

## System Safety Assessment - Helicopters

### Helicopter System -Aircraft

Sub-System	Hazards	Pre-mitigation			Mitigation	Post-mitigation		
		Likelihood	Severity	Outcome		Likelihood	Severity	Outcome
Capabilities	High DA will overgross the aircraft	Occasional	Catastrophic	High	Use appropriate aircraft for mission. Conduct thorough pre-mission planning, load calculations, etc. Reinforce HHH Training.	Remote	Catastrophic	Serious
	AC not appropriate for mission. ICS Typing	Occasional	Critical	Serious	Ensure appropriate aircraft is ordered & utilized. Conduct thorough pre-mission planning, load calculations, etc.	Remote	Critical	Medium
	Mechanical failure - flight component	Remote	Catastrophic	Serious	Follow IHOG Policy Ch 14 Sched Maint, Pre & Post Flight, etc.	Remote	Catastrophic	Serious
	Equipment not well maintained & operational	Occasional	Critical	Serious	Follow IHOG Policy Ch 9. Ensure personnel receive adequate basic training.	Occasional	Marginal	Medium
Visibility	Lack of Hi Vis AC Markings	Occasional	Catastrophic	High	Identify paint schemes that are NOT highly visible & add that to the contract as NOT approved.	Improbable	Catastrophic	Medium
Inspection	Lack of standardization of Gov't Inspectors	Frequent	Critical	High	Recommend development & implement of Interagency Standardized inspection process. If one Agency does not approve an aircraft or contractor for operation other agencies should follow and accept that decision.	Occasional	Critical	Serious
	Level of Training for HEMGs on inspection process is inadequate	Frequent	Marginal	Serious	Develop training for HEMGs on MEL, maintenance buzz words (Watch-Outs). Act on opportunity for HEMGs to attend inspections.	Occasional	Marginal	Medium
Equipment	Personnel not proficient with equipment	Frequent	Marginal	Serious	Inspectors ensure Contractors (Pilots) are adequately trained & skilled with equipment provided. Ensure contract language requires equipment to be commensurate with current technology.	Occasional	Marginal	Medium
Maintenance	Maintenance in the field	Frequent	Critical	High	Fly aircraft to shop/hanger for maintenance whenever possible. Allow adequate time for mechanics to work in field. Provide light/power/water if possible.	Remote	Critical	Medium
	Lack of thorough documentation	Occasional	Critical	Serious	Develop training for HEMGs on MEL, maintenance buzz words (Watch-Outs). Enhance awareness through training for HEMGs on when to call MI for assistance with Contractor & maintaining equipment.	Remote	Critical	Medium
	Poor Communications between all parties (Contractor, GACC,CO, ACO, COR, PI, MI, HEMG)	Frequent	Critical	High	Enhance and integrate tracking of maintenance records AND Contract Evaluations of the a/c over the duration of the contract period in order to recognize issues-CWN & Ex Use. Hire additional Maintenance Inspectors to keep up with this increased workload.	Occasional	Critical	Serious

Helicopter System - Facilities (permanent and temporary)								
Sub-System	Hazards	Pre-mitigation			Mitigation	Post-mitigation		
		Likelihood	Severity	Outcome		Likelihood	Severity	Outcome
Communications	Lack of adequate base station VHF & FM radios-Not able to adequately communicate to helicopters out working missions/projects with handheld radios.	Occasional	Critical	Serious	Provide all Ex Use crews with mounted FM & AM radios on chase trucks (NOT just handhelds). Utilize Ex Use crews more often on incidents because they have the support equipment. Helibase Commo trailers should be on a National Contract instead of Geographic Area in order to lower cost.	Remote	Critical	Medium
	Lack of adequate computers-not able to access necessary flight planning, ABS, and weather documents prior to missions.	Frequent	Critical	High	Have Cache computers available for Incident/Unit personnel to check out that are Intranet accessible. These computers should be able to access Internet as well for Weather updates, TFR information, filing of flight plans, completing electronic payment forms, etc. <b>Ensure ALL Ex Use bases have Internet as well as Intranet access in order to access critical WX, TFR &amp; Flight Planning information.</b>	Remote	Critical	Medium
Environment	Haz Mat concerns/spills-Lack of adequate spill prevention/mitigation equipment on site and the knowledge to utilize it.	Frequent	Marginal	Serious	Provide permanent as well as temporary helibases with approved Haz Mat storage facilities/equipment. Solicit for National Contracts to provide portable haz mat storage facilities for Incidents	Remote	Marginal	Medium
Inspection/Evaluation	Lack of Accountability/Follow Up on Annual/Triennial Helibase Reviews	Probable	Marginal	Serious	Hold Management accountable to conduct follow up and remedy critical issues found in reviews and adhere to interagency and OSHA standards.	Remote	Negligible	Low

Helicopter System - Personnel (Government)								
Sub-System	Hazards	Pre-mitigation			Mitigation	Post-mitigation		
		Likelihood	Severity	Outcome		Likelihood	Severity	Outcome
Utilization	Span of Control/Collateral Duties. Personnel are often tasked with multiple duties especially during the emergence of an incident. Focused on Task at hand & not able to provide adequate oversight.	Probable	Catastrophic	High	Ensure existing staffing, supervision and management policies & procedures are met. Place aviation resource needs at higher priority level in the resource ordering process. Need to ensure situation is recognized & ensure additional resources/supervision is ordered. Limit collateral duties in key supervisory positions. If unable to fill key positions operations will be shut down or limit use of aircraft until span of control issues are resolved.	Remote	Catastrophic	Serious
Policy	Operational and mission goals during all-hazard assignments may be unstated or unclear and may conflict with interagency standards and policy	Probable	Critical	High	Adequate in-brief and dissemination of Commander's intent. Clarification of scope of authority & policy in place. Adhere to interagency policy, procedures and guidelines (e.g., IHOG). If unable to perform duties utilizing interagency policy, perform a separate Risk Assessment with appropriate approval sign off. Ensure personnel are working within the scope of their employment. Implementation of Aviation Doctrine may further mitigate conflicts between direction and policy.	Occasional	Critical	Serious

