NOAA WORKBOAT RECOVERY INCIDENT

BACKGROUND:

1. On March 5, 2012, a NOAA Ship was holding position, with the ships Dynamic Position System (DPS). During the attempt to recover the ship's work boat (boat) with the starboard crane, the crane hoisting wire parted dropping the boat 12-14 feet while suspended over the water. The boat dropped into the water clearing the side of the ship on the way down with the sea painter and forward and aft frapping line still attached. Minor damage was sustained to the cabin top of the boat from the impact of the crane's overhaul ball and hook assembly. Personnel involved in the boat recovery operations were clear and sustained no injuries. Personnel involved in the recovery operation were following the vessel's written procedures for boat lower/raising operations and were wearing all required personal protective equipment.

2. The work boat, is a 27' X 10'3" Pilot Master, welded aluminum cabin vessel, with integrated air/foam collar, manufactured in 2003 by Northwind Marine. The original delivered dry weight was 6,800lbs including the propulsion system. The fuel capacity is 142 gals of diesel at 100% tank capacity. The manufacturers' suggested capacity is a maximum carrying capacity of 1800 lbs, persons and cargo, not more than 8 persons. The boat was weighed a week after the incident using a calibrated load cell. The total hoisted weight was indicated at 8,134 lbs with all required equipment and 64 gallons of fuel (45% of tank capacity). This is the configuration and hoisting weight for this work boat as documented in the ships written policy.

3. The crane involved in the mishap was manufactured by Appleton Marine, and is a telescoping hydraulic crane; model EB70-60-25S, located on starboard side of the 01 level deck. The vessel has an identical crane mounted on the port side (*see figure 2*). The crane involved in the incident was installed onboard the ship, January 5, 2005, during initial ship construction and was certified by American Bureau of Shipping. Certified Safe Working Load (SWL) is 8100lbs for a radius of 25'-42' and 5000lbs at 60' extended with 0 degree boom angle. The installed wire rope at the time of the mishap was a 5/8" diameter steel stranded core. The overhaul ball (headache ball) and hook assembly were stamped with a weight of 150lbs (*see figure 3*). The crane is equipped with an Allen Bradley panel view 300 loading cell and alarm panel system. The loading alarm panel has 4 weight limiting modes of operation; "Dockside Static (8100lbs)," "At Sea on Vessel 2.5m waves (8100lbs)," "At *Sea off Vess*el 2.5m waves (5000lbs)," and "At Sea on Vessel 4.0m waves (5000lbs)." The launching and recovery of the boat is restricted to protected water only, and only when panel *mode is in "Dock*side Static" or "At Sea on Vessel 2.5m wave" modes as per the ships written operational procedures. The loading alarm panel was calibrated in FY-2009 dry-dock. The last load test was conducted by the ship's crew on Jan. 5, 2012. The last documented maintenance was on Feb. 27, 2012 and included a visual inspection and greasing of the wire rope performed by ships personnel. Weight verification was conducted approximately a week after the incident utilizing a calibrated load cell used for scientific research and the loading alarm panel was found to be displaying the applied weight accurately within 3%.

Figure 2. Left photo – Starboard Crane; right photo – Port Crane

FINDINGS:

1. Appleton Marine crane manual EB70-60-25S drawing, BWD-502, indicates both cranes were engineered and designed with a 300 lbs overhaul ball (headache ball) and hook assembly. Port crane has 170 lbs headache ball assembly and starboard cranes assembly is 150 lbs. (*see Figure 3*). The headache ball and hook assembly does not have enough weight to maintain constant tension with no load attached to crane, which allows slack in the rope throughout its travel. Crew reports that the wire rope has repeatedly jumped off the boom head sheave and become caught between the sheave and sheave block. (*see figure 4*) Crew also reported the wire, when being payed in, does not always lie properly on the winch drum and tends to rat nest or cross lay.

Figure 3. Overhaul (headache) ball weights
(left - crane manual diagram; center - port crane; right - starboard crane)

Figure 4. Starboard Crane sheave and sheave block

2. On November 24, 2009, during the winter 09/10 dry-dock period, new rope wires were purchased from Carpenter Rigging and Supply by the ships force and installed on both of the ship's 01 deck cranes. The wire rope involved in the MISHAP is 5/8" 19X7 IP (Improved Plow) IWRC (Independent Wire Rope Cores), Breaking Strength (BS) of 33,600 lbs, Safe Working Load (SWL) of 6,720 lbs at a safety factor of 5 to 1. No OSHA certificate of testing was provided. The original wire rope at the time of the ship's delivery was 5/8" 6X36 XXIP (Extra Extra Improved Plow) IWRC, BS of 48,900 lbs, SWL of 9080 lbs, with an OSHA test result certificate provided.

