PROPRIETARY

OYSTER PROJECT

Civil Design Requirements

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RID will release this document with purpose AFC (Approved for Construction) after the detailed engineering in Phase 2 is finalised and approved.

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HYUNDAI ENGINEERING & CONSTRUCTION
HYUNDAI ENGINEERING CO., LTD.

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Oyster Project Delft
Basis of Design

Hyundai Engineering Co Ltd

10 July 2015
Final Report
BD4376

Royal HaskoningDHV
Enhancing Society Together

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1 INTRODUCTION

1.1 General

Hyundai Engineering & Construction is awarded the design & construction contract for optimization and upgrade of the existing facilities of the Reactor Institute Delft (RID). Hyundai Engineering and Construction is a major construction company in South Korea and carries out projects all around the world. HEC provides engineering services for process plant, power plant, infra structures and environmental sectors. Having the relevant expertise on nuclear installations KAERI/Hyundai Consortium (KHC) won this contract and searched for a local consulting company in the Netherlands. HaskoningDHV Nederland B.V., hereafter Royal HaskoningDHV, is delighted to be selected as their partner in this project.

1.2 Scope of the BoD

This Basis of Design (BOD) contains the basic technical information for the Oyster Project to progress to subsequent phases of project development, i.e. development of the basic and detailed design.

This BOD provides a general description of the project and defines the site conditions and basic design data.

The specific design and engineering services which will be prepared by Royal HaskoningDHV are listed below:

a) Architectural design in co-operation with lead Architect RID
b) Structural Design including Geotechnical Investigation and Interpretative report
c) Mechanical & Electrical and Plumbing
d) HVAC
e) Civil & External works (limited to the area around the CNS building)
f) Assistance to prepare the Cost estimate

For a detailed description of the services see the reference documents.

The Project Plan described the general execution of the project in terms of project management, coordination and communication whereas the BoD contains the technical information to execute the engineering services.

1.3 Reference documents

General reference in this document is made to the following documents

- BD4376 Hyundai-ROYAL HASKONINGDHV service agreement Oyster Project Delft - signed
  This final contract is based on the following documents:
  - HEC's RFQ for Civil & Building Engineering Works, Doc. No. OST-CA-DP-001, Rev.4, November 19, 2014
  - The submitted proposal "BD4376 Hyundai Oyster proposal -rev 4 " with reference BD4376/R00100/600151/Rott, 25 November 2014
  - Comments on ROYAL HASKONINGDHV's Proposal & answers 2014-12-16

1.4 Document status

This basis of design is a document that will be up-dated in the start-up phase and basic of design phase of the project. After the Basic Design phase the document is frozen and will only be changed on behalf of a change request by the client.

The table below shows the record of issues, changes and amendments.

Issue	Date	Description
P0	08.04.2015	For approval
P1	22.05.2015	Final Basis of Design
0	10.07.2015	Final document Basic Design phase

2 PROJECT DESCRIPTION

2.1 Site location

The site is located in the western part of the "Zuidpolder van Delfgauw" within the boundaries of the city of Delft.

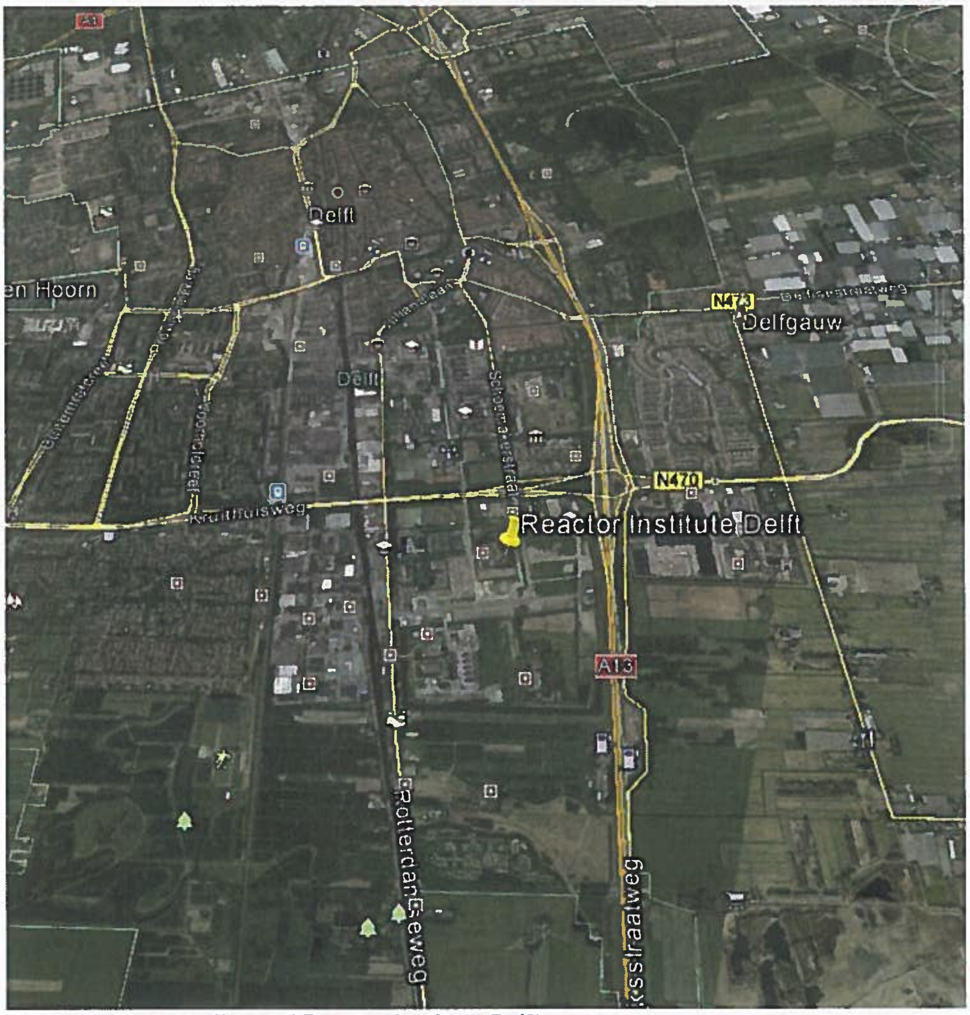

Figure 1 - Surroundings of Reactor Institute Delft

Figure 2 - Detail location

2.2 CNS facility location

The CNS facility will be located between the North Wing of the offices building and the Reactor Hall.

