No. 12

All Nippon Airways, NAMC YS-11, JA 8658 accident at Matsuyama Airport, Japan, on 13 November 1966. Report No. 75 dated 26 December 1968, released by the Civil Aviation Bureau, Ministry of Transport, Japan

1.- Investigation

1.1 History of the flight

Flight 533 was a scheduled domestic flight from Osaka International Airport to Matsuyama Airport. It departed Osaka International Airport at 1913 hours, one hour and twenty-five minutes behind schedule with an ATC clearance via G-4, Kure Point, direct Matsuyama NDB at an altitude of 8 000 ft. At 1940 hours it flew over Takamatsu NDB at an altitude of 8 000 ft and reported to Takamatsu Tower an estimated time over Kure Point of 2001 hours. At approximately 2000 hours the crew established communications with Iwakuni Approach Control and reported estimating over Kure Point at 2005 hours and over Matsuyama NDB at 2015 hours. They were twice given the meteorological information for Matsuyama Airport and were cleared to descend to 5 000 ft. At approximately 2003 hours during the descent they requested Matsuyama Tower to check operational conditions of Matsuyama NDB as they had doubts regarding its reliability. Matsuyama NDB, which had been closed at 2000 hours as scheduled, resumed operation at approximately 2010 hours. Almost at that time they requested from Iwakuni Approach Control an ATC clearance to go direct to Matsuyama from Iwakuni since they had already passed Kure Point, and reported in addition that Matsuyama NDB had returned to normal.

Iwakuni Approach Control then cleared the flight to Iwakuni NDB at an altitude of 5 000 ft, requested its estimated time over Iwakuni NDB and further instructed the flight to proceed on a magnetic bearing of 134° after passing Iwakuni NDB.

The flight passed over Iwakuni NDB at approximately 2015 hours and whilst on a magnetic bearing of 135°, it was cleared to descend to and maintain 3 000 ft to Matsuyama NDB. During its descent to 3 000 ft the flight reported to Iwakuni Approach Control its estimated time over Matsuyama NDB as 2023 hours. Shortly thereafter the flight reported that the runway was in sight and was instructed to establish contact with Matsuyama Tower, which it did at 2024:03 hours. It was then instructed to report downwind for Runway 31 and informed that the wind was 020°/10 kt, and the altimeter setting 29.80 in. Hg. This was acknowledged.

At approximately 2025:44 hours, while turning on base leg, the flight reported gear down and checked and was cleared to land the wind being 010°/10 kt. This was also acknowledged.

Based on the testimony of eyewitnesses and the recording of ATC communications, the final phase of the flight was reconstructed as follows:

The altitude of the aircraft on final approach was slightly higher than usual and touchdown occurred approximately 460 m from the threshold of Runway 31. Immediately before touchdown on the runway the engine power had been increased. After a ground run of

approximately 170 m the aircraft became airborne and the flight path was slightly to the left of the centre line as the aircraft passed the Runway 13 threshold. A few seconds later, at 2027:30 hours the aircraft reported it was making a go-around.

At approximately 2027:41 hours the flight was instructed to report turning base leg for Runway 31, and six seconds later it replied "Roger, will report turning base Runway 31". This was the last communication from the flight. The climb out angle was observed to be shallower than usual and on reaching a height of 230 - 330 ft a left turn was commenced. Shortly thereafter the aircraft descended and crashed into water, the flight path angle at impact being about 5°.

The site of the accident was approximately 450 m NE of the point where the empennage was recovered (7 580 m on a true bearing of 157° from Tsurushima Light Beacon). The co-ordinates of the site of the accident were 33°49'36"N 132°40'24"E and the time of the accident was estimated as approximately 2028:10 hours.

1.2 Injuries to persons

Injuries	Crew	Passengers	Others
Fatal	5	45	
Non-fatal			
None			

1.3 Damage to aircraft

The aircraft was destroyed by the impact with the water.

1.4 Other damage

There was no other damage.

1.5 Crew information

The pilot-in-command, aged 41, held a valid airline transport pilot's licence with ratings on DH 114-1B, Fokker F-27 and YS-11 aircraft. He passed his latest medical examination on 14 May 1966 and his medical certificate was valid until 30 November 1966. He had been a check pilot of the airline since 8 April 1965, also he had qualified as pilot-in-command on YS-11 aircraft on 27 August 1965. He had passed his latest qualification on check on the Osaka-Matsuyama route on 14 June 1966. At the time of the accident he had flown a total of 8 118 flying hours including 527:50 hours on YS-11 aircraft. He had flown 2 327 hours as pilot-in-command after joining All Nippon Airways, including 484:45 hours on YS-11 aircraft. During the last three months he had flown 208:25 hours.

