Safety Issue Risk Assessment

10 Tanker Air Carrier, LLC

SUMMARY:

10 Tanker Air Carrier, LLC as undertaken a comprehensive risk assessment in accordance with current industry best practices of both fuel loading and retardant loading on board the DC-10 aircraft with the number two (center) engine operating at ground idle thrust. As a result of that analysis, we have concluded:

- the probability of any high consequence accident during fuel loading with an engine operating at ground idle is sufficiently mitigated through the application of existing defenses designed into our existing standard operating procedures;
- the probability of any high consequence accident during retardant loading with an engine operating at ground idle is equivalent to that of routine loading without an engine operating, with the incorporation of any additional controls into our existing standard operating procedures; and,
- the probability of any high consequence accident during concurrent fuel and retardant loading is sufficiently mitigated through the application of existing defenses designed into our existing standard operating procedures.

METHODS AND CONCLUSIONS

10 Tanker Air Carrier, LLC convened a review board comprised of:

- Captain Jack Maxey, Chief Supervisor / Chief Pilot
- Charles Ferling, Director of Safety and Security
- Paul Myers, Manager of Internal Evaluation
- Mike Burton, Analyst, Safety and Security

The review board developed a comprehensive Hazard Registry through a series of brainstorming sessions in which both conditions known to have occurred in industry and those generally not known to have occurred were identified and categorized.

The hazard registry was further analyzed to identify hazards that were unique to fuel and/or retardant loading with the number two (center) engine operating at ground idle and those that were independent to the operation of an engine. Only one specific hazard, Hazard ID 1 in Table 2, was identified as unique to the question under consideration.

The review board took into consideration that the number two (center) engine of the DC-10 are significantly farther removed (~24 m / 79 ft) from the particularly hazardous areas below the under-wingtip fuel system vents identified by McDonnell Douglas. This distance also exceeds the industry standard equipment restraint area (7.5m / 25 ft) .

The review board determined that the unique hazard had never occurred in the operator’s experience and was not known to have occurred in industry during an equivalent phase of operation with any similar aircraft types. The review board selected the Safety Issue Risk Assessment (SIRA) tool as published by the European Commercial Aviation Safety Team (ECAST) as the most appropriate quantitative model to assess a potential future hazard.

The review board described a triggering event, the Undesirable Operational State (UOS), and the worst case accident outcome within the SIRA model. The board then identified barriers to the UOS and those barriers remaining available to recover before the accident contemplated.

The review board estimated the frequency of the triggering event, failure of the barriers to the UOS, failure of the remaining recovery barriers, and the severity of the worst case accident. The board used guidance from the International Civil Aviation Organization's (ICAO) Safety Management Manual DOC 9859 to convert Qualitative probability to Quantitative probability and then to further refine the quantitative descriptions to those used in the SIRA model. (See Table 1 – Conversions)

Table 1 - Conversions

	Extremely Improbably	Extremely Remote	Remote	Reasonably Probable	Frequent
Qualitative Definition	Should Virtually never occur in the whole fleet life.	Unlikely to occur when considering several systems of the same type, but nevertheless has to be considered as being possible.	Unlikely to occur during the total operational life of each system but may occur several times when considering several systems of the same type.	May occur once during total operational life of one system.	May occur once or several times during operational life.
Quantitative Definition	$< 10^{-9}$ per flight hour	10^{-7} to 10^{-9} per flight hour	10^{-5} to 10^{-7} per flight hour	10^{-3} to 10^{-5} per flight hour	1 to 10^{-3} per flight hour
SIRA		About every 10M sectors	About every 1M sectors	About every 1000 sectors	About every 100 sectors

The review board calculated the SIRA mean accident frequency to be $<1X10^{-21}$ (the lowest frequency supported by the SIRA model), or "Extremely Improbable". See Table 3 – SIRA Unique Hazard Analysis.

The review board went on to identify and analyze one hazard, Hazard ID 2, that is known to have occurred on several occasions in industry during an equivalent phase of operation with similar aircraft types. The board used the methods described above to calculate the SIRA mean accident frequency to be $<1X10^{-15,}$ or "Extremely Improbable". See Table 4 – Independent Hazard Analysis.

Finally, the review board consider four additional hazards associated to less consequential accident outcomes (substantial damage and personal injury) using the same methods and model to calculate that all had a SIRA mean frequency equivalent to "Extremely Improbable" events.

