

Risk Assessment of Aircraft Fueling Operation: A Case Study of Margaret Ekpo International Airport Calabar

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Abstract
This study has identified the failure events which can result in a fuel spill on the ramp during fuelling, aircraft maintenance and defuelling activities. Frequency data has been derived from a review of historical information on spills from a number of Nigerian airports . The main consequence of a release of fuel was determined to be a pool fire if the spill were ignited. It has been assessed that the risk from aircraft fuelling is not negligible . In terms of both individual and societal risk, hydrant fuelling presents a higher risk than fuelling using a refueller. Hardware and safety management measures have been recommended to reduce the risk. In some cases cost benefit analysis arguments have been used to support the selection of a particular measure. The recommended measures have been presented as: measures specifically designed to reduce the major contributors to the risk; and additional safety management measures which are not specifically related to the major risk contributors but which need to be implemented.
Keywords: Fuelling operations, Jet A -1, aircraft, AVGAS, Spill, Risk, Assessment.

1. INTRODUCTION

1.1 BACKGROUND

The main type of fuel used for both civil and military aircraft is Jet A-1 (a kerosene type fuel). This is a low volatility fuel which is more difficult to ignite (i.e. requires a more powerful ignition source) than aviation gasoline (AVGAS). The use of AVGAS is becoming confined to light aircraft. A number of major fuel spills of aviation Jet A-1 fuel have occurred at various airports around the world and in the Nigeria, over the last 25 years. Such incidents have been reported at Barbados, our own Lagos, Denmark, Antigua, New Zealand and Australia. Failures during fueling operations of aircraft are not uncommon and have included:

- Underwing couplings becoming detached from the aircraft;
- Nozzle quick disconnects separating;
- Vehicle impact damage to hydrant couplers;
- Failure of hydrant couplers due to incorrect re-assembly after being modified;
- hose ruptures;
- Failure of valve or poppet to close; and
- Accidental disconnection of a coupling after the failure of an interlock.

The replacement of AVGAS by Jet A-1 in the past was a significant factor in reducing the risk during fueling mainly because it significantly reduced the likelihood of ignition. It also reduced the speed of flame spread across the spill increasing the probability of escape for the people around the stand.

1.2 OBJECTIVES

The overall objective of this project was to carry out a study of the potential risks from major fuel spills on the apron at Nigeria airports using Margaret Ekpo International Airport Calabar as a case study. The overall objective can be broken down as follows:

- obtain details of historical incidents world-wide which resulted in a fuel spill during aircraft fueling;
- assess the fire and/or explosion risk from aircraft fueling operations involving Jet A-1; and
- recommend cost effective risk mitigation measures for implementation at Nigeria airports.

1.3 SCOPE OF WORK

The scope of work included:

- A literature search to identify historical incidents world-wide which resulted in a Jet A-1 fuel spill during aircraft fueling;
- conducting Risk Assessment of aircraft fueling and refueling using a refueller;
- Identification of potential risk mitigation measures.

2. GENERAL DESCRIPTION OF AN AIRPORT

2.1 TYPICAL AIRPORT LAYOUT

The type of airport which forms the basis of this study is divided into two main areas, namely, landside and airside. This study is concerned with aircraft stands which are located on the airside. A major airport have around 40 to 80 stands. But it is important to note here that Margaret Ekpo International Airport Calabar has only 4 (four) stands.

Taxiways and runway(s) are also located on the airside.

2.2 ORGANISATIONS ASSOCIATED WITH AN AIRCRAFT TURN ROUND

The organization at an airport consists of the airport operator and a large number of companies who are providing services associated with an aircraft turnaround. A significant percentage of these companies are subsidiaries of airlines and/or the airport operator. Like in Margaret Ekpo International Airport Calabar there three airlines in operation. This Airlines are Arik Airline, Aero contractors Airline and Air Peace Airline (which started work on 3rd of August 2015).

