

Technical Specifications (In-Cash Procurement)

Technical Specification of LV Electrical Cubicles for TCWS 1st Plasma

The Purpose of this document is to define the design, manufacture, assembly, testing, supply and delivery requirements for the TCWS 1st Plasma Low Voltage (LV) electrical control cubicles, the battery backed uninterrupted power supply (UPS) cubicles and SIC local control panels.

Table of Contents

1	PURPOSE	4
2	GENERAL SCOPE	4
2.1	EXCEPTIONS AND CLARIFICATIONS	5
3	DEFINITIONS	6
4	GENERAL DESIGN BASIS	7
4.1	TCWS INTRODUCTION	7
4.1.1	Applicable Documents	7
4.1.2	Codes, Standards and Directives	10
4.1.3	Environmental Conditions	12
4.1.4	Seismic and Safety Classification (SIC & NON-SIC)	13
4.1.5	Magnetic Field Qualification (SIC & NON-SIC)	17
4.1.6	Radiation Fields (SIC & NON-SIC)	19
4.1.7	Design Life	19
4.1.8	Electrical System Description and Distribution for LV Cubicles	19
5	QUALITY ASSURANCE PROGRAM (QAP)	20
5.1	TRACEABILITY	20
5.2	THIRD PARTY	21
5.3	QUALIFICATION OF NDE PERSONNEL	21
5.4	EQUIPMENT CALIBRATION	21
5.5	TECHNICAL QUALIFICATIONS	21
5.6	MANUFACTURING AND INSPECTION PLAN (MIP)	22
5.7	ACCESS TO MANUFACTURER'S PREMISES	22
5.8	QUALITY RECORDS	23
5.8.1	Document Retention Requirements	23
5.8.2	Test Sample Retention Requirements	24
5.8.3	Nonconformities and Deviation Requests	24
5.9	VERIFICATION AND VALIDATION OF SOFTWARE(S)	24
6	PROCUREMENT QUALITY	25
7	SCOPE OF SUPPLY	25
8	ELECTRICAL MOTOR CONTROL FUNCTIONAL REQUIREMENTS.....	28
8.1	GENERAL FUNCTIONAL REQUIREMENTS	28
8.2	MOTOR CONTROL FUNCTIONAL REQUIREMENTS (NON-SIC)	33
8.3	MOTOR CONTROL FUNCTIONAL REQUIREMENTS (SIC)	35
9	ELECTRICAL UPS CUBICLES FUNCTIONAL REQUIREMENTS	37
9.1	GENERAL FUNCTIONAL REQUIREMENTS	37

9.2	UPS RECTIFIER	39
9.3	UPS BATTERIES	40
9.4	UPS INVERTER.....	40
9.5	UPS STATIC TRANSFER SWITCH.....	41
9.6	UPS POWER DISTRIBUTION BUS.....	42
9.7	INSTRUMENTATION, CONTROL & MONITORING	42
10	DESIGN AND CONSTRUCTION	43
10.1	CUBICLE ENCLOSURES	43
10.2	SPACE HEATERS	45
10.3	FIRE PROTECTION FOR SIC AND NON-SIC CUBICLES.....	46
10.4	SIC LOCAL CONTROL PANEL ENCLOSURES	47
10.5	INTERNAL WIRING	48
10.5.1	General guidelines for Internal Wiring	48
10.6	24 VDC POWER.....	48
10.7	PUSHBUTTONS, SELECTOR SWITCHES AND E-STOPS	49
10.8	INDICATING LAMPS	49
10.9	CURRENT TRANSFORMERS	50
10.10	CONTROL TRANSFORMERS	50
10.11	METERS	50
10.12	TERMINAL BLOCKS	51
10.13	CABLE TERMINATIONS	51
10.14	EARTHING (GROUND) BUS	51
10.15	LABELLING AND NAMEPLATES.....	52
10.15.1	General Guidelines	52
10.15.2	Label Colour	53
10.15.3	Colours for Electrical Cubicles	54
11	CONTROL AND PROTECTIVE DEVICES	54
11.1	GENERAL REQUIREMENTS	54
11.2	MOTOR PROTECTION CIRCUIT BREAKER	54
11.2.1	Circuit breaker Technical Requirements	54
11.2.2	Design Data	55
11.3	FUSE PROTECTION.....	56
11.3.1	Codes and standards.....	56
11.3.2	Technical Requirements.....	56
11.3.3	Design Data	56
11.4	CONTACTORS	57
11.4.1	Codes and Standards	57
11.4.2	Technical Requirements.....	57
11.4.3	Design Data	58
11.5	SOFT STARTERS	58
11.5.1	Design Data	59

11.6 MOTOR STARTING	59
11.6.1 Codes and Standards	59
11.6.2 Technical Requirements	59
12 DRAWING AND DOCUMENTATION REQUIREMENTS	60
13 TEST AND INSPECTIONS.....	61
13.1 ROUTINE TESTS.....	61
13.2 TEST TYPES NON-SIC AND SIC CUBICLES.....	61
13.3 TEST TYPES FOR SIC CUBICLES	62
13.4 FACTORY ACCEPTANCE TEST	62
13.5 COMPLIANCE WITH CONSTRUCTIONAL REQUIREMENT	62
13.6 SITE ACCEPTANCE TEST	63
14 PACKAGING AND TRANSPORTATION	63
14.1 PACKAGING	63
14.2 TRANSPORTATION.....	63
14.3 GUARANTEE.....	64
15 BILL OF MATERIAL	65
15.1 LV ELECTRICAL MOTOR CONTROL CUBICLES	65
15.2 SIC LOCAL CONTROL PANELS.....	72
15.3 UPS ELECTRICAL CUBICLES	73
APPENDIX A HILTI ANCHOR SYSTEM TYPE HST3.....	78
APPENDIX B EXAMPLE OF PLATFORM MOUNTING	78
APPENDIX C GRAPHS	79
APPENDIX D LIST OF I & C CUBICLES FOR EACH UPS.....	84
APPENDIX E LV CUBICLES DIMENSIONS	86

1 Purpose

1. The Purpose of this document is to define the design, manufacture, assembly, testing, supply and delivery requirements for the TCWS 1st Plasma Low Voltage (LV) electrical control cubicles, the battery backed uninterrupted power supply (UPS) cubicles and SIC local control panels.

2 General Scope

1. The scope of this document covers the requirements for the design, fabrication, assembly, testing, qualification, documentation, and delivery of all Low Voltage (LV) motor control cubicles and associated protection system components, the battery backed UPS cubicles and the SIC local control panels as required to operate the TCWS 1st Plasma electrical equipment.
2. The TCWS LV motor control cubicles are depicted in the supplemental single line diagrams “ITER_26PHVV_SLD_001 (3G33KG) Single Line Diagram(SLD) for the VV PHTS, ITER_26DR00_SLD_001 (3F4A57); Single Line Diagram(SLD) for the Draining and Refilling System”, “ITER_26DY00_SLD_001(3G2SR7) Single Line Diagram (SLD) for the Drying system and ITER_260000_SLD_001 (3SAAU5) Single Line Diagram (SLD) for UPS cubicles .
3. The TCWS LV motor control cubicles shall consist of combination IEC motor starter units with the exception of a one (1) IEC soft start controller for the Charging Compressor (26DY00-CMC-1005) with all devices completely assembled and wired in an IP-52 enclosure. Components to be provided shall include, but not be limited to contactors with auxiliary contacts, protective circuit breakers with a remote reset, protective overload devices, ammeters, voltmeters and a copper earthing (grounding) bar in the enclosure. Operator interfaces as defined in this document and LED indicators displaying the status of the system shall be installed on the front of enclosure and all internal wiring shall be complete.
4. The TCWS battery backed UPS cubicles shall consist of a distribution system completely assembled and wired in an IP-52 enclosure. Components to be provided shall include, but not be limited to protective circuit breakers (incoming and outgoing) with remote resets and auxiliary contacts and a copper earthing (grounding) bar in the enclosure. LED indicators displaying the status of the system shall be installed on the front of enclosure and all internal wiring shall be complete.
5. The local control panels (LCP) for the SIC rated equipment. These enclosures shall be rated IP-68, include operator interfaces as defined in this document and LED indicators displaying the status of the system shall be installed on the front of LCP enclosure. A copper earthing (grounding) bar shall be included, and all internal wiring shall be complete.
6. The vendor shall submit a proposal to provide all components requested in this specification meeting all referenced requirements and shall supply as a minimum:
 - The design, manufacturing and testing of the required system.
 - The delivery of the required system to the ITER Organization

- Onsite start-up and commissioning assistance (Proposed as an option at an hourly rate)
- Design, manufacturing and testing of a fire detection and protection system for the SIC cubicles as defined in Section 10.2 Fire Protection for SIC and Non-SIC Cubicles. A similar system for Non-SIC cubicles shall be proposed as an option.
- A comprehensive list of manufacturer recommended Spare Parts

2.1 Exceptions and Clarifications

1. The information provided regarding electrical loads is preliminary and subject to change following the final detail design.
2. After award of the contract, the seller shall submit to the IO the applicable design drawings and documentation as specified in Section 12 “Drawing and Documentation Requirements”. Manufacturing shall not begin until these drawings and related documentation are approved by the IO.
3. All references to LV electrical cubicles include the motor control cubicles and the UPS cubicles.
4. All TCWS 1st Plasma LV motor control electrical cubicles that are in the scope of this document are powered by 400 VAC, 3-Phase, 50 Hz power provided by a four (4) wire (3-phases, neutral) system plus an earthing connection.
5. All TCWS 1st Plasma LV UPS electrical cubicles that are in the scope of this document are powered by 400 VAC, 3-Phase, 50 Hz power provided by two (2) separate four (4) wire (3-phases, neutral) systems plus an earthing connection. Only one (1) of the two (2) provided feeders shall be active at any time. For details refer to Section 9 Electrical UPS Cubicles Functional Requirements.
6. All TCWS 1st Plasma UPS cubicle feeds to the associated I & C cubicles are 230 VAC, 1-Phase, 50 Hz power provided by a two (2) wire (hot, neutral) system plus an earthing connection. Reference Section 9 for details.
7. All TCWS 1st Plasma UPS Cubicles are Classified as Non-SIC.
8. The I & C Cubicles that are provided power by the UPS cubicles are not in the scope of this specification.
9. All TCWS 1st Plasma SIC local control panels that are in the scope of this document are powered by 24 VDC power provided by the associated LV electrical control cubicle.
10. Local Control Panels for Non-SIC equipment **are not** in the scope of this specification and shall be provided by others. However, provisions for functionally interfacing with these LCPs as defined in Section 8 shall be provided.
11. All control power for the motor controls circuit, local control panels, indicator lamps, pushbuttons, meters and other operator interfaces shall be 24 VDC.

12. All circuit breakers shall have the capacity to be remotely reset using a digital 24 VDC signal.
13. The manufacturer shall propose as an option to the scope of supply to provide a fire detection and protection system for the cubicles as defined in this document in Section 10.2 Fire Protection for SIC and Non-SIC Cubicles. This optional system shall be approved by the IO prior to manufacturing.
14. The low voltage (LV) electrical heater control cubicles VV PHTS Baking Heater 26PHVV-CMC-1018; VV PHTS Baking Heater 26PHVV-CMC-1019; VV PHTS Pressurizer Proportional Heater 26PHVV-CMC-1016; VV PHTS Pressurizer Backup Heater 26PHVV-CMC-1017 and Drying Heater 26DY00-CMC-1008 are not in the scope of this specification.
15. Medium voltage (MV) electrical control cubicles are not in the scope of this specification.
16. The Medium Voltage VFD (26DY00-VFD-0009) for the Drying Compressor (26DY00-PC-1002) is not in the scope of this specification.
17. An electrical control cubicle is not required for the Medium Voltage (MV) VV PHTS Primary Pump (26PHVV-PL-1001) and is not in the scope of this specification.

3 Definitions

TCWS	Tokamak Cooling Water System
VV PHTS	Vacuum Vessel Primary Heat Transfer System
DR	Draining & Refilling System
DY	Drying System
COTS	Common Off The Shelf
DOL	Direct online Starter
IO	International Organization (ITER)
LED	Light Emitting Diode
LCP	Local Control Panel
LV	Low Voltage
LOT	Quantity That is Required
MCCB	Molded Case Circuit Breaker
MPCB	Motor Protection Circuit Breaker
MV	Medium Voltage
PBS	Plant Breakdown Structure
PLC	Programmable Logic Controller
PSS	Plant Safety System
RCD	Residual Current Device
SA	Sampling
SIC	Safety Important Class
SR	Safety Related
SRD	System Requirement Document

TBD	To Be Determined By The Supplier
TMB	Thermal Magnetic Trip
UPS	Uninterrupted Power Supply (Battery Backed)

For a complete list of ITER abbreviations see: ITER_D_2MU6W5 - ITER Abbreviations

4 General Design Basis

4.1 TCWS Introduction

The TCWS is the primary coolant system of the ITER machine with the functionality to remove the heat generated by the plasma and transferred to dedicated components of the machine and to release it to the secondary coolant system. The TCWS has the following main functions:

1. To remove the heat load transferred from the Plasma to the Vacuum Vessel and in-vessel components (e.g. Blanket modules, Diverter, and In-Vessel Coils) with pressurized water (< 130 °C and 4.0 MPa).
2. To provide the decay heat cooling.
3. To provide hot water (up to 240 °C and 4.4 MPa) and hot nitrogen gas (up to 390 °C and 3.1 MPa) for baking of Vacuum Vessel and In-Vessel Components.
4. To confine the activated corrosion products and the tritium potentially contained in the water.
5. The Tokamak Cooling Water System (TCWS) is comprised of the 1st Plasma systems Vacuum Vessel Primary Heat Transfer System (VV PHTS), Draining (DR), Drying (DY), and the 2nd Plasma systems Integrated Blanket, ELM, Diverter Primary Heat Transfer System (IBED PHTS), Neutral Beam Injection Primary Heat Transfer System (NBI PHTS) and Chemical & Volume Control System (CVCS).
6. For additional information regarding TCWS reference the document “TCWS System Description Document (SDD) - EXPORT CONTROL ([94WLDK](#))”.

4.1.1 Applicable Documents

RD0	Electrical Design Handbook (2DSPT6)
RD1	Electrical Design Criteria Basis TCWS 1st Plasma (25SWBV)
RD2	Electrical Load List (ELL) For TCWS 1st Plasma (23GDBU)
RD3	ITER_26PHVV_SLD_001 (3G33KG)
RD4	ITER_26DR00_SLD_001 (3F4A57)
RD5	ITER_26DY00_SLD_001 (3G2SR7)
RD6	Electrical Cubicle Allocation TCWS 1st Plasma (2ZN7QN)
RD7	PBS26 Electrical Enclosure Drawings in Tokamak Complex (RU4J5Z)
RD8	System Requirements Document Tokamak Complex Buildings (2DQZ92)
RD9	ITER Site Meteorology (2UT36S)

RD10	Mitigation Strategies for TCWS EEE Against Radiation and Magnetic Field (3Q3E5Z)
RD11	IO Cable Catalogue (355QX2)
RD12	IO Cable Tray Catalogue (NVYFKD)
RD13	System Requirement Document TCWS (2823A2)
RD14	Interface Sheet 26-43 (2MYNR4)
RD15	Plant Control Design Handbook (27LH2V)
RD16	Test method for ITER equipment for static (d.c.) magnetic fields (98JL4W)
RD17	ITER Quality Assurance Program (QAP) (22K4QX)
RD18	Requirements for Producing a Quality Plan (22MFMW)
RD19	Requirements for Producing an Inspection Plan (22MDZD)
RD20	Procedure for management of Nonconformities (22F53X)
RD21	List of ITER-INB Protections Important Activities (PSTTZL)
RD22	Quality Classes to Software Qualification Policy (KTU8HH)
RD23	Procedure for the management of Deviation Request (2LZJHB).
RD24	Safety requirement Room-book (KF63PB)
RD25	Provisions for Implementation of the Generic Safety Requirements by the External Interveners (SBSTBM)
RD26	Safety Important Functions and Components Classification Criteria and Methodology (347SF3)
RD27	Tokamak Complex - Floor Response Spectra 2016 - Esteyco (TFN4DN)
RD28	Defined requirement for PBS 26 (M369M3)
RD29	List of Protection Important Components (PIC list) (EN) (JDS5K7)
RD30	Propagation of the Defined Requirements for Protection Important Components Through the Chain of External Interveners (BG2GYB)
RD31	Surveillance Plan for PBS 26 - Cooling Water System (CAJTAL)
RD32	TCWS System Description Document (SDD) - EXPORT CONTROL (94WLDK)
RD33	Accident Analysis Report (AAR) Volume I - Event Identification and Selection (2DPVGT)
RD34	Accident Analysis Report (AAR) Volume II - Reference Event Analysis (2DJFX3)
RD35	Accident Analysis Report (AAR) Volume II - Figures (2EBGU5)

- RD36 Accident Analysis Report (AAR) Volume III - Hypothetical Event Analysis
([2E2XAM](#))
- RD37 Accident Analysis Report (AAR) Volume III - Figures ([2EL9ML](#))
- RD38 ITER Procurement Quality Requirements ([22MFG4](#))
- RD39 ITER Project Management Plan (PMP) ([2NCR3F](#))
- RD40 Overall Surveillance Plan of the Chain of External Actors for Protection
Important Components, Structures and Systems and Protection Important
Activities ([4EUQFL](#))
- RD41 Procedure for ITER CAD Data Exchanges ([2NCULZ](#))
- RD42 Procedure for the CAD management plan ([2DWU2M](#))
- RD43 Procedure for the Management of Diagrams and Drawings in pdf Format Using
the SMDD Application ([KFMK2B](#))
- RD44 Provisions for Implementation of the Generic Safety Requirements by the
External Actors/Intervenors ([SBSTBM](#))
- RD45 Requirements for Producing a Contractors Release Note ([22F52F](#))
- RD46 Software Qualification Policy ([KTU8HH](#))
- RD47 Specification for CAD data Production in ITER direct contracts ([P7Q3J7](#))
- RD48 Instructions for Structural Analyses ([35BVV3](#))
- RD49 IO/In-Cash Contractor Documentation Exchange and Storage Working
Instruction ([G8UMB3](#))
- RD50 Collection of Input Data to support Qualification Plan in charge of TCWS
electro- mechanical equipment supplier ([YST3YH](#))
- RD51 SRD-26-PH, -CV, -DR, -DY, -SA (TCWS) from DOORS ([2823A2](#))
- RD52 Static and transient magnetic field maps at level B1 tokamak complex
([QDFMW9](#))
- RD53 Static and transient magnetic field maps at level B2 tokamak complex
([QE42YB](#))
- RD54 Static and transient magnetic field maps at level R1 tokamak complex
([R35C6B](#))
- RD55 Static and transient magnetic field maps at level L3 tokamak complex
([QQGFU6](#))
- RD56 Static and transient magnetic field maps at level L4 tokamak complex
([QUDEGC](#))

- RD57 Static and transient magnetic field maps at level L5 tokamak complex
([R2RVRE](#))
- RD58 ITER Numbering System for Components and Parts ([28QDBS](#))
- RD59 Engineering Technical Documentation - PBS 62.11, 62.14 and 62.74 - Tokamak Complex - Technical Recommendation for Post Drilled Systems in Tokamak Complex - ENG_51_TR_110005_CW ([W8U3MC](#))

4.1.2 Codes, Standards and Directives

The design and manufacture of 400VAC motor control LV cubicles and the LV UPS cubicles shall comply with the latest editions of the IEC recommendations and as noted in EDH Part 3: Codes and Standards.

- IEC 60038 - IEC Standard Voltages
- IEC 60228 - Conductors of Insulated cables
- IEC 60269 - Low-voltage fuses
- IEC 60439 - Low-voltage switchgear and control gear assemblies
- IEC 60529 - Degree of protection provided by enclosures
- IEC 60947 - Low-voltage switchgear and control gear
- IEC 60073 - Coding principles for indicators and actuators
- IEC 60364 - Low-voltage electrical installations
- NF C 15-100 – Cabling, Electrical installations rules, calculation notes, operation procedure.
- IEC 62040 - Uninterruptible Power Systems (UPS)
- EN 50272-2 - Safety requirements for secondary batteries and battery Installations Part 2: Stationary batteries
- EN 50091 – Uninterruptible Power Systems (UPS)
- IEEE 446 – Recommended practice for emergency and standby power systems for industrial and commercial applications
- IEEE 1106 - IEEE Recommended Practice for Installation, Maintenance, Testing, and Replacement of Vented Nickel-Cadmium Batteries for Stationary Applications
- IEEE 1115 – IEEE Recommended Practice for Sizing Nickel-Cadmium Batteries for Stationary Applications
- IEC 60050-482 International Electro technical Vocabulary-Part 482: Primary and secondary cells and batteries
- IEC 60623 Secondary cells and batteries containing alkaline or other non-acid electrolytes – Vented nickel-cadmium prismatic rechargeable single cells
- IEC 61438 Possible safety and health hazards in the use of alkaline secondary cells and batteries. Guide to equipment manufacturers and users
- IEC 62259 Secondary cells and batteries containing alkaline or other non-acid electrolytes – Nickel-cadmium prismatic secondary single cells with partial gas recombination
- IEC 61000 – Electromagnetic Capability (EMC).
- C-63-429 – Service Indices.
- IEC 61024-1-1- Protection against lightning – Part 1: General principles

- IEC 61024-1-2 – Protection against lightning – Part 3: Physical damage to structures and life hazard ITER follows S.I. units for the project. The electrical system should be defined and built following S.I. units for measurement.
- IEC 60898 Circuit-breakers for AC operation
- IEC 60255 Safety requirements for measuring relays and protection equipment
- IEC 60309 Plugs, socket-outlets and couplers for industrial purposes
- IEC 62671 Nuclear power plants – Instrumentation and control important to safety – Selection and use of industrial digital devices of limited functionality
- IEC 62061 Safety of machinery: Functional safety of electrical, electronic and programmable electronic control systems
- IEC-742 Non-Short Circuit Proof Isolating Transformers
- IEC-529 Outlines an international classification for the sealing effectiveness of enclosures of electrical equipment against the intrusion into the equipment of foreign bodies (i.e., tools, dust, fingers) and moisture.
- IEC 898 Circuit-breakers for overcurrent protection for household and similar installations
- IEC 61513 Instrumentation & Control for Systems Important to Safety in Nuclear Power Plants
- IEC 62138 Nuclear power plants – Instrumentation and control systems important to safety
- ISO 13849-1 General principles for design, provides safety requirements and guidance on the principles of design and integration of safety-related parts of control systems (hardware or software)
- IEC 60068 Environmental testing of electrotechnical products – Vibration
- RCC E Design and construction rules for electrical and I&C systems and equipment
- IEC 61439 Standard for low-voltage switchgear and control gear assemblies
- CE Conformité Européenne
- EUROCODE 3: NF P22-313, NF EN 1993-1-3, 2007)
- EU Directive 2014/35/EU/
- IEC 60987 Nuclear power plants - Instrumentation and control important to safety - Hardware design requirements for computer-bases systems
- IEC 62138 Nuclear power plants - Instrumentation and control systems important to safety - Software aspects for computer-based systems performing category B or C functions
- IEC/IEEE 60780-323 Nuclear facilities - Electrical equipment important to safety - Qualification.
- IEEE 649-2006 IEEE Standard for Qualifying Class 1E Motor Control Centers for Nuclear Power Generating Stations
- IEC 61508 Functional Safety of Electrical/Electronic/Programmable Electronic Safety-Related Systems
- IEC 61511 Functional safety - Safety Instrumented Systems for the Process Industry Sector

The UPS sets and assemblies shall be in compliance with at least the following directives of the European Commission:

- | | |
|--------------|-------------------------------|
| • 2014/30/EU | Electromagnetic Compatibility |
| • 2014/35/EU | Low Voltage Equipment |
| • 2006/66/EC | Hazardous Substances |

- 99/92/EC and 94/9/EC Explosive Atmospheres (ATEX)
- 2003/10/EC Noise Emission
- 2002/96/EC Waste Electrical and Electronic Equipment
- 2002/95/EC Restriction of Use of Certain Hazardous Substances in Electrical and Electronic Equipment (RoHS)

4.1.3 Environmental Conditions

1. The ITER project site is located at Saint-Paul Lez Durance in France.
2. An overview of the environmental and climatic data for the electrical system design are referenced below in Table 1.
3. Environmental conditions to be assumed during Incident Condition (Cat II) and Accident Condition (Cat III/IV) are defined in the document “Collection of Input Data to support Qualification Plan in charge of TCWS electro-mechanical equipment supplier ([YST3YH](#))”
4. For additional information regarding Accident Conditions reference the documents “Accident Analysis Report (AAR) Volume I - Event Identification and Selection ([2DPVGT](#)), Accident Analysis Report (AAR) Volume II - Reference Event Analysis ([2DJFX3](#)), Accident Analysis Report (AAR) Volume II - Figures ([2EBGU5](#)), Accident Analysis Report (AAR) Volume III - Hypothetical Event Analysis ([2E2XAM](#))” and Accident Analysis Report (AAR) Volume III - Figures ([2EL9ML](#))”.
5. All electrical equipment shall be suitable for continuous operation in the site conditions specified.
6. Environment conditions at ITER are further detailed in the document “ITER Site Meteorology ([2UT36S](#))”.

