Inspectie Leefomgeving en Transport
Ministerie van Infrastructuur en Waterstaat

Standard Scenario (STS)

UAS OPERATIONS ABOVE RAILWAYS WITHIN RURAL AND URBAN POPULATIONS

Inspectie Leefomgeving en Transport - CAA The Netherlands

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Introduction

In order to avoid time consuming appraisals of repetitive individual approvals, CAA-NL applies the methodology to define "Standard Scenarios" for a growing number of predefined operations with known threats and acceptable risk mitigations. Standard Scenarios limit the administrative burden for both UAS operators and the authorities and stimulates innovation by lowering the entry level for certain types of operation.

A standard scenario includes a declaration that must be signed by the operator's accountable manager and submitted to the authorities. By submitting the declaration the operator indicates the covered operation will be conducted in accordance with the indicated general conditions and that all mitigation measures are in place and verified.

This methodology is in line with all known elements of upcoming EU drone legislation. Some underlying elements of this legislation and associated guidance material are still under construction. Therefore, until further notice, all operators wishing to conduct the operation covered by this standard scenario in The Netherlands, also need to obtain the specific approval of CAA-NL by applying for extension of the privileges under their RPAS Operators Certificate (ROC).

Dutch ROC-holders may send their declarations and applications to iltdocumentmanagement@ilent.nl. They should make sure that all required documents as mentioned in the application form are included, including the updated operations manual. Random checks by CAA-NL will be part of the appraisal process.

This standard scenario covers the operation of UAS above railways and the associated infrastructure in both rural and congested areas as described in the ConOps. Any part of an operation outside the ConOps and general conditions is not covered by the obtained privilege associated with this standard scenario.

The contents of this standard scenario is based on JARUS guidelines on Specific Operations Risk Assessment (SORA), edition number 2.0 dated 30/01/2019, published by JARUS. All mitigation measures have been scrutinized by the Dutch Drone Expert Group, including experts of the Ministry of Infrastructure and Water Management, CAA-NL, ATC, trade associations and various knowledge institutions. This does not render the content of this document to be perfect. Any comment is welcome. Please send these to drones@ilent.nl.

Glossary of Terms

Abnormal procedure:
Abnormal (or Contingency) procedures are procedures for a situation in which it is no longer possible to continue the flight using normal procedures but the safety of the aircraft or persons on board or on the ground is not in danger.

AGL:
In aviation, atmospheric sciences and broadcasting, a height above ground level (AGL) is a height measured with respect to the underlying ground surface.

AIP:
Aeronautical Information Publication (or AIP) is defined by the International Civil Aviation Organization as a publication issued by or with the authority of a state and containing aeronautical information of a lasting character essential to air navigation. For The Netherlands refer to http://www.ais-netherlands.nl.

Airspace Class C:
In The Netherlands Class C is controlled airspace and comprises:

- CTRs: Eelde, Maastricht, Rotterdam, Schiphol.
- Military CTR: Eindhoven.

Airspace Class D:
In The Netherlands Class D is controlled airspace and comprises:

- Military CTRs: Deelen, De Kooy, De Peel, Gilze Rijen, Leeuwarden, Volkel, Woensdrecht.
- CTRs extending over the Netherlands territory: Niederrhein
- Military CTRs extending over the Netherlands territory: Kleine-Brogel

AMC:
Acceptable Means of Compliance

ATC:
Air Traffic Control, Luchtverkeersleiding Nederland in The Netherlands.

Atypical Airspace

- Restricted Airspace or Danger Areas;
- Airspace where manned aircraft normally cannot go (e.g. airspace within 100 ft. of buildings or structures);
- Airspace characterization where the encounter rate of manned aircraft (encounter is defined as proximity of 3000 ft. horizontally and ± 350 ft. vertically) can be shown to be less than 1E-6 per flight hour during the operation);
- Airspace not covered in Airspace Encounter Categories (AEC) 1 through 12.

C3 Link:

The term "C3 link" encompasses:

- The Command and Control (C2) link, and
- Any communication link required for the safety of the flight.

CAA-NL:

Civil Aviation Authority The Netherlands, Inspectie Leefomgeving & Transport department Vergunningen Luchtvaart for The Netherlands

ConOps:

A user-oriented document that describes systems characteristics for a proposed system from a user's perspective. A ConOps also describes the user organization, mission, and objectives from an integrated systems point of view and is used to communicate overall quantitative and qualitative system characteristics to stakeholders.

Congested areas:

Any area in relation to a city, town or settlement that is largely used for housing, commercial activity or recreation. Draft versions of SORA and the Commission Implementing Regulation do not mention the term 'congested areas' and use 'populated environment' instead. However, populated environment is not clearly defined in either document.

Controlled ground area:

A controlled ground area is defined as the intended UAS operational area that only involves active participants (if any).

CTR:

A control zone (CTR or controlled traffic region) in aviation is a volume of controlled airspace, normally around an airport, which extends from the surface to a specified upper limit, established to protect air traffic operating to and from that airport.

EASA:

The European Aviation Safety Agency or EASA is an agency of the European Union with responsibility for civil aviation safety. It carries out certification, regulation, and standardisation, and also performs investigation and monitoring. It collects and analyses safety data, drafts and advises on safety legislation, and coordinates with similar organisations in other parts of the world.

ERP:

Emergency Response Plan. Plan of actions to be conducted in a certain order or manner, in response to an emergency event.

EVLOS:

Extended Visual Line of Sight. An Unmanned Aircraft System (UAS) operation whereby the Pilot in Command (PIC) maintains an uninterrupted situational awareness of the airspace in which the UAS operation is being conducted via visual airspace surveillance, possibly aided by technology means. The PIC has a direct control of the UAS at all time.

