REPORT

Aeronautical Ground Lighting Design

AGL Substation Design Report

Client: Rijkswaterstaat, Grote Projecten en Onderhoud

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Table of Contents

Table of Tables

Table of Figures

Abbreviations

ADM	Aerodrome Design Manual
AGL	Aeronautical Ground Lighting
ALCMS	Airfield Lighting Control and Monitoring System
ASDA	Accelerate-Stop Distance Available
ATC	Air Traffic Control
ATS	Automatic Transfer Switch
AWOS	Automated Weather Observing System
BES	Bonaire, Eustatius and Saba
BIA	Bonaire International Airport N.V.
BMS	Building Management System (GBS = Gebouw Beheer Systeem)
BON	IATA Airport code for Flamingo International Airport / Bonaire International Airport
CARNA	Civil Aviation Regulation Netherlands Antilles
CAT	Category
CCR	Constant Current Regulator
CMK	Centrale MeldKamer (Central Controlroom)
FAA	U.S. Federal Aviation Administration
FAT	Factory Acceptance Test
GA	General Aviation
HALO	Halogen
HVAC	Heating Ventilation Air Conditioning
HV	High Voltage
I/O	Input/Output
ICAO	International Civil Aviation Organization
ILT	Inspectie Leefomgeving en Transport
LDA	Landing Distance Available
LED	Light Emitting Diode
LV	Low Voltage
MDB	Main Distribution Board
MEB	Main Earth Bar
MEP	Mechanical, Electrical, Plumbing
MV	Medium Voltage
NACO	Netherlands Airport Consultants
PAPI	Precision Approach Path Indicator

PE	Protected Earth
PoR	Programme of Requirements
RESA	Runway End Safety Area
RMU	Ring Main Unit
ROM	Rough Order of Magnitude
RWS	Rijkswaterstaat, Grote Projecten en Onderhoud
RWY	Runway
TODA	Take Off Distance Available
TORA	Take Off Runway Available
TWY	Taxiway
SBD	Sub-Distribution Boards
SLD	Single Line Diagram
SoW	Scope of Works
UPS	Uninterruptable Power Supply
WEB	Water & Energy company Bonaire
WDI	Wind Direction Indicator

Table 1 Abbreviations used in the report

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1 Introduction

Rijkswaterstaat, the executive agency of the Dutch Ministry of Infrastructure and Water Management, has commissioned NACO to design, provide tender support and construction supervision for the implementation of a new Aeronautical Ground Lighting (AGL) system at Bonaire International Airport.

This report describes the design criteria of the AGL substation building.

The current report entails the Concept Final Design Stage, and it is meant to:

- Define the work package scope and limits
- List the applicable standards and codes
- Define the Basis of Design

1.1 Applicable regulations and standards

- Bouwbesluit 2012
- BES code 2018
- Eurocode with Dutch National Annexes
- ICAO Annex 14 Aerodrome Design

1.2 Design Criteria

The design criteria are sub divided in:

- Architectural concept
- Mechanical system
- Electrical system

In the SoW of the Contractor is to notice the design criteria as described in this document to take over the design responsibility and to prepare the execution design (Uitvoeringsontwerp).

The Contractor shall consider when selecting materials, the environmental circumstances e.g. UV-radiation by sunlight, salty air etc.

2 Project Definition

2.1 Scope of Works

The airport is the primary gateway to and from the island of Bonaire. Installing a new energy efficient LED lighting system will accommodate safe air traffic during day and night.

The scope of works for the aeronautical ground lighting at Bonaire International Airport is shown in Figure 2-1.
Part of the scope of works is building a new AGL substation, located at the ATC site as shown in Figure 2-2.
This document describes the design criteria of the AGL building to accommodate the CCR's including all relevant AGL equipment.

