AI2024-2

AIRCRAFT SERIOUS INCIDENT INVESTIGATION REPORT

Nakanihon Air Service Co., Ltd.
J A 0 2 A H

February 29, 2024

Japan Transport Safety Board

The objective of the investigation conducted by the Japan Transport Safety Board in accordance with the Act for Establishment of the Japan Transport Safety Board (and with Annex 13 to the Convention on International Civil Aviation) is to prevent future accidents and incidents. It is not the purpose of the investigation to apportion blame or liability.

TAKEDA Nobuo
Chairperson
Japan Transport Safety Board

Note:

This report is a translation of the Japanese original investigation report. The text in Japanese shall prevail in the interpretation of the report.

《Reference》

The terms used to describe the results of the analysis in "3. ANALYSIS" of this report are as follows.

i) In case of being able to determine, the term "certain" or "certainly" is used.
ii) In case of being unable to determine but being almost certain, the term "highly probable" or "most likely" is used.
iii) In case of higher possibility, the term "probable" or "more likely" is used.
iv) In a case that there is a possibility, the term "likely" or "possible" is used.

AIRCRAFT SERIOUS INCIDENT INVESTIGATION REPORT

CASE WHERE A SLUNG LOAD CARRIED EXTERNAL TO AN AIRCRAFT WAS RELEASED UNINTENTIONALLY NAKANIHON AIR CO., LTD. EUROCOPTER AS 350 B3 (ROTORCRAFT), JA02AH ONO CITY, FUKUI PREFECTURE AT APPROXIMATELY 13:08 JST, OCTOBER 24, 2022

February 9, 2024
Adopted by the Japan Transport Safety Board

Chairperson TAKEDA Nobuo
Member SHIMAMURA Atsushi
Member MARUI Yuichi
Member SODA Hisako
Member NAKANISHI Miwa
Member TSUDA Hiroka

1. PROCESS AND PROGRESS OF THE AIRCRAFT SERIOUS INCIDENT INVESTIGATION

1 Summary of the Serious Incident	On Monday, October 24, 2022, after completing the cargo transportation in the vicinity of Yugami Power Plant, a Eurocopter AS 350 B3, JA02AH, operated by Nakanihon Air Co., Ltd., was flying toward Kuzuryu Ski Resort Temporary Operation Site in Ono City, Fukui Prefecture from the loading site in Yugami Power Plant in Ono City, Fukui Prefecture. During this flight, at around 13:08 JST (JST: UTC+9 hours; unless otherwise noted, all times are indicated in JST in this report on a 24-hour clock), the underslung sling cable was broken as contacting with transmission lines and a part of the hook and sling cable dropped. The sling cable was broken and damaged, in addition, the transmission lines were damaged and required some repair or replacement. There was neither damage to the helicopter nor to the personnel inside and outside the helicopter.
1.2 Outline of the Serious Incident Investigation	The occurrence covered by this report falls under the category of "Case where a slung load carried external to an aircraft was released unintentionally" as stipulated in item (xvi), Article 166-4 of the Ordinance for Enforcement of the Civil Aeronautics Act (Order of the Ministry of Transport No. 56, 1952) and is classified as a serious incident. On October 24, 2022, the Japan Transport Safety Board (JTSB) designated an investigator-in-charge and an investigator to investigate the serious incident. Although the serious incident was notified to the French Republic as the State of Design and Manufacture of the rotorcraft and engine involved in the serious incident, the State did not designate such as the accredited

	representative. Comments on the draft Final Report were invited from parties relevant to the cause of the serious incident and the Relevant State.

2. FACTUAL INFORMATION

2.1 History of the Flight

The history of the flight was summarized below based on the statements of the captain and the onboard mechanic.

On the day of the serious incident, the captain was seated in the right pilot seat and the onboard mechanic in the left seat of cabin. After the helicopter took off from Kuzuryu Ski Resort Temporary Operation Site in Ono City, Fukui Prefecture (hereinafter referred to as "Kuzuryu Operation Site") and carried out cargo transportation from No.21 loading site to Yugami Power Plant seven times, at around 13:08 on the way of returning to Kuzuryu Operation Site, the underslung 21 m long sling cable was broken as contacting with transmission lines, and a part of the hook and sling cable dropped. The sling cable was broken and damaged, in addition, the transmission lines were damaged and required some repair or replacement. There was neither damage to the helicopter nor to the personnel. For the transmission lines to which high voltage applied, the safety device for the electric power facility on the ground was activated at around 13:08, the high electric voltage was shut down.

