**sECTION 2.2.4**

**EQUIPMENT AND PROCESS**

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본 챕터에서는 FFF에 설치 예정인 주요 장비의 기능 및 구성에 대하여 설명한다. 장비별 필요 유틸리티, 예비품, 소모품은 첨부 기기목록을 참조 바람.

1. MANUFACTURING PROCESS EQUIPMENT
   1. Powder Preparation Process

분말준비 공정은 UO2, Gd2O3 분말을 취급한다. 각 분말준비 공정은 유사한 타입의 장비를 사용하며, 분말 혼입 방지를 위하여 별도의 제조 라인을 구축한다. Gd 분말 준비공정은 전용 Mill이 추가된다.

* + 1. **Powder Unpacking System**

분말(UO2) 운송용기(3516)으로부터 공정 내에서 취급 가능한 분말 용기로 분말을 옮겨 담기 위한 설비이며, Air balancing device & suction unit, Dust Extraction Hood, Weighing Scale 등으로 구성된다.

* + 1. **Pre-compactor & Granulator**

첨가제가 혼합된 분말로부터 지정된 압분밀도의 예비압분체를 생산하여 예비압분체를 분쇄하고 체로 걸러서 조립분말을 만드는 기기이며, Feed Hopper, Compacting Roller, Crusher 등으로 구성된다.

* + 1. **Additive Input System**

첨가제를 설정된 양 만큼 자동으로 체질 및 계량하여 분말용기로 투입하는 기기이며, Cyclone, Sifter, weighing device 등으로 구성된다.

* + 1. **Tumble Blender**

분말용기와 조립분말용기에 첨가제 투입한 후 용기를 회전시켜 분말과 첨가제를 혼합하는 기기이며, Blender, lifting system 등으로 구성된다.

* + 1. **Powder Container & Storage Rack**
    2. **Mill**
  1. Pelletizing Process
  2. Fuel Rod Manufacturing Process
  3. Guide Thimble Assembly Manufacturing Process
  4. Fuel Assembly Manufacturing Process
  5. UO2 Powder/Pellet Inspection Facility
  6. Fuel Rod/Assembly Inspection Facility
  7. UO2 Powder Container

1. Utility Equipment
   1. Nuclear Part
   2. Mechanical Equipment Description
   3. Electrical Description
   4. Control and Instrumentation Description
   5. Piping Description
   6. HVAC System Description
   7. Fire Fighting Description
2. Radioactive Waste Treatment and Storage Facilities
   1. Gaseous Radioactive Waste Treatment System
   2. Liquid Radioactive Waste (LRW) Treatment System
   3. Solid Radioactive Waste (SRW) Treatment System
3. Raidation Monitoring System
   1. Working Environment Monitoring System
   2. Waste Monitoring System
   3. Environmental Radiation/Radioactivity Survey and Monitoring System
   4. Radiological Environmental Impact Assessment
4. Emergency Power Supply Equipment
   1. Emergency Generator
   2. Uninterruptible Power Supply (UPS)
5. Fire Protection System Equipment
6. Heating, Ventilation and Air Conditioning (HVAC) System
   1. Powder Preparation Area
   2. Pelletizing Area
   3. Uranium Storage Area
   4. Waste Treatment & Laboratory Area
   5. 2nd Welding & Change Room Area
   6. Entrance Area
   7. Byproduct Treatment Area
   8. Component Building Area
7. Emergency Alarm System
   1. Emergency Fire Alarm System
   2. Emergency Alarm System of the Radiation Monitoring System
8. Civil & Building Works
   1. Codes, Standards and References

The following codes, standards and standards shall be applied in the design and construction of plant buildings and associated structures.

* + - CIRIA/ C577 Guide to the Construction of Reinforced Concrete in the Arabian Peninsula
    - CIRIA Report PE/0807/04/03
    - NACE STD. RP0187-2005 Item No. 21034 Standard Recommended Practice Design Considerations for Corrosion Control of Reinforcing Steel in Concrete
    - ADIBC Abu Dhabi International Building Code
    - IBC 2009 International Building Code
    - ASCE 7-05 Minimum Design Loads for Buildings and Other Structures
    - ACI 318-11 Building Code Requirements for Structural Concrete
    - ACI 350-06 Code Requirements for Environmental Engineering Concrete Structures
    - ACI 350.3-06 Seismic Design of Liquid-Containing Concrete Structures
    - ACI 301-05 Specification for Structural Concrete
    - ACI 351.3R-04 Foundation for Dynamic Equipment.
    - ACI 530-08 Building Code Requirements for Masonry Structures
    - ACI 534R-00 Design, Manufacture, and Installation of Concrete Piles
    - AISC 360-10 Specification for Structural Steel Building
    - AISC 341-10 Seismic Provisions for Structural Steel Buildings
    - AISC 303-05 Code of Standard Practice for Steel Building and Bridges
    - ASTM American Society for Testing and Materials
    - AWS Structural Welding Code for Steel
    - NFPA 101 Life Safety Code
    - NFPA 850 Recommended Practice for Fire Protection for Electric Generating Plants and High Voltage Direct Current Converter Stations
    - ISO International Organization for Standardization
    - CMAA Crane Manufacturers Association of America
    - AISI American Iron and Steel Institute (as applicable)
    - AASHTO American Association of State Highway & Transportation Officials (as applicable)
    - API American Petroleum Institute (as applicable)
    - DIN 4024-1 Machine foundations of flexible structures that support machines with rotating elements
    - DIN 4024-2 Machine foundations of rigid foundations for machine with periodic excitation
    - BS British Standards (as applicable)
    - JIS Japan Industrial Standards (as applicable)
    - USACE US Army Corps of Engineers
    - NAVFAC Naval Facilities Engineering Command
    - FHWA Federal Highway Administration(U.S Dept. of Transportation)
    - CFEM Canadian Foundation Engineering Manual
    - KS1) Korean Standard (as applicable)
    - GB1) Chinese Standard (as applicable)

Note: 1) These standards (KS and GB) would be subject to approval of Owner (’s).

* 1. Site Information
     1. Site Location

The plant site is situated at Mirfa Complex five kilometers west of the town of Mirfa on the Arabian Gulf coast of U.A.E. about 100 kilometers southwest of the city of Abu Dhabi.

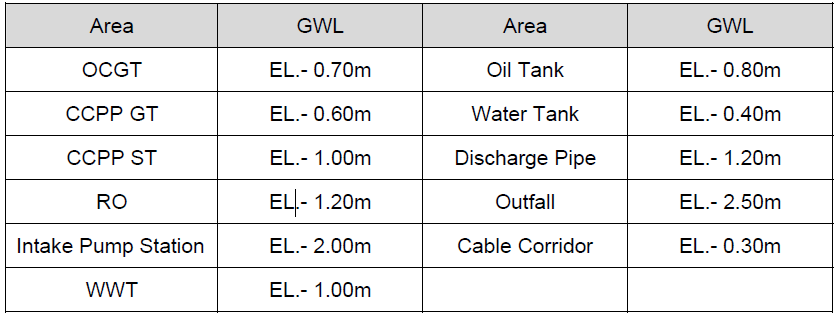
* + 1. Elevation of Tides
    - Highest astronomical tide : EL. -2.60m ( A.C.D.+2.10m)
    - Mean sea level(MWL) : : EL. -3.35m ( A.C.D.+1.35m)
    - Lowest astronomical tide : EL. -4.34m ( A.C.D.+0.36m)

Where, the elevations of highest and lowest astronomical tide are determined with consideration of the seasonal effects. The Elevation Level (EL.) and A.C.D. are defined in section 1.6.1 as “GL.±0.00 = EL.±0.00 = A.C.D.+4.70m = A.D.D.+3.70m”

* + 1. Temperature
    - Minimum ambient air temperature : 1.0°C
    - Maximum ambient air temperature : 52°C
    - Maximum metal temperature in the sun : 85°C

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* + 1. Humidity(Relative)
    - Min. : 61%
    - Max. : 100%
    1. Wind
    - Refer to section 2.1.4
    1. Rainfall
    - Maximum rainfall in one day : 200 mm
    - Maximum rainfall in one hour(Abu-Dhabi Design Manual, 2000) : 26.75 mm
    - Average annual rainfall : 50mm
    1. Earthquake
    - Refer to section 2.1.5
    1. Design Ground Water Level



Note) Ground water level is considered for average ground water level and seasonal variation in accordance with soil investigation report.

* + 1. Expected Chemical Condition in Soil

According to the soil investigation report, soil includes sulphate and chloride with Class S2 and C2 respectively. The used classes are on the base of ACI318-11 Table 4.2.1.

* + 1. Site Grading

Plant Datum and Site Elevation

Admiralty Chart Datum (A.C.D) will be used for the project. The finished Ground Level (GL.±0.00) and Elevation Level (EL.±0.00) will be A.C.D.+4.70 m. The Elevation Level (EL.) will be generally indicated in the documents with note of project ground level of A.C.D.