3. Crane wire ropes are secured to deck pad eyes under 2,000 lbs of tension when not in use to reduce lateral movement of the crane's boom in its cradle while at sea. This was a common deck practice not documented in ship policy. Excessive tension on the wire rope while lying in the sheaves causes the wire rope to flatten, which over time reduced the wire's tensile strength. The point at which the wire parted was at the same distance from the headache ball as where it lies on the sheaves. (*see figure 2*)

4. Both Crane boom cradles are constructed to allow for 3-5" of lateral movement when the crane is resting in its cradle, secured for sea. This lateral movement increases the dynamic tension being applied to the wire rope over and above the 2,000 lbs of tension being applied by securing the rope to the deck pad eye.

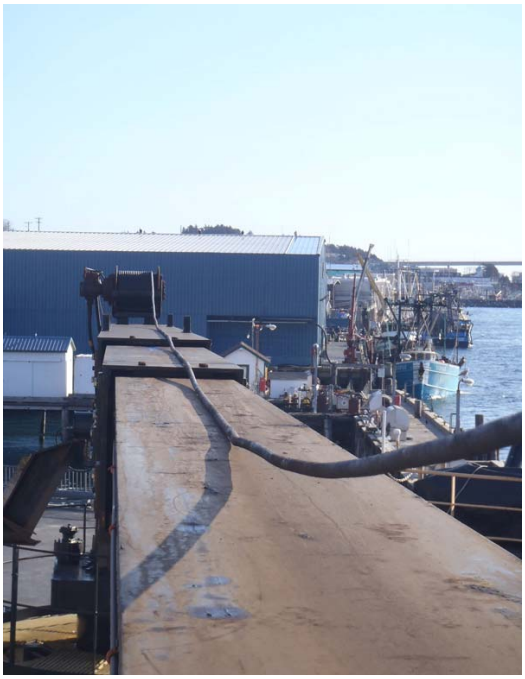
5. Crane cradle pedestal supports were not designed to reduce port and starboard lateral movement when the boom is resting in its cradle. The only way to reduce lateral movement of the boom at sea is to apply tension by securing the wire rope to the deck pad eye.

6. Post MISHAP inspection of the parted wire rope strands indicated an irregular fracture of the individual wires; which is caused by a combination of bending fatigue and tensile overload. (*see figure 5)* Corrosion of the internal strands was documented during the inspection. (*see figure 5*) Maintenance records and crew interviews indicate the parted wire rope on the ship had been greased by hand.

7. An abnormal bend was documented during the post MISHAP visual inspection of the existing wire rope on the STBD crane. This deformation occurred *after* the defective section of wire rope had been cut off, re-terminated and the headache ball reattached. The ship used the crane to re-secure the boat on deck for transit and secured the crane for sea. The current deformation occurred over a one month time span. (*see Figure 6*)

Figure 5. Close up of parted wire rope
left - internal strands; center - whole wire photographed during investigation;
right - whole wire photographed immediately following incident

Figure 6. Deformed existing wire rope on Starboard crane



8. The boat was weighed a week after the incident and found to be 8,134 lbs, which exceeds the crane's 8,100 lb SWL limitation. The weight test was done with 64 gals (45%) of fuel and minimal required equipment. Crew had reported on occasions when lifting the boat that the weight limiting alarm would sound, but they would ignore the alarm indication of overloading.

9. Maintenance records indicate the crane involved in the incident had not been examined annually by a competent person from American Bureau of Shipping (ABS) or a third party inspector certified by OSHA as required by OSHA's Maritime Crane Accreditation and Certificate Program. An initial ABS inspection and weight test was completed on Jan. 5, 2005. A certificate of Register of Lifting Appliances was issued by the attending ABS surveyor. ABS requires an annual inspection be conducted by an ABS surveyor to maintain validity of a certificate and verify operational condition of an apparatus. The certificate was last endorsed by ABS in 2008, which included visual inspection and a 125% weight test. After 2008, the certificate was allowed to lapse and become invalid. OSHA regulations require that the certificate needed to be reissued in January 2010 by ABS, or that we conduct an alternate OSHA approved procedure, quadrennial overhaul and weight test inspection by an OSHA certified inspector (see 29 CFR 1919.14-15).