Sr. No	Parameters	Value
1	Altitude above mean sea level	315 Meters
2	Ambient Temperature - Outside Building	Max. Dry Bulb Temperature: +40°C Min. Dry Bulb Temperature: -8°C
3	Relative Humidity - Outside building	Summer – 40% RH Winter – 90% RH
4	Ambient Temperature – Inside building	18°C - 35°C
5	Relative Humidity (Inside building)	20% -60% RH
6	Ambient Temperature	Absolute Max.: +45°C Absolute Min.: -15°C
7	Pollution level: (per IEC 60071-2)	1 (light)
8	Wind Speed (Outside of Building)	166.6 km/hr. (max.)
9	Seismic classification	Refer to Section 4.1.4

10	Rated voltage, Frequency and variations for Class IV power	LV: Voltage: 400V/230V $\pm 10\%$ Frequency: 50Hz $+1\%$
11	Rated voltage, Frequency and variations for Class III-SR power	LV: Voltage: 400V/230V $\pm 10\%$ Frequency: 50Hz $+1\%$ Important note: Voltage level is at 75% of the nominal voltage when the diesel is started. This must be considered in the system sizing for cubicles supplied with Class III-SR power. For additional information reference the Electrical Design Handbook (2DSPT6) Guide C.
12	24 VDC Control Power for: <ul style="list-style-type: none"> • Motor control circuit • Local Control Panel • Operator Interface (Indication lamps, Pushbuttons, meter displays etc.) • Plant System PLC & I/O 	Vendor provided 24VDC supply powered by 230V 1Phase AC, 50Hz supply derived from one (1) phase (Line) to Neutral Voltage inside LV Cubicle
13	Magnetic Field	Range between 5mT - 30mT. For additional information reference the document “Collection of Input Data to support Qualification Plan in charge of TCWS electro-mechanical equipment supplier (YST3YH) and Table 2 of this document.
14	Radiation	TID: 10Gy ENF: $1E10 @1Mev Si eq n.cm-2$ TNF: $1E2 n.cm-2.s-1$

Table 1: Site Conditions and General Information is Applicable for Normal Operating Conditions

4.1.4 Seismic and Safety Classification (SIC & NON-SIC)

1. The TCWS 1st Plasma electrical equipment are either classified as SIC cubicle (if they contribute to a safety function) or NON-SIC cubicle (if they do not contribute to any safety function).
2. For SIC cubicles (and associated component), as per the document “Safety Important Functions and Components Classification Criteria and Methodology ([347SF3](#))”, they are requested to be SC1(SF) in order to be able to perform their safety functions in the event of an earthquake SL-2. As such, all SIC cubicles shall be designed to withstand and required to be fully operational after the seismic event SL-2.
3. Nuclear standards such as IEEE 649, IEC 61513 + IEC 60987 + IEC 62138 + IEC 60780 or RCC-E should be used for the design and manufacturing of SIC Cubicles.

Alternatively, industrial standard IEC 61508 or IEC 61511 for at least SIL-2 (Low demand application) in association with IEC 60780 for qualification purpose are acceptable for used.

4. For NON-SIC cubicles (and associated component), they are requested to be SC2 in order to ensure no collapse, falling, dislodgement or other spatial response which could jeopardize the functioning of other components providing a safety function.
As such, all NON-SIC cubicles shall be designed to ensure that the structural integrity is maintained during and after the seismic event SL-2.
For investment protection reason, all NON-SIC cubicles shall be designed to withstand and required to be fully operational after the seismic event SL-1.
5. For each cubicle (SIC and NON-SIC) listed in Table and Table , the associated Floor Response Spectra is provided and corresponding to SL-2 event. Calculation shall be performed using a damping of 3%, conservatively round-up to a damping of 2%.
6. For NON-SIC cubicle, seismic event SL-1 is deducted from SL-2 by applying a ratio of 0.34 on SL-2 value ($SL-1=0.34*SL-2$)
7. The seismic qualification for SC1(SF) and SC2 rated cubicles shall be provided by the supplier based on the conditions in the room the cubicle will be located in. Qualification by analytical calculation is acceptable for mechanical integrity verification but qualification by test is expected for operability verification.
8. Cubicles shall be installed either attached to concrete plinth or to a metallic platform.
9. Cubicles shall be assumed to be arranged side by side without any gap left between them.
10. The manufacture shall propose an adequate way to connect each applicable cubicle to the floor or platform in the specified room it is located to satisfy the Seismic and Safety requirements. The associated loads transferred from the cubicle to the connection shall be provided to IO to ensure that it is compliant with the mechanical structure (ground or platform) to which the cubicle is connected to.
11. For cubicles connected to concrete plinth, supplier shall ensure the proper attachment and it is recommended to use HILTI anchor system type HST3 (Reference Appendix A).
12. The anchor system shall be compliant with the following codes and standards and use of other anchor systems shall be subject to IO approval. If the supplier cannot provide a 10 cm maximum distance in the charging capacity of the plinth, the corresponding reduction shall be taken into account by the supplier at no additional cost.

Code And Standards		Title		Description
[I-3] ETAG 001		Guideline for European Technical Approval of Metal Anchors for Use in Concrete		Guideline for the design of metal anchors for PDS mentioned
[I-4] ETAG 001 – Annex C		Annex C of ETAG 001 – Design Methods for anchorages		Detailed calculation method for the design of the metal anchors for PDS mentioned

[I-5] CISMA		Guide Technique – Recommandations professionnelles sur le chevillage		Guide To be used for the earthquake resistance of the PDS mentioned
[I-6] EOTA TR029		EOTA Technical Report - Design of Bonded Anchors		Document to be used for the design of post drilled bonded anchors (chemical or hydraulic) mentioned
[I-7] EOTA TR045		EOTA Technical Report – Design of Metal anchors for use in concrete under seismic actions		Document to be used for the design of metal anchors for use in concrete under seismic actions mentioned

Table 2 Anchor System Codes and Standards

13. Cubicle shall be assumed to be install at the end of the concrete plinth, considering a concrete plinth width of 1.0m and a maximal distance from the cubicle edge to the concrete edge of 0.1m
14. Concrete is of Class C40/50 with properties provided in the table below extracted from Reference document “ Engineering Technical Documentation - PBS 62.11, 62.14 and 62.74 - Tokamak Complex - Technical Recommendation for Post Drilled Systems in Tokamak Complex - ENG_51_TR_110005_CW (W8U3MC)”

Parameter	Symbol	Value
Concrete class	-	C40/50
Characteristic compressive cylinder strength	fck	40 Mpa
Young’s Modulus for accidental conditions	Ecm	35,000 Mpa
Young’s Modulus for normal conditions	Ecsta	12,000 Mpa

Table 3 Concrete Properties

15. Anchor sizing shall be performed assuming cracked concrete conditions and sizing shall ensure that the following concrete requirements are verified:
16. Tension loading: concrete pull-out resistance, concrete cone resistance and concrete splitting resistance
17. Shear loading: concrete pry out resistance, concrete edge resistance
18. Anchor sizing shall be compliant with EUROCODE 3: NF P22-313, NF EN 1993-1-3, 2007.
19. Loads provided to the anchor system shall be calculated by the manufacturer taking into account the dead weight as well as the seismic SL-2 event, combined in the most conservative way and taking into account any necessary safety margin factor for the code

20. For cubicles connected to metallic platform the supplier is expected to provide proper attachment system using the recommended HILTI anchor system HST3 M12 bolting.
21. For cubicles located on the platform, supplier should provide the capacity to route cables either from top or bottom and with the final decision provided by IO in the frame of the Supply Order signature.
22. For an example of the platform mounting reference Appendix B.
23. Regarding cubicle installed on platform, supplier is in charge to assess if direct bolting of the cubicle to the platform or use of a metallic/monobloc plinth is the most preferable option. In such case, the height of the metallic/monobloc plinth should be limited to 10mm to minimize the impact on the overall cubicle dimension.
24. Loads generated from the cubicle to the platform shall be provided by the manufacturer in order to allow proper design of the metallic platform (not in the scope of cubicle manufacturer)
25. The floor and platform connection proposal shall include detailed drawings and a list of components required for the connection.
26. In general the 1st Plasma TCWS electrical equipment design shall followed the applicable guidelines defined in the documents “Provisions for Implementation of the Generic Safety Requirements by the External Interveners ([SBSTBM](#))” and ““Collection of Input Data to support Qualification Plan in charge of TCWS electro-mechanical equipment supplier ([YST3YH](#))”.
27. For additional information regarding SIC components refer to the document “List of Protection Important Components (PIC list) (EN) ([JDS5K7](#))” and “Propagation of the Defined Requirements for Protection Important Components Through the Chain of External Interveners ([BG2GYB](#))”.
28. Defined Requirements for Protection Important Components Through the Chain of External Interveners ([BG2GYB](#))”.

Cubicle Tag	Cubicle Location	Building	Level	Figure (Reference Appendix C)	Cubicle Connection (Ground or Platform)
26PHVV-CMC-1010	11-B2-02NE	B11	B2	Figure 1 & Figure 2	Ground
260000-BD-9037	11-B2-02NE	B11	B2		Ground
260000-BD-0016	11-B2-02NW	B11	B2		Ground
260000-BD-0056	11-L3-02NE	B11	L3	Figure 3 & Figure 4	Ground

260000-BD-0053	14-L4-04	B14	L4	Figure 5 & Figure 6	Ground
260000-BD-1004	74-B2-03	B74	B2	Figure 7 & Figure 8	Ground

Table 4: Cubicle connected on the ground with associated Floor Response Spectra according to the document “Tokamak Complex - Floor Response Spectra 2016 - Esteyco (TFN4DN)”.

Cubicle Tag	Cubicle Location	Building	Level	Figure (Reference Appendix C)	Cubicle Connection (Ground or Platform)
260000-BD-0030	11-L4-01N	B11	L4	Figure 9 & Figure 10	Platform
26PHVV-CMC-1003	11-L5-05S	B11	L5		Platform
26DR00-CMC-1009	11-L5-05N	B11	L5		Platform
26PHVV-CMC-1006	11-R1-01E	B11	R1		Platform
26PHVV-CMC-1001	11-R1-01E	B11	R1		Platform
26DY00-CMC-1005	11-R1-01E	B11	R1		Platform
260000-BD-9500	14-L3-23	B14	L3		Platform
26DR00-CMC-1013	74-B1-03	B74	B1		Platform* *False Bottom

Table 5: Cubicle connected on the platform with associated Floor Response Spectra according to the document Reference “FRS for CSS-N seismic qualification (TK2PJZ)”

At the current time of this Technical Specification, design of platform is on-going. An updated platform FRS spectra will be provided at the time of the Supplier Order by IO if necessary.

For additional information reference the graphs in Appendix C

4.1.5 Magnetic Field Qualification (SIC & NON-SIC)

1. No special requirement or qualification is needed for LV electrical cubicles located in the diagnostics (Building 74) or the tritium (Building 14) buildings (reference “Electrical Cubicle Allocation TCWS 1st Plasma ([2ZN7QN](#))”) and for any LV electrical cubicles in the Tokamak building (B11) located in areas with magnetic fields lower than 5 mT.
2. For LV electrical cubicles located in areas where the static magnetic field is between 5 mT - 30 mT, either the cubicle is certified to be compliant within the anticipated fields or a specific test has to be prepared to certify the correct operation of the cubicle.
3. In the case that a test is required, the SIC equipment has to be tested for a field strength that is between 1.4 to 2.0 of the current field values and as per the magnetic field compatibility tests specified in the document “Test Method for ITER Equipment for Static (d.c.) Magnetic Fields ([98JL4W](#)) Chapter 5”.

4. For Non- SIC equipment, a test with a field strength of 1.0 of the current field values and as per the magnetic field compatibility tests specified is adequate.
5. Most of the TCWS 1st Plasma LV electrical cubicles in the Tokamak building (B11), are exposed to magnetic fields above the 5 mT range and shall be required to have a compliance or test certificate for the defined magnetic field.
6. The specific magnetic field strength at the location of each LV electrical cubicle is provided in Table 4 below. These field values are applicable in three directions.
7. For additional information regarding magnetic field strength reference the documents:
 - Static and transient magnetic field maps at level B1 tokamak complex ([QDFMW9](#))
 - Static and transient magnetic field maps at level B2 tokamak complex ([QE42YB](#))
 - Static and transient magnetic field maps at level R1 tokamak complex ([R35C6B](#))
 - Static and transient magnetic field maps at level L3 tokamak complex ([QQGFU6](#))
 - Static and transient magnetic field maps at level L4 tokamak complex ([QUDEGC](#))
 - Static and transient magnetic field maps at level L5 tokamak complex ([R2RVRE](#))

NO.	Cubicle Number	Cubicle Location	Magnetic Field Value Modulus	Magnetic Field Value Vertical Component	Magnetic Field Value Radical Component
VV PHT					
1	26PHVV-CMC-1006	11-R1-01E	15 mT/s	10 mT	15 mT
2	26PHVV-CMC-1001	11-R1-01E	15 mT/s	10 mT	15 mT
3	26PHVV-CMC-1003	11-L5-05S	<1 mT/s	<1 mT	10 mT
4	26PHVV-CMC-1010	11-B2-02NE	5 mT/s	5 mT	< 2.5 mT
DR SYSTEM					
1	26DR00-CMC-1013	74-B1-03	2.5 mT/s	2.5 mT	< 2.5 mT
2	26DR00-CMC-1009	11-L5-05N	2.5 mT/s	< 2.5 mT	15 mT
DY SYSTEM					
1	26DY00-CMC-1005	11-R1-01E	15 mT/s	10 mT	15 mT
UPS CUBICLE SYSTEM					
1	260000-BD-9037	11-B2-02NE	5 mT/s	5 mT	< 2.5 mT
2	260000-BD-9500	14-L3-23	7.5 mT/s	5 mT	5 mT
3	260000-BD-0053	14-L4-04	5 mT/s	< 2.5 mT	< 2.5 mT
4	260000-BD-0030	11-L4-01N	10 mT/s	< 2.5 mT	10 mT

5	260000-BD-0016	11-B2-02NW	10 mT/s	10 mT	5 mT
6	260000-BD-1004	74-B2-03	5 mT/s	5 mT	2.5 mT
7	260000-BD-0056	11-L3-02NE	10 mT/s	5 mT	7.5 mT

Table 6 Magnetic Field Strength**4.1.6 Radiation Fields (SIC & NON-SIC)**

1. Comprehensive radiation analysis has been done on the predicted conditions in the Tokamak building (B11) and there are numerous documents that define and detail the ITER Radiation Policy (reference Section 4.1.1 Applicable Documents). These analysis documents define a wide range of radiation dosages across the Tokamak building and suggest various mitigation strategies to help reduce radiation exposure.
2. The TCWS 1st Plasma LV electrical cubicles shall follow the guidelines established in the document “Mitigation Strategies for TCWS EEE Against Radiation and Magnetic Field (3Q3E5Z v1.0)
3. In general, these guidelines recommend locating the LV electrical cubicles in areas protected from radiation exposure. Therefore, no specific radiation tolerance requirements or qualification is necessary for the TCWS 1st Plasma LV electrical cubicles.

4.1.7 Design Life

1. The TCWS 1st Plasma LV electrical cubicles shall be designed for a minimum of 10 years required for the installation, testing and commissioning period and shall have in addition an operation lifetime of 14 years of nuclear operation as specified in the document “Collection of Input Data to support Qualification Plan in charge of TCWS electro-mechanical equipment supplier ([YST3YH](#))”. Total designed lifetime shall be a minimum of 24 years.

4.1.8 Electrical System Description and Distribution for LV Cubicles

1. The Electrical power supply network at the ITER plant is classified as PPEN (Pulsed Power Electrical Network) and SSEN (Steady state Electrical network). The VV PHTS, DR and DY LV cubicles are fed from the SSEN which is under the scope of PBS-43.
2. The power available to the ITER plant is 400kV, which is reduced to 22kV, then to 6.6kV and then to 400V by transformers.
3. The VV PHTS, DR and DY electrical loads are detailed in the Electrical Load List (ELL) For TCWS 1st Plasma ([23GDBU](#)).
4. Electrical loads greater than 200kW are fed from the 6.6kV power supply and loads less than or equal to 200kW are fed from the 400V LV power supply.
5. The TCWS 1st Plasma System Heaters are exempt from this requirement and shall be powered by 400 VAC regardless of electrical load. Note that the TCWS 1st Plasma Heaters are not in the scope of this specification.
6. PBS 43 provides power to all LV electrical cubicles and this power consists of 400 V, 50 Hz 4-wire system (Three Phase & Neutral) with an earthing conductor.

7. PBS 43 provides power to all UPS electrical cubicles and this power consists of 400 V, 50 Hz 3-phase+N+PE system.
8. The details of the CLASS of power and load centers can be found in the Interface Sheet 26-43 ([2MYNR4](#)).
9. For LV distribution, PBS 43 provides the power and PBS 44 routes it to the TCWS 1st Plasma LV electrical cubicles.
10. The routing of the LV power, the associated cables and the field termination at the LV cubicle are not in the scope of this specification.

5 Quality Assurance Program (QAP)

1. The Manufacturer's QAP shall be applied to the entire product and services as defined under this Specification. For reference the ITER QAP is the document "ITER Quality Assurance Program (QAP) ([22K4QX](#))" and "ITER Project Management Plan (PMP) ([2NCR3F](#))".
2. A Manufacturer's Project Specific Quality Plan meeting the specifications as defined by the document "Requirements for Producing a Quality Plan ([22MFMW](#))" shall be submitted for IO review and approval.
3. The Manufacturer's Project Specific Quality Plan shall meet the requirements of the IO procedure for such a plan.
4. The Manufacturer shall ensure that all of their subcontractors that provide any part of the Product or services as defined by this Specification are in compliance with the QA requirements under the relevant QA classifications.
5. Similar control of quality activities for all levels of subcontractors supplying material or services is requested when inspection or certification is required.
6. The Quality Plan shall identify:
 - The critical quality activities
 - The specific allocation of resources, duties, responsibilities, and authority
 - The details of all suppliers/subcontractors and how interfaces will be managed
 - The specific procedures, methods, and work instructions to be applied
 - The specific methods of communication, both formal and informal, to be established between working groups

5.1 Traceability

1. The Manufacturer shall have traceability procedures in place that will guarantee traceability between materials delivered and from the beginning of manufacturing.
2. These procedures shall be submitted to and approved by the IO prior to the start of any manufacturing.
3. Traceability shall be maintained by procedural methods that cover receipt, identification, storage, and transfer to production, temporary storage and for use in production.
4. Manufacturer Responsibilities:
 - The Manufacturer shall be fully responsible for quality with respect to all services, materials, manufacturing, and testing, etc. The Manufacturer shall be responsible

for imposing all technical and quality requirements as applicable to all the Manufacturer's sub-contractor furnishing hardware or services in accordance with all applicable Specifications.

- The technical and quality requirements of all applicable specifications shall be passed down to all levels of subcontractors. These include, but are not limited to requirements for handling, packaging, shipping, storage, and inspections and testing.
- Manufacturer shall identify to all its Subcontractors all applicable QA requirements imposed by the supply order and this Specification and shall ensure Subcontractor's compliance thereto and shall include the requirements in procurement documents.
- The Manufacturer shall conduct internal audits of its own facilities and external audits of its subcontractor.
- QA and QC activities by the IO shall not relieve the Manufacturer and their sub-contractors from responsibility to perform all inspections and tests required by the contract and governing codes and standards.

5.2 *Third Party*

1. The IO has the option to use a third party to evaluate the Manufacturer's quality assurance program.
2. In such a case, the third party shall be the technical organization that is responsible for the approval and monitoring of the Manufacturer's quality assurance system and the direct inspection of the product.
3. The Manufacturer shall provide access and information required by the third party to perform the necessary evaluations and tests to fulfill its responsibilities.

5.3 *Qualification of NDE Personnel*

1. Personnel for non-destructive examination (NDE) must be approved by a Notified Body or a third-party recognized by a Member State.
2. All NDE personnel qualifications shall conform to the following requirements:
 - Personnel shall be qualified in accordance with NF EN ISO 9712.
 - The third party or ANB shall check that the qualifications of the personnel responsible for NDE are valid in terms of time and appropriateness for the work to be carried out.

5.4 *Equipment Calibration*

1. Measuring and Test Equipment shall be calibrated and calibration records maintained according to a calibration program based on a recognized standard. The measuring and test equipment shall have a current Certificate of Calibration traceable to a national recognized testing laboratory.
2. Certificates of Calibration must be submitted to the IO.
3. All heat treatment equipment shall be calibrated and all personnel performing heat treatment shall be qualified to do so.

5.5 *Technical Qualifications*

1. When a technical qualification is required, the Manufacturer must demonstrate that the manufacturing operations selected for the component subject to this technical qualification will ensure that the risks of heterogeneity among its mechanical and chemical characteristics are controlled.

5.6 *Manufacturing and Inspection Plan (MIP)*

1. A Manufacturing and Inspection Plan (MIP) shall only be prepared by the Manufacturer for materials that are considered fabricated materials (components made from manufacturing operations capable of altering mechanical properties).
2. The MIP prepared by the Manufacturer shall meet the requirements of the ITER document “Requirements for Producing an Inspection Plan (22MDZD)”.
3. The MIP is a listing of the chronological sequence of manufacturing operations affecting quality encompassing the whole scope of the subcontract and ranging from verification of materials, manufacture, inspection and test to delivery.
4. For PIC elements, the MIP also clearly identifies the PIA. A list of the PIA for ITER is presented in the document “List of ITER-INB Protections Important Activities PSTTZL”.
5. The MIP will be used to monitor quality control and acceptance tests. It is permissible for the Manufacturer to submit multiple MIPs that are more sufficient and manageable to the particular operation.
6. Prior to Manufacturing operations, the MIP shall be generated in accordance with the procedure provided in Section 4 of ITER Manufacturing and Inspection Plan (MIP) and shall be sent to the IO for approval. This requirement is to be passed down to all levels within the procurement chain.
7. The level of detail in a MIP shall be sufficient to prevent the inadvertent by-passing of critical operations and to enable adequate planning, monitoring and verification of critical operations.
8. This document shall be submitted to the IO for review.
9. The document, when approved by all parties shall be provided to the Manufacturer at least 10 days prior to the start of fabrication.
10. The IO may add hold, witness or require notification points to the MIP and identify tests or inspections that must be witnessed by the IO representative.
11. The Manufacturer shall indicate intervention points that must be witnessed by the IO representative with a “W” code at the appropriate locations in the MIP. The MIP template is provided in the document “Requirements for Producing an Inspection Plan (22MDZD)”.
12. The IO approved MIP is a prerequisite to the Manufacturer proceeding with the work as defined.
13. It is permissible for the IO to indicate partial approval to authorize operations that would be constrained due to issues with subsequent operations.

5.7 Access to Manufacturer's Premises

1. The Manufacturer shall grant access rights to the IO, US ITER, Innovative Design Inc. and the Autorité de Sûreté Nucléaire (ASN) organization to its facilities, records, proprietary processes and/or information and those of its Subcontractors for the purposes of surveillance of defined requirements during the construction/manufacturing of a PIC.
2. This surveillance shall also include the examination of all protective-important actions and the follow-up and verification of all corrective actions which are to be implemented.
3. The Manufacturer shall inform the IO of all locations where fabrication will be done.
4. Source surveillance activities may be conducted at the Manufacturer's facility or any sub-tier supplier facility that the IO determines necessary to ensure quality objectives are met.
5. Representatives of the IO, US ITER, Innovative Design Inc. and the ASN require the same access to execute their own inspections or observations. Such surveillance may include auditing and monitoring of production processes, in-process inspection and controls, chemical or physical certifications, final inspection and tests, preparation for shipment, and review of certification data. Proprietary processes or restricted access areas shall in no way prevent such surveillance.
6. Surveillance visits can be announced on short notice. Source surveillance by the IO, US ITER, Innovative Design Inc. and the ASN representatives shall not constitute product acceptance by the IO and shall in no way relieve the Manufacturer of the responsibility to furnish acceptable items.
7. To ensure the safety of the IO, US ITER, Innovative Design Inc. and the ASN representatives who visit the Manufacturer's or their supplier's facilities, the Manufacturer shall provide relevant information about facility safety procedures including, for example, safety glasses, hearing and respiratory protection, emergency preparedness, rally point, and general safety rules; and shall review typical workplace hazards with the representative(s) upon their arrival.
8. The IO, US ITER, Innovative Design Inc. and the ASN representatives who visit the Manufacturer's or their supplier's facilities shall be bound by appropriate confidentiality obligations to be agreed upon in advance.

5.8 Quality Records

1. Records shall be maintained to show objective evidence of quality.

5.8.1 Document Retention Requirements

1. Documentation records shall be maintained in accordance with the Manufacturer's QA program to show objective evidence of quality. No quality records shall be destroyed or otherwise disposed of prior to completion of the work and the IO shall have an opportunity to acquire possession of such records prior to their disposal. After completion and delivery of the Product to the IO, the Manufacturer shall maintain the records for a period of five years.

2. The IO shall have an opportunity to acquire possession of such records prior to disposal.
3. Documents shall be annotated with the IO supply order number or other numbering system traceable to it for identification.

5.8.2 Test Sample Retention Requirements

1. For this specification, this section is not applicable and is only listed to verify the issue has been addressed .
2. Any test coupons and specimens used for acceptance per lot shall be kept by the Manufacturer for a period of up to three (3) years.
3. The IO shall have an opportunity to acquire possession of such test samples prior to disposal.

5.8.3 Nonconformities and Deviation Requests

1. Nonconformities are the product or process which does not fulfil or fails in meeting IO specified requirements. The management of the nonconformities regarding the design and the manufacturing of the product is described in the document “Procedure for management of Nonconformities ([22F53X](#))’.
2. The Manufacturer shall ensure that they implement a system compliant with this document to control the nonconformities. The nonconformities reports shall be opened, identified, solved, closed and recorded in line with the IO agreement.
3. Deviation requests are requests for deviation from a formal agreement between the Manufacturer and the IO. The Deviation requests should be issued by the Manufacturer or by the IO.
4. The procedure for the management of Deviation Request and the responsibilities of the stakeholders are described in the document “Procedure for the management of Deviation Request ([2LZJHB](#))”.
5. If the conformity assessment of the NPE/PE is not completed because of NCR from the Manufacturer and/or its subcontractor(s) and supplier(s), the Manufacturer shall have the related activities or parts redone at its own cost.

