

## SEVERE INJURY WITH HAND AMPUTATION AND SKULL FRACTURE

Type of accident:

Lost Time Injury

Data of accident:

March, 14<sup>th</sup> 2003

Job position:

Motorman

Type of activity:

Offshore construction

Activity performed:

Maintenance



## SUMMARY

### **1. Accident description**

1.1. Sequence of events

1.2. Conclusion

1.3. Accident result

### **2. Actions taken after the accident**

### **3. Root causes analysis**

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## 1. ACCIDENT DESCRIPTION

### 1.1. Sequence of events

- ⌚ At approximately 17.25 hrs some operators understood that there was a problem with the engine of the power generator, called "PACCO ASTRA" no. 2.

The deck team under the leadership of a Mechanical Assistant went to investigate. The team included: a Mechanical Assistant (Team Leader), two Motormen (one was the injured person) and a Deck Electrician (Foreman)

↪ **All of them are experienced personnel having at least 10 years experience each on the Semi Submersible Crane Vessel.**



#### Description of equipment

The "Pacco Astra" is a large container (12m x 3m) weighting 40.000 kg containing a Detroit Diesel V16 generating set, a compressor, welding sets and two electrode ovens. It is normally lifted onto platform jackets and used for providing independent power for welding operations. In this incident it has been decided to use the Astra to provide power for testing the some winches rather than having unnecessary lengths of 440v cables running on the deck from the crane tubes, which are the normal source of deck power.

↪ **When the generator is running it is hot and very noisy inside the container with a large throughput of air being continuously drawn in.**

## 1.1. Sequence of events (cont'd)

- ⌚ The Mechanical Assistant and the two Motormen were immediately involved in the inspection of the engine, whilst the Deck Electrician was called after the decision taken by the others to change the filters and so the need to shut down the generator.

The Mechanical Assistant and the two Motormen went into the container to investigate the fluctuating engine note, they were followed shortly by the Deck Electrician.

The Motorman – injured person, first adjusted the engine revolution using the remote and then he and the Mechanical Assistant went on the left side of the generator to check the fuel filters (the filter bowls, as in similar previous occasions, had shown evidence of water contamination).



↪ **Changing the filters was considered a routine task and did not require Permit to Work.**

- ⌚ One Motorman and the Deck Electrician stayed by the control panel.

The Motorman – injured person stayed by the filters, whilst the Mechanical Assistant returned to the panel to ask the other Motorman to fetch new filters from the store.

The Mechanical assistant went outside to tell the winch crew to stabilise the winches as the generator needed to be shut down for the filters to be changed.

↪ **The engine was still running.**

## 1.1. Sequence of events (cont'd)



- ⌚ The other motorman, before to go to the store, recalls seeing the Injured Person bending over with his hands on his knees near the filters before he left.

At that moment the Deck electrician was near the control panel.

- ⌚ The Deck Electrician left the container to see what was happening with the winches.

He recalls hearing some strange noises from the container and went back inside. He saw the Injured person in a sitting position on the engine frame with his back against the radiator mesh, he appeared to be looking under the engine.

The Deck Electrician left the container. After being outside for few seconds he became anxious about the Motorman and went back in and saw him in the same position, knew something was wrong and shouted for help.



The Deck Electrician opened the circuit breaker whilst the Mechanical Assistant who had re-entered upon hearing the shout for help, shut down the generator using the emergency stop.

## 1.2. Conclusion



The investigation revealed that in preparation for the filter change, the injured person had partially removed his jacket, releasing his right arm first.

The suction created by the fan pulling in air from outside the container, physically pulled the free part of the jacket and the Injured Person's left hand, which was still inside the jacket sleeve, into the unguarded balance wheel pulley assembly.

## 1.3. Accident result

The Motorman – injured person has suffered a traumatic amputation of his left arm below the elbow and a fractured skull as a result of the contact of his head with the cylinder block or exhaust manifold.



## 2. ACTIONS TAKEN AFTER THE ACCIDENT

### ⇒ Onboard Medical Intervention and MEDEVAC

The entire process of the first medical intervention and treatment and the immediately subsequent activation of MEDEVAC procedure was performed in professional way with Team on board and the client support.

### ⇒ Actions on the ASTRA container

Shut down the engine.

Forbidden access to the container. Only authorized personnel entered into the container.

Placed specific stoppage signs.

Removed the guard to the ventilation fan in order to recover the clothing and any possible part of the Injured person to be provided to the MEDEVAC team. The area where the Injured person was found was searched for the missing portion of his arm in case it could be saved.

### ⇒ Activate an Investigation Team and prepare the relevant report.

## 3. ROOT CAUSES ANALYSIS

<b>UNSAFE ACTS</b>	
<b>Following procedures</b>	<p>There is no specific written procedure for this kind of operation. It is considered a normal inspection and maintenance operation. Nevertheless common sense and the normal operation requires to shut down the system before starting any maintenance. This was the correct approach that the involved team was taking at the time of the accident. In fact the accident occurred immediately before the engine was switched off and the maintenance operation (change of the filters) had started.</p> <p>The only written procedure is the operating manual provided by the manufacturer of the Astra Package and in particular of the engine.</p>
<b>Use of tools or equipment</b>	<p>At the time of the accident, the injured person was not using any tool or equipment. No equipment or tools had been found in the surrounding area of the accident</p>
<b>Use of protective methods</b>	<p>As per statement of the witnesses, the injured person came in the Astra container wearing a jacket and the safety helmet as per safety procedures.</p> <p>He didn't remove any existing guards, warning system or safety devices from the engine where he was supposed to start the maintenance operation.</p> <p>It is most likely that due to the warmer environment in comparison with the external weather, the injured person removed the jacket and also his helmet in order to prepare himself and be more comfortable for the operation to be performed.</p> <p>In fact, the helmet had been found on the floor of the container and does not reveal any impact footprint.</p>
<b>Lack of awareness</b>	<p>The operation that the injured person was suppose to perform is a routine maintenance job that, other than the normal precautions when handling manual tools, do not require any specific attention.</p>