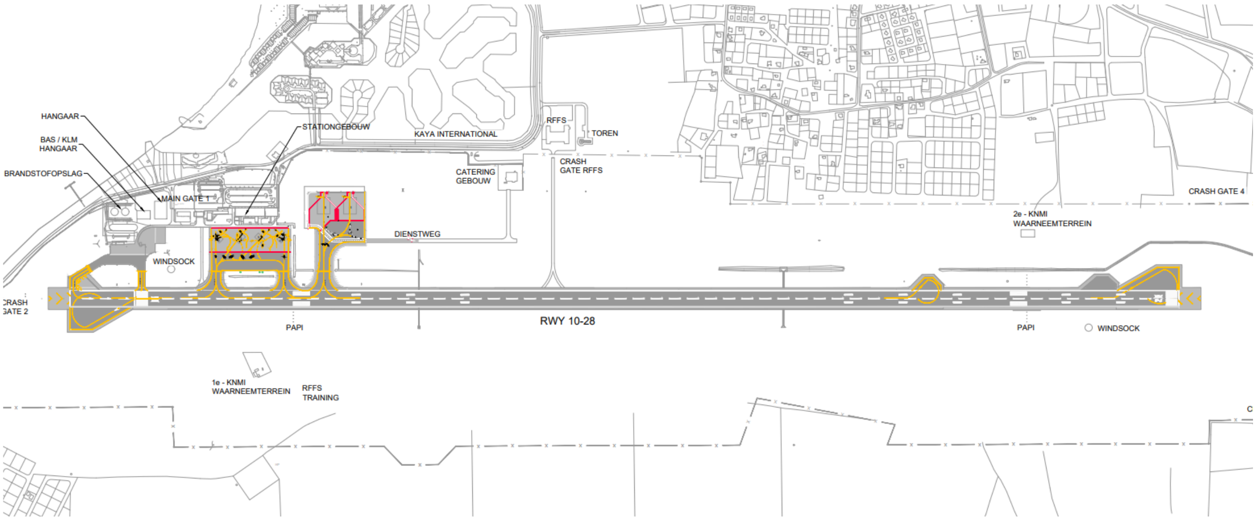

Figure 2-1: Bonaire airport layout

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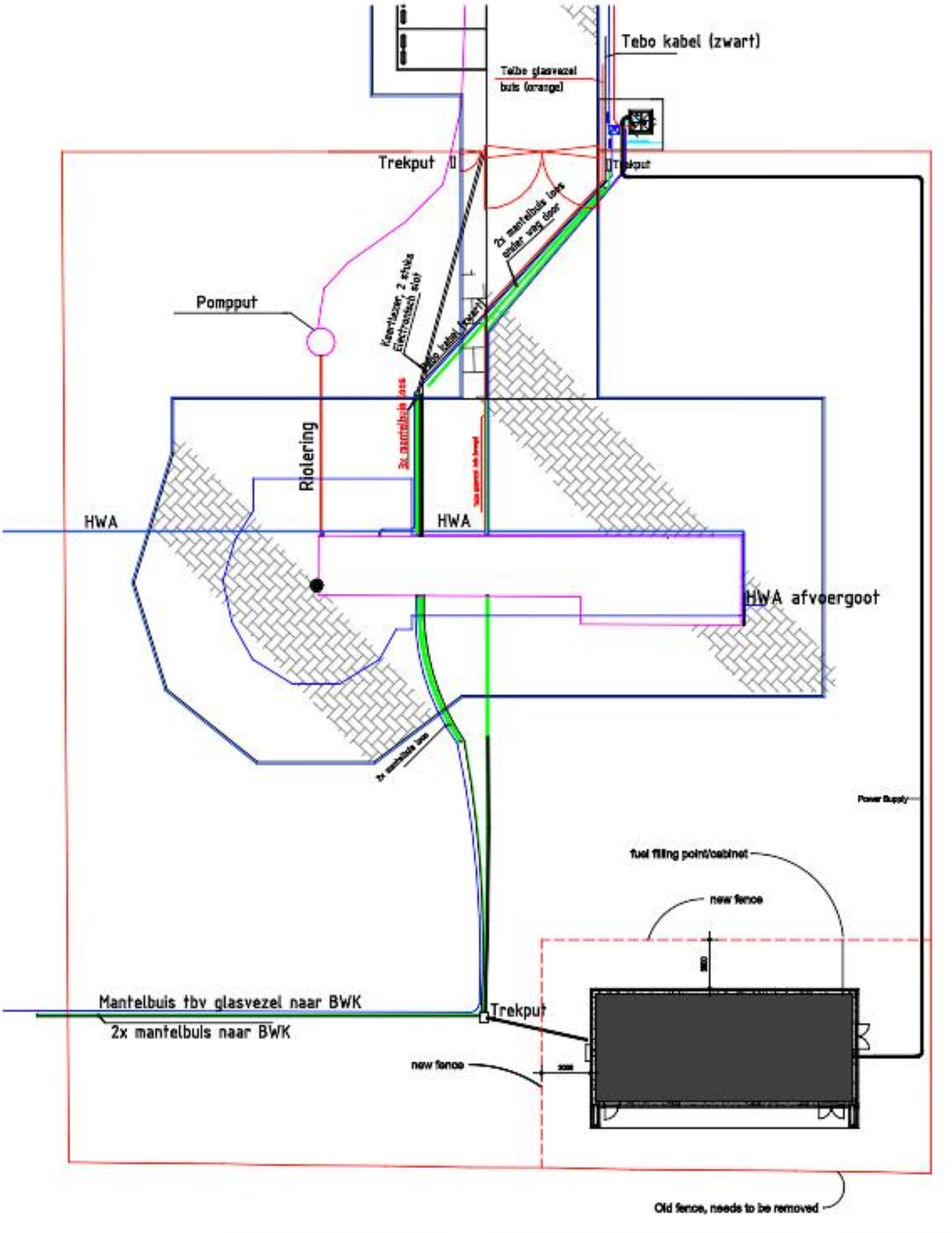
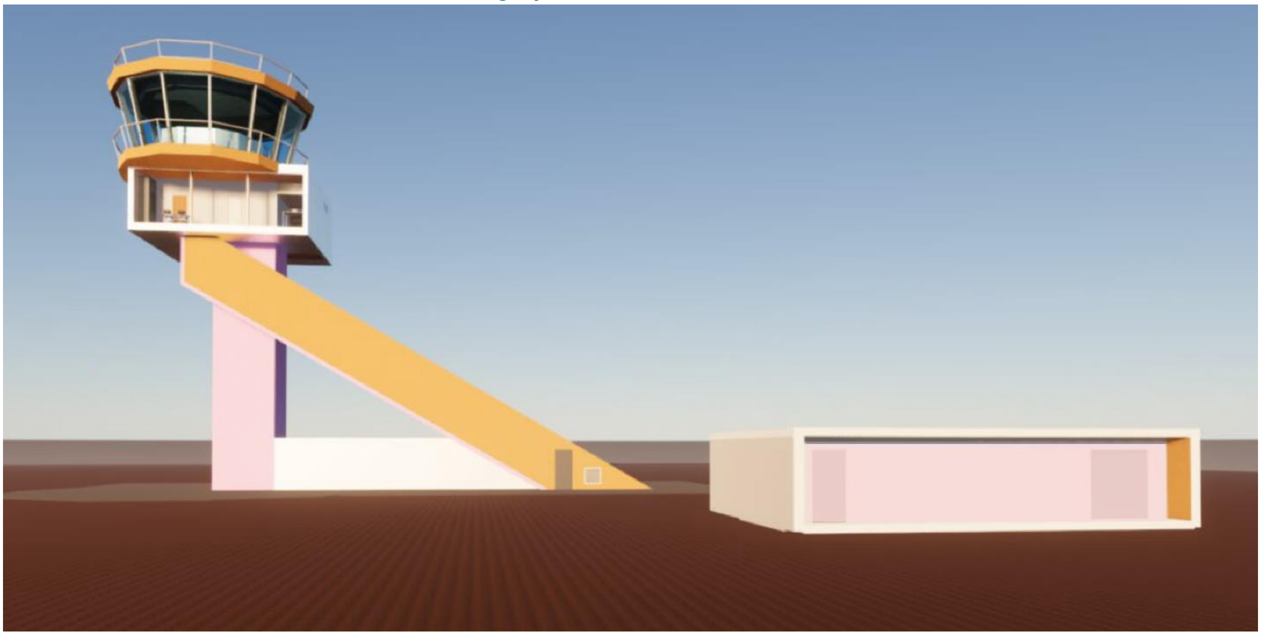


