NOPSA

NATIONAL OFFSHORE PETROLEUM SAFETY AUTHORITY

SAFETY ALERT 25

Tensioner Failure

What happened?

In Australian waters, two separate incidents have occurred recently on semi-submersible MODUs. Each incident involved a guide line or pod line tensioner operated Rod End Down (RED). In each case, the wire rope parted, releasing the load on the tensioner and allowing the tensioner piston to stroke downwards in an unrestrained manner until it came into contact with the end cover plate of the cylinder. The impact of the piston on the end of the cylinder was severe enough to cause damage. In the first case the mounting bolts fractured allowing the complete tensioner unit to fall to the deck. In the second case, the bottom cover plate securing bolts fractured, allowing the piston assembly to come out of the cylinder and land on the grating below.

Both of these incidents had the potential to cause fatal injuries if persons had been in the vicinity.

What could go wrong?

If a tensioner wire rope breaks, the load on the tensioner piston is suddenly released. The HP air pressure on top of the piston will force the piston to stroke out to the end of the cylinder in an unrestrained manner. To prevent this from happening, tensioners operating RED have the following design safety feature built into them. *(See the sketch attached to the end of this alert)*.

When the piston moves downwards, it forces the hydraulic fluid in the lower part of the cylinder through an orifice plate and into the LP hydraulic fluid reservoir. For unrestrained motion of the piston, the flow of hydraulic fluid through the restriction of the orifice plate will be sufficient to restrain the speed of the piston and allow it to safely come to rest against the cylinder end cover plate without causing any damage.

In both of these incidents, the operator was unaware that hydraulic fluid had inadvertently become displaced by air. When the wire rope broke, the piston speed was unrestrained because of the lack of hydraulic fluid in the lower part of the cylinder. Damage was caused by the collision impact of the piston into the end of the cylinder.

For tensioners operating RED, this design safety feature incorporates a small purging non-return valve fitted into the piston rod just under the piston. The downstream side of the non-return valve is connected via a flexible hose back to the LP reservoir. When the piston is stroking downwards, hydraulic fluid is forced through the orifice plate at the bottom of the cylinder. This creates a small overpressure in the tensioner cylinder relative to the LP reservoir. The overpressure is sufficient to lift the non-return valve off its seat. Any HP air that has leaked past the piston seals will be vented through the open non-return valve and into the LP reservoir. When the piston rod moves upwards again, the non-return valve will close. The action of the purging non-return valve will keep the lower part of the cylinder purged of air and full of hydraulic fluid. It is therefore essential in maintaining the integrity of this design safety feature.

This design safety feature can be compromised by an air build up which replaces the hydraulic fluid in the lower part of the tensioner cylinder. The most common causes are:-

- If the HP air leakage rate past the piston seals is high enough, the action of the purging non-return valve will not have the capacity to purge all of the air from the lower part of the cylinder.

- If the purging non-return valve becomes blocked.
- If the hydraulic fluid level is not maintained.

Under these circumstances, there will be no hydraulic fluid system protection to prevent unrestrained piston movement should a tensioner wire rope break.

Key Lessons:

From the investigation of these two incidents it was found that:-

Hydraulic System

- There was no maintenance procedure or built in system for detecting piston seal leakage rates, in particular, leakage rates high enough to cause the hydraulic fluid to be ejected from the lower part of the tensioner cylinder back into the LP reservoir. Before one of the tensioner failures occurred, the operator had noticed air and hydraulic fluid mist being vented from the LP air pressure regulator in the control cabinet. The LP air pressure regulator is used to maintain the air pressure on top of the hydraulic fluid in the tensioner LP reservoir. The operator had not linked the cause of this venting to possible piston seal leakage and failure in one of the tensioners.
- Other than at the end of a well (EOW), there was no system or procedure in place for determining if the correct quantity of hydraulic fluid was present in the LP side of the tensioner. At EOW, when the tensioner was not in service, the procedure used was the method given in the manufacturer's manual. This required the piston to be fully stroked out then fully retracted before checking that the fluid level was visible in the lower sight glass of the LP reservoir.
- There was no maintenance procedure used to determine if the purging non-return valve was operating correctly.

Wire Rope

- One wire rope broke at the tensioner turn down sheave due to wire fatigue. The normal procedure used to change the wear points in a wire rope is by slipping and cutting. For a tensioner, this is normally carried out when the tensioner is not in use, usually at EOW. On this occasion, the rope had been in constant use for a period three times longer than normal because the rig remained on the same location to drill a multilateral well. The deteriorating condition of the rope at the wear points had not been noticed by the operator until the rope parted.
- In the second incident, the wire rope had jumped the sheave at a time when adjustments were being made to the tensioner and the tensioner was not under load. When the tensioner was returned to service, the wire rope was left rubbing against the shaft and mounting plate for the sheaves. This situation remained unnoticed until the wire rope parted five days later.

Contact

For further information email alerts@nopsa.gov.au and quote Alert 25.

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