5.9 Verification and Validation of software(s)

1. If applicable, the Manufacturer must perform the Verification and Validation of all the software applications used within the framework of this contract according to ASME NQA-1, the document “Quality Classes to Software Qualification Policy ([KTU8HH](#))” and for any SIC related software IEC 62671.
2. The Manufacturer shall prepare software qualification plans or technical procedures based upon the software requirements. The plans or procedures shall include test cases encompassing the range of intended use for the new or revised software. Qualification testing should be taken into consideration to demonstrate that software meets its specifications and is ready for use in its target environment or integration with its containing system.
3. Where necessary to evaluate technical adequacy for verification, the plan should indicate how the results are to be evaluated. For example, the results may be compared to results from alternative methods such as:

- Analysis without computer assistance
- Other qualified software
- Experiments and tests
- Standard problems with known solutions
- Confirmed publications or correlations

6 Procurement Quality

1. For procurement Quality requirements reference the documents “ITER Procurement Quality Requirements ([22MFG4](#))”.

7 Scope of Supply

1. The TCWS 1st Plasma LV electrical control cubicles as depicted by the TCWS 1st Plasma supplemental documents “ITER_26PHVV_SLD_001 (3G33KG) Single Line Diagram(SLD) for the VV PHTS; ITER_26DR00_SLD_001 Single Line Diagram(SLD) for the Draining and Refilling System (3F4A57);” and “ITER_26DY00_SLD_001 Single Line Diagram(SLD) for the Drying system (3G2SR7)” and referenced in Table 7 below shall be furnished with all required components as defined in this document:
2. This specification defines the seven (7) electrical motor control cubicles required for the thirteen (13) pieces of electrical equipment in the TCWS 1st Plasma (VV PHTS, DR and DY) and specifically applies to:
 - The VV PHTS LV cubicle (26PHVV-CMC-1006) required for the Chemical Injection Pump (26PHVV-PL-4000) and the Filter Booster Pump (26PHVV-PL-1801). This cubicle is classified Non-SIC.
 - The VV PHTS LV cubicle (26PHVV-CMC-1001) required for the Volume Control Pump 1 (26PHVV-PL-5000). This cubicle is classified Non-SIC.
 - The DR LV cubicle (26DR00-CMC-1013) required for the SDT1 Refilling/Transfer Pump – 1 (26DR00-PL-0001), NDT1 Refilling/Transfer Pump (26DR00-PL-0002), DR Drain Tank Refilling/Transfer Pump (26DR00-PL-0003), Auxiliary Drain Tank Transfer Pump (26DR00-PL-0004) and the SDT1 Refilling/Transfer Pump – 2 (26DR00-PL-0007). This cubicle is classified Non-SIC.
 - The DY LV cubicle (26DY00-CMC-1005) required for the Charging Compressor (26DY00-PC-3001). This cubicle is classified Non-SIC.
 - The VV PHTS LV cubicle (26PHVV-CMC-1003) required for the Volume Control Pump 2 (26PHVV-PL-5002). This cubicle is classified SIC.
 - The VV PHTS LV cubicle (26PHVV-CMC-1010) required for the Decay Heat Pump (26PHVV-PL-1901). This cubicle is classified SIC.
 - The DR LV cubicle (26DR00-CMC-1009) required for the Vacuum Pump (26DR00-PV-0001). This cubicle is classified SIC.

3. This specification defines the seven (7) UPS electrical cubicles required for the sixty-seven (67) I & C cubicles in the TCWS 1st Plasma (VV PHTS, DR and DY) and specifically applies to:
 - UPS Cubicle 260000-BD-9037 : 12kW Provides power to six (6) I & C Cubicles
 - UPS Cubicle 260000-BD-9500: 18 kW Provides power to nine (9) I & C Cubicles
 - UPS Cubicle 260000-BD-0053: 14 kW Provides power to seven (7) I & C Cubicles
 - UPS Cubicle 260000-BD-0030: 32 kW Provides power to sixteen (16) I & C Cubicles
 - UPS Cubicle 260000-BD-0016: 16 kW Provides power to eight (8) I & C Cubicles
 - UPS Cubicle 260000-BD-1004: 8 kW Provides power to four (4) I & C Cubicles
 - UPS Cubicle 260000-BD-0056: 34 kW Provides power to seventeen (17) I & C Cubicles
4. This specification defines the three (3) SIC local control panels required for three (3) SIC pieces of equipment required for TCWS 1st Plasma. Specifically, for the Vacuum Pump (26DR00-PV-0001), VV PHTS Decay Heat Pump (26PHVV-PL-1901) and the VV PHTS Volume Control Pump 2 (26PHVV-PL-5002).
5. All components required to satisfy the functional requirements as defined in Section 8 of this document shall be provided.
6. All electrical equipment and components shall be COTS, unless exceptions are required to satisfy this specification. All exceptions shall be approved by the IO prior to manufacturing.
7. Halogen free material (wiring, TB, etc.) shall be provided for all the components and cables inside the cubicle.
8. One set of any required special tools and/or equipment shall be provided.
9. All relevant drawings, data, instructions and written literature such as the Equipment Operation and Maintenance Manuals (EOMM) shall be in French and English.
10. CE marking of the cubicles and components is required for all TCWS 1st Plasma LV cubicles, UPS cubicles and local control panels.
11. A Comprehensive List of Manufacturer Recommend Spare Parts shall be provided.
12. TCWS 1st Plasma LV cubicles, UPS cubicles and SIC local control panels shall carry certifications of compliance to IEC EMC standards.
13. TCWS 1st Plasma Non-SIC Local Control Panels are not part of this specification
14. TCWS 1st Plasma MV Electrical Cubicles are not part of this specification.
15. TCWS 1st Plasma Heater Control Cubicles are not part of this specification.

Description of Equipment	Equipment Number	Cubicle	Cubicle Location	SIC or Non-SIC	KW Rating	Quality Class	PLC Interface
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PHVV SYSTEM							
VVPHTS Chemical Injection Pump	26PHVV-SK-4000	26PHVV-CMC-1006	11-R1-01E	Non-SIC	7.5	3	A
Filter Booster Pump 1	26PHVV-PL-1801	26PHVV-CMC-1006	11-R1-01E	Non-SIC	15	3	A
Volume Control Pump 1	26PHVV-PL-5000	26PHVV-CMC-1001	11-R1-01E	Non-SIC	15	3	A
Volume Control Pump 2	26PHVV-PL-5002	26PHVV-CMC-1003	11-L5-05S	SIC	30	1	C
VV PHTS Decay Heat Pump	26PHVV-PL-1901	26PHVV-CMC-1010	11-B2-02NE	SIC	20	1	C
DR SYSTEM							
SDT1 Refilling/Transfer Pump - 1	26DR00-PL-0001	26DR00-CMC-1013	74-B1-03	Non-SIC	11	3	A
NDT1 Refilling/Transfer Pump	26DR00-PL-0002	26DR00-CMC-1013	74-B1-03	Non-SIC	45.7	3	A
NBI Drain Tank Refilling/Transfer Pump	26DR00-PL-0003	26DR00-CMC-1013	74-B1-03	Non-SIC	20.7	3	A
Auxiliary Drain Tank Transfer Pump	26DR00-PL-0004	26DR00-CMC-1013	74-B1-03	Non-SIC	3.6	3	A
SDT1 Refilling/Transfer Pump - 2	26DR00-PL-0007	26DR00-CMC-1013	74-B1-03	Non-SIC	11	3	A
Vacuum Pump	26DR00-PV-0001	26DR00-CMC-1009	11-L5-05N	SIC	11	1	C
DY SYSTEM							
Charging Compressor	26DY00-PC-3001	26DY00-CMC-1005	11-R1-01E	Non-SIC	26.3	3	B

Table 7: LV Electrical Motor Control Cubicles

All the equipment electrical ratings shall be updated as per finalized vendor input.

UPS CUBICLE SYSTEM					
Description of Equipment	Name of UPS Cubicle	Cubicle Location	KW Rating Of UPS Cubicle	Number of I & C Cubicles To Distribute Power To (2 KW Each)	PLC Interface
UPS Cubicle	260000-BD-9037	11-B2-02NE	12	6	D
UPS Cubicle	260000-BD-9500	14-L3-23	18	9	D
UPS Cubicle	260000-BD-0053	14-L4-04	14	7	D
UPS Cubicle	260000-BD-0030	11-L4-01N	32	16	D
UPS Cubicle	260000-BD-0016	11-B2-02NW	16	8	D
UPS Cubicle	260000-BD-1004	74-B2-03	8	4	D
UPS Cubicle	260000-BD-0056	11-L3-02NE	34	17	D

Table 8: UPS Cubicles (All UPS Cubicles are Classified as Non-SIC)

8 Electrical Motor Control Functional Requirements

8.1 General Functional Requirements

The general functional control requirements of VV PHTS, DR and DY LV Electrical Control Cubicles and the associated local controls are defined in this section.

Specific Control Functional requirements for the LV Cubicles (Non-SIC & SIC) are defined in Section 8.2 and 8.3.

1. All electrical equipment and components shall be COTS, unless exceptions such as those necessary for SIC componets are required to satisfy this specification. All exceptions shall be approved by the IO prior to manufacturing.
2. Each electrical control cubicle shall have the capacity to be hardwired interfaced to an associated local control panel (LCP) with the capability to be operated/controlled in LOCAL or REMOTE mode as selected by the LCP.
3. Local control panels for the SIC equipment are in the scope of this document. Local control panels for the Non-SIC equipment shall be provided by others.
4. Each local control panel shall have a functional two (2) position key Lockable selector switch (REMOTE/LOCAL) and START and STOP pushbuttons.

5. The local mode motor control circuits shall be hardwired into the electrical control circuit. Intervention by a remote device (PLC) shall not be required to operated in LOCAL mode.
6. Protection parameters shall be hardwired into the electrical control cubicle to prevent operation during an abnormal event.
7. Each electrical control cubicle shall have a functional two (2) position key Lockable selector switch (REMOTE/LOCAL) and START and STOP pushbuttons installed on the exterior of the front door of the cubicle.
8. Each electrical control cubicle shall have separate lights to indicate if the system is in REMOTE mode with the TCWS PLC is controlling it, if the system is in LOCAL mode as selected at the electrical control cubicle or if in LOCAL mode as selected at the LCP.
9. These indicating lights shall provide the system operating status and shall be utilized as follows:
 - If the electrical control cubicle LOCAL mode indicating light is ON and the LCP LOCAL indicating light is OFF, the system can be control by the electrical control cubicle and LCP START/STOP pushbuttons are disregarded/not active.
 - If the system is to be operated from the LCP; the electrical control cubicle selector switch is placed in LOCAL and then the LCP is also place in LOCAL. The system can then be controlled by the LCP and the electrical control cubicle START/STOP pushbuttons are disregarded/not active. The indicating light for the LCP LOCAL located on the electrical control cubicle is ON.
 - If the LCP is returned to REMOTE mode and the electrical control cubicle remains in LOCAL mode, the system can be controlled by the electrical control cubicle START/STOP pushbuttons and the LCP START/STOP pushbuttons are disregarded/not active. The indicating light for the LCP mode of operation shall be LOCAL OFF and LOCAL ON for the electrical control cubicle.
 - If the electrical control cubicle selector switch is then switched to REMOTE and the LCP remains in REMOTE mode, the PLC shall be placed in control. The indicating lights for the mode of operation shall be LOCAL OFF at the electrical control cubicle for both the LCP and the electrical control cubicle.
10. Operating Mode Summary:
 - When the electrical control cubicle is in REMOTE mode of operation and the LCP is in REMOTE mode, the system is controlled by the TCWS PLC and the START/STOP pushbuttons located on the electrical control cubicle and the LCP are disregarded/not active.
 - When the electrical control cubicle is in LOCAL mode of operation and the LCP is in REMOTE mode, the system is controlled by the START/STOP pushbuttons located on the electrical control cubicle and the TCWS PLC and the LCP cannot control the system.

- If the electrical control cubicle is in LOCAL mode and the LCP is in LOCAL mode, the system can be operated from LCP and not from the electrical control cubicle.
11. Each electrical control cubicle shall have an Emergency Stop push button provided by the manufacturer and mounted on the exterior of the cubicle in an easily accessible location. This E-Stop shall be hardwired (software independent) to immediately open the associated electrical circuit inside the cubicle when the E-Stop is activated regardless of operating mode. The Emergency Stop button located on the electrical control cubicle shall stop the pump regardless of the status of the electrical control cubicle selected mode of operation (Remote/Local).
 12. Any E-Stop that is activated must be re-set before the motor/pump can be re-started.
 13. Any E-Stop that is activated will interrupt power to the contactor coil. Re-setting of the E-Stop will not automatically re-start the motor/pump. The devices require that a start command be issued either from manual or remote controls.
 14. Each electrical control cubicle shall be provided with the hardware required for monitoring, displaying on the exterior of the cubicle and transmitting to the TCWS PLC the Voltage, Current and Power levels of the electrical control cubicle.
 15. The current for each of the three (3) phases of each electrical load with the exception of the VVPHTS Chemical Injection Pump located in cubicle 26PHVV-CMC-1006, shall be displayed and transmitted to the plant PLC control system with a 4-20ma signal.
 16. Each phase to phase (A-B; A-C; B-C) voltage for on the incoming primary feeder for each cubicle shall be displayed and transmitted to the plant PLC control system with a 4-20ma signal.
 17. Additional voltmeters and ammeters are required for the UPS cubicles. Please reference the BOM & UPS SLD for the exact quantity and type.
 18. Each electrical control cubicle shall have essential displays on the exterior to indicate the status of the motor controls (RUNNING, STOPPED, FAULTED) and the breaker (OPEN, CLOSED, TRIPPED) for each electrical load. For additional details reference Sections 8.2 and 8.3.
 19. Each electrical control cubicle shall have essential displays on the exterior to indicate the status of the main incoming feeder breaker (OPEN, CLOSED, TRIPPED). For additional details reference Sections 8.2 and 8.3.
 20. Each electrical motor control cubicle shall have the capability to interface with the plant PLC control system or PSS by utilizing auxiliary contacts as applicable for all indication, monitoring and control. Reference Table 7, 8 & 9 for PLC Interface category (A, B, C, D). For additional details reference Sections 8.2 and 8.3.
 21. Normal START/STOP commands from the PLC shall be in the form of a maintained digital 1 to START and a digital 0 to STOP. This will insure that if communication

with the PLC is lost for whatever reason (cut cable, loss of power, etc.) the associated equipment will STOP if the PLC is in control.

22. A STOP command from the PLC for equipment protection or EMERGENCY STOP conditions shall be issued in the form of a Digital 1 and is separate form the normal START/STOP Commands.

A. NON-SIC MOTOR CONTROL		C. SIC MOTOR CONTROL	
COMMANDS FROM PLC TO MCC		COMMANDS FROM PLC TO MCC	
START/STOP	1	START/STOP	1
STOP (E-STOP, EQUIPMENT PROTECTION)	1	RESET BREAKER	1
RESET BREAKER	1		
Sub-Total	3	Sub-Total	2
INDICATORS FROM MCC TO PLC		INDICATORS FROM MCC TO PLC	
REMOTE	1	REMOTE	1
LOCAL	1	LOCAL	1
RUNNING	1	RUNNING	1
STOPPED	1	STOPPED	1
INCOMING VOLTAGE (4-20MA)	3	INCOMING VOLTAGE (4-20MA)	3
OUTGOING CURRENT AMPS (4-20MA)*	3	OUTGOING CURRENT AMPS (4-20MA)	3
BREAKER OPEN	1	BREAKER OPEN	1
BREAKER CLOSED	1	BREAKER CLOSED	1
BREAKER TRIPPED	1	BREAKER TRIPPED	1
E-STOP ACTIVATED (LOCATION)	2	E-STOP ACTIVATED	1
24 VDC POWER (OK, ALARM)	2	PSS CONTROL	1
FRONT/BACK DOORS OPEN/CLOSED	4	24 VDC POWER (OK, ALARM)	2
COOLING FANS RUNNING/STOPPED	2	FRONT/BACK DOORS OPEN/CLOSED	4
CUBICLE TEMPERATURE (RTD)	1	COOLING FANS RUNNING/STOPPED	2
		CUBICLE TEMPERATURE (RTD)	1
Sub-Total	24	Sub-Total	24
TOTAL BETWEEN MCC AND PLC	27	TOTAL BETWEEN MCC AND PLC	26
* Applicable to all cubicles except 26DR00-CMC-0013 which has fifteen (15).			
B. NON-SIC MOTOR CONTROL WITH MOTOR HEATER		D. UPS CUBICLES	
COMMANDS FROM PLC TO MCC		COMMANDS FROM PLC TO MCC	
START/STOP	1	RESET MAIN BREAKERS	2
STOP (E-STOP, EQUIPMENT PROTECTION)	1	STOP (E-STOP, EQUIPMENT PROTECTION)	1
RESET BREAKER	2	RESET DISTRIBUTION BREAKERS	**TBD

RESET SOFT STARTER	1			
Sub-Total	5		Sub-Total	**TBD
INDICATORS FROM MCC TO PLC			INDICATORS FROM UPS CUBICLE TO PLC	
REMOTE MODE	1		MAIN BREAKER OPEN	2
LOCAL MODE	1		MAIN BREAKER CLOSED	2
RUNNING	1		MAIN BREAKER TRIPPED	2
STOPPED	1		MAIN 400V POWER ACTIVE	1
INCOMING VOLTAGE (4-20MA)	3		SECONDARY 400V POWER ACTIVE	1
OUTGOING AMPS (4-20MA)	3		BATTERY ACTIVE	1
BREAKER OPEN	1		BATTERY LOW	1
BREAKER CLOSED	1		BATTERY CHARGER FAULT	1
BREAKER TRIPPED	1		BATTERY MCCB TRIP	1
E-STOP ACTIVATED (LOCATION)	2		STATIC SWITCH FAULT	1
HEATER ENABLED	1		STATIC SWITCH CLOSED	1
HEATER NOT ENABLED	1		MAINTENACE BY-PASS SWITCH CLOSED	1
HEATER RUNNING	1		INVERTER FAULT	1
HEATER NOT RUNNING	1		RECTIFIER MODE	1
HEATER FAULTED	1		BUSBAR LOW VOLTAGE	1
24 VDC POWER (OK, ALARM)	2		GENERAL FEEDER TRIP ALARM	1
FRONT/BACK DOORS OPEN/CLOSED	4		DISTRIBUTION BREAKER OPEN	**TBD
COOLING FANS RUNNING/STOPPED	2		DISTRIBUTION BREAKER CLOSED	**TBD
CUBICLE TEMPERATURE (RTD)	1		DISTRIBUTION BREAKER TRIPPED	**TBD
			FRONT/BACK DOORS OPEN/CLOSED	4
			COOLING FANS RUNNING/STOPPED	2
			CUBICLE TEMPERATURE (RTD)	1
			INCOMING VOLTAGE (4-20MA)	6
			UPS OUTPUT VOLTAGE (AC) 4-20MA	3
			UPS OUTPUT CURRENT (AMPS) 4-20MA	3
			UPS OUTPUT FREQUENCY (AMPS) 4-20MA	1
			BATTERY DC CURRENT & VOLTAGE (4-20mA)	1
			INVERTER AC CURRENT (4-20mA)	3
			INVERTER AC VOLTAGE (4-20mA)	3
			INVERTER FREQUENCY (4-20mA)	1
Sub-Total	29		Sub-Total	**TBD
TOTAL BETWEEN MCC AND PLC	34		TOTAL BETWEEN UPS CUBICLE AND PLC	**TBD
			**Will Depend on the Number of I & C Cubicles that each UPS Cubicle Distributes Power to. Reference Appendix D For Number of I & C Cubicles for Each UPS cubicle	

		<p>Apart from the above the bidder is to consider the commands & indicators as indicated in Section 9.7. Also, bidder should propose any other required commands & indicators which is required for continuous operation of UPS.</p>
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Table 9 Interface (A,B,C,D) to Plant PLC Control System

8.2 Motor Control Functional Requirements (NON-SIC)

1. All NON-SIC motor controller cubicles shall have associated operator interface devices (selector switch, pushbuttons, indicating lights, meters, etc.) installed on the exterior of the cubicle door.
2. All NON-SIC motor controller cubicles shall hardwire interface to an associated local control panel (LCP). The NON-SIC local control panel is not in the scope of this document and shall be provided by others. However, the motor control circuit design shall incorporate the functionality of the LCP as defined into the motor control system. This would include receiving hardwired START/STOP commands from the LCP and energizing the appropriate indicator lights on the LCP.
3. Each electrical control cubicle shall have a functional two (2) position key Lockable selector switch (REMOTE/LOCAL) and START and STOP pushbuttons installed on the exterior of the front door of the cubicle.
4. The selection of REMOTE (AUTO) or LOCAL (MANUAL) mode of operation shall be done with a hardware two (2) position REMOTE/LOCAL Key Lockable Selector Switch mounted on the exterior of the cubicle door or by utilizing a similar selector switch located on the associated local control panel (by others). Hardwired interlocks shall prevent the selection of the operation mode to be by any other means other than either of the REMOTE/LOCAL Key Lockable selector switches.
5. Operational modes are defined in detail in Section 8.1, but in summary:
 - When the motor controller cubicle and the LCP are in AUTO mode, the system is controlled by the TCWS PLC
 - When the motor controller cubicle is in LOCAL mode and the LCP is in REMOTE mode, the system is controlled by the motor controller cubicle and the TCWS PLC and the LCP cannot control the system.
 - If the motor controller cubicle is in LOCAL mode and the LCP is in LOCAL mode, the system can be operated from the LCP but not from motor controller cubicle or the PLC.
 - Indicator lights on the motor controller cubicle and on the LCP indicate the status of the operating mode of the motor controller cubicle and the LCP (LOCAL/REMOTE).

6. An EMERGENCY STOP pushbutton provided by the manufacturer and mounted on the exterior of the control cubicle, if activated, shall immediately open the power circuit regardless of operating mode. The interface to this EMERGENCY STOP shall be hardwired (non-software) to the motor control cubicle.
7. In addition, provisions for a minimum of one (1) local EMERGENCY STOP (provided by others) installed near the equipment to immediately open the power circuit regardless of operating mode, shall be provided. The interface to this EMERGENCY STOP shall be hardwired (non-software) to the motor control cubicle. This local E-STOP(s) is not in the scope of supply and shall be provided by others.
8. The LCP EMERGENCY STOP pushbutton shall stop the system regardless of the status of the motor control cubicle or LCP operating mode (LOCAL/REMOTE).
9. Individual LED indicator lights on the front panel of the motor controller cubicle shall be provided to indicate the operation mode of the motor control circuit (REMOTE, LOCAL) with a minimum two (2) additional hardware auxiliary contacts (NO/NC) provided per LED indicator to provide the operational mode to the TCWS PLC and to the local control panel.
10. Individual LED indicator lights shall be provided on the local control panel (provided by others) to indicate the operation mode of the motor control circuit (REMOTE, LOCAL). These lights (provided by others) will be hardwired (non-software) and energized by the motor control circuit.
11. Individual LED indicator lights on the front panel of the motor controller cubicle shall indicate the status of the motor as either RUN or STOPPED with a minimum of two (2) additional hardware auxiliary contacts (NO/NC) per LED indicator to provide the status to the TCWS PLC and to the local control panel.
12. Individual LED indicator lights shall be provided on the local control panel (provided by others) to indicate the status of the motor as either RUN or STOPPED. These lights (provided by others) will be hardwired (non-software) and energized by the motor control circuit.
13. Individual LED indicator lights on the front panel of the motor controller cubicle shall indicate the status of the circuit breaker for the primary feed to the motor control cubicle as OPEN, CLOSED or TRIPPED with a minimum of two (2) additional hardware auxiliary contacts (NO/NC) per LED indicator provided to indicate the status to the TCWS PLC and to the local control panel.
14. Individual LED indicator lights shall be provided on the local control panel (provided by others) to indicate the status of the circuit breaker for the primary feed to the motor control cubicle as OPEN, CLOSED or TRIPPED. These lights (provided by others) will be hardwired (non-software) and energized by the motor control circuit.
15. When in REMOTE mode, the motor shall be controlled by the TCWS PLC. The PLC shall only be allowed to START the motor when the motor control circuit is in REMOTE mode. When in REMOTE mode, the START pushbuttons located on the

local control panel and on the motor control cubicle will not be active. No local operation is possible.

16. When in REMOTE mode hardwire protection shall be implimened to STOP the system if commuinction from the PLC is lost such as in the case of a broken cable or loss of power. Reference Section 8.1 and Table 9.
17. The PLC shall be allowed to STOP the motor in either REMOTE or LOCAL mode if operating conditions monitored by the PLC exceed limitations on critical physical parameters such as temperature or pressure (in accordance with I&C Functional Requirement) for which the motor shall be stopped to protect the equipment. Reference E-STOP and equipment protection STOP in Section 8.1 and Table 9.
18. The motor control cubicle 26DY00-CMC-1005 for the Charging Compressor (26DY00-PC-3001) shall have a circuit for powering a motor space heater provided by others.
19. This circuit shall be 230V single phase and shall operate as follows if enabled by an interface (either PB or switch) located on the LCP:
 - If the motor is running, motor space heater is OFF
 - If the motor is OFF, motor space heater is ON
20. The load of the heater shall be provided after the equipment is procured.
21. The circuit shall be protected with an adequately sized circuit breaker.

