REPUBLIC OF THE MARSHALL ISLANDS

Maritime Administrator

NAN BEI HU SAFETY INVESTIGATION REPORT

Occupational Fatality

Rio Tuba Anchorage, Republic of the Philippines | 16 March 2024

Official Number: 8002

IMO Number: 9747900

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AUTHORITY

An investigation, under the authority of the Republic of the Marshall Islands laws and regulations, including all international instruments to which the Republic of the Marshall Islands is a Party, was conducted to determine the cause of the casualty.

Maritime Administrator

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LIST OF ABBREVIATIONS AND ACRONYMS

Administrator . . . . . Republic of the Marshall Islands Maritime Administrator

ASD. . . . . Able Seafarer Deck

C/O . . . . . Chief Officer

C/E . . . . . Chief Engineer

CH. . . . . Cargo Hatch

cm . . . . . Centimeters

DRS. . . . . Defect Reporting System

ILO . . . . . International Labor Organization

IMO. . . . . International Maritime Organization

JHA . . . . . Job Hazard Analysis

No. . . . . Number

PMS. . . . . Planned Maintenance System

PPE . . . . . Personel Protective Equipment

QHSE . . . . . Quality, Health, Safety and Environment

RA. . . . . Risk Assessment

SMS. . . . . Safety Management System

SWL . . . . . Safe Working Load

UTC. . . . . Universal Coordinated Time

DOCUMENTS CITED

MLC, 2006 . . . . . Maritime Labour Convention, 2006

STCW Code . . . . . Seafarers' Training, Certification and Watchkeeping Code

GBM Manual for Grab Type RC024-5-12 . . . . . Shanghai Guanbo Machinery & Equipment Co., Ltd
Documentation Grab Type RC024-5-12, Contract No. CLN10-190805,
Manufacture No. GE2019385, 2019386, 2019387, 2019388

PART 1: EXECUTIVE SUMMARY

On 16 March 2024, the Republic of the Marshall Islands-registered bulk carrier NAN BEI HU, managed by Fleet Management Limited (the "Company") was loading nickel ore by means of the ship's cranes and grabs from barges that came alongside at Rio Tuba anchorage, Republic of the Philippines (hereinafter the "Philippines"). At 1430,[1] no more barges were available and grabs Nos. 1 and 2 were parked on deck fully open to carry out maintenance on the hydraulic lines.

To drain the hydraulic lines, a plastic drum was placed under the through-beam of the grabs. The plastic drum used to drain grab No. 1 did not fit under the fully opened grab and consequently, the grab was partially closed to lift the through-beam.

When the grab was parked on deck, the Bosun and the C/O noticed that the thimble of the grab wire of grab No. 1 was dislodged. It was decided to immediately replace the wire. An RA was completed. The C/O conducted a Toolbox Talk with the crewmembers involved in the task.

To remove the grab wire, the dead end had to be removed from the wire socket. The crane hoisting wire and the grab wire were both slackened. As a result, the grab rested on the two partially opened scoops without hydraulic pressure in the lines or in the cylinder. A chain block was connected to the grab wire on one end and to a D-ring on deck on the other end to pull the wire out of the wire socket.

Around 1700, the ASD2 went under the grab to operate the chain block. When the chain block came under load, the grab opened unexpectedly to its fully open position, which reduced the space between the through-beam and the deck to approximately 30 cm and pushed the ASD2 down onto the deck.

The ASD1 and ASD3 immediately ran to the crane cabin and lifted the grab to free the ASD2. The breathing of the ASD2 was observed to be weak. The Master and other crewmembers were notified and subsequently, medical oxygen was administered. The Master contacted the ship's agent to arrange shoreside medical assistance, and telemedical advice was established.

1 Unless stated otherwise, all times are ship's local time (UTC +8).

At 1855, a shore rescue team boarded the ship and at 2044, the ASD2 was transferred to the local hospital. At 2136, the ASD2 arrived at the hospital and shortly thereafter was declared deceased due to internal hemorrhage and hypovolemic shock.

The below lessons learned were identified.

- Procedures to execute non-routine and unplanned jobs need to be followed and that simultaneous operations impose additional risks that should be addressed.
- The importance of recognizing unsafe behavior and the use of the stop-work authority when an unsafe act is observed.
- The need for familiarization with the ship's equipment prior to executing maintenance jobs to the grab and associated components.

PART 2: FACTUAL INFORMATION

The following Factual Information is based on the information obtained during the Republic of the Marshall Islands Maritime Administrator's (the "Administrator's") marine safety investigation.

Ship particulars at the time of the incident: *see* chart to right.

NAN BEI HU

NAN BEI HU was built in 2019 in Zhoushan, People's Republic of China by Yangfan Group Co., Ltd. It is a geared bulk carrier with five cargo holds, equipped with four electrohydraulic cranes of 30 tons SWL *(see Figure 1)*.