Figure 1.showing a picture of two aircrafts, aero contractors and Air Peace at tarmac of Margaret Ekpo International Airport Calabar.

The following activities take place during a turn round:
• fueling;
• Unloading and loading of passengers;
• Delivery of food;
• Engineering and maintenance;
• Unloading and loading of baggage;
• Unloading and loading of cargo;
• Internal cleaning of the aircraft;
• Provision of fresh water;
• Removal of toilet waste;
• Aircraft pushback/head-setting. A ground handling company may undertake all of these activities. In addition, more than one ground handling company could be involved in a particular turnaround. Typically, there could be between 3 to 5 companies competing to provide these services. To complicate matters further, one ground handling company may sub-contract one or more of these services to one or more ground handling companies. This results in a range of permutations of services and service providers existing airside. Because of seasonal variations in demand, the ground handling companies use a large proportion (approximately 50%) of temporary staff, who are only employed during the summer months. The contracts with the airline operator have financial penalty clauses for late delivery of services. For example a baggage handling company may have to have the first bag off the aircraft within 12 minutes of it arriving on stand and the last one off within 20 minutes. If the caterers are late delivering food they may have to provide the food free of charge. For a short haul flight a turn round has to be completed typically in 30 minutes. On a long haul flight it is more likely to be of the order of an hour or more. At time under review, the baggage handling company at Margaret Ekpo International Airport Calabar is SAHOOL handler and they are the only company at the Airport that is charged with that responsibility.

3. INFORMATION RELATING TO JET A-1 FUEL

3.1 IDENTIFICATION AND CLASSIFICATION

Formula	
Synonyms	
Substance Identification	Mixture of petroleum hydrocarbons, chiefly of the alkane series, having 10 - 16 carbon atoms per molecule. Cn H2n+2
Number	AVIATION KEROSENE; JET A; JET A-1; JET FUEL A; JET KEROSENE; JP-7; TURBO FUEL A; TURBO FUEL A-1
Emergency Action Code CAS Number (Kerosene)	UN 1223
EU Labelling:	
Symbol	3Y
Risk Phrases:	8008-20-6
	Xn Harmful R10 Flammable R22 harmful if swallowed R38 Irritating to the skin R52/53 Harmful to aquatic organisms, may cause long-term adverse effects in the aquatic environment
Safety Phrases:	S2 Keep out of the reach of children S24 Avoid contact with the skin S36/37 Wear suitable protective clothing and gloves S43 In case of fire use foam, dry powder, AFFF, CO2 – Never use water S61 Avoid release to the environment. Refer to special instructions/Safety Data Sheet S62 if swallowed, do not induce vomiting: seek medical advice immediately and show this label or container

3.2 PHYSICAL PROPERTIES OF JET A-1

Jet A-1 is a fuel manufactured from the kerosene cut of crude oil which then undergoes other processes, such as de-sulphurization, in order to achieve the purity required for aircraft engines Additives may be used to impart some of the required properties. It is a mobile liquid at ambient temperature. It is clear water white/straw in colure with a characteristic odor. It also has the following properties:

Acidity/Alkalinity:		Not applicable
Initial Boiling point:		150°C
Liquid density:		775 to 840 kg/m3 @ 15°C
Vapor density (Air = 1):		> 5
Vapor pressure:		< 0.1 kPa @ 20°C
Solubility	-Water	Very Low
`	-Fat/solvent	Not available
Surface tension		0.026 N.m-1
Shear viscosity		0.0014 kg.m-1.s-1
Volumetric Expansion		1% for a 7.8°C temperature increase

Jet A-1 has a low vapor pressure at ambient temperatures and as such a spill will be relatively slow to evaporate. In addition, the vapor is more than five times heavier than air which will make it relatively slow to disperse.