Training	Unable to bring seasonals on early enough to provide all the required training prior to sending on incidents	Frequent	Critical	High	Ensure line officers are committed to providing adequate time and funding to develop personnel as necessary.	Occasional	Critical	Serious
	Lack of CRM	Probable	Critical	High	Provide adequate time for training and provide time for Modules to develop CRM prior to field season. Provide training in CRM for Modules annually. Brief/debrief, maintain positive attitude.	Occasional	Critical	Serious

### Helicopter System - Personnel (Government) - Continued

Sub-System	Hazards	Pre-mitigation			Mitigation	Post-mitigation		
		Likelihood	Severity	Outcome		Likelihood	Severity	Outcome
Human Factors	Fatigue/burnout due to incident duration as well as year round All Risk incident support .	Probable	Critical	High	Adhere to work/rest guidelines. Monitor fatigue levels of crews. Rotate personnel and helicopter programs to manage fatigue and burnout. Manage number and duration of assignments. Ensure adequate time off and provide quality R & R while on assignments.	Occasional	Critical	Serious
	Acceptance of high risk missions as normal.	Probable	Catastrophic	High	Review risk assessment & existing policy/procedures, brief/debrief with all personnel and utilize risk management tools to include Go-No-Go Checklists. Educate personnel on the hazards of normalization of risk and complacency. Mission decision made at appropriate level. Must have better communication and collaboration between Operations and Aviation.	Remote	Catastrophic	Serious
	High workload for Maintenance Inspectors may compromise their ability to perform thorough inspections. Standard inspections criteria not followed consistently among agencies or regions.	Probable	Critical	High	Increase amount of personnel available to perform the duties of Maintenance Inspector in proportion with span of control. Ensure inspection standards are developed and maintained by agencies.	Remote	Critical	Medium
	Conflicting personalities resulting in hazardous attitudes.	Occasional	Critical	Serious	If individuals cannot professionally resolve differences, managers and supervisors must intervene immediately. Brief/debrief, employ CRM, provide honest and objective feedback, maintain positive attitude. Maintain professionalism and mission focus at all times.	Remote	Critical	Medium

### Helicopter System - Personnel (Contractors)

Sub-System	Hazards	Pre-mitigation			Mitigation	Post-mitigation		
		Likelihood	Severity	Outcome		Likelihood	Severity	Outcome
Training/Experience	Inadequate/falsification of documentation	Occasional	Catastrophic	High	Adhere to existing contract requirements requiring Contractors to validate pilots' experience and training. Ensure HIPs review pilots' experience records.	Remote	Catastrophic	Serious
	Lack of training in Firefighting strategy, tactics, terminology, basic ICS, frequency mgmt, etc.	Probable	Critical	High	Establish requirements for documentation of online training to meet basic, minimum level of knowledge for all contracts. Consider pilot academy.	Occasional	Critical	Serious
	Pilots unfamiliar and not proficient using and programming contract required radio and navigation equipment	Frequent	Marginal	Serious	Inspectors ensure Contractors (Pilots) are adequately trained & skilled in use and programming of avionics equipment. Ensure contract language requires equipment to be commensurate with current technology.	Occasional	Marginal	Medium
Pilot Experience & Capabilities	Low flight time/experienced pilots	Probable	Critical	High	Develop, implement and support a pilot mentoring program in appropriate contracts. Consider pilot academy.	Occasional	Critical	Serious

### Helicopter System - Personnel (Contractors) - Continued

Sub-System	Hazards	Pre-mitigation			Mitigation	Post-mitigation		
		Likelihood	Severity	Outcome		Likelihood	Severity	Outcome
Human Factors	Fatigue	Probable	Critical	High	Managers work with company personnel to ensure adequate rest. Manage missions to be most effective with proper use of pilots & aircraft. Implement Phase Duty Limitations as appropriate.	Remote	Critical	Medium
	Acceptance of high risk missions as normal.	Probable	Catastrophic	High	Conduct thorough risk assessments & brief/debrief. Pilot and Helicopter Manager train in CRM and work together on mission planning. Mission approval made at appropriate level.	Occasional	Catastrophic	High
	Low CRM with crew rotations (multiple relief pilots)	Frequent	Critical	High	Ensure there incoming crews are thoroughly briefed. Practice CRM, conduct effective AARs, etc. Enforce contract language regarding relief pilot/personnel changes.	Occasional	Critical	Serious
	Conflicting personalities	Occasional	Critical	Serious	Brief/debrief, CRM, honest feedback, maintain positive attitude and professionalism. Immediately take action. Notify Contracting Officer/Inspector Pilot. <b>Don't let problem persist.</b>	Remote	Critical	Medium
	Sense of urgency/pressure/mission driven	Probable	Critical	High	Ensure Managers are not placing undue pressure on pilot. Thorough risk assessment & brief/debrief. Pilot training in CRM with the Helicopter Manager. Pilot participate in Mission development. Mission decision made at appropriate level.	Occasional	Critical	Serious
	Pre-flight/Post-flight inspections not thorough	Occasional	Catastrophic	High	Managers ensure adequate <b>REVENUE</b> time for Inspections. Ensure Managers are briefed/trained on the contract & realize that Contractors do get paid for this time. Encourage Pilot/Mechanic to utilize time to complete Inspections.	Remote	Catastrophic	Serious