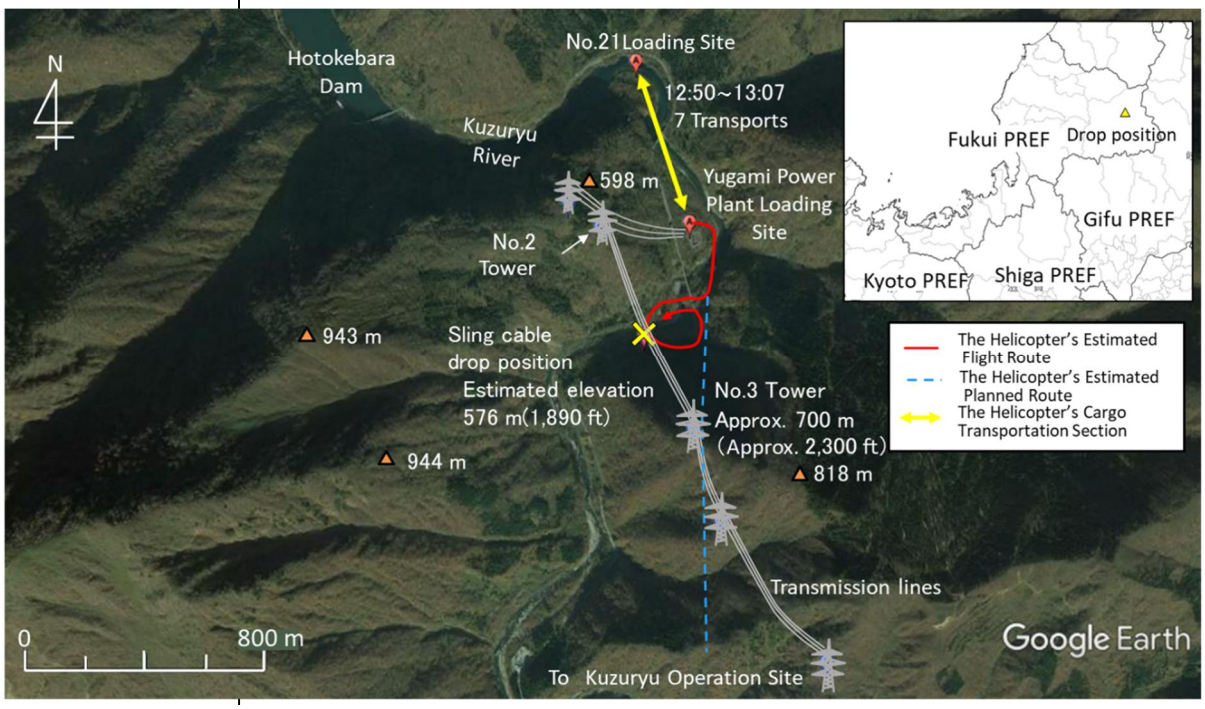

Figure 1: The Helicopter's Estimated Flight Route from the End of Cargo Transportation to the Position of the Contact with Transmission Lines

(1) Statement of the Captain

After the briefing on such as the cargo transport plan and the precautions on the day, the helicopter took off from Nagoya Airport at around 11:00 and landed at Kuzuryu Operation Site at 11:35. After the helicopter landed, a meeting was held regarding such as the conditions of loading sites and wind,

the position of transmission lines and birds' (Raptores) nest, and risk prediction activities were performed. Regarding the approximate position of birds' nest, the person in charge explained to the captain that there were two nests near Yugami Power Plant. At around 12:43, the helicopter took off from Kuzuryu Operation Site with the 21 m long sling cable slung externally and flew at approximately 3,000 ft heading toward the loading site. After the confirmation flight around the loading sites, the helicopter carried out cargo transportation from No.21 loading site to the loading site in Yugami Power Plant a total of seven times until around 13:05.

After completing the cargo transportation, the helicopter turned its head eastward once and departed from Yugami Power Plant in order to head for Kuzuryu Operation Site. After moving to east side, the helicopter turned right and commenced to climb to 3,000 ft at an airspeed of approximately 40 kt so as to be able to pass over the tower ahead. The captain thought that with 2,500 ft would be enough to cross over the tower. While the helicopter was climbing, at approximately 1,800 ft, the captain visually recognized an eagle-like big bird in the direction of about 30° to the left. Therefore, in order to avoid a bird strike, the captain made an evasive maneuver by making a level turn to the right, opposite to the direction the bird flying from. While performing the evasive maneuver to avoid the bird, the captain's attention to the transmission lines were somewhat diminished. After dodging the bird to the left, the captain visually recognized the transmission lines in front. In order to avoid contacting with the transmission lines, the captain made a steep turn while deaccelerating at approximately 45° bank to the left. While making a left steep turn, the captain was able to see the transmission lines from the lower right window of the cockpit. After completing to make a 360-degree left turn, when seeing the transmission lines in front, the captain found a part of the hook and sling cable hanging from the transmission lines. Checking the underside of the helicopter with the rearview mirror below the cockpit revealed that the sling cable was broken. During the left steep turn, there was neither impact to the helicopter nor abnormality in the instruments particularly. Even after the left steep turn, there was no abnormality in the helicopter, and there was no site nearby for the helicopter to land, thus the captain judged that heading for Kuzuryu Operation Site would be appropriate and continued to fly the helicopter, then the helicopter landed Kuzuryu Operation Site at 13:15.

(2) Statement of the Onboard Mechanic

After the helicopter landed at Kuzuryu Operation Site at around 11:35, a meeting was held, and risk prediction activities were performed. Then the 21 m long sling cable was slung external to the helicopter, and at around 12:43, the helicopter took off from Kuzuryu Operation Site and headed for near Yugami Power Plant.