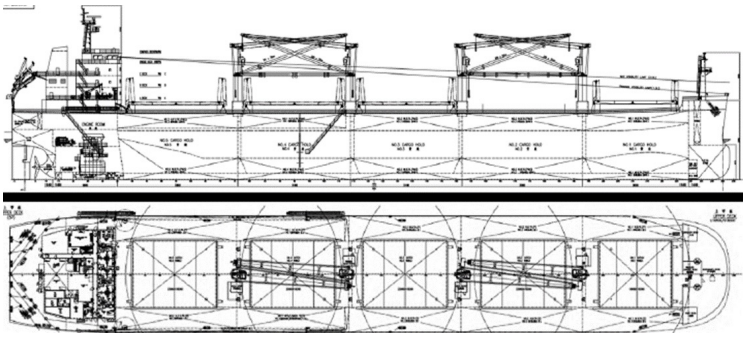


Figure 1: NAN BEI HU General Arrangement.

SHIP PARTICULARS

Vessel Name
NAN BEI HU

Registered Owner
Tianjin Xiangyun-VII Leasing Limited

ISM Ship Management
Fleet Management Limited

Flag State
Republic of the Marshall Islands

IMO No.	Official No.	Call Sign
9747900	8002	V7QV7

Year of Build	Gross Tonnage
2019	36,353

Net Tonnage	Deadweight Tonnage
21,605	63,550

Length x Breadth x Depth
194.8 x 32.2 x 18.5 m

Ship Type
Bulk Carrier

Document of Compliance Recognized Organization
DNV

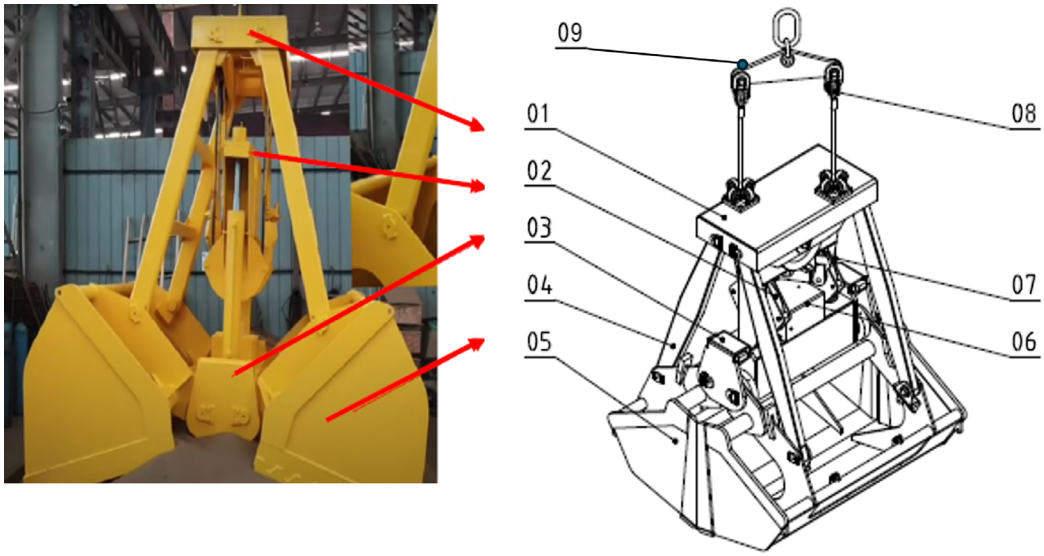
Safety Management Certificate Recognized Organization
Lloyd's Register

Classification Society
Lloyd's Register

Persons on Board
20

Grabs

NAN BEI HU was equipped with four RC024-5-12 radio remote-controlled grabs, manufactured by Shanghai Guanbo Machinery Equipment Co., Ltd *(see Figure 2)*. The mass of each grab was 9,500 kg. The four grabs were placed on board when the ship was built in 2019.



1. Grab Head
2. Transverse Frame
3. Through- beam
4. Press Rods
5. Scoops
6. Control Valve Group
7. Cylinders
8. Grab Wire
9. Lifting Beam

Figure 2: Grab layout.

Each of the four grabs had two grab wires. The working end of each of the grab wires had an eye splice and was secured by a shackle to the lifting beam. The dead (e.g., standing) end of the grab wires were secured to the transverse frame by means of a wedge socket.[2] The cylinder piston rods were connected to the transverse frame and the barrels were connected to the through-beam. The drain plug for the hydraulic oil was located on the bottom of the through-beam.