### Helicopter System - Technology

Sub-System	Hazards	Pre-mitigation			Mitigation	Post-mitigation		
		Likelihood	Severity	Outcome		Likelihood	Severity	Outcome
Utilization	Lack of standardization of equipment	Frequent	Critical	High	Allow time for the pilot, mechanic, and Helicopter Manager to conduct thorough pre-use familiarization with cockpit layout and avionics equipment.	Remote	Critical	Medium
	Some pilots do not know how to operate radios, GPS, etc. Managers not familiar with equipment.	Probable	Critical	High	Train all personnel to be proficient in the use of avionics equipment on the helicopter as per contract requirements. Provide computer based or hands-on training for various models of GPS units and radios for helicopter managers.	Remote	Critical	Medium
Human Factors	Cockpit overload, pilots flying, programming radios/GPS, dropping water, talking on three different radios, etc.	Frequent	Critical	High	Experience, OJT w/experienced supervision (HIP or Chief Pilot), CRM-work with experienced Helicopter Manager. Ensure appropriate levels of aerial supervision are in place. Encourage pilots to speak up when starting to get overloaded. Discuss safety options with the pilot.	Occasional	Critical	Serious

Helicopter System - Operations								
Sub-System	Hazards	Pre-mitigation			Mitigation	Post-mitigation		
		Likelihood	Severity	Outcome		Likelihood	Severity	Outcome
Missions	Multi tasking-Pilot, Helicopter Manager, Helibase Manager, Helitack Crew personnel, fueler.	Frequent	Critical	High	Ensure existing staffing, supervision and management policies & procedures are met. Order resources early when the need is anticipated. Dispatchers need to recognize aviation staffing is a critical safety priority. Limit collateral duties in key supervisory positions. If unable to fill key positions, operations will be shut down or use of aircraft will be limited until span of control issues are resolved.	Occasional	Critical	Serious
	Complexity beyond capabilities/experience of available resources	Probable	Critical	High	Disengage, reassess & realign objectives until appropriate level of supervision is present. Conduct risk analysis. Ensure situation is recognized & ensure appropriate supervision/resources are ordered. Provide OJT and conduct frequent simulations of highly complex situations.	Occasional	Critical	Serious
	Poor Aviation Strategy (poor risk vs. reward, heli-mopping, overuse-are there alternative ways of doing this)	Frequent	Catastrophic	High	Utilize safe and effective strategy & tactics. Involve pilot in mission planning. Conduct thorough risk assessment prior to mission. Brief/debrief. Seek appropriate level of approval for high risk missions, i.e. Helicopter Manager, IC, District Manager, Forest Supervisor, etc. Involve Aviation overhead with operational planning of strategies and tactics for the Appropriate Management Response. Avoid risk/exposure transference.	Remote	Catastrophic	Serious
	Jurisdiction/Borders-Mid Air collision avoidance	Frequent	Catastrophic	High	Boundary Airspace Plan developed/utilized. Follow FTA procedures. Utilize airspace coordinator. <b>COMMUNICATE.</b> Establish TFRs as needed. See & Avoid. Utilization of TCAS. Make AFF a requirement on all aircraft contracts.	Remote	Catastrophic	Serious
	Low level flight profile-below 500', Special Use (recons, aerial survey, game count, mapping, etc)	Occasional	Catastrophic	High	Conduct thorough risk assessment training. Thorough risk assessment/mission plan/performance planning is completed and signed at the appropriate level. Minimize exposure time. Utilize Part 27 certificated T3 helicopters. Ensure that the appropriate PPE/ALSE is used and that the flight is limited to essential flightcrew members. Ensure aircraft and pilot are carded for the mission. Conduct high level recon prior to working below 500' AGL.	Remote	Catastrophic	Serious
	PASP/Go-NO-Go Checklist absent or not complete (Policy Deviation)	Occasional	Critical	Serious	Ensure PASP and risk assessment are completed and approved at appropriate level. Ensure Unit Aviation Managers and Forest Aviation Officers are involved in mission planning when necessary. PASP should be used as a briefing tool. Stress that on the "GO/NO-GO" checklist a "NO GO" halts the operation. Ensure that if there are multiple briefings that all information is given at the primary briefing.	Remote	Critical	Medium
Management Decisions	Incident Management Team strategies shift risk from ground operations to aviation operations.	Frequent	Catastrophic	High	Utilize safe and effective strategy & tactics. Involve Pilot in mission planning. Conduct thorough risk assessment prior to mission. Brief/debrief. Acquire appropriate-level approval signatures for high-risk complex missions; i.e. Helicopter Manager, IC, District Manager, Forest Supervisor, etc. Involve Aviation overhead with Operational planning of strategy and tactics for the Appropriate Management Response. Avoid risk/exposure transference.	Remote	Catastrophic	Serious

<b>Utilization</b>	Inefficient or improper use of Aircraft for the assigned mission (wrong aircraft selected for a mission, flying without tactical/logistical objectives, etc.)	Frequent	Critical	High	Use only an appropriate aircraft for the mission. Conduct thorough pre-mission planning and load calculations. Ensure that tactical/logistical missions have clear, obtainable goals (i.e., Appropriate Aviation Management Response is used). Aircraft assigned should be based on performance and capabilities.	Occasional	Critical	Serious
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### Helicopter System - Operations - Continued

