The Use of High Frequency Radio on Aircraft Operating in the Uncontrolled Airspace of Sam Ratulangi International Airport Manado

Jihan Nafila Timami [1], Sri Rahayu Surtiningtyas [2], Yuni Saptandari [3]

[1,2,3] *Civil Aviation Polytechnic of Surabaya, Jemur Andayani I/73, Wonocolo, Surabaya,Jawa Timur, 60236*
**Corresponding author. E-mail: jihannafila76@gmail.com*

ABSTRACT
High Frequency (HF) radio remains essential for maintaining two-way communication between pilots and air traffic controllers, particularly in uncontrolled airspace beyond the reach of Very High Frequency (VHF) signals. This communication is critical for flight safety, especially for small aircraft operating in remote or transoceanic areas around Sam Ratulangi International Airport, Manado. However, some aircraft are still operating without HF equipment, posing potential hazards to other flights within the responsibility of Ujung Pandang FIC Makassar Sector. This study aims to examine the use of HF radio by aircraft operating in uncontrolled airspace around Sam Ratulangi International Airport and its impact on flight safety and traffic flow. A qualitative research approach was applied, with data collected through field observation, in-depth interviews with Air Traffic Control (ATC) personnel at Perum LPPNPI Manado Branch, and documentation of operational procedures and regulations regarding HF radio usage. The findings indicate that HF radio remains a primary and backup communication tool in areas beyond VHF coverage. The main challenges include poor audio quality and frequent interference. Moreover, some aircraft still lack HF radios, highlighting the need for stricter equipment standards and regulatory socialization to enhance aviation safety in the region.

Keywords **:** *High Frequency Radio, Uncontrolled Airspace, Aircraft.*

1. INTRODUCTION

Manado, the capital of North Sulawesi, is known for its natural beauty and biodiversity. Sam Ratulangi International Airport serves as a key gateway supporting tourism and trade, connecting eastern Indonesia with domestic and international destinations. Perum LPPNPI Manado Branch manages two sub-branches, ten AFIS airports, and one CTAF airport, including several small island airports. Air traffic to and from these airports falls under the responsibility of the Ujung Pandang FIC Makassar Sector (Casr, 2022).

Provision of air traffic services in Ujung Pandang FIC Makassar Sector, with the area of responsibility defined as:

1. Vertical limits with an upper limit of 10,000 ft and a lower limit of ground/water, and lateral limits up to 31 NM from the outermost MDC coordinates; and
2. Vertical limits with an upper limit of FL 245 and a lower limit of 10,000 ft, and lateral limits beyond the outermost MDC coordinates.

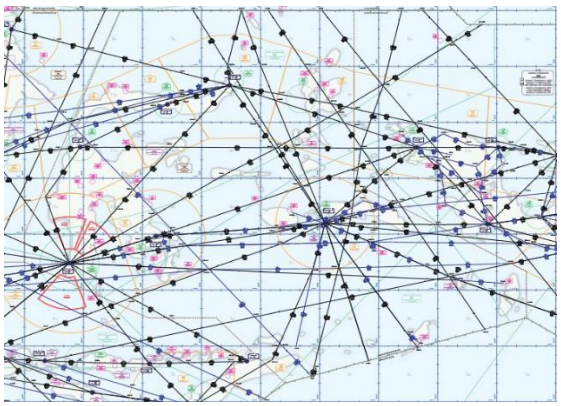

Figure 1 Provision of Ujung Pandang FIC Makassar Sector (Source: Rules et al., 2000)

The distance between Sam Ratulangi Airport in Manado and Juwata Airport in Tarakan is 456 nautical miles (Nm). There is no VFR route or designated waypoints available for navigation

toward Tarakan. Consequently, an aircraft flying through this uncontrolled airspace without HF radio equipment is considered an "uncontrolled flight." Even though the flight falls under the responsibility of Ujung Pandang FIC Makassar Sector, aircraft that do not communicate with the air traffic service unit cannot be effectively monitored. This situation poses potential hazards to other traffic in the same airspace and creates operational challenges for personnel at Manado Approach Control Service (APP) and Ujung Pandang FIC Makassar Sector in managing and controlling air traffic (Hendiyanto & Isnawijayani, 2024).