External services provider:

Encompasses any service provider necessary for the safety of the flight , e.g.

- Communication Service Provider (CSP)
- UTM service provider

External system:

External systems supporting the operation are defined as systems not already part of the UAS but used to:

- Launch / take-off the UAS,
- Make pre-flight checks,
- Keep the UA within its operation volume (e.g. GNSS, Satellite Systems, Air Traffic Management, UTM).

External systems activated/used after the loss of control of the operation are excluded from this definition.

HMI:

Human Machine Interface. The interaction between a human (pilot) and a machine (UAS).

ICAO:

International Civil Aviation Organisation. A specialized agency of the United Nations. It 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.

LAPL

Light Aircraft Pilot License

OSO

Operational Safety Objectives are a series of prescribed mitigation measures at various levels of robustness. These can be found in Annex E to SORA.

JARUS:

Joint Authorities for Rulemaking on Unmanned Systems. An advisory body to various (European) regulators.

LVNL:

Luchtverkeersleiding Nederland. Air Traffic Control in The Netherlands.

Medical Certificate:

Certificate given to a (remote) pilot after have conducted a medical examination. Minimum a LAPL for remote pilots in The Netherlands.

Participant (Active):

Active participants are those persons directly involved with the operation of the UAS or fully aware that the UAS operation is being conducted near them. Active participants are fully aware of the risks involved with the UAS operation and have accepted these risks. Active participants are informed on and able to follow relevant effective emergency procedures and/or contingency plans.

Participant (Non-Active):

Non-Active participants are those persons who are located near a UAS operation and may or may not be aware that a UAS operation is being conducted. Passive participants may or may not be aware of the risks associated with the operation and have not accepted these risks.

PIC
Pilot in Command

ROABL:
Regeling op afstand bestuurde luchtvaartuigen. Dutch regulation covering the professional operation of RPAS in the Netherlands.

ROC:
RPAS Operator Certificate. Permit for Dutch persons or companies professionally operating RPAS.

RPA-L:
Remotely Piloted Aircraft License. License for Dutch remote pilots operating under a RPAS Operator Certificate.

RPAS:
Remotely Piloted Aircraft System. Also referred to as drone, UAS, sUAS and UAV.

SERA:
Standardized European Rules of the Air. Common rules of the air and operational provisions regarding services and procedures in air navigation in the European Union.

SORA:
Specific Operations Risk Assessment. A means by which an aircraft operator is granted approval by certifying authorities to operate an unmanned aircraft system within the limitations set forth by the authorities in the Specific Category.

UAS:
Unmanned Aerial System. Also referred to as drone, RPAS, sUAS and UAV.

UDP:
Universal Daylight Period. The period of daylight including 15 minutes before sunrise and 15 minutes after sunset.

VFR:
Visual Flight Rules. Rules for visual flight dictating parameters such as minimum visibility, visual contact with ground or water, and horizontal and vertical distance to clouds.

VLOS:
Visual Line Of Sight. VLOS is the pilot in command and the person manipulating the flight controls, keeping the UAS close enough to be capable of seeing the aircraft with vision unaided by any device other than corrective lenses, and seeing and avoiding all threats and hazards. With a maximum of 500 meters from the pilot in the Netherlands under ROABL.

ConOps

Operations with UAS's above railways and the associated infrastructure in both rural and congested areas in The Netherlands are desirable. Numerous innovative UAS applications will be made possible by allowing these operations, serving not only the commercial interest of the operators but public interest as well. An example of this are maintenance inspections of railway tracks and trains. The deployment of UAS's and high-tech sensors for inspection and surveillance purposes is not only considered a cost effective means of collecting valuable data in hard to reach places, by itself the deployment is considered a mitigating measure that contributes to the safety of people involved in these otherwise dangerous operations.

UAS operations above railways and the associated infrastructure are currently not possible by restrictions in national regulations. However, the upcoming European regulations allow operations with UAS's over any area provided the requirements for mitigating measures resulting from an extensive risk assessment are met. SORA, under development by JARUS may be used as an AMC for this. These requirements are specified in this Standard Scenario.

Basic criteria for professional UAS operations in The Netherlands are governed by the Dutch regulation 'Regeling op afstand bestuurde luchtvaartuigen' and SERA. These dictate the following requirements:

The Operator requires:
- An approved Operations Manual
- An insurance in accordance with EC 785/2004
- A RPAS Operator Certificate

The Pilot requires:
- A Remotely Piloted Aircraft Licence (RPA-L)
- A medical certificate (LAPL)

The UAS requires:
- A Certificate of registration (BvI)
- A Certificate of Airworthiness (S-BvL)

The basic requirements for the Operational Volume are:
- Within Atypical airspace
- Within populated and sparsely populated area
- Within VLOS
- Within VFR conditions
- Within daytime (UDP)

Caution: Other exemptions or Standard Scenarios may be applicable when operating within this Standard Scenario (e.g. operations within class C or D airspace or operations in close proximity and above an object within an urban population). If applicable, operators must strictly adhere to the requirements related to these exemptions or Standard Scenarios. If in doubt, operators are advised to contact the Dutch CAA (IL&T) for more information.

Scenarios

UAS operations above railways and the associated infrastructure can be divided in two main operational scenarios, where the second scenario has two sub-scenarios:

- UAS operations with railway tracks in use;

- UAS operations with railway tracks not in use:
  - UAS operations during a planned shutdown
  - UAS operations during a calamity

General working environment

The working environment when performing UAS operations above railways within unpopulated and populated areas is defined in the Voorschrift Veilig Werken - Trein (VVW). This document (available at ProRail and (sub)contractors) describes the applicable dimensions when working at or near railway infrastructure.