Sub-System	Hazards	Pre-mitigation			Mitigation	Post-mitigation		
		Likelihood	Severity	Outcome		Likelihood	Severity	Outcome
<b>Environment</b>	Weather: Poor Visibility/Thunder storms/Hot-High DA/Turbulence	Frequent	Catastrophic	High	Obtain most current/accurate weather reports available. Conduct risk assessment & determine need to conduct mission. Wait until conditions improve. Follow policy on visibility, wind speed, updating load calcs, etc. Utilize part 27 certificated T3 helicopters or better. Establish trigger points to stop operations.	Remote	Catastrophic	Serious
	Mountainous Terrain	Frequent	Catastrophic	High	Ensure Pilot is trained, experienced & qualified/carded. Non-local flight crews obtain thorough briefing on local conditions before starting operations. Aircraft appropriate for the mission. Performance planning is completed for environmental conditions. Consider dual pilot operations or utilize a mentor pilot for low experience pilots.	Remote	Catastrophic	Serious
	Urban Interface: Wires, General Aviation Traffic, Major Airport Traffic, Communications, Congestion, High Complexity	Probable	Catastrophic	High	Conduct thorough briefings. Review/establish Interagency agreements. Provide pre-season briefing for Media aircrews. Preplan dipsites, staging area, helispots, etc. Update aerial hazard maps. Establish TFRs & issue NOTAMs as appropriate. Require dipsite management. Order/utilize aerial supervision (HLCO). Perform Airspace deconfliction and coordination. Provide frequency and airspace management training. Complexity is managed at appropriate level.	Remote	Catastrophic	Serious
<b>Communications</b>	Lack of Compatibility (Banding/Frequencies)	Probable	Critical	High	Utilize Unified Command. Review/establish interagency agreements to reduce/eliminate compatibility issues. Continue education/training.	Remote	Critical	Medium
	Frequency management - lack of timely response for Incident Support to obtain additional frequencies.	Probable	Critical	High	Evaluate prior reviews and conduct additional national Interagency reviews of frequency management. Release frequencies back to NICC as soon as they are no longer needed. Encourage Dispatch offices to order additional frequencies early in emerging incidents.	Occasional	Critical	Serious
	Cockpit overload	Frequent	Critical	High	Encourage pilots to speak up when starting to get overloaded. Discuss safety options with the pilot. Practice division of workload and CRM on incidents and in simulations.	Occasional	Critical	Serious
	Inadequate briefing	Occasional	Critical	Serious	Stress to Managers & Pilots the need to slow down & ensure adequate briefings. Follow Policy and guidelines, use existing checklists (IHOG, IRPG, etc) as a minimum. Solicit feedback, reiterate information given, use of maps, IAPS, and frequency lists. Ensure AARs are being conducted and documented.	Remote	Critical	Medium

<b>Training</b>	Lack of training for specialized missions i.e. rehab (Bale dropping, waddle placement), guzzler placement, etc.	Occasional	Critical	Serious	Consider and encourage using End Product Contracts. When end-product is not feasible, develop standardized description of how to sling unusual items. Develop a source list for approved equipment. Utilize PASPs. Utilize subject matter experts. Use "Tech Tips" to share information/procedures.	Remote	Critical	Medium
	Lack of standardized training with non-Federal cooperators (non-standard terminology, target description, resource capability & limitations)	Probable	Critical	High	Promote joint training with non-Federal cooperators. Ensure thorough briefings are conducted prior to starting operations. Check Incident Qualification cards.	Remote	Critical	Medium
<b>Human Factors</b>	Lack of Crew Resource Management (CRM)	Probable	Critical	High	Training, Brief/debrief, maintain positive attitude. Promote and attend formalized CRM training for contractors as well as agency employees. Include CRM training/topics at Helicopter Manager Workshops (RT-372). Include CRM as part of the training curriculum for S-372.	Occasional	Critical	Serious

## System Safety Assessment - Rappel

### Rappel System - Aircraft

		Pre-mitigation			Mitigation	Post-mitigation		
Sub-System	Hazards	Likelihood	Severity	Outcome		Likelihood	Severity	Outcome
Adequate Screening/Evaluation	Lack of Standardization	Frequent	Critical	High	Develop National Rappel Standards/Evaluation Board.	Remote	Critical	Medium
	Aircraft perform near limits of capabilities due to mission, payload, and environment	Occasional	Catastrophic	High	Create national rappel specifications template for Schedule B. Utilize SMEs - Helicopter managers/HOSs/rappel specialists when developing aircraft contract specifications/modifications	Remote	Catastrophic	Serious
Performance, Capabilities, Limitations	Operating close to performance limitations of aircraft (weight/balance, DA, height/velocity curve, CG)	Frequent	Catastrophic	High	Strict compliance with flight manual and increased awareness training of aircraft performance for helicopter managers and proper mission planning. Continue using high performance Type 2 Helicopters and Part 27 Type 3 Helicopters.	Remote	Critical	Medium
	Pilot visibility/vertical & horizontal reference.	Occasional	Critical	Serious	Develop National screening/evaluation process, identify minimum standards for visibility in rappel aircraft	Remote	Critical	Medium
	Pilot moving from right to left seat to fit mission in Bell medium helicopters.	Occasional	Critical	Serious	Ensure that Schedule B contract language is standardized Nationally for Type 2 Helicopters.	Remote	Critical	Medium
Equipment	Rappel anchor failure	Remote	Catastrophic	Serious	Ensure anchor is approved with proper & valid STCs, tested annually, installed correctly, and inspected at manufacturer's recommendations.	Improbable	Catastrophic	Medium
	Spotter anchor failure	Occasional	Catastrophic	High	Ensure anchor is approved with proper & valid STCs, tested annually, installed correctly, and inspected at manufacturer's recommendations.	Improbable	Catastrophic	Medium
	Aircraft modifications improperly installed/false documentation	Remote	Catastrophic	Serious	Thorough maintenance inspections, verification of STC documentation and compliance, increased training for helicopter managers.	Improbable	Catastrophic	Medium
	ICS communications not available to all rappellers	Occasional	Critical	Serious	National rappel template for Schedule B.	Improbable	Critical	Medium
Communications	Spotter cannot independently manipulate FM radios from back seat (pilot task saturation)	Occasional	Critical	Serious	Audio panel conveniently available for pilot and spotter to individually manipulate.	Remote	Critical	Medium
Configuration	Doors off flight; crash survivability	Remote	Catastrophic	Serious	Minimize doors off operation to essential missions only, create doors off checklist for IHOG and IHRG.	Improbable	Catastrophic	Medium
	Doors off flight; non secured items	Remote	Catastrophic	Serious	Training on proper storage of equipment when flying with doors off. Create doors off checklist for IHOG and IHRG.	Improbable	Catastrophic	Medium
	External basket security	Remote	Catastrophic	Serious	Assure security of external loads prior to mission.	Improbable	Catastrophic	Medium