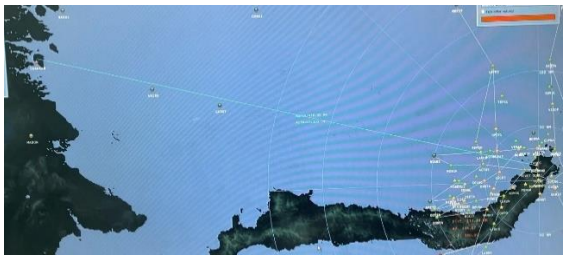

Figure 2 The distance between Sam Ratulangi Airport in Manado and Juwata Airport in Tarakan

Based on the description, the author formulates the problem as follows: 'How is the use of high frequency (HF) radio on aircraft operating in the uncontrolled airspace of Sam Ratulangi International Airport, Manado?'. The purpose of this paper is to identify the use of high frequency (HF) radio on aircraft in uncontrolled airspace within the jurisdiction of Sam Ratulangi International Airport, Manado.

This study is limited to examining the use of high frequency (HF) radio on aircraft operating in uncontrolled airspace, particularly in maintaining two-way communication between the aircraft and Ujung Pandang FIC Makassar Sector at Sam Ratulangi International Airport, Manado (Republic of Indonesia Ministry of Health, 1979). The main focus of the research includes operational procedures, equipment availability, and the obligation of HF radio usage as part of efforts to enhance aviation safety standards in the area.

2. THEORITICAL STUDY

The Director General of Civil Aviation Regulation No. KP 110 of 2017 provides technical guidelines for using radio frequencies in aviation operations (Direktorat Jendral Perhubungan Udara, 2017). Chapter 3, Section 3.2.3 states that radio frequency allocations for aviation communication are standardized worldwide to facilitate long-distance communication between aircraft and ground stations, supporting global flight safety and order. This use follows ITU Radio Regulations (Appendix 27). HF (High Frequency) radios enable long-range communication in areas beyond VHF coverage, such as transoceanic routes and remote regions, by reflecting signals off the ionosphere, allowing communication over thousands of kilometers.

2.1. Air Traffic services

In Indonesia, air traffic services are managed by agencies providing aviation navigation services, including air traffic control, flight information provision, and readiness services. Personnel delivering Air Traffic Services (ATS) consist of Air Traffic Controllers (ATC) and flight communication officers, who operate in accordance with regulations and procedures set by the civil aviation authority (PM_65_Tahun_2017_new (3), n.d.).

According to the Minister of Transportation Regulation No. 65 of 2017, Chapter 1.9, units within air traffic services are classified as follows:

1. Units within the aerodrome area, namely:
   a) Aerodrome control tower (TWR)
   b) Aerodrome Flight Information Services (AFIS)
   c) Aeronautical Station
2. Unit responsible for the en-route to approach phases, including:
   a) Approach Control Unit (APP)
   b) Terminal Control Area
3. Navigation service units for the en-route phase, which consist of:
   a) Area Control Centre (ACC)
   b) Flight information Center (FIC)
   c) Flight Service Station (FSS)

2.2. Uncontrolled Airspace

Uncontrolled airspace cannot be reached via VHF radio. To ensure effective air traffic services and two-way communication, aircraft operating to or from AFIS or CTAF airports must have HF radios (Elisabeth Risamasu, 2023). This enables Ujung Pandang FIC Makassar Sector to relay critical information to pilots, such as weather updates or other aircraft in the uncontrolled airspace.

The Ujung Pandang FIC Makassar Sector, also known as "Ujung Information," is part of Indonesia's air traffic services system. Its responsibilities are regulated under Ministry of Transportation Regulation No. 65 of 2017, Chapter 1, Section 1.6, points 1.b and 3, which include:

1. The airspace under its responsibility is provided with air traffic services according to the type of airspace, which consists of:
   a) Controlled airspace
   b) Uncontrolled airspace
2. Uncontrolled airspace is an airspace where air traffic services consist of flight information service, alerting service, and air traffic advisory service.