Figure 2-2: AGL substation location ATC site

3 Architectural concept

The ATC tower concept defines the supporting infrastructure of the tower as minimalist utilitarian boxes. The AGL substation will be located on the tower site and will impact the overall appearance.

The AGL substation becomes related to the tower and is defined as another white utilitarian box of supporting infrastructure.
The box that this AGL substation relates to architecturally is the support level box below the visual control room of the tower. The box is raised on a grey toe board.



The AGL substation requires a 400mm raised access floor. The soil conditions are such that it is more efficient to raise the finished floor level, than to excavate the building. This will also improve flooding resilience.
The southern façade is recessed creating a niche; the 2 cooling condensers are to be in the recessed area.

The CCR room is accessible by a double door on the south side. To provide a 2-way escape route in case of an emergency, an escape door is in the south facade.

The Generator room is only accessible from the outside via a double door in the east facade. For inlet air and outlet air, walls/doors shall be provided with louvres.

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3.1 Structural design

3.1.1 General design structure

The ground floor is an in-situ concrete floor slab on grade. Around the edges of the building, an edge beam will be provided as a foundation. Underneath the columns and interior walls, the floor will have a thicker beam to spread the loads in the soil.
Because of a computer floor in part of the building, the structure of the ground floor is not flat. The height difference will be filled with sand, to provide proper support for the floor slab. The thickness of the floor will be 200 mm, with an edge beam around the floor. The edge beam should be 300 mm wide. Underneath the interior walls, a beam with a width of 400 and a height of 400 mm is integrated in the ground floor. Underneath the columns supporting the centre beam, a pad footing of 1000x1000x400 will be integrated in the floor.

Load bearing capacity of foundation is assumed to be at least 150 kN/m^2. This needs to be verified by the Contractor in the execution stage.

The roof will be a concrete slab, supported by concrete beams and a ring beam. The roof has a cantilever. The thickness of the roof slab is 200 mm, the beams below the roof are 200x400 (including roof thickness) The roofbeams are supported by concrete columns 200x400, with 8"-masonry blocks (thickness 200 mm) between the columns. These columns and masonry provide stability for the building.
According to the BES-code, the maximum length of a masonry wall (and therefore the center to center distance of the columns) is 5,0 meters.
The fire resistance of the building needs to be at least 30 minutes.

3.1.2 Reference period and consequence class

The reference period for the substation is 50 years.

Since the building is necessary for electricity in some airport facilities, the consequence class is CC3, and Klasse 4 in the BES-code.

3.1.3 Material properties

The material properties need to be applied according to the Eurocode+National Annex, and BES code
Material properties:

- In situ concrete quality: minimal C25/30
- Prefab concrete quality: minimal C45/55
- Reinforcement: B500-B (in case of earthquake engineering, B500-C is to be applied, according to the BES-code.)
- Masonry blocks wall: 8" blocks. With characteristic strength of blocks >4,5 N/mm^2 and mortar strength >7,5 N/mm^2, this results in f'-rep- = 1,5 N/mm^2
- For the environmental class of the building, the following applies for all concrete elements: XC2, XS1

3.1.4 Deflections and Vibrations

Deflections are to be calculated with load combinations of dead and live loads, all factored with 1,0.
Deflection of horizontal elements
For concrete beams and floors, the allowable short-term deflections under live load for spans < 10 m: 1/333*L

For concrete elements, the allowable deflections for the long term are: Live load + K * dead load < 1/250*L, with K=1,8 for reinforced concrete with a minimum of 0,2% of compression reinforcement
Deflection and sway of vertical elements
For vertical elements, the maximum deflection and sway have the following limits:
Maximum lateral sway of all building is h/500 under design wind or temperature loading.
Railings and guardrails: maximum deflection is L/150 under qh or Fh, with L= horizontal distance between vertical supports, limited to 20mm of both rail and supports.

The structure needs to be able to withstand the vibrations that might be introduced from installations.