<b>Maintenance</b>	Lack of compliance with AD's, manufacture's inspections	Remote	Catastrophic	Serious	Strict compliance with flight manual, increased awareness training of maintenance requirements and AD's for helicopter managers, spot inspections of aircraft. <b>Recommend all rappel contract helicopters require a mechanic.</b>	Improbable	Catastrophic	Medium
<b>Aircraft Health</b>	Undetected corrosion, stress crack, structural. limited, and/or unknown amount of aircraft health testing and monitoring being performed on current aircraft (fatigue, corrosion, airframe, etc.).	Remote	Catastrophic	Serious	Ensure Maintenance Inspectors are conducting thorough reviews of aircraft maintenance logs	Improbable	Catastrophic	Medium

### Rappel System - Equipment

Sub-System	Hazards	Pre-mitigation			Mitigation	Post-mitigation		
		Likelihood	Severity	Outcome		Likelihood	Severity	Outcome
<b>Common factors</b>	Misuse/mistreatment	Occasional	Catastrophic	High	Education, supervision for following equipment use standards. When in doubt about equipment's usage, retire it.	Remote	Catastrophic	Serious
	Use of non-standard equipment	Occasional	Critical	Serious	Maintain current equipment standards for rappel equipment, only utilize approved rappeling equipment, random peer inspections	Remote	Critical	Medium
	Improper inspections	Occasional	Catastrophic	High	Education, supervision for following equipment inspection standards (IHRG)	Remote	Catastrophic	Serious
	Improper rigging	Occasional	Catastrophic	High	Proper training. Standardization. Maintain currency, proficiency, checks and balances. Place photos of correct model specific rigging on national rappel website and in IHRG.	Remote	Catastrophic	Serious
	Inconsistent documentation	Occasional	Critical	Serious	Education, supervision for following equipment documentation standards, random inspections. Utilize rap records database.	Remote	Critical	Medium
	Not following established procedures/policy	Occasional	Critical	Serious	Peer monitoring, annual base reviews, accountability at all levels for compliance, follow-up of action items. Mandatory attendance of spotters to biennial rappel workshop or rappel academy.	Remote	Critical	Medium
<b>Spotter tether/Gunner strap</b>	Improper adjustment	Occasional	Critical	Serious	Initial set-up of gunner straps and spotter tethers for specific model aircraft, pre-mission check. Post photos of correct adjustments on national rappel website and IHRG.	Remote	Critical	Medium
<b>Research &amp; Development</b>	Improper use of newly approved equipment or during testing phase.	Occasional	Catastrophic	High	Education, training, documentation, thorough field testing in multiple platforms and obtain feedback from field users. If one component of the system gets changed, the entire system needs to be re-evaluated.	Remote	Catastrophic	Serious
<b>Cargo delivery system</b>	No standard configuration	Frequent	Critical	High	Identify and establish model specific configuration and procedures.	Remote	Critical	Medium
	Use of unapproved containers	Occasional	Marginal	Medium	Supervisors, managers ensure only approved containers are properly utilized. All approved equipment is posted on the MTDC website.	Remote	Marginal	Medium
	Improper cargo restraint straps/cargo compartment netting (internal only)	Occasional	Critical	Serious	Establish minimum standard for cargo restraint straps and protective netting.	Remote	Critical	Medium

Rappel System - Operations								
Sub-System	Hazards	Pre-mitigation			Mitigation	Post-mitigation		
		Likelihood	Severity	Outcome		Likelihood	Severity	Outcome
Training	Non standard/inconsistent	Frequent	Marginal	Serious	Utilize joint training. Train the trainer to one standard.	Occasional	Marginal	Medium
Supervision	Not properly qualified for firefighting mission	Remote	Catastrophic	Serious	Ensure Spotter and firefighters adhere to qualifications outlined in the IHRG.	Improbable	Catastrophic	Medium
	Escape routes and safety zones not identified	Occasional	Catastrophic	High	Ensure Spotter and ALL firefighters have knowledge and location of safety zones, and escape routes prior to fast rope deployment.	Remote	Catastrophic	Serious
Rappel site selection	Poor site selection	Occasional	Catastrophic	High	Spotter training, develop national standard Spotter Training Handbook, CRM, depth of fire experience, minimal redcard qualification of single resource boss with ICT4 being preferred.	Remote	Catastrophic	Serious
Rappel procedure	Non-standard procedures / policy deviation	Occasional	Catastrophic	High	Frequent unscheduled inspections by HOS/check spotter/peers/SME, suspend operations until corrections are made. Violations will result in program suspension. Utilize joint training when practical. Check spotters from other bases and regions will conduct combined training. Attendance of National or Regional Rappel Spotter Workshop is mandatory every two years.	Remote	Catastrophic	Serious
	Non-standard verbiage, direction, and interaction between spotter and pilot during rappel operations	Frequent	Critical	High	Increase simulation training, mock-ups, and proficiency (especially with relief pilots). Ensure proper briefing for new/relief personnel. Develop Challenge and Response criteria between spotter and pilot. Develop CRM training specific to pilot-spotter relationship to be included in IHRG or 310-1.	Remote	Critical	Medium
	Deviation from intended mission with limited information	Frequent	Critical	High	Obtain necessary information prior to accepting mission, obtain frequencies, contacts, coordinates, additional aircraft, known hazards, deconflict airspace, follow all FTA procedures. Ensure crew is "re-briefed" on new mission.	Occasional	Critical	Serious
	Exposure to off site landing	Frequent	Critical	High	Follow standard procedures (high-low recon, power checks, verify load calculations as valid, etc.) Follow risk management process. Site selection needs to be mutually agreed upon by pilot and spotter. Respond to the incident configured to rappel when appropriate.	Occasional	Critical	Serious
External cargo letdown	Rappellers on board helicopter during delivery of cargo which translates to longer exposure to personnel during high power settings in hover	Frequent	Critical	High	Follow standard procedures (high-low recon, power checks, verify load calculations as valid, etc.) Follow risk management process. Site selection needs to be mutually agreed upon by pilot and spotter. Respond to the incident configured to rappel when appropriate.	Occasional	Critical	Serious
	Overflying highways, major population area, personnel	Occasional	Critical	Serious	Establish and brief on proper flight paths, update maps, see and avoid, find other means for mission	Remote	Critical	Medium