The co-pilot, aged 28, held a valid commercial pilot's licence with rating on YS-11 as co-pilot since 1 March 1966. He passed his last medical examination on 9 November 1966 and his medical certificate was valid until 31 December 1966. He had flown a total of

880 hours including 739:15 hours on YS-11 aircraft of which 592:35 hours were flown as co-pilot. During the last three months he had flown 168:50 hours.

Another pilot, aged 27, assigned for co-pilot training since 25 October 1966, was also aboard. He held a valid commercial pilot's licence with rating on YS-11 aircraft. He passed his last medical examination on 20 July 1966, and his medical certificate was valid until 27 July 1967. He had flown a total of 342 hours including 96:55 hours on YS-11 aircraft. During the last three months he had flown 47:45 hours.

Two stewardesses were also aboard; they were properly qualified and had received appropriate training. The duty time and rest time of all crew members were within specified limitations.

1.6 Aircraft information

The Certificate of Airworthiness of the aircraft was valid until 19 May 1967. The aircraft had been properly maintained in accordance with the procedures established by the airline and had flown a total of 1 070 hours, including 245 hours since the latest 300 hours check.

At the time of take-off from Osaka International Airport the gross weight of the aircraft was 48 774 lb including approximately 6 000 lb of Standard JP-1 fuel, and its centre of gravity was at 27 per cent MAC. Both were within allowable limits.

The gross weight and centre of gravity at the time of the accident were computed as being approximately 45 000 lb and 26.8 per cent MAC respectively, i.e. within allowable limits.

1.7 Meteorological information

Meteorological conditions at Matsuyama Airport before and after the accident were:

2000 hours: ceiling 2 000 ft, visibility 3 miles, moderate rain, wind N/8 kt

2035 hours: ceiling 2 000 ft, visibility 6 miles, very light rain, haze and smoke, temperature 62°F, wind NNE/6 kt.

From 1900 hours to 2100 hours the atmospheric pressure varied only by 1 mb around a mean pressure of 1 008 mb.

The wind direction varied between northeast and north from past 1700 hours until approximately 2035 hours, and thereafter it moved through east to southeast from approximately 2045 hours to 2120 hours. The transition from the northeast system to a southeast system was not abrupt since about 20 minutes elapsed during the change. The wind speed was up to 10 kt between 1840 and 2030 hours following which it decreased gradually to 5 kt.

1.8 Aids to navigation

Matsuyama NDB was closed at 2000 hours as normal, but resumed operation at approximately 2010 hours for the subject aircraft.

A VASIS had been in operation on a test and evaluation basis since 7 November. A special flight check conducted on 15 November indicated a normal glide slope angle of 3.1°.

1.9 Communications

All communications between the aircraft and Matsuyama Tower were made by the trainee co-pilot and communications were normal up to the time of the accident.

1.10 Aerodrome and ground facilities

Runway 31 was 1 200 m long and 45 m wide. It had an elevation of 2 m and was provided with medium intensity threshold and runway lighting. It was established that the lighting was operating satisfactorily when the aircraft touched down and made its go-around.

1.11 Flight recorders

The aircraft was not equipped with a flight recorder.

1.12 Wreckage

About 95 per cent (by weight) of the wreckage was recovered. The main wreckage was dispersed approximately 300 m in width and approximately 600 m in length on a magnetic bearing of 38° from the location where the empennage was recovered.

The left wing outboard of the engine nacelle was broken into a number of small pieces due to impact with water, its leading edge being fractured into several pieces. Examination of the wing revealed that it had been subjected to upward bending, rearward bending and nose-up torsional bending and that separation of the aileron and flaps started at the outboard of the wing, indicating that the aircraft struck the water left wing tip first. A hole, approximately 10 mm long and 15 mm wide, was found on the left wing curtain seal. Evidence revealed that it resulted from friction of the stopper of the aileron against the curtain seal.

Damage to the airframe, controls, engines and propellers were consistent with high dynamic forces generated at the time of impact with water and subsequent hydro-dynamic forces. No evidence of malfunction or failure of the flight control system prior to impact was found, the trim tabs were at neutral.