2.3. High-Frequency (HF) Radio Usage

The allocation of aviation communication frequencies is regulated in Appendix 27 of the Radio Regulations (RR) issued by the International Telecommunication Union (ITU) (*Radio Regulations - Appendices - Edition of 2020*, n.d.). These frequencies are categorized based on their usage, including:

1. High Frequency (HF) (2-30 MHz): Used for long-range communication between aircraft and ground stations, as well as between aircraft operating beyond radar coverage and standard communication infrastructure.
2. Very High Frequency (VHF) (118-137 MHz): Used for communication between aircraft and air traffic control (ATC) personnel.
3. Ultra High Frequency (UHF): Generally used for military communications and other specialized services.

HF radio is widely used for long-distance aviation communication, especially in remote or transoceanic areas beyond VHF coverage. It relies on ionospheric reflection to transmit signals over thousands of kilometers, enabling reliable pilot-to-ATS and aircraft-to-aircraft communication without modern infrastructure (Utami, 2020).

Despite its advantages, HF radio has some drawbacks, such as lower audio quality compared to VHF and potential transmission delays due to ionospheric reflection. Nevertheless, HF remains a vital component of international aviation communication, especially in uncontrolled airspace beyond VHF coverage.

2.4. Coordination Procedure

According to the Air Traffic Services (ATS) APP Standard Operating Procedure (SOP) at Perum LPPNPI Manado Branch, coordination between ATS units providing Flight Information Service and adjacent Manado ATS units must be conducted for both IFR (Instrument Flight Rules) and VFR (Visual Flight Rules) flights to ensure that necessary flight information is delivered to aircraft.

Each Air Traffic Control (ATC) unit is required to coordinate and perform a transfer of control for aircraft within its area of responsibility before the aircraft enters the next ATC unit's airspace. This process is carried out through the following steps:

1. Initial transmission of flight data as the first coordination step;
2. Coordination by the transferring ATC unit for the transfer of control;
3. Confirmation of transfer of control receipt by the accepting ATC unit; and
4. Formal execution of the transfer of control to the accepting unit.

2.5. Emergency Situation

In the Air Traffic Services (ATS) APP Standard Operating Procedure (SOP) at Perum LPPNPI Manado Branch (Standar & Lintas, 2022), specifically in Chapter 6.2, an aircraft is considered potentially in an emergency condition if any of the following indications occur:

1. No radio communication occurs when it is expected;
2. Radio communication is suddenly lost;
3. The pilot reports an aircraft malfunction;
4. Unusual signals or indications appear on the radar monitor;
5. The aircraft is overdue at a position or fails to arrive at the destination airport without further information.

This emergency situation is classified into three phases as follows:

a) Uncertainty Phase:
   i. No information whatsoever is received regarding the aircraft within 30 (thirty) minutes from the initial attempt to establish contact.
   ii. The aircraft does not arrive or fails to land within 30 (thirty) minutes after the estimated time of arrival (ETA).

b) Alert Phase:
   i. Attempts to contact the aircraft and obtain information from other sources have been unsuccessful.
   ii. Information is received indicating that the aircraft has sustained damage, although not requiring an emergency landing.
   iii. It is known or believed that an occurrence has taken place that may jeopardize flight safety.
   iv. The aircraft has been given landing clearance, but within 5 minutes after the estimated time of landing it has not landed and cannot be contacted again.
c) Distress Phase:
   i. Further attempts to contact the aircraft continue to fail, and it is strongly suspected that the aircraft is in distress.
   ii. It is estimated that the aircraft's fuel is insufficient to reach either its destination or an alternate airport.
   iii. Information is received that the aircraft has sustained damage and will conduct an emergency landing.
   iv. It is confirmed that the aircraft has made or will make an emergency landing, unless it is known that there is no threat to passenger safety and no immediate assistance is required.

3. RESEARCH METHOD

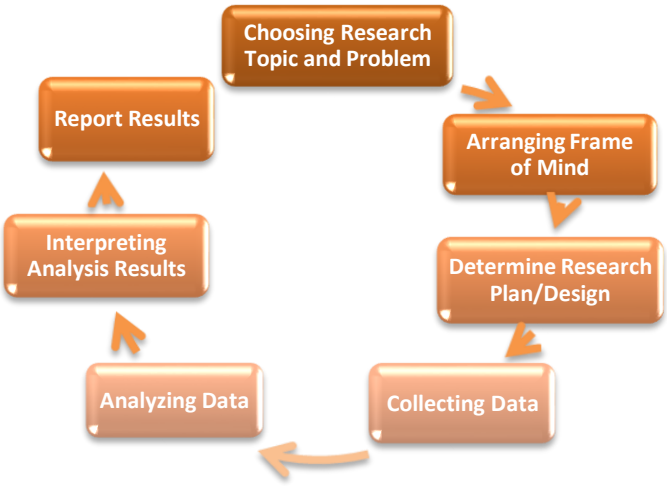

Figure 3 Research Design (Source: Author, 2024)