The grab scoops are opened while the grab is suspended using the remote control to activate a solenoid valve. Activating the solenoid valve allows hydraulic oil to flow into the lower portion of the cylinder barrels, displacing the oil that is in the upper portion of the cylinder barrels. This causes the piston rods, which are connected to the transverse frame, to extend, pushing the through-beam down. The downward movement of the through-beam causes the scoops to open. Pressure created by the hydraulic oil in the lower portion of the cylinder barrel controls the rate at which the through-beam moves downward and the scoops open.

When the grab wires are slack, the transverse frame moves down due to the force of gravity, pushing the piston rods into the cylinder barrels. As the piston rods are pushed downward, the hydraulic oil in the lower part of the cylinder

2 Wedge sockets secure the wire rope to the end attachment by passing it around a steel wedge and then pulling the wire under load into socket.

barrels is displaced and flows into the upper portion of the cylinder barrels, locking the piston rods in place. When the crane wire is hoisted, the grab wires come under tension, lifting the transverse frame and through-beam. The upward movement of the through-beam closes the scoops.

The manufacturer's maintenance recommendations for the grabs included:

(a) checking the grab wires at least once a week; and

(b) changing the hydraulic oil every 800 hours or six months, whichever is earlier.

The manufacturer's operating manual stated when changing the hydraulic oil "the grab should be fully open and be put steady on the ground." It also included the following warning: "the remote control should remain open, or it could be dangerous." The manual did not specify why it could be dangerous if the remote control was not left open.

The operating manual did not include a procedure or working instruction for replacing the grab wires.

Narrative

On 13 March 2024, NAN BEI HU anchored at Rio Tuba loading anchorage, Philippines and commenced loading nickel ore from barges using the ship's deck cranes and grabs. Multiple cranes were in use at the same time.

On 14 March 2024, the loading operations continued. Around 1500, grab No. 4 was taken out of service due to a hydraulic oil leakage in the lines. Consequently, a grab connected to another crane had to be moved to crane No. 4 when crane No. 4 needed to be operated.

On 15 March 2024, the loading operations continued through the day using the ship's four cranes and three available grabs. During the morning meeting, the planned repair of the hydraulic lines of grab No. 4 was discussed.

By 1930, welders from a shore workshop arrived on board and started repairing the hydraulic lines of grab No. 4. At the same time, crewmembers observed hydraulic oil leaking from the hydraulic lines of grab No. 3 that required it to be placed out of service. The Master decided to have the shore workers renew the hydraulic lines of grabs Nos. 1, 2, and 3 after they finished working on grab No. 4.

On 16 March 2024, loading operations resumed with four cranes and the two available grabs. Around 0400, grab No. 4 was repaired and the shore workers started repairing grab No. 3. They finished repairing grab No. 3 at 1300.

At 1300, grab No. 3 was available for use again.

At 1430, loading was temporarily stopped since a barge was not available. It was decided to use the idle time to replace the hydraulic lines of grabs Nos. 1 and 2.

Grab No. 1 was placed on deck in the fully open position so the ship's engineers could drain the hydraulic oil before the shore workers started renewing the grab's hydraulic lines. When the grab was on deck, it was observed that the plastic drum, into which the oil was going to be drained, did not fit under the through-beam of the fully open grab. It was decided

to take tension on the grab wires and lift the transverse frame until the through-beam was high enough above the deck so the plastic drum could be placed beneath the drain plug *(see Figure 3)*.