Examination of the engines and propellers revealed that both turbines were rotating at high speed at the time of impact and that the pitch angles of No. 1 and 2 propellers were approximately 29°-31° and 31°-33° respectively. No evidence of abnormal vibrations prior to impact was found.

The undercarriage and flaps were fully retracted at impact. No evidence that the auto-pilot was in operation was found.

Judging from positions of valves of the air conditioning system, it was believed that the pressurization system was not in operation and that no hot air was being supplied in the aircraft. Examination of bulbs indicated that D.C. was available at impact.

Strip examination of the altimeters revealed that the pilot-in-command's altimeter was at a setting of 29.80 in. Hg and the co-pilot's altimeter at a setting of 29.82 in. Hg. The other instruments were so badly damaged that no conclusions could be drawn from their examination.

No evidence of an in-flight explosion or fire was found. Evidence revealed that neither the fire extinguishing system, nor the oxygen system had been in use.

1.13 Fire

There was no fire.

1.14 Survival aspects

This was a non-survivable accident.

1.15 Tests and research

(a) Test on interference between aileron stopper and curtain seal

A hole, similar to the one discovered in the curtain seal on the left wing side, was set up on an aircraft of the same type and tests were carried out to assess the degree of interference with the aileron. It was found that it was not possible for the stopper bracket to get stuck in the hole, but that a stopper bolt could be caught into the hole with a left aileron down angle of more than 15°. In such a case operation of the aileron would be restricted. However, taking into consideration the fact that normal operation range of the aileron is less than 15° downwards, no restriction on the operation was conceivable.

(b) Analysis of foreign material on horizontal stabilizer

A reddish-brown strip was found on the horizontal stabilizer near station 2200. Laboratory examination revealed that it came from a paint coating used for shipping and not a blood stain resulting from a bird strike.

(c) Analysis of sediments in fuel system

Investigation on sediments which were found in No. 2 fuel booster pump and the fuel flow indicator transmitter revealed that they consisted of aluminium compounds produced in the system by corrosion and sea sand which entered into the system after impact with water.

(d) Test on warning lights

Out of a total of 75 warning and indicating lights, normally installed in the aircraft, 37 were recovered and thoroughly examined. The filaments of the following lights were broken or fused after stretching: No. 2 alternator failure warning light, No. 1 engine oil warning light, No. 1 instrument power failure warning light, No. 1 generator indicating light and No. 1 high stop removed indicating light; those of the following

lights were stretched by more than 50 per cent but neither broken nor fused: No. 2 generator indicating light, No. 2 wind shield anti-icing indicating light, No. 1 alternator failure warning light, the flaps overtravel warning light and No. 1 landing lights extended indicating light; those of the following lights were stretched by 20 per cent to 40 per cent: No. 1 alternator leak indicating lamp, flap asymmetry warning light, No. 1 fuel filter anti-ice warning light and Nos. 1 and 2 scavenge pump indicating light.

In order to determine whether these lights were "on" or not prior to impact, high impact and vibration tests were conducted on identical lights. It was found that the same stretching, breaking and fusion of filaments as in the case of the accident aircraft could occur if the warning light circuit comes "on" subsequent to the impact with water and high impact load or considerable vibrational loads were applied for a short period.

(e) Seat impact experiments

Damage to seats of the accident aircraft and injuries sustained by the passengers indicated that the direction from which the impact was applied was about 20° from the left. Impact experiments were conducted on 2 sets of 2 seater seats of the same specification as those of the aircraft. The seats were mounted on a testing sled with the same pitch and with two dummies on the rear seats. During these experiments it was found that:

(1) When an impact was applied 20° from the left, damage to the seats and the seat tracks was similar to those found in the wreckage.

(2) Injuries to heads and lower legs of passengers probably resulted from the jack-knife reaction, and substantial injuries found in the heads were probably caused by impact with metal frames of the back rest of the front seat and lower fixing pipes of the back rest.

(3) Seat fittings to the floor were almost destroyed by approximately 80 G.

(4) At the time of impact considerable upward and downward G were applied alternately on the waist.

(5) Seat belt attachments to the seat were not fractured at less than 80 G, and seat attachments to the floor structure fractured first. Furthermore, when the belt buckle was not parallel to the texture, there was a possibility that the belt would slip out of the buckle.