3.3 HAZARDS ASSOCIATED WITH JET A-1

Jet A-1 has a low electrical conductivity, making it possible for static electricity to be generated and for charges to be accumulated. The degree to which a static charge may be acquired by aviation fuels depends upon many factors: the amount and type of residual impurities, dissolved water, the linear velocity through piping systems, the presence of static generating mechanisms e.g. Filters and the opportunity for the fuel to relax for a period of time to allow any charge generated to dissipate safely to earth. Jet A-1 is more prone to static generation than

AVGAS. While all fuels generate static charges, the electrical conductivity of the fuel bears a direct relationship to the speed of charge relaxation (dissipation).Aviation turbine fuels contain antistatic additives. However they do not work by preventing the formation of static charges, instead they increase the conductivity of the fuel thereby considerably shortening the relaxation time. Antistatic additives actually increase the propensity for a fuel to generate static as they are an impurity in the fuel. The charge generation is increased as the fuel passes filters, strainers, water separators and other equipment. If a conductive object (which is isolated from earth) is in the vicinity of the charge generation point before the charge has had time to dissipate safely to earth, it can concentrate up and store the static charge until a high-energy static spark results. If a flammable vapor is present then ignition may result but this will depend on the energy of the spark and the minimum ignition energy for the vapor. Classification for Supply the CHIP 94 Regulations and guidance to the regulations (HSE, 1999a) apply to the hazards associated for substances for supply purposes. These regulations have three classifications which apply to the flammability of liquids. These are defined as follows:

EXTREMELY FLAMMABLE
Liquid substances and preparations which have a flash point lower than 0°C and a boiling point (or, in case of a boiling range the initial boiling point) lower than or equal to 35°C.

HIGHLY FLAMMABLE
Liquid substances and preparations having a flashpoint below 21°C, but which are not extremely flammable.

FLAMMABLE
For liquid substances and preparations
Having a flash point equal to or greater than 21°C, and less than or equal to 55°C. But also, when tested at 55°C in the manner described in Schedule 2 of the Highly Flammable Liquids and Liquefied Petroleum Gases Regulations 1972, it supports combustion. Therefore, Jet A-1 is classed as a flammable liquid for supply. This is the lowest liquid flammability category. In contrast AVGAS would be classed as extremely flammable. Institute of Petroleum Classification The Institute of Petroleum have produced a code for area classification (IP, 1990a) which includes a system for classifying petroleum liquids including crude oil and its products into Classes 0, 1, II(1), II(2), III(1), III(2) and Unclassified based upon their flash points. Under this system Jet A-1 is classed as II(1), as it has a flashpoint in the range from 21°C up to and including 55°C and is handled below its flashpoint. In contrast AVGAS is classed as I, as it has a flashpoint below 21°C. Highly Flammable Liquids & Liquefied Petroleum Gases Regulations 1972 (HSE, 1972) these regulations (sometimes known as the HFL Regulations) require precautions to reduce the risk of fires and explosions, where flammable liquids or gases are stored. Precautions include measures to prevent leaks, spills and dangerous concentrations of vapors, and to control ignition sources. These regulations apply when liquids with a flashpoint of less than 32°C, and which support combustion (when tested in the prescribed manner), are present at premises subject to the Factories Act 1961. Therefore, they will apply to the maintenance hangars and vehicle maintenance workshops. However, with a minimum flashpoint of 38°C (by specification) Jet A-1 is not classed as a Highly Flammable Liquid according to the HFL Regulations, whereas, AVGAS is.

