



Appendix G: Qualitative Aviation Risk Assessment

Qualitative Aviation Risk Assessment

Modification

Rye Park Wind Farm, NSW

Client

Rye Park Renewable Energy Pty Ltd

LB00300

Draft v003

22 July 2020

Landrum & Brown Worldwide (Aust) Pty Ltd, 2020

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1 Introduction

Rye Park Renewable Energy Pty Ltd (RPRE), a solely owned subsidiary of Tilt Renewables, has tasked Landrum & Brown Worldwide (Australia) Pty Ltd to prepare a Qualitative Aviation Risk Assessment (QARA) for the proposed modification of the Rye Park Wind Farm located approximately 55km north of Canberra.

Development consent was issued for the Rye Park Wind Farm based on a layout comprising 92 WTGs with a maximum height of 157 m AGL.

The modified Rye Park Wind Farm will comprise 80 Wind Turbine Generators (WTGs) with the maximum height from ground level to the tip of an upright vertical WTG blade of 200 m above ground level (AGL) and 6 permanent Met Masts. When considering terrain elevations, the elevations of the WTG blade tips vary from 860 m AHD to the maximum height of 971 m AHD. The height of the permanent met masts will be modified in line with the height of the WTGs..

An Aeronautical Impact Assessment was provided to Tilt Renewables in March 2020. That assessment considered the aeronautical information contained in Aeronautical Information Publication effective 27 February 2020 and on Aeronautical Charts effective 7 November 2019. There are no changes to these publications that affect the wind farm with the AIP amendment dated 21 May 2020.

The general location of the wind farm and the ATC Radar location at Bobbara Mountain are shown in Figure 1.

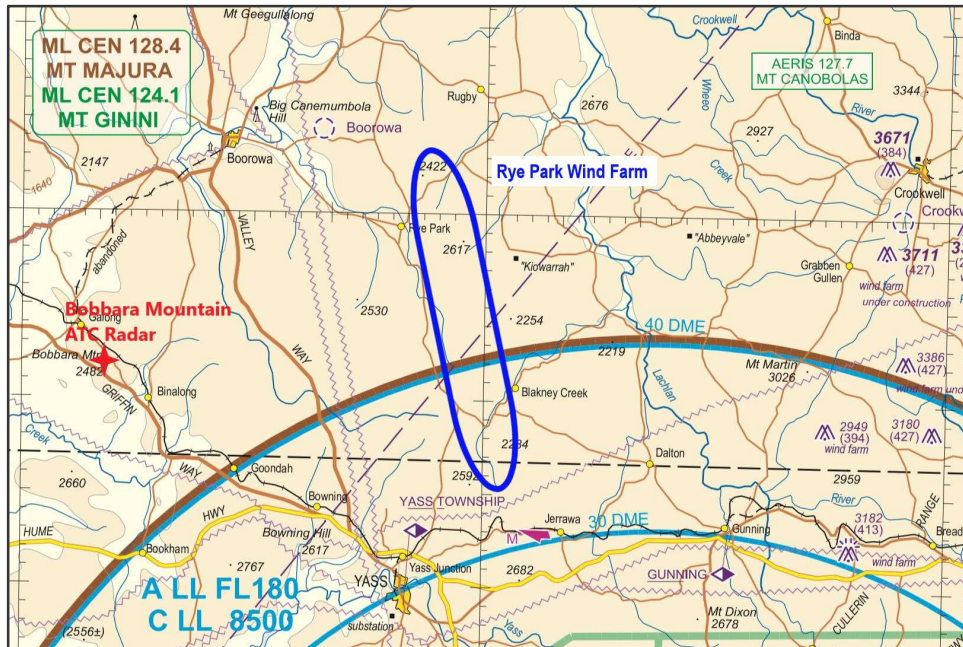


Figure 1: Rye Park Wind Farm (Source: Aircservices Australia)

Goulburn Airport and Cowra Airport are the nearest certified airports and have published instrument approach procedures.

The unlicensed airfields at Boorowa and Crookwell, shown on the chart at Figure 1, are far enough away from the wind farm that aircraft operations will not be affected.

There may be other privately-owned airstrips in the area that are not published in the Aeronautical Information Publication (AIP). The owners of these airstrips and the pilots that use them are responsible for ensuring that the condition of the airstrip and the surrounding terrain and obstacle environment are suitable for the safe operation of the aircraft using them.