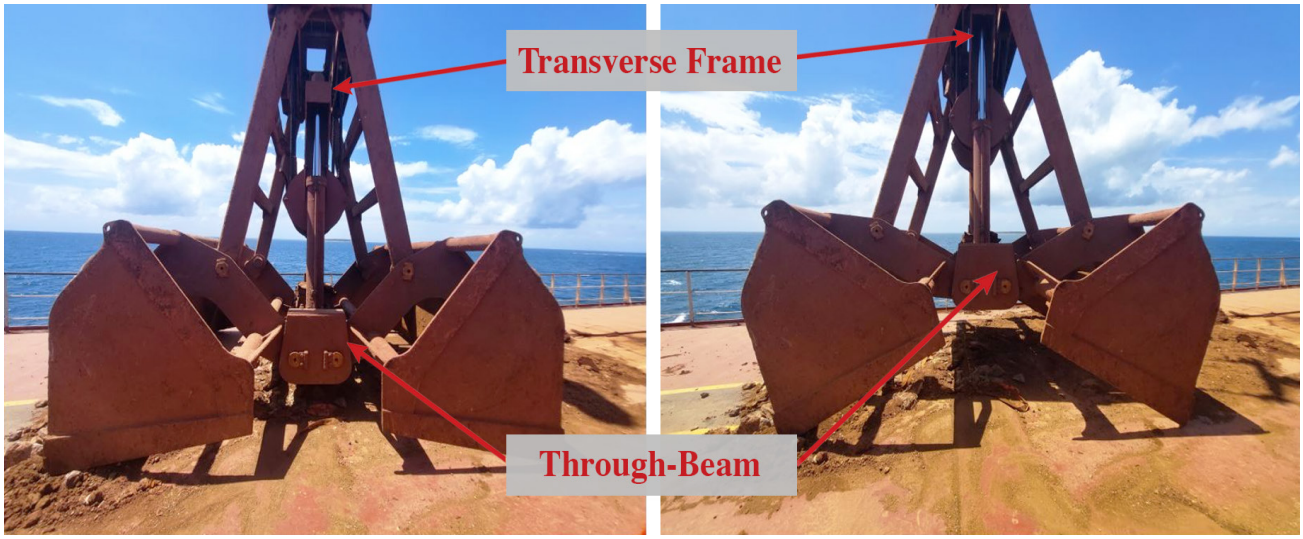


Figure 3: Grab No. 1 shown fully open on the left and partially closed on the right. The height from deck to the underside of the through-beam when the grab was fully open was 30 cm. The piston rods are extended in both pictures because the weight of the transverse frame is being supported by the deck crane's hoisting wire and the grab wires.

Two of the ship's engineers climbed under the through-beam and opened the drain plug to drain the hydraulic oil tank and lines. After draining the hydraulic oil, the engineers started preparing the hydraulic lines so they could be replaced by the shore workers. The deck crane was used to keep the grab wires under tension while the ship's engineers were draining the hydraulic oil from the grab and preparing the hydraulic lines for replacement.

Around the same time, the Bosun and the C/O noticed that the thimble for the eye splice at the working end of one of the grab wires for grab No. 1 was dislodged *(see Figure 4)*. In consultation with the Master, it was decided to renew the grab wire immediately.

Figure 4: Dislodged thimble on grab wire for grab No. 1.

The Master, C/O, and Bosun reviewed the Company's RA for deck maintenance and cargo operations. The identified hazards and associated controls included on the RA were injuries due to fatigue, working on slippery surfaces, and working at height. They did not document any hazards related to the grab, which they thought could not open any further after the hydraulic oil had been drained from it. The RA was not completed as it had not been signed. At 1445 the C/O also issued a permit for working at height that was signed by the Bosun and the ship's three ASDs.

Before starting the job, the C/O conducted a Toolbox Talk with the Bosun and three ASDs. The hazards and associated controls that were reviewed were based on either the Company's JHA for changing tug wires (attached to grabs), or for changing of wires in general, or for changing gangway wires.

The old grab wire had to be removed before the new grab wire could be installed. The crane hoisting wire was lowered until both grab wires were slack. The crane hoisting wire was left connected to the lifting beam but was not supporting the grab, which remained partially open. The crewmembers then opened the shackle to disconnect the grab wire with the dislodged thimble from the lifting beam *(see Figure 4)*.

Next, the dead end of the grab wire had to be removed from the wedge socket *(see Figure 5)*. The crewmembers used a hammer and crowbar to pry the dead end of the grab wire and wedge from the socket. They were able to create a small space between the wire rope and the wedge but were not able to remove the wire from the socket due to extensive corrosion inside the socket.

Figure 5: Dead end of the grab wire inside the wedge socket (circled in red).

The crewmembers were then going to use an electric grinder to cut the wire out of the socket. Because the only electric grinder available on board was being used by the shore workers, it was decided to use a chain block to pull the wire out of the socket.

The upper hook of the chain block was connected to the grab wire by placing the hook through the space between the wedge and the wire that was created when the crewmembers used the hammer and crowbar to remove the wire from the socket. The other hook was connected to a D-ring on deck. The ASD2 positioned himself under the through-beam, in a squatting position, to operate the chain block. The Bosun and ASD1 were both standing inside the grab, on the outside of the through-beam. The C/O and the ASD3 were standing outside of the grab.

As soon as the chain block was brought under tension, the through-beam came down, hitting the ASD2 on his back and opening the grab to the fully open position. The ASD2 was trapped between the bottom of the through-beam and the deck plate. Neither the Bosun nor the ASD1 were struck when the through-beam dropped and the grab fully opened.

The ASD1 and ASD3 immediately rushed to the crane cabin and hoisted the crane wire to lift the grab enough for the C/O and Bosun to pull the ASD2 out from under the through-beam. They laid him on deck, clear of the grab. At 1702, the C/O called the Master over his hand-held radio and requested him to come to grab No. 1. The ASD2 was observed without external injuries, but his breathing was very weak.

The C/E heard the call for help on the hand-held radio and arrived on-scene together with the Master. They started to administer medical oxygen and first aid to the ASD2.

At 1715, the Master requested the agent to urgently arrange for shore-side medical assistance. At 1825, the Master was in contact with the Company's doctor and first aid was administered as per the received advice.