8.3 *Motor Control Functional Requirements (SIC)*

1. All SIC motor controller cubicles shall have associated operator interface devices (selector switch, pushbuttons, indicating lights, meters, etc.) installed on the exterior of the cubicle door.
2. All SIC motor controllers shall have an associted SIC local control panel. The SIC local control panel is in the scope of this document and shall be supplied by the cubicle manufacturer. The motor control circuit design shall incorporate the functionality of the local control panel as defined into the motor control system.
3. Each electrical control cubicle shall have a functional two (2) position key Lockable selector switch (REMOTE/LOCAL) and START and STOP pushbuttons installed on the exterior of the front door of the cubicle.
4. The selection of REMOTE (AUTO) or LOCAL (MANUAL) mode of operation shall be done with a hardware two (2) position REMOTE/LOCAL Key Lockable Selector Switch mounted on the exterior of the cubicle door or by utilizing a similar selector switch located on the associated SIC local control panel. Hardwired interlocks shall prevent the selection of the operation mode by any means other than by either of the REMOTE/LOCAL Key Lockable selector switches.
5. Operational modes are defined in detail in Section 8.1, but in sumary:

- When the motor controller cubicle and the LCP are in AUTO mode, the system is controlled by the TCWS PLC
 - When the motor controller cubicle is in LOCAL mode and the LCP is in REMOTE mode, the system is controlled by the motor controller cubicle and the TCWS PLC and the LCP cannot control the system.
 - If the motor controller cubicle is in LOCAL mode and the LCP is in LOCAL mode, the system can be operated from the LCP but not from motor controller cubicle or the PLC.
 - Indicator lights on the motor controller cubicle and on the LCP shall indicate the status of the operating mode of the motor controller cubicle and the LCP (LOCAL/REMOTE).
6. The SIC motor control circuit shall always allow the Plant Safety System (PSS) to take command of the motor controller and START or STOP the motor regardless of operating mode.
 7. When the PSS is in control, only it will be allowed to START and STOP the pump/motor. All other control interfaces (Local Control Panel, cubicle pushbuttons, PLC commands) will be ignored with the exception of the EMERGENCY STOP pushbutton provided by the manufacturer and mounted on the exterior of the control cubicle.
 8. The EMERGENCY STOP pushbutton provided by the manufacturer and mounted on the exterior of the control cubicle, if activated, shall immediately open the power circuit regardless of operating mode. The interface to this EMERGENCY STOP shall be hardwired (non-software) to the motor control cubicle.
 9. To facilitate giving priority motor control to the PSS, a safety relay shall be provided and installed in the LV SIC electrical control cubicle. When the relay is de-energized, control of the system belongs to the PSS. This shall be accomplished by utilizing normally closed contacts on the relay. This interface shall be hardwired (non-software) in the motor control circuit.
 10. The safety relay shall be certified in accordance IEC 62061 and ISO 13849-1 .
 11. Individual LED indicator lights on the front panel of the motor controller cubicle shall be provided to indicate the operation mode of the motor control circuit (REMOTE, LOCAL, PSS) with a minimum of two (2) additional hardware auxiliary contacts (NO/NC) provided per LED indicator to provide the operational mode to the TCWS PLC and to the local control panel.
 12. Individual LED indicator lights shall be provided on the SIC local control panel to indicate the operation mode of the motor control circuit (REMOTE, LOCAL, PSS). These lights will be hardwired (non-software) and energized by the motor control circuit.

13. Individual LED indicator lights on the front panel of the motor controller cubicle shall indicate the status of the motor as either RUN or STOPPED with two (2) additional hardware auxiliary contacts (NO/NC) per LED indicator to provide the status to the TCWS PLC and to the SIC local control panel.
14. Individual LED indicator lights shall be provided on the SIC local control panel to indicate the status of the motor as either RUN or STOPPED. These lights will be hardwired (non-software) and energized by the motor control circuit.
15. Individual LED indicator lights on the front panel of the motor controller cubicle shall indicate the status of the circuit breaker for the primary feed to the SIC motor control cubicle as OPEN, CLOSED or TRIPPED with two (2) additional hardware auxiliary contacts (NO/NC) per LED indicator provided to indicate the status to the the TCWS PLC and to the SIC local control panel.
16. Individual LED indicator lights shall be provided on the SIC local control panel to indicate the status of the circuit breaker for the primary feed to the motor control cubicle as OPEN, CLOSED or TRIPPED. These lights will be hardwired (non-software) and energized by the motor control circuit.
17. When in REMOTE mode the motor shall be controlled by the TCWS PLC unless controlled by the PSS. The PLC shall only be allowed to START or STOP the motor when the motor control circuit is in REMOTE mode and not controled by PSS. When not in REMOTE mode the E-STOP and equipment protection STOP referenced in Section 8.1 and Table 9 shall be ignored for SIC operations.

9 Electrical UPS Cubicles Functional Requirements

The general functional requirements of the UPS Cubicles for the VV PHTS, DR and DY I & C Cubicles are defined in this section.

9.1 General Functional Requirements

1. All electrical equipment and components shall be COTS, unless exceptions are required to satisfy this specification. All exceptions shall be approved by the IO prior to manufacturing.
2. UPS Cubicle Specifications:
 - Input Voltage: 400V, 3 Phase, 50 Hz from two (2) separate feeds.
 - Power Capacity: 8kW to 34kw Reference Table 8 for the specific requirements for each UPS Cubicle.
 - Output Voltage: 230V, Single Phase, 50 Hz (derived from a single phase and the neutral of the 400V distribution bus as indicated in UPS SLD 3SAAU5).
 - Output Power distributed to each I & C Cubicle: 2kW per I & C cubicle. Reference Appendix D for the specific number of I & C cubicles that each UPS Cubicle shall distribute power to.
3. Each UPS Cubicle shall have a rechargeable battery sized to provide 100% of the required uninterrupted 230V power to the asociated I & C cubicles for a duration of no less than three (3) minutes after the main supply power to the UPS Cubicle has been interrupted.

4. Battery shall be sized as per the kW loads for each UPS cubicle as indicated in Table 8 and capacity shall be rated 100% of the UPS cubicle kW requirement.
5. The efficiency of the UPS at 100% load shall be greater than or equal to 90%.
6. During normal operation, the inverter shall be fed from the rectifier and shall provide power to the AC loads. During periods when the rectifier is not available, or when momentary high current draw occurs, the inverter shall be fed from the battery.
7. During inverter failure, overload or loss of incoming voltage, the by-pass must supply the required power, automatically and without service interruption, through the actuation of the static transfer switch. If the transfer switch activation was due to overload or low input voltage, the transfer back to inverter supply shall be performed automatically once the overload or low voltage condition is removed. For inverter failure or lack of incoming supply, the transfer back to inverter supply shall be performed manually.
8. Each UPS Cubicle shall have properly sized main power terminal lugs for receiving 400V 3 phase power from two (2) separate sources. Access to these lugs will be at the top of the cubicle and easily accessible.
9. These main termination lugs shall be wired to two (2) separate properly sized circuit breakers per the electrical loads for the UPS cubicles as indicated in Table 8 UPS SLD ITER_260000_SLD_001 (3SAAU5).
10. All circuit breakers shall have the capability to be remotely reset with a digital signal.
11. Power monitoring instrumentation and relays shall be utilized to configure each UPS Cubicle to switch to the battery power upon the loss of the Main 400 V supply & Bypass Supply and to switch from the battery to the secondary 400V supply without any interruption of service.
12. Each UPS Cubicle shall have a distribution system to supply power to the designated number of I & C cubicles as indicated in Appendix D. A 20% spare capacity shall be included in the distribution components.
13. This distribution system shall consist of three (3) power termination lugs (hot, neutral, earth) for each I & C cubicle as indicated in Appendix D. These lugs shall be easily accessible for field wiring to the associated cubicle.
14. Each distribution system “hot” terminal lug shall be wired to a properly sized single pole circuit breaker for each distribution feed.
15. Circuit breakers for each I & C cubicle feed shall be sized for 2 kW loads at 230 V single phase power as indicated in Appendix D.
16. The main 400V circuit breakers shall have LED indicator lights on the front panel of the UPS cubicle to indicate the status of the circuit breakers as OPEN, CLOSED or TRIPPED with a minimum of two (2) additional hardware auxiliary contacts (NO/NC) per LED indicator provided to indicate the status to the TCWS PLC.
17. Each distribution circuit breaker shall have a minimum of two (2) hardware auxiliary contacts (NO/NC) per indication to provide the status as OPEN, CLOSED or TRIPPED to the TCWS PLC.

18. Local alarm indications, with associated auxiliary contacts and 4-20mA outputs wired to terminal blocks for remote indication (by others), shall be provided for rectifier mode selected, battery charger anomaly, battery MCCB trip, battery dc current and voltage (4-20mA), inverter anomaly, inverter AC current, voltage and frequency (4-20mA), static switch anomaly, static switch closed, maintenance by-pass switch closed, incoming breaker status (closed or tripped), busbar low voltage, and a general “any feeder tripped” alarm. The required status and monitoring signals are indicated in Table -9.
19. All auxiliary contacts and distribution feeds shall be wired to easily accessible termination blocks to facilitate field wiring.
20. Apart from above bidder shall propose any design / component / system which is required for continuous operation of UPS with out any single point failure for ITER review/ approval.

9.2 *UPS Rectifier*

1. The technical requirements for the UPS rectifier shall be as required in order to provide the necessary input to the inverter.
2. The rectifier input rating shall be 400 Vac, 3Ph, 50 Hz.
3. The output voltage ripple (without the battery connected) shall be no more than 5%. Additionally, the floating and equalizing output voltage regulation shall be $\pm 1\%$ (static) and $\pm 10\%$ (dynamic).
4. The rectifier design shall provide for three charge modes (“float”, “equalize” and “boost”) selectable by a three-position selector switch located on the front of the unit.
5. “Boost” charge mode shall only be a manual operation. An interlock shall be provided which permits “boost” charge only when the corresponding busbar feeder disconnect is open.
6. “Equalize” charge mode may be selected manually with a selectable duration or may be automatically programmed to occur at regular intervals for a selectable duration.
7. Necessary features shall be provided to permit the “boost” or “equalize” charge cycle to be stopped, before the selected duration of the charge mode is complete.
8. All charge mode operations shall be key controlled to prevent undesired actuation.
9. The rectifier shall be protected against damage in the event that the battery is connected in reverse.
10. The rectifier shall protect itself from a short circuit in the output side using electronic means (current limiting).
11. The rectifier shall have stable voltage output during all conditions including no load and during battery disconnection.

12. The rectifier shall maintain its output voltage for any loading between no-load up to the current limiting point.
13. Rectifier cabinet shall consist of vertical sections fitted with lifting bolts made of 2 mm thick (minimum) brake-form welded steel, screwed to each other, making up a free-standing assembly. The sections shall be accessible by means of doors on the front. The enclosure degree of protection shall be IP 31.
14. The rectifier components in the cabinets shall be arranged such that they are readily accessible for adjustment, inspection and maintenance through the front access doors.
15. Each cabinet shall be equipped with internal lighting and a power outlet protected by thermal-magnetic circuit breaker as well thermostat-controlled anti condensation heaters, all rated for 230Vac operation.
16. The front of each rectifier cabinet shall be provided with a functional diagram.
17. Cable entrance shall be in the lower part of the cabinets through a suitably sized cover plate.
18. In the lower part of the vertical sections, there shall be an earthing busbar to which all of the non-current carrying metal parts of the panel shall be connected.
19. Compression earth clamp shall be fitted to both ends of the earthing bar for the connection of 120 mm² cross-section copper cable (by others).
20. Covered recesses or lidded access points shall be provided in the rectifier cabinet in order to provide a connection point to the batteries for battery test equipment.

9.3 *UPS Batteries*

1. One number of stationary battery set shall be provided for each UPS Cubicle to provide 100% rated output with a back-up time of 3 Minutes.
2. Battery shall be vented or partial gas recombinant, nickel cadmium type and Battery Bank shall be mounted inside a Cabinet.
3. Battery nominal output voltage, the recommended number of cells & minimum end-of-discharge voltage shall be decided by Vendor.
4. The rated capacity of each battery set shall be as suitable to feed the UPS loads indicated in Table -8 for 3 Minutes.
5. The polarity of the terminals of each element shall be clearly indicated with indelible markings.
6. The cell terminal pole shall be provided with connector and nuts for bolting. Poles and connectors shall be insulated.
7. The terminals of each element shall be fitted with insulation covers to protect against accidental contact. Covers shall be easily removable to allow inspection of the

terminals. Measurement of terminal voltage shall be possible without removal of these covers.

8. All connections between the elements that form the battery shall be supplied. These connections shall ensure electrical contact and shall have enough cross section to minimize voltage drop between cells.

9.4 UPS Inverter

1. The inverter shall have a regulated output and shall have a control and synchronization unit to keep its ac outputs (voltage, phase and frequency) in phase with the ac bypass power supply.
2. The inverter shall be located in a vertical cabinet made of brake-formed welded steel plate, at least 2 mm thick, screwed to additional internal reinforcement bars, as required. The sections shall be accessible from the front through hinged, locking doors, and shall have air vents and dust filters.
3. The inverter shall be supplied completely hardwired, assembled and tested.
4. The main characteristics of the inverter are provided below.
 - Rated input voltage: To be Decided by Manufacturer
 - Rated output voltage: 400 V ac, 3Ph + N + PE, 50 Hz
 - Voltage regulation during static operation: $\pm 2\%$ between 0% and 100% load
 - Voltage regulation during dynamic operation: $\pm 10\%$ for 50% load swings
 - Rated output frequency during steady state and transient operation: $50 \pm 0.25\text{Hz}$
 - Response time for sudden load variation: $< 100\text{ ms}$
 - Harmonic distortion: $< 3\%$
 - Enclosure degree of protection: IP 31
5. The inverter shall have reverse polarity protection, input over/under voltage protection, input earth fault detection, transient overvoltage protection and short circuit protection via current limiting.
6. The front panel display of the inverter shall include frequency, ac voltage and current, dc voltage and current, status ("connected" indication), and minimum dc input low voltage alarm indication (also hardwired to terminals for remote indication).
7. Additionally, the front panel display of the inverter shall have a general alarm for inverter failure with local indication (also hardwired to terminals for remote indication). The general alarm shall be activated for tripping/opening of the incoming and outgoing circuit breakers, output frequency or voltage out of range, lack or loss of synchronism, blown semiconductor fuse and any other alarm deemed necessary by the manufacturer. The reason for general alarm activation shall be visible on the front panel display.

9.5 UPS Static Transfer Switch

1. The static transfer switch shall be rated for 400Vac three phase operation (3Ph+N+PE). During its operation, the transfer switch shall permit manual transfer to the alternate supply at any time.
2. The transfer shall maintain synchronism and may be performed automatically or manually, as operating needs demand. For manual transfer or transfer due to overload, the transfer time shall be instantaneous (0 milliseconds). Transfer time due to inverter failure or defect in power supply shall not be greater than five (5) milliseconds.
3. The output value for returning from the bypass transformer to the inverter shall be adjustable between 95% and 105% of the rated voltage.
4. In addition, there shall be a “make-before-break” bypass loop based on contactors, which shall provide uninterrupted power manually by means of the bypass alternative source in case of failure or maintenance of the static switch.
5. The construction and test standard for the static switch shall be IEC 60146.

9.6 UPS Power Distribution Bus

1. The output of each the two UPS’s static/maintenance transfer switches shall be fed into a 400V UPS bus from which supply for TCWS C & I panels will be arranged.
2. The incoming circuit breakers shall be molded case with Residual current device. The outgoing circuit breakers shall be miniature circuit breakers.
3. Metering devices (associated with the incoming circuit breakers) shall be provided in the busbar incomer for measuring voltage, current and frequency for local and remote indication via 4-20 mA transducers.
4. The Output Voltage from UPS Power distribution bus shall be 230V, Single Phase, 50 Hz (derived from a single phase and the neutral of the 400V distribution bus as indicated in UPS SLD 3SAAU5).
5. For the other outgoing miniature circuit breakers, 20% spare breakers shall be provided.

9.7 Instrumentation, Control & Monitoring

1. Measuring devices shall be provided as shown on the UPS single line diagram ITER_260000_SLD_001 (3SAAU5).
2. The local signalling and alarms listed below, or others as recommended by Supplier and described in the proposal, shall be available via the front panel HMI.
3. UPS System:
 - UPS input alarm: power failure, under voltage
 - UPS output alarm: earth fault (supply and return), power failure, under voltage, overvoltage, frequency out of range.
 - UPS general failure alarm
 - Cooling fans failure alarm (if applicable)
 - Sustained overload alarm

- Out of synchronization alarm
 - Over-temperature alarm
 - Bypass power supply feeding loads (signal)
 - Bypass power failure alarm
4. Rectifier:
- DC ammeter, to measure the output current
 - DC voltmeter, to measure the output voltage
 - Mode status (Float, Equalize)
 - Automatic/manual selector
 - General alarm (initiated from ac failure, ac over/under voltage, dc output over/under voltage, equipment earthing defect, other alarms the supplier deems necessary).
 - Local indication of particular cause which activated general alarm.
 - Power-on indication
 - Equalizing cycle indication, end of cycle indication
 - Positive/negative dc ground fault alarm
 - Battery monitor (tester) alarm
5. Inverter:
- Status indicating when “connected”
 - Low voltage in dc power feed
 - General alarm for inverter failure (initiated from tripping or opening of incoming and outgoing circuit breakers, output frequency and voltage out of range, loss of synchronism, semiconductor fuse blown, other alarms the supplier deems necessary).
 - Local indication of particular cause which activated general alarm.
 - For the “swing” module, indication as to which static transfer switch the module is connected.
6. Static Switch:
- Indication as to whether load is being supplied from inverters
 - Indication on whether load is fed from maintenance bypass loop
 - General failure alarm
 - Under voltage alarm in the bypass supply
 - AC ammeter to measure current in the bypass feed
7. The digital and analog (4-20mA) output signals listed below, or others as recommended by Supplier and described in the proposal, shall be wired to a terminal strip in the cabinet for external connection
- UPS inverter module: Output voltage (AC rms), Output current (amps rms), Frequency (Hz) – Analog Signal
 - Battery: Low battery voltage – Digital Signal

10 Design and Construction

10.1 Cubicle Enclosures

1. The design of the LV Cubicles shall always be based on the expectation of safe and reliable service. Safe conditions shall be ensured under all operating conditions, including those associated with the installation of the cubicle.
2. The LV Cubicles shall be designed to avoid the risk of personnel exposure to the electrical system. Hazard risks shall be identified and managed through operating procedures and access control.
3. All electrical cubicles shall be adequately protected against corrosive and solvent agents, water ingress, and moisture ingress, thermal and mechanical stresses as determined by the environmental conditions.
4. Electrical cubicles shall be rigid, constructed of braced rolled steel sections with recessed panels and substantial mounting frames for mounting of power and control cables.
5. Electrical cubicle dimensions shall not exceed those listed in Appendix E without the approval of the IO.
6. Electrical cubicle weight shall not exceed 750kg without the approval of the IO.
7. The LV Cubicles enclosure shall be as per EN61439 and conform to the degree of protection as defined by IP-52.
8. The Cubicles shall be fabricated preferably from cold rolled sheet steel of minimum thickness 14/16 inch gauge or metric equivalent (2mm/1.5mm).
9. All LV cubicles shall be lockable.
10. All LV Cubicles shall be of the module type allowing the removal of components including breakers.
11. The opening of the cubicle door shall not expose an individual to any live parts of the system.
12. If it is necessary to make provision for removal of barriers, the opening of enclosures or withdrawal of parts of enclosures, one of the following protective measures must be used to guard against direct contact with live parts:
 - Removal, opening, or withdrawal of any components must necessitate the use of a specific key or tool.
 - All live parts that can unintentionally be touched after the door has been opened shall be disconnected before the door can be opened.
 - An internal obstacle or shutter shielding of all live parts shall exist which provides protection against unintentional contact when the door is open.
13. Opening the back or front door of any cubicle shall not expose the bus bars. Access to the bus bars shall be possible only by removing bolted covers.
14. Any connections of the bus bars outside the bus bar compartment shall be insulated.
15. Bus bars shall be capable of withstanding all electrical and thermal stresses which may occur during installation. Provision shall be made for expansion and contraction of the bus bars that may result from temperature variations.

16. Bus bars shall be constructed of copper.
17. Bus bars shall withstand the fault level 65kA for 1 sec.
18. Clearances between live parts and to earth (ground) shall be in accordance with the IEC-61439 standard
19. All terminal blocks, points, relays and instruments, etc., shall be located so that they are safely accessible while the equipment is in service. Suitable protection shall be provided to prevent access to live parts when a cubicle door is open.
20. All cubicles should have the necessary hardware configuration for interfacing status and command signals with the TCWS PLC system. This interface shall be hardwire and consist of digital and analog signals.
21. The manufacturer shall define and propose this interface hardware configuration and it shall be agreed to by the IO prior to manufacturing.
22. All cubicles shall be complete with all mechanical interlockable, interior illumination lamps activated by a door switch, a 230 volt single phase convenience receptacle rated for 20A (4.278 kW), cable end boxes, color coded bus bars, internal wiring, terminal boards and accessories as required.
23. All cubicles shall have front access. Rear access shall be reserved for cable connections, maintenance and repair work. In case rear access is not possible due to installation constraints, then the cabling as well as any maintenance and repair work accessibility shall be provided through the front access.
24. All motor control cubicles shall be provided with cooling fans for maintaining the internal temperature of cubicles. Cooling fans shall be protected from local circuit protection with the help of a residual-current device (RCD).
25. The cubicle shall have auxiliary contacts wired to easily accessible terminal blocks to monitor the status of:
 - Cubicle front door status: Open/Close
 - Cubicle rear door status: Open/Close
 - Cooling fan status: Run/Stop
24. In addition, a temperature sensor (PT100 Class A 4-wire RTD) will be provided and wired to easily accessible terminal blocks to monitor the status of the internal cubicle temperature. The temperature sensor is a standard accessory, factory mounted in the cubicle and located near the outlet of the cooling system.
25. The temperature sensor value and the other status indicators shall be interfaced to the PLC I/O and transmitted over PON to the PSH/CODAC.
26. Control cubicles shall have finger-safe protection (IP2X).
27. As a minimum criterion, painting and surface protection coating shall meet the requirements of the Category C-5M according to ISO 12944.
28. The cleaning and painting for all equipment shall be made suitable for use under the ITER site environmental condition. Finish color shall be in compliance with the

requirement of the driven equipment subject to EDH guidelines unless otherwise specified

29. The appropriate colors mentioned in EDH Guide A Table 2.3.1 shall be used to identify voltage levels and the functions of the electrical equipment. These colors shall be applied on the equipment surface.

10.2 *Space Heaters*

1. Each individual enclosure shall be fitted with heating devices suitable for electrical operation on 230 VAC single phase, 50 Hz, of sufficient capacity to raise the internal temperature by about 5°C above the ambient temperature.
2. Heaters shall be controlled automatically by adjustable hygrometers (setting range about 50-100% relative humidity).
3. The protected boards shall be designed so that the maximum permitted rise in temperature is not exceeded if the heaters are energized while the apparatus is in operation.
4. Heating elements shall be suitably physically shielded to avoid burns due to accidental contact.
5. Heaters shall be connected to a suitable terminal box with a main switch and indicating lamp.
6. Heaters shall be placed in an accessible location and protected from local circuit protection with the help of RCD.
7. All equipment fitted with a heating device shall be provided with suitable drainage and be free from pockets in which moisture can collect.

10.3 *Fire Protection for SIC and Non-SIC Cubicles*

1. ITER has a specific requirement to ensure protection of SIC components in the event of fire in any cubicle in the same fire zone. Therefore, it may be necessary that all cubicles be protected in the event of fire.
2. The manufacturer shall propose to implement an automatic fire detection and suppression system for the SIC cubicles defined in this document. This system shall be approved by the IO prior to manufacturing.
3. In addition, the manufacturer shall propose as an option to provide a fire detection and protection system for the Non-SIC cubicles defined in this document. This optional system shall be approved by the IO prior to manufacturing.
4. As an example, reference the Automatic Fire Detection and suppression system (from FirePro company):
 - Fire Extinguishing Generator Model FP-200S: 10142
 - Fire Protection Controller Model FPC-4R: 10448
 - Linear Heat Detection Cable Model TH88N: 10245 or
 - TH105N: 10246

5. Automatic fire detection and suppression system of the SIC cubicles shall withstand an earthquake SL-2 and shall be functional after an earthquake (SC1-SF).
6. Automatic fire detection and suppression system inside the cubicles shall be halogen free.
7. The automatic fire detection and suppression system inside cubicles shall withstand the environmental conditions (radiation, magnetic field, temperature, humidity) of the room where the cubicle is installed.
8. Contacts for a hardwired interface indicating the status of the fire system as READY and when ACTIVATED shall be provided by the manufacturer.
9. These contacts shall be wired to easily accessible terminal blocks to facilitate field wiring.
10. Alarms from the automatic fire detection/suppression system inside cubicles shall be reported to the control rooms (normal and back-up control room).

10.4 SIC Local Control Panel Enclosures

1. The design of the SIC local control panel (LCP) shall always be based on the expectation of safe and reliable service. Safe conditions shall be ensured under all operating conditions, including those associated with the installation of the LCP.
2. The LCP enclosure shall be designed to avoid the risk of personnel exposure to the electrical system. Hazard risks shall be identified and managed through operating procedures and access control.
3. The LCP enclosure shall be adequately protected against corrosive and solvent agents, water ingress, and moisture ingress, thermal and mechanical stresses as determined by the environmental conditions.
4. The LCP enclosure shall be as per EN61439 and conform to the degree of protection as defined by IP-68.
5. The LCP shall be lockable.
6. The LCP shall consist of a one (1) piece enclosure with a hinged front door and a removeable internal backplane.
7. Clearances between live parts and to earth (ground) shall be in accordance with the IEC-61439 standard
8. Each SIC LCP shall have one (1) two (2) position REMOTE/LOCAL Key Lockable Selector Switch, one (1) START pushbutton and one (1) STOP pushbutton installed on the front of the LCP.
9. Each SIC LCP shall have LED indicators installed on the front of the LCP for displaying the status of the associated motor control mode of operation (LOCAL/REMOTE/PSS), status (RUNNING, STOPPED) and the status of the associated motor control circuit breaker (OPEN/CLOSED/TRIPPED).
10. All SIC LCP interface devices shall be wired to easily accessible terminal blocks to facilitate field wiring and hardwired interface with the associated electrical motor control cubicle.