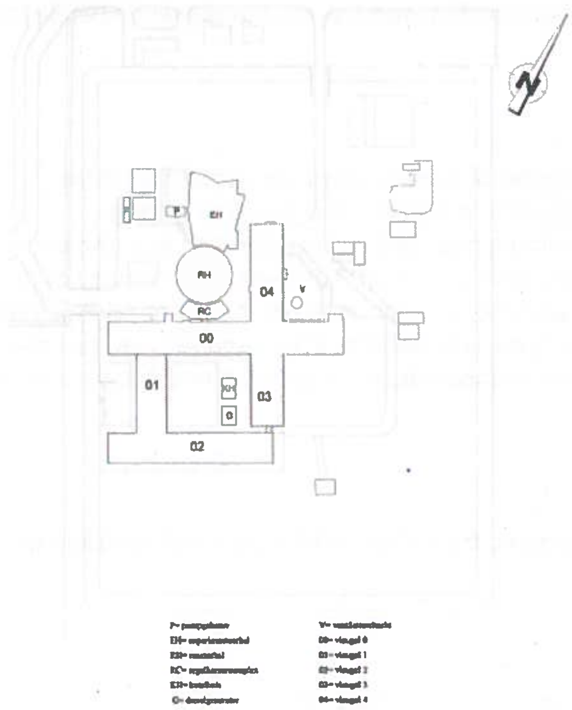

Figure 3 - Facility location

3 BASIC DESIGN INFORMATION

3.1 General

In this chapter the basic design information is described. For the project a SAR (Safety Analysis Report) and CSA-HOR (25-04-2013) (Complementary Safety Assessment report) have been drafted. Basic applicable data as terrain, seismicity and environmental conditions has been extracted and used in this document. Additional data has been supplemented in case required. The Dutch Building code is applicable to the design of the works including specific requirements of the RID.

3.2 Site Conditions

3.2.1 Terrain

Ground level (Maaiveld) is Reactor Hall Floor level : -1.20 m NAP
Ground Water level RID site : -2.80 m NAP.
The ground water level is controlled by electric pumping stations of the Delftse Schie.

3.2.2 Foundation

Geotechnical investigation report of the nearby Experimental Hall is present at the time of drafting this basic of design.

The top soil consists of Clay and Peat layers till a depth of approx. -10.00 m NAP. From -10.00 m NAP till -15.00 m NAP Sandy layers are present followed by Clay and Peat layers till -18.00 m NAP. Underneath this level firm sand layers are present suitable for installing foundation piles.

3.2.3 Seismicity

The CSA-HOR report, 31-05-2013 v2 contains a comprehensive evaluation of the seismic risk to the containment building and the reactor. The site area itself is considered to be non-seismic. The maximum peak ground acceleration that can occur at the HOR site is 0.22 m/s 2 according to data from KNMI. The area in the vicinity of the HOR is considered an area with a low seismic risk. According to the Dutch NVR 3.1 and the IAEA guideline SSG-9 (see 2.2.1.1.1) nuclear facilities in an area with low seismic risk have to be designed to withstand an earthquake with a peak ground acceleration of at least 1.0 m/s 2.

3.3 Environmental Conditions

Basic data of climate conditions are gathered from CSA-HOR report and specified as follows.

3.3.1 Air temperature

Highest temp measured on July 9th 2010	35.0 °C
Lowest temp measured January 7 1985	-17.4 °C

3.3.2 Precipitation

According to the statistics of the KNMI, in the Netherlands once in 10 years a rainfall of 50 to 62 mm will occur in some place. During the summer period it is possible that locally more than 100 mm rain can fall. The largest recorded amount of rainfall in one day in Delft is 77 mm on 14 September 1998.

3.3.3 Heavy snowfall

On average, occasions of more than 20 cm of snowfall occur once every 10 years and more than 35 cm occurs once every 50 years. In the design of the CNS building the Eurocode including National appendix shall be followed. The new CNS building will have a roof rim height of approximately 14.15 m which is substantially higher than the adjacent office block North. Due to this a higher snow load shall be imposed on this existing structure. The design of the roof structure shall be checked on this higher snow load, however this structural check including any adjustments to the roof structure of the office block is not part of the scope of the works of Royal HaskoningDHV. The text above serves as reminder and point of attention to the KHC. In a next phase of the project this issue should be discussed with RDI.

3.3.4 Wind

In the CSA-HOR report the following evaluation on extreme wind conditions are given.

Extreme wind speed
The highest wind speed measured is 23.7 m/s on 25 January 1990. Research shows that the maximum wind speed (hourly average) that can be expected once every 10,000 years is approximately 35 m/s.

Wind gust
A wind gust is a sudden, brief increase in speed of the wind. The duration of a gust is usually less than 20 seconds. KNMI has determined that the maximum wind gust is roughly 1.5 times the maximum hourly average wind speed. At a wind speed of 35 m/s, this results in a maximum wind gust of 53 m/s once every 10,000 years on average. The highest wind gust measured is 41.7 m/s on 25 January 1990.

Whirlwind
The highest wind speed that was observed by a monitoring station due to a whirlwind in the Netherlands is 56 m/s. On average, each year about two whirlwinds cause some damage to the infrastructure somewhere in the Netherlands, over an area of one square kilometre. It is estimated that for a random location in the Netherlands, the risk of damage by a whirlwind is 10^{-5} per year.

For the design of the CNS utility building the Eurocode on wind loads is applicable.

4 STANDARDS, REGULATIONS AND GUIDELINES (ACS)

4.1 Architectural

4.1.1 Architecture

The primary use of the building is industrial. It consists of three separate areas:
Access to the building on ground floor level

- Equipment room for vacuum box, N2 buffer tank on first floor;
- Equipment room including, electrical room and control room for not permanent occupancy of two controllers on the second floor.
- Roof level with Chillers and Helium buffer tank.

The architectural appearance of the CNS building will be developed by RID in cooperation with RHDHV.

4.1.2 Basic architectural finishes

Table 1 - Basic architectural finishes

	Floor	Wall	Ceiling	Remark
Ground floor area	Entrance concrete floor with epoxy coating. Outside area, pavement		Open to structure Water based epoxy coating	
First floor	Concrete floor with epoxy coating	Insulated wall finishes	Open to structure, water based epoxy coating	
Second floor equip. area	Concrete with epoxy coating		Open to structure, water based epoxy coating	
Second floor control room	Concrete with epoxy coating + Raised floor system		Open to structure, water based epoxy coating	
Roof floor	Concrete + insulation + water proofing (bitumen or pvc)			Concrete tiles for pavement

4.2 Passive fire safety

The fire safety of the building shall comply with the Dutch Building Code. Next to that, the RID or other parties can have complementary requirements regarding this subject. These are listed below. The firefighting strategy (passive and active) has to be considered with the fire brigade and the installer (i.e. Ascom).

4.2.1 Fire resistance

Because of the small area and almost no occupation of the building, this building has not to be divided in multiple fire compartments conform the Dutch Building Code.

The fire resistance between two fire compartments shall be 60 minutes. When no floor of an area for use is more than 5 meters above ground floor, it can be reduced to 30 minutes. Since a technical room is not considered as an area of use (Dutch Building Code), 30 minutes can be applied to this building unless other requirements prevail.

Below the building the fire brigade route is located for the other buildings on the site. Besides, RID indicated that towards buildings with a higher risk (the Dome and the lab), they prefer 60 minutes fire separations. Therefore, only the short facades and a part of the floor shall be 30 minutes fire resistant, while all other partitions/walls/floors have to be 60minutes fire resistant. Special care has to be taken to pass through applications, doors, shutters or other openings, which shall have the required fire resistance.