(f) Line of vision pursuit by eye mark recorder

On an aircraft of the same type a motion picture was taken by an eye mark recorder for the purpose of investigating visual checks which are usually made by a pilot-in-command during a "go-around". Assuming that operating conditions aboard the aircraft were normal and that the attention of the pilot-in-command was not distracted from his instruments it was concluded that, during the period of 30 sec. which elapsed between touchdown and the beginning of the turn, he could have checked the altimeter 3 times, the attitude indicator 5 times and the airspeed indicator 4 times and that, assuming a period of 15 to 20 sec. elapsed between the beginning of the turn and the impact, he could have checked the altimeter and the attitude indicator 3 times each and the airspeed indicator more than twice.

Since the accident occurred at night, it is inconceivable that the number of visual checks actually made were less than those mentioned above, and since at this altitude altimeters function like a one-pointer instrument a misreading of the altimeter is most unlikely.

(g) Detection of alcohol in blood of body

A considerable amount of alcohol was detected in contaminated blood from the body of the co-pilot trainee. However, detection of alcohol in the blood of animal bodies subjected to the same condition confirmed that alcohol could have been produced under the condition.

(h) Analysis of propeller sound

Sounds produced by the subject aircraft at the time of the go-around were recorded on the tower tape recorder. Acoustic analysis of the recording of the sounds produced by the propellers for approximately 8 sec. when the aircraft passed in front of the tower indicated that the engines accelerated from approximately 12 500 rpm to approximately 14 500 rpm in approximately 6 sec.

(i) Function text on propeller pitch lock assembly

Since external damage to pitch lock assemblies of Nos. 1 and 2 propeller was slight, functional tests were conducted before strip examination. The tests indicated that they were operating normally and no discrepancies were evident.

2.- Analysis and Conclusions

2.1 Analysis

According to testimony of the Osaka ground crew, evidence on injuries to the bodies, vibissae found on the instrument panel, blood types, analysis, and phonetical analysis, it was concluded that the pilot-in-command was in the left hand seat, the co-pilot in the jump seat, and the co-pilot trainee in the co-pilot seat, both at the time of departure from Osaka and at the time of the accident.

Injuries on the bodies indicated that impact forces of a considerable magnitude were mainly directed from a left forward direction. Partial reconstruction of the airframe flight control system and other systems was carried out. No evidence of malfunction or failures prior to impact was found.

Evidence revealed that the aircraft struck the water surface in a slightly nose-down and left bank attitude, possibly in a slight left side-slip, and with a rate of descent of approximately 10 m/sec.

The left wing struck the water first, immediately followed by No. 2 blade of No. 1 propeller which was torn off by the impact. No. 1 propeller made about one and a half rotations while striking water and the propeller shaft was fractured by bending load resulting from considerable dynamic water pressure from the forward direction at the time No. 4 blade came to a 5 and a half o'clock position as viewed from the forward direction and the propeller was separated from the engine.

Nos. 4, 3, 2 and 1 blade tips of No. 2 propeller cut outerskin on the starboard side of the central fuselage in this sequence and Nos. 4, 3 and 2 blades struck the fuselage with their back faces. The propeller struck the water, after making approximately 1/4 rotation subsequent to the cutting of the fuselage, starting with No. 4 blade, and the propeller shaft was fractured when No. 1 blade came to the 6 and a half o'clock position as viewed from the forward direction. The contact between the propeller and the fuselage resulted from a right upward movement of the forward fuselage due to the destruction of the central fuselage by impact forces from a left forward direction and to a relative movement of the right wing which was fractured and separated from the fuselage by the action of inertia forces in a forward direction.

Evidence revealed that the pitch angles of No. 1 and No. 2 propellers were 29°-31° and 31°-33° respectively at impact; however, since No. 1 propeller was subjected to pitch fining moment and No. 2 propeller to pitch coarsening moment at the time of impact with water, it was concluded that both propellers were at a 31° pitch angle just prior to impact, that No. 1 and No. 2 propeller were subjected to excessive torsion in the direction of fine pitch and coarse pitch, respectively, was due to the fact that when No. 1 propeller struck the water the aircraft speed was high and the effective angle of attack of the propeller at blade tips was very slightly negative whereas when No. 2 propeller later struck the water the speed of the aircraft had decreased, its attitude changed and therefore the effective angle of attack became positive.

With a pitch angle of 31° for both propellers and an engine speed of approximately 14 000 rpm to 15 000 rpm the aircraft speed (IAS) would have been in the order of 190 to 200 kt.

