Assessment
1.	Unable to fill water tank.	No Safety Effect	No safety effect on the rotorcraft resulting from the inability to fill the water tank. The inability to fill the water tank will be assessed and corrected by ground personal.
2.	Unable to dump water.	Minor	If unable to dump water via control or a mechanical emergency dump cable or EDUMP can dump water, there is minor effect on the rotorcraft resulting from the inability to dump water due to a slight workload increase. Even if both dump systems fail, the rotorcraft is certified for flight and landing with its water tank full. The inability to dump water will be assessed and corrected by ground personal.
3.	Water tank attachments becomes unsecure in-flight.	Major	The water tank installation includes an upper and a lower tank restraint system. The system utilizes existing tie-down locations in the main cabin between aircraft STA. 288 and STA. 398. The upper restraint system includes two struts which are mounted longitudinally to the forward and aft cargo ring points in the upper cabin. The existing cargo rings are removed, and one strut is attached to the left side and one is attached to the right side. Each strut has brackets which connect tie rods that attach to the water tank lid. There are lower restraint machined brackets that attach to existing floor tie-downs and connect to rails mounted on the forward and aft sides of the tank. The internal water tank restraint system complies with FAA regulations for crash loads with a full or empty tank: 1.5g Upward, 4.0g Forward, 2.0g Sideward, 4.0g Downward. Ref. report no. BHI-212-115

BLACKHAWK MISSION EQUIPMENT, LLC	BME WATERTANK & SNORKEL	Doc No. BHI-214-101
320 Main Street, Suite 200	FHA / SSA	Revision: A
Carbondale, CO 81623	UH-60 & S-70 Series ROTORCRAFT	Rev Date: 02/03/2020
Prepared By: Richard B Sands	Approved By: Frankie Marrero	Page: 22 of 47

FHA Failure Classifications and Safety Assessment			
No.	Failure Condition	Hazard Classification	Assessment
4.	Water tank electronics EMI affects aircraft COMM and NAV systems.	Minor	EMI/EMC testing was accomplished for the STC and satisfactorily reported and recorded in the EMI/EMC Test Report document (Ref. EMI/EMC Test Report No. BHI-212-222R). Any subsequent EMI interference resulting from the water tank electronics will be reported by the flight crew as a malfunction and assessed and corrected by ground personal.
5.	Water tank system and controls sustain power failure.	Minor	The water system controls are powered from the non-essential power buss. Operation of the water tank gate doors are power from a separate stand-only TSO aircraft battery. Pilot to dump water (if Possible) via E-Dump and return to base. Slight workload increase. A power failure in either system has no effect on the rotorcraft's ability to maintain flight or land. A failure in either system will be assessed and corrected on the ground by ground personal.
6.	Telemetry system failure	No Safety Effect	This is a datalink system only. The telemetry system is transparent to the flight crew. There is no interaction between the flight crew and the telemetry system. Telemetry system failures have no effect on the rotorcraft and will be assessed and corrected by ground personal upon landing.
7.	Snorkel pump becomes snagged on ground obstacle or object (in-flight/landing)	Major	Pilot pulls up on collective in order to detach the snorkel pump assembly from the aircraft. The snorkel pump assembly will detach from the aircraft/hose assembly if 2,500 lbs. of force is exerted on snorkel assembly. Damage, if any, to the water tank, snorkel assembly and aircraft will be assessed by ground personal upon landing.
8.	Snorkel hits or gets entangled in aircraft (other than rotator)	Minor	Pilot focuses on maintaining flight. Damage to aircraft and snorkel assembly will be assessed by ground personal upon landing.