The rabbit system is not part of the technical building. It is decided to place a 60 minute fire barrier around the total rabbit system. In that way, the system is no part of the fire compartment of the building and does not need any fire separations itself.

4.2.2 Escape routes

No requirements regarding maximum walking distances during evacuation are set for this building, because a technical room is considered not to be an area of use. However, the following requirements for an escape route will be applied to this building:

- Because of a low occupancy the maximum walking distance is 60 meters
- The width of an escape route has to be at least 0.85 meters
- The height of an escape route has to be at least 2.1 meters

4.2.3 Materials

The surface of the building element adjacent to indoor and outdoor air shall be of fire class D, according to NEN-EN 13501-1. To prevent external fire spread according to NEN 6068, fire class B materials have to be applied for building elements adjacent to outdoor air.

It is advised to apply building materials with fire class B in the total building to limit the development of fire and smoke. With a minimal investment, the safety is improved.

The roof shall comply to NEN 6063, being inflammable.

4.2.4 Infrastructural measures

Below the building a fire brigade route is located for the surrounding buildings at the site. In accordance with the Dutch Building Code this route has to comply with the following:

- The width of the route has to be at least 4.5 meters
- The surfaced road has to be suitable for a motor vehicle of 14,600 kg for at least a width of 3.25m
- The height of the route has to be at least 4.2 meters
- Effective drainage is required

The route shall be accessible at all time in the final situation, even with fences in front of it.

During the construction period the area enclosed by building 00, building 04, the reactor hall and the new CNS building under construction is not accessible by vehicles because of the pavement, foundation and construction works over the full width between the reactor hall and building 04.

Close to the entrance of the building (<40 meters) a fire hydrant shall be available. The fire brigade access shall be adjusted with the fire brigade itself.

4.3 Civil / infrastructural

The terrain around the NCS building is enclosed by various other buildings, i.e. the office blocks, the containment building and the experiment building. The area is paved and provides pedestrian access to the various buildings and access for small truck vehicles. After construction of the CNS building the pavement will be reinstalled similar to the existing pavement.

4.4 Structural

4.4.1 Codes and standards

The following codes of practice and regulations shall be applied in the design of the structures and shall be compliant with the Dutch Safety Instructions and all applicable standards and regulations.

EN 1990+A1+A1/C2:2011/NB:2011	Eurocode - Basis of structural design
EN 1991-1-1+C1:2011/NB:2011	Eurocode 1: Actions on structures – Part 1-1: General actions – Densities, self-weight, imposed loads for buildings
EN 1991-1-2+C1:2011/NB:2011	Eurocode 1: Actions on structures – Part 1-2: General actions – Actions on structures exposed to fire
EN 1991-1-3+C1:2011/NB:2011	Eurocode 1: Actions on structures – Part 1-3: General actions – Snow loads
EN 1991-1-4+A1+C2:2011/NB:2011	Eurocode 1: Actions on structures – Part 1-4: General actions – Wind loads
EN 1991-1-5+C1:2011/NB:2011	Eurocode 1: Actions on structures – Part 1-5: General actions – Thermal actions
EN 1992-1-1+C2:2011/NB:2011	Eurocode 2: Design of concrete structures – Part 1-1: General rules and rules for buildings
EN 1992-1-2+C1:2011/NB:2011	Eurocode 2: Design of concrete structures – Part 1-2: General for structural fire design
EN 1993-1-1+A1:2011/NB:2011	Eurocode 3: Design of steel structures – Part 1-1: General rules and rules for buildings
EN 1993-1-2:2005/NB:2007	Eurocode 3: Design of steel structures – Part 1-2: General rules for structural design
EN 1993-1-8+C2:2011/NB:2011	Design of steel structures – Part 1-8: Design of joints
EN 1997-1+C1:2012/NB:2012	Eurocode 7: Geotechnical design – Part 1: General rules
EN 1997-2:2007/NB:2012	Eurocode 7: Geotechnical design – Part 2: Ground investigation and testing
EN 1998-1:	Eurocode 8: Design of structures for earthquake resistance – Part 1: General rules, seismic actions and rules for buildings

All above standards shall be used in conjunction with the relevant National Annex. (NB=Dutch Annex)

4.4.2 Bearing structure

The bearing structure will consist of a combination of a concrete and steel super structure. The sub structure will consist of a piled foundation.

4.4.3 Stability

Stability will be provided by a framed superstructure with bracings.

4.4.4 Materials

Table 2 - Materials

Concrete			NEN-EN 206 (NEN 8005)
	Grade of concrete		C35/45
	Grade of reinforcement		B500B
	Exposure classes		
		walls, other	XC4, XF1
		beams	XC4, XF1, XA3
		pads	XC2
		slabs	XC3, XA3; water cement ratio ≤ 0,45
Steelwork			NEN-EN 1090-1&2
	Hot rolled sections		S235JRG2
	Rectangular hollow sections		S275J0
	Circular hollow sections		S235JRH/S355J0
	Integrated beams		S355J0
	Plates		S235JRG2
	Bolts interior		8.8
	Bolts exterior		RVS (AISI 316 Ti, A4, class 70 or 80)
	Anchors		4.6 [with hook]
			8.8 [with anchor plate]
Joint mortal			
	At steel columns		min. K70 (fcm >= 70 N/mm2) As concrete but with faster setting time.

4.4.5 Basis of the structural design

For the subsections below, refer to EN 1990 Eurocode: Basis of structural design, unless specified otherwise.

General

Function of building	**Industrial / office**
Design working life category	4
Design working life	50 years
Consequences class	CC3
Reliability class	RC3
Reference period	50 years
K_{FI}	1,0

Design values

Table 3 - Ultimate limit states

Design working life category	ULS	Load combination	Eq.	γ_G		γ_Q	
				unfavourable	favourable	unfavourable	favourable
3	STR/GEO	fundamental	(6.10a) (6.10b)	1.3	0.90	1.65	-
3	GEO	fundamental	(6.10)	1.00	1.00	1.30	-
3	EQU	fundamental	(6.11b)	1.00	1.00	1.00	-

Table 4 - Serviceability limit states

Design working life category	Load combination	Eq.	γ_G		γ_Q	
			unfavourable	favourable	unfavourable	favourable
3	Characteristic	(6.14b)	1.00	1.00	1.00	-
3	Frequent	(6.15b)	1.00	1.00	1.00	-
3	Quasi-permanent	(6.16b)	1.00	1.00	1.00	-

Table 5 - ψ-factors

Load	ψ_0	ψ_1	ψ_2
Imposed loads buildings	refer to paragraph "Imposed loads"		
Snow loads (less than 1000m site altitude)	0	0.2	0
Wind loads	0	0.2	0
Temperature (no fire)	0	0.5	0

note:
ψ_0 = factor for combination value of a variable action
ψ_1 = factor for frequent value of a variable action
ψ_2 = factor for quasi-permanent value of a variable action

4.4.6 Dead loads

Densities for some various materials:

Table 6 - Dead loads

Concrete	25.0	kN/m^3
Steel	78.5	kN/m^3
Timber	5.5 – 7.5	kN/m^3
Masonry	20.0	kN/m^3
Soil, wet	14,0 - 20.0	kN/m^3
Soil, dry	13,0 - 18.0	kN/m^3
Water	10.0	kN/m^3

4.4.7 Imposed loads

At least in compliance with EN 1991-1-1:

Table 7 - Imposed loads

Offices and technical rooms Including the top floor (roof)			
	Category B:	q_k	7.00 kN/m^2
	(A = 0.1m x 0.1m)	Q_k	10.0 kN
	factor for combination value of a variable action	ψ_0	0.5
	factor for frequent value of a variable action	ψ_1	0.5
	factor for quasi-permanent value of a variable action	ψ_2	0.3

4.4.8 Thermal loads

According to EN 1991-1-5

Table 8 - Thermal loads

		Summer	Winter
Air temperature of the inner environment **(for calculations of stresses and forces only)**		18°C	18°C
Temperature of the outer environment	Bright light surface	40 - 10°C	-10°C
	Light coloured surface	40 + 0°C	
	Dark surface	40 + 10°C	
Underground parts		18°C	18°C

4.4.9 Wind loads

According to Eurocode 1 and national Dutch annex.

Table 9 - Wind loads

Extreme wind pressure 15m above ground	P_w	0.8	kN/m²
Pressure coefficient	C_{pe10}	+0,8 / -0,5	
Correction factor (windward + leeward)		0,85	
Combined factor	C_sC_d	1	
Local wind factors see Dutch Annex			

4.4.10 Snow loads

According to Eurocode 1

Table 10 - Snow loads

Characteristic value of snow on the ground at a site altitude less than 200m	s_k	0.7	kN/m²
Shape coefficients	μ_1	0.8	flat roof / to be calculated
	μ_s	0	sliding from upper roof
	$\mu_{w;max}$	2.8	due to wind near taller construction works; Dutch Annex
	. $\mu_{w;max}$	2.0	drifting at parapets and obstructions
Drift length	l_s	2h	$5 \le l_s \le 15$
Exposure coefficient	C_e	1.0	
Thermal coefficient	C_t	1.0	
Snow load on the roof (general)	s	0.56	kN/m² ($\mu_i \cdot C_e \cdot C_t \cdot (s_k + \Delta s_{1=0,0})$)
Snow load on the flat roof	s	0.56	kN/m²
Max. snow load near taller construction works	s	2.80	kN/m²
Max. snow load near parapets and obstructions	s	2.00	kN/m²

4.4.11 Seismic loads

According to Eurocode 8

Table 11 - Seismic loads

Horizontal ground acceleration	a_g	1.0	m/s² (seismic zone ")
Ground Class		C	
Parameter related to ground class	S	1.5	
Parameters response spectrum	T_B, T_C, T_D	0.1, 0.25, 1,2	s
Importance Class		IV	Power plants
Importance factor CC3	γ_I	1.7	
Type of structural system	C_t	0.075	Braced steel structure
Height of building	h	To be calculated	m (height of mass)
Fundamental period of vibration	T_1	0.25	s ($C_t \cdot h^{0.75}$)
Response factor	q	4.0	Steel structure; dissipative design concept; ductility class medium → 1.5 raised to 4.0
Acceleration of gravity	g	10	m/s²
Dimensioning spectrum of horizontal ground acceleration	S_d	0.1	

Horizontal forces
Eurocode with national annex is governing: $S_d = 0{,}10$
Seismic base shear: $F_d = S_d \,.\, \Sigma j(G_k + \Sigma \Psi_2 Q_k)_j$
Distribution per floor i: $F_i = F_b \,.\, z_i \,.\, m_i \,/\, \Sigma(z_j \,.\, m_j$ (z = height; m = mass)

Vertical forces
Not applicable for the static system of the proposed structure.

4.4.12 Accidental actions

Accidental snow loads:
Design value of exceptional snow load on the ground s_{Ad} 1.35 kN/m²

4.4.13 Serviceability

Requirements for additional deflections due to variable actions	
Slabs and roofs	$w_3 \leq l/250$
Slabs with walls sensitive for cracking	$w_3 \leq l/500$

Requirements for remaining total deflections	
Slabs and roofs	$w_{max} \leq l/250$

Requirements for horizontal displacements	
Overall horizontal displacements over the building height H:	$u \leq H/500$
Horizontal displacement over a storey height H_i:	$u_i \leq h/300$

4.4.14 Fire resistance

Because of the small area of the building, the building will be one fire compartment. Therefore no requirements exist to prevent progressive failure.
Since an escape route is located below the building, the first floor has to be 30 minutes resistant to fire. The floors and walls with a 60 minutes fire separation to other buildings have to be intact for this time.
Therefore in general the fire resistance to be met is 60 minutes, which means in principle a fire resistant coating will be applied on steel columns and beams. Fire resistance calculation of the structure shall be in accordance with EN 1991-1-2.

4.4.15 Applicable software

For all normal structural calculations Technosoft programs will be used which have the Eurocode incorporated. Technosoft is a Dutch company, market leader in the Netherlands for 2D structural programs.

Royal HaskoningDHV

5 STANDARDS, REGULATIONS AND GUIDELINES FOR BUILDING RELATED MEP WORKS

5.1 Codes and standards

5.1.1 Mechanical installations

Relevant EN- (CEN – European Committee for Standardization) and standards are applicable with particular reference to the following (all latest issue):

NEN-EN 1011	Welding – Recommendations for welding of metallic materials
NEN-EN 10216	Seamless steel tubes for pressure purposes - Technical delivery conditions
NEN-EN 10217	Welded steel tubes for pressure purposes - Technical delivery conditions
NEN-EN 10220	Seamless and welded steel tubes - Dimensions and masses per unit length
NEN-EN 10226	Pipe threads where pressure tight joins are made on the threads
NEN-EN 10241	Steel threaded pipe fittings
NEN-EN 1057	Copper and copper alloys - Seamless, round copper tubes for water and gas in sanitary and heating applications
NEN-EN 1092	Flanges and their joints - Circular flanges for pipes, valves and fittings
NEN-EN 12056	Gravity Drainage Systems Inside Buildings
NEN-EN 12200	Plastics Rainwater Piping Systems for Above Ground External Use Plasticized Polyvinyl Chloride (PVC-u)
NEN-EN 12237	Ventilation for buildings - Ductwork - Strength and leakage of circular sheet metal ducts
NEN-EN 14511	Air Conditioners, Liquid Chilling Packages and Heat Pumps with Electrically Driven Compressors for Space Heating and Cooling
NEN-EN 1507	Ventilation for buildings - Sheet metal air ducts with rectangular section - Requirements for strength and leakage
NEN-EN 1886	Ventilation for Buildings – Air Handling Units – Mechanical Performance
NEN-EN 378	Refrigerating Systems and Heat Pumps – Safety and Environmental Requirements
NEN-EN 671	Fixed Fire Fighting Systems - Hose Systems
NEN-EN 779	Particulate filters for general ventilation – Determination of the filtration performance
NEN-EN 809	Pumps and Pump Units for Liquids - Common Safety Requirements
93/68/EEC	European CE-marking Directive, including amending Directives
97/23/EC	European Pressure Equipment Directive
---	LuKa Handbook for air ducts