3.3.1 HEALTH HAZARD

Jet A-1 is classified, for supply purposes as harmful, as a result of the aspiration hazard and irritation to the skin. Acute Health Hazards Toxicity following a single exposure to high levels (orally, dermally or by inhalation) of Jet A-1 is of a low order. However, exposure to higher vapor concentrations can lead to nausea, headache and dizziness. If it is accidentally ingested, irritation to the gastric mucous membranes can lead to vomiting and aspiration into the lungs can result in chemical pneumonitis which can be fatal. Inhalation Under normal conditions of use Jet A-1 is not expected to present an inhalation hazard. Skin Jet A-1 is slightly irritating to the skin, and has a defatting action on the skin. Eyes Jet A-1 may cause discomfort to the eye. Chronic Health Hazards Prolonged and repeated contact with Jet A-1 can be detrimental to health. The main hazards arise from skin contact and in the inhalation of mists. Skin contact over long periods can lead to defatting of the skin, drying, cracking and possibly dermatitis. Excessive and prolonged inhalation of mists may cause chronic inflammatory reaction of the lungs and a form of pulmonary fibrosis. Exposure Limit Values Jet A-1 does not contain any components to which exposure limits apply, however it is chemically very similar to white spirit, for which the following Uk occupational exposure standards apply (HSE, 2000): Occupational Exposure Limit (OEL) = 575 mg/m3 (100 ppm) 8-hour TWA value Occupational Exposure Limit (OEL) = 720 mg/m3 (125 ppm) 10-min TWA value (TWA - Time Weighted Average)

3.3.2. ENVIRONMENTAL HAZARD

Air
Jet A-1 is a mixture of non-volatile components, which when released into the air will react rapidly with hydroxyl radicals and ozone.

Water
If released into water, the majority of Jet A-1 will evaporate at a moderate rate but a small proportion will dissolve. Dissolved components will be either absorbed in sediments or evaporate into the air. In aerobic water and sediments they will biodegrade, but in anaerobic conditions they will persist. Jet A-1 is slightly toxic to aquatic organisms and contains components which have a high potential to bio accumulate, but is unlikely to persist in the aquatic environment for sufficient time to pose significant hazards.

Soil
Small volumes released on land will evaporate at a moderate rate, with a proportion being absorbed in the upper layers of the soil and be subject to biodegradation. Larger volumes may penetrate into anaerobic soil layers in which it will persist. A spill of Jet A-1 may reach the water table on which it will form a floating layer, and move along with the groundwater flow. In this case, the more soluble components, such as aromatics, will cause groundwater contamination. Mammalian toxicity is expected to be of a low order.

3.3.2 IDENTIFICATION OF THE PEOPLE AT RISK

This Risk Assessment is solely concerned with the risk of fatality due to fuel spills during aircraft fueling. There are many other risks associated with fuel spill events, such as the environmental and financial (replacement costs for damaged equipment, business loss, cost of remediation of environmental damage etc.) risks, but these are not considered in this report. The main groups of people that will be considered in the risk assessment are:

a) The fueling operators
b) The other ground services staff (ground crew)
c) The flight/cabin crew
d) Passengers (frequent, typical or infrequent fliers) these population groups must be considered separately as the risks to each group may be very different. For example, a typical fueling operator will be present at a large number of fueling operations during the course of the year, whereas a passenger may only be present a few times per year. Furthermore, a fueling operator is much more likely to be involved in a small spill than a passenger (who may be in the aircraft or in the terminal building) is.

4.1 FUELING OPERATIONS CARRIED OUT AT MARGARET EKPO INTERNATIONAL AIRPORT

The majority of modern passenger carrying aircraft have the facility for receiving fuel either by over wing or underwing methods. Over wing fueling is achieved under gravity whereas underwing fueling is achieved by pumping the fuel into the aircraft's fuel tank i.e. Pressurized fueling. For this reason, underwing fueling is the quickest way of fueling aircraft and the most common method found at airports. Pressurized fueling of aircraft can be achieved by one of two methods, namely hydrant fueling or fueling using a refueler vehicle. The particular fueling method available at any one airport will depend upon its size and the facilities available. The number of fueling operations carried out at airports will depend upon the number of aircraft movements, although not all aircraft movements will require fuel. For Margaret Ekpo International Airport Calabar the number of fueling operations carried out in 2015 was estimated to be 372,900, of which 100% are fueling using a refueled. The fuel to be uplifted to an aircraft can be as much as 50% of the total aircraft's weight. For this reason the distribution of fuel is significant in terms of the aircraft Centre of gravity.

Figure 2. Showing picture of me and some fueling operator Refueling of Aero contractors Airline flight 5N-8JO.

The CAA's recommended practices for fueling and defueling operations at airports are designed to minimize the potential for fire. These practices are contained in CAP 74. Within this document are measures to control ignition sources. CAP 74 is the minimum standard for ensuring safety of fueling operations. In general, individual fuel companies and the airlines produce their own fueling procedures which incorporate the requirements of CAP 74. Two key areas discussed within CAP 74 are the "fueling area" and the "fueling zone". Fueling Area As a general guide, a fueling area should be sited so as to avoid bringing fueling equipment or aircraft fuel tank vents to within 15 meters of any building other than those constructed for the purpose of direct loading or unloading of aircraft.

4.1.2 FUELLING ZONE

The fueling zone is an area extending not less than 6 metres radially from the filling and venting points on the aircraft, and from the fuelling equipment including the hydrant pit when used. These zones do not physically exist, as they are not marked on the apron in any way. Potential ignition sources around an aircraft include:

• Hot surfaces on auxiliary power units (APU);
• Electrical sparks due to connection/disconnection of ground power units;
• Internal combustion engines on vehicles;
• Hot surfaces on aircraft engines and brakes;
• Electrical sparks due to communication systems, switch
Gear, radar;
• Starting engines, operating switches, mobile phones;
• Static sparks due to the discharge of accumulated electrostatic charges generated during fueling;
• Welding and cutting operations;
• Naked flames;
• Procedural violations e.g. smoking in a 'No Smoking' area. Controls to prevent ignition sources within the fueling zone include:

• Smoking and naked lights are prohibited;
• Operation of switches on non-intrinsically safe lighting systems are prohibited;
• Radios, radio telephones, pagers etc. should be certified for use or 'intrinsically safe';
• Fueling operators should not carry matches or other means of ignition. This includes wearing footwear with metal studs;
• Only authorized persons and vehicles allowed in the fueling zone;
• if an aircraft's APU is required to be operating during fueling and the exhaust duct would discharge into the fueling zone, the APU should be started before the fuel connection is made;
• Ground power units (GPUs) should not be operated within the fuel zone;
• Equipment with wheels that are capable of generating a spark should not be moved in the fueling zone;
• Hand torches and inspection lamps should be certified for use or 'intrinsically safe';
• Electronic instruments on the fueling vehicle are certified 'intrinsically safe';
• Vehicle engines should not be left running unnecessarily;
• Vehicles must not be parked underneath the wing tank vents;
• Photographic flash equipment should not be used in the fuel zone;
• No maintenance work which may create a source of ignition should be carried out;
• ATC should issue guidance on whether fueling should be suspended during electrical storms;
• An aircraft's external lighting and strobe system should not be operated;
• Connection and disconnection of electrical equipment should not be carried out.

Where possible, many of the larger airports are moving towards replacing ground power units with fixed power supplies attached to the air bridge. This reduces the number of vehicle engines (and potential ignition sources) on the stand. It also reduces the level of noise pollution.

A member of the flight crew is advised to instruct the fueling operator in the event of an aircraft fire or engine overheat warning. In such circumstances fueling should not commence until the cause has been identified and it is considered safe to fuel. Similarly, the airline or airline operator should check to ensure that the undercarriage is not excessively hot. If it is found to be the case, the Airport Fire Service should be called and fueling stopped until the heat has dissipated. From the list of measures to control ignition sources within the fueling zone, it can be seen that there appears to be a lot of emphasis made on controlling electrical ignition sources but less on the control of hot surfaces. An unprotected electrical meter, for example, is less likely to be an ignition source as it would normally require there to be a fault, however hot surfaces from vehicle engines or the APU running present an ignition source which is continuously present.

Control of Electrostatic Sparks

A bonding line is used to connect the fueling vehicle to the aircraft prior to commencing a fuel transfer. This is to ensure that there is no difference in electrical potential between the two vehicles, which might otherwise cause static sparks e.g. when the delivery hose is connected or disconnected from the aircraft. Also, Jet A-1 contains anti-static additives to aid the safe dissipation of any static charges which might be generated during the fueling process. Control of hot surfaces Surfaces, if they are hot enough, can heat a spill up to a temperature where spontaneous combustion can occur. The above list suggests some measures to control ignition by hot surfaces. However, both of the fire incidents in Barbados and Antigua resulted from a fuel spill being ignited by the aircraft's engine just after it had been shut down. Currently, there are no control measures for this source of ignition. One fuel company experimented with a cover placed over the exposed hot surfaces at the rear of the jet engine prior to commencing fueling, but it was found to be impractical and was abandoned. One way of controlling this ignition source would be to delay fueling until the engines had cooled down to a safe temperature.

4.1.3 HEALTH CONSEQUENCES

Jet A-1 is classified (for supply purposes) as harmful, as a result of the aspiration hazard and irritation to the skin. In the event of a spill during refueling the fueling operator and ground handling staff are likely to be sprayed with liquid and they are also likely to inhale vapor. This short term exposure is only likely to result in short term consequences to health. Jet A-1 is slightly irritating to the skin, and has a defatting action. If it gets into the eyes it will cause discomfort. Toxicity following a single exposure to high levels (orally, dermally or by inhalation) of Jet A-1 is of a low order. However, exposure to higher vapor concentrations can lead to nausea, headache and dizziness. If it is accidentally ingested, irritation to the gastric mucous membranes can lead to vomiting and aspiration into the lungs can result in chemical pneumonitis which can be fatal.

4.1.4 ENVIRONMENTAL CONSEQUENCES

Through talking to various airport operators at Margaret Ekpo International Airport Calabar, it has become apparent that the main concern arising from fuel spills are the consequences to the environment. With most airports now having environmental policies and management systems in place, pollution is very high on the agenda. With consent limits being set on discharges to the environment by the Environment Agency (EA) or other relevant bodies, the airport and particularly the company involved can be liable to prosecution and a substantial fine.

Although Jet A-1 is not particularly toxic there are still concerns about it entering the environment. The main concern is that of exceeding Biological Oxygen Demand (BOD) and/or

Chemical Oxygen Demand (COD) consent limits. If the fuel enters a watercourse it will be degraded either biologically or chemically. This process reduces he oxygen level in the water, damaging aquatic life. Depending on the nature of the watercourse, this can be a very significant problem. There are certain components of Jet A-1 fuel which have a high potential to bio accumulate, but they are unlikely to persist in the aquatic environment long enough to pose a significant hazard. The effects of Jet A-1 on mammals are reported to be very low. Depending on the location of the spill and the surface involved (i.e. a spill near the edge of a concrete surface or on an asphalt surface) it may reach the soil and cause ground contamination. For small spills the fuel will either evaporate or be biodegraded before it can cause a significant problem. However, a large spill may cause ground contamination, contamination of ground waters and it could also pollute local aquifers if they are present.

Mitigation measures. There are several ways to prevent fuel spills reaching the environment. These are as follows:

Spill kits.

By placing spill kits near to fueling operations, they can be quickly used to mop up any spills. The kits should contain adsorbent materials and booms to prevent any spill spreading. This is a preferred alternative to the practice of diluting and dispersing the spill, employed at most airports.

Containment

Following a large spill, it is quite common for the fire service to use firewater hoses to form a temporary bund around the spill to stop it spreading and entering the drainage system. Fuel clean-up vehicles are then used to remove as much of the liquid spill as possible for subsequent disposal off-site. In the event of a spill entering the drainage system, some airports are able to switch the system over to 'containment' mode in order to retain the spill within the system.

Interceptors

Interceptors on the drains should separate jet fuel from the discharge water. They must be alarmed, adequately sized and regularly emptied.

Catchment plans

If a large spill was to occur then the catchment plan could be used to determine which drains would be affected by the spill. These drains could then be isolated or diverted to stop the fuel reaching the outfall.

Groundwater monitoring.

Regular monitoring of the groundwater around the site would determine if any spills were reaching the water table.

5.0. RECOMMENDATION AND CONCLUSION

In conclusion, this study has identified the failure events which can result in a fuel spill on the ramp during refueling, maintenance or defueling. The main consequence would be a pool fire if the spill was ignited. With the development of the jet engine during and after the Second World War, the use of kerosene type fuel, such as Jet A-1, has largely replaced the gasoline type fuel known as Avgas. With its much higher flash point, lower volatility and much lower rate of flame spread, Jet A-1 offers some safety benefits. It reduces the risk of injury/fatality during fueling mainly because it significantly reduces the likelihood of ignition. It also reduces the speed of flame spread across the spill increasing the probability of escape for the people around the stand. However, it must be remembered that the Auto Ignition Temperature of Jet A-1 is significantly lower than it is for AVgas.

The following measures which also incur relatively low cost are recommended and should be implemented. Unclear safety responsibilities for turn round activities in the world, the Courts have ruled that organizations retain some responsibility for health and safety during activities carried out by contractors on their behalf. Relying on standard clauses requiring the contractor to comply with relevant health and safety legislation is unlikely to be enough. Clients must take all reasonably practicable steps to assess, co-ordinate, control and monitor the work that the contractors carry out on their behalf. This means that airlines, as the clients of the turn round operation, have a significant degree of responsibility for ensuring that it is carried out safely. Airport authorities have a role to play, ensuring that the equipment and workplace they provide is safe. They can influence standards through issuing and enforcing Airport Standard Instructions and should also seek to develop airport-wide coordination and co-operation, for example through an Airside safety committee which represents the whole airport community. Service providers should also play their part, for example by co-operating around the aircraft during a turn round, attending Airport safety committee meetings and obeying Airport Standing instructions. Airport Authorities need to ensure that ground handling agents train their staff in awareness and understanding of fueling operations. The oil companies should be prepared to assist in this activity; Airport Authorities require a more systematic approach to inspection and audit activities to ensure all aspects of turn round procedures are regularly assessed, noncompliance's identified, remedy ablations specified and recommendations properly implemented. Systems to check for trends in non-compliances and persistent offenders should be in operation, as well as effective sanctions available and implemented in order to deter repeat violations effectively; Airlines need a systematic approach to monitoring their contractors (see recommendation 3); It is suggested that Airport Authority activities are not in accordance with the requirements of HS(G)65. There appears to be a need for a more structured approach to auditing so that a benchmarking system can be established to standardize safety management across Nigeria airports. The CAA audit of Airport Authorities could usefully be employed to check on the adequacy of internal audits. Management Control (applies to all parties associated with a turn round): An essential part of any safety management system is the control, monitoring and feedback mechanism. Regular safety audits/checks should be performed to ensure understanding and compliance with operating procedures and standards. In cases where breaches are observed, application of disciplinary procedures should be invoked. A common practice in the working environment is the use of "team briefings" or "tool box" talks. These allow for informal discussions which provide positive feedback on problems encountered in the working environment. Without such feedback, problems of both the work activity and requirements of the procedures cannot be effectively managed. Recording Spill Incidents: No standard spill incident report was available as guidance or to use. Consequently, each airport authority or fire service has developed their own format. For any future analysis involving fuel spills, consideration should be given to developing a standard format. A simple tick list approach could be adopted. Deficiencies found in the spill reports included: no indication as to whether a fueling procedure was in progress, method of fueling, incomplete information, estimated spill volume, details of cause etc.

REFERENCE

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