HAZARD REGISTRY

Table 2 - Hazard Registry

Type of operation	Generic Hazard	ID	Specific Hazard	Existing Defenses	Risk Characteristic	SIRA Mean Accident Frequency
Concurrent ground servicing with number two engine running	Fire	1	Aircraft jumps chocks while under single engine ground idle thrust, colliding with ground support equipment with associated fuel leak and fire	1 pilot flight station occupied Flight engineer station occupied External observer with communication to flight compartment Ground idle thrust only Wheel chocks Aircraft brakes Emergency brake actuation Reverse thrust Engine shut down Sloped aerodrome pavement External fire extinguisher (Emergency service standby on the field)	UNIQUE	$< 1 \times 10^{-21}$
		2	Aircraft settles on ground support equipment during concurrent loading puncturing fuel tank with resultant fire	Limited range of strut compression. SOP no unattended equipment under aircraft	Independent to issue examined – hazard exists in “normal operations”.	1×10^{-15}
		3	SPP coupling breaks with resultant fuel spill and fire	Deadman control of fuel service equipment. Clay valve automatic shutdown of hydrant on loss of backpressure External observer with communication to flight compartment	Independent to issue examined – hazard exists in “normal operations”.	
		4	Over fuelling with resultant fuel spill from box vent and resultant fire	Deadman control of fuel service equipment. External observer with communication to flight compartment SOP protection of particularly hazardous area under box vent	Independent to issue examined – hazard exists in “normal operations”.	

Type of operation	Generic Hazard	ID	Specific Hazard	Existing Defenses	Risk Characteristic	SIRA Mean Accident Frequency
		5	Fuel bowser / hydrant truck is not parked properly and moves unexpectedly striking aircraft with resultant fire	Wheel chocks SPP connecter interlock to brake / engine shut down. Elevated platform interlock to brake / engine shut down Fuel bowser/ hydrant truck external emergency shutdown SOP no unattended equipment under aircraft Fuel bowser/ hydrant truck external emergency shutdown External observer with communication to flight compartment	Independent to issue examined – hazard exists in “normal operations”.	
		6	Vehicle runs over fuel supply line resulting in fuel spill and fire	Deadman control of fuel service equipment Clay valve automatic shutdown of hydrant on loss of backpressure External observer with communication to flight compartment	Independent to issue examined – hazard exists in “normal operations”.	
		7	Fuel bowser / hydrant truck is not properly bounded, earthed, or both.	Fuel supply line bonding SPP closed system – limited venting Limited use of wide-cut fuel External observer with communication to flight compartment	Independent to issue examined – hazard exists in “normal operations”.	
		8	Static discharge during switch loading with wide-cut fuel	Fuel vent flash protection SOP restrictions on switch loading	Independent to issue examined – hazard exists in “normal operations”.	
		9	Lightening strike to aircraft causes ignition of fuel vapor	Fuel vent flash protection SOP restrictions on fuel loading with lightening reported in the immediate area	Independent to issue examined – hazard exists in “normal operations”.	

Type of operation	Generic Hazard	ID	Specific Hazard	Existing Defenses	Risk Characteristic	SIRA Mean Accident Frequency
		10	Terror attack during ground servicing	Aerodrome access control Aircraft access control No published schedule SOP - Operations Security	Independent to issue examined – hazard exists in “normal operations”.	
	Substantial damage	11	Aircraft jumps chocks while under single engine ground idle thrust, colliding with ground support equipment	1 pilot flight station occupied Flight engineer station occupied External observer with communication to flight compartment Ground idle thrust only Wheel chocks Aircraft brakes Emergency brake actuation Reverse thrust Engine shut down Sloped aerodrome pavement External fire extinguisher (Emergency service standby on the field)	Independent to issue examined – hazard exists in “normal operations”.	$1 X10^{-21}$
		12	Aircraft settles on ground support equipment during concurrent loading	Limited range of strut compression. SOP no unattended equipment under aircraft	Independent to issue examined – hazard exists in “normal operations”.	$1X10^{-17}$