The safety at the workplace when working at or near rail infrastructure is defined by two risks:
- The risk of a collision with people and or equipment by track-bound equipment (e.g. trains, work-trains, maintenance equipment etc.);
- The risk of electrocution by contact of persons and/or equipment with electrically charged parts of the power supply installation or train-safety installation.

The VVW defines three zones (A - C) where these risks occur and determines rules and guidelines how employees can safely set up their workplace.

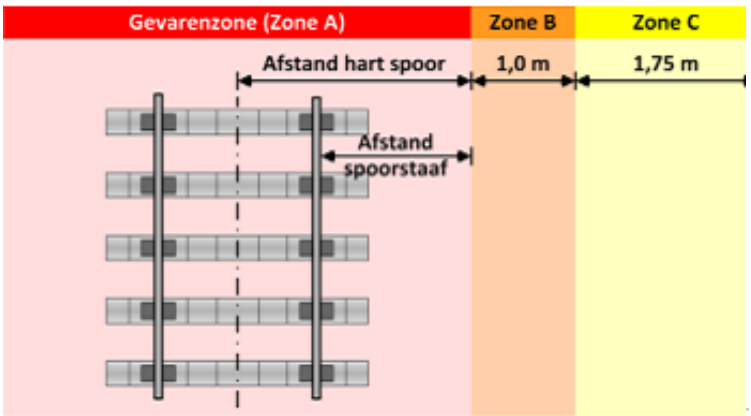

Image 1

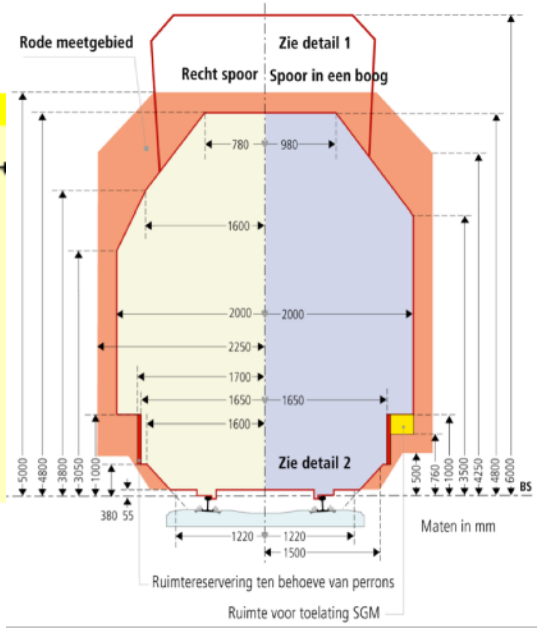

Image 2

Collision riks

The danger zone (A) is the zone where a risk of collision exists. The dimensions of this zone are dependent on the speed of the train or other track-bound equipment. Outside the danger zone there are two zones (B and C) that, due to the proximity of danger zone A, are exposed to side effects of passing track-bound equipment. Requirements are set for these zones to control the risk of entering danger zone A. The requirements for zone B are more strict than for zone C. Furthermore a safety zone (refuge) is defined where employees can position themselves to prevent being exposed to the risk of a collision when track-bound equipment is passing.

Dimensions

The border of danger zone A is dependent on the maximum allowable speed on the track. The table below defines the dimensions applicable to the various track-speeds.

Snelheid in km/h	Grens gevarenzone (zone A) t.o.v. hart spoor in meters	Afstand t.o.v. dichtstbijzijnde spoorstaaf in meters
0-140	2,25[10]	1,50
141-160	2,40	1,65
161-200	2,75	2,00
201-300	3,00	2,25

HSL
▪ Hanteert een vaste afstand t.o.v. dichtstbijzijnde spoorstaaf van 2,25 m in combinatie met een snelheidsbeperking tot 120 km/u.

Proximity zone B has a standard dimension of 1 meter and starts at the border of danger zone A. Proximity zone C has a standard dimension of 1,75 meters and starts at the border of proximity zone B. For all activities within the three zones, a separate Risk Inventory & Evaluation (RI&E) must determine how the risks that result from the nearby danger zone A are managed.

The safety zone has a minimum dimension of 0,8 meters. This zone is an area where employees, with or without their materials and equipment, can position themselves so that the risk of a collision is excluded. The safety zone must be accessible without passing any obstacles (e.g. fence or stair). Furthermore it is prohibited to pass an active track to reach the safety zone. The safety zone must always be positioned outside of danger zone A and the dimensions are dependent on the number of persons and equipment/materials that are in use.

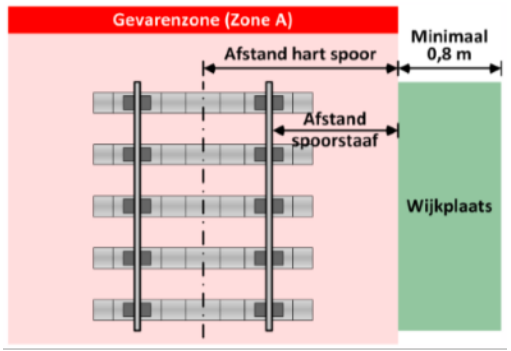

Image 3

Electrocution risk: high voltage parts

International norms describe under which circumstances it is allowed to work on or near high voltage parts of the railway infrastructure. Working within danger zone A is only allowed when no tension is put on the installation. When performing activities within proximity zones B and C strict requirements are applicable to the minimum distances that must be kept. The tabel below specifies for different Voltages what the minimum distances are for persons, vehicles and electrically charged objects.