After completing cargo transportation between the loading site in Yugami Power plant and No.21 loading site on the north side, the mechanic was looking at the ground surface in the rear seat while the helicopter was flying, when the captain said "Whoa" and started to make

	a left steep turn, therefore the onboard mechanic thought the captain was trying to avoid a bird at first, however during the turn, the tower was seen, and the mechanic thought that the captain was trying to avoid the transmission lines. After the left steep turn, when the mechanic looked at the transmission lines ahead, and saw that the hook and sling cable hanging from the transmission lines. The onboard mechanic had the captain check whether there were such as any parameters indicating abnormalities in engines, but there was no problem, and when the sling cable was broken, no impact, thus judging that there was no abnormality in the helicopter.

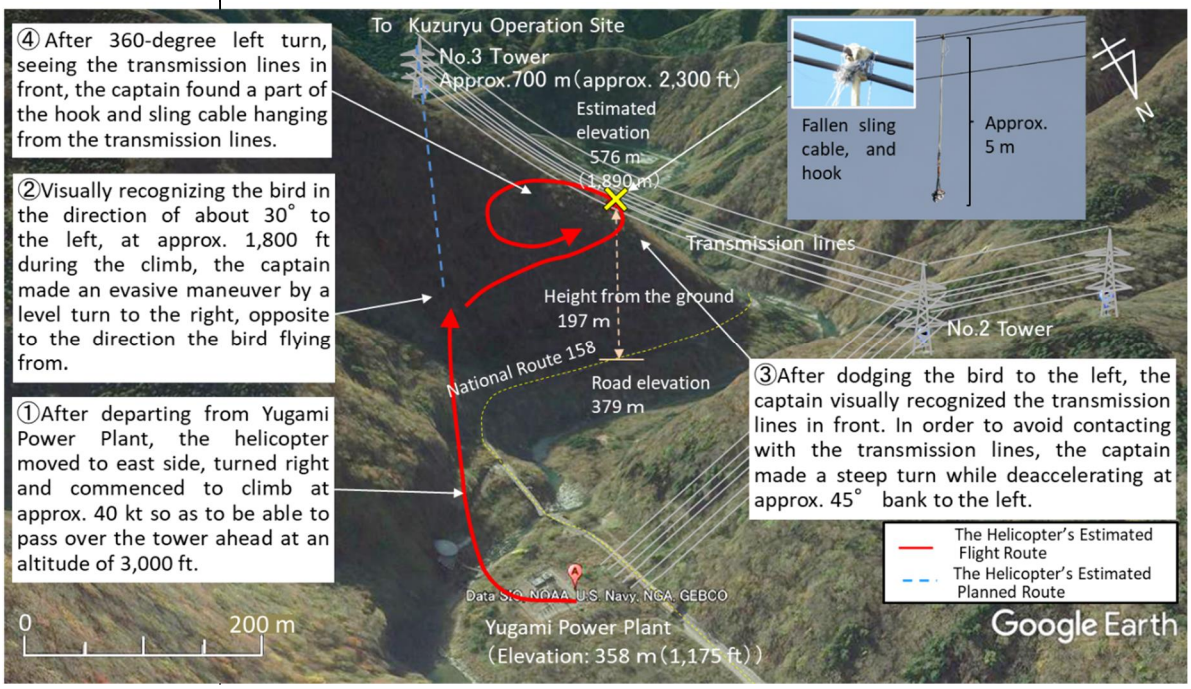

Figure 2: The helicopter`s estimated flight route when it fell the hanging object

This serious incident occurred at around 13:08 on October 24, 2022, at an altitude of about 1,900 ft, directly above National Route 158 (Latitude 35°56'26"N, Longitude 136°38'19"E).

2.2 Injuries to Persons	None
2.3 Damage to the Aircraft	Helicopter Damage: None Other Damage: (1) Damage to such as the transmission lines: The upper transmission line on the east side was made unusable, and the middle transmission line on the east side required for a repair. The transmission lines became unusable from October 24 to December 15, 2022. (2) Damage to Sling Cable The sling cable, which had been used, consisted of a yellow fabric (nylon-polyester blend) on outer skin and an inner polyester strong thread, with a design strength of over 8 t, and had one control cable (outer skin made of plastic coating and multi-core stranded wires of 9 mm diameter)

for releasing the hooks inside. A total of three sling cables, two 5 m and one 10 m, were connected, in addition a cargo hook section of 1.4 m in length and 31.4kg in weight was connected, making its total length approximately 21.4m.

As shown in Figure 3, there were two black burnt areas on the sling cable (6.4 m apart). The upper burnt area was 7.8 m from the lower part of the helicopter, and the lower burnt area was 7.2 m from the cargo hook, and the area side lower than the lower burnt area was fractured. Besides, there were new scratch marks without rust on the hook at the connection between 10 m sling cable and 5 m sling cable. Furthermore, there were two melting marks of plastic coating (9 m apart) on the control cable, in addition to the two brunt areas.