Some Instrument Flight Rules (IFR) air routes exist in the vicinity of the proposed Rye Park Wind Farm that will require an increase to the LSALT by Aircservices Australia.

2 Qualitative Aviation Risk Assessment

This Qualitative Aviation Risk Assessment identifies the effect of uncertainty on objectives by identifying likely hazards, determining the probability of the hazards occurring and if they happen, the impact of each occurrence expressed as Low, Medium or High as per the following matrix that defines the Level of Risk from the Likelihood of a Consequence.

Risk Element	Assessed Level of Risk	Comment
Canberra Airport – Aircraft Operations	NIL	Canberra aerodrome is located more than 30 nm from the boundary of the wind farm. The wind farm is outside all PANS OPS and OLS surfaces.
Goulburn and Cowra Certified Aerodromes – Aircraft Operations	NIL	Both aerodromes are located more than 30 nm from the boundary of the wind farm. The wind farm is outside all PANS OPS and OLS surfaces.
Boorawa and Crookwell Unlicensed Airstrip – Aircraft Operations	LOW	Both airstrips are located more than 5 nm from the boundary of the wind farm. Take-off and landing operations are conducted within 1 nm generally. Pilots operating at unlicensed airstrips are responsible to ensure the suitability of the airstrip for their proposed operation and compliance with Visual Meteorological Conditions (VMC) – be able to see at least 5 km around the aircraft, that will enable them to identify and avoid the wind turbines by a safe margin.
Unknown Unlicensed Airstrip in the area – Aircraft Operations	LOW	Pilots operating at unlicensed airstrips are responsible to ensure the suitability of the airstrip and environment for their proposed operation and compliance with visual flying conditions that will enable them to identify and avoid the wind turbines
Published Air Routes	LOW	Amendment of the LSALT to account for the wind farm will result in acceptable IFR and night flying operations.
Local Flight Operations – Civil and Military	LOW	Depiction of the wind farm on aeronautical charts will alert pilots to the presence of the wind turbines. Pilots operating in the area of the wind farm are responsible to ensure that they maintain visual reference to the ground and remain in VMC that will enable them to identify the wind farm in sufficient time to avoid them by required margins.
Flying Training Areas	NIL	There are no published flying training areas in the vicinity of the wind farm.
Aerial Agricultural, Police and Fire Fighting Operations	LOW	A preflight briefing by the pilot and general farm layout briefings by landowners along with the publication of the wind farm on aeronautical charts will alert pilots to the wind turbines. They are trained to understand the impact of downwind turbulence on low level flight operations.
Weather and Low Visibility Hazard that reduces the opportunity to see the wind turbines in sufficient time to avoid them	LOW	Pilots qualified to only fly in VMC, that continue flight into areas of reduced visibility below the VMC criteria are at a HIGH risk of colliding with undulating terrain, trees, powerlines and the whole range of other vertical obstacles. The low number of airfields and consequently aviation activity in the area reduces the risk to Medium. The rare number of known occurrences of such illegal and hazardous activities reduces the risk level to LOW.

Table 1: Risk Levels

2.1 Findings

NASF Guideline D - *Managing Risk to Aviation Safety of Wind Turbine Installations (Wind Farms) and Wind Monitoring Towers* refers to large wind turbines being sufficiently conspicuous, by day, due to their shape and size provided the turbine is of a contrasting colour to the background. Markings that comply with condition 4 of the development consent are generally acceptable to CASA.

Wind turbines at a maximum height of 200 m AGL are higher than the minimum flight altitude of 152 m (500 ft) above terrain and obstacles within 600 m of the aircraft. Publication of the location and height of the wind farm and their conspicuous marking allows pilots to identify the turbines in time to be able to comply with the minimum flight altitude requirements of the Civil Aviation Safety Regulations. Notification of the wind farm and the WTG coordinates and elevations to CASA, Airservices Australia and Defence will enable the wind farm to be published on aeronautical charts to enable pilots to recognise the presence of the high WTGs when planning their flights.

Very few pilots, other than those conducting flying training in flying training areas, fly at this minimum height when transiting between departure and destination points. It is uncomfortable in any winds stronger than 5 knots above undulating terrain and is not fuel efficient.

Flight operations between two points are generally conducted at altitudes much higher than the turbines and terrain, and usually above the LSALTs shown in other sections of this assessment.