3.1.5 Loads

General starting points loads
For CC3-buildings, the following load combinations apply, according to the Eurocode:
Factor KFI: 1,1
Reduction factor ξ: 0,89

	γ_g	γ_q
ULS (equation 6.10a)	1,3 / 0,9	1,65
ULS (equation 6.10b)	1,5	1,65 * ψ
SLS	1,0	1,0

Table 2 Loads
This table includes factor KFI = 1,0 and reduction factor ξ = 0,89

Dead loads
Dead loads of materials need to be taken into account according to Eurocode. The equipment in the building is considered to be dead load.
Ground floor:

- Self-weight of the floor h=200 mm: 5,0 kN/m^2
- Computer floor: 0,5 kN/m^2
- Installations: 20 kN/m^2 (pre-defined areas)

Roof:

- Self weight of the roof h=200 mm: 5,0 kN/m^2
- Finishing, insulation 0,5 kN/m^2

Facades:

- Concrete blocks 8”, thickness 200 mm 5,0 kN/m^2
- Finishing and isolation 0,3 kN/m^2

Live loads on floors
Live loads are loads superimposed by the intended use and occupancy of the building or area such as personnel, movable equipment and material, lateral earth pressures, vehicle, and impact loads. The floor area live load may be omitted from areas occupied by equipment whose weight is specifically included in dead load. Live load shall not be omitted under equipment where access is provided.

For the ground floor, this means the loads around the equipment is:

- Technical rooms (category E according to Eurocode): 5,0 kN/m^2 ($\psi 0$ = 1,0; $\psi 1$ = 0,9; $\psi 2$ = 0,8). Please note the inhousing of heavy equipment should be possible.
- Concentrated live loads on floors, other than the heavy equipment shall be limited by 7 kN (700 kg's) on 150x150mm^2.

For roofs the following live loads apply:

- Roofs (not accessible, only for maintenance) / ponding load: 1,0 kN/m^2 ($\psi 0$ = 0, $\psi 1$ = 0, $\psi 2$ = 0)
- Rainwater on roof, max. 180 mm: 1,8 kN/m^2 (ψ_0 = 0, ψ_1 = 0, ψ_2 = 0)
- Concentrated live loads on roofs: 2 kN, not to be combined with other live loads.

For railings and guardrails, the following live loads apply:

- q_h = 0,75 kN/m horizontal at top rail for stairs and non-public areas;
- F = 1,0 kN in any direction, not to be combined with qh;
- Not to be combined with other live loads.

Wind loads

The BES-code defines a wind pressure based on the 10-minute average wind speed wind, for the reference period of 50 years. For this building, with a height less than 5 meters, qp(z) can be 1,02 kN/m^2.

Hoogte z boven maaiveld	Bonaire 1/50 jaar $q_p(z) = c_e(z) . q_b$ (kN/m^2)	Bonaire 1/100 jaar $q_p(z) = c_e(z) . q_b$ (kN/m^2)	Saba en St. Eustatius 1/50 jaar $q_p(z) = c_e(z) . q_b$ (kN/m^2)	Saba en St. Eustatius 1/100 jaar $q_p(z) = c_e(z) . q_b$ (kN/m^2)
5 m	1,02	1,41	2,86	3,38
10 m	1,12	1,56	3,17	3,74
15 m	1,20	1,66	3,37	3,98
20 m	1,27	1,76	3,57	4,22
30 m	1,35	1,88	3,82	4,51
40 m	1,41	1,96	3,98	4,70
50 m	1,46	2,03	4,12	4,87
60 m	1,51	2,10	4,26	5,04
90 m	1,61	2,23	4,52	5,35
120 m	1,68	2,34	4,75	5,62

Voor tussenliggende hoogten z mag rechtlijnig worden geïnterpoleerd.

Table 3 Stuwdruk op hoogte z

To generate the correct wind load, this value needs to be multiplied by the factor c_{pe} / c_{pi} / $c_s c_d$. For the tables regarding these loads and factors, refer to Eurocode 1991-1-4.

- For this building, the shape factor cscd is set to a value of 1,0.
- For the factor for the internal pressure cpi, figure 7.13 from the Eurocode applies. This usually means that a factor of +0,2 or -0,3 needs to be added to the external factor c_{pe}.
- The factors c_{pe} depends on the shape of the building. For the façades, Figure 7.5 from the Eurocode applies, and for the roof, figure 7.6 from the Eurocode applies. The cantilever needs to be considered with a separate load factor c_{-pe}.

Seismic loads

According to the BES code, the Seismic zone for Bonaire is 2A, which means low seismicity.
The seismic loads can be expressed as a maximum static horizontal load.

