



2014 OFFSHORE TECHNOLOGY CONFERENCE ASIA

25–28 March 2014 • Kuala Lumpur, Malaysia
Kuala Lumpur Convention Centre

"Meeting the Challenges for Asia's Growth"

Riser Tension System Upgrades for 2nd / 3rd Generation Floating Platforms

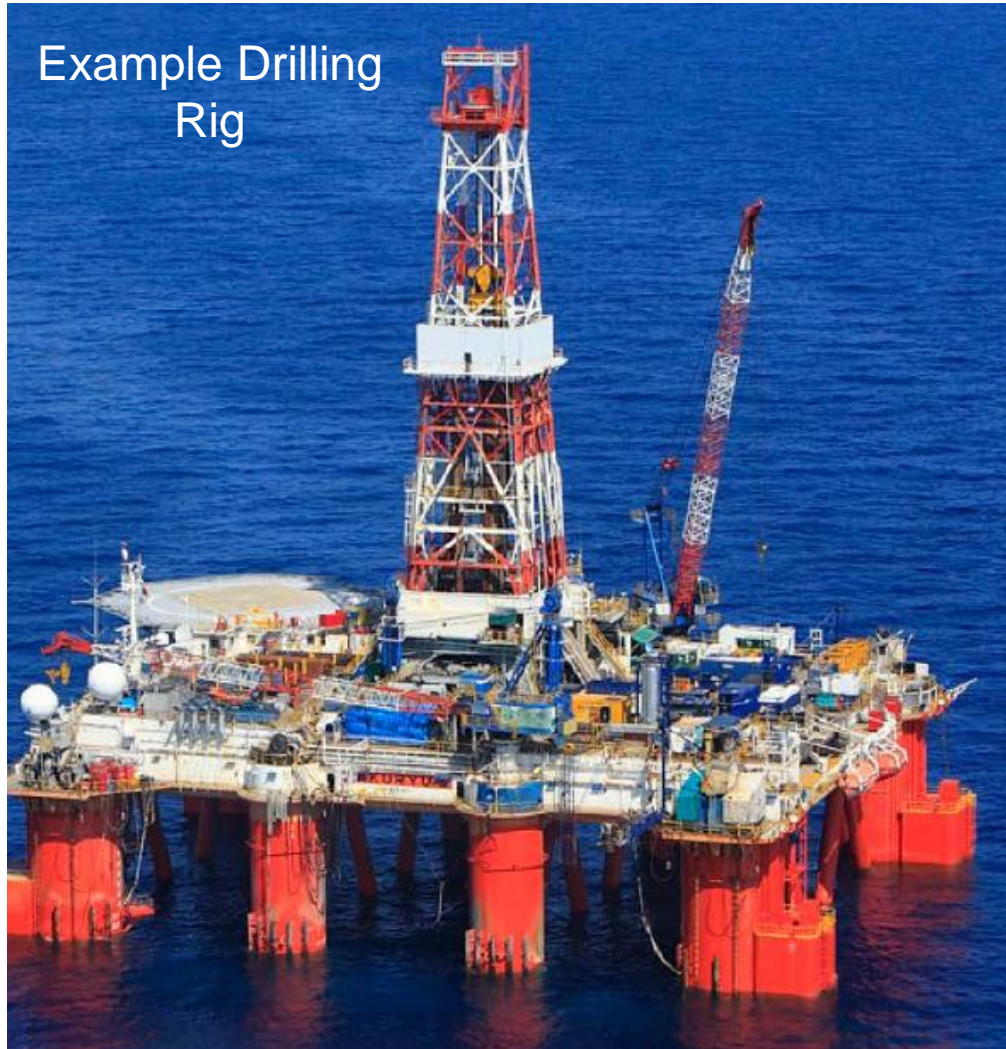
Making Older Rigs Fit For Deepwater Applications