The QARA shows that the Rye Park Wind Farm poses a LOW risk and therefore does not create an adverse hazard to aircraft safety in the region.

2.2 Obstacle Lighting Assessment

At night, the conspicuous marking of the wind farm does not allow pilots to see and identify them. The same situation applies to the terrain beneath them.

Night flying is conducted from airports in the region, including from flying schools in the Sydney area. The number of these operations, in the area of the wind farm is likely to be low as the wind farm is to be located in an area away from direct tracks from Sydney to Canberra. The small number of flying schools and clubs at Cowra, Narrandera and Griffith, the end points of the air routes that overlay the wind farm would also only produce low numbers of night flights in the area.

Pilots operating at night are required to comply with minimum height guidance provided by LSALTs published on aeronautical charts. Such operations would not be affected by the wind farm once the LSALTs indicated in the AIA are amended by Airservices Australia, prior to the construction of the wind turbines.

Other wind farms in the area between Crookwell and Gunning are shown on aeronautical charts and are not equipped with obstacle lighting. They are not as high above the ground as the proposed Rye Park Wind Farm's turbines are though.

It is unlikely that the 200 m turbines would create an adverse hazard to aviation activity in the area at night due to the highest risk value being determined as Low and therefore does not require lighting.

As the Rye Park Wind Farm turbine tip heights will exceed 110m AGL, formal notification to CASA and DoD is required in accordance with:

- CASA Advisory Circular AC 139-08(0) "Reporting of Tall Structures" to enable inclusion of the wind farm location and height of turbines in relevant aeronautical information publications; and
- CASA Form 406 – "Operational Assessment of Existing and Proposed Structures".

Appendix A: Discussion Regarding Obstacle Lighting Requirements

The aeronautical requirements for marking and lighting of wind farms are currently undergoing review by the International Civil Aviation Organization (ICAO), the Department of Infrastructure, Regional Development and Cities (DIRDC) and CASA.

DIRDC recently issued a Discussion Paper “Safeguards for Airports and The Communities Around Them” that implies an amendment to the criteria for wind turbine reporting heights from 110m to 152m AGL being applicable to wind farms in the vicinity of aerodromes. In addition, CASA is currently reviewing its withdrawn Advisory Circular AC139-181 “Obstacle Marking and Lighting of Wind Farms”.

The outcomes of these various reviews may result in:

- Revised criteria for reporting of wind farms; and
- Wind farms that are in remote locations, away from aerodromes, not requiring obstacle lighting, depending on the findings of a qualitative risk assessment to be undertaken by the proponent.

While the DIRDC Discussion Paper applies specifically to wind farms within the vicinity (generally accepted as 30km) of aerodromes, CASA is also currently reviewing the requirements for marking and lighting of obstacles and hazards remote from aerodromes. CASA has informally advised the renewable energy industry that a qualitative risk assessment approach to the potential hazards, as presented by wind farms, may be considered.

CASA’s current position on obstacle lighting of wind farms that are remote from an aerodrome (which is the situation for the Rye Park Wind Farm) is summarised as:

- CASA cannot mandate obstacle lighting for wind farms that are not within the vicinity of an aerodrome;
- provision of obstacle lighting is the responsibility of the proponent;
- any associated requirements placed on proponents by planning authorities, insurers or financiers are beyond CASA’s scope;
- a wind farm proponent may have a duty of care to the aviation industry and local operators in terms of ensuring obstacles are made conspicuous; and
- obstacle marking and lighting requirements in relation to Obstacle Limitation Surfaces, etc, as specified in the CASA Manual of Standards Part 139, Chapters 8 and 9 applies.

CASA Manual of Standards (MOS) 139, Chapter 9, Section 9.4 indicates that for structures more than 110m AGL, the proponent should expect that obstacle lighting will be required unless there are unusual circumstances. The turbines to be installed at Rye Park Wind Farm will have a maximum height of 200 m AGL. However, there have been situations where CASA has acknowledged non-provision of obstacle lighting of wind farms in Australia where the turbine height exceeds 110m AGL.

This risk assessment provides CASA with sufficient information for them to consider not recommending that lighting be provided on this wind farm, however such a decision cannot be pre-empted.

As indicated above, Australian policy, standards and recommended practices for obstacle marking and lighting of wind farms are currently under review. A current proposal includes a change to the criterion height of 110m (361ft) to 152m (500ft) AGL for wind farms within the vicinity of a certified or registered aerodrome.