The following earthquake loads have to be used in the load combinations:

1. $E_k = \rho{*}E_h + E_v$ for elements in the main structure of the building (local);
2. $E_{k;max} = \Omega_0{*}E_h$ for the whole building (global)

Where:

E_k =	the equivalent static horizontal earthquake load on an element of the structure, resulting from the combination of the horizontal component Eh and the vertical component Ev;
E_h =	the horizontal earthquake load due to the horizontal ground motion;
E_v =	the horizontal load effect resulting from the vertical component of the earthquake ground motion;
$E_{k;max}$ =	the maximum earthquake load that can be developed in the complete structure. Used to check tilting of the whole building;
Ω_0 =	the seismic force amplification factor that is required to account for structural overstrength. For this building, this value is 2,8
ρ =	Reliability / Redundancy factor. For seismic zone 2A, this value is set to 1,0

Table 4 Explanation seismic

To calculate E_h, the value for the base shear is necessary. For seismic zone 2A: $V = C_v * I * W / (R * T)$
This value should not exceed the following: $V = 2,5 * C_a * I * W / R$
This value should not be less than the following: $V = 0,11 * C_a * I * W$
E_v is the horizontal force due to vertical seismic movements. For whole building: $E_v = 0,5 * C_a * I * W$

Earthquake loads needs to be distributed to the various element of the vertical lateral-force-resisting system, in proportion to their stiffnesses.
In the formulas above, C_v is a coefficient for earthquakes according to table 4.2 of the BES code and C_a is a coefficient for earthquakes according to table 4.1 of the BES code. The following values apply:

- The soil profile type for Bonaire is considered to be profile S_D;
- Z = 0,15 for seismic zone 2A;
- $C_v = 0,32$
- $C_a = 0,22$
- For this building, the importance factor I = 1,25;
- W is the sum of the dead load and a part of the live load: $\Sigma G_k + \Sigma\psi 0{*}Q_k$;
- R is a factor depending on the flexibility of the chosen structure. For this building, a factor of 4,5 can be used;
- T is the value for the structure period due to a horizontal movement. T = Ct * (hn)3/4, where C_t = 0,0731 for buildings with reinforced concrete moment-resisting frames, and h_{n} = 4,0 m. That means $T = 0,0731{*}4,0^{3/4} = 0,21$ s

To calculate E_h, the value for the base shear is necessary. For seismic zone 2A:
$V = C_v * I * W / (R * T)$
$V = 0,32 * 1,25 * W / (4,5 * 0,21) = 0,42 * W$

This value should not exceed the following:
$V = 2,5 * C_a * I * W / R$
$V = 2,5 * 0,22 * 1,25 * W / 4,5 = 0,15 * W$

The value for the base shear that has to be taken into account is $V = 0{,}15 * W$

For the substation, the global seismic load is:
$E_h = \Omega_0 * V = 2{,}8 * 0{,}15 * W = 0{,}42 * W$

Rainwater
Accumulation of rainwater: due to possible heavy rainfall a height of 100 mm of water is allowed. This might be taken as an extreme event, not in combination with other live loads and safety factors. This means a live load of 1,0 kN/m^2 needs to be taken into account. To prevent higher amounts of water, the roof insulation will be inclined and needs to have enough provisions like drainage, overflows, etc. The BES-code is applicable for calculating the amount of rainwater on the roof.

Situation	Temperature * ψ[°C]	Temperature[°C]
Summer, outside, no direct sun,	28	40
Summer, outside, direct sun, very light colour (white, light grey, yellow, offwhite)	28	50
Summer, outside, direct sun, light colour (ochre, beige, grey, green, light blue	28	60
Summer, outside, direct sun, dark colour (black, blue, brown, red)	28	75
Summer, inside	28	40
Winter, inside / outside	Not applicable	Not applicable
Elements in soil	22	22

Table 5 Temperature

For calculating the drainage and emergency overflows, the rain intensity at Bonaire: it = $0{,}1*10^{-3}$ m/s

Temperature
For Bonaire, the temperatures from the BES-code need to be taken into account. For the situation during built, additional measures might be necessary.

Calamities, incidental and Special loads
Calamities: For the structure of the building, the design must be such that no progressive collapse of non-affected parts could occur, based on the requirements in de Eurocode. This is achieved by providing robust connections.

3.2 Functional design

3.2.1 CCR-room

The room/area where the cabinets are located, a raised floor (computer floor) shall be installed. Top of finished raised floor level must be equal to finished floor level of surrounding rooms/areas. Part of the room is reserved storage of spare parts and workshop.
The functional floor area will be approximately 81 m2

3.2.2 Generator room

For power back-up, a generator room is added to the floor plan. This room shall house a generator including diesel fuel tank (2.000 l).
The functional floor area will be approximately 20,6 m2.

3.3 Site facilities during construction

A construction site plan with location of (temporary) access roads, site equipment such as site fences (including gates), site huts, sanitary facilities, temporary connections, construction material storage, temporary parking personnel, waste containers etc. is part of the SoW.

3.4 Ground works

Earth works
All earthworks and excavations (including rock removal, back filling, compacting/soil stabilisation) required to construct the foundation, building and cable trench from existing draw pit PP0 towards new building and trench for the Low Voltage Feeder cable, are part of the SoW.
When excavating, take into account the presence of existing cables in conduits, pits and light pole.

Fencing
The current fence shall be partly dismantled facing the airside. new fencing will have to be erected around the building at min. 3 meter. The fencing must meet the same requirements as the current fencing on the tower site. Dismantling and new fence is part of the SoW.

3.5 Building envelope

3.5.1 Building physics

The CCR room will be air conditioned. For energy savings, the building envelope shall be insulated with a hard dense insulation layer (100 mm PIR) on the outside of the structure (walls and roof).
Internal condensation inside façade- and roof-construction must be avoided.

3.5.2 Materials and finishes

Main Structure
The main bearing structure will be a combination of reinforced concrete columns/beams with enclosed masonry and a reinforced concrete roof deck on reinforced concrete foundation slabs and beams.
Reinforcement in the concrete structure must be connected to the lightning protection.