Type of operation	Generic Hazard	ID	Specific Hazard	Existing Defenses	Risk Characteristic	SIRA Mean Accident Frequency
		13	Fuel bowser / hydrant truck is not parked properly and moves unexpectedly striking aircraft	Wheel chocks SPP connecter interlock to brake / engine shut down. Elevated platform interlock to brake / engine shut down Fuel bowser/ hydrant truck external emergency shutdown SOP no unattended equipment under aircraft Fuel bowser/ hydrant truck external emergency shutdown External observer with communication to flight compartment	Independent to issue examined – hazard exists in “normal operations”.	
		14	Lightening strike to aircraft during ground operations	Aircraft certification under specified EMP conditions Bonding of aircraft components	Independent to issue examined – hazard exists in “normal operations”.	
		15	Foreign object ingested into running engine causes uncontained engine failure	Distance from ground support personnel External observer with communication to flight compartment External control emergency shut down for APU External control discharge of APU fire extinguisher	Independent to issue examined – hazard exists in “normal operations”.	
		16	Fuel loaded into retardant tank	Incompatible coupling External observer with communication to flight compartment	Independent to issue examined – hazard exists in “normal operations”.	
		17	Retardant loaded into fuel tank	Incompatible coupling External observer with communication to flight compartment	Independent to issue examined – hazard exists in “normal operations”.	

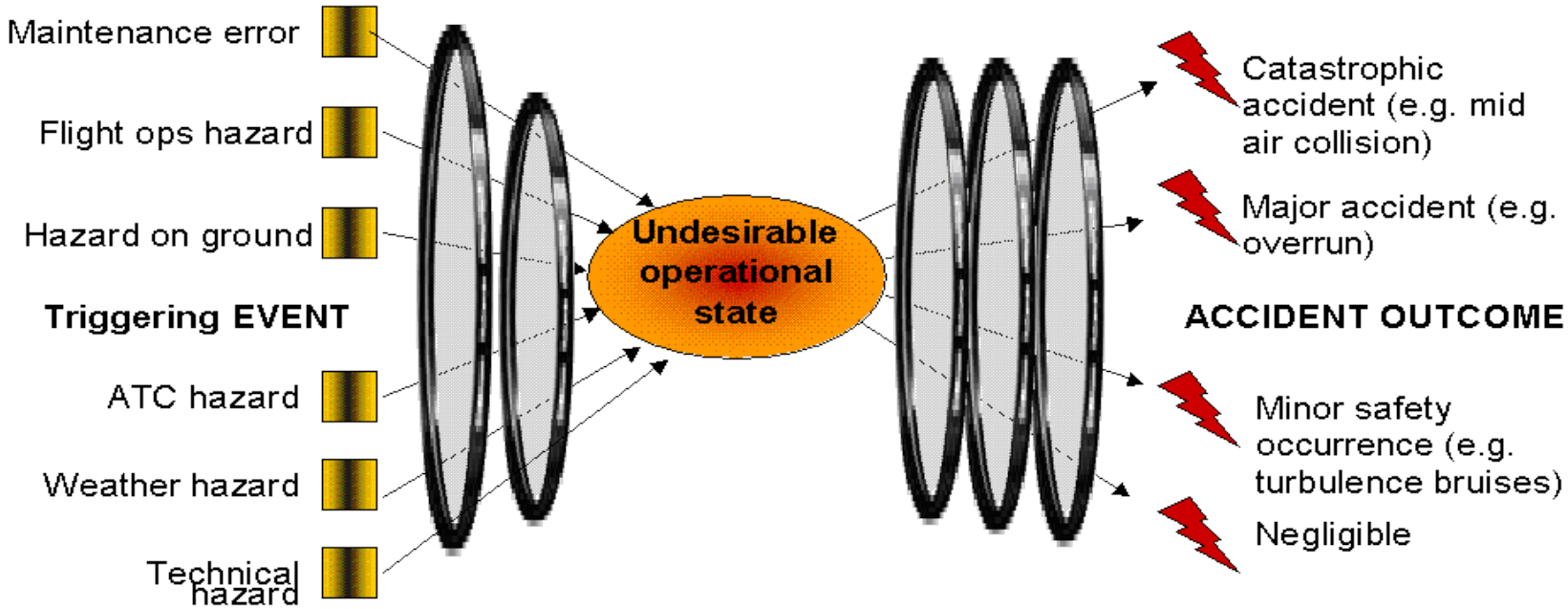
Type of operation	Generic Hazard	ID	Specific Hazard	Existing Defenses	Risk Characteristic	SIRA Mean Accident Frequency
		18	Terror attack during ground servicing	Aerodrome access control Aircraft access control No published schedule SOP - Operations Security	Independent to issue examined – hazard exists in “normal operations”.	
		19	High profile vehicle (stairs, catering) passes too closely behind engine operating at ground idle and is blown over.	Rotating beacon illuminated External observer with communication to flight compartment	Independent to issue examined – hazard exists in “normal operations”.	
	Personal injury	20	Aircraft jumps chocks while under single engine ground idle thrust, colliding with ground personnel	1 pilot flight station occupied Flight engineer station occupied External observer with communication to flight compartment Ground idle thrust only Wheel chocks Aircraft brakes Emergency brake actuation Reverse thrust Engine shut down Sloped aerodrome pavement External fire extinguisher (Emergency service standby on the field)	Independent to issue examined – hazard exists in “normal operations”.	$1 X10^{-21}$
		21	Aircraft settles on ground support equipment during concurrent loading	Limited range of strut compression. SOP no unattended equipment under aircraft	Independent to issue examined – hazard exists in “normal operations”.	$1X10^{-19}$
		22	Crew egress blocked by ground support equipment	SOP egress requirements External observer with communication to flight compartment	Independent to issue examined – hazard exists in “normal operations”.	