11. All components in the SIC LCP shall be rated for 24VDC power and will receive this power from the associated electrical motor control cubicle.
12. All terminal blocks, points, relays and instruments, etc., shall be located so that they are safely accessible while the equipment is in service. Suitable protection shall be provided to prevent access to live parts when the LCP is open.
13. The LCP shall have finger-safe protection (IP2X).
14. As a minimum criterion, painting and surface protection coating shall meet the requirements of the Category C-5M according to ISO 12944.
15. The cleaning and painting for all equipment shall be made suitable for use under the ITER site environmental condition. Finish color shall be in compliance with the requirement of the driven equipment subject to EDH guidelines unless otherwise specified
16. The appropriate colors mentioned in EDH Guide A Table 2.3.1 shall be used to identify voltage levels and the functions of the electrical equipment. These colors shall be applied on the equipment surface.
17. For earthing requirements reference Section 8.12.
18. For additional details on the functional operation of the SIC LCP refer to Section 8.3 Motor Control Functional Requirements (SIC).

10.5 Internal Wiring

10.5.1 General guidelines for Internal Wiring

The guidelines for wiring inside the LV cubicles are based on best engineering practices and should facilitate consistency across all LV cubicles. All LV wiring shall be in accordance with NFC 15-100 - French Standard. All cable components shall be halogen free. The overall guidelines for wiring are as follows:

1. Electrical wiring systems shall be so arranged or marked so that they can be identified for inspection, testing, repairs or alteration of the installation.
2. Where the circuit contains a protective conductor, this conductor shall be identified by bi-color green-and-yellow marking.
3. As per the EDH guidelines, where the circuit contains a neutral conductor, this conductor shall be identified by light blue colouring. Where the circuit does not contain a neutral conductor, the conductor identified by light blue colouring may be used for other purposes, except as a protective conductor. However, in the TCWS electrical system design light blue color should be restricted for only the neutral conductor.
4. Conductors identified by color other than green-and-yellow and light blue, or by other means, may be used for all purposes except as a protective conductors or neutral conductors.
5. If single-core cables are used, continuous colour identification of the insulation is not necessary. The ends of the conductors shall be permanently identified upon installation. Heaters shall be protected via local circuit protection.

6. Where necessary, conductors inside cubicles should be supported to keep them in place. Non-metallic ducts are only permitted when they are made from a flame- retardant insulating material (see the IEC 60332 series).
7. It is recommended that electrical equipment mounted inside the cubicle be designed and constructed in such a way as to permit modification of the wiring from the front or the rear of the cubicle.
8. Connections to devices installed on doors or other movable parts should be made using flexible conductors which are suitable for frequent movement. The flexible conductors should be anchored to the fixed and movable parts independently from the electrical connection.
9. The selection of conductor sizes will be in accordance with the operational conditions, see NFC 15 100 for more details.

10.6 24 VDC Power

1. 24 VDC power shall be provide in the LV Cubicles.
2. DC power supplies shall be sized as required to provide all required power for the LV cubicles and any associated LCP.
3. The input power for DC power supplies shall be provided by 230 V single phase derived from phase to neutral in the LV motor control cubicles.
4. DC power supplies shall be protected by a MCB, but shall also have a built-in incoming protective fuse.
5. Contacts shall be provided to indicate the status of the power supply (OK, Alarm, etc.) and wired to easily accessible terminal blocks to facilitate field wiring.
6. The seller may propose the use of a transformer/rectifier device to produce the required 24 VDC power. Use of this device shall be approved by the IO prior to manufacturing.

10.7 Pushbuttons, Selector Switches and E-Stops

1. Pushbuttons, selector switches and Emergency-Stop buttons shall be IEC rated in compliance with the standards:
 - IEC/EN 60947-1
 - IEC/EN 60947-5-1
 - IEC/EN 60947-5-5
2. All electrical control cubicles and the associated local control panels shall have a 2-position key lockable selector switch for REMOTE and LOCAL modes.
3. All electrical control cubicles and the local control panels shall be provided with START and STOP pushbuttons mounted in a logical and easily accessible location on the exterior of the enclosure.

4. All electrical control cubicles shall be provided with one (1) Emergency Stop (E-Stop) pushbutton mounted in a logical and easily accessible location on the exterior of the electrical cubicle. E-Stops shall be of the push-pull type with a RED mushroom head with a minimum diameter of 40mm and with two (2) Form C contacts (Normally Open / Normally Closed). All contacts from each of the E-Stops shall be wired to terminals clearly identified inside the electrical cubicle.

10.8 Indicating Lamps

1. The terms "indication lamps, lights," etc., does not necessarily require incandescent type bulbs. The use of LED or glow type bulbs would be acceptable if adequate brightness is ensured. The lifetime of bulbs operating at rated feeding voltage plus maximum positive tolerance shall not be below 2000 hrs.
2. Lamps to be provided shall have either interchangeable lenses or coloured lamps so that they can be readily reconciled later if required. Indication Lamps shall be colour-coded with respect to the condition (status) of the LV cubicles in accordance with Table 10.
3. Indicating lamps for the electrical cubicles and for the local control panels shall be powered and controlled by the motor control circuit utilizing auxiliary contacts.

Color	Meaning	
	Safety of persons or Environment	State of equipment
Red	Danger	Faulty
Yellow	Warning/Caution Abnormal	Abnormal
Blue	Mandatory Significance	
Green	Safe	Normal
White	No Specific meaning	
Grey	No Specific meaning	
Black	No Specific meaning	

Table 10: Colors for indicator lights with respect to the status of the Cubicle

10.9 Current Transformers

1. Current Transformers shall be cast-resin type confirming to IEC 60044, dry type for indoor use, insulated for full voltage of the system, and conveniently located in the panels.
2. Measuring CTs shall conform to accuracy class and burden as per SLD. The CT ratio shall be as required by the associated measuring instrument. The CTs shall have saturation factor of not less than 1.5 and higher limit shall be compatible with the overload capacity of the instrument connected on the secondary side.

10.10 Control Transformers

1. Control Transformers shall conform to IEC-742, IEC-529 and EN 61 558 with a CE mark on the product indicating compliance with the Low Voltage Directive 73/23/EEC.
2. Control Transformers shall be epoxy-encapsulated or epoxy resin impregnated completely sealing the transformer coils against moisture, dust, dirt and industrial contaminants for maximum protection in hostile and industrial environments.

3. Control Transformers shall have integrally molded barriers between terminals and transformer to protect against electrical creepage.
4. Control Transformers laminations shall be built with silicon steel to minimize core losses and to insure optimum performance and efficiency.
5. Control transformers shall utilize Copper magnet wire.

10.11 *Meters*

1. Meters shall have local displays on the exterior of the cubicle for visualization.
2. Ammeters shall be provided for each phase (A,B, C) of each connected motor load. The VV PHTS Chemical Injection Pump (26PHVV-SK-4000) is exempt from this requirement.
3. Voltmeters shall be provided only for the main incoming line to each cubicle, shall measure the phase to phase voltage (A-B, A-C, B-C) and shall be protected by an appropriately sized fuse.
4. Meters shall have output signals of 4-20mA available for connection to the TCWS PLC system for monitoring, visualization and alarms. These signals shall in turn be transmitted to the Main Control Room by the PLC over PON.
5. Meter output signals should be standardized, and careful consideration must be given to the distance (up to 300 meters) between the meter and the PLC that will receive the signal.

10.12 *Terminal Blocks*

1. Terminal blocks shall be 660V grade box-clamp type with marking strips, similar to LMEX 10 mm2 or equivalent.
2. Terminals for C.T. secondary leads shall have provisions for shorting.
3. No more than two wires shall be connected to any terminal.
4. Spare terminals equal in number to 20% of the active terminals shall be furnished.
5. Terminal blocks shall be located to allow easy access. Wiring shall be so arranged that individual wires of an external cable can be connected to consecutive terminals.

10.13 *Cable Terminations*

1. LV Cubicles shall be designed for cable entry from the top. Sufficient space shall be provided for ease of termination and the connection of the incoming cable cross sectional area.
2. Cables shall be Halogen free, XLPE overall sheathed with 2.5 mm2 stranded copper conductor for controls and stranded Copper conductor for power circuits as detailed in documents and drawings. Cables shall comply as per following standards.
 - Reduced flame propagation (according to IEC 60332-3 –flame spread for cable bunches- or NF 32070 C1).
 - Flame retardant (according to IEC 60332-1 –flame propagation on single cables).
 - Low smoke (according to IEC 61034).

- Zero Halogen (according to IEC 60754-1).
 - Non-Toxicity (according to IEC 60754-2).
3. All provisions and accessories shall be furnished for the termination and connection of cables, including removable gland plates, cable supports, and crimp type tinned copper lugs, brass compression glands with tapered washer (power cables only) and terminal blocks.
 4. Outgoing and incoming cable shields shall be connected to the ground bus for each cubicle.
 5. Gland plates shall be at a minimum 4 mm thick. Separate gland plate and supporting arrangement shall be provided for each individual core of power cables to minimize flow of eddy current.

10.14 Earthing (Ground) Bus

1. All the LV electrical cubicles and the local control panel components shall have the necessary provision for connecting them to the earth for grounding protection.
2. The on-site routing of the earthing bus-bar connection to the earth points is not in the scope of this document and shall be provided by others.
3. A copper earthing bus rated to carry maximum fault current 65kA for 1 second shall extend the full length of the LV electrical cubicles.
4. A copper earthing bus shall extend the full length of all local control panels.
5. The earthing bus shall be provided with two-bolt drilling with bolts and nuts at each end to receive a 50 x 6 mm Copper flat.
6. The cubicle earthing bars shall be provided with removable link to facilitate testing.
7. T & V.T secondary neutrals shall be earthed through removable links so that earth of one circuit may be removed without disturbing others.
8. The lightning protection scheme offered by EDH part 5 Section 6.4 which suggests the scheme/layout in Tokamak complex shall be followed.

10.15 Labelling and Nameplates

10.15.1 General Guidelines

1. All LV Cubicles and the SIC local control panels shall be provided with labels/nameplates showing the the unique identification Part Number ITER (PNI) supplied by the ITER Organization and meeting the requirements of the document “ITER Numbering System for Components and Parts ([28QDBS](#))”
2. The identification including description and other information as required per each component shall be provided on the labels/nameplates.
3. Exterior labels/nameplates shall display at a minimum:
 - Manufacturer name and address
 - Manufacture date

- Cubicle name and tag number
 - Cubicle model and serial number
 - CE marking
 - Input Voltage, Frequency, Phases
 - Power in kW
 - Control Voltage
 - Output Voltage (if different from input), Frequency, Phases
4. The labels/nameplates shall (depending on the purpose for which they are to be used), either be made of non-transparent or translucent heat-resisting synthetic resin, stainless steel or yellow brass as appropriate.
 5. Labels/nameplates shall be mounted on the component enclosure, local panels and cabinets and shall be fastened with rustproof screws or otherwise agreed-upon methods.
 6. Labels/nameplates shall be engraved through to core colour. Engraving shall be performed by rounded or square ended cutter. “V” type engraving is not acceptable. Lettering style shall be all capitals, gothic (san serif), condensed, and shall be consistently applied.
 7. Labels/nameplates shall have a minimum of 1.5mm thickness, 25 mm width and a length as required for the name or identifying number. Additionally for each side of the label space shall be provided for screw holes for the stainless steel screws (minimum size M3) are located. In case the equipment is small relative to the label, a separate stainless steel support shall be provided and installed, holding the label in a position to allow good reading.
 8. Labels/nameplates shall be written in English only. The letters and numbers shall have a minimum height of 8 mm and shall be engraved by professional means.
 9. The proposed arrangement of the labels/nameplates (material, colour, size and engravings) shall be submitted to the ITER Organization for approval.
 10. Labels/nameplates of cubicles shall designate the components identification and description.
 11. Devices inside cubicles, panels, boxes, etc., such as instruments, meters, relays and fuses, shall be properly labelled with individual component identification number (or item number) with a corresponding description. This number shall be the same as indicated in the pertaining documents (wiring diagrams, equipment lists, etc.).
 12. Cubicles shall also bear their identification on the rear side if rear access is allowed.
 13. Instruction plates showing the sequence diagrams or cautions for maintenance shall be fitted on the inside of the front door of the electrical cubicles.

10.15.2 Label Colour

1. Electrical equipment including electrical power supply equipment, e.g. SSEN and PPEN components, and electrical components designed, procured and maintained by other PBS groups shall be marked or labelled in a distinct manner with its corresponding safety colours as defined in Table 8.

2. The standard means of the safety colour coding for electrical equipment is coloured (foreground or background) equipment (identification) labels. If coloured equipment labels are practically unachievable to apply, permanently attached colour stripe above or below label (or nameplate) might be applicable.
3. In order to ensure optimum visibility and to highlight equipment labels from visual environment, colour contrast must be achieved between identification itself and the label and between the label and visual environment back-grounding the label. Thus, where used in equipment labels on bright equipment surface, the distinct colour should be a background colour, and the foreground colour is white. Where used in equipment labels on dark equipment surface, the distinct colour should be a foreground colour, and the background colour is white. Refer to Table 11.

Safety	Class	Train Color	RAL Id
SIC	Train A	Orange	RAL2000
SIC	Train B	Green	RAL6016
Non-SIC		Black	RAL9005

Table 11: Color Code for identification with Safety class

10.15.3 Colours for Electrical Cubicles

1. The LV Cubicles and the SIC local control panels shall be finished with Yellowish Grey RAL 1013 with two coats of epoxy-based paint (Ref, Section 2.3 EDH Guide A: Electrical Installations for SSEN Client Systems).

11 Control and Protective Devices

1. The design of electrical control and protective components to be installed at ITER shall provide selective and coordinated protection for the ITER power distribution system by the proper application of protective devices to prevent adverse effects of over currents, under voltages and over voltages that may cause damage to the electrical installation, supplied systems and building structures. The protection of an electrical system is typically performed by a range of devices, e.g. circuit breaker, overload relays, etc.

11.1 General Requirements

1. Low voltage switchgear is designed for switching and protection of electrical equipment. The selection of switching devices is based on the specific switching task, e.g. isolation, load switching; short-circuit current breaking, motor switching, protection against overcurrent and personnel hazard. Depending on the type, switching devices can be used for single or multiple switching tasks. Switching tasks can also be conducted by a combination of several switchgear units.
2. IEC 60947-1 contains the general stipulations for all types of low voltage switching devices. Further general stipulations for electromechanical control circuit devices and switching elements can be found in IEC 60947-5-1.
3. Devices for up to 690 V have a test level of 1890V for the rated insulation voltage. The rated impulse withstand voltage U_{imp} (stated on the switch or noted in the manufacturer's documentation) for service in power distribution is as a rule 6 kV (IEC 60947-1, Table H1).

11.2 Motor protection Circuit Breaker

1. The design and manufacture of MPCBs shall comply with the latest editions of the IEC recommendations. Particularly the following shall be applied to the select the MPCBs.
 - IEC 60038 IEC standard voltages.
 - 60947-2 Low-voltage switchgear and control gear – Part 2: Circuit breakers.

11.2.1 Circuit breaker Technical Requirements

1. All MPCBs shall be rated 4 pole, 600 Volt, 50Hz and have built-in motor overload protection.
2. MCBs shall be rated single pole, 230 Volt, 50 Hz
3. Circuit breakers for motor feeders shall be magnetic type only with adjustable instantaneous trip elements.
4. Circuit breakers shall be fully withdrawable for isolation and maintenance purposes and shall be lockable in the isolated position.
5. Breakers shall be equipped with an external operating mechanism to allow operation from the front with the unit door closed. The operating mechanism shall clearly indicate whether breaker is ON, OFF, TRIPPED and shall be lockable in the OFF position.
6. All breakers provided for the electrical equipment shall have individual auxiliary contacts to indicate that the breaker is OPEN, CLOSED or TRIPPED. These contacts shall be wired to terminals clearly identified in the terminal box for easy accessibility by field wiring and indicated on the referenced schematic diagram to be furnished by the Seller.
7. Circuit breakers shall be selected for the LV electrical cubicles in accordance with the protection coordination.
8. The breaker operating mechanism and the unit door shall be hardware interlocked to prevent opening the door when the breaker is in the ON (CLOSED) position. Means shall be provided to bypass the interlock for maintenance.
9. All circuits breakers shall be provided with a mechanism to remotely reset the breaker after a trip condition by using a digital signal.
10. The operational voltage of the remote reset device shall be 24 VDC.
11. The remote reset device shall have at a minimum rating of 10,000 Switching Cycles over it's Lifetime.
12. The remote switching unit shall comply with IEC 60947-2 Annex N.

11.2.2 Design Data

The minimum requirements MPCBs are described in Table 12.

Sr. No.	Description	Data	Remark
1	System nominal voltage, V	400	
2	Recommended(preferred) Rated current, A	2.5, 4, 6.3, 10, 16, 25, 40, 63, 100,	

3	Rated operating voltage, V	600	
4	Rated frequency, Hz	50	
5	Rated short-circuit breaking capacity at rated voltage, KA, sym, rms	65	
6	Rated insulation voltage, V	690	

Table 12: Technical Data for MPCB

The minimum requirements of MCBs are described in Table 13.

Sr. No.	Description	Data	Remark
1	System nominal voltage, V	230	
2	Recommended(preferred) Rated current, A	2.5, 4, 6.3, 10, 16, 25, 40, 63, 100,125	TBD BY THE SUPPLIER
3	Rated operating voltage, V	230 V/400 V	
4	Rated frequency, Hz	50	
5	Rated short-circuit breaking capacity at rated voltage, KA, sym, rms	6	
6	Rated insulation voltage, V	500	

Table 13: Technical Data for MCB

11.3 Fuse Protection

11.3.1 Codes and standards

- The design and manufacture of fuses shall comply with the latest editions of the IEC recommendations. Particularly the following shall be applied to select the fuses.
 - IEC 60038 IEC standard voltages
 - IEC 60269 Low-voltage fuses
 - IEC 60947-3 Low-voltage Switchgear and Control gear – Part 3: Switches, Disconnections, Switch Disconnections and Fuse-Combination Units

11.3.2 Technical Requirements

- Voltmeters shall be protected by current limiting fuses. Fuses shall be sized to prevent harmful overloads and shall be located to permit replacement while the cubicle is energized.
- Fuse holders shall be permanently labelled as to size and type of fuse installed. Fuse size shall be noted on all electrical schematic diagrams and wiring diagrams.
- Fuses shall be located in areas where it will not be hazardous to replace them.

4. Tripping of fuses shall be indicated by the local and remote alarm system and the event recorder. For remote alarm and event recording, group alarms may be provided.

11.3.3 Design Data

The minimum requirements for fuses are in Table 14.

Sr. No.	Description	Data	Remark
1	System nominal voltage, V	230VAC; 110V/48V DC	
2	Rated operating voltage, V	250, 400	
3	Rated frequency, Hz	50/DC	
4	Recommended (preferred) rated current, A	2, 4, 6, 8, 10, 12, 16, 20, 25, 32, or higher	TBD BY THE SUPPLIER
5	Minimum interrupting rating, A	To be determined in Tender design phase	TBD BY THE SUPPLIER

Table 14: Technical Data for Fuses

11.4 Contactors

11.4.1 Codes and Standards

1. Design and manufacture of contactors shall comply with the latest editions of the IEC recommendations. Particularly the following shall be applied to select the contactors.
 - IEC 60038 IEC standard voltages
 - IEC 60947-4-2 Low-voltage switchgear and control gear – Part 4-2: Contactors and motor – starters

11.4.2 Technical Requirements

1. Contactors shall be for Direct on Line (DOL) starting.
2. LV contactors shall be selected by utilization of categories as shown in the table below. In addition, the ratings (voltage, current, ambient temperature and control voltage) are to be considered. Background conditions such as switching frequency, number of poles, type of coordination, short circuit level, start-up conditions and contact life are also to be taken into account.
3. The contactor must be capable to operate satisfactorily with the following voltage limit values.
 - Pick up: between 75% and 110%
 - Drop off: below 70%
4. Contactors shall be capable of closing when a minimum transient voltage of 75% of the rated voltage is applied to the contactor coil.

5. When closed, the contactors shall withstand the system prospective fault current determined by the next coordinated short circuit tripping device. The associated thermal over-current releases shall either correspond to the primary current, or be fed via current transformer(s), as specified. They shall be adjustable in order to fit the motor requirements and be temperature compensated up to 70°C ambient temperature.
6. Suitable means shall be provided to prevent core vibration and noise. Contactors for motor control shall be suitable for direct-on-line motor starting and shall be capable of withstanding without damage the motor stalled current until the associated protective device operates. Contactors shall be designed for Type '2' co-ordination to IEC 609474.
7. Important accessories for the contactors include, for example, clip-on auxiliary contact blocks and overload relays for fitting to the contactor output terminals.

Utilization Category	Typical application
AC-3	Squirrel-cage motors: starting, disconnecting while running
AC-4	Squirrel-cage motors: starting, plug braking, reversing, Jogging

Table 15: Utilization categories for contactors as per IEC 60947-4-1

11.4.3 Design Data

The minimum requirements for contactors are below in Table 14.

Sr. No.	Description	Data	Remark
1	Rated operating voltage, V	690	
2	Rated insulation voltage, V	750	
3	Rated Control Voltage, V	24VDC	
4	Rated frequency, Hz	50	
5	Recommended(preferred) rated current, A		TBD BY THE SUPPLIER

Table 16: Contactors

11.5 Soft Starters

1. A soft start controller is only required for the Charging Compressor cubicle 26DY00-CMC-1005.
2. The soft start controller shall be installed in a similar location as the contactors in the other LV motor control cubicles and with the same protective devices and similar hardware configuration as the DOL contactors.
3. The soft start controller shall be energized to start/stop with digital hardwire signals like those that the contactors receive.

4. Provisions for a digital soft start controller reset signal shall be included. This signal is in addition to the breaker reset digital signal.
5. The soft start controller shall be configurable locally to start at a preferred ramp up speed and to stop at a preferred ramp down speed.
6. The soft start controller shall not require any external software or analog communication or continued maintenance after commissioning.
7. The soft start controller shall conform to the applicable requirements of IEC 60947-2 and IEC 947-4-2.
8. The soft start controller must be capable to operate satisfactorily with the following voltage limit values.
 - Pick up: between 75% and 110%
 - Drop off: below 70%
9. The soft start controller shall be capable of operating when a minimum transient voltage of 75% of the rated voltage is applied to the controller.
10. The soft start controller shall have at a minimum the following soft starting features:
 - Linear Torque control for Start
 - Current Limit Start
 - Voltage ramp with current limit Start
 - Soft Start with Selectable Torque Boost
 - Slow Speed time controlled
 - Bypass control
11. The soft start controller shall have at a minimum the following soft stop features:
 - Linear Torque control for Stop
 - Quadratic Torque control for Stop
 - Voltage ramp Stop
 - Coast to stop
 - Slow Speed time controlled

11.5.1 Design Data

The minimum requirements for soft start devices are below in Table 17.

Sr. No.	Description	Data	Remark
1	Rated operating voltage, V	600	
2	Rated insulation voltage, V	750	
3	Rated Control Voltage, V	24VDC	
4	Rated frequency, Hz	50	
5	Recommended(preferred) rated current, A		TBD BY THE SUPPLIER

Table 17: Soft Start Controllers

11.6 Motor Starting

11.6.1 Codes and Standards

1. The design and manufacture of motor starters shall comply with the latest editions of the IEC recommendations. Particularly the following shall be applied to select Motor Starters.
 - IEC 60038 IEC standard voltages
 - IEC 60947-4-2 Low-voltage switchgear and control gear – Part 4-2: Contactors and motor – starters

11.6.2 Technical Requirements

1. Motor starters based on electromechanical switching devices are also defined in IEC 60947-4-2. Accordingly, motor starters are used to start motors, accelerate them to normal speed, ensure motor operation, disconnect the motor from the power supply and, by means of suitable protection system, protect the motor and the corresponding circuit in the case of overload.
2. The starter may function as a direct-on-line starter (DOL). Short circuit protection, overload protection and in many cases an isolation device are also required. Circuit-breakers are preferred for short circuit protection.
3. The components must be designed for a rated impulse withstand voltage.
4. Short circuit protection is to be provided depending on the voltage level and the rated short circuit breaking capacity of the motor starter.
5. For the design of the motor control unit, assignment to a type class in accordance with IEC 60947-4-1 which indicates the level of service continuity to be achieved with the equipment is also necessary. Two type classes are defined. The maximum permissible limits for damage are stated for both types. Machine operators must on no account be exposed to hazards.
6. All components and wiring shall be readily accessible for ease of maintenance. Connection to the bus for the starter units shall be by means of self-aligning plated connectors having free floating spring construction so as to ensure a positive pressure contact with both sides of the bus.
7. The design of the starter units and their associated connectors shall include provisions for accurately guiding the units from the disconnected or withdrawn position to the connected position and to prevent miss-stabbing.
8. The design of the starter units shall be such that combination starters of the same starter size and type shall be interchangeable.
9. All similar devices and components shall be of one manufacturer to facilitate maintenance and repair.
10. Contactors for all motor starter units shall be equipped with a sufficient number of auxiliary contacts. Main and auxiliary contacts shall be silver plated.
11. Provisions shall be provided to manually reset trips of the protective devices remotely from outside the cubicles.

12 Drawing and Documentation Requirements

The Supplier shall furnish to the Client complete technical data with the following drawings and documents:

1. Outline and general arrangement drawings including as a minimum grounding locations, floor mounting methods and accessories.
2. List of and data sheets for all devices in the LV, UPS cubicles and the local control panels per this specification.
3. A Comprehensive List of Manufacturer Recommended Spare Parts shall be provided.
4. Power and control interconnecting wiring diagrams for all devices.
5. The wiring diagrams shall be in SEE Electrical Expert software, as required by Design Integration team at IO-List of recommended spare parts /special tools.
6. Test procedures and test reports
7. Operation and instruction manual.
8. All drawings and manuals shall be reproducible.
9. For additional information regarding drawings, refer to the documents “Procedure for ITER CAD Data Exchanges ([2NCULZ](#)), Procedure for the CAD management plan ([2DWU2M](#)), Procedure for the Management of Diagrams and Drawings in pdf Format Using the SMDD Application ([KFMK2B](#)), Specification for CAD data Production in ITER direct contracts ([P7Q3J7](#))” and “IO / In-Cash Contractor Documentation Exchange and Storage Working Instruction ([G8UMB3](#))”.