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Walls
Outer walls will be locally produced concrete blockwork (200mm), fair faced brickwork on both sides.
On the outside, outer walls shall be insulated with 100mm PIR, with stucco finish (strikolith or equal), white (RAL9010).
The wall in the recessed facade on the south side will be pink (RAL3015), matching the ATC tower.

The inside wall between CCR room and Generator room will be 60 minutes WBDBO (fire flashover and fire transfer), according to NEN6068.

Toe board around the building will the grey.

On the inside, the fair faced concrete brickwork walls shall be painted white (RAL9010).

All wall and façade finishes must be suitable for the local climate.

Doors
All doors and door frames (including hardware) will be metal/steel. Colour doors and frames will be equal to the colour of the wall of installation.

- Escape door will be equipped with panic hardware.
- Double entrance door to CCR room will be equipped with electronic locks with access control
- Double entrance door to the Generator room will be equipped with mechanical locks

All finishes of doors and doorframes including hardware must be suitable for the local climate.
All doors and doorframes including hard ware and finishing, must comply with the Dutch VMRG quality directives and standards.

Air louvres
Air louvres in the generator room according generator requirements will be metal/steel. Colour louvres equal to the wall of installation.

Air louvres finishes must be suitable for the local climate.

Ground floor
The ground floor will be an in situ made, reinforced concrete floor. Partly the ground floor will be recessed to create space below the computer floor.
Where the ground floor level = 0, a screed floor 50mm will be made. This screed floor will be finished with a suitable floor coating, colour grey.

In the CRR room, a demountable computer floor with self-supporting sub steel structure will be installed. Tile grid is 600x600mm. The load capacity of the computer floor will be at least 20kN/m2. Tiles will be finished with a PVC finish.

Roof
The roof deck will be a reinforced concrete floor. The roof will be covered with a sloped insulation layer (PIR), finished with a watertight, white layer of TPO roofing, suitable for the local climate, mechanically fixed.
(Alternative: cement screed slope with regular roofing insulation).
Al connections of the roofing material to the roof edge and potential roof penetrations, must be water tight.
The roof covering must be flame-resistant according to NEN6063.

Water drainage of the roof by 2 city spouts in the west and east facade. Drainage pipes will be recessed in the walls.
Capacity of roof drainage to be determined by contractor.

The roof will be equipped with safety life lines for safely carrying out future maintenance works.
For safe access to the roof, a safety ladder bracket will be mounted near the roofedge to safely secure an access ladder. The safely ladder is also part of the scope and must be stored inside the building.

Penetrations
All wall, floor, roof and foundation recesses/penetrations for installations (such as, but not limited to: high and low voltage cables, conduits, generator provisions) must be sealed off watertight and where applicable, 60 minutes WBDBO, according to NEN6069.

4 Mechanical system

The systems described in this chapter, include:
- Storm water drainage
- Sewage
- Fire Fighting
- Cooling System + I&C

4.1 Storm water drainage

Storm water is drained from the roof of the AGL building (and surrounding pavements when if not naturally absorbed by adjacent ground/'green' strip).
By minimal 2 downspouts the water should be carried of from the building to just above ground level and drained to the adjacent unpaved area where it infiltrates.
Downspouts to be integrated within the wall construction. Current intended roof slope is towards te wall (lowest point) between the building and the roof overhang. Outlet openings should direct the outflow water in the right direction.

Emergency roof overflows should be included if roof ballast could be too high during a blockage of the downspouts.

The storm water drainage shall be designed according the Dutch NEN 3215 and NTR 3216. The design capacity of storm water for the drainage system should be calculated based on the area and the max. rain intensity with an occurrence of ones in 10 years in Bonaire.

4.2 Sewage

The sewage system of the AGL building incorporates the drainage of condensation water from the cooling Computairs to outside the building at appropriate location(s) (infiltrating in adjacent ground/green strip).
Provisions should be incorporated to prevent a backflow of any water through the computairs and the entry of mice, insects etc. The design should minimize the risk of leakage within the server room (location, materials, connections, etc). Indoor piping should be insulated (vapor proof) if condensation at the pipe surface could occur.
To prevent undesirable (fragrant) infiltration air, Syfon(s) should be included in the system.
Fire resistant building penetrations to be executed in accordance with building requirements and standards.
Condensation pumps to be applied if necessary to get rid of the water.
Piping to be placed out of sight where possible and should fit within the building esthetics.
The sewage system shall be designed according the Dutch NEN 3215 and NTR 3216.

4.3 Fire Fighting

The CCR room and NSA room will be equipped with several fire extinguishers, placed at strategic locations. Each of them has a minimal capacity of 6L.
Firefighting shall be designed according to local standards and in dialogue with the local fire officer.

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4.4 Cooling System and I&C

This chapter describes the cooling and control system of the server area.

4.4.1 Design conditions

Property	Value
Indoor temperature (adjustable)	21,0 °C (achievable when people present)
Outdoor condition for building heat & moisture load	33,0 °C dry bulb and 26,7°C MC wet bulb. Sky solar irradiance: 1.000 W/m2 (horizontal)
Outdoor design temperature for cooling condensors	35,0 °C
Minimum additional required spare capacity in the outdoor condensers.	7,5%
Internal heat load of equipment & lighting	13,5 kW $_{(th)}$ (including future spare CCR's)
External (envelope) heat load	To be calculated based on outdoor design conditions and building physics.