Muhammad Sadiq



Typical Up-Grade Candidate W/ Existing Tension System Specification

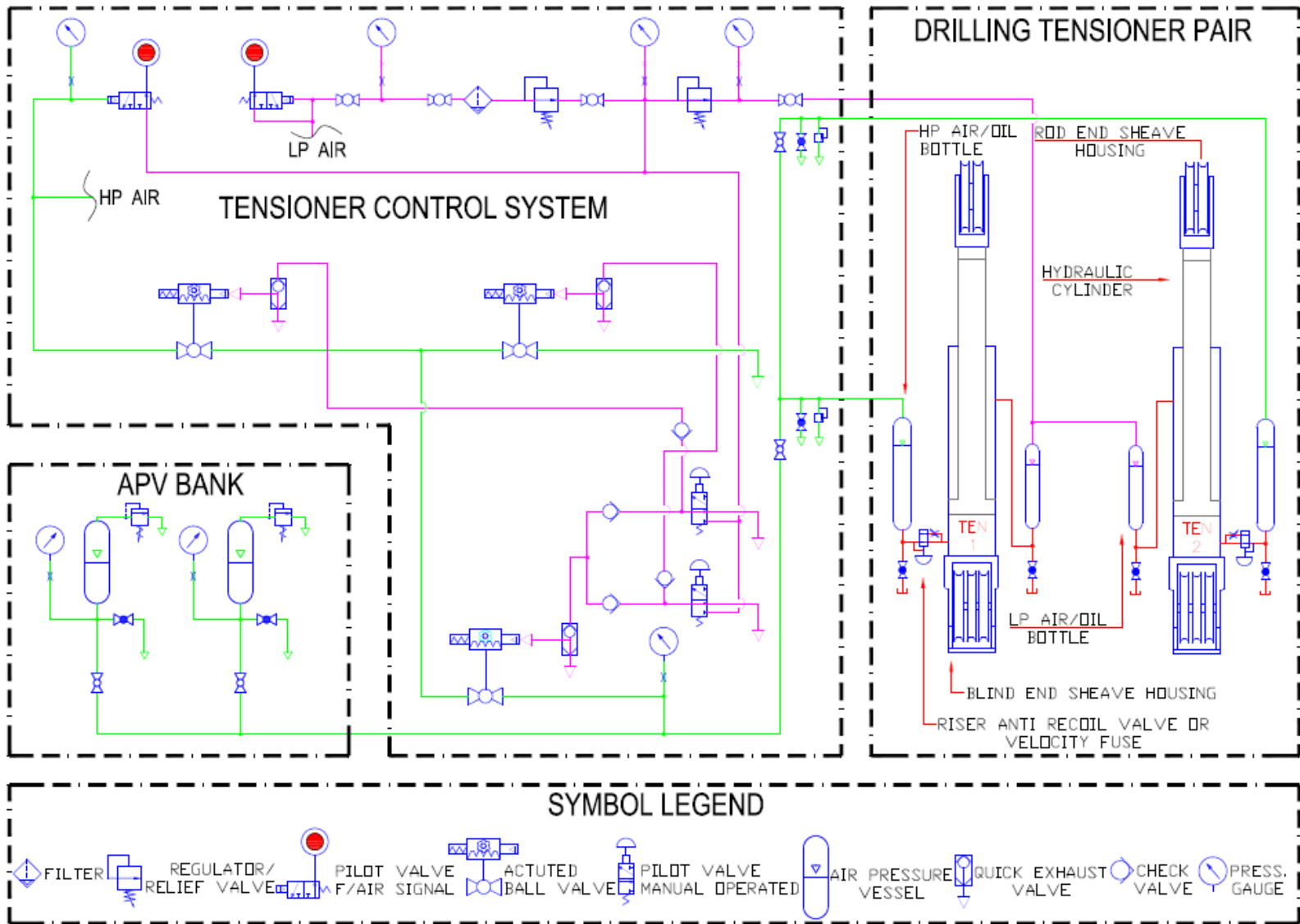
Example Drilling Rig



Dual Set Tensioners, Typically Installed in 4 -8 Sets

| ITEM | SPECIFICATION |
|-------------------|------------------------------------|
| Configuration | Single / Dual or Mixed |
| Wireline Tension | 80 kips / Single & 160 kips / Dual |
| Working Pressure | 2,400 psi |
| Wireline Travel | 50 feet |
| Wireline Diameter | 1.75 Inch |