Internal cargo letdown	Security of Cargo without appropriate or approved hardware	Frequent	Critical	High	Establish minimum standard for cargo restraint straps and protective netting.	Remote	Critical	Medium
	Exposure to rappellers during internal load operations due to additional weight on board the aircraft and denied living space	Frequent	Critical	High	Consider performing cargo operation separately. Ensure that method of securing cargo is adequate for the size and weight of the cargo in the event of an accident. When possible secure the cargo outside of the passenger compartment. Limit internal cargo weight. Require DOT approved containers for hazardous materials.	Occasional	Critical	Serious

**Rappel System - Operations (Cont.)**

Sub-System	Hazards	Pre-mitigation			Mitigation	Post-mitigation		
		Likelihood	Severity	Outcome		Likelihood	Severity	Outcome
Emergency Procedures	Lack of adequate training / Proficiency	Occasional	Critical	Serious	Increase simulation training, utilize tower/elevated platform to increase rappeller / spotter emergency procedure proficiency, develop training which includes pilot, spotter and rappeller. Improve / update spotter/rappeller training syllabus.	Remote	Critical	Medium
	Non standard verbiage for mission critical / non-critical situations (Emergency vs. Non-Emergency "in hover" during rappel ops)	Occasional	Critical	Serious	Increase simulation training, fund and utilize current simulators at McClellan, develop challenge/response criteria between spotter and pilot	Remote	Critical	Medium

## System Safety Assessment - External Loads

### External Load System - Aircraft

		Pre-mitigation			Mitigation	Post-mitigation		
Sub-System	Hazards	Likelihood	Severity	Outcome		Likelihood	Severity	Outcome
Visibility	Pilot visibility, vertical/horizontal reference	Occasional	Critical	Medium	National screening/evaluation process, identify standard for visibility	Remote	Critical	Medium
	Placement of gauges and warning lights in cockpit does not allow pilot to monitor quickly and easily while looking down at load	Frequent	Catastrophic	High	National screening/evaluation process, identify standard for placement of gauges	Remote	Catastrophic	Serious
	Pilots inability to see the load due to aircraft design limitations	Occasional	Critical	Serious	Consider modifications to aircraft to improve pilot visibility i.e.; bubble window, floor window. Utilize proper mission planning and aircraft selection for the mission.	Remote	Critical	Medium
	Pilot moving from right to left seat to fit mission in Bell medium helicopters without shutting down the helicopter	Remote	Critical	Medium	Enforce contract language regarding shut down before pilot exiting the aircraft.	Improbable	Critical	Medium
	Location of aircraft controls and switches not consistent, not standardized	Occasional	Critical	Serious	Establish standard configuration in helicopter contracts.	Remote	Critical	Medium
Doors off flight	In-flight exposure to environmental conditions	Occasional	Marginal	Medium	Provide appropriate clothing for weather conditions for occupants.	Remote	Marginal	Medium
Aircraft Equipment	Belly hook/remote hook not standardized	Occasional	Marginal	Medium	Familiarize crews with specific equipment. Cargo personnel should be briefed on equipment and aircraft to be used. (i.e. training and cross training on different hook types).	Remote	Marginal	Medium
	Non-standard ring size	Occasional	Critical	Serious	Ensure rings are compatible with specific helicopter rigging. Reference flight manual, and manufacturer data. Recommend hook placarding identify proper ring sizes.	Remote	Critical	Medium
	Cargo hook/remote hook failure leading to dropped load or inability to release load	Remote	Critical	Medium	Follow manufacturer's inspection and maintenance procedures. Check for proper operation before every mission.	Improbable	Critical	Medium
	Failure of electrical connection or electrical disconnect	Frequent	Critical	High	Inspect equipment and check for proper operation before every mission. Research and develop design for new, more reliable electrical connection system.	Occasional	Critical	Serious
Performance, Capabilities, Limitations	Operating outside design limitations of aircraft (weight/balance, DA, Height Velocity Curve)	Probable	Catastrophic	High	Strictly comply with approved flight manual. Increase awareness of aircraft performance by training Helicopter Managers in proper mission planning.	Occasional	Catastrophic	High
	Pilot visibility/vertical & horizontal reference.	Occasional	Critical	Serious	Develop National screening/evaluation process. Identify minimum standards for visibility in rappel aircraft.	Remote	Critical	Medium
	Pilot moving from right to left seat to fit mission in Bell medium helicopters.	Occasional	Critical	Serious	Ensure that Schedule B contract language is standardized Nationally for Type 2 Helicopters.	Remote	Critical	Medium
Aircraft Health	Limited and/or unknown amount of testing and monitoring being preformed on current airframe (fatigue, corrosion, etc)	Remote	Catastrophic	Serious	Ensure maintenance inspectors are conducting thorough reviews of aircraft maintenance logs.	Improbable	Catastrophic	Medium