Table 6 Design conditions

4.4.2 System description

The server area should be equipped with two (separate) Close Control Units (Computairs) with each its own outdoor cooling condenser and refrigerant network.
These cooling systems should be selected based on **2x50%** of the maximum cooling capacity based on the design conditions as mentioned in previous section (**plus 7,5%** for the outdoor condensers).
The netto cooling capacity should fit these loads, including some latent load due to air condensation.

Fabricate of the Cooling systems: Mitsubishi Electric IT Cooling Systems
Units specs including: inverter technology, EC-fans (both indoor and outdoor units), remote user terminal and interface electronic board.
Indoor unit type as downflow version with floor tile air grilles or front displacement if cooling air is equally distributed through the room.
Outdoor units as vertical airflow microchannel units (with EC-fans with controller) with coating and suitable for very corrosive environments (C5-I according to ISO 12944)
Controls of both cooling units should be connected to each other for backup functionality, optimum part load performance and failure communication.

The cooling systems should be connected and integrated in the overall automation system for the exchange of the following parameters: indoor temperature, malfunctions / alarms, operation mode.

Piping and cabling to be installed proper, robust and correctly (out of sight if possible and still maintainable).
Proposed locations of indoor and outdoor cooling units are visualized on the layout.
Outdoor condensers will be located on the floor below the roof overhang (not at the roof for hurricane risk).
To minimize an air short circuit at the outdoor condensers, guide plates should be installed above the horizontal condensers till the front of the roof overhang to guide the warm air trough above the building instead of against the ceiling. Guide plates should fit within the esthetics,robust and resistant to the local climate.

5 Electrical Systems

The systems described in this chapter, include:

- Power supply and distribution
- Emergency power
- Earthing
- Lightning system
- Cableways
- Lighting and emergency Sewage
- Communication system
- Safety systems
- Security systems
- Fault signals and visualization

5.1 Applicable regulations and standards

The European and Dutch regulations and standards but at least:

- NEN 1010:2015
- NEN-EN-IEC 60439
- NEN 2535
- NEN 2575
- NEN-EN 12464-1
- NEN-EN 1838
- NEN-EN-IEC 62305
- NEN-EN 50173
- NEN-EN 50174
- ICAO Annex 14 Aerodrome Design and Operations
- ICAO Aerodrome Design Manual Electrical System part 5

5.2 Power supply and distribution

The power demand of the AGL substation is 80kW/200A.
The voltage level is 230/400V-50Hz

The building shall be connected to the transformer station via an underground cable. The transformer station is located near the entrance of the tower area as shown in Figure 2-2. At the transformer station an outgoing circuit is available. The Contractor is responsible for the coordination with power supplier WEB to get a power connection. All costs involved shall be covered
A main distribution board (MDB) with integrated ATS shall be installed in the AGL substation to supply power to all consumers e.g. general 230V sockets, connection to CCR’s, connection to data cabinet, fire alarm panel, door controller. Each CCR shall be equipped with a maintenance switch at or nearby the CCR.

Minimum specification MDB:

- Free standing switchboard on frame
- Construction form 3b
- TNS-system - 250A
- Outgoing circuits on terminals

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- Incoming feeder from the bottom
- Outgoing cables from the bottom
- With digital meter with communication port
- 20% spare space

5.3 Emergency power

In case of failure of the primary source of power, electric power supply connections for which secondary power is required shall be automatically connected to the generator via an ATS in the MDB.

This secondary power supply must ensure a switch-over time less than 15 seconds for all lighting aids The backup power by a generator will take over the total power demand of the AGL substation.
The capacity of the generator will 80kW/110kVA and shall have a fuel day tank integrated in the base for 8 hours.
A storage fuel tank shall be installed with a capacity for 72 hours/2000 liter.
The storage tank consists of double-walled tank including valves, pumps, low level sensor and interconnection piping between fuel tank and generator and refill cabinet. The storage tank shall be installed on same level as generator.
The generator shall be an indoor type with all necessary arrangements.
Anti-vibration mounts between base and generator set.
Air outlet duct with louvres, air inlet louvres. The louvres required for air outlet and air inlet shall also protect the room from salty air and sand during stand-by of the generator.
The louvres will open during generator operation.

In case of failure of the primary source of power, electric power supply connections for which secondary power is required shall be automatically connected to the generator.
This secondary power supply must ensure a switch-over time below 15 seconds for all lighting aids, meeting the requirements detailed in the table below, extracted from ICAO Annex 14, section 8.1 for a non-precision approach runway.

To refill the fuel tank there shall be refill cabinet including drip box at the fence of the ATC site.

The following malfunctions/status signals by means of potential free contacts (fail save) shall be connected to the ALCMS system for visualisation on the control screens.

- WEB network in operation
- Generator in operation (failure WEB)
- Malfunction Generator set
- Fuel tank level low

Runway	Lighting aids requiring power	Maximum switch-over time
Non-instrument	Visual approach slope indicators[a] Runway edge[b] Runway threshold[b] Runway end[b] Obstacle[a]	See 8.1.4 and 8.1.9
Non-precision approach	Approach lighting system Visual approach slope indicators[a, d] Runway edge[d] Runway threshold[d] Runway end Obstacle[a]	15 seconds 15 seconds 15 seconds 15 seconds 15 seconds 15 seconds
Precision approach category I	Approach lighting system Runway edge[d] Visual approach slope indicators[a, d] Runway threshold[d] Runway end Essential taxiway[a] Obstacle[a]	15 seconds 15 seconds 15 seconds 15 seconds 15 seconds 15 seconds 15 seconds
Precision approach category II/III	Inner 300 m of the approach lighting system Other parts of the approach lighting system Obstacle[a] Runway edge Runway threshold Runway end Runway centre line Runway touchdown zone All stop bars Essential taxiway	1 second 15 seconds 15 seconds 15 seconds 1 second 1 second 1 second 1 second 1 second 15 seconds
Runway meant for take-off in runway visual range conditions less than a value of 800 m	Runway edge Runway end Runway centre line All stop bars Essential taxiway[a] Obstacle[a]	15 seconds[c] 1 second 1 second 1 second 15 seconds 15 seconds

a. Supplied with secondary power when their operation is essential to the safety of flight operation.
b. See Chapter 5, 5.3.2, regarding the use of emergency lighting.
c. One second where no runway centre line lights are provided.
d. One second where approaches are over hazardous or precipitous terrain.

