ELECTRICAL DESIGN CRITERIA

REV.	Date	Purpose of Issue	ORIG.	BY	PREP'D	CHECK'D	APP'D	COMPANY APP'D
					S.S.	A. S	M.A.	
02	27-Jun-21	Approved for Construction	IOEC	-	S.Saffari	A.Samadi	M.Aghaei	-
01	17-May-20	Issue for Approval	IOEC	-	S.Saffari	A.Samadi	M.Aghaei	-
00	20-Dec-20	Issue for Comment	IOEC	-	A.Samadi	A.Samadi	M.Aghaei	-

TABULATION OF REVISED PAGES

Sheet	Revisions					
	00	01	02	03	04	05
1	X	X	X			
2	X	X	X			
3	X	X	X			
4	X					
5	X		X			
6	X					
7	X					
8	X					
9	X	X				
10		X				

Sheet	Revisions					
	00	01	02	03	04	05

Sheet	Revisions					
	00	01	02	03	04	05

REVISION RECORD SHEET

REV. NO.	PURPOSE	LIST OF UPDATED MODIFIED SECTIONS IF ANY
01	Modification based on the agreement & endorsement	According to highlighted items
02	Issued as AFC Revision	-

Table of Contents

1. INTRODUCTION

1.1. Development Overview

The Resalat Field previously known as Rakhsh Field, is located in the Persian Gulf, some 80 km to the South of Lavan Island, in water depth of 65-75 meters. The facilities which were originally developed in 1968 have sustained some damage due to the Iran/Iraq war and adverse climate conditions thereafter.

To increase oil production capacity from this field (adding 12,000 stock barrels per day to current production), Iranian Offshore Oil Company (IOOC) has defined new project which includes Engineering, Drilling, Procurement, Construction for following items:

- New satellite Wellhead Platform (WHP1) with totally nine (9) conductor slots.
- Development and renovation of Existing offshore complex consist of new power generation, control system, HVAC, Electrical /control room, electrical panels(LV &MV),process & utility piping, and all necessary activities which shall be done for connection to existing facilities(Tie in requirements)
- Drilling of two new production wells in R1 and three wells in WHP1 platform and Re-entry and work-over of one existing well in R1 platform.
- One 10" productions submarine pipeline from WHP1 to PP and a single submarine cable (power and data) from SP to WHP1
- Inspection, Strengthening, Modification and Repair of existing R1 complex Jackets and topsides and replacement of boatlanding and Barge Bumpers.

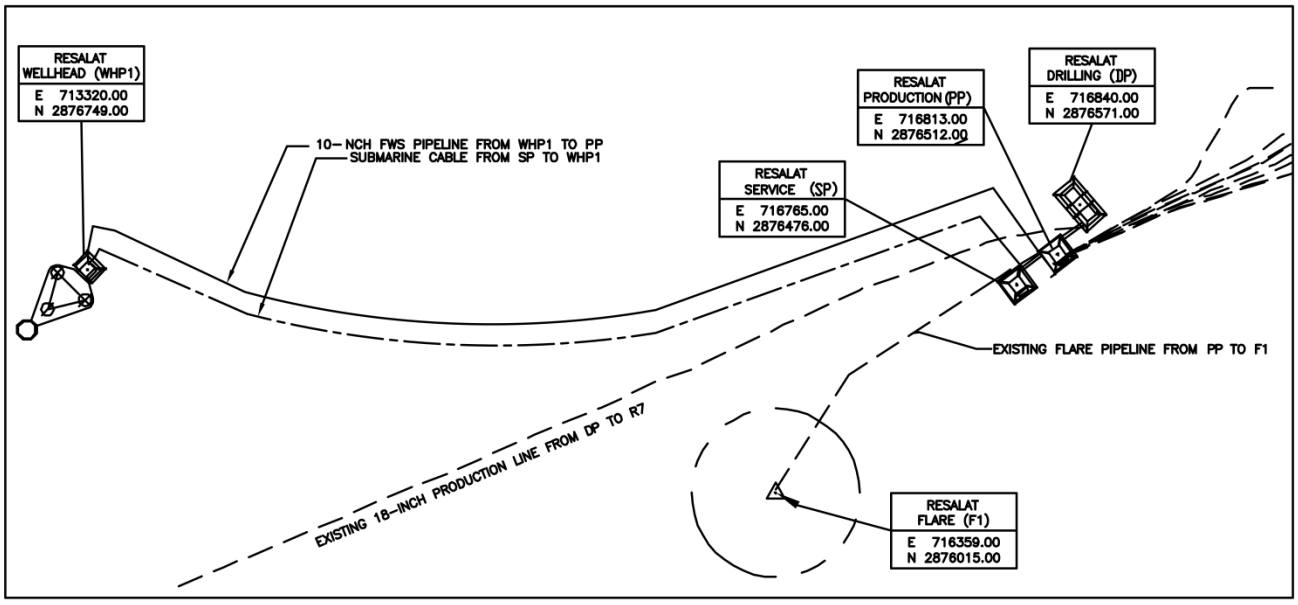

Figure 1: Resalat Development Field Layout (Datum ED 77, Zone 39, Cent. Meridian 51° East)

1.2. Purpose of Scope

This document describes the main concepts required for the general electrical design, equipment and Material for transformer, MV and LV switchboards, newcables between central and new facilities and other electrical equipment such as motor and the required cables, starter, AC and DC UPS's and etc. to be utilized for the project.

1.3. Definitions

PROJECT	Resalat Oil Field Development – Phase 1
COMPANY	Iranian Offshore Oil Company (IOOC)
CONTRACTOR	Consortium of Iranian Offshore Engineering and Construction Company (IOEC) and Intelligent Solutions Inc. (ISI)
SUB-CONTRACTOR	Tehran Raymand Consulting Engineers (TRCE)
PURCHASER	Any firm who buy services, material and/or equipment for execution of the project within a dedicated contract.
SUPPLIER	Any vendor, manufacturer who supply any Service, Material or Equipment for the project
SHALL	Refer to a mandatory requirement
SHOULD	Refer to a recommendation
MAY	Refer to one acceptable course of action

2. CODES AND STANDARDS

LRSL-000-PM-LI-743	List of Applicable Codes and Standards

3. ABBREVAIATION

MV	Medium Voltage
LV	Low Voltage
ICSS	Integrated Control and Safety System

UPS	Uninterruptible Power Supply
MCC	Motor Control Centre
LCS	Local Control Station
ONAN	Oil Natural Air Natural
ACB	Air Circuit Breaker
VCB	Vacuum Circuit Breaker
NER	Neutral Earthing Resistor
SCADA	Supervisory, Control and Data Acquisition
VT	Voltage Transformer
CT	Current Transformer
LTR	Local Technical Room
MCB	Miniature Circuit Breaker
RCCB	Residual Current Circuit Breaker
MCCB	Molded Case Circuit Breaker
PCS	Process Control System

4. GENERAL STATEMENT

The attached GENERAL ELECTRICAL DESIGN PHILOSOPHY (ENG-ELE-SP-1000) is confirmed as the Electrical Design Criteria, except as added/modified/deleted herein, and renumbered/reissued as Electrical Design Criteria (LRSL-000-EL-DB-603) for Resalat Oil Field Development Project, Phase 1.

5. ADDITION/MODIFICATION/DELETION

The following items refer to the attached GENERAL ELECTRICAL DESIGN PHILOSOPHY (ENG-ELE-SP-1000). The clauses set out below modify or replace the clauses in the original specification as noted.

5.1. Section: 5.3.1 POWER SUPPLY SYSTEM	
Deletion	The LV Emergency Switchgear/MCC for all Plant areas will be located in a separate room in the Main Electrical Substation.
5.2. Section: 5.3.3 -ELECTRICAL SYSTEM OPERATING PHILOSOPHY	
Modification	Mains electrical power shall be generated at high voltage by means of ~~turbine~~ Gas Engine driven generating sets. During normal operation, the emergency switchboard will be fed from the mains power supply and will provide power to essential and life support supplies (like AC/DC UPS systems, emergency lighting, F&G system, HVAC and ...) and to the ~~turbine~~ gas engine auxiliaries.
5.3 Section: 5.5.1 MAIN GENERATORS	
Modification	~~Turbine~~ Gas engine driven main generator sets shall be rated on a continuous running duty basis, type S1 in accordance with IEC 60034-1 and shall be expressed in kilo-Volt-Amperes available at the terminals at rated voltage, frequency and power factor when connected to a virtually non-deforming system and supply a virtually balanced load. ~~Turbine~~ Gas engine driven main generator set configuration and load requirements shall be stated on the relevant project documents. Associated gas will not be available during black start. Therefore, the ~~Turbine~~ Gas engine driven main generator sets shall be dual fuel (both associated gas and diesel). It shall be possible to operate the turbine driven main generator sets in both droop and isochronous mode. The total system shall perform equal load sharing both with respect to active and reactive load between the running ~~Turbine~~ Gas engine driven main generator sets.
Modification	Unless otherwise specified the ~~Turbine~~ Gas engine driven main generator sets shall be located outdoors in dedicated enclosures. The turbine driven main generator sets control panels shall be located indoors in the main switchgear room. The ~~Turbine~~ Gas engine driven main generator sets control panels shall contain the turbine control system, vibration monitoring equipment, electronic fuel governor control system, an effective load sharing system and regulation facilities for voltage and synchronization.