	1500/1800 V		25 kV	
	Gevarenzone	Nabijheidszone	Gevarenzone	Nabijheidszone
Personen	Niet toegestaan	1,5 m [#1]	Niet toegestaan	1,5 m [#1]
Personen (inspecties en metingen [#2])	0,12 m	1,5 m/2m	Niet toegestaan	2 m [#1]
	1500/1800 V		25 kV	
	Begrensd	Onbegrensd	Begrensd	Onbegrensd
Mobiele railgebonden voertuigen	0,5 m	Niet toegestaan	1 m	Niet toegestaan
Mobiele niet-railgebonden voertuigen op een spoorwagon	0,5 m [#3]	Niet toegestaan	1,0 m [#6]	Niet toegestaan
Mobiele niet-railgebonden voertuigen	0,5 m [#3/#4] 1,5 m [#3/#5]	Niet toegestaan	1,5 m	Niet toegestaan

[#1] Bij activiteiten aan de bovenleiding moet het vanuit een voertuig onmogelijk zijn om binnen de nabijheidszone van de aangrenzende spanningvoerende installatie te komen (bron: RLN00008).

[#2] Bepalingen voor het werken onder spanning (bron: RLN00128).

[#3] Als de werktuigen door uitvoering en/of oneffenheden in het spoor binnen de grenzen (kunnen) komen, dan mogen de activiteiten alleen worden uitgevoerd na toestemming van de installatieverantwoordelijke en na overleg tussen een werkverantwoordelijke en de werkgever van de personen die de activiteiten uitvoeren. In dit overleg komen aan de orde: de aard van de activiteiten, noodzakelijke veiligheidsmaatregelen, begintijd en tijdsduur van de activiteiten en het te houden toezicht (bron: RLN00128).

[#4] 0,5 meter als het betreffende werktuig door middel van een flexibele koperen leiding van ten minste 50 mm^2 verbonden is met de retourleiding, en als de hoogtebegrenzer zodanig is afgesteld dat het werktuig de contactleiding niet dichter nadert dan 0,5 meter. (bron: RLN00128).

[#5] 1,5 meter als er alleen sprake is van een hoogtebegrenzer die zodanig is afgesteld dat het werktuig de contactleiding niet dichter nadert dan 1,5 meter (bron: RLN00128).

[#6] Indien (delen van) werktuigen geïsoleerd zijn opgesteld, dan dienen deze (delen van) werktuigen door een (zwak)geleidende verbinding (maximaal 100 Ohm) met de aarde verbonden te zijn (bron: RLN00128).

UAS operations with railway tracks in use

During UAS operations with railway tracks in use the flight crew must be aware of the fact that trains can be present in the Operational Volume. These trains may have varying speeds and can pass in both directions (depending on the number and configuration of the track(s)). During these operations there will normally be a high voltage on the power lines of the railway infrastructure. The high voltage in combination with passing trains can cause fluctuations in the electromagnetic field. These fluctuations can impact the control and navigation of the UAS.

Therefore operations within the red measurement zone (rode meetgebied, refer to image 2) are not allowed when the railway track is in use. Operations above the railway track are allowed during automated flights (e.g. mapping flights), however the flight crew must be able to take manual control at any time. Operations above the railway track are not allowed during manual flights when a train is passing (e.g. close up inspections), therefore the UAS must be positioned above proximity zone C (or further) and at a minimum distance or altitude of 25 meters from the railway infrastructure when a train is passing.

Operations in this scenario must be conducted at a minimum height of 5 meters (manual flights) or 25 meters (automated flights) above the highest point of the railway infrastructure, except when the UAS is shielded against Electro Magnetic Interference (EMI).

During these operations the flight crew can reduce the risk of a collision risk by:
- A controlled access of trains (Beheerste Toelating, BT)
- A physical barrier (Fysieke Afscherming, FA)
- A guaranteed warning (Gegarandeerde Waarschuwing, GW)
- A personal observation (Persoonlijke Waarneming PW, door Grenswachter (GRW) of Veiligheidsman (VHM))
- A personal safety instruction (Taak Eigen Veiligheid)

A detailed description of these measures is available in chapter 4.3.1 of the VVW. The function of ‘Grenswachter’ and ‘Veiligheidsman’ may not be combined with the function of observer in the flight crew.

Before starting the operation the person responsible for engineering the safety at the workplace must be informed (V&G-coordinator or werkplekbeveiliger). He will be responsible for including the UAS operation in the instruction that the leader workplace safety (leider werkplekbeveiliging, LWB) gives to the people working at and around the workplace. Operations in this scenario must be performed in accordance with the requirements, regulations and guidelines stated in the Normenkader Veilig Werken (NVW), the Voorschrift Veilig Werken - Trein (VVW), the Life Saving Rules (LSR), Richtlijn: gedragsregels op spoorwegterrein (RLN00300). The NVW sets the framework for the organisation of a safe working environment in the rail-infrastructure branche. The VVW translates this framework into concrete rules for the specific (sub)environments and installations.

UAS operations with railway tracks *not* in use

Sub-scenario: UAS operations during a planned shutdown

When performing UAS operations during a planned shutdown there will not be any trains present in the Operational Volume. Refer to the VVW (Notification 2) for the two applicable safety-shells that prevent trains from entering the railway track. However there can be high tension on the power lines of the railway infrastructure. Therefore it is only allowed to operate an UAS within the red measurement zone (rode meetgebied) with permission of the local safety leader (Leider Lokale Veiligheid) and when the UAS is shielded against Electro Magnetic Interference (EMI).

Before starting the operation the person responsible for engineering the safety at the workplace must be informed (V&G-coordinator or werkplekbeveiliger). He will be responsible for including the UAS operation in the instruction that the leader workplace safety (leider werkplekbeveiliging, LWB) gives to the people working at and around the workplace. Operations in this scenario must be performed in accordance with the requirements, regulations and guidelines stated in the Normenkader Veilig Werken (NVW), the Voorschrift Veilig Werken - Trein (VVW), the Life Saving Rules (LSR), Richtlijn: gedragsregels op spoorwegterrein (RLN00300).