As shown in Appended Figure, the sling cable was not broken in the upper burnt area, and there was a burnt mark the same width as the transmission line as if to be caused by being pressed against the sling cable from one side and contact, in addition, the polyester strong thread around the internal control cable was melted. In the lower burnt area, there were scratch marks on the outer skin that cover the entire circumference, and the outer skin and the inner polyester strong thread were broken as if to be torn apart up and down. Besides, the internal control cable was burnt and severed, but in the polyester strong thread around the severed section, there were almost no melting marks as in the upper burnt area. Furthermore, in the outer skin of the broken sling cable, there were scratch marks within approximately 2.5 m from the lower burnt area.

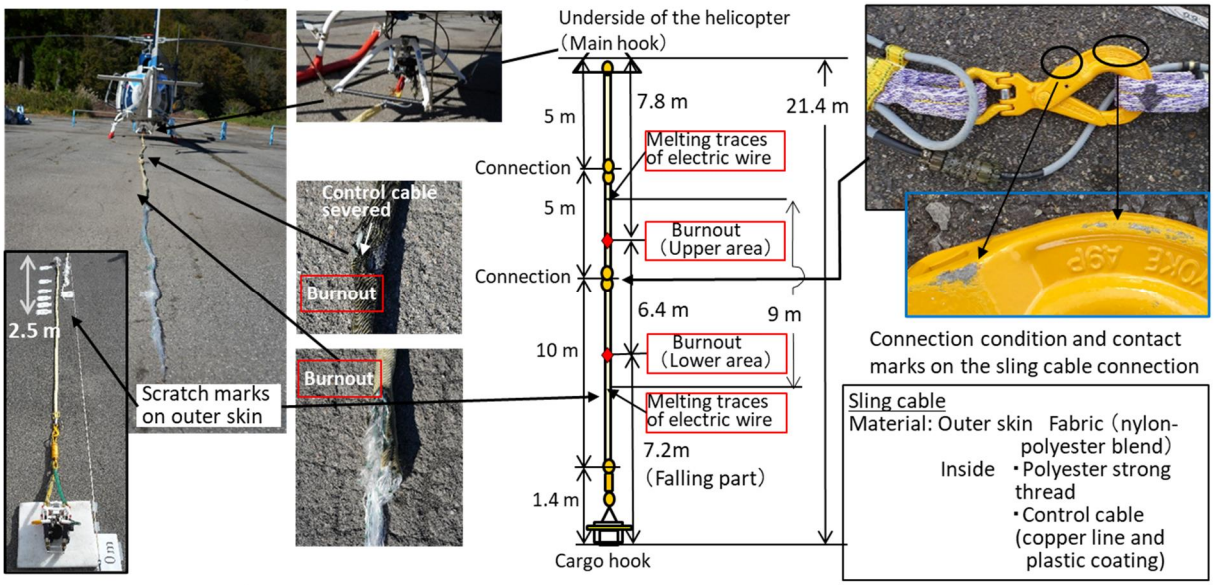

Figure 3: Sling Cable Damage Condition

2.4 Personnel Information	Captain: Age: 36 Commercial pilot certificate (Rotorcraft) February 27, 2008 Specific pilot competence Expiry of practicable period for flight: March 7, 2024 Type rating for single-turbine (land) February 27, 2008

	Class 1 aviation medical certificate	Validity: January 26, 2023
	Total flight time	3,243 hours 19 minutes
	Total flight time in the last 30 days	13 hours 13 minutes
	Total flight time on the type of aircraft	828 hours 36 minutes
	Total flight time in the last 30 days	6 hours 36 minutes
2.5 Aircraft Information	Aircraft type:	Eurocopter AS 350 B3
	Serial number:	3459
	Date of manufacture:	September 20, 2001
	Certificate of airworthiness:	No.DAI-2022-110
	Validity:	May 29,2023
	Total flight time:	5,588 hours 35 minutes
	When the serious incident occurred, the weight and the position of the center of gravity of the helicopter were within the allowable range.	
2.6 Meteorological Information	Observations at Regional Weather Station The observation values at Ono regional weather station, located approximately 13 km northwest of the serious incident site, around the time of the serious incident were as follows: 13:10 Wind direction: West-southwest, Wind velocity: 3.4 m/s, Temperature: 17.5 °C, Sunshine duration: 1.0 hours, Precipitation: 0.0 mm	
2.7 Additional Information	(1) Overview of Transmission Lines	

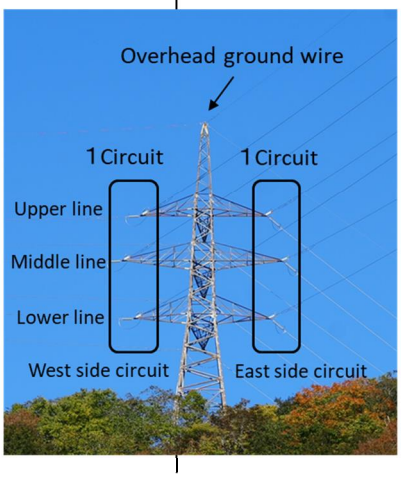

Figure 4: Tower Configuration (No.2 Tower)