Type of operation	Generic Hazard	ID	Specific Hazard	Existing Defenses	Risk Characteristic	SIRA Mean Accident Frequency
		23	Retardant spill causes slippery surface with resultant personnel slip and fall	Personal protective equipment – shoes SOP for retardant spill identification and mitigation	Independent to issue examined – hazard exists in “normal operations”.	
		24	Communications failure in high noise environment results in crew inability to notify ground personnel of a detected hazard	SOP hand signals.	Independent to issue examined – hazard exists in “normal operations”.	

Table 3 - SIRA Unique Hazard Analysis

SAFETY ISSUE RISK ASSESSMENT (SIRA) TOOL		
1	**Safety Issue title:**	**Concurrent fuel / retardant loading with number two engine running at ground idle**
2	**Define/scope the SI:**	
	Description of Hazard(s)	**CASE 1: Fire as a result of collision between aircraft and fuel service equipment**
	Description of Scenario	**Aircraft operating with number two engine at ground idle moves over wheel chocks, comes into contact with fuel service equipment, resulting in a fuel spill and fire resulting from an unspecified ignition source.**
	A/C types	**DC-10 Tanker**
	Locations	**All U.S. aerodromes**
	Time period under study	**Not applicable**
	Other	

3	**Analysis of potential Accident Scenario**				
	3.1 Triggering event		3.2 Undesirable Operational State		3.3 Accident Outcome
	Aircraft movement under ground idle thrust		**Collision with GSE, fuel leak with fire**		**Major accident**