The English word "research," which is composed of "re," meaning to do again, and "search," meaning to look for, thus etymologically indicating a process of searching again (Harahap, 2020). Research is a structured, planned, and logical activity aimed at obtaining objective data and information to test hypotheses or answer specific questions. Qualitative research is a procedure that investigates an issue deeply through observation, recording, interviews, and the direct involvement of the researcher as the main instrument, used for studying natural and complex phenomena.

3.1. Research Subject and Object

The research subjects refer to individuals or groups who serve as information sources, commonly called informants. They provide the data or insights needed by the researcher to understand the studied phenomenon and can include individuals, groups, or communities relevant to the research topic. In this study, the informants are the Air Traffic Controller (ATC) personnel at the Perum LPPNPI Manado Branch.

The research object is the focus of the study, such as a phenomenon, situation, or event being investigated. It can be abstract, like perceptions, experiences, or behaviors, or concrete, like places, objects, or processes. In this study, the research object is the use of high frequency (HF) radio as a two-way communication tool between pilots and air traffic controllers, specifically involving the Ujung Pandang FIC Makassar Sector at Sam Ratulangi International Airport, Manado.

3.2. Sampling Technique

In qualitative research, sampling involves selecting which aspects, events, or individuals to focus on at specific times and situations, and this process continues throughout the study. In this research, purposive sampling was used. Purposive sampling means the researcher deliberately chooses individuals or groups considered most relevant and capable of providing in-depth information about the phenomenon under study (Harahap, 2020). The sample size is not fixed but is determined based on research needs, continuing until data saturation is reached that is, when no new information is obtained from additional data.

3.3. Data Collection Technique

3.3.1. Observation

Observation is a data collection method involving direct, systematic, and planned monitoring of objects or phenomena. The researcher conducted observations at Sam Ratulangi International Airport, Manado, from October 2, 2024, to February 28,

2025, during On-The-Job Training (OJT), allowing in-depth study of pilot communications with Ujung Pandang FIC Makassar Sector, particularly regarding HF radio use in uncontrolled airspace.

3.3.2. Interview

Interview is a data collection method conducted through verbal communication, either directly or indirectly. There are three types of interviews, classified by their level of structure:

1. Structured Interview: Questions are prepared in advance with a fixed order and format.
2. Unstructured Interview: Flexible, without predetermined questions, allowing the interviewer to explore various topics with the informant.
3. Semi-Structured Interview: Combines elements of both types, where the interviewer has a question guide but can adapt flexibly to the informant's responses.

In this study, the author selected a semi-structured interview method to allow adjustment of questions based on the informants' responses, thereby enabling more in-depth information to be obtained. Intensive interviews will be conducted with Air Traffic Controller (ATC) personnel of Perum LPPNPI Manado Branch. The questions will focus on the use of HF radio on aircraft operating in the uncontrolled airspace of Sam Ratulangi International Airport, Manado.

3.3.3. Documentation

The researcher collected data through visual documentation by taking photos using a mobile device. This method was chosen to support the study of high-frequency (HF) radio usage on aircraft for flight safety in uncontrolled airspace at Sam Ratulangi International Airport, Manado. Visual documentation, such as photographs, serves as a qualitative data collection technique that provides additional information on field conditions and complements data obtained through other methods like observation and interviews.

3.4. Research Instrument

A research instrument is a tool selected and used by the researcher to systematically collect data, making the data-gathering process more organized and manageable.