13 Test and Inspections

1. Tests and inspections shall be made in accordance with applicable codes and standards. Written Documentation and/or certified test reports shall be submitted in accordance with the packaged submittal schedule.

13.1 Routine Tests

1. Routine tests are intended to detect faults in materials and workmanship and to ascertain proper functioning of the equipment. Routine test shall be as per the IEC 61439-1. Each individual LV cubicle after being completely assembled shall be tested and inspected, not limited to the following.
 - Visual and dimensional check
 - Functional tests
 - Dielectric tests
2. The UPS systems shall be factory tested, Routine and Type Tests in accordance with the IEC 62040-3. The routine tests shall be performed on each UPS set.

3. Evidence of type tests performed on equipment identical to that supplied under this specification shall be provided. Type tests shall have been performed by a reputable testing laboratory within 5 years of the contract award date.
4. The battery shall undergo routine acceptance testing in accordance with IEC 60623 and IEC 62259 including a dimensional check and a check of the general appearance of the elements.
5. The battery shall be type tested as per standards IEC 60623 and IEC 62259.
6. The entire UPS distribution set made up of the rectifier, inverter, batteries, static transfer switch and by-pass transformer, shall be type tested, as a whole, as recommended by the manufacturer according to Section 6 of IEC 62040-3.

13.2 *Test Types Non-SIC and SIC Cubicles*

1. The test types shall be as per IEC 61439 - 1&2. Test types are intended to verify compliance of the design of a given piece of equipment with this standard where applicable and the relevant product standard. They may comprise, as appropriate, the verification of:
 - Operational performance
 - Magnetic field test and documentation of the results
 - Constructional requirements.
 - Temperature-rise.
 - Dielectric properties.
 - Making and breaking capacities.
 - Short-circuit making and breaking capacities.
 - Operating limits.
 - Degree of protection of enclosed equipment.
 - Tests for EMC.

NOTE: The above list is a minimum requirement.

2. The type test details such as - selection of equipment, list of results, and if relevant, the test sequences and the number of samples- shall be specified in the relevant product standard at manufacturing engineering stage.

13.3 *Test Types for SIC Cubicles*

1. For SIC cubicles a qualification program shall be provided by the supplier for the definition of the test sequence applying IEC/IEEE 60780-323 or RCC-E. The tests shall comprise, as appropriate, the verification and documentation of:
 - Magnetic field test with recorded documentation of the results.
 - Aging test utilizing temperature data provided in the document "“Input data for qualification (YX7JXD)”” to simulate the status of the cubicle at the end of it’s life.

- Operation at high temperature (see the values provided in the document "“Input data for qualification (YX7JXD)” This is a dry test.
- Operation at low temperature (see the values provided in the document "“Input data for qualification (YX7JXD)” This is a dry test.
- Operation at high humidity (see the values provided in the document “Input data for qualification (YX7JXD)”. This is a damp test.
- Operability after a Seismic event.

13.4 *Factory Acceptance Test*

1. All tests mentioned above shall be performed in the presence of the Owner's representatives if so desired by the Owner before dispatch as per the approved QAP.
2. The manufacturer shall give at least thirty (30) days advance notice of the date when tests are to be carried out.

13.5 *Compliance with Constructional Requirement*

1. The verification of compliance with the constructional requirements shall be provided for as a minimum:
 - The materials.
 - The equipment.
 - The degrees of protection of enclosed equipment.

13.6 *Site Acceptance Test*

1. Site Acceptance Test shall be in accordance with the NFC 15 100 section 6. On completion of installations the following tests shall be carried out and the Test procedures shall be submitted to the client for approval.
 - Insulation Resistance Test.
 - Polarity Test of Switch.
 - Earth Continuity Test
2. The following verifications and tests will be performed on-site for UPS & Battery sets, under the supervision/witnessing of the Supplier where applicable and in conformance with the site support services delineated in the contract.
 - Conformity of the assemblies
 - Conformity of the wiring with the diagrams
 - Proper function of the electrical and other interlocks
 - Proper function of the control, measuring, protective and regulating equipment including heating and lighting
 - Mechanical operation checks
 - Control system operation and performance checks
 - Battery capacity testing
 - Insulation resistance test of battery rack to earth

Vendor may recommend a variant of the above list subject to ITER approval.

14 Packaging and Transportation

1. The packaging, transportation and installation of cubicles will be finalized during manufacturing engineering phase. However, some guidelines on the same are provided below.

14.1 *Packaging*

1. The supplier shall provide such packing of the LV cubicles as is required to prevent their damage or deterioration during transit to their destination as indicated in the Contract. The packing shall be sufficient to withstand, without limitation, rough handling during transit to their destination as indicated in the Contract and exposure to extreme temperatures, salt and precipitation etc., during transport and open storage. Packing case size and weights shall be taken into consideration wherever appropriate, the remoteness of the 'goods' destination and absence of heavy mechanized handling facilities, at all points in transit. The packing, marking and documentation within and outside the package shall comply strictly with these requirements.
2. For additional information refer to the document "Input data for qualification ([YX7JXD](#))"

14.2 *Transportation*

1. The LV cubicle must be transported to the place of installation or storage only by an experienced and qualified carrier. Depending on the commercial agreement and the regulations in force in the country of destination, the carrier may be held liable if any damage is observed upon delivery.
2. The cubicle environmental condition (temperature, humidity) shall be recorded during the transport and an accelerometer shall be installed to detect any falling item during transport.
3. For SIC and Non-SIC cubicles, the accelerometer which is installed shall record any acceleration encountered during the transport.
4. For export, regulations in force in the country of destination shall be applied with respect to the type of packaging authorized.
5. In addition to the forces due to oscillations and impacts, it is necessary to consider the risk of falling, overturning, tipping over and collision to avoid possible damage.
6. Chock the packaging to avoid shifting during transport. Use straps or steel cables.
7. For steel cables, use intermediate wedges (for example, wood) to avoid damaging the cases through the rubbing or tightening of the cable. When loading or unloading the cases.
8. The transport vehicle must be on a stable ground, with the parking brake pulled up. Make sure that the floor is stable. After loading, check that the case is properly chocked and fastened into the truck, to avoid all damage during transport.

9. Enclosures should preferably be laid flat for transport. Make sure to place the front panels of the enclosures (fragile side) towards the top. Do not stack the cases. If it is not possible to transport the enclosures horizontally, you can place them upright on a pallet by protecting the front panels with the appropriate cushioning material and by covering the case with plastic film.
10. Check the following points with the carrier:
 - The cubicles are properly chocked throughout transport.
 - That the truck will not stop in areas where the climatic conditions do not comply with the climatic constraints for the storage.
11. For additional information refer to the document “Input data for qualification ([YX7JXD](#))”

14.3 *Guarantee*

1. The supplier shall guarantee that the goods under the contract are new, of the most recent or current models and incorporate all recent improvements in design and materials unless provided otherwise in the contract. The supplier shall further guarantee that the goods supplied under this contract shall have no defects arising from design, materials or workmanship, installation, and erection, if that may develop under normal use of the supplied goods. The supplier shall also guarantee the performance of the works executed by him including the performance of all the materials/goods supplied by him.
2. Owner shall promptly notify supplier in writing of any claims arising under guarantee in respect of goods. Upon receipt of such notice, the supplier shall, with all reasonable speed, repair or replace the defective works or parts thereof, free of cost at site. All the expenses towards transportation of defective parts to supplier's works and of repaired/replaced parts to site shall be borne by the Supplier.
3. If the Supplier, having been notified, fails to remedy the defects within 14 days, the Owner will proceed to take such remedial action as may be necessary, at the supplier's risk and expenses. All expenses in this regard will be recovered from Supplier.

15 *Bill of Material*

Manufacturer shall at a **minimum** supply the Bill of Material (BOM) for each system as defined below. All values are preliminary and shall be confirmed prior to beginning manufacturing.

15.1 *LV ELECTRICAL MOTOR CONTROL CUBICLES*

Cubicle 26PHVV-CMC-1001: 15kW for VV PHTS Volume Control Pump 1 (26PHVV-PL-5000)			
Class IV, 400V (NON- SIC)			
No.	Item	Rating	Quantity
1	Cubicle 26PHVV-CMC-1001	IP-52	1
2	Fuse for Voltmeter	TBD BY THE SUPPLIER	3

3	Voltmeter Display	0- 400V	3
4	Current transformer	50 A/ 1A	3
5	Ammeter Display	0-50 A	3
6	MPCB with remote reset	50 A	1
7	4-wire RTD	PT100 Class A	1
8	Contactor	18.5kW/40 A	1
9	2 - Position Key Lockable Selector Switch (REMOTE/LOCAL)	IEC	1
10	Pushbuttons (START, STOP)	IEC	2
11	Indicating lamps Motor Control Status REMOTE, LOCAL, RUNNING, STOPPED, Breaker Status: OPEN, CLOSED, TRIPPED	IEC	7
12	Control Transformer	TBD BY THE SUPPLIER	TBD BY THE SUPPLIER
13	24 VDC Power Supply	TBD BY THE SUPPLIER	TBD BY THE SUPPLIER
14	4-wire RTD	PT100 Class A	1
15	Wiring	IEC	LOT
16	Accessories (TB, Labels, wire runs, lugs, auxiliary contacts, etc.)	TBD BY THE SUPPLIER	LOT
17	EMERGENCY STOP Pushbutton	IEC	1

Cubicle 26PHVV-CMC-1006: 22.5 kW (This Cubicle Supplies Motor Controls for two (2) Motors/Pumps)			
VV PHTS Chemical Injection Pump (26PHVV-SK-4000)			
VV PHTS Filter Booster Pump 1 (26PHVV-PL-1801)			
Class IV, 400V (NON- SIC)			
No.	Item	Rating	Quantity
1	26PHVV-CMC-1006	IP-52	1
2	Fuse for Voltmeter Switch	TBD BY THE SUPPLIER	3
3	Voltmeter	0-400V	3
4	MPCB with remote reset	100 A	1
5	4-wire RTD	PT100 Class A	1
6	VV PHTS Chemical Injection Pump (26PHVV-SK-4000) – 7.5 kW	7.5 kW	N/A
7	MPCB with remote reset	30 A	1
8	Contactor	11 kW/25 A	1
9	2 - Position Key Lockable Selector Switch (REMOTE/LOCAL)	IEC	1
10	Pushbuttons (START, STOP)	IEC	2
11	Indicating lamps Motor Control Status REMOTE, LOCAL, RUNNING, STOPPED, Breaker Status: OPEN, CLOSED, TRIPPED	IEC	7

12	Control Transformer	TBD BY THE SUPPLIER	TBD BY THE SUPPLIER
13	24 VDC Power Supply	TBD BY THE SUPPLIER	TBD BY THE SUPPLIER
14	Wiring	IEC	LOT
15	Accessories (TB, Labels, wire runs, lugs, auxiliary contacts, etc.)	TBD BY THE SUPPLIER	LOT
	EMERGENCY STOP Pushbutton	IEC	1
16			
17	VV PHTS Filter Booster Pump 1 (26PHVV-PL-1801)	15 kW	N/A
18	MPCB with remote reset	50 A	1
19	Contactor	18.5kW/40 A	1
20	Current transformer	50A/ 1A	3
21	Ammeter	0-50 A	3
22	2 - Position Key Lockable Selector Switch (REMOTE/LOCAL)	IEC	1
23	Pushbuttons (START, STOP)	IEC	2
24	Indicating lamps Motor Control Status REMOTE, LOCAL, RUNNING, STOPPED, Breaker Status– OPEN, CLOSED, TRIPPED	IEC	7
25	Control Transformer	TBD BY THE SUPPLIER	TBD BY THE SUPPLIER
26	24 VDC Power Supply	TBD BY THE SUPPLIER	TBD BY THE SUPPLIER
27	Wiring	IEC	LOT
28	Accessories (TB, Labels, wire runs, lugs, auxiliary contacts, etc.)	TBD BY THE SUPPLIER	LOT
29	EMERGENCY STOP Pushbutton	IEC	1

26DY00-CMC-1005: 26.3 kW for DY Charging Compressor (26DY00-PC-3001)			
Class IV, 400V (NON- SIC)			
No.	Item	Rating	Quantity
1	Cubicle 26DY00-CMC-1005	IP-52	1
2	Fuse for Voltmeter	TBD BY THE SUPPLIER	3
3	Voltmeter	0-400V	3
4	Current transformer	60 A/ 1A	3
5	Ammeter	0-60	3
6	MPCB with remote reset	60 A	1
7	Single Pole MCB with remote reset for heater circuit	TBD	1
8	4-wire RTD	PT100 Class A	1

9	Soft Start Controller	30 kW	1
10	2 - Position Key Lockable Selector Switch (REMOTE/LOCAL) for cubicle	IEC	1
11	Pushbuttons (START, STOP) for cubicle	IEC	2
12	Indicating lamps Motor Control Status REMOTE, LOCAL, RUNNING, STOPPED, Breaker Status– OPEN, CLOSED, TRIPPED for cubicle	IEC	7
13	Control Transformer	TBD BY THE SUPPLIER	TBD BY THE SUPPLIER
14	24 VDC Power Supply	TBD BY THE SUPPLIER	TBD BY THE SUPPLIER
15	Wiring	IEC	LOT
16	Accessories (TB, Labels, wire runs, lugs, auxiliary contacts, etc.)	TBD BY THE SUPPLIER	TBD BY THE SUPPLIER
17	EMERGENCY STOP Pushbutton	IEC	1

Cubicle 26DR00-CMC-1013: 97 kW (This Cubicle supplies Motor Controls for six (6) individual motors)			
SDT1 Refilling/Transfer Pump - 1 (26DR00-PL-0001) - 11 kW			
NDT1 Refilling/Transfer Pump (26DR00-PL-0002) – 45.7 kW			
NBI Drain Tank Refilling/Transfer Pump (26DR00-PL-0003) – 20.7 kW			
Auxiliary Drain Tank Transfer Pump (26DR00-PL-0004) – 3.6 kW			
SDT1 Refilling/Transfer Pump – 2 (26DR00-PL-0007) – 11 kW			
Class IV, 400V (NON- SIC)			
No.	Item	Rating	Quantity
1	Cubicle 26DR00-CMC-1013	IP-52	1
2	Fuse for Voltmeter	TBD BY THE SUPPLIER	3
3	Voltmeter	0-400V	3
4	MCCB with remote reset	250 A	1
5	4-wire RTD	PT100 Class A	1
6	24 VDC Power Supply	TBD BY THE SUPPLIER	TBD BY THE SUPPLIER
7	Control Transformer	TBD BY THE SUPPLIER	TBD BY THE SUPPLIER
8	Wiring	IEC	LOT
9	Cubicle Enclosure	IP-52	1
10	Accessories (TB, Labels, wire runs, lugs, auxiliary contacts, etc.)	TBD BY THE SUPPLIER	LOT
11	SDT1 Refilling/Transfer Pump - 1 (26DR00-PL-0001)	11 kW	N/A
12	MPCB with remote reset	50 A	1

13	Contactor	15kW/32A	1
14	Current transformer	50 A/ 1A	3
15	Ammeter	0-50 A	3
16	2 - Position Key Lockable Selector Switch (REMOTE/LOCAL)	IEC	1
17	Pushbuttons (START, STOP)	IEC	2
18	Indicating lamps Motor Control Status REMOTE, LOCAL, RUNNING, STOPPED, Breaker Status– OPEN, CLOSED, TRIPPED	IEC	7
19	24 VDC Power Supply	TBD BY THE SUPPLIER	TBD BY THE SUPPLIER
20	Control Transformer	TBD BY THE SUPPLIER	TBD BY THE SUPPLIER
21	Wiring	IEC	LOT
22	Accessories (TB, Labels, wire runs, lugs, auxiliary contacts, etc.)	TBD BY THE SUPPLIER	LOT
23	EMERGENCY STOP Pushbutton	IEC	1
24	NDT1 Refilling/Transfer Pump (26DR00-PL-0002)	45.7 kW	N/A
25	MPCB with remote reset	125 A	1
26	Contactor	55kW/110A	1
27	Current transformer	125 A/ 1A	3
28	Ammeter	0-125 A	3
29	2 - Position Key Lockable Selector Switch (REMOTE/LOCAL) for cubicle	IEC	1
30	Pushbuttons (START, STOP) for cubicle	IEC	2
31	Indicating lamps Motor Control Status REMOTE, LOCAL, RUNNING, STOPPED, Breaker Status– OPEN, CLOSED, TRIPPED for cubicle	IEC	7
32	24 VDC Power Supply	TBD BY THE SUPPLIER	TBD BY THE SUPPLIER
33	Control Transformer	TBD BY THE SUPPLIER	TBD BY THE SUPPLIER
34	Wiring	IEC	LOT
35	Accessories (TB, Labels, wire runs, lugs, auxiliary contacts, etc.)	TBD BY THE SUPPLIER	LOT
36	EMERGENCY STOP Pushbutton	IEC	1
37	NBI Drain Tank Refilling/Transfer Pump (26DR00-PL-0003)	20.7 kW	
38	MPCB with remote reset	50 A	1

39	Contactor	30kW/65 A	1
40	Current transformer	50 A/ 1A	3
41	Ammeter	0-50 A	3
42	2 - Position Key Lockable Selector Switch (REMOTE/LOCAL) for cubicle	IEC	1
43	Pushbuttons (START, STOP) for cubicle	IEC	2
44	Indicating lamps Motor Control Status REMOTE, LOCAL, RUNNING, STOPPED, Breaker Status– OPEN, CLOSED, TRIPPED for cubicle	IEC	7
45	24 VDC Power Supply	TBD BY THE SUPPLIER	TBD BY THE SUPPLIER
46	Control Transformer	TBD BY THE SUPPLIER	TBD BY THE SUPPLIER
47	Wiring	IEC	LOT
48	Accessories (TB, Labels, wire runs, lugs, auxiliary contacts, etc.)	TBD BY THE SUPPLIER	LOT
49	EMERGENCY STOP Pushbutton	IEC	1
50	Auxiliary Drain Tank Transfer Pump (26DR00-PL-0004)	3.6 kW	
51	MPCB with remote reset	20 A	1
52	Contactor	5.5 kW/12 A	1
53	Current transformer	20 A/ 1A	3
54	Ammeter	0-20 A	3
55	2 - Position Key Lockable Selector Switch (REMOTE/LOCAL) for cubicle	IEC	1
56	Pushbuttons (START, STOP) for cubicle	IEC	2
57	Indicating lamps Motor Control Status REMOTE, LOCAL, RUNNING, STOPPED, Breaker Status– OPEN, CLOSED, TRIPPED for cubicle	IEC	7
58	24 VDC Power Supply	TBD BY THE SUPPLIER	TBD BY THE SUPPLIER
59	Control Transformer	TBD BY THE SUPPLIER	TBD BY THE SUPPLIER
60	Wiring	IEC	LOT
61	Accessories (TB, Labels, wire runs, lugs, auxiliary contacts, etc.)	TBD BY THE SUPPLIER	LOT
62	EMERGENCY STOP Pushbutton	IEC	1
63	SDT1 Refilling/Transfer Pump – 2 (26DR00-PL-0007)	11 kW	
64	MPCB with remote reset	50 A	1
65	Contactor	15 kW/32 A	1

66	Current transformer	50 A/ 1A	3
67	Ammeter	0-50 A	3
68	2 - Position Key Lockable Selector Switch (REMOTE/LOCAL) for cubicle	IEC	1
69	Pushbuttons (START, STOP) for cubicle	IEC	2
70	Indicating lamps Motor Control Status REMOTE, LOCAL, RUNNING, STOPPED, Breaker Status– OPEN, CLOSED, TRIPPED for cubicle	IEC	7
71	24 VDC Power Supply	TBD BY THE SUPPLIER	TBD BY THE SUPPLIER
72	Control Transformer	TBD BY THE SUPPLIER	TBD BY THE SUPPLIER
73	Wiring	IEC	LOT
74	Accessories (TB, Labels, wire runs, lugs, auxiliary contacts, etc.)	TBD BY THE SUPPLIER	LOT
75	EMERGENCY STOP Pushbutton	IEC	1

Cubicle 26PHVV-CMC-1003: 30 kW for VV PHTS Volume Control Pump 2 (26PHVV-PL-5002)			
Class III, 400V (SIC)			
No.	Item	Rating	Quantity
1	Cubicle 26PHVV-CMC-1003	IP-52	1
2	Fuse for Voltmeter	TBD BY THE SUPPLIER	3
3	Voltmeter	0-400V	3
4	Current transformer	75 A/ 1A	3
5	Ammeter	0-75 A	3
6	MPCB with remote reset	75 A	1
7	4-wire RTD	PT100 Class A	1
8	Contactor	30 kW/65 A	1
9	2 - Position Key Lockable Selector Switch (REMOTE/LOCAL) for cubicle	IEC	1
10	Pushbuttons (START, STOP) for cubicle	IEC	2
11	Indicating lamps Motor Control Status REMOTE, LOCAL, RUNNING, STOPPED, PSS; Breaker Status– OPEN, CLOSED, TRIPPED for cubicle	IEC	8
12	24 VDC Power Supply	TBD BY THE SUPPLIER	TBD BY THE SUPPLIER
13	Control Transformer	TBD BY THE SUPPLIER	TBD BY THE SUPPLIER
14	Wiring	IEC	LOT
15	Accessories (TB, Labels, wire runs, lugs, auxiliary contacts, etc.)	TBD BY THE SUPPLIER	LOT

16	EMERGENCY STOP Pushbutton	IEC	1
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Cubicle 26PHVV-CMC-1010: 20 kW for VV PHTS Decay Heat Pump (26PHVV-PL-1901)			
Class III, 400V (SIC)			
No.	Item	Rating	Quantity
1	Cubicle 26PHVV-CMC-1010	IP-52	1
2	Fuse for Voltmeter	TBD BY THE SUPPLIER	3
3	Voltmeter	0-400V	3
4	Current transformer	75 A/ 1A	3
5	Ammeter	0-75 A	3
6	MPCB with remote reset	75 A	1
7	4-wire RTD	PT100 Class A	1
8	Contactor	30 kW/65 A	1
9	2 - Position Key Lockable Selector Switch (REMOTE/LOCAL) for cubicle	IEC	1
10	Pushbuttons (START, STOP) for cubicle	IEC	2
11	Indicating lamps Motor Control Status REMOTE, LOCAL, RUNNING, STOPPED, PSS; Breaker Status– OPEN, CLOSED, TRIPPED for cubicle	IEC	8
12	24 VDC Power Supply	TBD BY THE SUPPLIER	TBD BY THE SUPPLIER
13	Control Transformer	TBD BY THE SUPPLIER	TBD BY THE SUPPLIER
14	Wiring	IEC	LOT
15	Accessories (TB, Labels, wire runs, lugs, auxiliary contacts, etc.)	TBD BY THE SUPPLIER	LOT
16	EMERGENCY STOP Pushbutton	IEC	1

Cubicle 26DR00-CMC-1009; 11 kW for Vacuum Pump (26DR00-PV-0001)			
Class III, 400V (SIC)			
No.	Item	Rating	Quantity
1	Cubicle 26DR00-CMC-1009	IP-52	1
2	Fuse for Voltmeter Switch	TBD BY THE SUPPLIER	3
3	Voltmeter	0-400V	3
4	Current transformer	30 A/1 A	3
5	Ammeter	0-30 A	3
6	MPCB with remote reset	30 A	1
7	4-wire RTD	PT100 Class A	1
8	Contactor	15kW/32A	1
9	2 - Position Key Lockable Selector Switch (REMOTE/LOCAL) for cubicle	IEC	1

10	Pushbuttons (START, STOP) for cubicle	IEC	2
11	Indicating lamps Motor Control Status REMOTE, LOCAL, RUNNING, STOPPED, PSS; Breaker Status– OPEN, CLOSED, TRIPPED for cubicle	IEC	8
12	24 VDC Power Supply	TBD BY THE SUPPLIER	TBD BY THE SUPPLIER
13	Control Transformer	TBD BY THE SUPPLIER	TBD BY THE SUPPLIER
14	Wiring	IEC	LOT
15	Accessories (TB, Labels, wire runs, lugs, auxiliary contacts, etc.)	TBD BY THE SUPPLIER	LOT
16	EMERGENCY STOP Pushbutton	IEC	1

15.2 SIC LOCAL CONTROL PANELS

Local Control Panel for Cubicle 26DR00-CMC-1009 Vacuum Pump (26DR00-PV-0001)			
Class III, 400V (SIC)			
No.	Item	Rating	Quantity
1	Local Control Panel Enclosure	IP68	1
2	Indicating lamps Motor Control Status REMOTE, LOCAL, RUNNING, STOPPED, PSS; Breaker Status: OPEN, CLOSED, TRIPPED	IEC	8
3	2 - Position Key Lockable Selector Switch (REMOTE/LOCAL)	IEC	1
4	Pushbuttons (START, STOP)	IEC	2
5	Wiring	IEC	LOT
6	Accessories (TB, Labels, wire runs, lugs, auxiliary contacts, etc.)	TBD BY THE SUPPLIER	LOT

Local Control Panel for Cubicle 26PHVV-CMC-1010 for VV PHTS Decay Heat Pump (26PHVV-PL-1901)			
Class III, 400V (SIC)			
No.	Item	Rating	Quantity
1	Local Control Panel Enclosure	IP68	1
2	Indicating lamps Motor Control Status REMOTE, LOCAL, RUNNING, STOPPED, PSS; Breaker Status: OPEN, CLOSED, TRIPPED	IEC	8
3	2 - Position Key Lockable Selector Switch (REMOTE/LOCAL) for LCP	IEC	1
4	Pushbuttons (START, STOP) for LCP	IEC	2