Simplified Schematic Overview of Tension System



Up-Grade Methodologies

Example System: 4 set of Dual 80 k Tensioners; Operating Pressure 2,400 psi; Total Force = 640,000 lbf

Rod End Sheave Housing

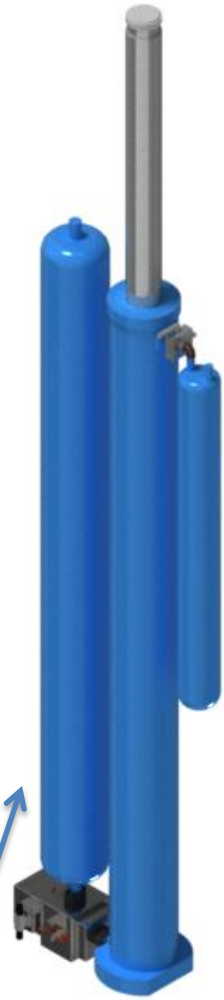
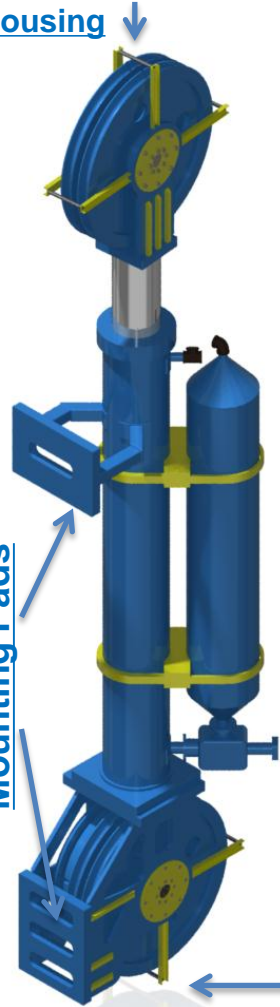
Method 1: Up-Grade 80k tensioners to 120k

Option A

- Replace 80k Hydro-Pneumatic Actuator with a new 120k type.
- Hydro-Pneumatic Actuator consists of minimum; hydraulic cylinder, high pressure accumulator, rod end low pressure accumulator, Anti Recoil Valve (explained in slide 7), necessary hydraulic & pneumatic valves and fittings
- New Hydro-Pneumatic Actuator will adapt to the existing mounting interface on rig
- Rod and blind end sheave housings can be retained (will require refurbishing)
- Cable size will stay same i.e. 1-3/4", however a higher grade cable may be required
- Existing Tensioner Control System along with operator panel stays the same, therefore no change in system pressure of 2,400 psig
- A simple stiffness analysis will determine the size of Air Pressure Vessel Bank (may or may not change)
- Net Increase in system's capacity: 40,000 lbf per tensioner X 4 sets i.e. 8 tensioners, therefore total force after upgrade = 960,000 lbf

Blind End Sheave Housing

Hydro-Pneumatic Actuator



Up-Grade Methodologies

Example System: 4 set of Dual 80 k Tensioners; Operating Pressure 2,400 psi; Total Force = 640,000 lbf

Method 1: Up-Grade 80k tensioners to 120k

Riser Tensioner Unit

Option B

- Replace existing 80k Riser Tensioner System with new 120k type rated system.
- New system shall include:
 - Single wireline type Riser Tensioners rated for 120,000 lbf at MID-STROKE with 50 feet standard wireline travel.
 - Idler Sheave Assemblies
 - Tensioner Control System rated at either 2,400 psi, 3,000 psi or 3,500 psi
 - Operator Control Panel will range from simple Manual Pneumatic Control or HMI based PLC Control.
 - Air Pressure Vessel Bank; sized and designed to provide optimum system stiffness.
 - Anti Recoil Valve System for increased SAFETY
- New system could adapt to the existing rig interface (structural strength analysis required)
- Cable size may stay same i.e. 1-3/4 Inch, therefore existing tension ring can be retained (if applicable)
- Selecting higher pressure system design may provide variable adjustment for the system tension i.e. increased range of tension from 80k per tensioner all the way to full 120k (if applicable)



Method 2: Replace dual 80k tensioners with single 250k units along with full system



Issues: Choice of Single or Dual Wireline Units, Engineering Evaluation, Rig Loading Issues, Different Tension Ring, Line Slip and Cut etc.