## 3. ROOT CAUSES ANALYSIS (cont'd)

### UNSAFE ACTS

#### Lack of awareness (cont'd)

The Injured Person, being very skilled and confident with this job, most likely did not consider the hazards related to the removal of PPE and the suction of the ventilation system. In fact the jacket was sucked by the ventilation and pulled into the pulley thereby causing the accident.

In this particular case, it is considered that the Injured Person may have misjudged the potential hazards and relevant risk.

### UNSAFE CONDITIONS

#### Protective system

One of the main causes of the accident can be considered to be the improper guarding of the pulleys and belt used to transfer the rotating motion to the ventilation/cooling system.

The fan blades are properly guarded while the pulley was not.

It has been confirmed by the Chief Engineer that the package has never been modified since it arrived on board, and in particular no modifications have been performed to the protection devices provided together with the generator.

It has been also confirmed by the management of the vessel that in the past no one person has recognised the hazard related to the un-protected pulleys and informed the management on the need to improve the general safety conditions within the container

## 3. ROOT CAUSES ANALYSIS (cont'd)

<b>UNSAFE CONDITIONS</b>	
<b>Safety warning and signs</b>	<p>Located outside the container, there is a warning system that provides information to personnel located outside on the running of the engine and any mechanical emergency situation that may exist.</p> <p>The container is not properly provided with safety signs, and there is no signage to indicate that only authorised personnel can enter</p>
<b>Work Exposure</b>	<p>The working environment where the accident occurred presents the following conditions:</p> <ul style="list-style-type: none"> <li>• High level of noise which create difficulties in the communication between the personnel inside the container. The main communication is done by hand signals.</li> <li>• Warmer condition in comparison with the external temperature</li> <li>• Access and egress is restricted and working area is cramped</li> <li>• The operators have to walk along the corridor (approximately 70 cm width) to reach the fuel filters which is where the accidents occurred. Battery rack is positioned alongside the container wall adjacent the engine further reducing access and egress.</li> <li>• Personnel working within the access way are in close proximity of the engine exhaust which present hot surfaces requiring protection.</li> </ul>
<b>Working place environment</b>	<p>The dimension of the container, the position of engines and of the control panel, the dimension and position of the walkways are not easily accessible and for this reason the access to them should be regulated.</p> <p>The operators movement within the container and in particular along the corridor are restricted.</p>

## 4. RECOMMENDATIONS AND FOLLOW UP

### **Mechanical Protection**

- Install protective devices to the rotating parts on the generator and engine, in particular close to the ventilation-cooling system
- Install protective devices for the hot surfaces (i.e. exhaust manifold) of the engine which may come into contact with operators
- Remove the batteries package and place it in less congested area
- Install safety signs at the entrance of the containers, such as “Authorised Person only”, “Hearing Protection required”, the normal PPE requirements
- Ensure the emergency stop is immediately accessible to a stand-by person supporting the inspection operation (see next section - Procedural).

#### *General*

- Perform an overall verification of all on board equipment and machinery in regards to Machinery Guarding or Machinery Protection of rotating and moving parts. The verification has to be performed by competent persons who shall be identified by both the offshore and onshore organisations.

### **Procedural**

All inspection operations beyond the control panel can only be performed with a stand-by person in attendance within the immediate area of the emergency stop and in a condition to easily see the inspection operators.

- Lone working is not allowed inside the container when working beyond the control panel or activities require working/inspection whilst the engine is in operation.

## 4. RECOMMENDATIONS AND FOLLOW UP (cont'd)

### **Procedural**

#### *General*

- Offshore management to identify all the working areas, other than those already subject to Permit to Work, where a watchman is required and lone working is not allowed. All relevant findings must be communicated to all personnel and properly identified with safety signs.
- In order to ensure continuous monitoring of the work areas (equipment conditions), a periodical (weekly) work site safety walk-through should be implemented on board. The Management team should visit different areas of the vessel in rotation. Safety Dept. to maintain log of the actions identified and monitoring the relevant implementation.

### **Personal Behaviors**

- Routine operations are normally those that create overconfidence in the operators. Management on board should emphasise during the meetings on board the need to maintain a high level of attention when performing routine operations.
- Safety dept. to ensure that also all the normal operations are assessed and JSA are available in order to maintain high level of awareness and continuous monitoring of the performance of these operations. All personnel should be involved in the identification of the hazards and the assessment of the relevant risks for all the routine operations, other than those specific for the projects.
- In order to ensure continuous improvement of the safety awareness, the safety observation system must be implemented on board. People should be continuously encouraged to report any situation that may create problems and management have to provide immediate feed back on the proposed actions. The system shall not be used to identify mistakes or breaches of procedures by other persons. This is in order to promote a "no blame" culture.

### **Personal Protection**

- Vessel Management to perform a survey and identify all the operations and the relevant Personal Protective Equipment to be used.
- Ensure that Safety helmet is kept on in all the working sites. Chin strap must be utilised in order to avoid loss of helmet when changing posture and changing environmental conditions