Table 1 Interview Instrument for Air Traffic Controller (ATC) Personnel

Dimension	Indicator	Data Source	Question Items
The use of HF (High Frequency) radio as a two-way communication tool between pilots and Ujung Pandang FIC Makassar Sector	Implementation of the obligation to use HF radio	ATC Personnel	1. What do you know about the use of HF radio in uncontrolled airspace? 2. How is the implementation of HF radio usage in flight operations? 3. To what extent do you assess the level of compliance of air operators with this regulation?
	The role of HF radio in preventing air incidents	ATC Personnel	1. How does the use of HF radio help prevent potential incidents during flights? 2. Can you share an experience when there was an aircraft that did not carry an HF radio? 3. What challenges do you face if there is an aircraft that cannot make

Dimension	Indicator	Data Source	Question Items
			contact with Ujung Pandang FIC Makassar Sector due to not carrying an HF radio?
	Quality of communication in the use of HF radio	ATC Personnel	1. How do you assess the quality of communication when using HF radio? 2. How do weather conditions or other environmental factors affect the quality of HF radio communication?
	Proposed improvements and optimization	ATC Personnel	1. In your opinion, what can be done to improve the effectiveness of HF radio use in uncontrolled airspace? 2. Do you have any suggestions regarding regulatory improvements or training that could support the optimization of HF radio usage?

3.5. Data Analysis Technique

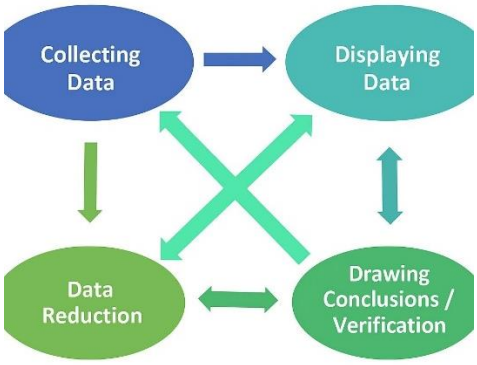

Figure 4 qualitative data analysis model developed by Miles and Huberman (Source: Miles et al., 1992)

In this study, the researcher applied the qualitative data analysis model developed by Miles and Huberman. According to Miles and Huberman (1992), data analysis involves three main stages: data reduction, data display, and conclusion drawing/verification.

3.6. Data Credibility Testing

In this section, the researcher explains how data were verified to ensure the accuracy and validity of the study's results using data triangulation. Data triangulation aims to confirm or complement research findings by examining data from multiple perspectives and methods. According to Denzin, as cited by Tohirin, there are four types of triangulation used in qualitative research: source triangulation, method triangulation, investigator triangulation, and theory triangulation. In this study, the author only used 2 out of the 4 methods mentioned above, there are source triangulation and method triangulation.

4. RESEARCH RESULTS

4.1. Validation Result

The validation of the research instruments indicated that the validators considered the descriptions of the data collection guidelines—covering observation, interviews, and documentation study—to be accurate and relevant. Consequently, the instruments were deemed suitable and reliable for use in data collection for this study.

4.2. Observation Result

Field observations revealed that some operators still did not comply with mandatory equipment requirements in uncontrolled airspace. Aircraft equipped with HF radios generally maintained effective two-way communication with air traffic controllers, though technical issues like broken audio or lost radar signals occurred, especially east of the 90 NM radius from MNO VOR/DME, due to geographic and weather limitations.

In such situations, pilots often take the initiative to contact their company over long-range communications. This highlights a gap in communication procedures, as no alternative protocol is established if the HF radio fails or contact with Makassar Sector FIC cannot be made. This underscores that HF radio remains essential for ensuring safety in uncontrolled airspace.