Generally, the top elevation of structures or etc. will be as follows;

* + - Station finished ground level(GL.±0.00) : EL.±0.00 m
    - Finished floor level of buildings : EL.+0.20 m
    - Minimum level(i.e. the bottom of foundation steel plate) of

outdoor equipment/steel structure pedestals : EL.+0.30 m

* 1. Loads and Load Combinations

The following loads shall be considered in the foundation and structure design. If other loads are expected, those loads shall be included in the design.

* + 1. Dead Loads (DL)

Dead loads comprise of the weight of structural members and all permanent materials and weight of equipment as well as the weight of pipes, air ducts, cables, insulation, and other similar items fastened thereto or supported thereby, which are not considered in the live load hereinafter.

Ds : Self weight of structural element in analysis model

Dd : Material weight of structural floor, non-structural element or finish

De : Equipment loads to be provided by mechanical engineers

Dp : Estimated area loads for piping and cable tray to be provided by Piping/Elec. engineers or operating(or test) load of equipment or piping.

The weights of structural or nonstructural material to be considered are as follows:

* + - Reinforced concrete : 25.0 kN/m3
    - Steel : 78.5 kN/m3
    - Plaster : 20.0 kN/m3
    1. Live Loads (LL or Lr)

Live loads are all non-permanent and occur over an area, which is not occupied by fixed equipment. This is stationary or movable loads and can occur regularly during the expected service life of the power or only during special operating conditions, like transportation, inspection, assembling and dismantling of components.

* + - Short circuit forces
    - Anchor loads(force) on pipe anchor supports due to movement restrains
    - Vehicle loads
    - Surcharge on soil / surface adjacent to retaining walls (affected by traffic loads, construction loads or expected maintenance loads)
    - Any other relevant load as per manufacturer’s specified loading data

The minimum live loads given below will be used in the structural design unless the special load requirement provided by manufacturer is indicated.

Turbine Building

Unloading ground concrete floor (S.O.G) : 15.0kN/m2

Ground concrete floor (S.O.G) : 10.0kN/m2

Ground grating floor : 10.0kN/m2

Operating floor with lay-down areas : 15.0kN/m2

Other floor concrete areas : 10.0kN/m2

Other floor grating/steel plate areas : 7.5kN/m2

Electrical equipment room : 10.0kN/m2

Stairs : 4.8kN/m2

Access platform and catwalks : 4.8kN/m2

Concrete roof : 4.8kN/m2

Metal roof : 1.0kN/m2

Others Building

Ground concrete floor (S.O.G) : 10.0kN/m2

Control rooms : 7.5kN/m2

Electrical equipment rooms : 10.0kN/m2

Battery room : 12.5kN/m2

Storage areas : 7.5kN/m2

General equipment rooms : 4.8kN/m2

Offices or locker room, general room : 4.8kN/m2

Concrete roof with equipment : 4.8kN/m2

Metal or concrete roof : 1.0kN/m2

Stairs : 4.8kN/m2

The reduction of live or roof live load can be applied according to provisions of ASCE 7-05, if necessary.

* + 1. Crane Loads (CL)

The maximum wheel load will be determined in accordance with ASCE/SEI 7-05, section 4.10.1 of. Design loads for runway beams or supports of cranes shall include the maximum wheel loads of the crane and vertical impact, lateral, and longitudinal forces induced by the moving crane.

* + - Vertical force = maximum wheel load x 1.25
    - Lateral force = (rated Capacity + hoist wt + trolley wt) x 0.20
    - Longitudinal force = Maximum wheel load x 0.10

Where, maximum wheel load is the summation of bridge weight, rated capacity and trolley weight.

* + 1. Wind Load (W)

Basic wind speed to be used is obtained from table 4.1-1 in section 4.1.1 design condition of General Technical Spec.(Part II of RFP). The design wind load shall be taken in accordance with the requirements of ASCE/SEI 7-05(section 6.5) with parameters mentioned below;

* + - Basic wind speed( V) : 45.0 m/sec(160kph)
    - Importance factor(I) : 1.15
    - Site exposure category : D
    - Occupancy category : III
    - Topographic factor : 1.0

Where, the basic wind speed V, corresponds to a 3second gust speed at 10m above ground in exposure category D.

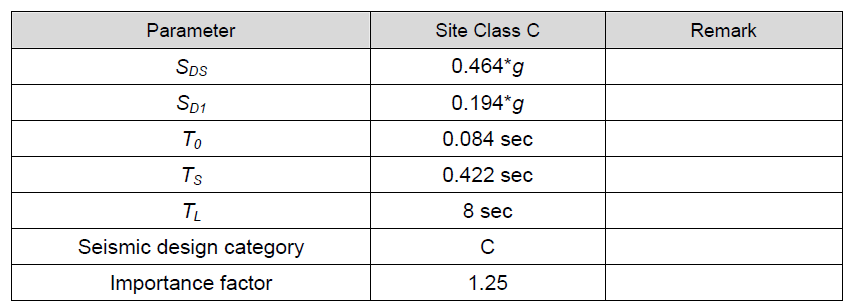
* + 1. Seismic Load (E)

The mapped MCE(Maximum Considered Earthquake) spectral response accelerations of SS and S1 shown in ADIBC 2013 are 0.60g and 0.18g respectively for project site location.

The site class is assigned as Site Class C in Geotechnical Site Investigation Report.

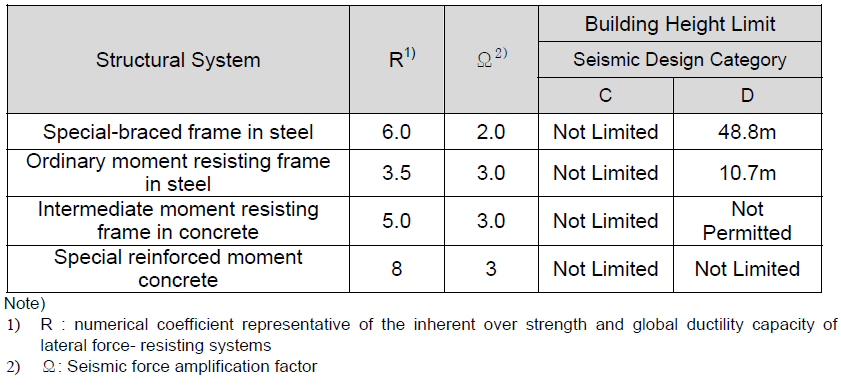
Earthquake Loads will be determined based on following parameters in accordance with ASCE/SEI 7-05, which is equivalent to ADIBC 2013 or IBC09.

Tabulated below are the key parameters for the design response spectrum based on MCE spectral response accelerations and Site Class C assigned above:



A. Building Structures

Some of the lateral force resisting frame systems classified in ASCE, table 12.2-1 will be used as listed table below for building structures of this project. The total design horizontal force of static or dynamic procedures shall be calculated from the requirements of ASCE - chapter 12.



B. Non-Structural Component and Non-Building Structure

Non-structural component and non-building structures will be designed according to section 13 and 15 of ASCE respectively.

C. Coupling of earthquake action

For non-parallel systems irregularity which is defined at Item 5 of Table 12-3-1 in ASCE 7- 05, the orthogonal effects shall be considered in accordance with the requirements defined in Section 12.5.3 of ASCE 7-05.

* + 1. Lateral Soil Pressures or Ground Water Pressure (H)

The lateral pressure of soil or water, or the upward pressure of water, where applicable, shall be properly included in design of underground facilities, such as retaining walls, culverts, external walls of underground compartments, ditches, pits, sumps or ponds etc.

The seismic lateral soil pressure will be calculated according to Mononobe-Okabe method.

Where, the pseudo-static ground horizontal accelerations necessary for this method correspond to one third to the peak ground acceleration at project site.

* + - Pseudo-static horizontal acceleration : 0.07g
    - Pseudo-static vertical acceleration : 0.05g

Where, the vertical acceleration is defined by horizontal acceleration by a factor of two-thirds.

* + 1. Fluid Load (F)

Fluid load, which is well defined pressures and maximum heights, defines structural actions in structural supports, framework, or foundations of a storage tank, vessel, or similar container due to stored liquid products.

* + 1. Thermal Load (T)

Thermal load are forces occurring from thermal expansion due to difference in temperature among the materials of structure, forces occurring at anchor points of piping and equipment, and sliding or rolling friction forces due to thermal expansion.

On the basis of engineering practices of power plant, a thermal load induced from temperature difference will not be considered in the design of the building structure with limited length listed below.

* + - Steel building structure : Length ≤ 70m
    - RC building structure : Length ≤ 40m

If building structures exceed the above length without appropriate expansion joints, thermal effects or a design temperature change of 25°C is to be applied based on Technical Report No.65 Expansion Joints in Buildings by Federal Construction Council as referred by AISC 14th Steel Construction Manual (page 2-39) and the temperature data gathered by National Center of Meteorology and Seismology e-government services (http://new.ncms.ae) for Abu Dhabi.

* + 1. Rain Load (in Roof, R)

The amount of rain water that could accumulate on a roof from blockage of the primary drainage system shall be considered in accordance with ASCE 7-05, section 8.