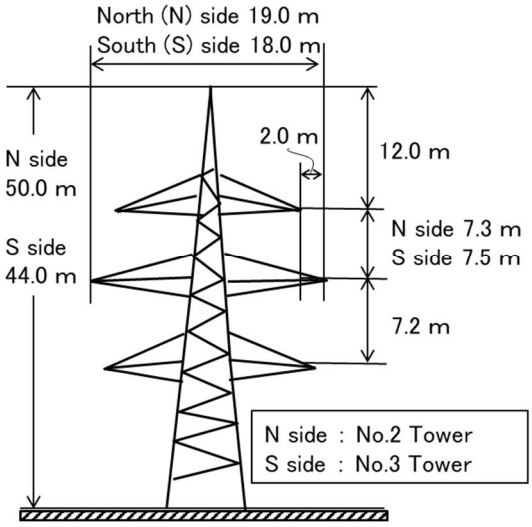

Figure 5: Tower Height and Spacing between Transmission Lines

According to the transmission line management company, the transmission lines with which the sling cable had contacted are alternating current (AC) transmission lines (a three-phase three-wire system) where a single-circuit AC transmission line has three phases, and the power is transmitted through two circuits, one on the east side and the other on the west side, across the tower (see Figure 4). The spacing between each line on the tower is as shown in Figure 5, at the top, an

overhead ground wire made of aluminum-covered steel stranded wire (AC wire) with a diameter of 12 mm is strung, and for the lower transmission line, aluminum cable steel reinforced (ACSR wire) with a diameter of 28.5 mm is used (see Figure 7). Among three transmission lines on the one side of the tower, the spacing between the upper and middle lines is approximately 7.4 m. When this serious incident occurred, a voltage of 154 kV was applied on both circuits. Due to the design of transmission lines, when the spacing between the lines becomes within 1.7 m, air as an insulator causes dielectric breakdown*1 which could allow electricity to run in the air (discharge). When discharge occurs between the lines, discharge marks is highly likely left on mutual line surfaces.

(2) Contact Marks on the Transmission Lines and Tangled Sling Cable

The fallen sling cable was wrapping around the upper and middle lines of the transmission lines on the east side at the position of 464 m from No.2 tower located on the north side. To the north from that position, at 26 m on the upper transmission line and at 32 m on the middle transmission line, there were discharge marks, respectively. Besides, at the position of 22 m to the north of the upper transmission line, there were yellow paint and impact marks, which was the same color of the sling cable connection, (see Figure 8). Furthermore, yellow and white fibrous material was slightly attached on the middle transmission line on the north side from the position where the sling cable wrapped around.

Regarding the condition of the tangled sling cable, its approximately 5 m including the cargo hook at the bottom was hanging from transmission lines, and the upper part of approximately 2 m wrapped around the upper and middle of the transmission lines on the east side circuit as if to cover them doubly.

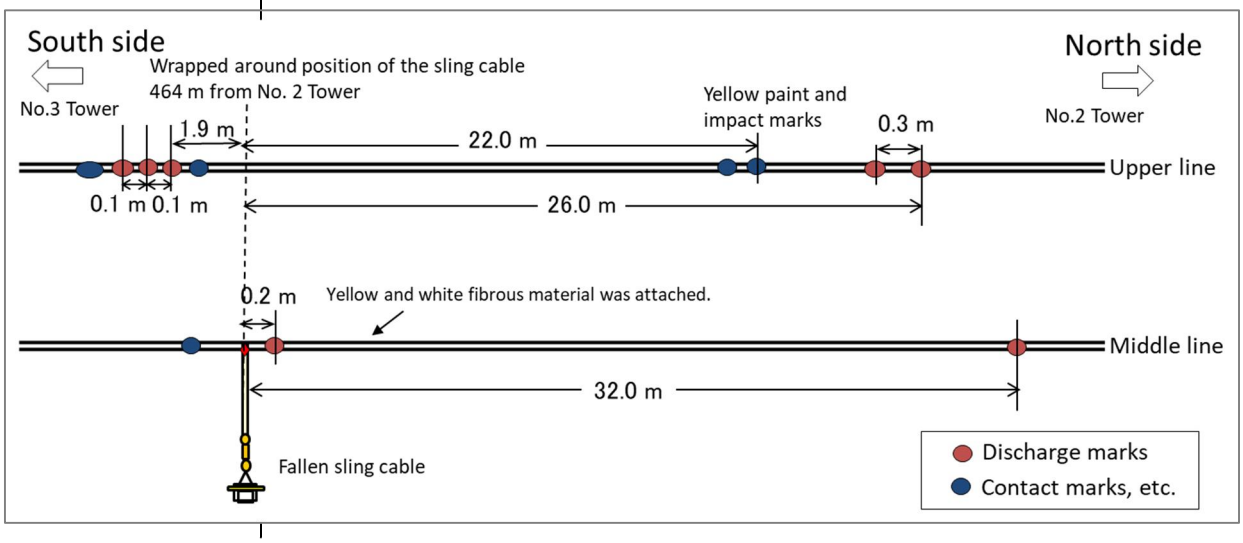

Figure 6: Discharge Marks and Impact Marks, etc. on Transmission Lines

*1 "Insulation breakdown" refers to the phenomenon in which when the strength of the electric field applied to an insulator exceed a certain value, electrical resistance drops sharply and large currents flow.