At 1855, a shore medical team arrived on board and began making arrangements to disembark the ASD2 to a barge for transport to shore. At 2040, a barge with the injured ASD2, the shore medical team, and NAN BEI HU's C/O on board was underway and en route to shore. The barge arrived at the terminal at 2113. The ASD2 was transported by ambulance to a shore-side hospital where at 2143, he was declared deceased following internal hemorrhage and hypovolemic shock.

Crew

NAN BEI HU had a complement of 20 crewmembers, four more than what was required by the Minimum Safe Manning Certificate issued by the Administrator. All crewmembers were found medically fit and in possession of valid certificates for their assigned position on board.

RANK	EXPERIENCE ON BOARD BULK CARRIERS	EXPERIENCE ON BOARD GEARED BULK CARRIERS	EXPERIENCE WITH THE COMPANY	TIME IN RANK
Master	3.8 years	Yes	1.1 years	1.5 years
C/O	4 years	Yes	2 years	2 years
Bosun	10.5 years	Yes	4.3 years	4 years
ASD 1	2.9 years	Unknown	1.5 years	1.3 years
ASD 2	3.6 years	Yes	1.3 years	3.4 years
ASD 3	0.9 years	Unknown	10 days	10 days

The Bosun, the C/O, and the three ASDs joined the ship on 6 March 2024. Almost the entire crew joined the ship either on 1 March 2024 or 6 March 2024. The Master and the Third Officer joined the ship on 1 February 2024. It was the first voyage for the entire crew on board NAN BEI HU. The Company had managed the ship since 8 November 2021. The ship was sold on 25 August 2023 to the current owner.

The Administrator did not find any indication that any crewmembers involved with this marine casualty did not receive the required amount of rest mandated by the IMO's STCW Code, Section A-VIII/1, paragraphs 2 and 3, and the ILO's MLC, 2006, regulation 2.3.

Familiarization

All crewmembers were required to complete an initial safety familiarization within 24-hours of signing on board. New crewmembers were also required to complete a ship-specific equipment familiarization before being assigned any duties. This was to include a period of familiarization during which time the new crewmember was to be suitably instructed by the respective head of the department about the use and operation of the machinery and equipment he or she was likely to handle, as well as his or her specific duties and responsibilities.

The operation of the deck cranes was referenced in the familiarization checklists for deck officers and deck ratings. Neither the checklist for deck officers or for deck ratings addressed the operation of the grabs.

Neither the C/O, Bosun, nor three ASDs had previously worked on board NAN BEI HU, they had also not been involved in the replacement of a grab wire on this ship before 16 March 2024. The C/O received his initial safety familiarization and ship-specific equipment familiarization from the Master on 6 and 7 March 2024.

The C/O conducted the initial safety familiarization and ship-specific equipment familiarization for the Bosun and three ASDs on 6 and 7 March 2024.

Company PMS

Maintenance of the grabs is included in the Company's ship-specific PMS. The PMS for all of the Company's ships is digitalized and accessible for review by the shore-based management.

The PMS of NAN BEI HU required maintenance for the grabs that included:

1. a weekly check of the grab wires;
2. renewal of the grab wires, every 24-months or 750 running hours;
3. a three-monthly maintenance that included testing the grabs, greasing all lubricating points, checking all hydraulic lines and oil pressures, and cleaning the oil filters;
4. replacement of the hydraulic oil every 3,000 hours; and
5. a six-monthly oil sample analysis.

A DRS was implemented on board to track all outstanding repair items that were generated from the registered defects. There was no record of any outstanding repairs for the grabs.

The grab wires for grabs Nos. 1 and 3 had most recently been renewed in June 2023 and were not due for replacement. Renewal of the wires for grabs Nos. 2 and 4 was overdue, as the 24-month interval had expired. The grab wires for grab No. 2 had been due since February 2023 and had 496 running hours recorded. The grab wires for grab No. 4 had been due since September 2023 and had 301 running hours recorded. Based on an inspection conducted by the ship's crewmembers, it was determined that the grab wires for grabs Nos. 2 and 4 were still in good condition and did not need replacement. The Company had not approved this postponement and no information about a new replacement date was available. There was no record in the PMS of any outstanding maintenance on the grabs.

The ship was 4.3 years old and had not been dry-docked since it began trading. No major maintenance of the grabs had been carried out since they were taken into use. When senior management of the Company boarded the vessel after the incident, they observed that the grabs showed excessive corrosion. The poor condition of the grabs had not been reported to the Company.

Safe Working Procedures

The Company's SMS required that a Toolbox Talk be conducted with the crewmembers assigned to conduct a particular task before they started working. The Toolbox Talk was required to include the JHA and/or the RA for the assigned task.