Sub-scenario: UAS operations during a calamity

When performing UAS operations during a calamity there will not be any (normal) train traffic present in the Operational Volume. The treindienstleider (TRDL) will take the necessary measures to ensure the safety of emergency personnel and to prevent danger for travellers and road-users (refer to VVW Notification 4). However there can be high tension on the power lines of the railway infrastructure. Therefore it is only allowed to operate an UAS within the red measurement zone (rode meetgebied) with permission of the Officer on Duty (Officier van Dienst, OvD) and when the UAS is shielded against Electro Magnetic Interference (EMI)

UAS operations during a calamity may only be performed by ProRail (or by ProRail contracted parties) and emergency services (e.g. Police, Fire Department, Rijkswaterstaat, etc.) in accordance with the applicable safety documentation (available at ProRail or partners/contractors of ProRail or at organisations performing activities near the railway terrain). Before starting the operation (outside or inside the red measurement zone) a permission must have been obtained from the Officer on Duty (OvD). The OvD will inform the TRDL, who will inform operators of other track-bound equipment that the UAS operation is taking place.

Operations in this scenario must be performed in accordance with the requirements, regulations and guidelines stated in the Normenkader Veilig Werken (NVW), the Voorschrift Veilig Werken - Trein (VVW), the Life Saving Rules (LSR), Richtlijn: gedragsregels op spoorwegterrein (RLN00300). Permission is required from ProRail when processing any data that is obtained from a UAS operation during a calamity.

General Conditions

SUMMERY OF GENERAL CRITERIA FOR UAS OPERATIONS ABOVE CONGESTED AREAS	
ConOps description	Operator/applicant provides additional details of deviations with a separate SORA to CAA-NL when operations are not fully covered by this narrative.
UAS dimension	Not more than 3 meters
UAS total kinetic energy	< 34 KJ, implying rotorcraft with maximum total mass of 25kg at maximum 120 meters AGL. Kinetic energy depends on mass and speed. In order for the kinetic energy be less than 34 KJ a UAS with a MTOM of 25 kg may not fall at a greater speed than 52 m/s in case of engine failure. This speed is reached when falling from 120 m AGL, if the cross sectional area of the UAS is approximately 0,21 m^2, or 46 cm x 46 cm. Most commercial rotorcraft have a more favourable seize-to-mass ratio, therefore it is safe to claim that the 'typical' kinetic energy of a UAS with a maximum mass of 25 kg at a maximum height of 120 meters, will not generate more energy than 34 KJ.
UAS category	Rotorcraft. In The Netherlands this category is identified by the letter 'H'. Fixed Wing (A) and Other Aircraft (OA) are not considered in this standard scenario in order to meet conditions associated with controlled ground area and staying within 30 meters of an object. Tethered UAS are also not considered in this standard scenario due to additional safety risk associated with the applicable power- and data cables.
Flight conditions	VLOS: For the purposes of this assessment, VLOS is the pilot in command and the person manipulating the flight controls, keeping the UAS close enough to be capable of seeing the aircraft with vision unaided by any device other than corrective lenses, and seeing and avoiding all threats and hazards with a maximum of 500 meters from the pilot. EVLOS: An Unmanned Aircraft System (UAS) operation whereby the Pilot in Command (PIC) maintains an uninterrupted situational awareness of the airspace in which the UAS operation is being conducted via visual airspace surveillance, possibly aided by technology means. The PIC has a direct control of the UAS at all time. EVLOS UAS operations in The Netherlands require a specific approval from the Dutch CAA. VFR: Operations take place in Visual Meteorological Conditions (VMC) during day time (Uniform Daylight Period).
Horizontal (air)speed	Low speed. Speed of UAS that will not result in a crash outside the controlled ground area in case of total (engine) failure.

SUMMERY OF GENERAL CRITERIA FOR UAS OPERATIONS ABOVE CONGESTED AREAS	
SORA airspace class	Atypical Airspace. For the purpose of this assessment Atypical Airspace is defined as airspace where manned aircraft normally cannot go. Therefore, operators shall keep the UAS within 30 meters distance from buildings or structures (objects) to sufficiently mitigate the the risk of encountering manned aircraft.
SERA airspace classes	As atypical airspace implies the risk of encountering manned aircraft is low, the SERA airspace classification scheme has no particular impact on this standard scenario. However, other legal requirements associated with airspace classification still have to be met. UAS operations in class C and D airspace in The Netherlands, require a specific approval from the Dutch CAA.
Area in relation to ground risk class	Operations take place above railways in a populated area or sparsely populated area. Two definitions of an populated area are currently available: - A town, outer suburban, suburban, residential area, urban, metro, city, and/or open-air assembly of people. - Defined as 1⁄2 nm (3038 ft.) buffer around all Urbanized Areas. Urbanized Areas are defined as an area containing an average population of 500 people per square mile (1295 people per square kilometer). A sparsely populated area is defined as: All areas not defined as populated area and not within an airport environment. Current Dutch regulations define a populated area as a Congested Area: an area in relation to cities, towns and settlements that is largely used for housing, economic activity or recreation. If operations take place in close proximity and above an object within an congested area, the requirements stated in the STS CAA-NL CLOSEPROX must be adhered to.