Appendix B: Glossary of Aeronautical Terms and Abbreviations

To facilitate the understanding of aviation terminology used in this report, the following is a glossary of terms and acronyms that are commonly used in aeronautical impact assessments and similar aeronautical studies.

Advisory Circulars (AC) are issued by CASA and are intended to provide recommendations and guidance to illustrate a means, but not necessarily the only means, of complying with the *Regulations*.

Aeronautical Information Publication (AIP) is a publication promulgated to provide operators with aeronautical information of a lasting character essential to air navigation. It contains details of regulations, procedures and other information pertinent to flying and operation of aircraft within the applicable country. AIP Australia is produced by Airservices Australia under contract to CASA.

Aeronautical study is a tool used to review aerodrome and airspace processes and procedures to ensure that safety criteria are appropriate.

Air routes exist between navigation aids or waypoints to facilitate the regular and safe flow of aircraft operating under the IFR.

Airservices Australia (ASA) is the Australian government-owned corporation Air Navigation Service Provider (ANSP) providing safe, secure, efficient and environmentally sound air traffic management and related airside services including telecommunications, aeronautical data, navigation services and aviation rescue and firefighting services to the aviation industry within the Australian flight information region.

Air Traffic Control (ATC) service is a service provided in controlled airspace for the purpose of preventing collisions between aircraft and between aircraft and obstructions on the manoeuvring area of controlled aerodromes whilst maintaining an expeditious and orderly flow of air traffic.

Altitude is the vertical distance of a level, a point or an object, considered as a point, measured from mean sea level.

Area navigation (RNAV) A method of navigation which permits aircraft operation on any desired flight path within the coverage of the station-referenced navigation aids or within the limits of the capability of self-contained aids, or a combination of these.

Circling approach An extension of an instrument approach procedure which provides for visual circling of the aerodrome prior to landing.

Civil Aviation Safety Authority (CASA) is the Australian government authority responsible under the *Civil Aviation Act 1988* for developing and promulgating appropriate, clear and concise aviation safety standards. As Australia is a signatory to the ICAO *Chicago Convention*, CASA adopts the standards and recommended practices established by ICAO, except where a difference has been notified.

Civil Aviation Safety Regulations (CASR) are promulgated by CASA and establish the regulatory framework (*Regulations*) within which all service providers must operate.

Civil Aviation Act 1988 (the Act) establishes the CASA with functions relating to civil aviation, in particular the safety of civil aviation and for related purposes.

Decision altitude (DA) or decision height (DH) A specified altitude or height in a 3D instrument approach operation at which a missed approach must be initiated if the required visual reference to continue the approach has not been established. *Note— Decision altitude (DA) is referenced to mean sea level and decision height (DH) is referenced to the threshold elevation.*

Elevation The vertical distance of a point or a level, on or affixed to the surface of the earth, measured from mean sea level.

Height The vertical distance of a level, a point or an object considered as a point, measured from a specified datum.

Instrument Flight Rules (IFR) are rules applicable to the conduct of flight under IMC. IFR are established to govern flight under conditions in which flight by outside visual reference is not available due to cloud cover or restricted visibility. IFR flight depends upon a qualified instrument rated pilot flying by reference to instruments located in the flight deck. Navigation is accomplished by reference to electronic signals. It is also referred to as, “a term used by pilots and controllers to indicate the type of flight plan an aircraft is flying,” such as an IFR or VFR flight plan. IFR flights can and do regularly operate in VMC but remain an IFR flight for rule and ATC requirements. Regular Public Transport flights are required to file an IFR flight plan, irrespective of the weather conditions.

Instrument Meteorological Conditions (IMC) are meteorological conditions that are less than the minimum specified for visual meteorological conditions.

International Civil Aviation Organization (ICAO) is an agency of the United Nations which codifies the principles and techniques of international air navigation and fosters the planning and development of international air transport to ensure safe and orderly growth. The ICAO Council adopts standards and recommended practices concerning air navigation, its infrastructure, flight inspection, prevention of unlawful interference, and facilitation of border-crossing procedures for international civil aviation. In addition, the ICAO defines the protocols for air accident investigation followed by transport safety authorities in countries signatory to the Convention on International Civil Aviation, commonly known as the *Chicago Convention*. Australia is a signatory to the *Chicago Convention*.