The Company's SMS also included a procedure for ensuring that unplanned jobs were conducted safely. Unplanned jobs included those that were not included in the Company's list of routine jobs or that had not been included on the ship's daily work plan. The checklist used when preparing to conduct an unplanned job included, among other things, the need to address the experience of persons involved, the manufacturer's guidance, the exercise of Stop-Work Authority, the availability of tools, and the management of simultaneous operations. Any unplanned job was not to be undertaken without the Company's approval if it was determined that one or more of the required criteria in the checklist could not be met.

A JHA library for routine jobs was available on board and the content was controlled by the Company. A matrix of Company-generic RAs for routine tasks and critical processes was also available on board. An RA must be carried out for any activity that is not included in the matrix or in the Company's controlled list of routine jobs. The JHA library did not include a JHA for changing the grab wires. The matrix of RAs included a generic RA for deck maintenance and cargo operations but not one for changing grab wires. Also, there was neither a JHA nor an RA for draining or changing the grabs' hydraulic oil.

The Master, C/O, and C/E meet daily to plan work to be completed on board. A record of planned work, which includes the relevant JHA, is maintained on board and signed by the Master, C/O, and C/E. The planned work record indicates if a work permit and an RA are required. The record of planned work for 16 March 2024 included assisting the shore workers with the repairs of the grabs and replacing the grab wire for grab No. 1. The identified JHA for changing the grab wire was 10.17, which is titled "Changing of Gangway Wires." The C/O referenced JHA 1.7, which is titled "Changing of Tug Wires (attached to grab)," when interviewed as part of the Administrator's investigation. The record of planned work also indicated that an RA was required.

General control measures such as the availability of trained and experienced crew, fatigue, the conduct of a Toolbox Talk, donning of PPE, and adherence to the Permit to Work system were included in both JHA 1.7 and 10.17. However, neither of these JHAs stated that it could be used for the changing of grab wires.

The RA that was prepared for changing the grab wire of grab No. 1 was prepared by an RA team consisting of the Master, C/O, and Bosun. The RA was dated 16 March 2024 and the described task was the "Change of No. 1 grab wire." The RA was identified as an RA in the category "Deck Maintenance, Cargo Operations – Dry, Structural Failure / Damage, Potential Breach of SMS, Cold Work, Working Aloft" and included generic hazard categories, such as manual handling activities, the use of hand tools, low light levels, and legal or statutory breach. The RA included control measures for three identified hazards: fatigue, working on a slippery surface, and working at height. Other hazards were not addressed. The overall risk rating of the RA remained "medium," where the RA form stated that the risk level should be reduced to low. The RA was not signed by the Master.

A permit for working at heights was issued and duly signed by all personnel involved and the Master.

The Company's SMS included a procedure for managing hazards that may occur when two or more potentially conflicting activities are being executed in the same location at the same time on board. The procedure included a process for assessing whether simultaneous operations can be avoided. It also included additional safety measures that needed to be put in place when simultaneous operations cannot be avoided.

A stop-work authority to stop any unsafe act or work was published on board and endorsed by the Managing Director of the Company. All officers and ratings on board received training in generic hazard identification by a Pre-departure Orientation Course, computer-based RA and Hazard Identification Course, and by a Safety Behavior Program.

PART 3: ANALYSIS

The following Analysis is based on the above Factual Information.

Accident Event

Grab No. 1 was partially open in a non-standard condition due to the hydraulic cylinders not being operational after the ship's engineers drained the hydraulic oil from the grab. When the grab wires were slackened so the ship's crewmembers could renew one of the grab wires, the weight of the transverse frame would have pushed the piston rods down into the cylinder barrels. The force of the friction between the scoops and deck plates prevented the transverse frame and through-beam from dropping all the way and fully opening the scoops after the grab wires were slacked.

Bringing the chain block under tension to pull on the grab wire applied additional downward force on the transverse frame and through-beam. This additional force combined with the downward force of the weight of the transverse frame and through-beam was sufficient to overcome the force of friction, causing the through-beam to drop, trapping the ASD2 between grab No. 1 and the deck.

Company Safe Work Procedures

The Company had procedures in place to ensure work on board ships in their managed fleet could be conducted safely. These procedures included requirements for planning daily work, conducting RAs, issuing work permits, and procedures for conducting unplanned jobs and simultaneous operations. To be effective, they must be consistently implemented.

There is no indication that consideration was given by the Master or C/O about implementing the Company's procedure for conducting unplanned jobs after it was decided to immediately replace the grab wire while cargo operations were stopped. Rather, the job was recorded in the ship's record of daily planned work.