## External Load System - Operations

Sub-System	Hazards	Pre-mitigation			Mitigation	Post-mitigation		
		Likelihood	Severity	Outcome		Likelihood	Severity	Outcome
Communications	Lack of positive communication due to frequency overload, wrong frequencies	Frequent	Critical	High	Proper mission planning, effective frequency management, and thorough briefing / debriefings, better utilization of Helicopter Coordinators, commo checks prior to departure.	Occasional	Critical	Serious
	Poor communications from ground to aircraft (background noise)	Frequent	Critical	High	As a minimum, increase the use of available communication cords from handheld radios to flight helmets, or handhelds to headsets. This should be required at all helibases that have a high volume of cargo operations.	Occasional	Critical	Serious
	Lack of common terminology	Occasional	Marginal	Medium	Utilize IAT website as a training tool (update on-line course if necessary). Stress use of common terminology during training and in briefings.	Remote	Marginal	Medium
Human Factors	Pilot/agency personnel fatigue	Probable	Catastrophic	High	Prioritize missions, evaluate risk vs. benefits. Consider rescheduling missions, avoid unnecessary flights, utilize optional days off as needed/requested. Promote open & honest communications regarding fatigue levels.	Remote	Catastrophic	Serious
	Lack of depth perception due to pilot not wearing prescription lenses	Occasional	Catastrophic	High	Brief with pilot on status of vision.	Remote	Catastrophic	Serious
	Pilot unfamiliar with aircraft	Probable	Critical	High	Utilize pilot check in process. Allow adequate time for pilot transitions. Address with Contractors via the CO.	Occasional	Critical	Serious
	Pilot unfamiliar with mission	Probable	Critical	High	Conduct proper briefings, encourage incident orientation flight. Utilize Helicopter Coordinators for pilot familiarization. Consider using a second pilot or mentor pilot for orientations.	Occasional	Critical	Serious
	Ergonomics; aircraft not configured well (bubble window, adjustable seating, etc.)	Occasional	Critical	Serious	Consider using a screening and evaluation board to assess the issue. Use appropriate flight crew and aircraft for the mission.	Remote	Critical	Medium
	Selection of aircraft inadequate for mission	Occasional	Critical	Serious	Improve education of key personnel on helicopter capabilities and limitations. (i.e. Update on-line IAT courses.) Obtain critical mission information from ground personnel, ATGS, HLCO. Select appropriate aircraft and pilot for mission via risk analysis.	Remote	Critical	Medium
In-flight Hazards	Controlled flight into towers, wires, trees, etc. (Aerial hazards) with external load.	Occasional	Catastrophic	High	Post updated hazard map(s), communicate with field personnel/pilots for additional hazard map updates. Always perform high level reconnaissance before transition to low level operations. Use extreme caution when diverted from intended mission/known flight paths. Utilize Helicopter Coordinators.	Remote	Catastrophic	Serious
	Other aircraft, congested airspace	Frequent	Catastrophic	High	Perform proper mission planning and utilize see and avoid tactics overcongested areas. Order airspace coordinator earlier. Ensure that TFRs are practical/realistic for the incident, are validated for each operational period, and are adjusted as needed. Require TCAS in all aircraft. Ensure pilots are checking NOTAMs for TFRs. Establish flight routes over incidents. Ensure appropriate level of aerial supervision is in place and there is compliance with FTA protocols. Follow boundary fire protocols/plans. Coordinate early and often with military.	Remote	Catastrophic	Serious

<b>In-flight Hazards (Cont)</b>	Dropped load in congested area	Remote	Catastrophic	Serious	Utilize updated hazard maps in briefings. Establish flight paths. Helibases and cargo areas should be established in areas to minimize flights over congested areas with external loads. Utilize alternative methods of cargo transport.	Improbable	Catastrophic	Medium
	Unstable load during flight	Occasional	Catastrophic	High	Improve crew training on load preparation/assembly. Prepare cargo correctly using approved equipment. Consider and use other means of transport when possible (ground, internal cargo). Standardize procedures for recurring missions.	Remote	Catastrophic	Serious

**External Load System - Operations (cont.)**

Sub-System	Hazards	Pre-mitigation			Mitigation	Post-mitigation		
		Likelihood	Severity	Outcome		Likelihood	Severity	Outcome
<b>In-flight Hazards</b>	Overgross load	Occasional	Critical	Serious	Ensure proper mission planning (i.e. proper performance planning, load calculations, manifesting). Improve training through A-219. Utilize load cell.	Remote	Critical	Medium
	Inappropriate length of line for mission	Probable	Catastrophic	High	Better mission planning, better site assessment, improve training through A-219. Follow IHOG standards for site selection & rotor clearance. Ensure thorough communications from the field/incident to the helibase and from the helicopter to the ground personnel.	Remote	Catastrophic	Serious
	Poor visibility due to smoke, sun, shadows	Occasional	Critical	Serious	Time missions for optimal visibility, obtain feedback from on-site personnel and pilots regarding conditions, utilize aerial supervision, Stress that sunrise/sunset charts are minimums.	Remote	Critical	Medium
<b>Ground Hazards</b>	Dragged load	Frequent	Critical	High	Provide for pilot proficiency while on contract, improve the carding process for approving external load operations. Ensure site is adequate. Monitor fatigue.	Occasional	Critical	Serious
	Personnel too close to drop site	Occasional	Critical	Serious	Provide pilot with ground contact. Improve utilization of Helicopter Coordinators. Provide training for ground personnel to emphasize hazard identification and communication methods.	Remote	Critical	Medium
	Inexperienced ground personnel	Probable	Critical	High	Check qualifications prior to mission acceptance, provide additional pre-season training (A-219).	Occasional	Critical	Serious
	Snagged load (net, bucket)	Occasional	Catastrophic	High	Better site evaluation and preparation, trained personnel at site for positive communication with pilot.	Remote	Catastrophic	Serious
	Rotor wash, falling snags	Occasional	Catastrophic	High	Improve process of site evaluation and preparation. Utilize trained personnel at site for positive communication with pilot.	Remote	Catastrophic	Serious
	Pilot unfamiliar with dipsite, sling spot	Frequent	Critical	High	Conduct proper pre-mission briefing. Improve utilization of Helicopter Coordinators.	Occasional	Critical	Serious
	Unsecured load on steep terrain	Occasional	Critical	Serious	Ensure experienced personnel are at the site, develop approved tag line(s) for some equipment (blivet)	Remote	Critical	Medium
	Cable or line inadvertently placed over skid	Occasional	Catastrophic	High	Mitigation possible through better raining, increased experience, and good communications with pilot during preflight checks. Emphasize thorough visual aircraft safety walk around and checks by ground personnel prior to flight.	Remote	Catastrophic	Serious
	Working in close proximity to hovering helicopter	Frequent	Critical	High	Better site evaluation and preparation, trained personnel at site for positive communication with pilot.	Occasional	Critical	Serious
	Poor site selection	Occasional	Critical	Serious	Improve utilization of Helicopter Coordinators to assist ground personnel. Don't utilize aircraft if site can't be improved or relocated.	Occasional	Critical	Serious