5.1.2 Electrical installations

Relevant standards as applicable with particular reference to the following:

NEN 1010:	Safety requirements for low-voltage installations;
NEN-EN-IEC 61439:	Low-voltage switchgear and control gear assemblies;
NEN-EN-IEC 62305:	Protection against lightning;
NEN-EN 12464:	Light and lighting - Lighting of work places;
NEN-EN 1838:	Lighting applications - Emergency lighting;
NEN 2535:	Fire safety of buildings - Fire detection installations - System and quality requirements and guidelines for detector siting;
NEN 2575:	Fire safety of buildings - Evacuation alarm installations - System and quality requirements and guidelines for locating of alarm devices;
NEN-EN-50173:	Information technology - Generic cabling systems;
NEN-EN-50174:	Information technology - Cabling installation;
NEN-EN 50132:	Alarm system - CCTV surveillance system;
NEN-EN 50133:	Alarm system - Access control system;
NEN-EN 50131	Inbraaksignalering;
NVFN	Noodverlichting praktijkgids
---	Handboek TU Delft FMVG

- All equipment and installations shall be designed to operate in accordance with the applicable requirements of the statutory authorities, including those listed above and for health and safety.

5.2 Heating, ventilation, and air conditioning (HVAC)

The main purpose of the HVAC system is to provide a suitable environment for personnel and equipment located within the CNS utility building.

5.2.1 Outdoor design conditions

The HVAC system is designed according to the extreme summer and winter conditions as listed below.

Table 12 - Outdoor design conditions used for the design of the HVAC system

Condition	Summer	Winter
Temperature	32 °C (DB)	-12 °C (DB)
Relative humidity	55%	75%
Wind speed	5 m/s	5 m/s
Enthalpy	74,5 kJ/kg	-9,6 kJ/kg
Specific mass	1,14 kg/m³	1,35 kg/m³
Elevation above sea level	-1,2 m NAP	-1,2 m NAP
Standard ambient pressure	1013,39 hPa	1013,39 hPa

The transmission losses of the building are calculated with use of an R_c-value of 3,5 m^2K/W for the walls, roof and floor.

Infiltration through the building façade is calculated with use of an infiltration factor q_v of $19 \cdot 10^{-5}$ m³/s per square meter of the building façade (ISSO publication 51 – Heat loss calculation for buildings, mechanical ventilation). A correction factor Z of 0,5 is used to correct for the surrounding buildings.

5.2.2 Indoor design conditions

The design conditions for the indoor temperature, relative humidity and air pressure are summarized below.

Table 13 - Indoor design conditions used for the design of the HVAC system

Condition	Control room	CNS Utility rooms
Temperature	15 - 28°C	15 - 28°C
Relative humidity	Not controlled	Not controlled
Pressure relationship	Neutral relative to the outside of the building	Neutral relative to the outside of the building

5.2.3 Internal heat loads

Table 14 - Internal heat loads

Room	Persons [W]	Lighting load [W/m²]	Equipment [W]
Control + electric room	200	12	11463
CNS Utility room first floor	0	12	1511
CNS Utility room second floor	0	12	33570

As listed in the table above, the internal heat load due to persons in the control room is 200W in total. This number is based on two persons of 100W each. The values for the internal heat load due to equipment are based on information supplied by HEC.

5.2.4 Ventilation

Fresh and filtered air is supplied to each room in the building. The minimum amount of fresh air is listed below.

Table 15 - Supply of fresh and filtered air

Room	Minimum permissible ventilation rate
Control + electric room	50 m³/h per person or air change rate of 2/h
CNS Utility room first floor	Air change rate of 0,5/h
CNS Utility room second floor	Air change rate of 0,5/h

Note: In above table only the minimum requirements are stated. In case the internal heat load requires more ventilation this requirement will be addressed in the relevant design document.

5.2.5 Operation requirements

The HVAC system is designed to operate 24 hours per day and seven days per week, adapting continuously to the heating or cooling demand in the building.

5.2.6 Safety Classification

There is no specific safety classification defined related to the HVAC system.

5.2.7 Control and electrical requirements

The HVAC system shall be controlled by a Honeywell DDC controller and equipment, located in a control cabinet. The DDC controller shall be connected to the Honeywell Building Management System of the RID. The functionality and layout of graphics shown on the BMS related to the new HVAC system shall be equal to the existing graphics used at the site of the RID.

The electrical components of the HVAC system shall be fed by the power supply from the control cabinet, which is connected with the Motor Control Centre (MCC) of the building as described in chapter 5.3.4.

5.2.8 Material requirements

The material requirements for the HVAC system and its components will be determined in the detailed design and are in line with the guidelines of the RID ('Bestek Werktuigbouwundig Procedure').

5.2.9 Interfaces and boundaries

No interfaces with existing utilites are used.

5.2.10 Noise criteria

Internal
The design and installation of the HVAC systems will be executed in such a way that the sound levels (excluding background noise) are reduced to the minimum, but will not exceed 70 dB(A).

External
The sound emission of outdoor equipment is limited by the MER-permit at the RID site.

5.3 Electrical

The design will allow for effective future maintenance, operations and accessibility to the equipment. Materials and equipment used for the electrical installations shall be suitable for the humid and corrosive environment in which they will be used.

5.3.1 Design lighting levels

Lighting inside and outside the building is designed with the lighting levels as listed below.

Table 16 - Outdoor & indoor lighting levels

Area	Lighting level [Lux]
Outside – bottle storage	150
Outside – Drive through area	150
Outside – Roof (circulation area)	100
Indoor – Control + electric room	400
Indoor – Utility room floor 1	200
Indoor – Utility room floor 2	400
Indoor – Floor level (circulation area)	100

5.3.2 Design emergency lighting

Emergency lighting levels shall be in accordance with the European standard EN 1838. The emergency lighting shall consist of escape route lights and evacuation lights.

Table 17 - Emergency lighting levels

Function	Lighting level [Lux]
Escape routes (floor level)	1
Near safety equipment (e.g. water hose reels, fire extinguishers etc.)	5
Indoor – Control + electric room	30
Indoor – Utility room floor 2	30

5.3.3 Design power demand

Process equipment
The power demand of the process equipment depends on the required cooling capacity of the reactor and the corresponding refrigeration units. In case of eight refrigeration units and four chillers, the electric power demand is 488 kW. The diversity factor will be 1.0 and a power factor of 0.85

Building services
The power demand of the systems related to building services (lighting, small power sockets and HVAC) is 59kW. The diversity factor will be 0.75 and a power factor of 0.85.

Total power demand will be estimated at 547 kW / 623kVA.

5.3.4 Main power distribution infrastructure

The design voltage	230/400V AC
Maximum operating variations	+/- 10 %
Typical operating variations	+/- 5 % (from transformer to end-use)
Nominal frequency	50 Hz
Maximum frequency variations	+/- 0.5 %

5.3.5 Emergency power supply

No emergency power supply is required by means of generator power. The critical process equipment will be connected to the Uninterruptable Power Supply (UPS) as part of the process delivery.