Lowest Safe Altitude (LSALT) are published for each low level air route segment. Their purpose is to allow pilots of aircraft that suffer a system failure to descend to the LSALT to ensure terrain or obstacle clearance in IMC where the pilot cannot see the terrain or obstacles due to cloud or poor visibility conditions. It is an altitude that is at least 1,000 feet above any obstacle or terrain within a defined safety buffer region around a particular route that a pilot might fly.

Manual of Standards (MOS) comprises specifications (Standards) prescribed by CASA, of uniform application, determined to be necessary for the safety of air navigation in relation to a particular segment of the aviation regulations. For example, MOS 139 relates to CASR Part 139 – Aerodromes.

Minimum descent altitude (MDA) or minimum descent height (MDH) A specified altitude or height in a 2D instrument approach operation or circling approach operation below which descent must not be made without the required visual reference. Note: Minimum descent altitude (MDA) is referenced to mean sea level and minimum descent height (MDH) is referenced to the aerodrome elevation or to the threshold elevation if that is more than 2 m (7 ft) below the aerodrome elevation. A minimum descent height for a circling approach is referenced to the aerodrome elevation.

Minimum Obstacle Clearance (MOC) is the minimum distance above an obstacle or terrain that aircraft conducting instrument approach or departure procedures are not allowed to fly below in IMC. The MOC varies depending on the distance from the runway or in mountainous areas.

Notices to Airmen (NOTAMs) are notices issued by the NOTAM office containing information or instruction concerning the establishment, condition or change in any aeronautical facility, service, procedure or hazard, the timely knowledge of which is essential to persons concerned with flight operations.

Obstacles. All fixed (whether temporary or permanent) and mobile objects, or parts thereof, that are located on an area intended for the surface movement of aircraft or that extend above a defined surface intended to protect aircraft in flight.

Obstacle assessment surface (OAS) is a defined surface intended for the purpose of determining those obstacles to be considered in the calculation of obstacle clearance altitude/height for a specific APV or precision approach procedure.

Obstacle Limitation Surfaces (OLS) are a series of planes associated with each runway at an aerodrome that defines the desirable limits to which objects may project into the airspace around the aerodrome so that aircraft operations may be conducted safely.

Prescribed airspace is an airspace specified in, or ascertained in accordance with, the Regulations, where it is in the interests of the safety, efficiency or regularity of existing or future air transport operations into or out of an airport for the airspace to be protected. The prescribed airspace for an airport is the airspace above any part of either an OLS or a PANS OPS surface for the airport and airspace declared in a declaration relating to the airport.

Procedures for Air Navigation Services – Aircraft Operations (PANS-OPS) is an ICAO term denominating rules for designing instrument approach and departure procedures. Such procedures are used to allow aircraft to land and take off under Instrument Meteorological Conditions (IMC) using the Instrument Flight Rules (IFR). ICAO document 8168-OPS/611 (volumes 1 and 2) outlines the principles for airspace protection and procedure design which all ICAO signatory states must adhere to. The regulatory material surrounding PANS-OPS may vary from country to country.

PANS OPS Surfaces. Similar to an Obstacle Limitation Surface, the PANS-OPS protection surfaces are imaginary surfaces in space, below the nominal flight path of the aircraft, which guarantee a certain minimum obstacle clearance above the ground or man-made obstacles. These surfaces may be used as a tool for local governments in assessing building development. Where buildings may (under certain circumstances) be permitted to penetrate the OLS, they cannot be permitted to penetrate any PANS-OPS surface, because the purpose of these surfaces is to guarantee pilots operating in IMC an obstacle free descent or climb path for a given approach, holding procedure or departure.

Regulations (Civil Aviation Safety Regulations)

Threshold (THR). The beginning of that portion of the runway usable for landing.

Visual Flight Rules (VFR) are rules applicable to the conduct of flights that are only permitted in VMC due to aircraft equipment and pilot qualifications. The visual flight rules allow a pilot to operate an aircraft in weather conditions that allow the pilot to navigate by visual reference to the ground or water by maintaining visual contact with the terrain and obstacle environment in order to be able to see and avoid other aircraft, terrain, obstacles or other hazards. Specifically, the weather must be equal to or better than basic VFR weather minima. If the weather is worse than VFR minima, IFR qualified pilots operating an IFR qualified aircraft are able to operate under the IFR.

Visual Meteorological Conditions (VMC) are meteorological conditions expressed in terms of visibility, distance from cloud and ceiling, equal or better than specified minima.