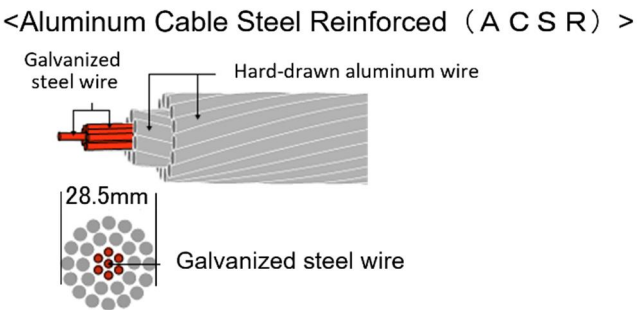

Figure 7: Overview of Transmission Lines

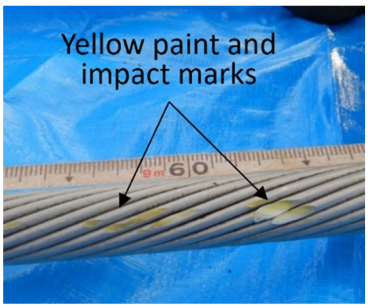

Figure 8: Contact Marks on Transmission Line Surface

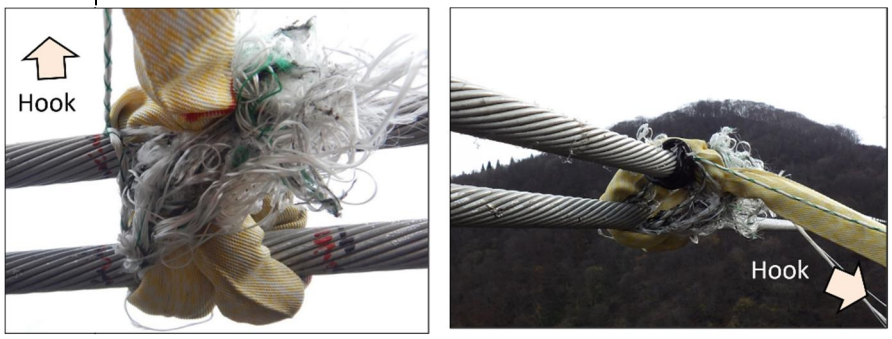

Figure 9: Tangled Sling Cable on Transmission Lines
(The photo taken during removal work)

(3) Emergency Release Operation for Cargo Sling Hook

In order to release a sling cable from the main hook directly below the rotorcraft in the event of an emergency, the main hook is electrically released by turning "ON" the "Main QUICK RELEASE" switch on the collective pitch lever and the switch panel of feeding device for cargo hook. When the main hook is not electrically released, the main hook is mechanically released by pulling the "EMERGENCY RELEASE HANDLE" below the collective pitch lever.

(4) Ordinary Maneuver of Crossing Transmission Lines

In the investigation report on the aircraft accident involving a Bell 206L-3, JA6055, that occurred on February 10, 2009, safety actions to avoid a contact with a transmission line are described as follows:

Cross at a tower with sufficient safety margin when crossing over transmission lines.

In addition, the "Wire Avoidance" issued by Bell Helicopter Textron Inc., the safety notices issued by Robinson Helicopter Company, and general books for other helicopter operations describe the same content, as an ordinary maneuver of crossing transmission lines.

(5) Past Accidents Involving Contact with Transmission lines

The accidents, in which helicopters crashed after coming into contact with transmission lines or overhead wires in Japan since 2009, are as follows:

Date of Occurrence	Summary
Febrary10, 2009	A Bell 206L-3, JA6055 contacted one of transmission lines that intersected the subject transmission line during transmission line inspection near Minakami-machi, Tone-gun, Gunma Prefecture and crashed. The helicopter was destroyed. Two persons on board sustained serious injuries. https://www.mlit.go.jp/jtsb/eng-air_report/JA6055.pdf
August 18, 2010	A Bell 412EP, JA6796, hit overhead wires during patrolling flight near Sanagijima, Tadotsu-cho, Nakatado-gun, Kagawa Prefecture and crashed. The helicopter was destroyed. Five persons on board suffered fatal injuries. https://www.mlit.go.jp/jtsb/eng-air_report/JA6796.pdf
September 26, 2010	An Aérospatiale AS332L, JA9635, crashed after its underslung cargo came to be caught by ground objects near Yakushima-Town, Kumage-Gun, Kagoshima Prefecture. The helicopter was destroyed. Two persons onboard suffered fatal injuries. https://www.mlit.go.jp/jtsb/eng-air_report/JA9635.pdf
March 6, 2015	An Aérospatiale AS332L1, JA6741, collided with transmission lines when leaving and climbing from hovering and crashed near Kihoku town, Kitamuro gun, Mie prefecture. The helicopter was destroyed. Two persons on board suffered fatal injuries. https://www.mlit.go.jp/jtsb/eng-air_report/JA6741-AA2016.pdf
July 29, 2019	An Aérospatiale AS350B, JA9252, contacted with a transmission line while spraying pesticide near Chikusei City, Ibaraki Prefecture and crashed. The helicopter was destroyed. The captain sustained minor injury. https://www.mlit.go.jp/jtsb/eng-air_report/JA9252.pdf

3. ANALYSIS

(1) Relationship between Sling Cable Burnout and Transmission Lines

The JTSB concludes as follows regarding "Relationship between Sling Cable Burnout and Transmission Lines".