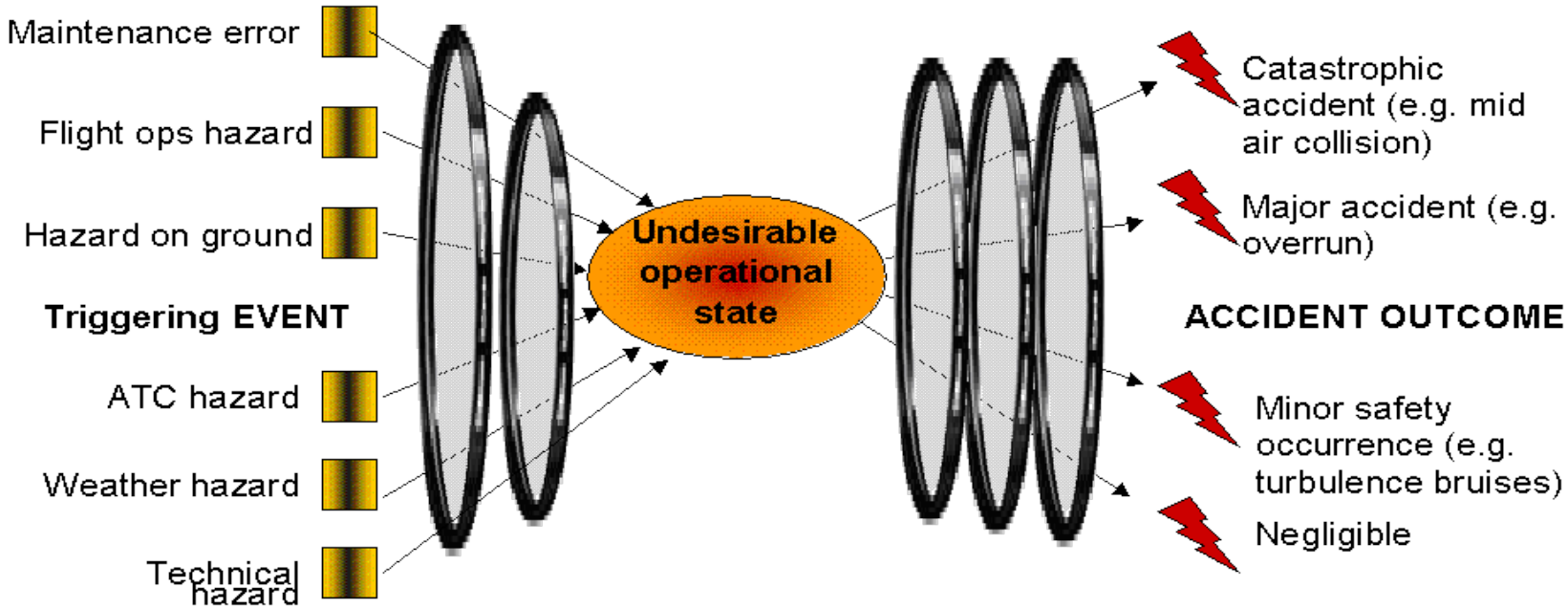


4	**Describe the barriers**				
		4.1 To avoid the UOS		4.2 To recover before the Accident	
		1 pilot at flight station; Flight Engineer at flight station; External observer with communication to the flight compartment; Ground idle thrust; Parking brake; Wheel chocks		External observer with communication to flight compartment; Aircraft brakes; Reverse thrust; Engine shut down; Aerodrome pavement slope; External control of fuel equipment emergency shutdown; Frangible couplings on equipment attached to aircraft	
5	**Risk Assessment**				
	The estimated frequency of the triggering event (per flight sectors) is:	The barriers will **fail** in AVOIDING the UOS...		The barriers will **fail** in RECOVERING the situation before the ACCIDENT...	The accident severity would be...
	About every 10 M sectors	Once in 10M times		Once in 10M times	Minor
	1.E-07	**1.E-07**		**1.E-07**	
			UOS frequency:		**Mean Accident frequency:**
			1.E-14		**1.E-21**
6	**Result**				
	6.1 Resulting risk class	**Accept**	*Accept*		
	Comments on actions:				

Table 4 - SIRA Independent Hazard Analysis

SAFETY ISSUE RISK ASSESSMENT (SIRA) TOOL		
1	**Safety Issue title:**	**Concurrent fuel / retardant loading with number two engine running at ground idle**
2	**Define/scope the SI:**	
	Description of Hazard(s)	**Aircraft settles on ground support equipment under aircraft**
	Description of Scenario	**Concurrent loading of fuel and retardant resulting in a greater than normal aircraft settling rate with equipment under aircraft.**
	A/C types	**DC-10 Tanker**
	Locations	**All U.S. aerodromes**
	Time period under study	**Not applicable**
	Other	

3	Analysis of potential Accident Scenario				
	3.1 Triggering event		3.2 Undesirable Operational State		3.3 Accident Outcome
	Aircraft settling		**High rate of settling with equipment under aircraft**		**Minor safety occurrence**



4	**Describe the barriers**				
		4.1 To avoid the UOS		4.2 To recover before the Accident	
		External observer with communication to the flight compartment; Limited range of strut compression; SOP prohibiting unattended equipment under aircraft.		External observer with communication to flight compartment; Frangible couplings on equipment attached to aircraft; Contact safety switches on elevated work surfaces	
5	**Risk Assessment**				
	The estimated frequency of the triggering event (per flight sectors) is:	The barriers will **fail** in AVOIDING the UOS...		The barriers will **fail** in RECOVERING the situation before the ACCIDENT...	The accident severity would be...
	About every 1000 sectors	Once in 10M times		Once in 10M times	Minor
	1.E-03	**1.E-07**		**1.E-07**	
			UOS frequency:		**Mean Accident frequency:**
			1.E-10		**1.E-17**
6	**Result**				
	6.1 Resulting risk class	**Accept**			
	Comments on actions:				