Table 2 Observation Results

No	Date	Observation Result
1.	10/11/ 2025	1. On November 10, 2025, the author was on the morning shift at the Manado Approach unit. The author received the transfer of control of an aircraft with the callsign 'PK SNS', overflying from Ternate to Tarakan (WAEE–WAQQ) with an estimate over MNO VOR/DME at 03:55 UTC from Babullah Tower. 2. At 03:13 UTC, PK SNS first made contact with Manado Approach while at Point Halmo at an altitude of 8,500 feet. 3. While within the Manado Approach area, aircraft PK SNS was continuously provided with air traffic services such as traffic information, separation, and regular position checks every few minutes using MNO VOR/DME as reference. 4. At 04:20 UTC, the aircraft reported its position on Radial 270 of MNO VOR/DME at a distance of 60 NM. ATC instructed PK SNS to make initial contact with Makassar Sector FIC before entering their area of responsibility. 5. No further report was received from the aircraft after 20 minutes. ATC then contacted Makassar Sector FIC and was informed that the aircraft had not yet established contact. Manado Approach attempted to call 'PK SNS' again, but there was no response, and the aircraft was not detected on radar. 6. Due to limited communication equipment with the adjacent unit at Juwata Tarakan Airport, ATC at Manado Approach could only wait for updates from Makassar Sector FIC regarding the aircraft's position and condition. Later, it was confirmed that aircraft PK SNS had established contact at Juwata Tarakan Airport at 06:25 UTC.
2.	29/01/ 2025	1. There was a VFR aircraft with the callsign PK VIK flying at an altitude of 8,000 feet. The aircraft was overflying from Ternate to Gorontalo (WAEE–WAMG) without being equipped with an HF radio. 2. PK VIK reported to ATC at Manado Approach that they were not carrying an HF radio. They also chose to follow the VFR route within a radius of 50–100 NM from MNO VOR/DME in order to proceed directly to Djalaluddin Gorontalo Airport. 3. Since the aircraft chose to use the Manado VFR route, it was not an issue when it did not make contact with Makassar Sector FIC. This was because the aircraft was still within the Manado Control area and was still able to receive air traffic services from ATC at the Manado Approach unit.
3.	18/02/ 2025	1. There was an aircraft with the callsign PK VIK flying at an altitude of 9,000 feet. The aircraft was overflying from Gorontalo to Ternate (WAMG–WAEE) without being equipped with an HF radio.

No	Date	Observation Result
		2. PK VIK reported to ATC at Manado Approach that they were not carrying an HF radio. They chose to fly via the RNP Manado route (direct Point Gonta), then overhead MNO VOR/DME in order to proceed directly to Sultan Babullah Airport, Ternate. 3. Since the aircraft chose to use the RNP Manado route, it was not an issue when it did not establish contact with Makassar Sector FIC. This was because the aircraft was still within the Manado Control area and could still receive air traffic services from ATC at the Manado Approach unit.

Figure 5 Observation Documentation at the Manado Approach Unit

4.3. Interview Result

The researcher conducted in-depth interviews with several Air Traffic Controller (ATC) personnel at Perum LPPNPI Manado Branch. Interviewees were selected based on their length of work experience to ensure diverse and representative responses. The following presents the data reduction results from the interviews conducted:

1. Use of HF Radio in Uncontrolled Airspace

All informants stated that HF radio remains a primary communication tool for aircraft in uncontrolled airspace, especially for long-range flights beyond VHF coverage or radar, such as transoceanic routes or areas with limited communication infrastructure.

2. Challenges in Using HF Radio

ATC personnel reported common HF radio issues, including poor audio quality, communication delays, and limited signal range. Obstacles like mountains near the airport (e.g., Makaweimbeng/MWB) and bad weather further degrade HF and VHF signal quality.

3. The Role of HF Radion in Aviation Safety

Respondents emphasized that HF radio remains essential for maintaining two-way communication with aircraft, especially when out of VHF and radar range, ensuring monitoring and contact during emergencies.

4. Recommendations and Expectations for Operator Compliance in Using HF Radio

Respondents recommended stricter enforcement of HF radio regulations by airlines and operators, with OTBAN overseeing compliance, reviewing flight plans, and promoting awareness. As Mr. Bangkit stated, once regulations are clear and communicated, airlines will at least equip their aircraft with HF radios.

4.4. Documentation Study Result

The researcher collected documentation in the form of photos, files, and tables to support arguments and statements during the study. These materials were gathered while conducting On the Job Training (OJT) at Sam Ratulangi International Airport, Manado.

5. DISCUSSION

The use of HF radio remains crucial for aircraft operating in uncontrolled airspace. HF radios enable long-distance communication via ionospheric reflection, reaching areas beyond VHF and radar coverage, such as transoceanic routes and regions with limited infrastructure. This is particularly relevant for routes from Sam Ratulangi International Airport to destinations like Tarakan (456 NM), which lack VFR paths, conventional routes, or adequate waypoints for position reporting. Interview data from ATC personnel confirm that HF radio is essential for maintaining two-way communication, allowing continuous monitoring of aircraft positions and status, providing flight information and alerting services, and detecting potential conflicts in uncontrolled airspace.