Although the spacing between the upper and middle lines is approximately 7.4 m, the spacing between the two burnt areas on the damaged sling cable was approximately 6.4 m, therefore, it is more likely that the sling cable initially contacted with the middle line, the sling cable lifted the middle line, which made the spacing between the upper and middle lines come to 6.4 m, when the burnout occurred. The sling cable was burnt probably because when the sling cable contacted with the two high-voltage transmission lines, excessive current exceeding an allowable limit value flowed in the control cable, causing short-circuit at the contact point and catching fire.

(2) Contact and Fracture of the Underslung Sling Cable

The JTSB concludes as follows regarding "Contact and Fracture of the Underslung Sling Cable".

There were discharge marks and contact marks on the surfaces of the upper and middle lines of the transmission 4 lines on the east side, as shown in Figure 6. Besides, at 22 m on the east side upper line north of the drop position (its wrapped around position) of the sling cable, there were yellow paint and impact marks, which was the same color of the sling cable connection, furthermore, yellow and white fibrous material, which was the materials for the outer skin of sling cable, was attached on the middle line on the north side from the drop position of the sling cable. Based on these traces and the burnout condition of the sling cable, in an extremely short time during the steep turn, the underslung sling cable more likely contacted with the transmission lines on the east

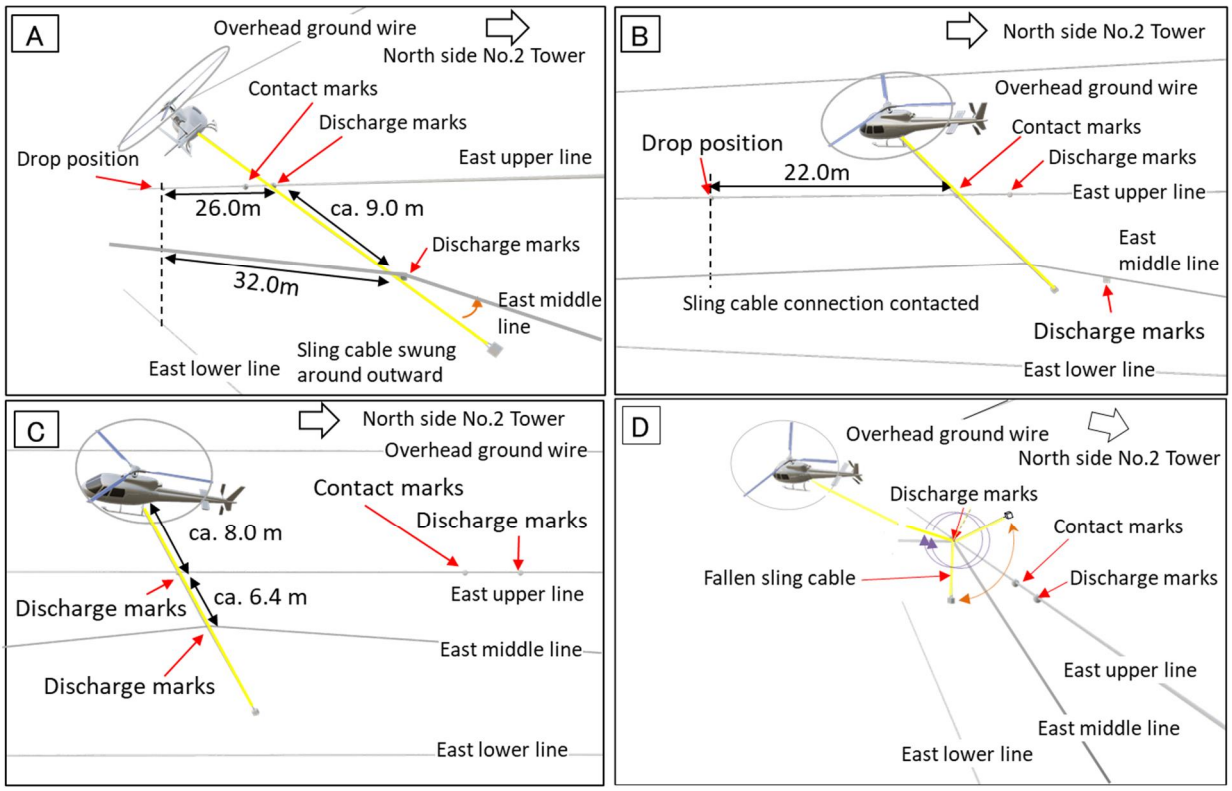

Figure 10: Sling Cable Status from the Contact with Transmission Lines to the Fracture

side in a state as shown in Figure 10, and was broken.