Visual Segment Surface (VSS) A PANS-OPS design segment of a straight-in instrument approach procedure, which needs to be monitored and kept clear of any penetrations by obstacles.

Abbreviations

Abbreviations used in this report, and the meanings assigned to them for the purposes of this report are detailed in the following table.

Abbreviation	Meaning
AC	Advisory Circular (document support CAR 1998)
ACFT	Aircraft
AD	Aerodrome
ADS-B	Automatic Dependent Surveillance – Broadcast
AHD	Australian Height Datum
AIP	Aeronautical Information Publication
Airports Act	Airports Act 1996, as amended
AIS	Aeronautical Information Service
ALT	Altitude
AMSL	Above Mean Sea Level
APARs	Airports (Protection of Airspace) Regulations, 1996 as amended
ARP	Aerodrome Reference Point
AsA	Airservices Australia
ATC	Air Traffic Control(ler)
ATM	Air Traffic Management
BARO-VNAV	Barometric Vertical Navigation
BRA	Building Restricted Area
CAO	Civil Aviation Order
CAR	Civil Aviation Regulation
CASA	Civil Aviation Safety Authority
CASR	Civil Aviation Safety Regulation
Cat	Category
DAP	Departure and Approach Procedures (charts published by AsA)
DER	Departure End of (the) Runway
DME	Distance Measuring Equipment
Doc nn	ICAO Document Number nn
DIT	Department of Infrastructure and Transport. (Formerly Dept. of Infrastructure, Transport, Regional Development and Local Government and Department of Transport and Regional Services (DoTARS))
DOTARS	See DIT above
ELEV	Elevation (above mean sea level)
ENE	East North East
ERSA	Enroute Supplement Australia
FAF	Final Approach Fix

Abbreviation	Meaning
FAP	Final Approach Point
FAS	Final Approach Surface of a BARO-VNAV approach
ft	feet
GBAS	Ground Based Augmentation System (satellite precision landing system)
GNSS	Global Navigation Satellite System
GP	Glide Path
IAS	Indicated Airspeed
ICAO	International Civil Aviation Organisation
HIS	Inner Horizontal Surface, an Obstacle Limitation Surface
ILS	Instrument Landing System
ISA	International Standard Atmosphere
km	kilometres
kt	Knot (one nautical mile per hour)
LAT	Latitude
LLZ	Localizer
LSALT	Lowest Safe Altitude
LONG	Longitude
LNAV	Lateral Navigation criteria
m	metres
MAPt	Missed Approach Point
MDA	Minimum Descent Altitude
MGA94	Map Grid Australia 1994
MOC	Minimum Obstacle Clearance
MOS	Manual of Standards, published by CASA
MSA	Minimum Sector Altitude
MVA	Minimum Vector Altitude
NASAG	National Airports Safeguarding Advisory Group
NDB	Non Directional Beacon
NE	North East
NM	Nautical Mile (= 1.852 km)
nnDME	Distance from the DME (in nautical miles)
NNE	North North East
NOTAM	NOtice to AirMen
OAS	Obstacle Assessment Surface
OCA	Obstacle Clearance Altitude
OCH	Obstacle Clearance Height
OHS	Outer Horizontal Surface

Abbreviation	Meaning
OIS	Obstacle Identification Surface
OLS	Obstacle Limitation Surface
PANS OPS	Procedures for Air Navigation Services – Aircraft Operations, ICAO Doc 8168
PBN	Performance Based Navigation
PRM	Precision Runway Monitor
QNH	An altimeter setting relative to height above mean sea level
REF	Reference
RL	Relative Level
RNAV	aRea NAVigation
RNP	Required Navigation Performance
RPA	Rules and Practices for Aerodromes — replaced by the MOS Part 139 — Aerodromes
RPT	Regular Public Transport
RTCC	Radar Terrain Clearance Chart
RWY	Runway
SFC	Surface
SID	Standard Instrument Departure
SOC	Start Of Climb
STAR	STandard ARrival
SGHAT	Solar Glare Hazard Analysis Tool
TAR	Terminal Approach Radar
TAS	True Air Speed
THR	Threshold (Runway)
TNA	Turn Altitude
TODA	Take-Off Distance Available
VNAV	Vertical Navigation criteria
V _n	aircraft critical Velocity reference
VOR	Very high frequency Omni directional Range
WAC	World Aeronautical Chart