5	Wiring	IEC	LOT
6	Accessories (TB, Labels, wire runs, lugs, auxiliary contacts, etc.)	TBD BY THE SUPPLIER	LOT

Local Control Panel for Cubicle 26PHVV-CMC-1003 for VV PHTS Volume Control Pump 2 (26PHVV-PL-5002)			
Class III, 400V (SIC)			
No.	Item	Rating	Quantity
1	Local Control Panel Enclosure	IP68	1
2	Indicating lamps Motor Control Status REMOTE, LOCAL, RUNNING, STOPPED, PSS; Breaker Status: OPEN, CLOSED, TRIPPED	IEC	8
3	2 - Position Key Lockable Selector Switch (REMOTE/LOCAL) for LCP	IEC	1
4	Pushbuttons (START, STOP) for LCP	IEC	2
5	Wiring	IEC	LOT
6	Accessories (TB, Labels, wire runs, lugs, auxiliary contacts, etc.)	TBD BY THE SUPPLIER	LOT

15.3 UPS ELECTRICAL CUBICLES

UPS Cubicle 260000-BD-9037 12kW			
Primary Feed Class III-IP 400V & Secondary Feed Class IV 400V			
No.	Item	Rating	Quantity
1	UPS Cubicle 260000-BD-9037	IP-52	1
2	Main MCCB with TMD with remote reset	30 A	2
3	MCCB with RCD with remote reset	30 A	1
4	MCCB with TMD (internal to UPS) with remote reset	Bidder to decide	1
5	MCCB for Battery with remote reset	Bidder to decide	1
6	Indicating lamps Main Breaker Status: OPEN, CLOSED, TRIPPED	IEC	6
7	Distribution two Pole MCB with remote reset	15 A	6
8	4-wire RTD	PT100 Class A	1
9	Current Transformers, Voltmeter, Ammeter & Frequency meter	AS per UPS SLD	LOT
10	Ni-Cd Battery with Accessories for 3 Mins back-up	Bidder to decide	1
11	Wiring	IEC	LOT
12	Accessories (TB, relays, sensors, labels, wire runs, lugs, auxiliary contacts, etc.)	TBD BY THE SUPPLIER	LOT

UPS Cubicle 260000-BD-9500 18 kW			
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Primary Class III-IP 400V & Secondary Class IV 400V			
No.	Item	Rating	Quantity
1	UPS Cubicle 260000-BD-9500	IP-52	1
2	Main MCCB with TMD with remote reset	50 A	2
3	MCCB with RCD with remote reset	50 A	1
4	MCCB with TMD (internal to UPS)	Bidder to decide	1
5	MCCB for Battery with remote reset	Bidder to decide	1
6	Indicating lamps Main Breaker Status: OPEN, CLOSED, TRIPPED	IEC	6
7	Distribution two Pole MCB with remote reset	15 A	9
8	4-wire RTD	PT100 Class A	1
9	Current Transformers, Voltmeter, Ammeter & Frequency meter	AS per UPS SLD	LOT
10	Ni-Cd Battery with Accessories for 3 Mins back-up	Bidder to decide	1
11	Wiring	IEC	LOT
12	Accessories (TB, relays, sensors, labels, wire runs, lugs, auxiliary contacts, etc.)	TBD BY THE SUPPLIER	LOT

UPS Cubicle 260000-BD-0053 14 kW			
Primary Class III-IP 400V & Secondary Class IV 400V			
No.	Item	Rating	Quantity
1	UPS Cubicle 260000-BD-0053	IP-52	1
2	Main MCCB with TMD with remote reset	30 A	2
3	MCCB with RCD with remote reset	30 A	1
4	MCCB with TMD (internal to UPS)	Bidder to decide	1
5	MCCB for Battery with remote reset	Bidder to decide	1
6	Indicating lamps Main Breaker Status: OPEN, CLOSED, TRIPPED	IEC	6
7	Distribution two Pole MCB with remote reset	15 A	7
8	4-wire RTD	PT100 Class A	1
9	Current Transformers, Voltmeter, Ammeter & Frequency meter	As per UPS SLD	LOT
10	Ni-Cd Battery with Accessories for 3 Mins back-up	Bidder to decide	1
11	Wiring	IEC	LOT
12	Accessories (TB, relays, sensors, labels, wire runs, lugs, auxiliary contacts, etc.)	TBD BY THE SUPPLIER	LOT

UPS Cubicle 260000-BD-0030 32 kW			
Primary Class III-IP 400V & Secondary Class IV 400V			
No.	Item	Rating	Quantity
1	UPS Cubicle 260000-BD-0030	IP-52	1
2	Main MCCB with TMD with remote reset	70 A	2
3	MCCB with RCD with remote reset	70 A	1

4	MCCB with TMD (internal to UPS) with remote reset	Bidder to decide	1
5	MCCB for Battery with remote reset	Bidder to decide	1
6	Indicating lamps Main Breaker Status: OPEN, CLOSED, TRIPPED	IEC	6
7	Distribution two Pole MCB with remote reset	15 A	16
8	4-wire RTD	PT100 Class A	1
9	Current Transformers, Voltmeter, Ammeter & Frequency meter	AS per UPS SLD	LOT
10	Ni-Cd Battery with Accessories for 3 Mins back-up	Bidder to decide	1
11	Wiring	IEC	LOT
12	Accessories (TB, relays, sensors, labels, wire runs, lugs, auxiliary contacts, etc.)	TBD BY THE SUPPLIER	LOT

UPS Cubicle 260000-BD-0016 16 kW			
Primary Class III-IP 400V & Secondary Class IV 400V			
No.	Item	Rating	Quantity
1	UPS Cubicle 260000-BD-0016	IP-52	1
2	Main MCCB with TMD with remote reset	50 A	2
3	MCCB with RCD with remote reset	50 A	1
4	MCCB with TMD (internal to UPS) with remote reset	Bidder to decide	1
5	MCCB for Battery with remote reset	Bidder to decide	1
6	Indicating lamps Main Breaker Status: OPEN, CLOSED, TRIPPED	IEC	6
7	Distribution two Pole MCB with remote reset	15 A	8
8	4-wire RTD	PT100 Class A	1
9	Current Transformers, Voltmeter, Ammeter & Frequency meter	AS per UPS SLD	LOT
10	Ni-Cd Battery with Accessories for 3 Mins back-up	Bidder to decide	1
11	Wiring	IEC	LOT
12	Accessories (TB, relays, sensors, labels, wire runs, lugs, auxiliary contacts, etc.)	TBD BY THE SUPPLIER	LOT

UPS Cubicle 260000-BD-1004 8 kW			
Primary Class III-IP 400V & Secondary Class IV 400V			
No.	Item	Rating	Quantity
1	UPS Cubicle 260000-BD-1004	IP-52	1
2	Main MCCB with TMD with remote reset	20 A	2
3	MCCB with RCD with remote reset	20 A	1
4	MCCB with TMD (internal to UPS) with remote reset	Bidder to decide	1
5	MCCB for Battery with remote reset	Bidder to decide	1

6	Indicating lamps Main Breaker Status: OPEN, CLOSED, TRIPPED	IEC	6
7	Distribution two Pole MCB with remote reset	15 A	4
8	4-wire RTD	PT100 Class A	1
9	Current Transformers, Voltmeter, Ammeter & Frequency meter	AS per UPS SLD	LOT
10	Ni-Cd Battery with Accessories for 3 Mins back-up	Bidder to decide	1
11	Wiring	IEC	LOT
12	Accessories (TB, relays, sensors, labels, wire runs, lugs, auxiliary contacts, etc.)	TBD BY THE SUPPLIER	LOT

UPS Cubicle 260000-BD-0056 34 kW			
Primary Class III-IP 400V & Secondary Class IV 400V			
No.	Item	Rating	Quantity
1	UPS Cubicle 260000-BD-0056	IP-52	1
2	Main MCCB with TMD with remote reset	70 A	2
3	MCCB with RCD with remote reset	70 A	1
4	MCCB with TMD (internal to UPS) with remote reset	Bidder to decide	1
5	MCCB for Battery with remote reset	Bidder to decide	1
6	Indicating lamps Main Breaker Status: OPEN, CLOSED, TRIPPED	IEC	6
7	Distribution two Pole MCB with remote reset	15 A	17
8	4-wire RTD	PT100 Class A	1
9	Current Transformers, Voltmeter, Ammeter & Frequency meter	AS per UPS SLD	LOT
10	Ni-Cd Battery with Accessories for 3 Mins back-up	Bidder to decide	1
11	Wiring	IEC	LOT
12	Accessories (TB, relays, sensors, labels, wire runs, lugs, auxiliary contacts, etc.)	TBD BY THE SUPPLIER	LOT

Note: The above indicated BOM for UPS cubicles is indicative. However, complete BOM shall be considered as per ITER_260000_SLD_001 (3SAAU5) Single Line Diagram (SLD) for UPS cubicles. Also, Bidder shall indicate items which are required for continuous operation of UPS for ITER approval.

Appendix A HILTI Anchor System Type HST3



HST3 Metal
expansion anchor.p

Appendix B Example of Platform Mounting



Typical Cubicle
Installation Detail on

Appendix C Graphs

FLOOR RESPONSE SPECTRA FOR CUBICLES CONNECTION TYPE: “GROUND”