5.3.6 Electrical installations

The indoor electrical installations consist of:
- Cableways and conduits of power feeder, communication, safety and security cables;
- Earthing system;
- Lighting and emergency lighting;
- Small power (230V and 400V socket for general use);
- Data/telephone outlets;
- Fire alarm and evacuation system;
- Emergency alarm system (push buttons);
- Oxygen detection system
- Burglar alarm system;
- Intercom system;
- Camera system;
- Access control system;
- Building management system.

The outdoor electrical installations consist of:
- Routing of power feeder, communication, safety and security cables between building 4 and new building;
- Lighting at the pedestrian route and drive through;
- Lighting at roof;
- Lightning protection system on roof;
- IP dome camera.

5.3.7 LV Power distribution

The technical room with the Motor Control Centre (MCC) will be provided with a raised floor.
All switchboards will be designed with 30% spare circuits and additional with 30% spare space. Differential protection devices will only be installed when imposed by a relevant applicable standard

Socket outlets used within the building are listed below

Type	Properties
1Ph-single socket outlets	230V – 16A
1Ph-double socket outlets	240V – 16A
3Ph-socket outlets	400V – 16A CEE

Within the CNS rooms at first and second floor, the socket outlets are of a waterproof quality.

5.3.8 Earthing

The building will be provided with an earthing system. The control + electrical room will be provided with a local earth bar (LEB). The LEB shall be connected to the main earth bar (MEB) in the low voltage room of building 00. All metal parts, as for instance: steel structures, conduits, ducts, frames, casings, etc. shall be connected to the LEB.

5.3.9 Cable ways

The building will be provided with cableducts, cabletrays, conduits to install all cables. Special provisions should be taken into account fire separations and functional integrity requirements.

5.3.10 Lighting

Lighting shall be designed according to the lighting levels listed in 5.3.1.
The lighting fixtures inside the building will be of waterproof type (IP 65).

Lighting will be controlled by pushbutton, switch (control room) and building management system. In case of a burglar alarm the lighting system shall be switch on via the building management system.

5.3.11 Emergency lighting

The emergency- and route-indication lighting in escape-routes shall be provided with battery back-up in the respective luminaries with a minimum duration of 1 hour.

5.3.12 Lightning protection system

Lightning protection systems is required at the new building. The lightning system shall be connected to the existing lightning system of building 04.
The lightning protection level (LPL) will be at least of a minimum level II and equal to the existing lightning system at building 04.

5.3.13 Data and telephone installation

Each workplace in the control room shall be provided with a double telecom/data outlet, connected with a UTP CAT-6a cable and according to the RID's ICT specifications.
The outlets shall be connected to the SER room in building 00.

5.3.14 Intercom system

An intercom system is required in each room (utility room first floor, utility room second floor and the control + electric room) in order to communicate with the control room in the reactor building. The intercom units shall be connected to the central intercom equipment of building 00. A new intercom control system should be added to the existing systems of building 00.

5.3.15 Emergency alarm system

The emergency alarm system consists of alarm push buttons installed at each technical floor of the building. The colour of the push buttons shall be yellow.
The push buttons shall be connected to the building management system.

5.3.16 Gas detection

An O_2-detector shall be installed on the 2^{nd} floor of the building, in order to detect leakages of process gasses. An acoustic and visual alarm is required at each floor as evacuation system.
The detectors shall be connected to the existing gas detection system in building 00.

5.3.17 Camera systems

Two types of camera systems are used at the RID site.

Outside IP-dome cameras provide the security personnel with full sight on building entrance doors, the exact amount of new cameras shall be determined in the detailed design phase. The outdoor cameras shall be connected to the system in building 00.

Inside the building, a camera shall be placed in the technical areas on the first and second floor. These cameras shall be connected to the camera system in the control centre in the reactor hall.

5.3.18 Access control system

The access to the building shall be regulated with an electronic access control system. A card reader with electronic lock installed at the entrance door.
The card reader system shall be connected to the existing access control system equipment in building 00.

A standalone access control system (Salto lock) shall be installed at the door of the control + electric room.

These systems may not obstruct safe escape from the building.

5.3.19 Burglar alarm system

A burglar alarm shall be installed at every outside door and shutter on the building periphery.

Climb protection and a vibration detector shall be installed at all rain water piping which is attached at the outer walls.
The burglar system shall be connected to the system in building 00.

5.3.20 Safety classification

The building is a non-classified area.

5.3.21 Building Management System (BMS)

The functionality and layout of graphics shown in the BMS related to the new electric safety, HVAC and firefighting systems shall be equal to the existing graphics.

5.3.22 Material requirements

The material requirements for the electric and security system shall be determined in the detailed design and are in line with the guidelines of the RID ('Bestek Werktuigbouwundig Procedure' and 'Bestek Elektronisch Procedure').

5.3.23 Interfaces and boundaries

Interfaces between electric and security systems in the building and utilities at the site are listed below.

Table 18 - Interfaces and boundaries

System	Interface	Brand / installer	Connected with BMS
Electric	Low voltage transformers in building 00 T1 (2 x 250A) T2 (1 x 160A) T3 (1 x 160A)	OK / C2000	No
Lightning protection	Lightning protection of building 04	Vd Heide	No
Data / telecom	Data / telephone network in the ground floor of building 00	SPIE	No
Intercom	Intercom system in the basement of building 00	Commend / ADT	No
Gas detection	Gas detection alarm system in the basement of building 00	Dräger	Yes
Emergency alarm system	BMS		Yes
Cameras outside	Camera system in the basement of building 00	Keyprocessor	No
Cameras inside	Connected with the camera system in the control room of the reactor building	Ajax Chubb Varel	No
Access control system	Connected to the system on the ground floor of building 00	Keyprocessor Polyx / Salto	No
Burglar alarm and vibration detector	Connected to the system on the ground floor of building 00	Honeywell	Yes

5.4 Fire safety systems

Fire safety measures in the building consist of fire detection, evacuation and firefighting installations.

5.4.1 Fire detection and evacuation installation

In the total building an automatic fire detection system (NEN 2535) is required. Therefore, a fire detector is applied in each room of the building, combined with an evacuation alarm system (NEN 2575) conducted as a 'spoken word installation'. The installation in the new building is grouped with building 5 and connected with the RID's BMS.

The program of requirements related to the fire detection and the evacuation alarm system shall be prepared by RID's preferred installer ASCOM. ASCOM shall also be consulted in the design of the system.

5.4.2 Firefighting

Within the building no automatic fire suppression system (i.e. sprinkler, gaseous) is required by the Dutch Building Code, nor by the user of the building.

To fight a starting fire, indoor fire hose reels and fire extinguishers are applied. A fire hose reel is placed at each floor, while the amount of extinguishers is to be determined from a risk analysis performed by the health and safety organisation.

The fire hose is connected to the process water system of the RID site, which is of drinking water quality. Legionella prevention shall be taken into account in the design of the firefighting system.