Equipment	Component failure resulting in dropped load	Remote	Catastrophic	Serious	Ensure contractor equipment meets requirements under Part 133, agency personnel need to inspect and maintain all rigging equipment.	Remote	Catastrophic	Serious
	Snorkel snagged on object	Remote	Catastrophic	Serious	Utilize <b>experienced</b> dipsite managers whenever possible, encourage managers to approve site, perform high recon. Ensure dip tanks are clean of hardware that may cause snag.	Remote	Critical	Medium
	Non standard or approved method of securing cargo to steep terrain	Probable	Critical	High	Use approved tag lines for blivets.	Occasional	Critical	Serious
Training	Inadequate pilot longline proficiency	Frequent	Catastrophic	High	Provide opportunities and funding for pilot proficiency flights while on contract.	Occasional	Catastrophic	High
	Lack of experience	Frequent	Catastrophic	High	Implement longline training school, contractor mentoring program, use of simulators, etc.	Occasional	Catastrophic	High
	Pilots with little experience being qualified for external load operations	Frequent	Catastrophic	High	Hold contractors accountable to what is stated in the Vertical Reference Standards located in the national contract. Additional Helicopter Inspector pilots may be needed to ensure contractors meet these standards. Pilot(s) should NOT be issued a card unless these standards are being met.	Remote	Critical	Medium

### External Load System - Operations (cont.)

Sub-System	Hazards	Pre-mitigation			Mitigation	Post-mitigation		
		Likelihood	Severity	Outcome		Likelihood	Severity	Outcome
Environment	High wind or poor visibility	Occasional	Catastrophic	High	Increase the use of Helicopter Coordinators. Establish trigger points and shut down missions early if necessary. Treat IHOG standards as limits. Limit or stop operations before limits are met or exceeded. Receive briefing on local weather and wind conditions to encourage proactive decision making.	Remote	Catastrophic	Serious
	Flight routes not identified	Occasional	Catastrophic	High	Improve use of Helicopter Coordinators. Require better maps at Helibases and in IAP's. Allow for input and concurrence from pilots at briefings. Utilize Airspace Coordinators as necessary.	Remote	Catastrophic	Serious
Hover Hookups	Working in close proximity to hovering helicopter	Frequent	Critical	High	Minimize exposure (only personnel essential to the mission should be in area) Use proper ---- Develop, brief, and utilize emergency egress procedures when working under hovering helicopter.	Occasional	Critical	Serious
	Damage to aircraft (antenna, bubble)	Remote	Marginal	Medium	Brief personnel on aircraft	Remote	Marginal	Medium
Emergency Procedures	No <b>established procedure</b> for extracting critically injured personnel as an external load with contracted aircraft	Frequent	Catastrophic	High	Develop a standard procedure for extracting critically injured personnel.	Remote	Catastrophic	Serious

External Load System - Loading								
Sub-System	Hazards	Pre-mitigation			Mitigation	Post-mitigation		
		Likelihood	Severity	Outcome		Likelihood	Severity	Outcome
Training	Inconsistent training among interagency personnel (exclusive use vs. CWN helitack, handcrew, hotshot, smokejumpers, etc.). Using untrained or unqualified personnel.	Frequent	Critical	High	Fully implement IAT A-219 course. Provide training to appropriate supervisory and key personnel. External load operations should be supervised by trained personnel.	Occasional	Critical	Serious
	Unfamiliarity with specific aviation BAER projects (rigging, procedures, equipment)	Occasional	Critical	Serious	Utilize experienced helitack personnel to assist with preplanning, mission planning and implementation of project. Provide training specific to new equipment and procedures. Verify that all equipment and procedures are approved. Use SME's when implementing projects.	Remote	Critical	Medium
	Inconsistent inspections and improper repair of rigging equipment	Occasional	Critical	Serious	Follow manufacturers' maintenance requirements. Post inspection sheets where equipment is stored. Perform pre-use inspection of equipment. Remove any damaged/faulty equipment from use.	Remote	Critical	Medium
Equipment	Use of unapproved equipment for flying loads that won't fit in a net	Occasional	Critical	Serious	Use only proper and approved equipment for flying external loads. Consider other ways to accomplish the mission and avoid making hasty, poor decisions under pressure to get the job done.	Improbable	Critical	Medium
	Inability to weigh some cargo items due to size, shape	Probable	Critical	High	Evaluate alternative scales through market research, procure/evaluate new products, and make them available for helicopter cargo operations.	Occasional	Critical	Serious
Human Factors	Estimating cargo weights	Probable	Critical	High	Provide appropriate scales, allow adequate time to prepare loads for missions. Rely upon standard equipment weight lists. When in doubt overestimate weights. Do not fly loads if weights cannot be adequately determined.	Occasional	Critical	Serious
	Changing priorities and weights	Probable	Critical	High	Conduct better mission planning. Be flexible for changes and anticipate/plan for most reasonable occurrences.	Occasional	Critical	Serious