SUMMERY OF GENERAL CRITERIA FOR UAS OPERATIONS ABOVE CONGESTED AREAS	
Ground conditions	Controlled Ground Area The intended UAS operational area only involves active participants (if any) Active participants are those persons directly involved with the operation of the UAS or fully aware that the UAS operation is being conducted near them. Active participants are fully aware of the risks involved with the UAS operation and have accepted these risks. Active participants are informed on and able to follow relevant effective emergency procedures and/or contingency plans. Non-Active participants are those persons who are located near a UAS operation and may or may not be aware that a UAS operation is being conducted. Non-active participants may or may not be aware of the risks associated with the operation and have not accepted these risks.
National regulations	Limitations and conditions in the 'Regeling op afstand bestuurde luchtvaartuigen' (Roabl) are adhered to, amongst which; • Operator - RPAS Operator Certificate - an approved operations manual - insurance against liability • UAS - special Certificate of Airworthiness - Certificate of Registration • pilot - medical certificate - license: RPA-L

Operator Requirements

General

The requirements below are subtracted from the Operational Safety Objectives that resulted from the Specific Operations Risk Assessment (SORA) that was conducted for this Standard Scenario. Many OSO requirements are covered under the current national regulations in The Netherlands related to professional UAS operations; ROC, RPA-L and Special Certificate of Airworthiness. Where this is the case, this will be stated in the 'Implementation' column below. Information about the implementation of any additional mitigation measures is identified by the header "Action:".

Subject	Description SORA Requirement	Implementation
Controlled Ground Area	Within SORA controlled ground area is an input parameter for determining the GRC and not a mitigation. A controlled ground area is defined as the intended UAS operational area that only involves active participants (if any). Controlled ground areas are a way to strategically mitigate the risk on ground; the assurance that there will be non-active participants in the area of operation is under full responsibility of the operator. Operational area, as such, is not defined by SORA. However, the operational volume is, and includes the containment area. UAS leaving the containment area triggers the deployment of emergency procedures.	**Action:** Typical factors in relation to the physical characteristics of the controlled ground area around the railway track shall be addressed in the Operations Manual. Factors that need to be included are (but are not limited to); - Danger zone (A) and proximity zones (B and C) - Location of T/O and Landing area (zone C or further) - (Railway) infrastructure including high voltage power lines - Trains and other track-bound equipment - height above ground (or water) - horizontal speed of UAS - wind speed and direction - the effects of turbulence and the Venturi-effect - the proximity and number of expected (un)involved people The specifics of these considerations and related procedures shall be covered in a section of the Operations Manual dedicated to flights above railways within (sparsely) populated environments.

Subject	Description SORA Requirement	Implementation
Adjacent Area/Airspace Considerations	UAS: - No probable failure of the UAS or any external system supporting the operation shall lead to operation outside of the operational volume. Compliance with the requirement above shall be substantiated by a design and installation appraisal and shall minimally include: - design and installation features (independence, separation and redundancy); - any relevant particular risk (e.g. hail, ice, snow, electro-magnetic interference...) associated with the ConOps. - The probability of leaving the operational volume shall be less than 10^{-4}/FH. - No single failure of the UAS or any external system supporting the operation shall lead to operation outside of the ground risk buffer. Compliance with the requirements above shall be substantiated by analysis and/or test data with supporting evidence. - Software (SW) and Airborne Electronic Hardware (AEH) whose development error(s) could directly lead to operations outside of the ground risk buffer shall be developed to an industry standard or methodology recognized as adequate by the competent authority.	**Partly covered by Dutch regulations related to Airworthiness Requirements.** **Action:** - The Operations Manual must include an instruction and/or procedure that emergency procedures shall be activated immediately when the UA leaves the operational volume. *Note:* The operational volume is composed of the flight geography and the contingency volume. To determine the operational volume the applicant shall consider the position keeping capabilities of the UAS in 4D space (latitude, longitude, height and time). In particular the accuracy of the navigation solution, the flight technical error of the UAS and the path definition error (e.g. map error) and latencies shall be considered and addressed in this determination. - The UAS must be shielded against EMI for operations within the red measurement zone.

Subject	Description SORA Requirement	Implementation
C3 link characteristics (e.g. performance, spectrum use) are appropriate for the operation	For the purpose of the STS the term "C3 link" encompasses: - the Command and Control (C2) link, and - any communication link required for the safety of the flight. UAS: - The applicant determines that performance, RF spectrum usage and environmental conditions for C3 links are adequate to safely conduct the intended operation. - The UAS remote pilot has the means to continuously monitor the C3 performance and ensures the performance continues to meet the operational requirements. Other: - The applicant declares that the required level of integrity has been achieved.	**Covered by Dutch regulations related to Airworthiness Requirements.** *Note:* For operations within a populated area the requirements of STS-CAA-NL-CLOSEPROX must be met.
Safe design	UAS: - When operating over populous areas or gatherings of people, it can be reasonably expected that a fatality will not occur from any probable failure of the UAS or any external system supporting the operation. - A design and installation appraisal is available. In particular, this appraisal shows that: • the design and installation features (independence, separation and redundancy) satisfy the low integrity criterion; • particular risks relevant to the ConOps (e.g. hail, ice, snow, electro-magnetic interference …) do not violate the independence claims, if any.	**Partly covered by Dutch regulations related Airworthiness Requirements.** **Action:** - The UAS must be shielded against EMI for operations within the red measurement zone.

Subject	Description SORA Requirement	Implementation
External services supporting UAS operations are adequate to the operation	Other: - The applicant ensures that the level of performance for any externally provided service necessary for the safety of the flight is adequate for the intended operation. If the externally provided service requires communication between the operator and service provider, the applicant ensures there is effective communication to support the service provisions. Roles and responsibilities between the applicant and the external service provider are defined. - The applicant declares that the requested level of performance for any externally provided service necessary for the safety of the flight is achieved (without evidence being necessarily available).	**Action:** - In case the operator uses an external service other than from governmental entities (e.g. KNMI, LVNL, etc.) the operator shall ensure the information presented by the used resources is correct and reliable. In particular information presented by flight managent applications, when used, shall be considered. - The applicant declares that the requested level of performance for any externally provided service necessary for the safety of the flight is achieved (without evidence being necessarily available).