5.4 Section: 5.5.7 UPS EQUIPMENT	
Modification	Note: 1 x 100% DC rectifier with 1 x 100% battery configuration for each main ~~Turbine~~ Gas engine driven package shall be considered.
5.5 Section 5.6.4 CURRENT TRANSFORMERS	
Modification	The rated secondary currents shall be ~~5A~~ 1A~~, except that for remote metering, 1A shall be used. 1A shall also be used for protection where the burden at 5A would be excessive when using standard control cables.~~
5.6 Section 5.6 METERING, PROTECTION AND CONTROL EQUIPMENT	
Modification	Relays will be modular type ~~and draw-out construction~~ with test plugs provided for selected relays.
5.7 Section 5.5.4 TRANSFORMER	
Modification	Transformers shall be in accordance with the project standards, hermitically sealed, totally filled (~~without gas cushion~~ with gas cushion) with Synthetic Oil (such as silicon oil).
5.8 Section 5.7.6 JUNCTION BOXES AND LOCAL CONTROL STATION (LCS)	
Modification	Ammeter (~~3 phase~~ 1 phase) for all motors > 4KW
5.9 Section 5.6.8 METERING AND INDICATION	

Modification	All motors ~~greater than and equal to 4kW~~ shall be provided with ~~an~~ three ammeters at the motor starter panel.

ELECTRICAL
DESIGN PHILOSOPHY

REV	DATE	PREPARED	CHECKED/APPROVED	DESCRIPTION
01	Nov. 2017	B.L, B.S	M.R.M	

مدیریت توسعه بازار تأسیسات دریایی ایران

خوانده شد و مورد تایید است

مدیریت توسعه بازار تأسیسات دریایی ایران

خوانده شد و مورد تایید است

Table of Contents

مدیریت توسعه بازار تأسیسات دریایی ایران

خوانده شد و مورد تایید است

مدیریت توسعه بازار تأسیسات دریایی ایران

خوانده شد و مورد تایید است

1. INTRODUCTION

Iranian Offshore Oil Company (IOOC) with over half century of experience has 6 major operational areas in the Persian Gulf.

These six areas include Kharg, Sirri, Lavan, Bahregan, Queshm, Kish and relevant onshore and offshore facilities.

Description of this section shall be continued as per relevant project.

2. DEFINITION OF TERMS

COMPANY	Means Iranian Offshore Oil Company (I.O.O.C)
COMPANY DOCUMENTS	Means all information, data, documents calculations, notes, data sheets, computer data, specifications, drawings, plans, sketches, procedures, letters, reports and the like to be provided by COPMANY.
CONTRACTOR	Refers to the persons, firm or company whose tender has been accepted by the company.
SUB-CONTRACTOR	Means the contractor to whom some part of the contract has been awarded to undertake and perform part of work.
EXECUTOR	Executor is the party which carries out all or part of construction and/or commissioning for the project.
INSPECTOR	The Inspector referred to in this Standard is a person/persons or a body appointed in writing by the company for the inspection of fabrication and installation work.
PROJECT	Means the specified job defined for contractor according to scope of work.

مدیریت توسعه بازار تاسیسات دریایی ایران

خوانده شد و مورد تایید است

TPA	Means the project Third Party Authorized Agency/company (or the representative person) which shall be approved by company.
VENDOR	Means the manufacturer and/or supplier of a commodity, system or piece of equipment to perform the specified duty.
PURCHASER	Means the Company/Contractor as the client of VENDOR for a Job, duty, system or equipment to be purchased.
WORK	Means the whole activities to be performed by EPC CONTRACTOR under the CONTRACT to fulfill Scope of Work
YARD	Means worksite upon which CONTRACTOR shall perform fabrication, erection, pre-commissioning, and commissioning activities prior to transportation of component to the SITE.
SITE	Means the location of installation/construction and operation of the project.
SHALL	Is used where a provision is mandatory.
SHOULD	Is used where a provision is advisory only.
MAY	is used for acceptable alternatives.

3. GENERAL

3.1 SCOPE OF THIS DOCUMENT

This document describes the main concepts required for the general electrical design, equipment and material for transformer, MV and LV switchboards, new cables between central and new facilities and other electrical equipment such as motor and the required cables, starter, AC and DC UPS's and etc. to be utilized for the project.

مدیریت توسعه بازار تأسیسات دریایی ایران

خوانده شد و مورد تایید است

For the new platforms MV and LV switchboard and technical room will be built on each platform. 230V AC UPS, 110V DC UPS, navigation system with a dedicated DC UPS powered from solar arrays as back up, etc. shall be provided.

This document is the basis for other electrical documents. Any conflicts between this document and any other document of this project or codes and standards, shall be brought into attention in writing for clarification prior to any further action. In addition, attention shall be immediately called to any error or omission in this specification.

Any conflict between requirement of this document, specifications, contract documents, standards and codes of practice shall be referred to the COMPANY for clarification. Where conflict occur, the order of precedence shall be as follows

- Statutory requirements
- Contract scope of work
- Electrical design philosophy
- Specifications
- Applicable codes and standards

3.2 ABBREVIATIONS

Standard terms and abbreviations are used in this document. Listed below are the abbreviations that may be used here and in subsequent documents.

MV	Medium Voltage
LV	Low Voltage
ICSS	Integrated Control and Safety System
RMU	Ring Main Unit
UPS	Uninterruptible Power Supply
MCC	Motor Control Centre
LCS	Local Control Station
VDU	Video Display Unit
LNAN	Liquid Natural Air Natural

مدیریت توسعه بازار تاسیسات دریایی ایران

خوانده شد و مورد تایید است

ACB	Air Circuit Breaker
VCB	Vacuum Circuit Breaker
NER	Neutral Earthing Resistor
SCADA	Supervisory, Control and Data Acquisition
FBA	Factory-built Assemblies
IACS	International Annealed Copper Standard
VT	Voltage Transformer
CT	Current Transformer
LTR	Local Technical Room
MCB	Miniature Circuit Breaker
RCCB	Residual Current Circuit Breaker
MCCB	Molded Case Circuit Breaker
COG	Centre of Gravity
SWL	Safe Working Load
PCS	Process Control System

4. DESIGN

4.1 GENERAL

The electrical systems shall be designed to provide:

- Safety for operating and maintenance personnel. (Personnel safety involves no compromise, the safest system according to SOLAS[safety of life at sea] shall be considered)
- Safety to materials, platform structure and electrical equipment
- Reliability of power supply and electrical equipment
- Good operability and easy maintenance of equipment
- No risk of fire
- Adequate flexibility for future installations and interchangeability

مدیریت توسعه بازار تأسیسات دریایی ایران
خوانده شد و مورد تایید است

- All electrical equipment shall be designed, purchased and erect for a minimum life time of 25 years

4.2 CODES AND STANDARDS

The following latest Codes and Standards shall be applied for electrical system.

IEC 60034 Rotating electrical machines

IEC 60038 IEC standard voltages

IEC 60050 International electro-technical vocabulary

IEC 60068-2 Basic environmental testing procedures for electric components and electronic equipment

IEC 60079 Electrical apparatus for explosive gas atmospheres

IEC 60079-0 General requirements

IEC 60079-1 Construction and verification test of flameproof enclosures of electrical apparatus

IEC 60079-2 Electrical apparatus type of protection 'p

IEC 60079-7 Increased safety 'e'

IEC 60079-8 Classification of maximum surface temperature

IEC 60079-10 Classification of hazardous areas

IEC 60079-11 Construction and test of intrinsically safe and associated apparatus

مدیریت توسعه بازار تأسیسات دریایی ایران

خوانده شد و مورد تایید است

IEC 60079-13 Construction and use of rooms or buildings protected by pressurization

IEC 60079-14 Electrical installations in explosive gas atmospheres (other than mines)

IEC 60079-15 Electrical apparatus with type of protection 'n'

IEC 60092-350 Low voltage shipboard power cables (General Construction and test requirements)

IEC 60092-353 Single and multi core non radial field power cables with extruded solid insulation for rated voltage 1 kV and 3kV

IEC 60092-354 Single and three core power cables with extruded solid insulation for rated voltage 6kV, 10kV and 15kV

IEC 60092-360 Insulation and Sheathing materials for shipboard and offshore units, power, control, instrumentation and telecommunication cables

NEK-606 Design guide for offshore cables

UL 1581 Sunlight (UV) resistant cables

IEC 60144 Degree of "IP" protection for electrical apparatus

IEC 60227 Polyvinyl chloride insulated cables of rated voltage up to and including 50/750 V

IEC 60228 Conductors of insulated cables

IEC 60245 Rubber insulated cables of rated voltage up to and including

مدیریت توسعه بازار تاسیسات دریایی ایران
خوانده شد و مورد تایید است

450/750 V.

IEC 60255 Electric relays

IEC 60331 Fire resisting characteristics of electric cables

IEC 60332 Tests on electric cable under fire conditions (part 1: test on a single vertical insulated wire or cable - part 3: test on bunched wires or cable)

IEC 61363 Short circuit current evaluation

IEC 60439 Low voltage switchgear and control gear assemblies.

IEC 60529 Degrees of protection provided by enclosures (IP Code).

IEC 60536 Classification of electrical and electronic equipment with regard to protection against electric shock.

IEC 60540 Test methods for insulation and sheaths of electric cable and cords (elastomeric and thermoplastic compounds)

IEC 60623 Vented nickel-cadmium prismatic rechargeable single cells

IEC 60742 Isolating transformers and safety isolating transformers

IEC 60754-1 Flame retardant

IEC 60754-2 Tests on gases evolved during combustion of electric cables.

IEC 60801 Electromagnetic compatibility for industrial-process measurement and control equipment

مدیریت توسعه بازار تأسیسات دریایی ایران

خوانده شد و مورد تایید است

IEC 60754-2 Tests on gases evolved during combustion of electric cables.

IEC 60811-2-1, clause 9 Hot set test

IEC 60811-2-1, clause 10 Mechanical characteristics after immersion in hot oil

IEC 61034 Smoke light transmittance

IEC-61000-5-2 Electromagnetic compatibility (EMC) Part 5 - Mitigation methods and installation guidelines Section 2 - Earthing and cabling

IEC 61200 Electrical installation guide

IPS-E-EL-100 Engineering standard for electrical system design

IPS-E-EL-110 Engineering standard for hazardous area

IPS-C-EL-115 Construction standard for electrical installation

IPS-I-EL-215 Procedure for initial and periodic inspection in potentially explosive atmospheres

IPS-I-EL-217 Inspection standard for pre-commissioning electrical tests

IPS-M-EL-131 Material and equipment standard for low voltage induction motors

IPS-M-EL-143 Materials and equipment standard for low voltage switchgear and control gear

IPS-M-EL-1[illegible] Material and equipment standard for medium and high

مدیریت توسعه بازار تاسیسات دریایی ایران
خوانده شد و مورد تایید است

voltage switchgear and control gear

IPS-M-EL-152 Material and equipment standard for oil immersed power transformers

IPS-M-EL-174 Material and equipment standard for battery and battery charger

IPS-M-EL-176 Material and equipment standard for uninterruptible power system (UPS)

IPS-M-EL-271 Material and equipment standard for low voltage cables and wires

IPS-M-EL-272 Material and equipment standard for medium and high voltage power cables

IPS-M-EL-273 Material and equipment standard for submarine power cables with inherent optical fibers

CAP 437 Offshore Helicopter Landing Areas - Guidance on Standards

IALA 0-114 Recommendation on the marking of offshore structures

Norsok Standard, S001 Technical safety

IP 15 Model Code of Safe Practice Part 15 - Area Classification Code for Installations Handling Flammable Fluids

API RP 540 Electrical installations in petroleum processing plants

مدیریت توسعه بازار تاسیسات دریایی ایران

خوانده شد و مورد تایید است

SOLAS Safety of life at sea

4.3 UNITS OF MEASUREMENTS

The International System (S.I.) shall be adopted for the project.

4.4 LANGUAGE

All equipment labeling shall be in English. All documentation, drawings and correspondence shall be in English.

4.5 NOISE

The maximum sound pressure emitted by electrical equipment shall not exceed 80dBA at one meter.

4.6 ENVIRONMENTAL CONDITIONS

Environmental conditions shall be as specified in environmental conditions are accordance to environmental design data of project.

The equipment shall be designed for 45°C ambient temperature and 100% maximum relative humidity. Altitude is less than 1000m above sea level.

5. ENGINEERING REQUIREMENTS

5.1 HAZARDOUS AREA CLASSIFICATION

The hazardous area classification has been developed according to IEC 60079-10, API 505, IP 15 Code and HSE documents. Hazardous area zones in according with gas groups and temperature classes are defined in document "Hazardous area schedule" and the layout of hazardous areas are shown on drawing "Hazardous Area Classification Layouts"

Safe areas are classified as all regions have sufficient distance from process equipment and permanently flammable gases as well as areas/rooms where flammable gases are continuously leave out due to adequate ventilation systems.

مدیریت توسعه بازار تاسیسات دریایی ایران

خوانده شد و مورد تایید است

Electrical equipment for hazardous areas shall be selected in accordance with section 5.2 below.

5.2 EQUIPMENT SELECTION

The minimum enclosure ingress protection degree of equipment shall be in accordance with their area and shall be as follows:

1) Indoor (in enclosed buildings) equipment degree of ingress protection shall be as a minimum:

- Panels degree of ingress protection shall be as a minimum: IP42
- Equipments such as but not limited to, junction boxes, lighting fixtures, receptacle sockets, etc.: IP44, transformers (IP 21) and neutral earthing resistors (IP 23).

2) Outdoor equipment degree of ingress protection shall be as a minimum:

- General electrical equipment: IP55
- Electric motors: IP56
- Small installation materials such as but not limited to, junction boxes, lighting fixtures, control stations, distribution boards, control panels, receptacle sockets, cable glands, etc. : IP66

3) Submerge equipment degree of ingress protection shall be IP68

Note: Equipment exposed to direct sunlight shall be provided with suitable sunshades.

Electrical equipment shall be selected with protection appropriate to degree of risk and the hazardous area classification i.e. Zone 1 (Division 1) or Zone 2 (Division 2), in accordance with the following:

1) Zone 0: Ex'ia'

2) Zone 1: protections classified suitable for Zone 0, and Ex”d”, Ex”e”, Ex”ib”, Ex”o”, Ex”p”, Ex”q”, Ex"m"

مدیریت توسعه بازار تأسیسات دریایی ایران
خوانده شد و مورد تایید است

3) Zone 2: protections classified suitable for Zone 1

Note1: On offshore platforms for equipment selection, all other areas except Zones 0 & 1 shall be considered as Zone 2 as minimum for safety concepts and standardization reasons.

Note2: Indoor and outdoor Equipments such as Navigation and Aviation aids systems, escape lighting, battery backed up lighting, ESD, F&G systems and Splitter boxes which are to be kept in operation for safety purposes under emergency conditions or are still energized, shall be suitable for zone 1 and Ex-d type and certified.

Note 3: Protection classification of HV motors is limited to Ex"d or Ex"p" only.

4) Safe Area:

For indoor area where the room is pressurized for safety, non explosion proof equipment is usable, except for equipment described in the above (Note 2).

The only exception in this regard is battery room; selected equipment shall be of Zone 1, Gas Group IIC, Temperature Class T3 and Ex-d type, and degree of protection IP66.

All materials installed in a hazardous area shall have a certificate of conformity for the classified area by a recognized Certifying Authority (e.g. BASEEFA or equivalent as approved by Company). Certificates shall be in English or be accompanied with an exact English translation.

5.3 ELECTRICAL NETWORK MAIN CONCEPTS

5.3.1 POWER SUPPLY SYSTEM

Main power generation and distribution systems shall be installed on the plant to provide main power for the process and utility systems. Generators shall be connected to a HV Switchboard located in the adjacent Main Electrical Substation. HV Switchgear located in Main Electrical Substation will include generator incomers, bus section, all HV outgoing feeders.

مدیریت توسعه بازار تأسیسات دریایی ایران

خوانده شد و مورد تایید است

LV switchboards/Motor Control Centres shall be installed in the Main Electrical Substation to feed process skid LV motors, LV heaters, lighting and small power, generally for Generation & Utilities.

Diesel engine driven black start generator sets shall be installed to support emergency supplies and black-start facility for the power turbines.

The LV Emergency Switchgear/MCC for all Plant areas will be located in a separate room in the Main Electrical Substation.

Dual AC and DC uninterruptable power supply (UPS) system shall be installed to serve vital loads in case of a total power shutdown.

The 400V main switchboards will be generally be fed from the HV switchboards by means of HV/LV distribution transformers.

Each power transformer shall be capable of feeding the total LV load with a design margin of 25% above maximum load, however, during normal operation both transformers will share the load (2 x 100% configuration). LV switchboards shall be provided with bus section switches, which will be operated normally open. The switchboards continuous and withstand ratings shall at least be based upon one fully loaded transformer incoming supply. Transformer incomers shall be provided with interlocking circuits to prevent continuous parallel operation of both transformers exceeding 5 seconds.

The total harmonic distortion (THD) on the power network shall not exceed 8%.

5.3.2 CLASSIFICATION OF LOADS

Classification of consumers has been done according to the following list:

Normal consumers	Consumers for normal production activities
Essential consumers	Consumers to maintain safety conditions (in case of power failure from main sources), to prevent equipment and plant damage, to restore to the normal condition

مدیریت توسعه بازار تاسیسات دریایی ایران

خوانده شد و مورد تایید است

Safety consumers	Consumers for survival, telecommunication and if required, safety for personnel evacuation

Normal consumers, Essential consumers and Safety consumers are categorized as loads which are connected to the main busbar and always can be operative.

Intermittent consumers are supposed to work for a specified duration of a certain time, in the other word the operating duty cycle of these consumers is not continuously.

Inrush current of all categories of consumers should be considered separately. They are not considered as a load category.

5.3.3 ELECTRICAL SYSTEM OPERATING PHILOSOPHY

NORMAL OPERATION:

Mains electrical power shall be generated at high voltage by means of turbine driven generating sets. Basically there will be N + 1 main generating sets installed, where N is the number of main generating sets to supply the peak load. A spinning reserve of at least 15% will be installed.

The 400V main switchboards will generally be fed from the HV switchboards by means of HV/LV distribution transformers.

With regard to the N+1 operation philosophy, the '+1' generator set is considered stand by, and not running.

BLACK START AND EMERGENCY POWER:

During normal operation, the emergency switchboard will be fed from the mains power supply and will provide power to essential and life support supplies (like AC/DC UPS systems, emergency lighting, F&G system, HVAC and ...) and to the turbine auxiliaries. In case of interruption of the mains power supply and during black start, diesel engine driven emergency generators shall provide power to the emergency switchboard. Synchronization means on the emergency switchboard shall be provided to allow synchronization across the 400V main switchboard.

مدیریت توسعه بازار تأسیسات دریایی ایران

خوانده شد و مورد تایید است

5.3.4 VOLTAGE DROPS CRITERIA

Electrical system components shall be selected in order that the maximum voltage drops in distribution network up to consumers, under normal operating conditions, shall not exceed the following values:

a. MV motors < 2.5
b. Transformer secondary feeder (MV & LV) <1 %
c. LV motors <2.5
d. Package feeder <2%
e. AC / DC UPS (Between UPS & Consumer) <2.5
f. Lighting:
   - Lighting distribution board to furthest fixture <3 %
   - Switchgear to lighting distribution board <1 %
g. Motor starting <15%

5.4 UTILIZATION VOLTAGES

5.4.1 GENERAL

The following voltage levels shall be adopted to ensure standardization with existing systems:

MV-Motors (>150 KW)	- MV AC, 3 phase, 50 Hz
LV-Motors (≤150 KW)	- 400 VAC, 3 phase, 50 Hz (230V, 1 Ph. < 0.1 KW)
MV/LV circuit breaker closing/tripping/protection/sprig charging motor	- 110 V DC, 4 hours from DC UPS
LV motor starter control	- 230VAC, 1 Phase, 50 Hz from individual Control transformer on each circuit.
Back-up lube oil pumps DC motors	- Power supply and autonomy time by Vendor. Execution according to relevant project documents.
HV fused contactor closing/tripping/protection/sprig	- 110 V DC, 4 hours from DC UPS

مدیریت توسعه بازار تاسیسات دریایی ایران
خوانده شد و مورد تایید است

charging motor	
Heating < 3 KW	- 230VAC, 1 Phase, 50 Hz
Heating ≥ 3 KW	- 400VAC, 3 Phase, 50 Hz
Welding socket outlets	- 400VAC, 63A, 3 Phase + N + E, 50 Hz (5 pin)
Convenience Socket outlets	- 230VAC, 16A, 1 Phase + N + E, 50 Hz (3-pin)
Plant lighting	- 230VAC, 1 Phase, 50 Hz, photocell control
Emergency lighting	- 230VAC, 1 Phase, 50 Hz from emergency distribution board
Escape lighting	- 230VAC, 1 Phase, 50 Hz from built in 120min back up battery.
ESD, F&G and DCS systems	- 230VAC, 1 Phase, 50 Hz AC UPS maintained 6 hours by batteries
Telecommunications & Marine radio	- 230VAC, 1 Phase, 50 Hz AC UPS maintained 8 hours by batteries
Operator consoles	- 230 VAC, 1 phase, 50 Hz AC UPS maintained 6 hours by batteries
Navigation aids system	- 230 VAC for incoming feeder and 24 VDC from dedicated DC UPS maintained 96 hours for Nav. aids (+Solar System)

Some of medium voltage levels in various districts of IOOC are as below:

a) Kharg:

Old power plant:	3.3KV
Over-head lines:	33KV
Aboozar platform:	6KV
Dorood 2:	11/3.3KV
Dorood 3:	6.6KV

b) Sirri:

مدیریت توسعه بازار تأسیسات دریایی ایران
خوانده شد و مورد تایید است

Old installations/NGL: 6.6KV

Salman gas plant: 6KV

Subsea cables: 33KV

Nasr, Nosrat and Alvand: 6.6KV

c) Bahregan:

Onshore installations: 3KV

Sorosh platform: 11KV

Nowrooz platform: 6KV

Bahregansar platform: 3KV

Subsea cable to Hendijan: 11KV

d) Lavan:

Old power plant: 4.16KV, 60Hz

New power plant: 3.3KV

Parsian dist. Switchgear: 20KV

Salman Platform: 6.3KV

Balal Platform: 6KV

R4 Platform: 1KV

5.4.2 VOLTAGE AND FREQUENCY DEVIATION

Electrical equipment shall be capable of giving its rated output continuously at +10% of the nominal system voltage, coincident with frequency variations of ±5% of the nominal system frequency.

5.5 DESIGN AND SELECTION REQUIREMENTS FOR EQUIPMENT AND CABLES

Equipment is sized, based on the load (kW), determined as below with the data abstracted from the electrical load list.

مدیریت توسعه بازار تأسیسات دریایی ایران

خوانده شد و مورد تایید است

5.5.1 MAIN GENERATORS

Turbine driven main generator sets shall be rated on a continuous running duty basis, type S1 in accordance with IEC 60034-1 and shall be expressed in kilo-Volt-Amperes available at the terminals at rated voltage, frequency and power factor when connected to a virtually non-deforming system and supply a virtually balanced load.

Turbine driven main generator set configuration and load requirements shall be stated on the relevant project documents.

Associated gas will not be available during black start. Therefore, the turbine driven main generator sets shall be dual fuel (both associated gas and diesel).

It shall be possible to operate the turbine driven main generator sets in both droop and isochronous mode. The total system shall perform equal load sharing both with respect to active and reactive load between the running turbine driven main generator sets.

Generators shall be capable of withstanding without damage, a three-phase, line-to-line, line-to-earth or two-line-to-earth short circuit at generator terminals for a period limited to 3 seconds when operating at rated speed and with an excitation corresponding to 5% overvoltage at no load, under AVR control.

The generator and its exciter shall be totally enclosed air cooled, with either an air-to-air heat exchanger or an air-to-water heat exchanger in the cooling circuit.

Unless otherwise specified the turbine driven main generator sets shall be located outdoors in dedicated enclosures. The turbine driven main generator sets control panels shall be located indoors in the main switchgear room.

The turbine driven main generator sets control panels shall contain the turbine control system, vibration monitoring equipment, electronic fuel governor control system, an effective load sharing system and regulation facilities for voltage and synchronisation. The equipment shall be capable of performing fully automatic synchronising with other

مدیریت توسعه بازار تاسیسات دریایی ایران
خوانده شد و مورد تایید است

generators. Furthermore manual synchronisation and circuit breaker control shall be included. A Power Management System shall be included.

5.5.2 NEUTRAL EARTHING RESISTORS

The rating of the neutral earthing resistors (dry type) shall be such as to limit the possible earth fault current to a magnitude approximately equal to the rated full load current of the supply equipment for duration of not less than 10 seconds.

Segregation of the fault zone shall be performed at the HV Switchgear and control-gear, and not in the resistor circuit, i.e. the resistor shall never be disconnected between the generators neutral star point and the earthing system.

Resistance shall be ± 10% of declared value at 20°Celsius.

The neutral earthing resistors (dry type) shall be located indoors. The minimum enclosure degree of ingress protection, in accordance with IEC 60529 shall be IP23, as determined by ventilation requirements. Bare bushings outside enclosure for cable terminations are not acceptable. Cables shall be terminated in cable boxes.

Earthing provisions as per project standards shall be provided on the enclosure.

Protective CT's can be of the classified class 1 (measuring CT).

5.5.3 EMERGENCY DIESEL DRIVEN GENERATOR SETS

Each emergency diesel engine driven generator set shall be self contained, i.e. providing diesel is available and batteries are fully charged, a black start can be initiated with the diesel engine. Diesel day tanks capacity shall be adequate to provide diesel to emergency generator for at least 24 hours.

Each diesel engine driven emergency generator set shall have capability to run in parallel with the main generators for testing purposes. Therefore, special attention is required on the assessment of circulating third harmonics.

The EDG shall have sound-proof enclosure.

Note: All emergency loads like AC&DC UPS systems, emergency lighting, F&G

مدیریت توسعه بازار تاسیسات دریایی ایران
خوانده شد و مورد تایید است

system, HVAC and..., shall be fed from the emergency diesel driven generator (EDG). So the EDG shall be sized respectively.

5.5.4 TRANSFORMER

Transformers shall be in accordance with the project standards, hermitically sealed, totally filled (without gas cushion) with Synthetic Oil (such as silicon oil).

Notes:

1- For onshore installations the oil of transformers may be mineral oil.

2- Distribution transformers with ratings above 3150kVA are not allowed.

The transformers shall be designed for continuous operation at 105 % of the rated voltage without exceeding guaranteed temperature rise. Sizing will also be such as to permit starting of largest motor with the remaining normal load operating without exceeding the secondary bus voltage drop specified in this document. The criterion for sizing of Power transformers is described in above mentioned section.

Transformers shall be 3 phase delta connected primary and Wye connected secondary Dyn11, naturally oil and air cooled (ONAN), and shall have externally operable off-load tap changers.

Insulation class shall be class ‘A’ for oil immersed transformers.

Power transformers will be equipped with plug in elastimold cable connection for HV/MV sides.

5.5.5 HV SWITCHGEAR AND CONTROL-GEAR

The high voltage switchgear and control-gear shall be in accordance with the project standards.

The high voltage switchgear and control-gear shall be designed to minimize the risk of short circuit and to ensure personnel and operational safety during all operating conditions, inspection, maintenance, the connection of main, control and auxiliary cables, and the equipping and commissioning of spare panels whilst

مدیریت توسعه بازار تاسیسات دریایی ایران
خوانده شد و مورد تایید است

alive in operation.

The high voltage switchgear and control-gear shall be of the metal clad withdraw-able type, free-standing, floor-mounting, having a single copper busbar system and consist of a number of separate panels assembled into one or more sections. Sections shall be electrically interconnected, by a sectionalising switching device.

In exception to above construction requirements, ring main units may be considered for high voltage switchgear and control-gear with a nominal current of 250 Amps.

The HV switchgear and control-gear shall be freestanding, floor mounted, consisting of switchgear panels forming a single assembly with a common bus-bar system. The HV switchgear and control-gear shall be installed indoors in an air-conditioned environment.

Switchgear shall be air insulated, and the switching device shall be vacuum type.

Switchgear controls shall allow for Local and Remote operation (open/close).

At least 20% spare feeder shall be provided for future extension.

All Synchronizing check relay shall be provided between incomers and bus couplers.

5.5.6 LV SWITCHGEAR AND CONTROLGEAR

The low-voltage AC switchgear and control-gear assembly shall be in accordance with the project standards. The low-voltage AC switchgear and control-gear assembly shall be designed to minimise the risk of short circuit and to ensure personnel and operational safety during all operating conditions, inspection, maintenance, the connection of main, control and auxiliary cables, and the equipping and commissioning of spare panels whilst alive in operation.

The low-voltage AC switchgear and control-gear assembly shall be freestanding, floor mounted and fully withdraw-able type. The assembly shall consist of standard switchgear and control gear panels forming a single assembly with a

مدیریت توسعه بازار تاسیسات دریایی ایران
خوانده شد و مورد تایید است

common bus-bar system and shall have front access only for operation, cable connection and maintenance activities. The low-voltage AC switchgear and control-gear assembly shall be installed indoors in an air conditioned environment.

The low-voltage AC switchgear and control-gear assembly shall have a complete enclosure of sheet steel. The busbars shall be copper.

Contactors, breaker contactors shall not be used in normal operation over 80% of their rated power.

Moulded case circuit breakers with built-in protection are preferred to fuse protection.

At least 20% spare feeder shall be provided for future extension.

5.5.7 UPS EQUIPMENT

DC UPS SYSTEMS

A DC battery back-up system shall be provided for the MV and LV Switchgear control, indications and switching supplies in accordance with the project specification. The nominal output voltage of the system shall be 110V DC, unearthed, equipped with earth fault/leakage monitoring device.

DC UPS consists of two DC power supply units. Each unit shall normally supply half the switchboard load but shall be capable of supplying the whole board. The two supplies shall be operated in parallel. A fault on one DC power supply unit shall not affect the other. Each DC power supply unit shall have one 50% battery bank and one 100% battery charger. DC UPS shall be capable of closing two MV switching devices simultaneously and all others in succession.

DC UPS system shall consist of the following components:

- Two rectifiers each one with capacity 100%

مدیریت توسعه بازار تأسیسات دریایی ایران
خوانده شد و مورد تایید است

- 2x50% battery bank, very low maintenance Ni-Cd type.
- One distribution panel equipped with molded case circuit breakers.

In normal condition, when AC mains power is available, both battery banks will be float- charged by its respective charger while feeding the DC loads, thus working in parallel with each other and equally sharing the total load.

In case of failure of each charger, the other one shall float-charge the complete battery banks while supplying the complete DC load.

The voltage variation shall be limited to plus 1% and minus 1% of the nominal DC system voltage, unless more stringent requirements have to be applied because of the equipment connected.

The DC power supply units shall be installed adjacent to the MV switchboard or in a nearby room with a similar environment.

Battery systems shall be of the nickel cadmium very low maintenance type, and designed for a standby time of 4 hours.

Rectifier shall be of constant voltage, current limiting and static design suitably protected against overloading. The performance characteristics shall match the capacity of the batteries and of the load.

The DC power supply unit shall be non-earthed with earth fault/leakage monitoring.

Note: 1 x 100% DC rectifier with 1 x 100% battery configuration for each main turbine driven package shall be considered.

AC UPS

UPS system for instrumentation service shall consist of the following components:

- Two rectifiers each one with capacity 100%
- Two inverters each one with capacity 100%

مدیریت توسعه بازار تاسیسات دریایی ایران
خوانده شد و مورد تایید است

- 2x50% battery bank, maintenance free Ni-Cd type.
- One stand-by line
- One by-pass transformer
- One static switch for load automatic transfer from inverter to stand-by line in case of inverter fault.
- One manual by-pass switch to exclude both inverter and static switch and to supply the loads from stand-by line
- One distribution panel equipped with molded case circuit breakers.

In normal condition, when AC mains power is available, both the rectifiers shall operate in parallel and supply DC power for float/boost charging the batteries and simultaneously to the inverters. In case of failure in one rectifier, the other rectifier shall feed the complete load and the batteries without any interruption.

The UPS shall be sized including 20% spare power and battery system capacity to supply loads at full load. The input voltage shall be 3-phase 400 V 50Hz. The output voltage shall be 230 V ±1% single phase and neutral, neutral unearthed, 50Hz ±1%.

The UPS shall be non-earthed, equipped with full earth fault/leakage monitoring system.

BATTERIES FOR DC/AC UPS

Batteries for AC and DC UPS systems shall be very low maintenance Nickel-Cadmium type, and shall be provided with an Ex'd' isolator with shunt trip for connection to ESD system.

Battery monitoring shall be provided with a battery string monitoring system.

EPC Contractor to consider separate fire rated battery rooms.

All batteries for AC and DC UPS and other batteries if any shall be located in a dedicated battery room.

مدیریت توسعه بازار تأسیسات دریایی ایران

خوانده شد و مورد تایید است

5.5.8 ASYNCHRONOUS MOTORS

Asynchronous motor and all its related electrical auxiliary equipment shall comply with the project standards. The drive system shall have sufficient inertia to limit the variations in motor current to maximum 20 % of rated full load current.

Motors shall be designed for a minimum of three (3) years continuous operation without interruption for maintenance.

Stator windings shall be made of copper conductor. Use of Aluminum enclosure is strictly forbidden.

All insulation materials shall be class F in accordance with IEC 60034-18. The rating of the motor shall be based on a class B temperature rise of all parts of the motor windings.

All HV motors and LV motors shall be equipped with heating devices (space heaters) to prevent condensation during periods of idleness.

Motors shall be suitable for Direct On Line Starting.

The maximum starting current shall not exceed 7 times of rated current for LV motors.

For motors rated above 150 kW, the starting current shall not exceed 6 times the rated current of the motor.

A motor starting study regarding starting of big electric motors shall be performed and any limitation in starting current of the motors shall be specified in relevant data sheets.

5.5.9 NAVIGATIONAL AIDS SYSTEM (OFFSHORE PLATFORMS)

All platforms shall be equipped with a marine navigational aids system. The design of the navigational aids system shall comply with the statutory and IALA requirements applicable for the local area.

The offshore complex comprises the following:

مدیریت توسعه بازار تاسیسات دریایی ایران

خوانده شد و مورد تایید است

- Wellhead platform

The Navigational Aids System shall mark the whole group of platforms considering it just as a single unit.

Feeding of the system shall be fed by a solar cell, and dedicated back-up battery bank for the system. The battery bank shall be NI-Cd type and sized to ensure system operation for 96 hours as a minimum.

Navigational Aids System shall consist of:

> Visual system by white flashing lights, having a visibility range of 10 nautical miles, positioned on the group of platforms in order to ensure the visibility of the light from any direction

> Audible system by fog horns, having an audibility range of 2 nautical miles, to be operated in case of fog

> Control panel, installed in Technical Room

> Centralized battery system, 24V DC, located in Battery Room

> Dedicated 24V DC UPS, fed from emergency LV bus

> Centralized solar cell system , located on top deck

> Control system shall be a centralized control panel. It shall perform:
> Distribution solar cell system
> Back-up battery charging
> Synchronization and driving of all audible and visible signals positioned on different platforms

- Remote signaling of main system alarms and equipment status

Control circuits for fog horns and flashing lights shall be housed in Ex-d, Gas Group IIB, and Temperature Class T3 enclosures placed in the Navigational Aids Control Panel. They shall ensure the no-break and safe operation from the battery system in case of platform ESD or other emergency.

مدیریت توسعه بازار تأسیسات دریایی ایران

خوانده شد و مورد تایید است

Note: A dedicated navigation aids system shall be installed as "temporary navigation system" for load out, transportation and installation phases of both jacket and main platform. This system shall be in service until the main system comes into service.

5.5.10 AERONAUTICAL AIDS

Aeronautical aids system subject to the statutory and ICAO requirements applicable for the local area.

The aeronautical aids system will be fed from AC UPS.

5.6 METERING, PROTECTION AND CONTROL EQUIPMENT

Metering protection and control equipment shall comply with the project standards. Programmable/communicating type relays shall be used for all HV switchgear incomers and feeders, and all LV incomers, inter-connectors and motor drives. Protection shall be standardised. Metering protection and control equipment shall be provided as detailed below.

5.6.1 GENERAL

The protection system will be designed such that a faulty circuit is identified and disconnected safely and quickly without adversely affecting the stable operation of the other healthy circuits in the distribution system.

The setting of protective devices will be selected to be stable during motor starting and transient conditions caused by current surges in circuits outside the protected zones.

Microprocessor type protective devices will be selected and will be positioned on their associated breaker or motor starter cubicle. Relays will be modular type and draw-out construction with test plugs provided for selected relays. Protective relays are located in the relevant main switchboard where necessary CT's and VT's are located.

Overload and over current relays shall be inverse or very inverse type.

Earth fault protection shall apply to all outgoing circuits for direct contact (lighting

مدیریت توسعه بازار تاسیسات دریایی ایران
خوانده شد و مورد تایید است

and small power) and indirect contact (motors, contactor feeders, etc) protection.

Earth fault relays shall have the following sensitivity rating at different stages:

- 300mA motor and other main outgoing feeders
- 30mA for lighting and small power outgoing circuits

5.6.2 RELAYS

All high set instantaneous over current relays shall be of the low transient over-reach type in order to reduce sensitivity to the D.C. component of the fault current.

All protection relays shall be multi-functional microprocessor-based type.

Tripping of all circuit breakers shall be initiated by separate tripping relay (86). The relay operating coil shall be energized by protective schemes. The relay shall be heavy duty and hand reset type with clear reset trip indication.

5.6.3 VOLTAGE TRANSFORMERS

Voltage transformers shall be of the withdraw-able cast resin type, complying with IEC 60186.They shall be protected on the primary side by high voltage fuses and the secondary side by MCB's.

Voltage transformers (VT) shall be specified in the following locations as a minimum:

> For voltage indication on each bus section and on the supply side of each incoming MV switchgear.

The rated secondary voltage of VT shall be 110 V.

The rated burdens of VT shall be selected from the standard values given in IEC 60044-2.

The accuracy classes of voltage transformers shall be specified as follows:

> Metering VT shall be class 0.5.
> Protection VT shall be class 3P.

مدیریت توسعه بازار تاسیسات دریایی ایران
خوانده شد و مورد تایید است

5.6.4 CURRENT TRANSFORMERS

The rated primary currents for all CT's shall be selected from the standard values given in IEC60044-1. The rated secondary currents shall be 5A, except that for remote metering, 1A shall be used. 1A shall also be used for protection where the burden at 5A would be excessive when using standard control cables.

C.T.'s with separate secondary shall be used for protection and measurement duties. The rated burdens for measuring CT shall be at least 150% of the connected load and shall be one of the values given in IEC60044-1. Metering current transformers shall be Class 0.5.

Protective current transformers supplying relays with a time delay shall generally be class 5P10. High speed protection e.g. differential and / or restricted earth protection shall use class X CT's. The secondary side of each CT shall be earthed.

5.6.5 TRANSFORMER PROTECTION

Transformer protection relays shall be withdraw-able type and shall be of microprocessor based construction. Main power transformers shall have as a minimum the following protective and metering devices:

- IDMT over current and earth fault on primary and secondary arranged to trip primary and secondary as required.
- Instantaneous protection set to operate only for faults on the primary side of the transformer
- Lockout, hand reset relay, trip circuit supervision relay, alarm and trip relay for DGPT protection. During fault operation by DGPT2 both sides of transformer shall be isolated from network.

All transformers with earthed secondary neutral points shall have earth fault protection for the secondary side of the transformer by means of CT in the neutral to earth connection. The relay for this protection shall be located in the LV switchboard.

مدیریت توسعه بازار تأسیسات دریایی ایران

خوانده شد و مورد تایید است

All transformers shall be provided with primary and secondary inter tripping facilities in the circuit breaker.

5.6.6 MOTOR PROTECTION

All motors shall have overload, short-circuit and single-phasing protection as a minimum.

Circuit breaker shall be used as short circuit protection and the following motor protection and metering shall be provided as a minimum:

Single phase motors up to 400 watts: Built-in or external thermal over load relay, motor feeder circuit breaker, ammeter.

Up to 30kW: Thermal overload 3 pole, motor feeder circuit breaker, ammeter (3 phase)

Up to 75kW: Thermal overload 3 pole, motor feeder circuit breaker, ammeter (3 phase)

Up to 150kW: Multifunction motor protection relay of the microprocessor type including earth fault protection and motor feeder circuit breaker, ammeter (3 phase)

Above 150kW: Multifunction motor protection relay of the microprocessor type including, unbalance current, earth fault protection and motor feeder circuit breaker. Winding temperature protection via temperature detectors in the windings, Thermal over load protection, negative phase sequence protection, under voltage protection, incomplete sequence protection, anti restart protection, locked rotor protection, breaker failure protection, Trip circuit super vision, ammeter (3 phase)

Over load relay shall be three poles, ambient compensated, incorporating single phase protection.

Over load relay rating above 72 ampere shall be C.T. operated.

5.6.7 SWITCHGEAR AND FEEDER PROTECTION

Unrestricted over current and earth fault protection shall be provided at all the

مدیریت توسعه بازار تأسیسات دریایی ایران
خوانده شد و مورد تایید است

outgoing MV feeders using multi function relays of microprocessor based type.

The LV Switchgear/MCC incoming feeder and bus breaker shall be provided with over current and earth fault protection using multi function relays of microprocessor based type.

The LV switchgear outgoing feeder supplying power to main distribution board or MCC shall be provided with over current and earth fault protection using multi function relays of microprocessor based type.

Cables shall be protected against exceeding overload and short circuit ratings.

5.6.8 METERING AND INDICATION

The design shall include adequate metering for proper control, operation and check of the electrical installation.

All motors greater than and equal to 4kW shall be provided with an ammeter at the motor starter panel.

Switching counters shall be provided on all MV panels.

Running hour meters shall be provided for all MV motors.

Generally, ammeters (3 phase), voltmeters (3 phase), watt-hour meter, watt-meter, VAR-meter, frequency meter and power factor meter shall be provided for MV switchgears.

Electrical energy and KVARH metering shall be provided to enable assessment of the total platform energy consumption and the output of each generator. Ammeters and voltmeters shall be of Accuracy Class 1.5, as defined by IEC 60051-2.

Energy meters and power meters shall be of Accuracy Class 2.5, as defined by IEC 60051-3. The upper limits of effective range of indicating instruments should be chosen so that the full load reading is approximately 80% of full-scale deflection.

مدیریت توسعه بازار تأسیسات دریایی ایران

خوانده شد و مورد تایید است

Each feeder at least shall have four indication lamps on panel:

i) Red lamp for close position

ii) Green lamp for open position

iii) Yellow or amber lamp for tripping or fault purpose

iv) Red lamp for earth switch close position

The trip circuit supervision system (T.C.S.) shall be achieved by use of digital input of microprocessor base relay with associated LED, or with separate T.C.S relay.

There shall be a dedicated push button for lamp test reason.

5.7 BULK MATERIALS AND ACCESSORIES

5.7.1 SUBSEA CABLES

Subsea cables, integrating subsea power with fiber optic for power delivery and communication between platforms is used.

The subsea cable shall be suitable for laying on the seabed and shall have sufficient mechanical strength to allow pulling into the J-tubes without damage to the cable and shall be suitable for direct installation up to 100 m water depth.

The cable design and materials used shall be such as to maximize the self burial properties of the cable. Water penetration shall be permitted to the armor and screens to maximize the negative buoyancy minimize armor corrosion and maximize the screen to earth conductance. Insulation shall be triple extruded cross-linked polyethylene (XLPE).

The cable design shall ensure in-place hydrodynamic stability against wave and current action. The cable shall be of the three cores, wet design, allowing free flooding as far as the exterior of the Insulation of the power cores, protected by a single layer of galvanized steel wire armor. The cables shall be supplied as continuous installation lengths of armored cable, i.e. with no joints installed after

مدیریت توسعه بازار تاسیسات دریایی ایران
خوانده شد و مورد تایید است

the core assembly process, and without the need for offshore splices. The life expectancy of the equipment shall conform to the requirements of 25 years. The optical unit shall be located in the interstice of the power cable. The optical fibers will provide the main means of communication between platforms and onshore. For these reasons the inclusion of optical fibers shall be designed for full operational life.

The cable system shall provide a minimum of 2*12, single mode fibers.

5.7.2 OTHER CABLES

Cables for medium and low voltage power installations shall be stranded annealed copper conductor, extruded XLPE insulated, UV, Oil, Mud and water resistant, flame retardant, low smoke and zero halogen (LSZH), gas and vapor tight, and galvanized steel wire braided, with SHF-Mud outer sheath in accordance with NEK 606 or IEC 60092-360 standards as mentioned in clause 4.2.

For production and living quarter platforms SHF2 cables shall be provided.

SHF-Mud cables shall be considered for wellhead platforms.

For offshore platforms single core cables shall have Phosphor Bronze Wire Braided armour (PBWB).

For onshore applications single core cables shall have aluminum Wire Braided armour.

Low voltage power cables shall be 600/1000V.

Earthing cables are considered non-current carrying cables. Earthing cables shall be made of tinned annealed copper, with green/yellow SHF2 sheath. The SHF2 sheath is a protection against electrolytic corrosion, UV radiation and hydrocarbon.

Cables for safety systems and life support shall be fire resistant in accordance with IEC 60332 and IEC 60331.

NOTE: For onshore installations, oil resistant cables may have lead sheath layer

مدیریت توسعه بازار تاسیسات دریایی ایران

خوانده شد و مورد تایید است

instead of SHF-MUD or SHF2 outer sheath layer.

Cable cores shall be identified as follows:

Single core: Black

2 cores: Black/Red

3 cores: Red/Yellow/Blue

4 cores: Red/Yellow/Blue/Black

Above 4 cores: White whit black numbers or black with white numbers

Cables sheath color shall be:

Black	For low voltage
Red	For MV voltage
Orange	For fire resistant
Yellow/Green	For earthing

Minimum cross sections of conductors shall be:

Alarms, protection system, and instruments	2.5mm2 (min)
Lighting and small power	2.5mm (min)
L.V Power circuits, Motor feeders	4 mm2 (min) to 3Cx240mm2 and/or 1Cx400mm2 (max)

MV Power Circuits 3/6 / 11 / 15 / kV Minimum size, subject to short circuit level (not less than 50mm2), maximum3Cx240mm2 (3Cx300mm2 for subsea cable) and/or 1Cx400mm2 (max)

Note: For MV cable sizing calculation, the duration of short circuit current shall be considered 1Sec. (as minimum).

5.7.3 GLANDS

Cables shall be terminated with appropriate cable glands with -as minimum- the same degree of protection and hazardous classification as the equipment being

مدیریت توسعه بازار تاسیسات دریایی ایران
خوانده شد و مورد تایید است

connected. Cable glands shall have capability to provide earth continuity of armors and mechanical support. Cable glands shall comply with BS 6121 part 1.

Cable glands shall be made of Nickel brass, double seal compression type with armor clamp suitable for all outdoor installed cables. They shall be disconnect-able/ reconnect-able without degrading tightness.

All cables glands shall be supplied with ISO metric threads.

5.7.4 MCTS

Only cables penetration through water tight wall, floor or roof shall be fitted with gas and fire tight multi-cable transits, having fire protection characteristics equal to the wall. All parts of MCTs (Including Frames, Stay-plates, and Screws and …) shall be stainless steel 316L.

20% spare capacity of MCTs shall be provided. The spare transits shall be fitted with blank fillers.

5.7.5 CABLE TRAY AND LADDERS

Cable tray and ladders shall be equipped with bolted covers if installed outdoor. The following materials shall be used:

- Stainless Steel (SS 316L) trays, for outdoor and indoor installations in offshore and jetty.
- Stainless Steel (SS 316L) trays, for outdoor installation in onshore facilities.
- Hot Dip Galvanized (HDG) trays for indoor installation in onshore facilities may be used.

Note: Cable ladders may be used only for installation of MV armoured cables and LV incoming armoured cables from Transformers and Emergency Diesel Generators (EDGs) to LV switchgear.

Separate cable trays shall be used for:

- Electrical

مدیریت توسعه بازار تاسیسات دریایی ایران
خوانده شد و مورد تایید است

- Instrument and communication

In all cases, structural steel supports shall be prefabricated and installed. Supports for tray shall be a proprietary manufactured system assembled from standard profiles. Trays pieces as tees, flat bends, risers, crossings, splices, covers, etc. shall be prefabricated, which should be adjustable for ease of installation.

5.7.6 JUNCTION BOXES AND LOCAL CONTROL STATION (LCS)

All junction boxes and local control stations shall be selected in accordance with the hazardous area classification and shall be housed in enclosures made of Cast Iron or Stainless Steel 316L.

All LCSs shall be Ex-d certified for both Zone1 and Zone2 areas.

Each motor on the platform shall be provided with a Local Control station (LCS). At least two push buttons and one selector switch should be considered for each LCS. The LCS shall be installed on a secure structure, in a convenient location, close to the motor.

Junction boxes and LCSs enclosure shall be ingress protected to a degree not less than IP66, as defined by IEC 60529.

Junction/marshalling boxes shall include a minimum of 25% spare capacity. Terminals shall be provided such that only one conductor is terminated on each side.

Junction boxes located in or adjacent to deluge areas shall have bottom cable entry only.

Standard LCS shall have the following:

- Start-stop push button
- Local-off-remote (or manual-off-automatic) selector switch according to process requirements, pad lockable in the "Off' position.
- Ammeters (3 phase) for all motors > 4Kw

مدیریت توسعه بازار تأسیسات دریایی ایران
خوانده شد و مورد تایید است

5.7.7 SOCKET OUTLETS

Welding socket outlets and convenience socket outlets shall be suitable for the specified hazardous areas, fitted with padlocking facilities. The 5 pole outlets shall be equipped with 4-pole switches and the 3 pole outlets with double pole switches respectively.

Welding socket outlets and convenience socket outlets shall be connected so as to have the same phase rotation, ensuring that correct rotation of movable equipment is obtained from all outlets.

Welding socket: 63A, 400V, 50Hz, 3 phase + neutral + earth

Convenience socket: 16A, 230V, 50Hz, 1 phase + neutral + earth

Welding sockets shall be arranged such that from each outdoor location with a 25 meters cable can reach to a socket outlet. At least two power sockets are necessary in each indoor room. Convenient sockets shall be arranged such that from each outdoor location in platform with a 15 meters cable can reach to a socket outlet. This length decreases to 5 meters for indoor areas.

5.7.8 FITTINGS AND ACCESSORIES

They shall be in accordance with the hazardous areas classification and environmental conditions.

5.8 LIGHTING SYSTEM

5.8.1 GENERAL REQUIREMENTS

Normal lighting and emergency lighting shall consist of fluorescent-type lighting fixtures with 2 x 36W bi-pin long life lamps and electronic ballast. Lighting fixtures shall be suitable for the specified hazardous areas.

The number of emergency luminaries as part of the total number of fittings shall be determined as follows:

- Utility Area 30%

مدیریت توسعه بازار تاسیسات دریایی ایران
خوانده شد و مورد تایید است

- Process Area 20%

- Control Room and Auxiliary Rooms 50%

(Including 10% Connected To DC System)

- Substations, Field Auxiliary Rooms, 30%

Compressor and Generator Buildings

For standardization purpose, the same type of lighting fixtures selected for zone 2 areas shall be used in safe areas.

Emergency lighting fixtures shall be provided on escape routes and in vital operator areas. The lighting level on the escape routes shall under emergency conditions be at least 10 lux.

Escape lighting shall consist of fluorescent-type lighting fixtures with 2 x 36 W bi-pin long life lamps and electronic ballast. Escape lighting fixtures shall be Ex design and shall have integral batteries rated to maintain the lighting for at least 120 minutes with one lamp in operation.

The escape luminaries shall generally be part of the emergency luminary's installation, but the luminaries shall have integral batteries rated to maintain the lighting for at least 120 minutes. Escape luminaries shall be provided in all buildings so as to lead personnel out of the building along defined escape routes to defined muster points, which shall also be illuminated.

The use of 400W and 250W floodlights in specific areas shall be considered. Floodlights shall be of the high pressure sodium type, preferably with integral ballast.

Road and car park lighting shall be provided.

Outdoor lighting shall be operated by automatic photocell system with manual override switch.

The lights either outdoor or indoor with built-in batteries shall be considered as

مدیریت توسعه بازار تاسیسات دریایی ایران
خوانده شد و مورد تایید است

Zone 1, Ex'd'.

The lighting poles shall be collapsible type to enable fitting change out without additional access platform.

Location of lighting fittings shall allow for easy lamp cleaning and replacement.

5.8.2 ILLUMINATION LEVELS

The required illumination levels, measured at the working plane or 1 m above the floor level in a horizontal plane, are shown in the table below. These values shall be used as a basis for the design of new installations unless higher illumination levels are required in accordance with national or local regulations in the country of installation. The tabulated illumination levels apply when the luminaries are dirty, i.e. after taking account of the following fouling factors:

Location	Fouling Factor
Plant areas (both indoor and outdoor):	0.80
Non-plant areas (outdoor):	0.80
Non-plant areas (indoors):	0.85

Location	Lux	Notes
Switchgear room/Equipment room		
Front of switchgear	300	1
General, including front of control panels	300	
Rear of switchgear/panels	150	
Auxiliary equipment areas	150	
Outside, near entrances	150	

مدیریت توسعه بازار تأسیسات دریایی ایران
خوانده شد و مورد تایید است

PLANT AREAS			
Operating areas requiring regular operator intervention.	Pumps, compressors, drivers, valves, manifolds, etc.	150	
Local control and monitoring points	Indicating instruments, gauges and control devices	75	
Level gauges (see-through) to be lit from behind by single tube fluorescent luminaries			
Outdoor storage and handling areas		50	
Access ways:	Walkways, platforms, stairways, ladders, module roofs	50	

Note 1: In rooms where VDUs (Video Display Units) are permanently installed, the lighting shall be designed to avoid reflections and glare from the screens.

5.8.3 HELIDECK LIGHTING SYSTEM

The landing and take-off area of the helideck shall be provided with a lighting system comprising:

- Perimeter lighting
- Helideck floodlights
- Windsock lighting
- Helideck status lights

a) Perimeter Lighting

The lights shall be in compliance with CAP 437.

Perimeter lights shall be supplied from 230V AC UPS Distribution Board by at least two circuits.

b) Helideck Floodlights

The aiming circle and the letter "H" signed on the helideck shall be illuminated by helideck floodlights that will not blind the helicopter pilot.

Helideck floodlights shall be supplied from 230 AC UPS.

c) Windsock lighting

مدیریت توسعه بازار تأسیسات دریایی ایران

خوانده شد و مورد تایید است

The windsock shall be illuminated with white lights that will not blind the helicopter pilot.

Windsock Lighting shall be supplied from 230V AC UPS.

d) Helideck Status Lights

The helideck status lights shall comprise of two optic units, xenon type lamps, one red colored and one green colored, which shall alert by very quick flashes the approaching helicopter about the presence of fire or gas on the platform.

Control circuits shall be housed in an Ex-d enclosure including:

- Control circuit with cards ensuring programmable pulses
- Activation command through external signal
- 230VAC/24VDC rectifier to supply the lamps

Helideck status lights shall be supplied from 230V AC UPS distribution Board.

5.8.4AERONAUTICAL OBSTRUCTION LIGHTS

All high structures shall be fitted with aeronautical obstruction lights subject to the statutory and ICAO requirements applicable for the local area. These will include, but not limited to, turbine exhaust and flare stacks.

Aeronautical obstruction lights shall be supplied from 230 VAC UPS.

5.9 EARTHING AND LIGHTNING PROTECTION

The HV distribution system shall be low resistance earthed through individual resistors connected between the generators neutral star point and the earthing system. The HV distribution system shall be classified as TN.

The LV distribution system shall be solidly earthed through an earthing conductor connected between the respective transformers and emergency generators neutral star point and the earthing system. The LV distribution system shall be classified as TN-S.

مدیریت توسعه بازار تأسیسات دریایی ایران

خوانده شد و مورد تایید است

AC UPS circuits shall be floating (IT) and shall be provided with a central earth fault monitoring system.

The DC UPS systems shall be floating (IT) and shall be provided with a central earth fault monitoring system.

For AC and DC UPS, Individual earth leakage monitors (ELM's) for each outgoing feeder are required.

In case the number of outgoing feeders exceeds 5, an earth fault test facility shall be installed able to test each feeder individually without interrupting the circuit.

The earthing system shall ensure safety to personnel in relation to touch and step voltages and protect equipment against damage associated with rise of potential.

Earthing system resistance to earth shall be according to IEC standard and in any case shall not exceed one ohm.

All cable trays shall be first bounded to each other and then grounded at two ends by conductors with size that mentioned in relevant standards.

6. POWER SYSTEM CALCULATIONS AND STUDIES

6.1 CALCULATION OF MAXIMUM LOAD AND PEAK LOAD

Calculation of the maximum normal running load and the peak loads, in both kW and kVA, for the plant operating at design capacity shall be performed. These load figures shall be updated during the detail design stage of the project. They shall form the basis for the design of the electricity generation and distribution systems.

A separate load schedule for each switchboard and all switchboard loads shall be summarized to obtain the overall maximum running and peak loads.

The formula for the maximum demand and peak load calculation is as follows:

Max Demand = A + B,

Peak Load = A + B + C

مدیریت توسعه بازار تأسیسات دریایی ایران

خوانده شد و مورد تایید است

Where,

A = Total continuous load

B = 75% total intermittent load or single largest intermittent (whichever is larger)

C = 10% total standby load or single largest standby (whichever is larger)

Generator, transformer and switchboard capacity shall be capable of supplying continuously 120% of the peak load.

6.2 LOAD FLOW AND VOLTAGE DROP STUDY

The load flow study shall show the maximum flows of real and reactive currents in each part of the power system and shall compare these with the circuit ratings. The voltage level study shall determine the maximum and minimum voltage level at each switchboard on the plant.

6.3 FAULT LEVEL CALCULATIONS

Fault levels shall be calculated. The calculated results shall be compared with switchgear ratings. The study shall describe any limits of operation dictated by the system fault levels.

Maximum and minimum short circuit fault level calculations shall be carried out to establish equipment ratings and facilitate the design of a co-ordinate system of relay protection.

The maximum r.m.s. symmetrical short circuit current value shall be calculated on the basis of all generators connected to the main MV Switchgear with their bus section circuit breakers closed and system demand at maximum.

The study shall consider the possibility of future expansion and the effects on the system of additional generation.

Note: The short-circuited current carrying capacity of equipments shall be:

For MV equipments: 25KA, 1sec. or Calculated Short Circuit Current for

مدیریت توسعه بازار تاسیسات دریایی ایران
خوانده شد و مورد تایید است

1sec., whichever is larger.

For LV equipments: 50KA, 1sec. or Calculated Short Circuit Current for 1sec., whichever is larger.

6.4 RELAY COORDINATION STUDY

The purpose of this study is to establish the individual relay settings and MCCB settings required to ensure personnel and plant safety while maximizing discrimination between faulted and healthy equipment to prevent loss of stability of the overall system and to minimize disturbance to other electrical plant.

6.5 LARGE MOTORS STARTING STUDY

Voltage dips due to the starting of large motors shall be investigated in this study. The motor starting studies shall consider starting the largest MV or LV motors with minimum generation on the MV switchboard and the largest LV motor on the emergency system with only the emergency generator running.

Temporary voltage depressions shall not exceed 15% of the nominal system voltage at motor terminals during motor starting. These temporary voltage depressions occurring at switchgear busbar shall be such that to maintain a minimum of 90% and at least 85% of rated equipment voltage for all other consumers.

Note: All ETAP native files of above motioned studies in clauses 6.2, 6.3, 6.4 and 6.5 shall be delivered to IOOC during engineering period and at the end of the Project. The files shall have no password and shall be fully editable.

6.6 LOAD SCHEDULES

In order to confirm the distribution of load throughout the plant and to confirm the Key Single Line Diagram, the load schedules shall be reviewed. Preliminary data from suppliers and typical library information shall be the basis of the preliminary review. The schedules shall be updated on a regular basis until all final purchased supplier data is received.

مدیریت توسعه بازار تأسیسات دریایی ایران

خوانده شد و مورد تایید است

7. INSTALLATION REQUIREMENTS

7.1 GENERAL

The installation of the plant shall be in accordance with the latest edition of codes and standards.

All installed equipment and systems shall have execution in accordance with hazardous area classification.

7.2 ELECTRICAL ROOMS

The following rooms shall house the electrical equipment.

- Technical Room (common for electrical and instrumentation equipment)
- Battery Room
- MV Switchgear Room

All electrical rooms shall be located in non-hazardous areas. The electrical rooms shall be sized with adequate provision for future enlargement and maintenance operations.

The rooms shall be properly air conditioned by HVAC.

The technical room shall have a false floor in which all incoming and interconnecting cables shall be laid on cable trays.

The battery room shall have a water tap, eye wash basin, sink and drain.

Walls and floor of the battery room shall be anti-acid. Suspended ceilings shall not be installed.

The battery room shall be connected to the main HVAC system and shall have positive pressure compared to the outside atmosphere (equipments like split air cooler shall not be accepted). Adequate air change shall be done in accordance with H2 release to prevent risk of any explosion as per related safety and HVAC standards. All electrical equipment in the battery room shall be suitable for Zone 1, gas group IIC, T3 and Ex'd' type.

مدیریت توسعه بازار تاسیسات دریایی ایران

خوانده شد و مورد تایید است

7.3 CABLES INSTALLATION

Cables should be segregated and suitably identified in the applicable cable category,

- HV Power
- LV Power and Control
- Instrumentation (PCS and monitoring),
- Fire and gas (detection and protection),
- Telecommunications and telephone system.

Cables shall be laid on cable trays as described in part 5.3 of IPS-C-EL-115. Each cable tray shall be provided with minimum 20% free space for future utilization.

Power cables shall be laid on trays in one layer. When three phase power is carried by three separate single core cables, the cables shall be laid in trefoil.

Control cables shall be laid on trays in two layers maximum.

Cables shall have SS316L tags at both ends and at both sides of MCTs. They shall also have tags at each 15 meters of their running.

مدیریت توسعه بازار تاسیسات دریایی ایران

خوانده شد و مورد تایید است

APPENDIX 1: POWER SYSTEM CONTROL PHILOSOPHY

A Power Management System will act as a supervisory computer to control the power generation and distribution, automatic load sharing, automatic load shedding and load reconnection. This will be achieved by interfaces with:

i) Main Generator Control System - for supervising, synchronizing and load sharing of the gas turbine generators,

ii) Emergency Generator Control System - for controlling the emergency diesel generator,

iii) HV and LV switchgear control - for controlling circuit breakers (limited to incoming and bus tie units in case of LV switchgear), under load shedding conditions (only HV circuit breakers and contactors) and for status read-out for the main, normal and emergency LV switchboard.

An automatic load shedding scheme shall be included if more than 2 mains generator sets are installed.

The PMS shall also interface with the various other control panels to achieve specific operational requirements.

The design of the complete system shall provide an effective 'user friendly' method for controlling the electrical network to achieve high levels of reliability, flexibility and operability together with ease of testing and commissioning.

مدیریت توسعه بازار تأسیسات دریایی ایران

خوانده شد و مورد تایید است