5.4.3 Material requirements

The material requirements for the fire safety system will be determined in the detailed design and are in line with the guidelines of the RID ('Bestek Werktuigbouwundig Procedure') and ASCOM.

5.4.4 Interfaces and boundaries

The fire detection is connected with the fire alarm panel, which is in contact with the BMS. The evacuation alarm is connected with the fire alarm panel, and also communicates with the evacuation system in the basement of building 00.

It is possible to connect the fire hose reels to the piping between building 04 and the experiment hall, depending on the required capacity of the water supply. This is a 22mm pipeline with limited capacity. If this capacity is exceeded, a new connection has to be made to the main distribution, which is located in the basement of building 04.

Interfaces of the firefighting system are summarized in Table 19.

5.5 Plumbing

Besides the water used for firefighting, water is only required in for process cooling (closed loop) fill up and cleaning purposes. Drinking and eating is prohibited in the building, which means that a drinking water supply is not necessary

5.5.1 Water for cleaning purposes and process water

Process water is used for cleaning purposes within the building. Therefore, the following measures are taken at each floor of the building:

- Tap water point
- Sink basin
- Electric heater for hot water supply
- Floor drain (only at the second floor)

Process cooling water fill up is required for the process equipment, which is a closed loop system. Cooling water can be tapped from the tap water points by means of a temporary hose.

The water for cleaning purposes and process cooling water is taken from the process water system of the RID site. This water has a drinking water quality. Legionella prevention shall be taken into account in the design of the water supply system.

5.5.2 Drainage

The waste water is collected in a drain system, and connected to the external underground sewage piping system.

5.5.3 Rain water drainage

A rain water drainage system is required. The collected water can be discharged on the dedicated rain water drainage system on the site.

5.5.4 Material requirements

The material requirements for the plumbing system will be determined in the detailed design and are in line with the guidelines of the RID ('Bestek Werktuigbouwundig Procedure').

5.5.5 Interfaces and boundaries

It is possible to connect to the process water system of the RID site, which is of drinking water quality. Depending on the required capacity of the water supply, it is possible to connect to the piping between building 04 and the experiment hall. This is a 22mm pipeline with limited capacity. If this capacity is exceeded, a new connection has to be made to the main distribution, which is located in the basement of building 04.

Interfaces of the plumbing system are summarized in Table 19.

5.6 MEP interfaces

The interfaces between utilities in the new building and the existing buildings are summarized in the table below.

Table 19 - Interfaces of utilities

Number	Interface	Number	Interface
1	Central heating system, basement	8	Intercom system, basement
2	Process water, basement	9	Electric power supply, GF
3	Lightning protection, roof Bldg. 04	10	Data / telecom, GF
4	Indoor camera system, GF	11	Access control system, GF
5	Fire alarm & evacuation system, basement	12	Burglar alarm system, GF
6	Outside camera system, basement	13	BMS, basement
7	Gas detection system, basement		

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Appendix A
Explosive atmosphere (ATEX)

Not applicable to CNS building or other connected structures
Not RHDHV scope

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Appendix B
Specification of equipment loads

Equip. No.	Equip. Name	Q'ty	Classification		Technical Information		Construction Information			Remarks
			HOR Safety Class	Quality Class	Key Spec	Material	Location	Weight (approx., Ton)	Size	
1. Helium Refrigeration System										
HRS-RF01 ~ RF08	Refrigerator Unit (with cryofan, isolation valves and control cabinet)	8	SC3	QC3	1. Manufacturer : DH Industries 2. Model No. : SPC-4T 3. Type : Two stage 4. He Flow : [LATER] g/sec 5. Pressure (Discharge/Suction) : [LATER] 6. Power : 47 kW per unit, 400 V x 3 ph x 50 Hz 7. Required Chilled water : 4 m³/hr per unit at 15 ℃ 8. Compressed Air : 6 Normal liter at 6 bar(g) per operation (for each valve)	-	CNS Utility Building 2nd floor	1.8 per unit	Skid size per unit W = 1.735 m L = 0.75 m H = 2.048 m	
HRS-ZZ01 ~ ZZ08	Chiler Unit	4	SC3	QC3	1. Manufacturer : [LATER] 2. Model No : [LATER] 3. Type : Air Cooled 4. Pressure (Design / Operation) : [LATER] / [LATER] bar 5. Temperature (Design / Operation) : [LATER] / 15~25 ℃ 6. Power : 20 kW per unit, 400 V x 3 ph x 50 Hz	-	CNS Utility Building Roof floor	1.55 per unit	Skid size per unit W = 1.5 m L = 3.0 m H = apo. 2.0 m	
HRS-TK01	Helium Buffer Tank	1	SC3	QC3	1. Type : Cylindrical, Horizontal 2. Capa. : 8.0 m³ [TBD] 3. Operation Temperature : 5 ~ 40 ℃ 4. Operation Pressure : 20 ~ 27 bar(g)	Stainless Steel	CNS Utility Building Roof floor	(apo. 3.6) [TBD]	D = 1.6 m [TBD] L = 4.0 m [TBD] H = 2.0 m [TBD]	
HRS-TK02	Helium Buffer Tank	1	SC2	QC2	1. Type : Cylindrical, Vertical 2. Capa. : 5.0 m³ [TBD] 3. Operation Temperature : 5 ~ 40 ℃ 4. Operation Pressure : 20 ~ 27 bar(g)	Stainless Steel	Reactor Building	(apo. 3.0) [TBD]	D = 1.6 m [TBD] H = 3.0 m [TBD]	
2. Hydrogen System										
HYD-TK01	Hydrogen Buffer Tank	1	SC2	QC2	1. Type : Cylindrical, Horizontal 2. Capa : 1.75 m³ 3. Design Pressure - Inner tank: 500 kPa(a) - Outer tank: 3,000 kPa(a) 4. Cleanness Class : Class B (with no particle larger than 0.1 * 0.1 mm)	Stainless Steel	Reactor Building	1.50	D = 1.2 m L = 2.5 m H = 1.8 m	
HYD-TK02	Hydrogen Box	1	SC2	QC2	1. Type : Cylindrical, Horizontal 2. Design Pressure : 3,000 kPa(a) 3. Cleanness Class : Class B (with no particle larger than 0.1 * 0.1 mm)	Stainless Steel	Reactor Building	3.00	D = 1.8 m L = 2.4 m H = 1.9 m	
HYD-ZZ01	Hydrogen Storage Cabinet	1	NNC	Non-QC	1. Type : Self standing, Vertical type 2. Capa : 46.7 L Gas Cylinder (1EA) 3. Design Pressure : 1,101 kPa(a) 4. Power: 220 V x 1 ph x 50 Hz 5. H2 Purity : higher than 99.9999 %	Carbon Steel	Reactor Building	0.20	W = 0.5 m L = 0.65 m H = 2.5 m	
HYD-PP01	High Vacuum Pump	1	NNC	Non-QC	1. Type : Turbomolecular 2. Model No : TURBOVAC 361 (TBD) 3. Capa : 1,224 m³/hr 4. Ultimate Vacuum : 1*10^{-11} kPa(a) 5. Power : 0.68 kW, [Later] V x [Later] ph x 50 Hz	-	Reactor Building	0.012	W = 0.2 m L = 0.3 m H = 0.3 m	Reused
HYD-PP02	Low Vacuum Pump	1	NNC	Non-QC	1. Type : Rotary 2. Model No : TRIVAC D 16 B (TBD) 3. Capa : 16.5 m³/hr 4. Ultimate Vacuum : 2 * 10^{-1} kPa(a) 5. Power : 0.75 kW, 230 V x 3 ph x 50 Hz	-	Reactor Building	0.030	W = 0.2 m L = 0.55 m H = 0.3 m	Reused
3. Vacuum System										
VAS-PP01 / PP02	High Vacuum Pump	2	SC3	QC2	1. Type : Turbomolecular, Air Cooled 2. Capa : [LATER] m³/hr 3. Ultimate Vacuum : 1.33 x 10^{-6} kPa(a) 4. System Pressure : 1.33 x 10^{-4} kPa(a) 5. Power : [LATER] kW, 220 V x 1 ph x 50 Hz 6. Cleanness Class : Class B (with no particle larger than 0.1 * 0.1 mm)	-	Inside Vacuum Box	0.02	D = 0.2 m H = 0.3 m	