The requirements of the Company's procedures for planned and unplanned work are similar but not exactly the same. One difference is that the Company's procedure for conducting unplanned jobs required a decision about whether additional assistance or guidance from the Company is required. It also required the ship's Master, C/O, and C/E to conduct an assessment to determine if simultaneous operations (i.e., replacement of the hydraulic lines by the engineers and shore workers and replacement of the grab wire by the deck ratings) could be avoided or to identify additional safety measures required to manage the hazards associated with both tasks being conducted at the same time. This procedure prohibits starting an unplanned task without approval from the Company if the answer to any of the questions on the checklist for unplanned work is "no." Implementing this procedure could have potentially delayed the work to replace the grab wire and extended the period that grab No. 1 was not available for cargo operations.

Assisting the shore workers with repairing the hydraulic lines on the grabs was included in the record of the ship's planned work for 16 March 2024. Such assistance included draining the hydraulic oil from the grabs. There is no indication that the C/E conducted an RA for draining the hydraulic oil from the grabs or that there was a Toolbox Talk with the engineers before they drained the hydraulic oil from any of the grabs.

Pre-task Hazards Assessment

Planning for renewing the grab wire started shortly after 1430 when the C/O and Bosun first noticed the dislodged thimble and the Master decided the job should be undertaken immediately while cargo operations were stopped. The Permit to Work was signed at 1445 by the crew. Before the work started to renew the grab wire, the C/O conducted a Toolbox Talk with the Bosun and three ASDs. Between the time the dislodged thimble was first observed, and the commencement of work to renew the grab wire, reportedly the:

1. C/O and Bosun consulted with the Master regarding the need to renew the grab wire;
2. Master, C/O, and Bosun prepared an RA for the change of the grab wire for grab No. 1 using the Company's generic RA template for deck maintenance and cargo operations;
3. Bosun called the three ASDs, two of whom were off duty, and informed them they were needed to assist with renewing the grab wire;
4. C/O issued, and the Bosun and three ASDs signed, a permit for working from height; and
5. Bosun and ASDs gathered the tools needed to renew the grab wire.

Effective pre-task planning requires sufficient time to review the planned work and available safety information to ensure that all reasonably foreseeable hazards associated with the task and required barriers are identified and understood by the crewmembers who will be performing the work.

The three generic hazards that were identified by the RA were fatigue, working on a slippery surface, and working at height. These are hazards that could reasonably be associated with renewing the grab wire on grab No. 1. There is no indication that the Master, C/O, and Bosun identified any additional hazards that might be associated with replacing the grab wire, including that grab No. 1 was partially open in a non-standard condition.

The JHA referenced in the ship's record of planned daily work for changing the grab wire was 10.17, which is titled "Changing of Gangway Wires." When interviewed, the C/O referenced JHA 1.7, titled "Changing of Tug Wires (attached to grabs)" as the one that was referred to when he conducted the Toolbox Talk with the Bosun and three ASDs. Both JHAs were relevant to renewing the grab wire only to the extent they both addressed hazards associated with handling wire rope. Although JHA 1.7 did refer to working at height, a hazard associated with replacing the grab wire, it did not include any hazards associated with the grab being partially open and in a non-standard condition.

Generic RAs and JHAs can reduce the time needed to conduct a pre-task hazard assessment. However, they can also reduce the effectiveness of these assessments if they do not address all aspects of a specific task and the existing conditions. In this case, the existing conditions included that grab No. 1 was partially open and in a non-standard condition, that there was a team of shore workers on board to renew the hydraulic lines on grabs Nos. 1 and 2, and that cargo operations were stopped pending the arrival of a barge alongside. There is no indication that these conditions were considered when the Master, C/O, and Bosun prepared the RA for the change of the grab wire for grab No. 1 or when the C/O conducted the Toolbox Talk with the Bosun and three ASDs.

Grab Maintenance

Neither the grab manufacturer's manual nor the ship's PMS included procedures with relevant safety warnings for changing the grab wires. Although the manufacturer's manual did include a warning that the grab should be fully open and that the remote control "should remain open, or it could be dangerous," it did not address what the potential danger was of not leaving the grab or remote control open. The lack of procedures and relevant safety warnings or explanation of the potential danger of not leaving the grab open when changing the hydraulic oil prevented the Master and other crewmembers from having immediate access to critical safety information.

The grab manufacturer's maintenance recommendations were more extensive than those in the ship's PMS. It does not appear that those differences contributed to this very serious marine casualty.

Stop-work Authority

Stop-work authority can prevent marine casualties by allowing seafarers, regardless of their position on board, to manage safety in real time by giving them the responsibility, obligation, and right to stop-work that poses or creates an imminent danger to themselves, others, the ship and cargo, or the environment. For stop-work authority to be effective, it is not sufficient for crewmembers to be aware that they have this authority, they must also be aware of the procedures for and hazards associated with a given job.