Table 7 Secondary power supply requirements

5.4 Earthing

The PE protected earthing is coming via the feeder cable from the transformer station of WEB.
In the AGL substation a MEB shall be installed nearby the MDB.
The MEB shall connect the MDB, piping entering the building, cable tray, computer floor and outdoor ring of the lightning system.

5.5 Lightning system

The AGL building shall have a lightning system on the roof, with at four corners a down conductor.
The down conductor is connected to an earth electrode in an earth pit. An outer ring shall be installed at 2 meters from the façade and to be to connect the earth electrode in the earth pits and to be connected to the MEB.
The lightning system shall have a minimum protection level LPL III.

5.6 Cable ways

To install several cables into the computer floor cable tray and cable baskets shall be installed.
The cableways consist of cable trays for HV circuit cables and cable baskets for LV power cables and communication/signal cables.

5.7 Lighting and emergency lighting

The lighting in the building shall be of indoor lighting fixtures in the CCR room and water tide lighting fixtures in the Generator room.
Switching the lighting by manual switches indoor at the entrance of the room.
The lighting level shall be 500 Lux.

Emergency lighting
Both rooms, emergency lighting fixtures with one hour battery back-up shall be installed.
At the exits and emergency exit an emergency lighting fixture shall be installed above the door inside the room. At the emergency exit an emergency lighting fixture shall be installed outdoor above the door.
Consider the CCR-room as an electrical room.

5.8 Communication system

The building shall be executed with a structured cabling system CAT6A which consists of at least:
Data cabinet with OF patch panel and RJ45 patch panel with sufficient spare space.
Indoor data cabling type CAT6A with CAT6A RJ outlets.
The power analyser and ALCMS system shall be connected with a CAT6A cable only.
The data/telephone system shall be connected/integrated to the existing IT network of the airport.
Integration into existing IT system shall in the SoW of the Contractor including the coordination with IT department.

5.9 Safety system

5.9.1 Fire alarm detection and evacuation system

The building shall be executed with a fire alarm detection and evacuation system based on a Programme of Requirements (PoR). Preparation the PoR shall be part of the SoW of the Contractor including obtaining approvals and signatures.
At least the CCR- and generator room must be equipped with multi smoke detector to detect smoke as well as heat.
The fire alarm shall be connected to the existing EAL security system in the control tower to visualize the fire alarm at the BIA security desk in the terminal including an acoustic alarm.

The fire alarm shall also be connected to the ALCMS system to visualize a fire alarm and mal function fire alarm system at the maintenance department

5.9.2 Temperature control

A separate temperature monitoring shall be installed in the CCR room. If the measured indoor temperature will exceed a certain level (temperature too high) an acoustic alarm should activated in the room but should also generate an alarm at the maintenance department and BIA security desk.

5.10 Security system

5.10.1 Access control system.

The main entrance shall be equipped with a card reader and all doors shall be equipped with door contact the monitoring the status (open/close) of the doors.
This access control system shall be integrated into the existing access control system EAL of the airport.
For the execution of the works coordination with the security department of the airport is in de SoW of the Contractor.
Information and communication must be kept strictly confidential.

5.11 Fault signals and visualization

For operational and maintenance purpose several systems shall be monitored by the maintenance department.
The following fault/status signal shall be visualized on a remote screen of the ALCMS system in the maintenance department:

- WEB network failure
- Generator operation
- Generator unit malfunction
- Fuel tank level low
- Airconditioning units malfunction
- Temperature too high in CCR room
- Fire alarm
- Fire alarm system malfunction

The fault/status signals shall be connected to the ALCMS-system as a potential free contact (fail save).
Alignment and execution in close cooperation with supplier of the ALCMS system.

6 Commissioning and hand over

The Contractor shall commission the building and its MEP utilities prior to the final commissioning with the Client.
During the execution of works the Contractor shall inform the Client five days in advance when executing tests which need be witnessed by the Client e.g. megger power cables, testing OF and data cables, FAT MDB.

When the Contractor is ready to do the final commissioning, the Contract shall inform the Client two weeks in advance and shall submit the commissioning documents to the Client/representative of the Client.

All costs related to the commissioning and handover shall be covered in the quotation of the Contractor.

After the final commissioning the Contractor shall resolve all outstanding items within two weeks and report in written with evidence that all issues have been resolved.

All handover documents e.g. as built drawings, test reports, installation and maintenance manuals, product sheets, overview of all material with brand, type, order number and description.
Part of the handover document is a description of each system.

7 Guaranty and warranty

The Contractor shall give guaranty for 12-months on all products and 12-month warranty on each system. This 12 month means after system in operation and maximum 15 month after leaving the factory/supplier.