SAFETY System (ARV) Overview

Potential Effects of Riser Recoil:

- Riser Buckling: Momentum of riser continues upwards as recoil is arrested too quickly
- Cylinder Stroke-Out: Recoil is arrested too slowly
- Slack Wireline: Momentum of riser continues upwards as recoil is arrested too quickly
- Rope Whipping: Wireline flung violently after it's breakage
- Fluid Shock Pressure: After pulling a vacuum, load lands back on the top of fluid in cylinder.

Old Style Anti Recoil System:

- Provides
 - Wireline break protection
 - Limited valve functionality requires the operator to isolate correct number of air bottles to achieve optimal disconnect during a deep water disconnect event
- Limitations
 - No complete valve closure  Wireline Whipping
 - System not ideal for high heave disconnect events  Riser buckling & Cylinder Stroke Out

Anti Recoil Valve (SAETY VALVE) & Control System Up-Grade Options ^{Slide 7}

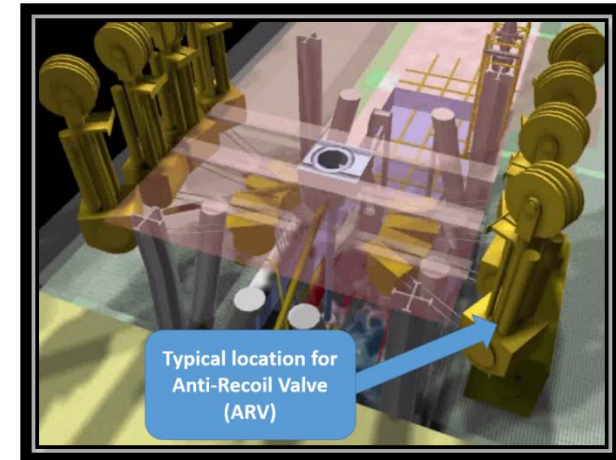
The modern Anti Recoil Valve has two core functions:



1. Protection against recoil caused by a parted riser
 - Rapid response that stops the flow from the HP accumulator(s) to the hydraulic cylinder
2. Controlled arresting of the system during an emergency disconnect event
 - Using an algorithm derived from system-level simulations, the ARV performs a metered closure

Choice of Anti Recoil Valve(s):

1. Electro-Hydraulic Anti Recoil Valve
 - The valve manifold is inclusive of an electrical / computer control system
2. Hydraulic Anti Recoil Valve (Velocity Fuse)
 - All functions are performed hydraulically / passively



Up-Graded System Certification

Certification requirements can be processed according to either
ABS or DNV Standards:

1. ABS (American Bureau of Shipping):

- GUIDE FOR THE CLASSIFICATION OF DRILLING SYSTEMS
September 2012 (Updated February 2014)

2. DNV (Det Norske Veritas):

- OFFSHORE STANDARD DNV-OS-E101 – Drilling Plant
October 2013



2014 OFFSHORE TECHNOLOGY CONFERENCE ASIA

25–28 March 2014 • Kuala Lumpur, Malaysia
Kuala Lumpur Convention Centre

"Meeting the Challenges for Asia's Growth"

Acknowledgements / Thank You / Questions

Japan Drilling Company: Hakuryu-5 Rig (Picture)

NOV: Shaffer 80k Dual Riser Tensioner (Picture)

Olmsted Products Co: Anti Recoil Valves

MHD Offshore Group: Riser Tensioner(s) and Associated Systems