PLUMB BOBS IN SHAFTS
USING TECHNOLOGY TO HELP STOP THE DROP

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Introduction

• Plumb Bob Use
  – Review components of the Plumb Bob System for Shaft Sinking
  – Share Incidents that occurred that prompted the analysis & design changes
  – Share learning’s from our experiences
  – Q & A
Introduction

• Let’s not have any incidents!!
  – How will we learn?
  – How will we get better?
  – How will we expand our knowledge?
  – It is how we deal with incidents that makes us improve!!
Typical Application

• Building Pyramids
• Wall Construction
• Door Jams
• Shaft/Trench Work
• Vertical Reference Line
• Fence Posts
Typical Plumb Bob Assembly

- Single strand wire (Piano Wire)
- Chain Weight (maintain tension on line)
- 50 lb Plumb Bob for greater accuracy
- Steady Brackets to keep line in position
- Suspended in the shaft from winch attached to shaft wall
Typical Plumb Bob Assembly

• Set up on 4 points in shaft subcollar (Cardinal Orientation)
• Operated by Deckperson upon request from Shaft Crew
• Typically winches are visible to the operator not the shaft crew
North Shaft Plumb Bob Incidents

• 6 Incidents in total between October 16, 2015 and April 19, 2016
  – Two of the incidents resulting in a falling objects
  – Four near miss reports indicate procedural changes had improved the situational awareness regarding conditions & movement
    • 2 were related to bunched up cables on the winch
    • 1 related to build up of salt/calcium on steady bracket/cable
    • 1 a broken strand was observed during inspection/maintenance
  – Not all incidents were the result of moving plumb bob up.
South Shaft Plumb Bob Incidents

• 4 Incidents in total between October 15, 2015, & March 27, 2016
  – All incidents in the south shaft resulted in a fall of object
  – The cable was damaged either by catching on a Crosby Clip part of the chain weight or plumb bob assembly
  – Each incident occurred in the up movement of the plumb line.
Typical Plumb Bob Assemblies Before
Typical Plumb Bob Assemblies Before
Typical Plumb Bob Assemblies Before
Challenges from Conditions

• Build up of salt/calcium from Brine water
  – Plumb Bob Chain
  – Plumb Bob Line

• Build up would impede movement of the line
Roll Out & Burst Out Potential
Non Engineered vs Engineered

Catch Points, No Established Anchor Point, roll out potential

Minimal Catch Points, Established Anchor Point, minimal roll out potential
Engineered Plumb Bob & Anchor Point

- Permanent design follows an engineered design, scheduled inspections & maintenance
Plumb Bob Winches & Cables

- Single strand wire winch
- Poor line of site for operator due to obstructions
- Poor Communication due to location
Plumb Bob Winches & Cables

- Access from sump in sub-collar
- Close proximity to winch
- Poor line of site
- Improper fleet angle
Plumb Bob Winches & Cables
Plumb Bob Control Station

- One of 4 stations
- Location clearly indicated
- Over/Under Tension Indicators
- Line Control Indicator
- Femco Phone
Plumb Bob Control Station

• Femco Phone at each station
• Pendant Controls to maintain line of sight
• All done without entering the sump of the sub-collars
Tension Meters & Line Control Instrument

- Display controller monitors the tension and payout.
- The up relay cuts the UP button and activates an OVERTENSION alert @ ~100lbs.
- The down relay activates a UNDERTENSION alert, example - Plumb bob removed.
Tension Meters & Line Control
Winch Cable Change

- Project first started with single strand stainless steel cable (piano wire)
- Wire rope small diameter cable
- Stainless wire rope, rotational resistant
Procedure Changes

• Procedural changes (some examples)
  – Pre-use inspection of Plumb lines
  – Fans off for all quiet
  – Confirm communication
  – All activities stop when moving plumb lines
  – Employees to retreat to exclusion zone (opposite side of area line is moving)
  – One Plumb line moved at a time
  – Move with only small weight on line
  – Attach Main Plumb Bob once at location
  – Plumb Bobs secured when not in use
  – Quarterly Rope Cuts & attachment changed (crimps, swivels etc)
  – Documented routine inspections
Closing Comments

- Plumb Bob is key to shaft sinking
- Most situations Plumb Bobs repaired on the fly
- Shift in reporting culture
- Use of the “Brothers Keeper Cards” to enhance – Hazard Reporting, Continuous Improvement & Positive Recognition – but that’s for another talk.
Questions

Thank You!!

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