Operations Manual and Procedures

Subject	Description SORA Requirement	Implementation
Emergency Response Plan (ERP)	Documentation: An Emergency Response Plan (ERP) should be defined by the applicant in the event of loss of control of the operation. These are emergency situations where the operation is in an unrecoverable state and in which: - the outcome of the situation highly relies on providence; or - could not be handled by a contingency procedure; or - when there is grave and imminent danger of fatalities. The ERP: - is suitable for the situation; - limits the escalating effects; - defines criteria to identify an emergency situation; - is practical to use; - clearly delineates Remote Crew member(s) duties. - in case of loss of control of the operation, the ERP is shown to significantly reduce the number of people at risk although it can be assumed that a fatality may still occur. The ERP and the effectiveness of the plan with respect to limiting the number of people at risk are validated by a competent third party. The applicant has coordinated and agreed the ERP with all third parties identified in the plan. The ERP is validated through a representative tabletop exercise consistent with the ERP training syllabus. The representativeness of the tabletop exercise is validated by a competent third party. An ERP training syllabus is available. A record of the ERP training completed by the relevant staff is established and kept up to date. In addition competencies of the relevant staff are verified by a competent third party.	**Mostly covered by Dutch regulations related to Operations Manual and Airworthiness Requirements.** **Action:** - The applicant has coordinated and agreed the ERP with all relevant third parties (ProRail or (sub)contractors) identified in the plan. - The ERP is validated through a representative tabletop exercise (e.g. chronological discussion of steps during a possible incident or accident) between the operator and the contracting party. - The ERP must be in accordance with the calamity scheme in the V&G-plan provided by ProRail (or subcontractor of ProRail). - The representativeness of the tabletop exercise is validated by a competent third party (Dutch CAA). - The ERP must be consistent with the ERP training syllabus. - An ERP training syllabus (explaining how and how often the crew is trained on the ERP) is available. A record of the ERP training completed by the relevant staff is established and kept up to date. In addition competencies of the relevant staff are verified by a competent third party (Dutch CAA).

Subject	Description SORA Requirement	Implementation
VLOS Deconfliction Scheme	Documentation: - The applicant should have a documented VLOS de-confliction scheme, in which the applicant explains which methods will be used for detection, and define the associated criteria applied for the decision to avoid incoming (air) traffic. In case the remote pilot relies on detection by observers, the use of communication phraseology, procedures, and protocols should be described. -In general, all VLOS requirements are applicable to EVLOS. EVLOS may have additional requirements over and above VLOS. EVLOS verification and communication latency between pilot and observers should be less than 15 seconds.	**Actions:** - The documented VLOS de-confliction scheme must be provided to the competent authority (Dutch CAA) for approval.
UAS maintained by competent and/or proven entity (e.g. industry standards)	Staff: - The maintenance staff is competent and has received an authorisation to carry out UAS maintenance. - The maintenance staff use the UAS maintenance instructions while performing maintenance. - A list of maintenance staff authorised to carry out maintenance is established and kept up to date. Documentation: - The UAS maintenance instructions are defined and when applicable cover the UAS designer instructions and requirements. - The maintenance instructions are documented. - A record of all relevant qualifications, experience and/or trainings completed by the maintenance staff is established and kept up to date. - The maintenance conducted on the UAS is recorded in a maintenance log system.	**Mostly covered by Dutch regulations related to Operations Manual and Airworthiness Requirements.** **Actions:** - A list of maintenance staff authorised to carry out maintenance is established and kept up to date (by the contracted maintenance provider). - A record of all relevant qualifications, experience and/or trainings completed by the maintenance staff is established and kept up to date (by the contracted maintenance provider).

Subject	Description SORA Requirement	Implementation
Inspection of the UAS (product inspection) to ensure consistency to the ConOps	Staff: - The remote crew ensures the UAS is in a condition for safe operation and conforms to the approved concept of operations. - The remote crew's is trained to perform the product inspection, and that training is self-declared (with evidence available). Documentation: - Product inspection is documented and accounts for the manufacturer's recommendations if available.	**Covered by Dutch regulations related to Operations Manual and Airworthiness Requirements.**

Subject	Description SORA Requirement	Implementation
Operational procedures	Documentation: - Operational procedures appropriate for the proposed operation are defined and as a minimum cover the following elements: - Flight planning, - Pre and post-flight inspections, - Procedures to evaluate environmental conditions before and during the mission, - Procedures to cope with unintended adverse operating conditions - Normal procedures, - Contingency procedures (to cope with abnormal situations), - Emergency procedures (to cope with emergency situations), and - Occurrence reporting procedures. - Normal, Abnormal and Emergency procedures are compiled in an Operation Manual. - The limitations of the external systems supporting UAS for safe operations are defined in an Operation Manual. - Operational procedures are complex and may potentially jeopardize the crew ability to respond by raising the remote crew's workload and/or the interactions with other entities (e.g. ATM…). - At a minimum, operational procedures provide: - a clear distribution and assignment of tasks - an internal checklist to ensure staff are adequately performing assigned tasks - Operational procedures do not require validation against either a standard or a means of compliance considered adequate by the competent authority. - The adequacy of the operational procedures is declared, except for Emergency Procedures, which are tested.	**Mostly covered by Dutch regulations related to Operations Manual, Crew Qualification and Airworthiness Requirements** **Action:** - Contingency procedures (to cope with abnormal situations) are defined. - The limitations of the external systems supporting UAS for safe operations are defined in an Operation Manual. - The adequacy of the operational procedures is declared, except for Emergency Procedures, which are tested by the applicant (e.g. in a simulated environment or at the Railcenter in Amersfoort). - Procedures for T/O and landing near railway tracks are defined (e.g. zone C or further, "always T/O with wind in the back"). - Procedures to safely "hold" at the passing of a train during manual operations are defined. - Procedures for coordination of operation with person responsible for applicable railway track (e.g. OvD) are defined. - Procedures for informing non-active participants (e.g. signs, and clothing) and checking of controlled ground area are defined.