BLACKHAWK MISSION EQUIPMENT, LLC	BME WATERTANK & SNORKEL	Doc No. BHI-214-101
320 Main Street, Suite 200	FHA / SSA	Revision: A
Carbondale, CO 81623	UH-60 & S-70 Series ROTORCRAFT	Rev Date: 02/03/2020
Prepared By: Richard B Sands	Approved By: Frankie Marrero	Page: 23 of 47

FHA Failure Classifications and Safety Assessment			
No.	Failure Condition	Hazard Classification	Assessment
9.	Lightning strikes aircraft and exits through snorkel	Minor	There are no catastrophic effects from lightning associated with this change to the rotorcraft. The design incorporates a large electrical conductor (0 AWG) gauge electrical bonding wiring that is bonded to the metal structure of the snorkel pump, running the length of the hose to the snorkel clamp on the water tank, and is bonded at that location; In both locations, an electrical bonding note will be added to the face of the installation drawing, requiring verification of electrical bonding during installation. An additional bonding strap will also be attached to the tank nozzle (which is bonded into the tank, carbon fiber structure by multiple fasteners) and will be attached to the aircraft structure at STA. 308 main beam. As with the other bonding strap, a note will be added to the face of the installation drawing requiring an electrical bond verification at installation. In the unlikely event that lightning attaches to the pump electrical wiring, lightning suppressors have been installed, prior to the current limiters on the electrical bus, feeding the snorkel pump. In addition, the rotorcraft is certified for lightning strikes.
10.	Lightning strikes snorkel pump and exits through aircraft surface	Minor	There are no catastrophic effects from lightning associated with this change to the rotorcraft. The design incorporates a large electrical conductor (0 AWG) gauge electrical bonding wiring that is bonded to the metal structure of the snorkel pump, running the length of the hose to the snorkel clamp on the water tank, and is

BLACKHAWK MISSION EQUIPMENT, LLC	BME WATERTANK & SNORKEL	Doc No. BHI-214-101
320 Main Street, Suite 200	FHA / SSA	Revision: A
Carbondale, CO 81623	UH-60 & S-70 Series ROTORCRAFT	Rev Date: 02/03/2020
Prepared By: Richard B Sands	Approved By: Frankie Marrero	Page: 24 of 47

FHA Failure Classifications and Safety Assessment			
No.	Failure Condition	Hazard Classification	Assessment
			bonded at that location; In both locations, an electrical bonding note will be added to the face of the installation drawing, requiring verification of electrical bonding during installation. An additional bonding strap will also be attached to the tank nozzle (which is bonded into the tank, carbon fiber structure by multiple fasteners) and will be attached to the aircraft structure at STA. 308 main beam. As with the other bonding strap, a note will be added to the face of the installation drawing requiring an electrical bond verification at installation. In the unlikely event that lightning attaches to the pump electrical wiring, lightning suppressors have been installed, prior to the current limiters on the electrical bus, feeding the snorkel pump. In addition, the rotorcraft is certified for lightning strikes.
11.	Water tank leaks water in main cabin	Minor	The main cabin, flooring, subflooring and electrical harnesses of the UH-60 are insulated and water proof per military design. In the unlikely event of tank leakage or rupture, the pilots dump the remaining water in the tank via Trotter controller or EDUMP. Any water leakage from water tank exits out main cabin doors. Inspect for damage or corrosion after landing. See IPC of subfloor in page 26 of this document.
12.	Snorkel pump overheats during pumping operation.	No Safety Effect	The snorkel pump is equipped with a thermal shut down mechanism should operating temperatures exceed specs. There is no effect on the rotorcraft or crew

BLACKHAWK MISSION EQUIPMENT, LLC	BME WATERTANK & SNORKEL	Doc No. BHI-214-101
320 Main Street, Suite 200	FHA / SSA	Revision: A
Carbondale, CO 81623	UH-60 & S-70 Series ROTORCRAFT	Rev Date: 02/03/2020
Prepared By: Richard B Sands	Approved By: Frankie Marrero	Page: 25 of 47

FHA Failure Classifications and Safety Assessment			
No.	Failure Condition	Hazard Classification	Assessment
			as the pumping operation is halted. Pump cannot reset. The pilot returns to base for ground crew troubleshooting of pump or pump replacement.

6.1. FHA / SSA Summary and Conclusion

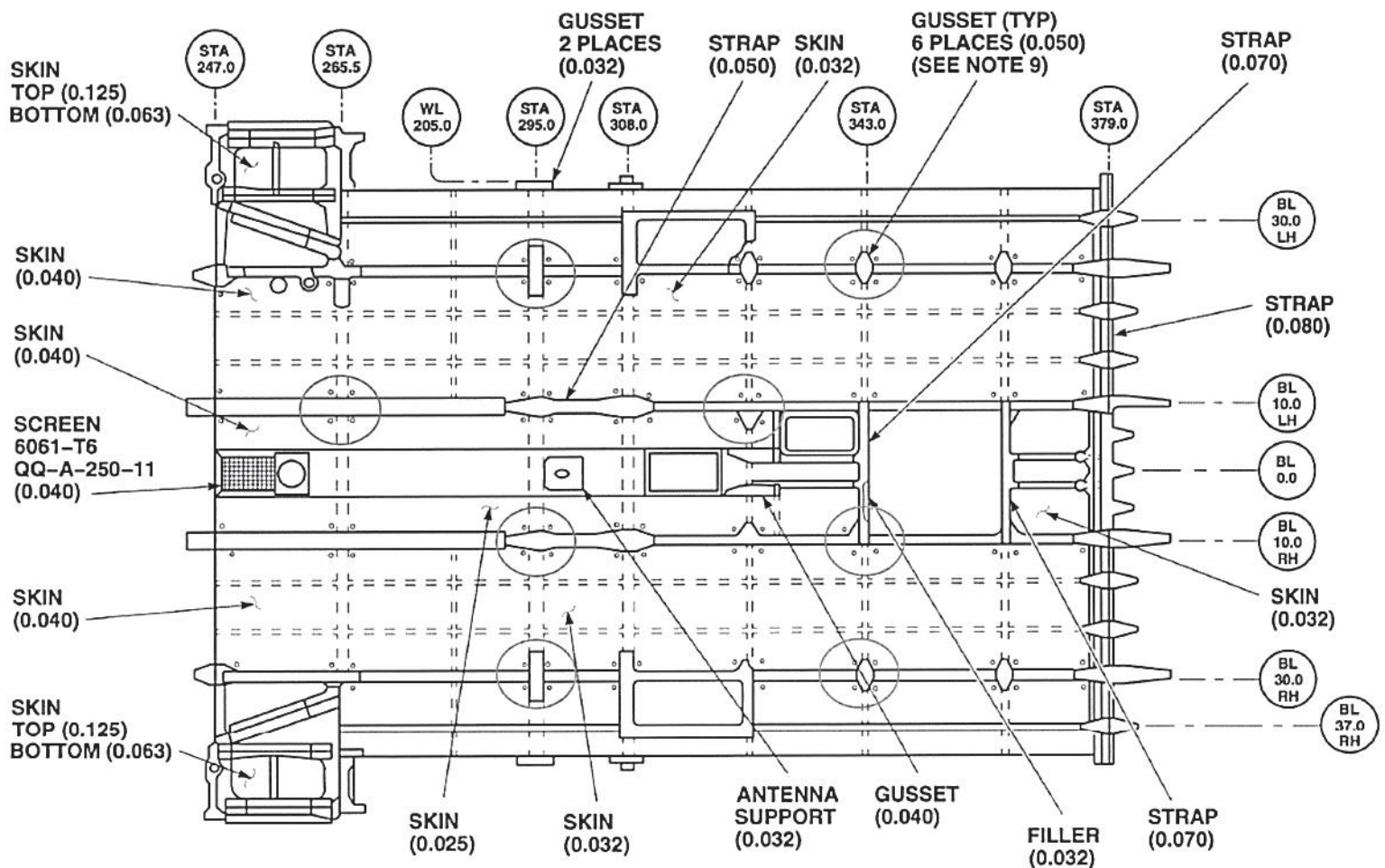
The objectives of the FHA are to consider the functions of the water tank, controls and snorkel system at the most appropriate level and to identify likely failure conditions and the associated classifications while considering both loss of functions and malfunctions. The FHA table identified two (2) failure classifications as major, seven (7) failure classifications as minor and three (3) failure classifications as having no safety effect.

As a result of the water tank, controls and snorkel system being a stand-alone system, failures within the systems would have little to no effect on the continued safe operational capability of the rotorcraft, nor would system failures unduly burden the flight crew's workload. IF there is a failure with the operation of the tank, the pilot can use the E-dump (if practical) to dump the tank contains and return to base as instructed in the RFMS. None of the identified failure conditions were consider to be hazardous or catastrophic. The minor failure conditions have a probability of occurrence of $\leq 1 \times 10^{-3}$ per flight hours and except for the lightning strikes, would not present a significant danger to the rotorcraft or significantly increase the work load of the flight crew.

BLACKHAWK MISSION EQUIPMENT, LLC	BME WATERTANK & SNORKEL	Doc No. BHI-214-101
320 Main Street, Suite 200	FHA / SSA	Revision: A
Carbondale, CO 81623	UH-60 & S-70 Series ROTORCRAFT	Rev Date: 02/03/2020
Prepared By: Richard B Sands	Approved By: Frankie Marrero	Page: 26 of 47

In the event of any water leaks from the tank, it will drain out the main cabin doors, any water that may leak underneath the main cabin floor is drained through drain holes in subfloor skin.

Once the flight crew became aware of a lightning strike, their focuses would be on maintaining continued safe flight as the water tank, controls and snorkel system were designed and installed to protection against lightning strikes. In addition, the rotorcraft itself is certified for lightning strikes. Damage to the rotorcraft, if any, would be assessed on the ground.



LOWER CABIN PLATING-LOOKING UP

The lower cabin subfloor skin has drain holes per type design from the OEM. For ease of identification we have added several red circles to show the hole locations.

BLACKHAWK MISSION EQUIPMENT, LLC	BME WATERTANK & SNORKEL	Doc No. BHI-214-101
320 Main Street, Suite 200	FHA / SSA	Revision: A
Carbondale, CO 81623	UH-60 & S-70 Series ROTORCRAFT	Rev Date: 02/03/2020
Prepared By: Richard B Sands	Approved By: Frankie Marrero	Page: 27 of 47

Once the flight crew became aware of a lightning strike, their focuses would be on maintaining continued safe flight as the water tank, controls and snorkel system were designed and installed to protection against lightning strikes. In addition, the rotorcraft itself is certified for lightning strikes. Damage to the rotorcraft, if any, would be assessed on the ground.

The failure conditions that present the greatest threat to the safe operation of the rotorcraft would be either the water tank becoming dislodged (unsecured) in flight or the snorkel hose snagging on a ground object or obstacle. This would be considered to be a Major failure condition and have a probability of occurrence of $\leq 1 \times 10^{-5}$ per flight hours.

In the unlikely event of the snorkel hose snagging on a ground object or obstacle, the pilot pulls up on the collective in order to detach the snorkel assembly from the tank and aircraft. The snorkel pump assembly will detach from the aircraft/hose assembly if 2,500 lbs. of force is exerted on the snorkel assembly. Damage, if any, to the water tank, snorkel hose assembly and rotorcraft would be assessed by ground personal upon landing.

The other major failure condition would be the failure of the water tank restraint system while in flight. The water tank installation includes an upper and lower tank restraint system. The system utilizes existing tie-down locations in the main cabin. The internal water tank restraint system complies with FAA regulations for crash loads for a full or empty tank. In the unlikely event of the water tank restraints failing, the flight crew would be focused on maintaining safe flight until able to land. The water tank restraint malfunction would be assessed on the ground.

From the analysis of FHA the water tank, controls and snorkel system meet the qualitative assessment requirements of AC 29-2C and ARP4761. The safety assessment provided the necessary assurance that all relevant failure conditions for the water tank, controls and

BLACKHAWK MISSION EQUIPMENT, LLC	BME WATERTANK & SNORKEL	Doc No. BHI-214-101
320 Main Street, Suite 200	FHA / SSA	Revision: A
Carbondale, CO 81623	UH-60 & S-70 Series ROTORCRAFT	Rev Date: 02/03/2020
Prepared By: Richard B Sands	Approved By: Frankie Marrero	Page: 28 of 47

snorkel system were identified, and that all significant combinations of failures that could cause these failure conditions have been considered.

From the assessment presented herein, it has been determined that the failure conditions listed in the FHA were major, minor, and not hazardous or catastrophic, and would not adversely affect the safe flight operation or landing of the rotorcraft. This assessment has demonstrated that the installed water tank, controls and snorkel system installation complies with the requirements of 14 CFR Part 29.1309(a)(b)2,(c)(d)(g)(h).

BLACKHAWK MISSION EQUIPMENT, LLC	BME WATERTANK & SNORKEL	Doc No. BHI-214-101
320 Main Street, Suite 200	FHA / SSA	Revision: A
Carbondale, CO 81623	UH-60 & S-70 Series ROTORCRAFT	Rev Date: 02/03/2020
Prepared By: Richard B Sands	Approved By: Frankie Marrero	Page: 45 of 47

8. ATTACHMENT B – LEAD ACID BATTERY SPECIFICATION AND TSO AUTHORIZATION

...the heart of your aircraft*



CONCORDE
Platinum Series®

Concorde Battery Corporation
2009 San Bernardino Road
West Covina, CA 91790 USA
Phone 626-813-1234 | Fax 626-813-1235
www.concordebattery.com

GENERAL AVIATION AGM AIRCRAFT BATTERY

RG24-15 Specifications

Voltage	24 Volts
Rated Capacity C ₁	13.6 AH
Maximum Weight	29.5 LB / 13.4 KG

Specifications are subject to change without notice

IEC Rated for Peak Power (IPP) & 15 Second Power Rating (IPR)

IPP	IPR	IPP	IPR	IPP	IPR
At 23° C (74° F)		At -18° C (0° F)		At -30° C (-22° F)	
850 A	600 A	575 A	375 A	450 A	350 A

Rated in accordance with International Standard 60952-1

ISO 9001+ AS9100

The data/information contained herein has been reviewed & approved for general release on the basis that this document contains no export controlled information.

TSO AUTHORIZED

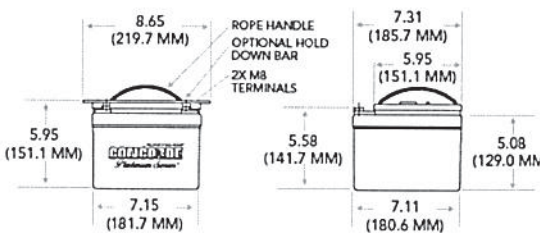
Concorde is a world leader in valve regulated lead acid (VRLA) aircraft batteries. Designed with advanced lead acid technology, the RG® Series (recombinant gas) is constructed with proprietary PolyGuard® separators and AGM (absorbed glass mat) technology that has been adopted by U.S. and foreign military air forces. Concorde's proven reliability and excellent performance has resulted in more certified installations as Original Equipment or Replacements than any other lead acid aircraft battery manufacturer worldwide.

Concorde batteries are engineered by a staff of experts with the distinction of having been selected to write military aircraft battery specifications and participate in setting FAA and International Aircraft Battery Standards. Outstanding customer support is provided by a professional staff with decades of experience in aircraft systems and the aircraft battery industry.

- Copper alloy corrosion free terminals & hardware provide low impedance connections.
- Superior starting power in hot & cold climates.
- Reliable essential power in the event of a generator failure.
- Larger intercell connections optimize outrush current flow & increase charge acceptance.
- Low impedance design.
- Proprietary PolyGuard® separators between the plates for added protection against shock & vibration.
- Non removable vent valves, water replenishment is never required – ever.
- Robust polypropylene containers.
- Fully serviced, tested & ready for installation when shipped from the factory.
- Non-spillable at any attitude.
- Ship Hazmat Exempt whether by land, sea or air.

Platinum Series®

- Extra cranking power resulting in less draw on the battery per cycle for longer battery life.
- Higher voltage output (more work) with less current.
- Lower percentage of drain resulting in more reserve capacity in the case of a generator failure.
- More power to operate avionics and electrical systems, thereby increasing the life of the aircraft's systems.




RG24-15

BLACKHAWK MISSION EQUIPMENT, LLC	BME WATERTANK & SNORKEL	Doc No. BHI-214-101
320 Main Street, Suite 200	FHA / SSA	Revision: A
Carbondale, CO 81623	UH-60 & S-70 Series ROTORCRAFT	Rev Date: 02/03/2020
Prepared By: Richard B Sands	Approved By: Frankie Marrero	Page: 46 of 47



U.S. Department
of Transportation

**Federal Aviation
Administration**

May 8, 2017

**Transport Airplane Directorate
Los Angeles Aircraft
Certification Office**

3960 Paramount Boulevard
Lakewood, California 90712-4137

In reply refer to: 130L-17-108

Mr. John Timmons
Concorde Battery Corporation
2009 San Bernardino Road
West Covina, California 91790

Concorde Battery Corporation
Lead Acid Batteries
Technical Standard Order C173a

Dear Mr. Timmons:

This is in reply to your letter dated April 18, 2017 requesting approval of a Technical Standard Order (TSO) authorization for your Lead Acid Batteries. We accept your statement certifying that your article meets the requirements of TSO-C173a and that you meet the requirements of Title 14 Code of Federal Regulations part 21 subpart O. Effective the date of this letter, we authorize you to identify the following Lead Acid Batteries with the marking requirements defined in 14 CFR § 45.15(b) and in TSO-C173a.

<u>Part Number</u>	<u>Description</u>
RG24-15 RG24-15M RG24-16	Lead Acid Battery

We consider your quality systems, as defined in your Quality Control Manual, currently on file at the Los Angeles Manufacturing Inspection District Office, is considered satisfactory and complies with 14CFR § 21.607 for production of this article at your facility located at 2009 San Bernardino Road, West Covina, CA 91790.

As required by the TSO, the following statement must be furnished with each manufactured unit:

The conditions and tests required for TSO approval of this article are minimum performance standards. Those installing this article either on or within a specific type or class aircraft must determine that the aircraft installation conditions are within the TSO standards which include any accepted integrated non-TSO functions. TSO articles and any accepted integrated non-TSO functions(s) must have separate approval for installation in an aircraft. This article may be installed only according to 14 CFR part 43 or the applicable airworthiness requirements.

BLACKHAWK MISSION EQUIPMENT, LLC	BME WATERTANK & SNORKEL	Doc No. BHI-214-101
320 Main Street, Suite 200	FHA / SSA	Revision: A
Carbondale, CO 81623	UH-60 & S-70 Series ROTORCRAFT	Rev Date: 02/03/2020
Prepared By: Richard B Sands	Approved By: Frankie Marrero	Page: 47 of 47

This TSO authorization, issued under 14 CFR § 21.611, is effective until surrendered, withdrawn or otherwise terminated under the provisions of 14 CFR § 21.613. With notice, we may withdraw this TSO authorization if articles are not in compliance with the applicable TSO performance standards per 14 CFR § 21.2.

You must obtain FAA approval prior to making any changes to the location of your manufacturing facilities pursuant to 14 CFR § 21.609(b).

Without further FAA approval, we don't allow manufacturers to mark articles after they change their company's name, address, or ownership. You must notify the ACO and MIDO of name, address, or proposed ownership changes.

Per 14 CFR 21.614, a holder of a TSOA may not transfer it. If you wish to transfer it, you must request a transfer from the FAA.

Send to the office below any design change(s) for this TSO article as outlined in 14 CFR 21.619(a). You should notify us of minor design changes within six (6) months.

Also, as recipient of this authorization, we require you to report any failure, malfunction, or defect relating to articles produced under this authorization in accordance with the provisions of 14 CFR 21.3. The report should be communicated initially by telephone to the Manager, Manager, Technical and Administrative, ANM-103L, (562) 627-5300, within 24 hours after it has been determined the failure has occurred and followed up with a written notice. Federal Aviation Administration Form 8010-4 (Malfunction or Defect Report) or other appropriate format is acceptable in transmitting the required details.

Please note that technical data the FAA retains may be subject to Freedom of Information Act (FOIA) requests. This office will notify you of any request(s) pertaining to your data and give you the opportunity to protect the data from public disclosure.

If you have any questions regarding this authorization, please contact Mr. William Coveney, Project Manager, by telephone at (562) 627-5211, by e-mail at William.Coveney@faa.gov, or by fax at (562) 627-5210.

Sincerely,



Steven Bogucki
Manager, Technical and Administrative
Support Staff

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
STATEMENT OF COMPLIANCE WITH AIRWORTHINESS STANDARDS

1. DATE
05 February 2020

AIRCRAFT OR AIRCRAFT COMPONENT IDENTIFICATION

2. MAKE See note 4	3. MODEL NO. See note 4	4. TYPE (Aircraft, Engine, Propeller, etc.) Helicopter	5. NAME OF APPLICANT Blackhawk Mission Equipment, LLC
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LIST OF DATA

6. IDENTIFICATION	7. TITLE
BME-214-101 REV A DATED 1/16/20	"FHA & SSA for the Internal Water Tank & Snorkel on the BME UH-60 and S-70 Series Rotorcraft" ----- NOTES: 1. Approval is for electrical systems and equipment engineering (lightning protection standards) aspects of the data at the revision level shown and i not installation approval. 2. Approval is in support of FAA STC Project no. ST7314DE-R 3. This form does not constitute FAA approval of all engineering data necessary for substantiation of compliance to necessary requirements for the entire STC installation. 4. Applicable Make and Models: BHI H60 Helicopters, LLC (UH-60A) Sikorsky Aircraft Corporation (S-70A & S-70C)

8. PURPOSE OF DATA

Recommend approval electrical aspects lightning and HIRF data in support of FAA STC Project No. ST7314DE-R

9. APPLICABLE REQUIREMENTS (List specific sections)

14 CFR 29.1309(h) Amendt.29-24

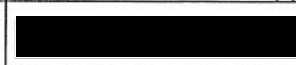
10. CERTIFICATION - Under authority vested by direction of the Administrator and in accordance with conditions and limitations of appointment under 14 CFR Part 183, data listed above and on attached sheets numbered _____ have been examined in accordance with established procedures and found to comply with applicable requirements of the Airworthiness Standards listed.

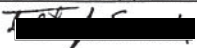


Recommend approval of these data

I (We) Therefore

Approve these data

11. SIGNATURE(S) OF DESIGNATED ENGINEERING REPRESENTATIVE(S)	12. DESIGNATION NUMBERS(S)	13. CLASSIFICATION(S)
		Electrical Systems & Equipment
Billy Martin		(Lightning Protection)

U.S. DEPARTMENT OF TRANSPORTATION FEDERAL AVIATION ADMINISTRATION STATEMENT OF COMPLIANCE WITH AIRWORTHINESS STANDARDS		1. DATE February 17, 2020	
AIRCRAFT OR AIRCRAFT COMPONENT IDENTIFICATION			
2. MAKE See note 4	3. MODEL NO. See Note 4	4. TYPE (Airplane, Radio, Helicopter, etc.) Helicopter	5. NAME OF APPLICANT Blackhawk Mission Equipment, LLC Leesburg, FL
LIST OF DATA			
6. IDENTIFICATION BME Document: BHI-214-101 Rev. A, Dated: 02/03/2020	7. TITLE FUNCTIONAL HAZARD ASSESSMENT AND SYSTEM SAFETY ASSESSMENT FOR THE INTERNAL WATER TANK AND SNORKEL ON THE BLACKHAWK MISSION EQUIPMENT, LLC UH-60 & S-70 SERIES ROTORCRAFT End of Data NOTES: 1. Approval is for mechanical systems and equipment engineering (mechanical E-dump) aspects of the design data at the revision level shown and is not installation approval. 2. Approval is in support of FAA Project ST7314DE-R 3. This form does not constitute FAA approval of all engineering data necessary for substantiation of compliance to necessary requirements for the entire STC installation. Additional Electrical and Lightning approvals required for this document. 4. Applicable Make and Models: BHI H60 Helicopters, LLC; UH-60A, Sikorsky Aircraft Corporation; S-70A, S-70C.		
8. PURPOSE OF DATA Presents FHA/SSA in support of FAA Project ST7314DE-R.			
9. APPLICABLE REQUIREMENTS (List specific sections) 14 CFR 29.1309(b)(2)(c)(d) Amdt 29-24.			
10. CERTIFICATION - Under authority vested by direction of the Administrator and in accordance with conditions and limitations of appointment under 14 CFR Part 183, data listed above and on attached sheets numbered <u>N/A</u> have been examined in accordance with established procedures and found to comply with applicable requirements of the Airworthiness Standards listed. ☐ Recommend approval of these data ☒ Approve these data I (We) Therefore			
11. SIGNATURE(S) OF DESIGNATED ENGINEERING REPRESENTATIVE(S) 	12. DESIGNATION NUMBERS(S) D	13. CLASSIFICATION(S) Systems & Equipment (Mechanical)	
T. J. Seach			