The design rainfall intensity will be used as “maximum record rainfall in one hour” in section 1.5.6 of this report.

* + 1. Blast Load(B)

For transformer area, blast load will be basically recommended by supplier. If not available, previous project data will be used as follow.

* + - Blast Load(Azito Phase3, Republic of Cote d'Ivoire) : 7.0 kN/m2
    1. Friction Force

Friction force shall be considered, the coefficient of friction factor shall be taken as follows:

* + - Steel to steel : 0.25
    - Steel to concrete : 0.4
    - Steel to roller : 0.0
    - Teflon to teflon : 0.06
    1. Load Combinations

Load combinations to be used are based on the provisions chapter 2 of ASCE/SEI 7-05. Buildings and structures will be designed to resist the following load combinations.

Load Cases

* + - DL : Dead load(=Ds + Dd + De(operating or empty) + Dp)
    - LL : Live load
    - Lr : Roof live load
    - CL : Crane loads
    - W : Wind load
    - E : Seismic load
    - H : Lateral soil pressure or ground water pressure
    - F : Fluids with well-defined pressures and maximum heights
    - T : Thermal load
    - R : Rain load(in roof)
    - B : Blast Load
    1. Load Combinations for ASD

These combinations will be used for determining the required strength of soil bearing and steel design with ASD method.

1-1) DL + F

1-2) DL + B

1-3) DL + H + F + LL + T

1-4) DL + H + F + (Lr or R)

1-5) DL + H + F + 0.75(LL+T) + 0.75(Lr + R)

1-6) DL + H + F + (W or 0.7E)

1-7) DL + H + F + 0.75(W or 0.7E) + 0.75LL + 0.75(Lr + R)

1-8) 0.6DL + W + H

1-9) 0.6DL+ 0.7E + H

Exception:

1. Crane live load (rated capacity of the crane) can be combined with 1/2 of maximum wind load.
   * 1. Factored Load Combinations for USD or LRFD

These combinations listed below will be used for the design of steel with LRFD method or concrete structures with USD method. Also, the additional load combinations and increased seismic loads mentioned in section 3.3 and 4.8 in this report will be considered for seismic design of steel and concrete structure

2-1) 1.4(DL + F)

2-2) 1.4(DL + B)

2-3) 1.2(DL + F + T) + 1.6(LL + H) + 0.5(Lr or R)

2-4) 1.2DL + 1.6(Lr or R) + (LL or 0.8W)

2-5) 1.2DL + 1.6W + LL + 0.5(Lr or R)

2-6) 1.2DL + 1.0E + LL

2-7) 0.9DL + 1.6W + 1.6H

2-8) 0.9DL + 1.0E + 1.6H

* 1. Structural Steel
     1. Codes and Standards

Steel structures will be designed in accordance with ASD or LRFD design method as specified in AISC360-10 “Specification for Structural Steel Buildings” and the requirement of seismic provision(AISC 341-10).

* + 1. Structural Steel

Structural steel shall be confirmed to ASTM A36M, ASTM A572 Gr. 345(50), ASTM A992 Gr. 345(50) or equivalent. Material properties based on ASTM shall be satisfied except that the minimum strength shall meet below requirement or equivalent depending on local availability.

* + - Minimum yield strength : 250 MPa for ASTM A36M

345 MPa for ASTM A572/A992

* + - Minimum tensile strength : 400 MPa for ASTM A36M

450 MPa for ASTM A572/A992

* + - Modulus of elasticity : 200,000 MPa
    1. Framing and Design Concept for Building

Structures designed to resist earthquake forces should have elements and connections that are capable of dissipating large quantities of energy. The seismic design requirements for buildings to be applied are as follows;

The required axial strength of columns, beams and its connections in special concentrically braced frames shall be determined by the following amplified seismic load combinations in lieu of seismic load combinations in section 2.2 of this report.

* + - 1-5’) 1.06 DL + H + F + 0.7Ω·Eh
    - 1-6’) 1.05 DL + H + F + 0.525Ω·Eh + 0.75LL + 0.75(Lr + R)
    - 1-8’) 0.54 DL- 0.7Ω·Eh + H
    - 2-5’) 1.29 DL + Ω·Eh + LL
    - 2-7’) 0.81 DL - Ω·Eh + 1.6H

Where, over-strength factor(Ω) is defined in section 2.1.5 of this report.

In the special concentrically braced frames, the brace elements subject to seismic loads shall be seismically compact section defined in Table D1.1 of AISC 341-10 and the slenderness ratio of bracing element in X, V, or inverted V bracing configuration shall be equal to or smaller than 200. The required strength of bracing will be expected yield strength in tension of brace. Alternatively, the strength can be the axial tension resulting from load combinations including seismic load, with seismic loads increased by 4(=R/1.5)

* + 1. Structural Bolt

High-strength bolts will be minimum diameter of 19mm conforming to galvanized ASTM A325 with type 1, nuts to ASTM A563 Grade DH, and washers to ASTM F436 in structural connections of the main structural systems. Hot-dip galvanizing process (ASTM 153) of high-strength bolts and nuts with washers must be considered as a manufactured fastener assembly. All high-strength bolted connections will be designed, detailed, and fabricated as friction type (Class A) connection. High-strength bolts will be tightened by the turn-of nut method or calibrated wrench installation.

For secondary members, such as landings, ladders, handrails, toe plates, girths (or purlins), and removable beams, common bolts with hexagonal nut conforming to galvanized ASTM A307 or equivalent (e.g. A36) will use M16 bolts. Joint type of common bolts will be snug-tightened.

* + 1. Anchor Systems

Design of anchor systems such as anchor bolts and shear keys shall conform with Appendix D of ACI 318-11, satisfying either of the following two additional requirements.

A. The anchor bolts of columns shall transmit tensile loads via a ductile steel elements with stretch length of at least eight diameters and no less than 250mm measured from base plates. The tensile loads are column reaction forces resulting from load combinations listed in section 2.2 of this report.

B. The anchor bolts shall be designed for tensile loads obtained from load combinations given in section 2.2 and 3.3 including the over-strength factor.

The material of anchor bolts shall be selected considering the following condition mention below;

Anchor bolts will be headed or bent type with requirements of ASTM F1554 Grade36 or equivalent (e.g. ASTM A36 or A307 with elongation at least 14 percent and reduction in area of at least 30 percent). Minimum anchor bolt diameter shall be 13mm. Where high strength anchor bolts are required, ASTM F1554 Grade 55 weld-able steel or equivalent (e.g. ASTM A449) will be provided. Anchor bolts will be hot-dip galvanized.

Anchor bolts for only intake facilities shall be stainless steel (Type 316Ti of AISI Standard or equivalent)

* + 1. Grouting Base Plate

Minimum compressive cube strength shall be 42MPa which will be tested based on ASTM C109. Grout depth under base plates will be designed according to column types (or compression strength amount) as follows:

* + - Main steel columns : 50mm
    - Wind columns for siding wall : 30mm
    1. Welds

All welding shall conform to the requirement of AWS codes listed below.

* + - A2.4: Welding symbols
    - D1.1: Steel
    - D1.3: Aluminum
    - D1.4: Reinforcing steel
    - C5.4: Stud welding

Welding electrode will have minimum specified tensile strength of 480Mpa (70,000psi). Where the welding is conducted in accordance with D1.1-steel, E70 Electrode will be used.

* + 1. Expansion Anchors and Adhesive Anchors
    - Expansion anchors : Hilti Kwik Bolt III or equivalent
    - Adhesive anchors : Hilti HIT HY 200 or equivalent

Where, expansion anchors will not be used to anchor for vibratory equipment or being subjected to earthquake action.

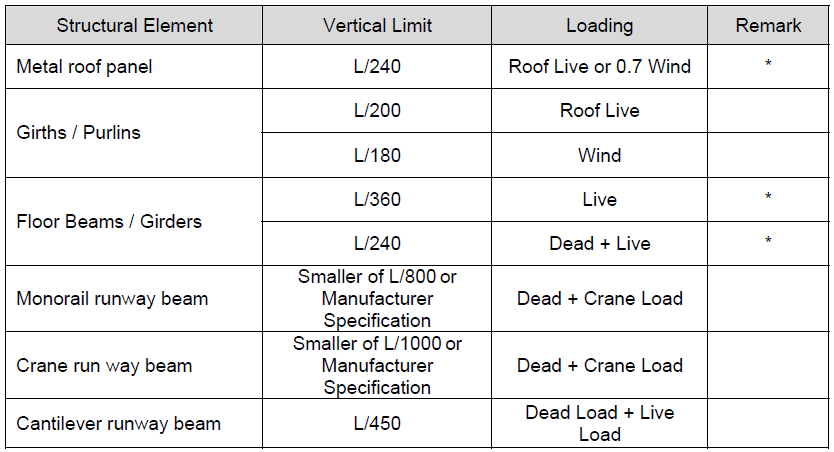
* + 1. Miscellaneous Steel

Steel grating, steel grating stair treads, metal steel floor deck, handrail, ladders or embedded items such as plates or bars will be hot dipped galvanized and shall be, if needed for safety requirement, properly painted.

* + 1. Deflections

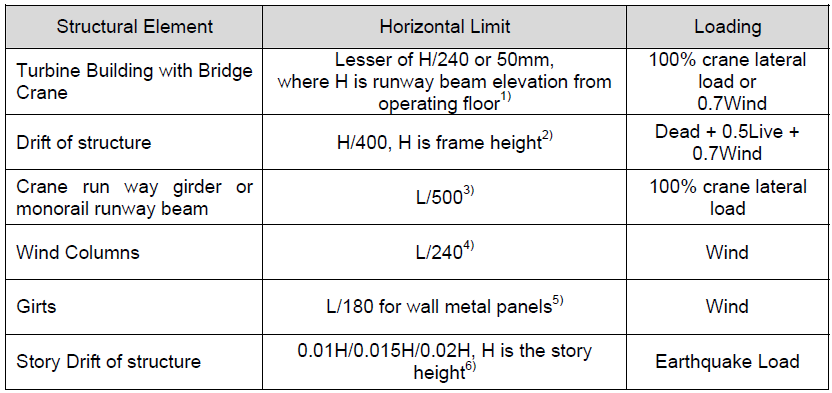
The maximum allowable deflections for structural steel elements, where L is the span for the element, are given in Tables below.

Limit of vertical deflection



Note: the values marked \* are taken from IBC 2009, Table 1604.3

Limit of horizontal deflection



Note)

1) AISC Steel Design Guide 3, p30

2) ASCE 7-02, p366, CB.1.2

3) BS 5950 Part1, 24p. Table 8

4) IBC 2009, Table 1604.3

5) AISC Steel Design Guide 3, p10

6) ASCE 7-05, p134, Table 12.12-1

* + 1. Pre-Engineered Buildings

Pre-Engineered Building (PEB) for a building(or shelter) with 1 story, if necessary, will be designed in accordance with the MBMA code for performance requirements such as deflection and building drift and AISC 360-10 for strength design of steel members.

* + 1. Coating

The painting and corrosion protection for the whole steel work in this project to be applied are as follows;

Structural Steel Surface (Indoor)

Surface preparation : Blasting SIS Sa 2.5 or Equivalent

Coat1 : Inorganic zinc-rich epoxy primer single coat system, DFT 75㎛

Coat 2 : High Build Epoxy Polyamide with satin or semi-gloss finish, DFT : 100㎛

Total DFT 175㎛

Structural Steel Surface (Outdoor)

Surface preparation : Blasting SIS Sa 2.5 or Equivalent

Coat 1 : Inorganic Zinc-rich Primer Single Coat System, DFT : 75㎛

Coat 2 : High Build Epoxy Polyamide with satin or semi-gloss finish, DFT : 125㎛

Coat 3 : Apliphatic Polyurethane - High Build, DFT : 75㎛

Total DFT 275μm

* 1. REINFORCED CONCRETE
     1. Codes and Standards

Concrete structure and foundation will be designed in accordance with ultimate strength design method as specified in ACI 318(M)-11 including the seismic provisions (chapter 21). Water or liquid retaining structure will be designed by ACI 350-06 or equivalent.

* + 1. Concrete Specifications

The minimum concrete strength specified as a cylinder above shall be compressive strength at age 28 days as determined by ASTM C39. The maximum slump of all concrete mixes shall be in accordance with ACI 301, paragraph 4.2.2.2.

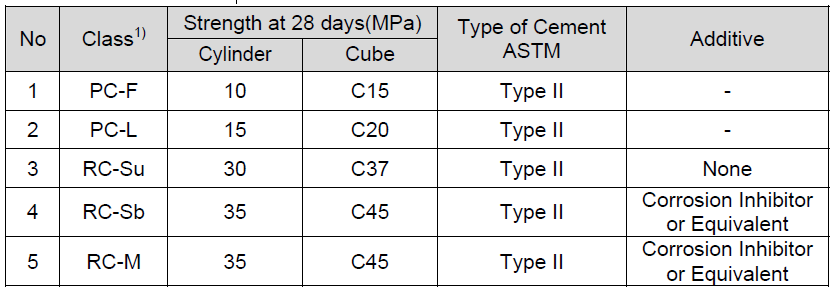
Also, Physical properties of concrete are as follows

* + - Modulus of elasticity (Ec) : 25,000 MPa (f’c = 35MPa)

21,500 MPa (f’c = 30MPa)

* + - Poisson’s ratio (υ) : 0.2

Concrete specifications



Note)

1) Concrete Classes are defined as follows;

PC-F : Plain concrete as filling concrete

PC-L : Plain concrete as lean (blinding) concrete

RC-Su : Reinforced concrete for super structures in buildings or general structures exposed to the atmosphere and trench

RC-Sb : Reinforced concrete for sub structures

RC- M : Structure exposed to seawater directly & marine structures

* + 1. Reinforcing Bar

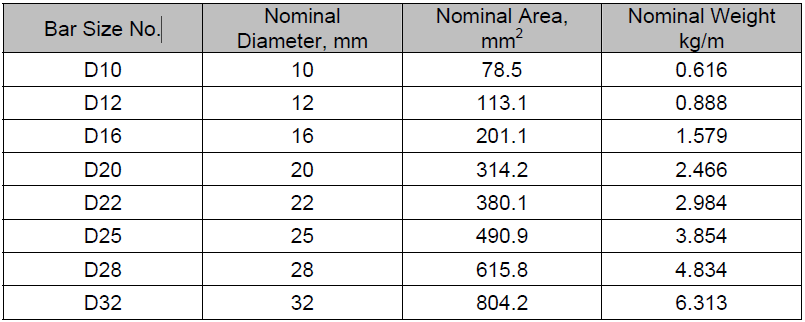
Reinforcing bar to be used in reinforced concrete will be deformed uncoated bars in accordance with BS 4449:2005 or equivalent with the following requirement:

* + - Minimum yield strength (fy) : 500 MPa

However, for shear reinforcement design, 420MPa of yield strength instead of above will be used to satisfy Sec. 11.4.2 of ACI 318-11.

Where, the strength of reinforcing bar is determined in consideration of local market availability.

Reinforcing Bar specifications (BS 4449)



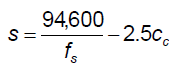
* + 1. Concrete cover

Concrete will have a minimum cover to the outermost reinforcement as listed below.

* + - Concrete below ground level with waterproof membrane or equivalent : 75mm
    - Concrete in contact with seawater and /or other liquids without waterproof membrane or equivalent : 100mm
    - Concrete for columns and beams : 50mm
    - Concrete for walls (exposed to dry winds) : 50mm
    - Concrete for walls (in dry chloride-free service environments) : 30mm
    - Concrete for slabs : 30mm
    1. Crack Control

This section prescribes rules for distribution of flexural reinforcement and the allowable stresses used to control flexural cracking in all members that are not compression controlled sections. The requirements of this section do not apply to load combinations that include earthquake loads. Permissible crack width for reinforced concrete shall be as follows.

* + - Other structures (beam and one way slab) : ACI 318(M)-11, section 10.6.4

, but not greater than 300mm (In environmental exposure case)

, but not greater than 300mm (Other case)

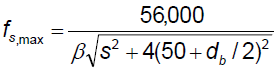
Where,

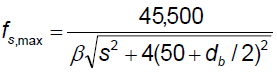
fs : Calculated stress in reinforcement at service load (Mpa)

Cc : Clear cover from the nearest surface in tension (mm)

s : Center-to-center spacing of flexural tension reinforcement (mm)

* + - Liquid retaining structures (beam and one way slab) : ACI 350-06, section 10.6.4

, (MPa, In normal environmental exposure areas.)

, (MPa, In severe environmental exposure areas.)

Where,

fs,max : Maximum allowable stress in reinforcement at service load (MPa)

: Strain gradient amplification factor

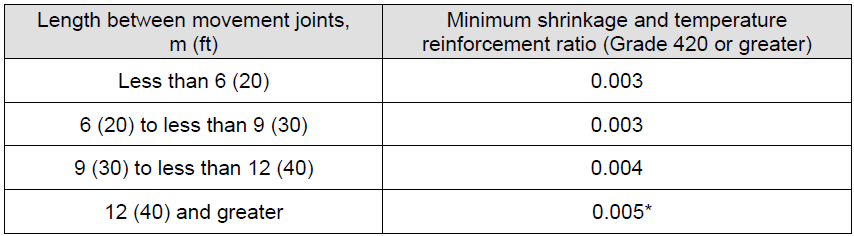
s : Center-to-center spacing of flexural tension reinforcement (mm)

db : Nominal diameter of bar (mm)

* + 1. Shrinkage and Temperature Reinforcement
    - Building and structures : ACI 318(M)-11, section 7.12

Deformed bars and welded wire fabric used(grade 420 or greater) : ρmin = 0.0018

* + - Water or liquid retaining structure : ACI 350-06, section 7.12



\* Maximum shrinkage and temperature reinforcement where movement joints are not provided.

Note: When using this table, the actual joint spacing shall be multiplied by 1.5 if no more than 50% of the reinforcement passes through the joint.

* + - Hydration peak consideration for major concrete liquid retaining structures: BS 8007

- Crack width : 0.2mm (BS 8007, 2.2.3.3)

- Fall in temperature between the hydration peak and ambient (T1)

: Refer to CIRIA C660

- Fall in temperature caused by seasonal variations(T2) : 25 °C (On ground)

: 15°C (Under ground)

* + 1. Development and Splices of Reinforcement

Development and splices of reinforcement will be determined based on chapter 12 of ACI 318(M)-11.

* + 1. Shear Required Strength

In Intermediate Moment Frame (IMF) of the seismic-force-resisting, the seismic design and details shall comply with the requirements of ACI, section 21.3. Especially the required shear strength is taken from load combinations (section.2.2.2) that include E, with E increased by the following amplifications.

* + - Columns : 3 times
    - Girders : 2 times
  1. FOUNDATION
     1. Safety Factor of Stability

Foundation will be designed to resist the overturning, uplift and sliding effects caused by applied forces with un-factored load case

* + - Overturning : 1.5
    - Sliding : 1.5
    - Buoyancy : 1.1
    - Allowable bearing capacity(static) : ultimate bearing capacity / 3.0
    - Allowable bearing capacity(seismic) : allowable bearing capacity(static) x 1.25

Note: allowable bearing capacity(static) : refer to soil investigation report (Table 11A, 11B)

* + 1. Subgrade Reaction Modulus

General foundation can be either footings or mats. They consist of reinforced concrete slabs formed directly on a prepared soil base. Footings may be spread, combined or continuous.

Allowable bearing capacity on foundation for the various combinations of footing dimensions and embedment shall be based on the site specific in the soil investigation report.

The subgrade reaction modulus for shallow foundation shall be based on the following formula.

* + - Vertical subgrade reaction modulus(KV)

KV = F.S x Qa /δ

where, Qa : Allowable soil bearing capacity

F.S : Safety factor

δ : Maximum design settlement

* + - Horizontal subgrade reaction modulus(Ks)

KS = λ KV

where, λ : Ratio of horizontal shear to vertical subgrade reaction modulus ( 1 / 3.5 )

* + 1. Friction Coefficient
    - Concrete on rock : 0.70
    - Concrete on gravel or coarse sand : 0.55
    - Concrete on backfill : 0.40
    - Concrete on surface protection material : 0.30
    1. Machine Foundations

Codes and standards for calculation are in accordance with DIN 4024, ISO or ACI 351.3R- 04. Foundations and structures supporting vibrating machinery shall be so proportioned that their natural frequency shall not fall within the range of 0.8 to 1.2 of the frequency of the machinery at normal operating conditions.

Further for major rotating machinery such as turbine generator, the amplitude of foundation or structure vibration at the equipment supports during normal operation shall not exceed the allowable amplitude specified by the machinery manufacturer or international codes.

As for rotating equipment located on floor slabs, beams with rather large stiffness shall be provided to support them where possible; and vibration analysis will be performed accordingly.

The above consideration may be omitted for vibrating equipment installed directly on concrete foundations more that the following ratio of the machinery weight.

* + - 3 times of the weight of centrifugal pumps, fans or other minor rotating machinery
    - 5 times of the weight of reciprocating compressors and pumps
    1. Concrete Surface Protection

All surfaces shall be pre-treated to be properly cured, free of dust, grease, oil, curing agent and other contaminants.

* + - Concrete in contact with soil

- Underneath foundation : Proofex Engage(4.5mm THK.)

- Vertical surface : Proofex 12(2.0mm THK.) + Protection Board(3.5mm THK.)

* + - Concrete in contact with atmosphere : Epoxy coating
    - Concrete in contact with seawater and /or other liquids

- Power plant : Epoxy coating

- R.O plant(direct contact to permeate water) : Epoxy coating(food grade)

The painting and corrosion protection for the concrete not in contact with soil in this project refer to Doc. No. MF-BM-GE-70-0001

* 1. Piling

Based on the results of soil investigation report provided by Owner, Bidder considered that the foundations supported by piles and their specifications are as follows:

* + - Turbine & Generator Foundation #1, #2 : Steel pile D610 (12t, 15m)
    - Except the above foundations, all foundation in CCGT area are considered as non-pile shallow type.

The foundation type (non-pile shallow type or pile type), Pile length, Pile type and quantity including construction methods are able to be changed as per the results of geo-technical investigation report by EPC.

* 1. PIPE RACK STRUCTURE
     1. Layout and Geometry

Yard pipe racks will generally be designed as braced frames in the longitudinal direction and as a series of transverse rigid frame main bents.

Longitudinal beams shall be provided as required to support piping or transfer thrusts to a braced bay (anchor bay).

Intermediate crossbeam shall be provided as required to reduce the unsupported length of piping, conduit or cable trays. Intermediate beams shall span between the longitudinal beams parallel to the main transverse bents.

Longitudinal stability of pipe racks shall be achieved by knee brace, braced bay or other systems depending on the magnitude of forces and layout.

Pipe racks must be designed with expansion joints in the structural system spaced not more than 50m apart.

Horizontal bracing of top flange in the plane of the transverse beams shall be considered at anchor bents due to the large horizontal loading.

* + 1. Loads and Load Combinations

Vertical Load

Vertical loads shall be due to weight of pipes, insulation, valves and other accessories, weight of fluid passing through the pipe, weight of the supporting structures and hydro-test weight of pipes.

Piping Horizontal Load

1) Frictional Force Parallel to the Pipe

With due regard to the friction forces caused by the expansion and contraction of pipe sliding across the pipe support, pipe support shall be designed for horizontal forces

2) Anchor Force

The beams of anchor bays shall be designed for anchor forces as given by piping engineer.

* + 1. Load Combination

For Allowable Stress Design

* + - DL
    - DL + T + LL
    - DL + 0.75(LL+ T)
    - DL + (W or 0.7E)
    - DL + 0.75(W or 0.7E) + 0.75LL
    - 0.6DL + W
    - 0.6DL + 0.7E

For Ultimate Strength Design

* + - 1.4DL
    - 1.2(DL + T) + 1.6LL
    - 1.2DL + (LL or 0.8W)
    - 1.2DL + 1.6W + LL
    - 1.2DL + E + LL
    - 0.9DL + 1.6W
    - 0.9DL + E

where,

DL: Dead load

W : Wind load

E : Earthquake load (Horizontal + Vertical components if applicable)

T : Thermal load (piping friction load)

LL : Live load (Hydro-test load, piping anchor load)

Allowable Stress design is for steel structures, according to provisions of AISC, including the additional requirements in section 6 above.

Ultimate strength design is for concrete structures, according to the provisions of ACI 318, including the additional requirements in section 7 above.

During hydro-test of pipes with full of water, this load shall not be combined with any other piping horizontal load, wind and earthquake load.

Piping friction forces are not considered to act at the same time as wind or earthquake forces, unless these friction forces are caused by normal operation conditions.

* 1. DRAINAGE

The storm water system will be constructed with French drain method. All down pipes from the roofs shall be connected to storm drainage system and drainage pipes that connect manhole to French drain trench shall be fiber cement or un-plasticized polyvinyl chloride (UPVC) pipes. The pipe shall be laid on sand bedding of thickness of more than 10cm + 1/10 of the pipe diameter. Road crossing storm water pipes will be protected with sleeves or concrete encasement.

The plant shall be provided with the following separated drainage systems.

* + - Storm drainage
    - Sewage/Sanitary waste water drainage
    - Oily/Chemical waste water drainage
    1. Flow Quantity of Drainage

The peak rain water run off for drainage system shall be based on the following rational formula.



where, Q : Quantity of run off (m3/sec)

C : Run off coefficient

Building area = 0.9

Paved area = 0.9

Graveled area = 0.2

Non-paved area = 0.15

I : Maximum rainfall intensity = 26.75mm/hr

A : Catchment’s area (hectare)

* + 1. Drain Design

Drain shall be designed for steady flow conditions and one-dimensional method of analysis shall be used.

Manning’s formula shall be used to size the drain.

Q = A x V

V = 1/n x R2/3 x S1/2 (m/sec)

where, Q : Discharge capacity (m3/sec)

A : Cross sectional area of projected flow (m2)

n : Roughness coefficient

P : Wetted perimeter (m)

R : Hydraulic radius, A/P (m)

S : Bed gradient

* + 1. Sewage Drain Design Concept

Sewage/Sanitary wastewater from sewage generating buildings will be collected to the concrete catch pits located close to the buildings through a separate network of underground UPVC pipes, and then the sewage collected in concrete catch pit will be led by pumping to the existing ADSSC sewage facilities.

* 1. Road and Paving
     1. General

Plant road shall be composed of asphalt pavement. Main roads shall be double lane roads with 8.0m wide vehicle carriageway and sub-roads shall have 6.0m and 4.0 m wide vehicle carriageway. The radius of bends shall not be less than 7.5m for eight and ten axle vehicles and 15m for 12 axle vehicles. In addition, minimum length of straight road not less than 35~40m shall be provided between reverse bends. Also, turning areas at blind ends and bollards shall be provided.

* + 1. Road Pavement

Road pavement will be designed in accordance with the local regulations and AASHTO requirement.

* + 1. Concrete Pavement

Concrete paving shall be designed based on the structural calculation, but minimum 150mm thickness at the necessary area.

* 1. Fencing and Gate
     1. Boundary Fence and Gate

Chain link fence with barbed wire will be provided around the ~~plant boundary including foreshore area~~ facility boundary. The minimum height of fence will be 3.0 meter high above ground. It will be topped by an extension with barbed wire facing out at 45º. The chain link fence will be galvanized or PVC coated.

A motor-operated sliding type gate will be placed across the main access road into the power plant area (from TP-1). The minimum height and width will be 3.0m and 10.0m, respectively. For foreshore area, chain link gate (swing type) will be placed at the entrance to Jetty and Intake Pump Station area.

* + 1. Fence and Gate for Transformer, Fuel Gas Supply System, and 500kV GIS Area

The fence and gate of chain link without barbed wire will be provided around Transformer, Fuel Gas Supply System, and 500kV GIS Area.

The chain link fence will be galvanized or PVC coated.

\*NOTE : Bidder considered that the height of fence(minimum 3.0 meter) is the dimension between the ground level and the top of barbed wire.

* 1. Landscaping

The area within plant boundary limit, not paved with asphalt, concrete, or gravel, will be covered with grass through either planting of sod, hydro-seeding or other methods, locally available. Trees will be planted, only along the boundary fence line on the west side of Power Plant area, which faces the adjacent BATANGAS-TABANGAO-LOBO Road.

For foreshore area, non-paved surface at Intake Pump Station area, surrounded by plant boundary limit and the access road to Jetty, will be covered with grass.

* 1. Building Description

Buildings will be designed and constructed in compliance with the proper safety requirements, building regulation and applicable standards.

Applied exterior finish system as follow.

1. Insulated Metal Cladding for Exterior Wall and Roofing
   * + Preformed metal cladding panels shall be fabricated from ~~0.7~~ 0.6 mm thick minimum galvanized sheet steel with Polyvinylidene Fluoride (PVDF).
     + Insulation shall be 50 mm ~~Polyurethane~~ Glass wool.
     + Cladding roofs shall be sloped as 10%.
2. Non-Insulated Metal Cladding for Exterior Wall and Roofing
   * + Preformed metal cladding panels shall be fabricated from ~~0.7~~ 0.6 mm thick minimum galvanized single sheet steel with Polyvinylidene Fluoride (PVDF).
     + Cladding roofs shall be sloped as 10%.
3. Concrete Masonry

Concrete Masonry Unit (CMU) walls shall be Hollow Concrete Block. All exterior CMU walls shall be cement plastered with emulsion paint. Inside face of CMU walls shall be cement plastered with emulsion paint. All occupied spaces shall have insulated exterior walls. Insulation shall be ~~50~~ 100 mm ~~Extruded Polystyrene~~ Glass wool.

1. Roofing System for Concrete Roof

Roof system shall be consisted of ~~concrete screed~~ concrete tile with slope mortar (min thk ~~50~~ 40mm), ~~50~~ 100mm rigid extruded polystyrene insulation board, water-proofing membrane and 2 layer of PE-sheets on reinforced concrete. A positive minimum slope of ~~10~~ 6.6mm per meter to drain shall be provided for concrete roofs.

* + 1. Building Size, Structure Type, Exterior Finish

The size, structure type and finish of buildings will be designed with the following:

|  |  |
| --- | --- |
| 1. Main Fuel Fabrication Building | |
| a) Dimension of Building | 58 x 125 x 16 m Height (3 story + 1B, 16,574 m2) |
|  |  |
| b) Type of structure | RC structure |
| c) Exterior finish | • Wall  - Concrete Block Wall  - Insulated Trapezoidal Cladding  • Roof : Concrete tile with slope mortar on 100mm Rigid Insulation + Waterproofing Membrane |
| d) Interior finish | Refer to 1.13.2 Building Interior Finish |
| 2. Administration Building | |
| a) Dimension of Building | 19.6 x 50.8 x 9.2 m Height (2 story, 1,723 m2) |
| b) Type of structure | RC structure |
| c) Exterior finish | • Wall  - Insulated Concrete Block Wall  • Roof : Concrete tile with slope mortar on 100mm Rigid Insulation + Waterproofing Membrane |
| d) Interior finish | Refer to 1.13.2 Building Interior Finish |
| 3. Workshop & Warehouse | |
| a) Dimension of Building | 16 x 36 x 7.2 m Height (1 story, 576 m2) |
| b) Type of structure | R.C structure |
| c) Exterior finish | • Wall  - Insulated Concrete Block Wall  • Roof : Concrete tile with slope mortar on 100mm Rigid Insulation + Waterproofing Membrane |
| d) Interior finish | Refer to 1.13.2 Building Interior Finish |
| 4. Fire Brigade Building | |
| a) Dimension of Building | 16.8 x 41.9 x 4.2/ 7/ 8.4 m Height (2 story, 801 m2) |
| b) Type of structure | R.C structure |
| c) Exterior finish | • Wall  - Insulated Concrete Block Wall  • Roof : Concrete tile with slope mortar on 100mm Rigid Insulation + Waterproofing Membrane |
| d) Interior finish | Refer to 1.13.2 Building Interior Finish |
| 5. Water Treatment Building | |
| a) Dimension of Building | 22.5 x 28 x 7 m Height (1 story, 630 m2) |
| b) Type of structure | R.C structure |
| c) Exterior finish | • Wall  - Insulated Concrete Block Wall  • Roof : Concrete tile with slope mortar on 100mm Rigid Insulation + Waterproofing Membrane |
| d) Interior finish | Refer to 1.13.2 Building Interior Finish |
| 6. Main Gate House | |
| a) Dimension of Building | 14.5 x 17.0 x 4.5 m Height (1 story, 245 m2) |
| b) Type of structure | R.C structure |
| c) Exterior finish | • Wall  - Insulated Concrete Block Wall  • Roof : Concrete tile with slope mortar on 100mm Rigid Insulation + Waterproofing Membrane |
| d) Interior finish | Refer to 1.13.2 Building Interior Finish |
| 7. Gas Storage Building | |
| a) Dimension of Building | 19.1 x 23.2 x 6.0 m Height (1 story, 442 m2) |
| b) Type of structure | R.C structure + Steel Structure(Roof) |
| c) Exterior finish | • Wall  - Insulated Concrete Block Wall  • Roof : Concrete tile with slope mortar on 100mm Rigid Insulation + Waterproofing Membrane / Insulated Trapezoidal Cladding |
| d) Interior finish | Refer to 1.13.2 Building Interior Finish |
| 8. Fire Water Pump Building | |
| a) Dimension of Building | 11 x 25 x 6 m Height (1 story, 275 m2) |
| b) Type of structure | R.C structure |
| c) Exterior finish | • Wall  - Insulated Concrete Block Wall  • Roof : Concrete tile with slope mortar on 100mm Rigid Insulation + Waterproofing Membrane |
| d) Interior finish | Refer to 1.13.2 Building Interior Finish |
| 9. Raw Water Pump Building | |
| a) Dimension of Building | 14.6 x 5 x 6 m Height (1 story, 73 m2) |
| b) Type of structure | R.C structure |
| c) Exterior finish | • Wall  - Insulated Concrete Block Wall  • Roof : Concrete tile with slope mortar on 100mm Rigid Insulation + Waterproofing Membrane |
| d) Interior finish | Refer to 1.13.2 Building Interior Finish |
| 10. Covered Car Parking Shelter(Type A) #1, #2, #3 | |
| a) Dimension of Building | 5.3 x 30 x 3.4 m Height (1 story, 159 m2) x 3 |
| b) Type of structure | Steel structure |
| c) Exterior finish | • No Wall  • Roof : Single Trapezoidal Cladding |
| d) Interior finish | Refer to 1.13.2 Building Interior Finish |
| 11. Covered Car Parking Shelter(Type B) | |
| a) Dimension of Building | 14 x 18 x 7.2 m Height (1 story, 252 m2) |
| b) Type of structure | Steel structure |
| c) Exterior finish | • No Wall  • Roof : Single Trapezoidal Cladding |
| d) Interior finish | Refer to 1.13.2 Building Interior Finish |

* + 1. Building Interior Finish

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **1. Main Fuel Fabrication Building** | | | | |
| **Room Name** | **Floor** | **Wall** | **Ceiling** | **Remark** |
| **1) Basement Floor** | | | | |
| Corridor / FF Waste Collection Tank / Liquid Waste Water Treatment Room / Stair #4 | Epoxy Paint Nuclear on FF Concrete | Epoxy Paint Nuclear on FF Concrete | Epoxy Paint Nuclear on FF Concrete |  |
| Cooling Water System Area | Epoxy Paint on Steel Trowel Finish | Epoxy Paint on FF Concrete | Epoxy Paint on Fair Faced Concrete |  |
| Stair #3 | Unglazed Ceramic Tile | Emulsion Paint on Fair Faced Concrete | Emulsion Paint on Fair Faced Concrete |  |
| Equipment Laydown | Epoxy Paint on Steel Trowel Finish | Epoxy Paint on FF Concrete | N.A |  |
|  |  |  |  |  |
| **1) Ground Floor** | | | | |
| Corridor / Health Physics Room / Laundry Room / Office (in UO2 Pellet MFG. Room) / Pellet Laboratory / Radiation Measurement Room | Epoxy Paint Nuclear on FF Concrete | Epoxy Paint Nuclear on FF Concrete | Suspended Acoustic Tiled Ceiling on Fair Faced Concrete |  |
| Uranium Storage Room(Pallet Storage) / Corridor / Decontamination Room / Fuel Rod 2nd Welding Room / Gd Pelletizing MFG. Room / Gd Rod Welding Room / Liquid Waste Treatment Room / Resingering & Performance Test Room / Solid Waste Treatment & Storage Room / Stair #1 / Stair #2 / Stair #4 / Stair #5 / UO2 Pellet MFG. Room | Epoxy Paint Nuclear on FF Concrete | Epoxy Paint Nuclear on FF Concrete | Epoxy Paint Nuclear on FF Concrete |  |
| Oratory (Prayer Room) -F / Oratory (Prayer Room) -M | Carpet Tile on Steel trowel Finish | Emulsion Paint on Fair Faced Concrete | Suspended Acoustic Tiled Ceiling on Fair Faced Concrete |  |
| Change Room (M) / Change Room (W) | Unglazed Ceramic Tile | Epoxy Paint Nuclear on FF Concrete | Suspended Acoustic Tiled Ceiling on Fair Faced Concrete |  |
| Hot Shower Room (F) / Hot Shower Room (M) / Toilet (M & W) / Toilet(M & W) | Unglazed Ceramic Tile | Glazed Ceramic Tile | Suspended Moisture Resistant Tiled Ceiling on Fair Faced Concrete |  |
| Locker Room (M) / Locker Room (W) | Unglazed Ceramic Tile | Epoxy Paint on FF Concrete | Suspended Acoustic Tiled Ceiling on Fair Faced Concrete |  |
| Corridor / Entry Vestibule / Lobby / Main Hall Lobby / Reception Area | Marble Tile | Emulsion Paint on Fair Faced Concrete | Suspended Acoustic Tiled Ceiling on Fair Faced Concrete |  |
| Stair #3 / Stair #6 / Stair #7 | Unglazed Ceramic Tile | Emulsion Paint on Fair Faced Concrete | Emulsion Paint on Fair Faced Concrete |  |
| SAS Room / Safety Guard | Heavy Duty P.V.C Tile | Emulsion Paint on Fair Faced Concrete | Suspended Acoustic Tiled Ceiling on Fair Faced Concrete |  |
| Air Compressor Room / DC/UPS Room / EDG Room / FA Cleaning Room / FA Packing Room / Fuel Assembly + Storage Room / Fuel Rod 1st Welding Room / GT Welding Area / Maintenance Room / NDT CT'L Room / Storage / Tool Room | Epoxy Paint on Steel Trowel Finish | Epoxy Paint on FF Concrete | Epoxy Paint on Fair Faced Concrete |  |
| Battery Room | Acid Resistant Paint on Steel Trowel Finish | Acid Resistant Paint on Cement Plaster" | Acid Resistant Paint on Fair Faced Concrete" |  |
| Lecture Room / Lounge / Meeting Room | Heavy Duty P.V.C Tile | Epoxy Paint on FF Concrete | Suspended Acoustic Tiled Ceiling on Fair Faced Concrete |  |
| Calibration Room / Component Cleaning Room / Corridor / Metallurgical Laboratory / Receiving & Inspection Room | Epoxy Paint on Steel Trowel Finish | Epoxy Paint on FF Concrete | Suspended Acoustic Tiled Ceiling on Fair Faced Concrete |  |
| Truck Zone (no wall) | Epoxy Paint on Steel Trowel Finish |  |  |  |
|  |  |  |  |  |
| **2) 1st Floor** | | | | |
| Corridor / Corridor (Visitor Tour) / Lobby / Lobby-2 / Network Equipment Room / Office-1 / Office-2 / Office-3 (Rest Room) / Office-4 (Public Address Room) / Office-5 / Office-6 (Conference Room) / Office-7 / Office-8 / Office-9 | Heavy Duty P.V.C Tile | Emulsion Paint on Fair Faced Concrete | Suspended Acoustic Tiled Ceiling on Fair Faced Concrete |  |
| Consumable Storage Room / Spare Parts Storage Room | Epoxy Paint on Steel Trowel Finish | Emulsion Paint on Fair Faced Concrete | Emulsion Paint on Fair Faced Concrete |  |
| Stair #4 / Stair #5 | Epoxy Paint Nuclear on FF Concrete | Epoxy Paint Nuclear on FF Concrete | Epoxy Paint Nuclear on FF Concrete |  |
| Electrical Room / FM200 Cylinder Room | Epoxy Paint on Steel Trowel Finish | Epoxy Paint on FF Concrete | Epoxy Paint on Fair Faced Concrete |  |
| Electrical and I&C Component Room / Process Electric Room / Utility Control Room | Anti-Static PVC Tile on Raised Floor(H=600) with Dust free paint beneath Access Floor | Emulsion Paint on Fair Faced Concrete | Suspended Acoustic Tiled Ceiling on Fair Faced Concrete |  |
| Toilet(M & W) | Unglazed Ceramic Tile | Glazed Ceramic Tile | Suspended Moisture Resistant Tiled Ceiling on Fair Faced Concrete |  |
| Stair #3 / Stair #6 / Stair #7 | Unglazed Ceramic Tile | Emulsion Paint on Fair Faced Concrete | Emulsion Paint on Fair Faced Concrete |  |
| Oratory (Prayer Room) -M | Carpet Tile on Steel trowel Finish | Emulsion Paint on Fair Faced Concrete | Suspended Acoustic Tiled Ceiling on Fair Faced Concrete |  |
|  |  |  |  |  |
| **3) 2nd Floor** | | | | |
| Additive & GD203 Storage / Air Filteration Area / Air Sampler Pump Room / Exhaust Fan Area / Gd Powder Preparation Room / Maintenance Room / PLC & MCC Room / Powder Preparation Room / Shaft / Solid Waste Treatment & Storage Room / Stack Monitoring Room / Stair #1 / Stair #2 / Stair #4 / Stair #5 | Epoxy Paint Nuclear on FF Concrete | Epoxy Paint Nuclear on FF Concrete | Epoxy Paint Nuclear on FF Concrete |  |
| Corridor / Lobby-2 | Epoxy Paint Nuclear on FF Concrete | Epoxy Paint Nuclear on FF Concrete | Suspended Acoustic Tiled Ceiling on Fair Faced Concrete |  |
| Chemistry Laboratory | Chemical Resistant Paint on Steel trowel Finish | Chemical Resistant Paint on FF Concrete | Suspended Acoustic Tiled Ceiling on Fair Faced Concrete |  |
| Stair #3 / Stair #6 / Stair #7 | Unglazed Ceramic Tile | Emulsion Paint on Fair Faced Concrete | Emulsion Paint on Fair Faced Concrete |  |
| Corridor (Visitor Tour) / Lobby / Office-1 / Office-2 | Heavy Duty P.V.C Tile | Emulsion Paint on Fair Faced Concrete | Suspended Acoustic Tiled Ceiling on Fair Faced Concrete |  |
| AHU Room / Supply Air Fan Room | Epoxy Paint on Steel Trowel Finish | Epoxy Paint on FF Concrete | Epoxy Paint on Fair Faced Concrete |  |
| Toilet (M & W) | Unglazed Ceramic Tile | Glazed Ceramic Tile | Suspended Moisture Resistant Tiled Ceiling on Fair Faced Concrete |  |
| Oratory (Prayer Room) -F | Carpet Tile on Steel trowel Finish | Emulsion Paint on Fair Faced Concrete | Suspended Acoustic Tiled Ceiling on Fair Faced Concrete |  |
|  |  |  |  |  |
| **2. Administration Building** | | | | |
| **Room Name** | **Floor** | **Wall** | **Ceiling** | **Remark** |
| 1. **Ground floor** | | | | |
| Corridor / Entry Vestibule / Lobby / Reception Area | Marble Tile | Emulsion Paint on Fair Faced Concrete | Suspended Acoustic Tiled Ceiling on Fair Faced Concrete |  |
| Break Room / Conference Room / Control Center / Emergency Management Center and Alarm Center / Medical Room / Security Office | Heavy Duty P.V.C Tile | Emulsion Paint on Fair Faced Concrete | Suspended Acoustic Tiled Ceiling on Fair Faced Concrete |  |
| Oratory (Prayer Room) -F / Oratory (Prayer Room) -M | Carpet Tile on Steel trowel Finish | Emulsion Paint on Fair Faced Concrete | Suspended Acoustic Tiled Ceiling on Fair Faced Concrete |  |
| DC/UPS Room / Electrical Room / FM200 Cylinder Room / Storage-2 | Epoxy Paint on Steel Trowel Finish | Emulsion Paint on Cement Plaster | Emulsion Paint on Fair Faced Concrete |  |
| Battery Room | Acid Resistant Paint on Steel Trowel Finish | Acid Resistant Paint on Cement Plaster | Acid resistant Paint on Fair Faced Concrete |  |
| Janitor / Toilet (F) / Toilet (M) | Unglazed Ceramic Tile | Glazed Ceramic Tile | Suspended Moisture Resistant Tiled Ceiling on Fair Faced Concrete |  |
| Stair-1 / Stair-2 | Unglazed Ceramic Tile | Emulsion Paint on Cement Plaster | Emulsion Paint on Fair Faced Concrete |  |
| Dining Entry Vestibule / Dining Room / Food Storage / Kitchen | Unglazed Ceramic Tile | Glazed Ceramic Tile | Emulsion Paint on Fair Faced Concrete |  |
|  |  |  |  |  |
| 1. **1st floor** | | | | |
| Break Room / Conference Room / Document Storage / Manager Office-1 / Manager Office-2 / Manager Office-3 / Office-1 / Office-2 / Office-3 / Office-4 / Open Office / Plant Manager Office / Secretary Room / Storage-2 | Heavy Duty P.V.C Tile | Emulsion Paint on Fair Faced Concrete | Suspended Acoustic Tiled Ceiling on Fair Faced Concrete |  |
| Oratory (Prayer Room) -M | Carpet Tile on Steel trowel Finish | Emulsion Paint on Fair Faced Concrete | Suspended Acoustic Tiled Ceiling on Fair Faced Concrete |  |
| Janitor / Shower & Locker Room (M) / Toilet / Toilet (F) / Toilet (M) | Unglazed Ceramic Tile | Glazed Ceramic Tile | Suspended Moisture Resistant Tiled Ceiling on Fair Faced Concrete |  |
| Corridor / Lobby | Marble Tile | Emulsion Paint on Fair Faced Concrete | Suspended Acoustic Tiled Ceiling on Fair Faced Concrete |  |
| Stair-1 / Stair-2 | Unglazed Ceramic Tile | Emulsion Paint on Cement Plaster | Emulsion Paint on Fair Faced Concrete |  |
|  |  |  |  |  |
| **3. Workshop & Warehouse** | | | | |
| **Room Name** | **Floor** | **Wall** | **Ceiling** | **Remark** |
| Chemical Storage Room / Conventional Material Warehouses / Electrical Room / Electrical and I&C Workshop / FM200 Cylinder Room / Mechanical Workshop (Maintenance) / Oils and Flammable Products Warehouse / Tool Room | Epoxy Paint on Steel Trowel Finish | Emulsion Paint on Cement Plaster | Emulsion Paint on Fair Faced Concrete |  |
| Corridor 1 / Corridor 2 / Office 1 / Vestibule | Heavy Duty P.V.C Tile | Emulsion Paint on Fair Faced Concrete | Suspended Acoustic Tiled Ceiling on Fair Faced Concrete |  |
| Shower & Locker Room (M) / Toilet(M) | Unglazed Ceramic Tile | Glazed Ceramic Tile | Suspended Moisture Resistant Tiled Ceiling on Fair Faced Concrete |  |
|  |  |  |  |  |
| **4. Fire Brigade Building** | | | | |
| **Room Name** | **Floor** | **Wall** | **Ceiling** | **Remark** |
| **1) Ground Floor** | | | | |
| Ambulance Bay / Electrical Room / FM200 Cylinder Room / Fire Truck Bay / Tool Room | Epoxy Paint on Steel Trowel Finish | Emulsion Paint on Cement Plaster | Emulsion Paint on Fair Faced Concrete |  |
| First Aid Room / Kitchen / Medical Station | Unglazed Ceramic Tile | Glazed Ceramic Tile | Suspended Acoustic Tiled Ceiling on Fair Faced Concrete |  |
| Command Room / Corridor | Heavy Duty P.V.C Tile | Emulsion Paint on Fair Faced Concrete | Suspended Acoustic Tiled Ceiling on Fair Faced Concrete |  |
| Toilet (M & F) | Unglazed Ceramic Tile | Glazed Ceramic Tile | Suspended Moisture Resistant Tiled Ceiling on Fair Faced Concrete |  |
| Stair | Heavy Duty P.V.C Tile | Emulsion Paint on Fair Faced Concrete | Emulsion Paint on Fair Faced Concrete |  |
|  |  |  |  |  |
| **2) 1st Floor** | | | | |
| Shower & Locker Room (M & F) | Unglazed Ceramic Tile | Glazed Ceramic Tile | Suspended Moisture Resistant Tiled Ceiling on Fair Faced Concrete |  |
| Break Room / Corridor / Sleeping Quarters / Staff Room | Heavy Duty P.V.C Tile | Emulsion Paint on Fair Faced Concrete | Suspended Acoustic Tiled Ceiling on Fair Faced Concrete |  |
| Stair | Heavy Duty P.V.C Tile | Emulsion Paint on Fair Faced Concrete | Emulsion Paint on Fair Faced Concrete |  |
|  |  |  |  |  |
| **5. Water Treatment Building** | | | | |
| **Room Name** | **Floor** | **Wall** | **Ceiling** | **Remark** |
| Chemical Storage Room / Water Treatment Room | Chemical Resistant Paint on Steel trowel Finish | Chemical Resistant Paint on FF Concrete | Epoxy Paint on Fair Faced Concrete |  |
| Laboratory Room | Unglazed Ceramic Tile | Glazed Ceramic Tile | Suspended Acoustic Tiled Ceiling on Fair Faced Concrete |  |
| Control Room | Anti-Static PVC Tile on Raised Floor(H=600) with Dust free paint beneath Access Floor | Emulsion Paint on Cement Plaster | Suspended Acoustic Tiled Ceiling on Fair Faced Concrete |  |
| FM200 Cylinder Room / MCC Room | Epoxy Paint on Steel Trowel Finish | Emulsion Paint on Cement Plaster | Emulsion Paint on Fair Faced Concrete |  |
| Toilet | Unglazed Ceramic Tile | Glazed Ceramic Tile | Suspended Moisture Resistant Tiled Ceiling on Fair Faced Concrete |  |
|  |  |  |  |  |
| **6. Main Gate House** | | | | |
| **Room Name** | **Floor** | **Wall** | **Ceiling** | **Remark** |
| Guard Room / Reception & Waiting Room / Vestibule | Marble Tile | Emulsion Paint on Fair Faced Concrete | Suspended Acoustic Tiled Ceiling on Fair Faced Concrete |  |
| Break Room / Corridor / Kitchen / Office / Security Control Room / Storage Room | Heavy Duty P.V.C Tile | Emulsion Paint on Fair Faced Concrete | Suspended Acoustic Tiled Ceiling on Fair Faced Concrete |  |
| Shower & Locker Room (M & F) / Toilet (F) / Toilet (M) | Unglazed Ceramic Tile | Glazed Ceramic Tile | Suspended Moisture Resistant Tiled Ceiling on Fair Faced Concrete |  |
|  |  |  |  |  |
| **7. Gas Storage Building** | | | | |
| **Room Name** | **Floor** | **Wall** | **Ceiling** | **Remark** |
| H2 Supply/Storage Area / Helium Supply/Storage Area | Epoxy Paint on Steel Trowel Finish | Emulsion Paint on Cement Plaster | Exposed Roof Cladding |  |
| Ar Gas Room / Forming Gas Supply/Storage Area / N2 Gas Room | Epoxy Paint on Steel Trowel Finish | Emulsion Paint on Cement Plaster | Emulsion Paint on Fair Faced Concrete |  |
|  |  |  |  |  |
| **8. Fire Water Pump Building** | | | | |
| **Room Name** | **Floor** | **Wall** | **Ceiling** | **Remark** |
| Engine Driven Fire Water Pump Room / Motor Driven Fire Water Pump Room | Epoxy Paint on Steel Trowel Finish | Emulsion Paint on Cement Plaster | Emulsion Paint on Fair Faced Concrete |  |
|  |  |  |  |  |
| **9. Raw Water Pump Building** | | | | |
| **Room Name** | **Floor** | **Wall** | **Ceiling** | **Remark** |
| Raw Water Pump Room | Epoxy Paint on Steel Trowel Finish | Emulsion Paint on Cement Plaster | Emulsion Paint on Fair Faced Concrete |  |
|  |  |  |  |  |
| **10. Covered Car Parking Shelter(Type A) #1, #2, #3** | | | | |
| **Room Name** | **Floor** | **Wall** | **Ceiling** | **Remark** |
| Covered Car Parking Shelter | N/A | N/A | Single Trapezoidal Cladding |  |
| **11. Covered Car Parking Shelter(Type B)** | | | | |
| Covered Car Parking Shelter | N/A | N/A | Single Trapezoidal Cladding |  |

1. Miscellaneous