Renewing grab wires is a common task on board geared bulk carriers. Although none of the crewmembers who were on board NAN BEI HU had renewed any of the grab wires for the ship's four grabs since they signed on board on 6 March 2024, it was a task the C/O, Bosun, and ASD2 had most likely either supervised or assisted with while working on board other geared bulk carriers. This familiarity, together with the absence of critical safety information in the grab operating manual and the lack of awareness regarding the working principle of the grabs, likely contributed to the failure to recognize the potential hazards associated with working on the partially open grab while it was in a non-standard condition. Rather, they thought that the grab could not open any further since the hydraulic oil had been drained from it.

Although each of the crewmembers that were involved with draining the oil from the grab or replacing the grab wire on grab No. 1 had the authority to stop-work, they were not aware of the hazards associated with working on the grab while it was partially open. This lack of understanding likely contributed to why none of the crewmembers exercised their stop-work authority at any time while they were engaged with replacing the grab wire.

PART 4: CONCLUSIONS

The following Conclusions are based on the above Factual Information and Analysis and shall in no way create a presumption of blame or apportion liability.

1. Causal factors that contributed to this very serious marine casualty include:
   (a) placing the chain block under tension which applied downward force to the transverse frame and caused the through-beam to drop and trap the ASD2 against the deck plate;
   (b) a lack of procedures and relevant safety warnings in the grab manufacturer's manual and reference in the Company's SMS for changing the grab's hydraulic oil and grab wires;
   (c) a lack of awareness of the ship's crewmembers regarding the working principle of the grabs and their incorrect understanding that the grab could not open after the hydraulic oil had been drained from it; and
   (d) inadequate pre-task hazards assessment and planning prior to starting work to renew the grab wire due to:
      i. the RA not including any hazards associated with working on the grab in a non-standard condition;
      ii. the lack of available information on board regarding the safety hazards associated with the grab being partially open and in a non-standard condition; and
      iii. a lack of familiarity by the crewmembers with respect to the ship's grabs.
2. Additional causal factors that may have contributed to this very serious marine casualty include:
   (a) that neither an RA nor a Toolbox Talk was conducted before the engineers drained the hydraulic oil rom any of the ship's grabs; and
   (b) non-compliance with the Company's procedures for conducting unplanned work and assessing safety hazards associated with simultaneous operations.

3. Additional issues that were identified but that did not contribute to this very serious marine casualty include:

   (a) maintenance instructions within the PMS that were not as extensive as the instructions from the manufacturer as stated in the manufacturer's manual.

PART 5: PREVENTIVE ACTIONS

In response to this very serious marine casualty, the Company has taken the following Preventive Actions.

1. Training will be included in the appraisals of the Master and C/O, including hazards of a crane and grab maintenance work activity prior to their next assignment on a company vessel.
2. All crewmembers will be re-trained to the Safety Behavior Program.
3. The Company's Training Centre will evaluate the possibility of developing a training module on maintenance of cranes and grabs.
4. The incident and lessons learned are discussed with all ship's staff, with particular focus on the importance of effective toolbox talks, RA prior to conducting unscheduled tasks, maintenance, and repairs on grabs.
5. The Quality Management System's Documentation Control Committee will evaluate the need for revising the Cargo Operations Manual for Bulk Carriers to include specific guidelines on cranes and grabs.
6. The Quality Management System's Documentation Control Committee will evaluate the need for including in the Company's JHA library the hazards associated with and mitigating measures for changing grab wires to facilitate safe work planning.
7. A safety alert will be sent to all vessels in the fleet, about the incident, and the countermeasures to be implemented.
8. A memo will be sent to all technical superintendents to check and ensure that the manufacturer's procedures for changing wires of cranes and grabs is available in the working language of the ship on their respective vessels.
9. All grabs will be inspected by the manufacturers at the next available opportunity to verify if they are in good condition.
10. A thorough cargo audit of the vessel will be conducted by the Dry Operations / Quality Teams to verify the implementation of safe cargo operation procedures.

In response to this very serious marine casualty, the manufacturer, Shanghai Guanbo Machinery & Equipment Co., Ltd has taken the following Preventive Action.

1. Developed an instruction for changing grab wires of RC024-5-12 radio remote controlled grabs.

PART 6: RECOMMENDATIONS

The following Recommendations are based on the above Conclusions and in consideration of the Preventive Actions taken.

1. The Company is recommended to:
   (a) conduct a generic RA or JHA for performing maintenance on the ship's grabs that includes all reasonably foreseeable hazards associated with working on the grabs;
   (b) evaluate the knowledge of supervisors related to RAs, the management and execution of unplanned jobs, simultaneous operations, and to reinforce the knowledge where needed; and
   (c) ensure that the content on the manufacturer's manual, related to grab maintenance, is included within the PMS maintenance instructions.

The Administrator's marine safety investigation is closed. It will be reopened if additional information is received that would warrant further review.