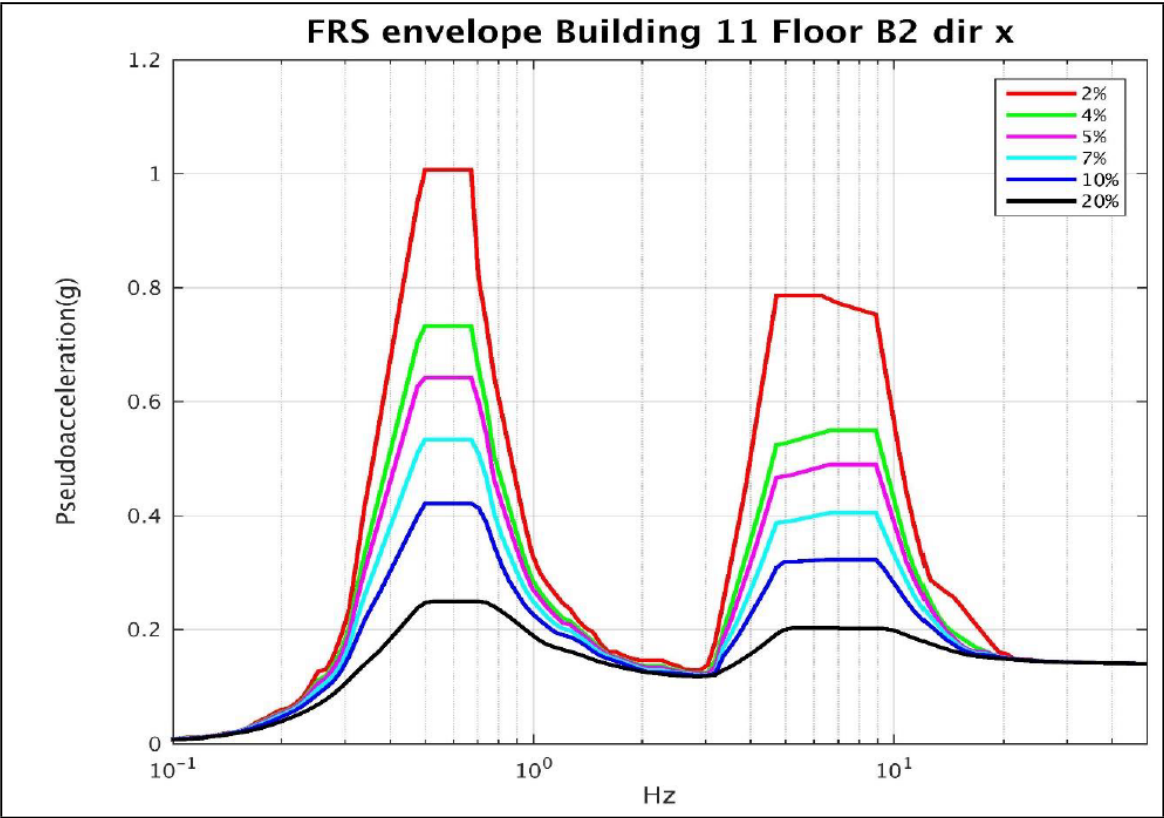


Figure 1: FRS For cubicles located at 11-B2. Acceleration on X and Y direction

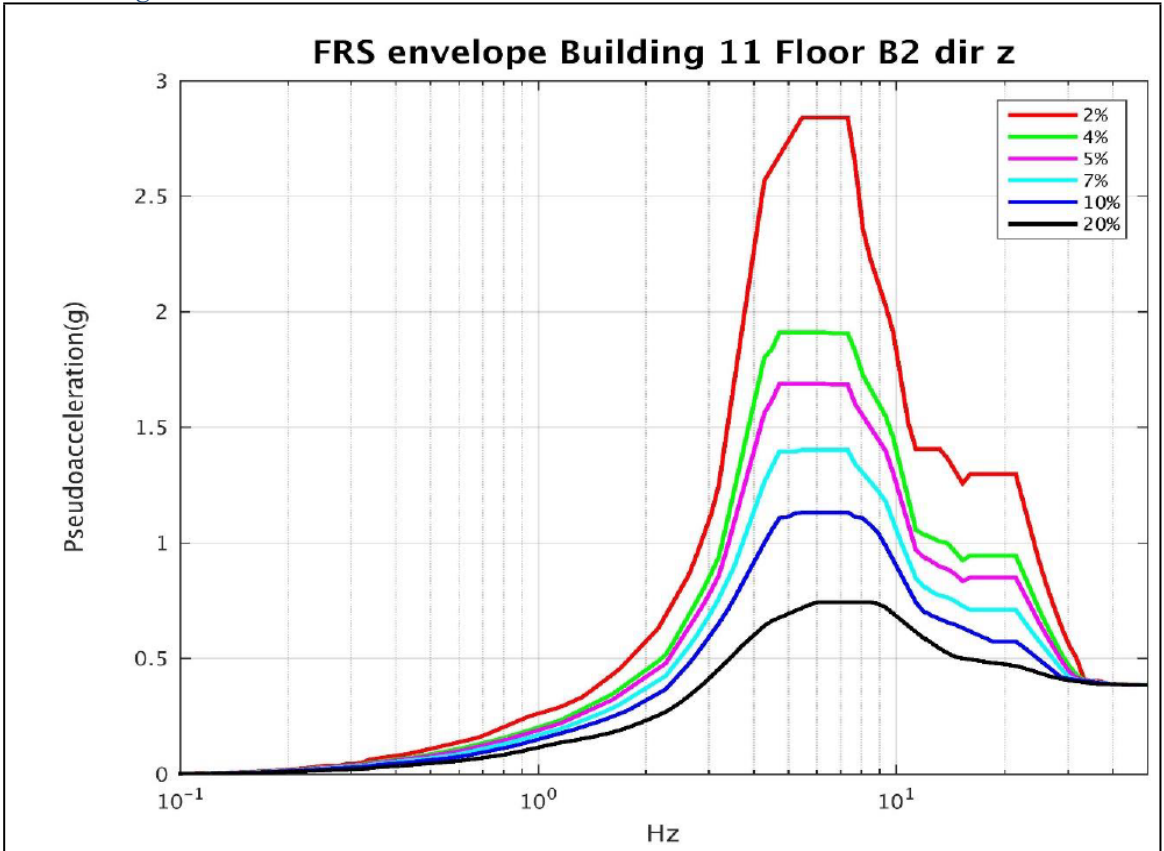


Figure 2: FRS For cubicles located at 11-B2. Acceleration on Z direction

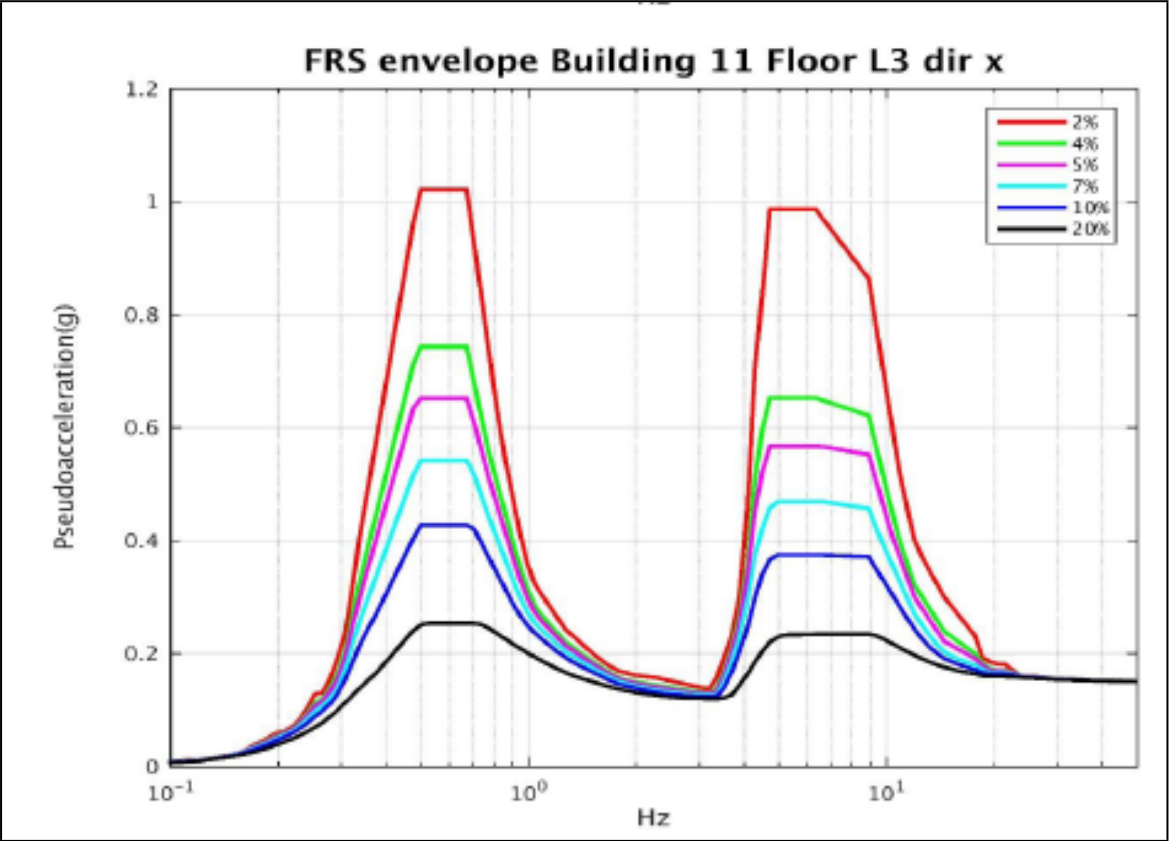


Figure 3: FRS For cubicles located at 11-L3. Acceleration on X and Y direction

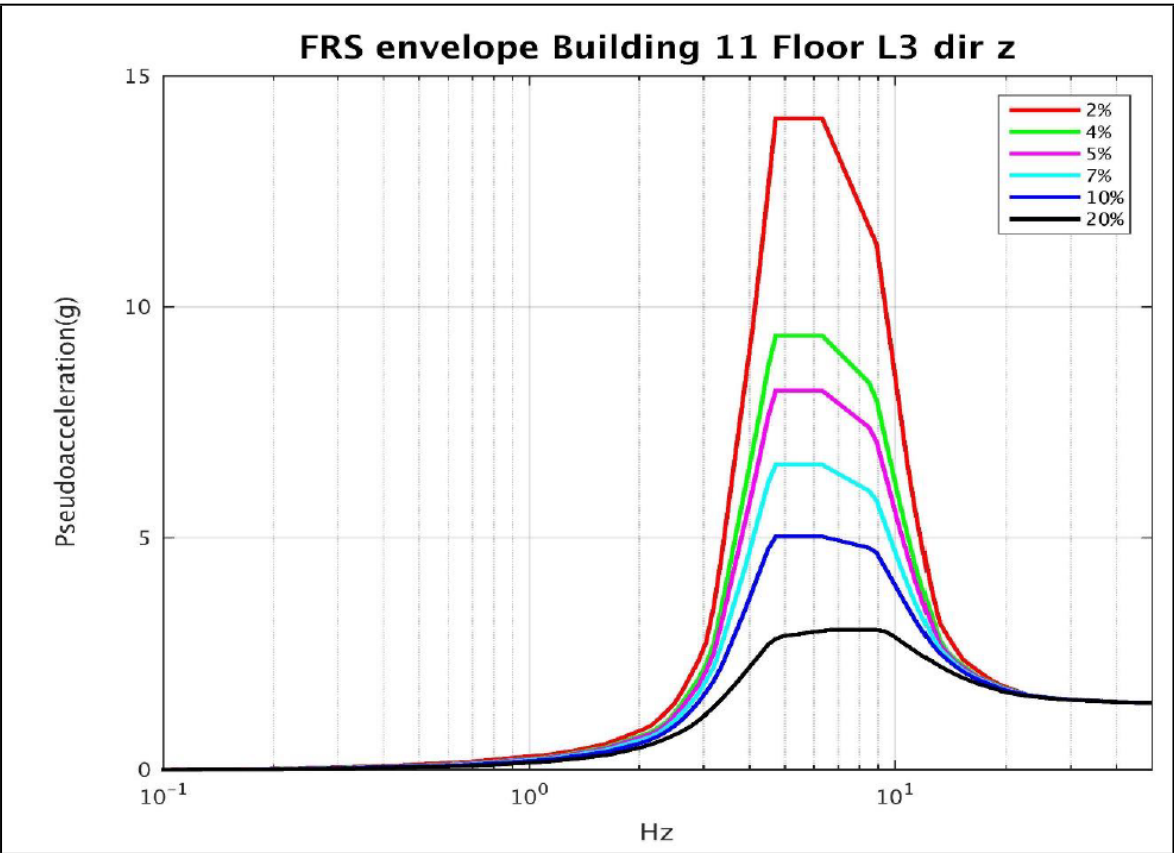


Figure 4: FRS For cubicles located at 11-L3. Acceleration on Z direction

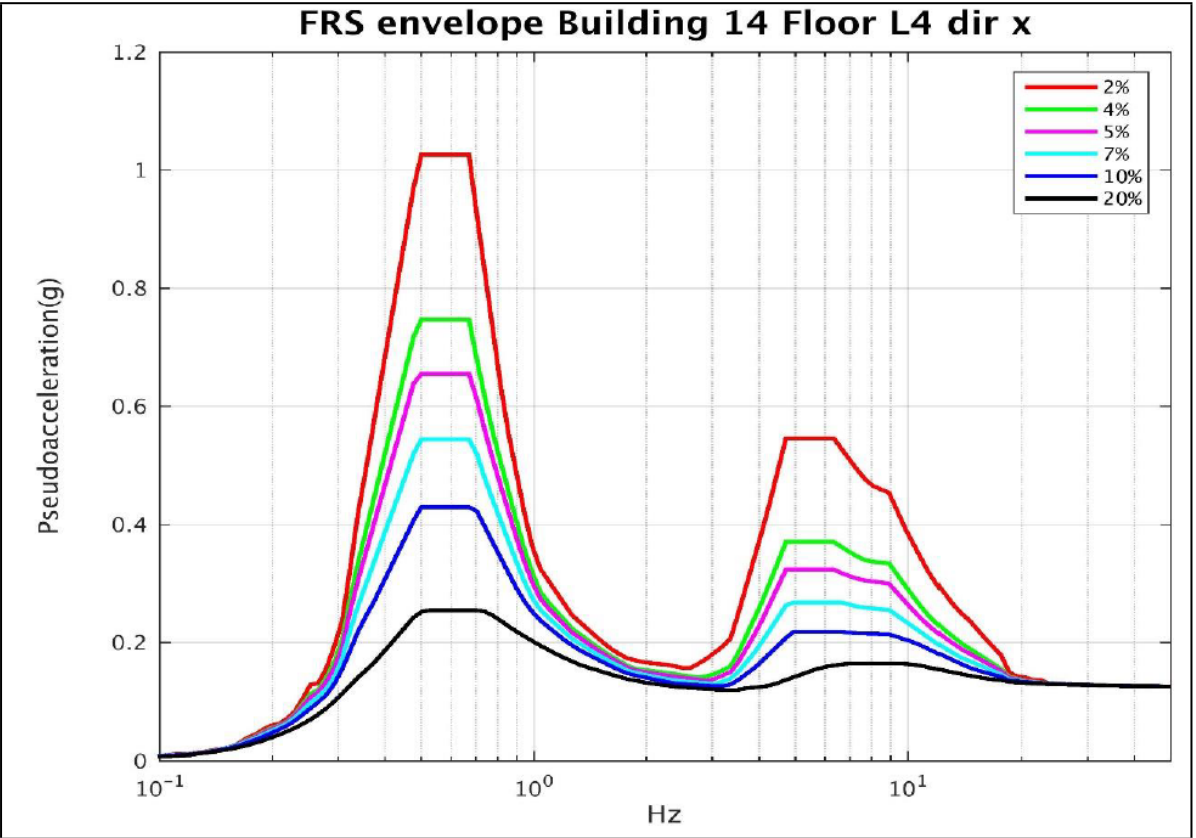


Figure 5: FRS For cubicles located at 14-L4. Acceleration on X and Y direction

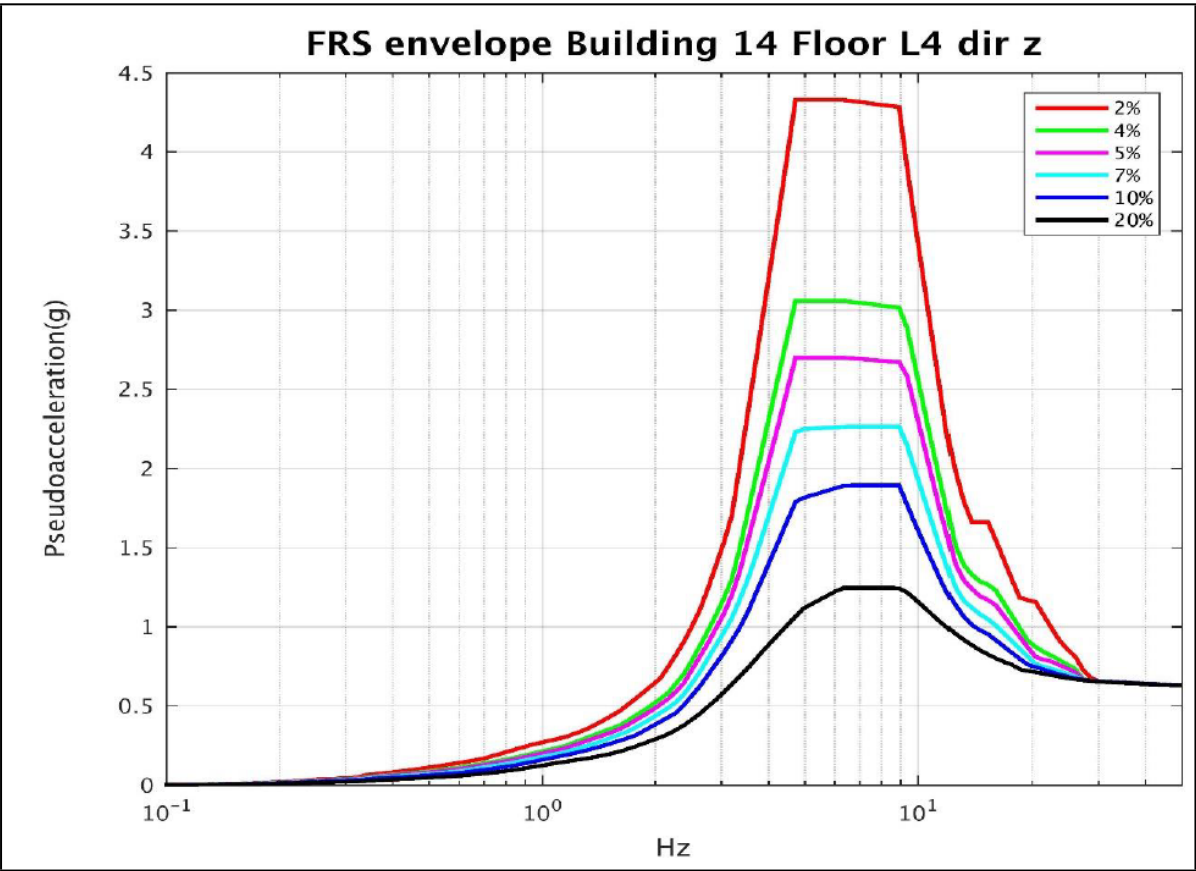


Figure 6: FRS For cubicles located at 14-L4. Acceleration on Z direction

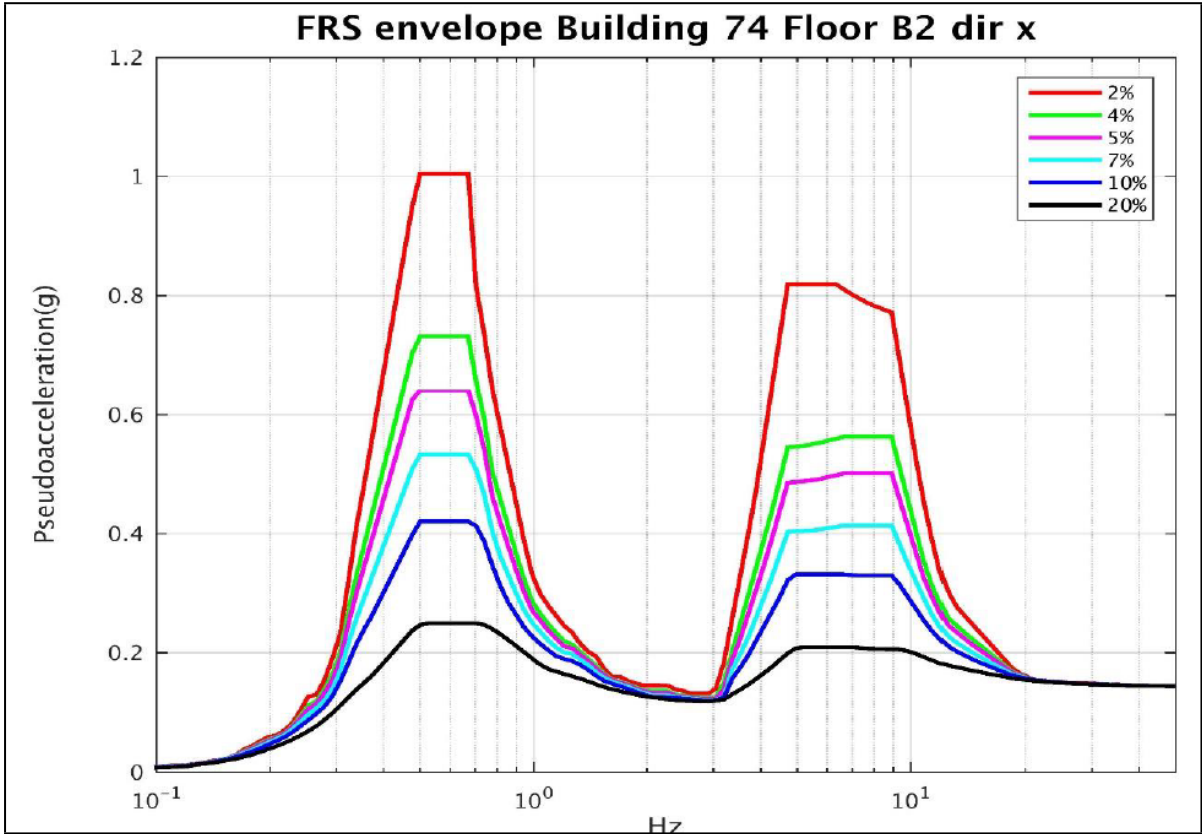


Figure 7: FRS For cubicles located at 74-B2. Acceleration on X and Y direction

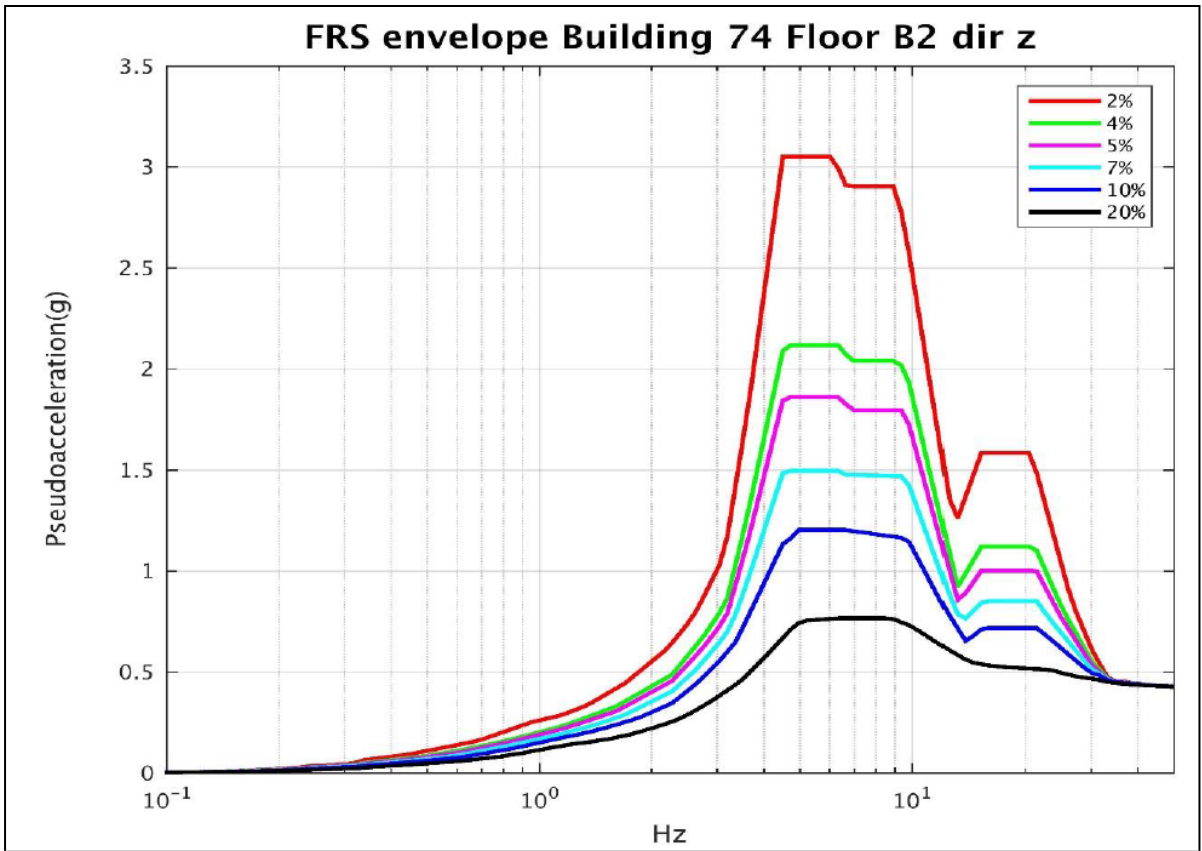


Figure 8: FRS For cubicles located at 74-B2. Acceleration on Z direction

FLOOR RESPONSE SPECTRA FOR CUBICLES CONNECTION TYPE: “PLATFORM”

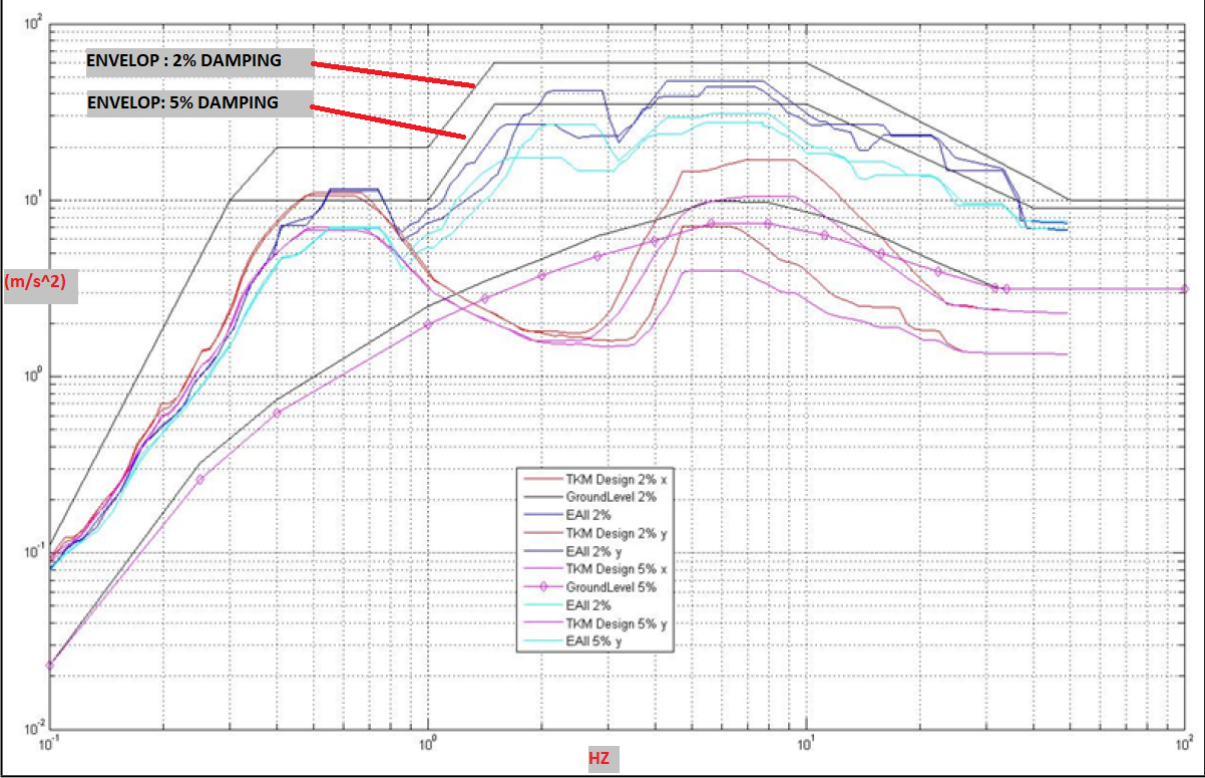


Figure 9: Pseudo FRS for cubicles installed on platform. Acceleration on X and Y direction

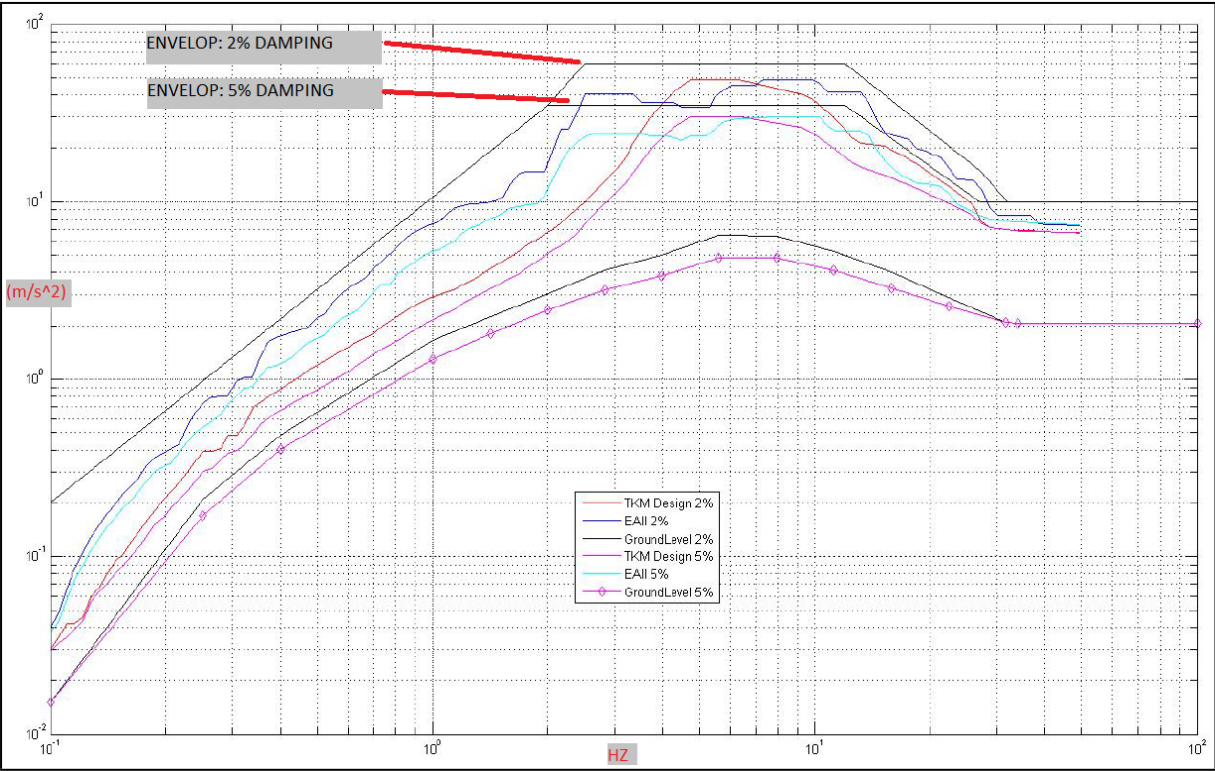


Figure 10: Pseudo FRS for cubicles installed on platform. Acceleration on Z direction

Appendix D List of I & C Cubicles for each UPS

Scope	Cubicle tag (PBS26)	Cubicle Location	Cubicle Description	First Plasma OR Second Plasma	UPS Cubicle Tag
26DR00	260000-CU-0008	11-B2-02NE	26TCWS, NON-SIC, SCC (USDA)	First Plasma	260000- BD-9037
26DR00	260000-CU-0009	11-B2-02NE	26TCWS, NON-SIC, SCC (USDA)	First Plasma	
26DY00	260000-CU-0010	11-B2-02NE	26TCWS, NON-SIC, SCC (USDA)	First Plasma	
26PHVV	260000-CU-0061	11-B2-02SE	26TCWS, NON-SIC, SCC (USDA)	First Plasma	
26PHBD	260000-CU-9002	11-B2-02NE	26TCWS, NON-SIC, SCC (USDA)	First Plasma	
26DR00	260000-CU-9003	11-B2-02NE	26TCWS, NON-SIC, SCC (USDA)	First Plasma	
26DR00	260000-CU-0081	14-L3-11	26TCWS, NON-SIC, SCC (USDA)	First Plasma	260000- BD-9500
26PHBD	260000-CU-0082	14-L3-11	26TCWS, NON-SIC, SCC (USDA)	First Plasma	
26SA00	26SA00-CU-9501	14-L3-23	26TCWS, NON-SIC, SCC (USDA)	Second Plasma	
26SA00	26SA00-CU-9502	14-L3-23	26TCWS, NON-SIC, SCC (USDA)	Second Plasma	
26SA00	26SA00-CU-9503	14-L3-23	26TCWS, NON-SIC, SCC (USDA)	Second Plasma	
26SA00	26SA00-CU-9504	14-L3-23	26TCWS, NON-SIC, SCC (USDA)	Second Plasma	
26SA00	26SA00-CU-9505	14-L3-23	26TCWS, NON-SIC, SCC (USDA)	Second Plasma	
26SA00	26SA00-CU-9506	14-L3-23	26TCWS, NON-SIC, SCC (USDA)	Second Plasma	
26SA00	26SA00-CU-9507	14-L3-23	26TCWS, NON-SIC, SCC (USDA)	Second Plasma	
26PHBD	260000-CU-0042	14-L4-04	26TCWS, NON-SIC, SCC (USDA)	First Plasma	260000- BD-0053
26CVNB	260000-CU-0043	14-L4-04	26TCWS, NON-SIC, SCC (USDA)	Second Plasma	
26CVBD	260000-CU-0044	14-L4-04	26TCWS, NON-SIC, SCC (USDA)	Second Plasma	
26CVBD	260000-CU-0045	14-L4-04	26TCWS, NON-SIC, SCC (USDA)	Second Plasma	
26CVBD	260000-CU-0046	14-L4-04	26TCWS, NON-SIC, SCC (USDA)	Second Plasma	
26DY00	260000-CU-0047	14-L4-04	26TCWS, NON-SIC, SCC (USDA)	First Plasma	
26PHNB	260000-CU-0115	14-L4-04	26TCWS, NON-SIC, SCC (USDA)	Second Plasma	
26PHBD	260000-CU-0025	11-L4-01N	26TCWS, NON-SIC, SCC (USDA)	First Plasma	260000- BD-0030
26PHBD	260000-CU-0026	11-L4-01N	26TCWS, NON-SIC, SCC (USDA)	First Plasma	
26PHBD	260000-CU-0027	11-L4-01N	26TCWS, NON-SIC, SCC (USDA)	First Plasma	
26CVNB	260000-CU-0028	11-L4-01N	26TCWS, NON-SIC, SCC (USDA)	Second Plasma	
26CVNB	260000-CU-0029	11-L4-01N	26TCWS, NON-SIC, SCC (USDA)	Second Plasma	
26PHNB	260000-CU-0031	11-L4-01N	26TCWS, NON-SIC, SCC (USDA)	Second Plasma	
26PHBD	260000-CU-0071	11-L4-01N	26TCWS, NON-SIC, SCC (USDA)	First Plasma	
26PHBD	260000-CU-0072	11-L4-01N	26TCWS, NON-SIC, SCC (USDA)	First Plasma	
26PHNB	260000-CU-0083	11-L4-01N	26TCWS, NON-SIC, SCC (USDA)	Second Plasma	
26PHVV	260000-CU-0085	11-L4-01N	26TCWS, NON-SIC, SCC (USDA)	First Plasma	
26DY00	260000-CU-0087	11-L4-01N	26TCWS, NON-SIC, SCC (USDA)	First Plasma	260000-

26DY00	260000-CU-0088	11-L4-01N	26TCWS, NON-SIC, SCC (USDA)	First Plasma	BD-0030
26DR00	260000-CU-0094	11-L4-01N	26TCWS, NON-SIC, SCC (USDA)	First Plasma	
26DY00	260000-CU-0095	11-L4-01N	26TCWS, NON-SIC, SCC (USDA)	First Plasma	
26DY00	260000-CU-0096	11-L4-01N	26TCWS, NON-SIC, SCC (USDA)	First Plasma	
26PHVV	260000-CU-0097	11-L4-01N	26TCWS, NON-SIC, SCC (USDA)	First Plasma	
26DR00	260000-CU-0004	11-B2-02NW	26TCWS, NON-SIC, SCC (USDA)	First Plasma	260000-BD-0016
26PHVV	260000-CU-0011	11-B2-02NW	26TCWS, NON-SIC, SCC (USDA)	First Plasma	
26DR00	260000-CU-0012	11-B2-02NW	26TCWS, NON-SIC, SCC (USDA)	First Plasma	
26PHVV	260000-CU-0048	11-B2-02NW	26TCWS, NON-SIC, SCC (USDA)	First Plasma	
26PHVV	260000-CU-0049	11-B2-02NW	26TCWS, NON-SIC, SCC (USDA)	First Plasma	
26PHVV	260000-CU-0066	11-B2-02NW	26TCWS, NON-SIC, SCC (USDA)	First Plasma	
26PHVV	260000-CU-0067	11-B2-02NW	26TCWS, NON-SIC, SCC (USDA)	First Plasma	
26DR00	260000-CU-9004	11-B2-02NW	26TCWS, NON-SIC, SCC (USDA)	First Plasma	
26PHBD	260000-CU-0002	74-B2-03	26TCWS, NON-SIC, SCC (USDA)	First Plasma	260000-BD-1004
26DY00	26DY00-CU-1002	74-B2-03	26DY00 LCC Cubicle (USDA)	First Plasma	
26PHBD	26PHBD-CU-1003	74-B2-03	26PHBD LCC Cubicle (USDA)	Second Plasma	
26PHVV	26PHVV-CU-1001	74-B2-03	26PHVV and 26DR00 LCC Cubicle (USDA)	First Plasma	
26PHBD	260000-CU-0013	11-L3-02NE	26TCWS, NON-SIC, SCC (USDA)	First Plasma	260000-BD-0056
26PHBD	260000-CU-0014	11-L3-02NE	26TCWS, NON-SIC, SCC (USDA)	First Plasma	
26DY00	260000-CU-0015	11-L3-02NE	26TCWS, NON-SIC, SCC (USDA)	First Plasma	
26PHVV	260000-CU-0016	11-L3-02NE	26TCWS, NON-SIC, SCC (USDA)	First Plasma	
26PHVV	260000-CU-0017	11-L3-02NE	26TCWS, NON-SIC, SCC (USDA)	First Plasma	
26DY00	260000-CU-0018	11-L3-02NE	26TCWS, NON-SIC, SCC (USDA)	First Plasma	
26PHVV	260000-CU-0019	11-L3-02NE	26TCWS, NON-SIC, SCC (USDA)	First Plasma	
26PHBD	260000-CU-0020	11-L3-02NE	26TCWS, NON-SIC, SCC (USDA)	First Plasma	
26PHBD	260000-CU-0050	11-L3-02NE	26TCWS, NON-SIC, SCC (USDA)	First Plasma	
26PHBD	260000-CU-0101	11-L3-02NE	26TCWS, NON-SIC, SCC (USDA)	First Plasma	
26PHBD	260000-CU-0102	11-L3-02NE	26TCWS, NON-SIC, SCC (USDA)	First Plasma	
26PHBD	260000-CU-0103	11-L3-02NE	26TCWS, NON-SIC, SCC (USDA)	First Plasma	
26PHBD	260000-CU-0120	11-L3-02NE	26TCWS, NON-SIC, SCC (USDA)	First Plasma	
26PHBD	260000-CU-9052	11-L3-02NE	26TCWS, NON-SIC, SCC (USDA)	First Plasma	
26PHBD	260000-CU-9053	11-L3-02NE	26TCWS, NON-SIC, SCC (USDA)	First Plasma	
26PHBD	260000-CU-9054	11-L3-02NE	26TCWS, NON-SIC, SCC (USDA)	First Plasma	
26PHBD	260000-CU-9060	11-L3-02NE	26TCWS, NON-SIC, SCC (USDA)	First Plasma	

Appendix E LV Cubicles Dimensions

No	Cubicle	Scope	Level	Size	Remarks
1	26PHVV-CMC-1010	TCWS	B2	2200mm x 2190mm x 800mm	No plinth
2	26DR00-CMC-1013	TCWS	B1	2260mm x 1800mm x 650mm	No plinth
3	26DR00-CMC-1009	TCWS	L5	2260mm x 1800mm x 650mm	No plinth
4	26PHVV-CMC-1003	TCWS	L5	2260mm x 1800mm x 650mm	No plinth
5	26DY00-CMC-1005	TCWS	R1	2260mm x 6600mm x 650mm	No plinth
6	26PHVV-CMC-1001	TCWS	R1	2260mm x 1800mm x 650mm	No plinth
7	26PHVV-CMC-1006	TCWS	R1	2260mm x 1800mm x 650mm	No plinth
8	260000-BD-9037	TCWS	B2	2340mm x 610mm x 510 mm	
9	260000-BD-9500	TCWS	L3	2200mm x 800mm x 800mm	
10	260000-BD-0053	TCWS	L4	2200mm x 800mm x 800mm	
11	260000-BD-0030	TCWS	L4	2200mm x 800mm x 800mm	
12	260000-BD-0016	TCWS	B2	2200mm x 800mm x 800mm	
13	260000-BD-1004	TCWS	B2	2200mm x 800mm x 800mm	
14	260000-BD-0056	TCWS	L3	2200mm x 800mm x 800mm	