Equip. No.	Equip. Name	Q'ty	Classification		Technical Information		Construction Information			Remarks
			HOR Safety Class	Quality Class	Key Spec	Material	Location	Weight (approx., Ton)	Size	
VAS-PP03 / PP04	Low Vacuum Pump	2	SC3	QC3	1. Type : Scroll Dry, Air Cooled 2. Capa : [LATER] m³/hr 3. Ultimate Vacuum : 1.0 × 10⁻¹ kPa(a) 4. Power : [LATER] kW, 220 V x 1 ph x 50 Hz 5. Cleanness Class: Class B (with no particle larger than 0.1 * 0.1 mm)	-	Inside Vacuum Box	0,05	W = 0.4 m L = 0.5 m H = 0.4 m	
VAS-TK01	Vacuum Valve Box	1	SC2	QC2	1. Type : Cylindrical, Horizontal 2. Design Pressure : 3,000 kPa(a) 3. Cleanness class: Class B (with no particle larger than 0.1 * 0.1 mm)	Stainless Steel	CNS Utility Building 1st floor	0,20	D = 0.65 m L = 1.1 m H = 0.65 m	
VAS-TK02	Vacuum Box	1	SC2	QC2	1. Type : Cylindrical, Horizontal 2. Design Pressure : 3,000 kPa(a) 3. Cleanness Class: Class B (with no particle larger than 0.1 * 0.1 mm)	Stainless Steel	CNS Utility Building 1st floor	2,50	D = 1.2 m L = 2.5 m H = 1.6 m	
VAS-TK03 / TK04	Vacuum Disposal Tank	2	SC3	QC3	1. Type : Cylindrical, Vertical 2. Design Pressure : 500 kPa(a) 3. Capa : 3 Liter 4. Cleanness Class: Class B (with no particle larger than 0.1 * 0.1 mm)	Stainless Steel	Inside Vacuum Box	excluded in Vacuum Box	D = 0.15 m H = 0.2 m	
VAS-TK05	Discharged Gas Collection Tank	1	SC3	QC3	1. Type : Cylindrical, Vertical 2. Design Pressure : 500 kPa(a) 3. Capa : 2.0 m³	Stainless Steel	CNS Utility Building 2nd floor	1,00	D = 1.2 m H = 2.8 m	
VAS-TK0?	Containment Isolation Valve Box	1	SC2	QC2	1. Type : Cylindrical, Horizontal 2. Design Pressure : 2,000 kPa(a) 3. Cleanness class: Class B (with no particle larger than 0.1 * 0.1 mm)	Stainless Steel	Isolation Valve Room	0,20	D = 0.65 m L = 1.1 m H = 0.95 m	
4. Gas Blanketing System										
GBS-ZZ01	Nitrogen Gas Supply Unit	1	NNC	Non-QC	1. Type : Cylinder 2. Capacity : 46.7 liter x 13EA 3. Gas Cylinder Max. Working Pressure: 12,101 kPa(a) 4. Gas Purity : 99.999 % 5. Cleanness Class: Class B (with no particle larger than 0.1 * 0.1 mm)	-	CNS Utility Building Ground floor (Outdoor)		W = 0.8 m L = 4.0 m H = 1.5 m	
GBS-ZZ02	Portable Vacuum Pump Unit	1	NNC	Non-QC			CNS Utility Building 2nd floor	0,12	W = 0.8 m L = 1.2 m H = 1.0 m	
	- High Vacuum Pump	1	NNC	Non-QC	1. Type : Turbomolecular 2. Model No. : TURBOVAC 361 (TBD) 3. Capa : 1,224 m³/hr 4. Ultimate Vacuum : 1*10⁻¹¹ kPa(a) 5. Power : 0.68 kW, [Later] V x [Later] ph x 50 Hz	-	Portable Cart	-	W = 0.2 m L = 0.3 m H = 0.3 m	Reused
	- Low Vacuum Pump	1	NNC	Non-QC	1. Type : Rotary 2. Mdoel No. : TRIVAC D 16 B (TBD) 3. Capa : 16.5 m³/hr 4. Ultimate Vacuum : 2 * 10⁻⁴ kPa(a) 5. Power : 0.75 kW, 230 V x 3 ph x 50 Hz	-	Portable Cart	-	W = 0.2 m L = 0.55 m H = 0.3 m	Reused
	- He Gas Cylinder	1	NNC	Non-QC	1. Type : Cylinder 2. Capacity : 3.4 liter x 1EA 3. Purity of Helium Gas : 99.999% 4. Gas Cylinder Max. Working Pressure: 12,101 kPa(a)	-	Portable Cart	-	-	
	- Sampling Gas Storage Tank	1	NNC	Non-QC	1. Type : Cylinder 2. Capacity : 1.0 liter x 1EA 3. Design Pressure : 1100 kPa(a)	-	Portable Cart	-	-	
	- Portable Cart	1	NNC	Non-QC	1. Type : Portable	-		-	W = 1.0 m L = 2.0 m H = 0.8 m	
GBS-ZZ03	Helium Gas Supply System	1	NNC	Non-QC	1. Type : Cylinder 2. Capacity : 46.7 liter x 4EA 3. Gas Cylinder Max. Working Pressure: 12,101 kPa(a) 4. Gas Purity : 99.999 %	-	CNS Utility Building Ground floor (Outdoor)	0,25	W = 0.5 m L = 1.5 m H = 1.5 m	
GBS-TK01	Nitrogen Buffer Tank	1	NNC	Non-QC	1. Type : Cylindrical, Vertical 2. Pressure (Design / Operation) : 1,100 kPa(a) / 800 kPa(a) 3. Capa : 1.0 m³ 4. Cleanness Class: Class B (with no particle larger than 0.1 * 0.1 mm)	Stainless Steel	CNS Utility Building 1st floor	0,50	D = 1.0 m H = 2.2 m	