HF radio usage faces several challenges, as highlighted by ATC personnel. Main issues include poor audio quality due to geographic and weather conditions around Sam Ratulangi International Airport, which can delay communication and critical information exchange, especially for conflict avoidance. Additionally, some small aircraft (e.g., helicopters and Cessnas) lack HF radios when operating in uncontrolled airspace, posing a hazard as they are considered "uncontrolled flights" due to the absence of communication with Makassar Sector FIC or Manado Approach.

6. CONCLUSION

Based on the discussion above, the author concludes that HF radio is essential for aircraft operating in uncontrolled airspace. Two-way communication between pilots and ATC personnel, specifically the Ujung Pandang FIC Makassar Sector, is mandatory to ensure smooth air traffic services. This allows the sector to provide services such as flight information and alerting, while ensuring the safety and security of all flights within its area of responsibility.

7. RECOMMENDATIONS

Based on the discussion above, the author proposes solutions to improve operations at Perum LPPNPI Manado Branch and reduce the number of aircraft or operators operating in uncontrolled airspace without HF radios. The suggested alternatives are as follows:

1. Elevate an aircraft to the uncertainty phase (INCERFA) if:
   a) No information is received about the aircraft within 30 minutes from the first attempt to establish contact.
   b) The aircraft does not arrive or fails to land within 30 minutes of the estimated time of arrival (ETA).
2. Perum LPPNPI Manado Branch cooperates with Airport Authority (OTBAN) Region VIII to conduct outreach to airlines or operators so that they comply more strictly with existing regulations and are more aware of the required equipment or devices that must be carried according to the flight routes being flown.
3. Airport Authority (OTBAN) Region VIII collaborates with the Air Traffic Service Reporting Office (ATS-RO/ARO) unit to tighten the monitoring of HF radio usage by checking the flight plans of aircraft that will operate in uncontrolled airspace. If there is an aircraft that plans to fly through uncontrolled airspace without being equipped with an HF radio, the ARO unit must not release the flight plan of that aircraft.
4. ATC at the Aerodrome Control (ADC/Tower) unit must re-confirm (double-check) the availability of HF radio with the pilot before issuing clearance for start-up or pushback, due to concerns that some aircraft may bypass the flight plan check from the ARO.

8. REFERENCES

Casr, T. P. (2022). *Manual Operasi Penyelenggara Pelayanan*.

Direktorat Jendral Perhubungan Udara. (2017). *Pedoman Teknis Operasional Bagian 171-10 (Advisory Mengingat : Undang-Undang Nomor 1 Tahun Organisasi Kementerian Negara (Lembaran Negara*.

Elisabeth Risamasu, E. (2023). Penggunaan Dan Manajemen Kanal High Frequency (HF) Pada Sistem Komunikasi Penerbangan Bandara Soekarno Hatta. *Jurnal Ilmiah Wahana Pendidikan*, *Juli*, *14*(14), 290–296. https://doi.org/10.5281/zenodo.8173478

Harahap, N. (2020). *Penelitian kualitatif*.

Hendiyanto, & Isnawijayani. (2024). Analisis Komunikasi Beban Kerja Air Traffic Controller (ATC) dalam Menjaga Keselamatan Lalu Lintas Penerbangan di Airnav Indonesia Cabang Palembang. *Jurnal Indonesia : Manajemen Informatika Dan Komunikasi*, *5*(1), 244–254. https://doi.org/10.35870/jimik.v5i1.458

Miles, M. B., Huberman, A. M., Rohidi, T. R., & Mulyarto. (1992). *Analisis data kualitatif: buku sumber tentang metode metode baru*. Penerbit Universitas Indonesia (UI-Press).

PM_65_Tahun_2017_new (3).

Radio Regulations - Appendices - Edition of 2020. (n.d.).

Republic of Indonesia Ministry of Health. (1979). *Republic of Indonesia Ministry of Health*.

Rules, V. F., Vfr, B., Firs, I., Zone, C., Vfr, S., &

Zones, C. (2000). *Aip indonesia (vol. i)*. *I*(Vol I), 5–6.

Standar, P. O., & Lintas, P. L. (2022). *Approach Control Service*.

Utami, P. D. (2020). Analisis Penggunaan Single Frequency Terhadap Keselamatan Penerbangan Pada Unit Flight Service Station Di Perum Lppnpi Cabang Pontianak. *Prosiding SNITP (Seminar Nasional Inovasi Teknologi Penerbangan)*, *4*, 1–13.