No. 2 blade of No. 1 propeller was found separated from the boss. It was concluded that the link mechanism had been damaged by dynamic water pressure at impact, that the thread was sheared off by centrifugal force and that the blade was then flung away.

Accurate estimation of the engines' speed and power at impact was impossible due to extensive damage sustained by the engines, their controls and instruments at impact and subsequent corrosion as a result of immersion. However, evidence revealed that they were operating at impact.

A number of warning lights were found with their filament extended or broken and fused. It was considered highly probable that the lights came "on" as a result of considerable impact forces. It was not positively established that No. 2 alternator failure warning light and No. 1 instrument power failure warning light were not lit prior to impact; however, failures, if any, of these systems should not have directly contributed to the cause of the accident.

According to the instructions given by Iwakuni Approach Control, the runway to be used by the aircraft was originally Runway 13, it was subsequently changed to Runway 31, then back to Runway 13 and finally Runway 31. This indicated that the wind direction did vary during this period. Testimony of eyewitnesses and of pilots of other aircraft which landed at Matsuyama Airport on the date of the accident also indicated that wind directions were variable near the airport. Recordings of the Matsuyama meteorological self-recorder revealed that the wind direction was variable between N and NE from approximately 1800 hours to 2035 hours and shifted to SE after approximately 2045 hours. Meanwhile, the wind velocity which was 5-8 kt from approximately 1930 hours until past 2000 hours decreased thereafter to 2-3 kt. Wind information given to the aircraft by Matsuyama Tower was 20°/10 kt at approximately 2024 hours and 10°/10 kt at approximately 2025 hours. There was a very slight rain fall at approximately the time the aircraft was making the final approach.

The reason why the aircraft was unable to make a normal landing could not be clarified except for a slightly high approach altitude. It was considered possible that raindrops on the windshield or wipers impaired accurate recognition of VASIS. A false indication or a misreading of air speed indicators was also considered but no evidence thereof was obtained.

The decision to go-around when touchdown was made around the middle part of the wet runway with a wind variable in direction and velocity was appropriate; however, the timing of the decision was somewhat late.

The flight path after the go-around was reconstructed as follows:

At approximately 2027:23 hours, the aircraft made a touchdown about 460 m after the threshold of Runway 31 and at approximately 2027:37 hours passed the end of Runway 31 deviating slightly left at an altitude of approximately 100 ft. Around that time the aircraft informed Matsuyama Tower of the go-around.

At approximately 2027:47 hours the aircraft acknowledged an instruction of "report turning base of Runway 31" from the tower, and at that time the aircraft was about 600 m beyond the end of Runway 31 on the runway extended line at an altitude of about 150-200 ft at an IAS of about 130-140 kt.

From approximately 2027:53 hours the track turned left and at that time the aircraft was about 1 000 m past the end of Runway 31 on the runway extended line at an altitude of approximately 230-330 ft an an IAS of approximately 145 to 155 kt. About that time, flaps were fully or very near to fully retracted.

After reaching an altitude of about 250-350 ft, at approximately 1 300 m from the end of the runway, the aircraft either held a level flight for a while, or entered into a shallow descent, and then descended at an angle of about 5°. At approximately 2028:10 hours, the aircraft struck the water about 2 500 m on the estimated flight path from the end of the runway at an IAS of about 190-200 kt.

Differences of the flight conditions after the go-around from those in a normal take-off and climb were that the climb was made at a rather small path angle, that the altitude was somewhat low during the turn and that the altitude was lost after the turn was started. However, the cause for such flight history has not been determined.

2.2 Conclusions

(a) Findings

The crew were properly certificated.

The aircraft had a valid Certificate of Airworthiness.

The aircraft, on final approach to Runway 31, touched down about 460 m beyond the runway threshold and made a go-around. It then climbed at a flight path angle somewhat shallower than normal, lost altitude after initiating a turn to the left at an altitude somewhat lower than normal, then made a shallow descent and crashed into water. At the time of impact the aircraft was in a somewhat nose-down and a left bank attitude with under-carriage and flaps fully retracted.

No evidence of malfunction or failure of the aircraft, its controls, engines or equipment to which the cause of the accident could be attributed were found. The reason why the aircraft continued its descent until striking the water was not determined.

(b) Cause or
Probable cause(s)

The reason why the aircraft lost altitude after the go-around and was led to crash into water was not determined.

3.- Recommendations

None were contained in the report.

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