10. Crewmembers aboard the ship have not received formal crane and rigging training from an OSHA or ABS approved training provider. Onboard Performance Qualification Standards (PQS) are currently the only requirements to complete prior to being qualified to operate the cranes and does not require formal training for any position onboard.

CONCLUSIONS:

1. The headache ball (see figure 3) is under rated for the application and was changed out by past crewmembers without referring to the Appleton Marine technical manual EB70-60-25S drawing, BWD-502. Appleton Marine designed and engineered the crane as a package to utilize the 300 lbs vice 150 lbs headache ball and hook assembly. As a result of the lighter headache ball, constant tension is not being applied to the wire rope when paying in and out. Constant tension must be applied to the wire rope to reduce the chance of repeated slacking of wraps on the winch drum and wedging between the sheave and sheave block, which ultimately resulted in bending, twisting, and deformation of an already under rated wire rope.

2. The existing crane's wire rope (SWL of 6,720 lbs) installed during the winter 09/10 dry-dock period was rated well below the 8,100 lbs SWL limit posted on the crane and listed in the manufacturer's technical manual for the ship.

3. Applying 2,000 lbs of tension to the cranes wire rope when made ready for sea contributed to flattening and deformation of the wire. (Reinforced by finding #7 above)

4. The excessive movement created by improperly securing the crane in the cradle added excessive strain to the wire far beyond the 2000 lb tension applied when the crane is attached to the deck. The lack of lateral support on the cradle structure added to this excessive tension. (Reinforced by finding #7 above)

5. The corrosion noted in the wire rope inner strands in conjunction with the deformation of the wire noted in conclusion #1, #3, and #4, severely decreased the tensile strength of the wire causing it to part when a load was applied.

6. The boat's lightship (minimum fuel and equipment) weight is beyond the crane's SWL capacity by 30-100 lbs. Neither the Port nor STBD cranes aboard the ship have the ability to lift the boat within their SWL.

7. Cranes, davits, winches, and associated equipment on board the ship are no longer being maintained to industry standard (since 2008) and are not being inspected to ABS or OSHA standards by a certified inspector.

8. Crewmembers repeatedly ignored the weight limiting alarm on the davit as it was indicating an overloading condition when lifting the boat.

9. Crewmembers have not had professional crane and rigging training to educate them in maintaining the lifting equipment or conducting proper annual and daily inspections.

RECOMMENDATIONS:

1. Remove and install correctly weighted headache ball and hook assembly on both cranes in accordance with the manufacturer's technical manual.

2. Conduct a NOAA fleet wide verification of current crane configuration; including the correct headache ball assembly and wire ropes for their specific lifting apparatuses in accordance with the manufacturer.

3. The ship is in the process of purchasing new wire rope with the appropriate SWL limits and size. Recommend testing the new wire rope at 125% of SWL in all positions of the crane's lifting capability prior to placing back into service. Recommend this test be witnessed by an OSHA certified inspector.

4. Recommend the ship crew reduce the amount of tension applied to the wire rope when attached to the deck and made ready for sea. The wire should be visually taut without any slack when attached to the deck pad eye to ensure the proper amount of tension.

5. Recommend eliminating the 3-5" of movement occurring between the boom and its associated cradle, thereby decreasing the additional tension on the wire when the crane is made ready for sea.

6. Review current procedures for maintenance and care of all steel wire ropes, and consider power slushing to reduce corrosion of the ropes internal stranded cores where that practice is not currently being utilized. Power slushing is a sound marine engineering practice and is the common standard used throughout the military, marine, and construction industries.

7. Define and implement clear standards for installation, maintenance, inspections and certified proof testing of weight handling gear aboard NOAA ships. OSHA, API, ABS, and the NOAA Small Boat Standards and Procedure Manual all provide regulations and guidance for weight handling equipment of all types. The potential for future catastrophic failure of these structures and associated equipment is unknown.

8. Remove the boat from onboard the ship. Identify a replacement boat which meets the ships operational specifications and can be raised and lowered at full capacity within the existing crane's SWL, or mount a new davit system to accommodate the boat at full load condition with passengers.

9. Recommend all small boats onboard NOAA ships be weighed annually. Maintain records of weight tests and identify added weight from growth or hull saturation.

10. Recommend documentation for weight handling equipment and wire rope certificates be kept onboard at all times and be verified during fleet inspections.

11. Recommend at least one crew member onboard all NOAA ships, who is responsible for operating and maintaining the lifting equipment, attend formal Crane and Rigging training that is accredited by ABS or OSHA.

12. Recommend technical manuals and manufacturers recommendations be consulted and strictly adhered to when replacing any weight handling gear on board NOAA ships.