A. It is probable that when the helicopter made a steep turn in order to avoid the transmission lines, the underslung sling cable swinged around greatly according to the change in the bank angle of the helicopter, and insulation breakdown occurred at the two locations (approximately 9 m apart between the two points) on the upper transmission line, approximately 26 m north and on the middle transmission lines, approximately 32 m north of the location where the lower part of the sling cable fell, and discharged an electrical current. It is more likely that as the sling cable contacted with the middle line initially, its voltage was applied to the sling cable, and when the sling cable approached the upper line, it discharged. At this time, the high voltage was temporarily shut down by a safety device.

B. Starting from the contact point with the middle line, the sling cable lifted the middle line due to inertial force, additionally, the sling cable connection contacted with the upper line like colliding with it. As a result, the upper line probable moved to the west like swinging.

C. The helicopter was flying approximately 8 m above the upper line on the east side in front of the

overhead ground wire, and the sling cable continues to make rubbing contact with the midline, during which high voltage was probable restored. When the spacing between the upper and middle lines came to 6.4 m, the upper line contacted as if to be pressed against the sling cable, and at the upper and lower contact points, excessive current flowed to the control cable inside the sling cable, short-circuit occurred at the contact points, resulting in catching fire. From then on, it is probable that the high voltage was cut off by a safety device.

D. The sling cable was burnt out at the upper and lower contact points, and in the lower burnt area (see Figure 3 and Attached Figure) the inner polyester fibers were broken as if to be torn apart up and down. The broken lower part of sling cable lifted the transmission lines from below due to the inertial force of the fallen hook, additionally, the upper part of the fallen sling cable wrapped around the two upper and middle transmission lines as if to cover them doubly.

(3) Examination of Risks in the Event of Sling Cable Contact

The JTSB concludes as follows regarding "Examination of Risks in the Event of Sling Cable Contact".

It is probable that in this serious incident, it did not fall into a risky situation like affecting the helicopter's attitude because immediately after visually recognizing the transmission line, the captain avoided them by making a steep turn and during the steep turn, the sling cable contacted with the two transmission lines and the contact points were burnt out in a very short time. In many past accidents involving contact with linear obstacles such as transmission lines or overhead wires, delayed avoidance maneuver or failure in visually confirming linear obstacles often led to a crash, therefore, it is important to fly the aircraft with leeway enough so as to avoid linear obstacles even in the event of encountering hazard such as birds.

In addition, like in this serious incident, when a sling cable is caught by transmission lines, it might be a probable way to emergently release the main hook, however, it is probably extremely difficult for the pilot to perform the release operation in a short time after feeling the rapidly applied tension.

(4) Approach to Transmission Lines after the Complete of the Cargo Transport.

The JTSB concludes as follows regarding "Approach to Transmission Lines after the Complete of the Cargo Transport".

The helicopter departed from the loading site in Yugami Power Plant after completing the cargo transport, and commenced to climb at an airspeed of approximately 40 kt so as to be able to pass over the tower at an altitude of 3,000 ft. As planned originally, if the helicopter had been able to pass over the tower at 3,000 ft, enough clearance could have more likely been secured. However, as the captain visually confirmed a big bird, the attention to the transmission lines was somewhat diminished, and the captain performed an evasive maneuver while making a level turn to the direction of the transmission lines, which highly probable brought the helicopter closer to the transmission lines at the altitude where the sling cable would encounter the transmission lines.

As linear obstacles such as transmission lines or overhead wires have low visibility, and the evasive maneuver after visual confirmation can be delayed, it is probably necessary to select such a flight route as enabling to ensure enough clearance even in narrow areas and fly the aircraft while doing in-flight communication so that the pilot would not diminish the attention to linear obstacles.

4. PROBABLE CAUSES

The JTSB concludes that the probable cause of this serious incident was that it is highly probable that while the helicopter was making an evasive from transmission lines maneuver by a steep turn, the underslung sling cable contacted with the two transmission lines, and the contact areas on the sling cable were burnt out and severed, then a part of the sling cable and the hook fell onto the transmission line.

The reason why the sling cable contacted with the transmission lines was because when the helicopter made a steep turn to avoid a bird strike after a big bird was spotted during the climb, the attention to the transmission lines was diminished, and a level turn was made at the same altitude as the transmission lines, which most likely brought the sling cable to an altitude in which the sling cable would come into contact with the transmission lines and did not allow sufficient clearance.

5. SAFETY ACTIONS

5.1 Safety Actions Required	A helicopter's cargo transportation in a mountain region is carried out in narrow areas, it is expected not to have sufficient clearance from obstacles. Therefore, even in the event of encountering hazard such as birds, it is necessary to select in advance such a flight route as enabling to ensure sufficient clearance not to be close to linear obstacles linear obstacles such as transmission lines or overhead wires and fly a helicopter while doing in-flight communication so as not to diminish the attention to linear obstacles.
5.2 Safety Actions Taken after the Serious Incident	After this serious incident, the Company took following safety actions. (1) As the preventive measures against the accidents involving contact with linear obstacles, they revised the cargo transportation implementation procedures in the operations manual, regarding the way to select a flight route to prevent linear obstacle related accidents and the in-flight communication when pilots make an evasive action. (2) The provided helicopter operation department personnel with education on the past accidents and the revised points in the operations manual.

Appended Figure: Sling cable damage condition