U.S. DEPARTMENT OF TRANSPORTATION FEDERAL AVIATION ADMINISTRATION STATEMENT OF COMPLIANCE WITH AIRWORTHINESS STANDARDS			1. DATE February 13, 2020
AIRCRAFT OR AIRCRAFT COMPONENT IDENTIFICATION			
2. MAKE See Note 5	3. MODEL NO. See Note 5	4. TYPE (Aircraft, Engine, Propeller, etc.) Helicopter	5. NAME OF APPLICANT Blackhawk Mission Equipment, LLC
LIST OF DATA			
6. IDENTIFICATION Blackhawk Mission Equipment: Analysis Document No: BHI-214-101 Rev A, Dated: 02/03/2020 =====	7. TITLE Functional Hazard Assessment and Safety Assessment for the Internal Water Tank and Snorkel on the Black Hawk Mission LLC UH-60 & S-70 Series Rotorcraft ===== END=====		
NOTES: 1. The above data is approved for the electrical aspects only. This approval does not address the structural aspects of the STC. 2. Approval is in support of FAA STC Project No. ST7314DE-R. 3. This form does not constitute FAA approval for all engineering design data necessary for substantiation of compliance to the necessary requirements for this STC. 4. Compliance with additional regulations not listed herein may be required. 5. Applicable Makes and Models: • BHI H60 Helicopters, LLC (UH-60A) • Sikorsky Aircraft Corporation (S-70A & S-70C)			
8. PURPOSE OF DATA: In support of FAA STC Project No. ST7314DE-R			
9. APPLICABLE REQUIREMENTS (List specific sections) 14 CFR Part 29.1309(a)(g) [Amdt 29-24]			
10. CERTIFICATION - Under authority vested by direction of the Administrator and in accordance with conditions and limitations of appointment under 14 CFR Part 183, data listed above and on attached sheets numbered <u> N/A </u> have been examined in accordance with established procedures and found to comply with applicable requirements of the Airworthiness Standards listed. ☒ Recommend approval of these data I (We) Therefore ☐ Approve these data			
11. SIGNATURE(S) OF DESIGNATED ENGINEERING REPRESENTATIVE(S) Richard B Sands	12. DESIGNATION NUMBER(S) 	13. CLASSIFICATION(S) Systems & Equipment - Electrical	

the 'information' and 'communication' fields. The 'information' field is defined as:

...the study of the processes of information production, distribution, access, use and evaluation, and the study of the social, cultural, economic and political contexts in which these processes take place. (p. 1)

The 'communication' field is defined as:

...the study of the processes of communication production, distribution, access, use and evaluation, and the study of the social, cultural, economic and political contexts in which these processes take place. (p. 1)

The 'information' field is defined as:

...the study of the processes of information production, distribution, access, use and evaluation, and the study of the social, cultural, economic and political contexts in which these processes take place. (p. 1)

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