Subject	Description SORA Requirement	Implementation
Multi crew coordination	Documentation: - Procedure(s) to ensure coordination between the crew members and robust and effective communication channels is (are) available and at a minimum cover: - assignment of tasks to the crew, - establishment of step-by-step communications. - Procedures do not require validation against either a standard or a means of compliance considered adequate by the competent authority. - The adequacy of the procedures and checklists is declared. Staff: - Remote Crew training covers multi crew coordination - Training is self-declared (with evidence available)	**Covered by Dutch regulations related to Operations Manual.**
Remote crew is fit to operate	Documentation: - The applicant has a policy defining how the remote crew can declare themselves fit to operate before conducting any operation. - The policy to define how the remote crew declares themselves fit to operate (before an operation) is documented. - The remote crew declaration of fit to operate (before an operation) is based on policy defined by the applicant.	**Covered by Dutch regulations related to Operations Manual**

Subject	Description SORA Requirement	Implementation
Environmental conditions for safe operations defined, measurable and adhered to	Documentation: - Environmental conditions for safe operations are defined and reflected in the flight manual or equivalent document. - Procedures to evaluate environmental conditions before and during the mission (i.e. real-time evaluation) are available and include assessment of meteorological conditions (METAR, TAFOR, etc.) with a simple recording system. - Procedures do not require validation against either a standard or a means of compliance considered adequate by the competent authority. - The adequacy of the procedures and checklists is declared. Staff: - Training covers assessment of meteorological conditions. - Training is self-declared (with evidence available).	**Covered by Dutch regulations including those related to Operations Manual, Crew Qualification and Airworthiness Requirements.**

Crew Qualification

Subject	Description SORA Requirement	Implementation
Remote Crew Training	Staff: The competency-based, theoretical and practical training ensures knowledge of: a) UAS regulation b) UAS airspace operating principles c) Airmanship and aviation safety d) Human performance limitations e) Meteorology f) Navigation/Charts g) UA knowledge h) Operating procedures - Training is adequate for the operation. - Training is self-declared (with evidence available).	**Partly covered by Dutch regulations related to Crew Qualification.** Current Dutch crew qualification requirements do not include flights over railways in (sparsely) populated areas. **Actions:** - Elements of training related to drone operations above railways shall be included in an internal crew qualification scheme. This training shall include all particulars addressed by this standard scenario (e.g. requirements of RailAlert such as a 'Digitaal Veiligheidspaspoort' or a 'Dagpas'). - The training programme and internal qualification requirements shall be incorporated in the company's Operations Manual.

Additional specifics

Subject	Description SORA Requirement	Implementation
Privacy	If necessary to mitigate risks pertaining to safety, privacy, protection of personal data, security or the environment, arising from the operation, the unmanned aircraft shall have the corresponding and specific features and functionalities which take into account the principles of privacy and protection of personal data by design and by default. Article 1.3 BR Annex IX	**Actions:** - The Operations Manual must contain instructions such that the following requirements on privacy can be fulfilled. To fulfill the requirements of privacy regulation the flight crew will have to take into account article 10 of the constitution. This article states the right to privacy: 'Every person has, in accordance with limitations stated in the law, a right to privacy in his personal environment'. Taking a picture of a person or his/her home or property can be seen as in impeachment of his/her privacy. However if the person agrees to taking a picture the right to privacy is waived. The European General Data Protection Regulation states that personal data is all information about an identified or identifiable person. This means that the information is directly linked to this person or can be linked to this person, e.g. licence plates of cars, addresses, etc. There are various reasons to justifiably process personal data. These could be: - Permission - Fulfilling a legal obligations - Vital interests - Public interest - Legitimate grounds A RPAS operator can process personal data on the basis of fulfilling a legal obligation (contract with a customer). Pictures of persons can in certain cases fall under the category of biometric data and are in this case personal data. Different regulations apply to this and fulfilling a legal obligation as a reason to process personal data does not hold ground in this case. A RPAS operator can make use of a contract with both the owner of an object/building and the user of the object/building, stating that images that show personal data may be processed. The controlled ground area will prevent unauthorized persons from entering the area. This mitigates the risk that people will be recorded against their will. A blurring tool should be used to blur windows, faces, licence plats and other personal data. However the removal of personal data also falls under processing of personal data and therefore a justifiable reason is needed to process this data.

Application for Authorization

Standard Scenarion (STS):

This standard scenario covers the operation of UAS above railways and the associated infrastructure in both rural and congested areas as described in the ConOps. Any part of an operation outside the ConOps and general conditions is not covered by the obtained privilege associated with this standard scenario.

Version: STS-3A-CAA-NL-RAILWAYS-V1.0

Restriction of declaration:

As EU regulations on drones are not implemented yet, Dutch law is still in effect and governing privileges related to the professional use of drones. This implies that a declaration related to this standard scenario, by itself does not qualify the operator to legally operate according this scenario. The privilege must be obtained by extending the existing ROC.

Declaration

With this declaration I assure that all safety measures identified by this standard scenario have effectively been carried out and implemented by my organisation,

Name Accountable Manager:
Name of Applicant/Operator:
RPAS Operator Certificate Nr.:

Signature:

Place: Date: