Base Load Power Hub (BLPH)

HARDWARE FACTORY ACCEPTANCE TEST (FAT) PROCEDURE

Document Number: 1724000594-QC-PRO-00030

Supplier Document Number: E366772C00-HW_FAT

Document Class: 2

02	04/02/2025	Accepted for Construction (AFC)	AG	AB	SC
01	11/09/2024	Accepted for Construction (AFC)	MP	KS/AB	SC
00	26/06/2024	Issue for Review (IFR)	MP	KS/AB	SC
Rev.	Date	Description	Prepared	Reviewed	Approved

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Revision / Change Log

Rev.	Description
00	Issue for Review (IFR)
01	Accepted for Construction (AFC)
02	Accepted for Construction (AFC)

HOLDS LIST

No.	Description

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1 Introduction

1.1 General

The purpose of this document is to define the methods and documentation that will be used to carry out the Factory Acceptance Test (FAT) on YOKOGAWA's PCS, SIS , FGS and SCADA. The FAT is performed to ensure that the system is properly configured, assembled and functional in accordance with the intended design as specified in the approved documents.

The objective of FAT is to demonstrate to CROSSWIND that the system hardware and software is built in accordance to requirements as specified in the approved documents.

Crosswind and Rosetti Marino would witness to verify the test. Upon successful completion of the test, a FAT Test Certificate and Shipping Release Notice would be signed by both YOKOGAWA as MAC and Crosswind /Rosetti Marino to signify the acceptance of the test and approval of shipment of the equipment.

1.2 Scope and Objective

The Factory Acceptance Test referred to as FAT applies to the PCS, SIS , FGS and SCADA Hardware and Software supplied by Yokogawa.

The objective of the FAT is to verify the conformance of the system against the approved specifications and FAT procedure before delivery to site. The FAT shall be conducted to test and verify the main items listed below:

- System Hardware
- Network and Communication Tests
- Cabinets (system, network, server)
- Other Hardware (KVM, etc..)

2 Reference Documents

2.1 Input Documents

The PCS, SIS and F&G systems are configured using input documents such as IO Database, P&IDs, Cause & Effect Diagrams, F&G Layouts, Process Control Narratives, etc. These input documents shall be used as reference documents for FAT. These documents are listed in Appendix 8.3 – Approved Document List.

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2.2 Codes, Standards and References

[1] IEC 60529: Specification for Degrees of protection provided by enclosures (IP Code)

[2] IEC 61000: Electromagnetic Compatibility of Industrial - Process Measurement and Control Equipment

[3] IEEE 802.3: Information Processing Systems – Local Area Networks

[4] IEC 61508 Functional Safety of Electrical/Electronic/Programmable Electronic Safety – Related Systems

[5] IEC 61511 Functional Safety- Safety instrumented systems for the process industry sector

2.5 Approved Document List (Detail Design Specification)

The Detail Design Specification used for construction shall be listed in this approved document list, and shall be used as reference in the FAT. In principle, the Detail Design Specification documents as included in this list shall form the basis for checking the PCS, SIS, FGS and SCADA system. The approved Detail Design Specification document list used for construction is listed in Appendix-3.

Hold-1: Appendix-8.3 To be provided during the project execution phase.

3 Definitions and Abbreviations

PROJECT:	HOLLANDSE KUST NOORD WIND PARK PROJECT
CONTRACTOR (CTR):	ROSETTI MARINO S.p.A.
COMPANY or Client (CPY):	CROSSWIND
VENDOR	YOKOGAWA ITALIA S.R.L.

Doc. No.	Description
ALARP	As Low as Reasonably Praticable
AMS	Alarm Management System
ATEX	Appareils destinés à être utilisés en ATmosphères Explosibles (Equipment intended for use in explosive atmospheres)
BESS	Battery Energy Storage System
BLPH	Base Load Power Hub
CAP	Critical Action Panel
CAPEX	Capital Expenditure

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CAT	Category
CCN	Central Control Network
CCR	Central Control Room
CCS	Central Control System
CCTV	Closed Circuit Television
COMPANY	Crosswind
CONTRACTOR (CTR)	ROSETTI MARINO S.p.A.
CTV	Crew Transfer Vessel
DEM	Design Engineering Manual
DEP	Design and Engineering Practice
DMZ	Demilitarised-Zone
DOCUMENT NAME	Document Title
ELM	Earth Leakage Monitor
EMC	Electromagnetic Compatibility
EMCS	Electrical Monitoring & Control System
EN	Engineering Notice
EPC	Engineering Procurement Construction
EPIRB	Emergency Position Indicating Radio Beacon
EWS	Engineering Workstation
Ex	Explosion Proof
FC	Fuel Cell
FCS	Field Control Station
FEED	Front End Engineering Design
FEED CONTRACTOR	Organisation contracted directly by COMPANY to provide engineering, design, or other services.
FGS	Fire & Gas System
FIO	Field Input/Output
FNU	Field Node Unit
FO	Fibre Optic
FOPP	Fibre Optic Patch Panel
GMDSS	Global Maritime Distress and Safety System

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GPS	Global Positional Satellite
HART	Highway Addressable Remote Transducer
HAZOP	Hazardous Operability Study
HKN	Hollandse Kust Noord
HMI	Human Machine Interface
HV	High Voltage
HVAC	Heating, Ventilation and Air Conditioning
HV-SCADA	The given name for the COMPANY's control system fwind farm infrastructure. BLPH's control system shall operate autonomously but will interface with HV-SCADA.
IACS	Industrial Automation and Control Systems
IAMS	Instrument Asset Management System
ICSS	Integrated Control and Safety System
IDCS	Intrusion Detection Control System
IEC	International Electrotechnical Commission
IP	Ingress Protection
IP	Internet Protocol
IS	Intrinsically Safe
ISO	International Organization for Standardization
ITER	Instrument & Telecoms Equipment Room
LACS	Local Access Control System
LAN	Local Area Network
LOPA	Layers of Protection Analysis
LHVS	Land High Voltage Station
LV	Low Voltage
MAC	Main Automation Contractor
MCC	Motor Control Centre
NAMUR	Interessengemeinschaft Automatisierungstechnik der Prozessindustrie (User Association of Automation Technology in Process Industries)
NIS	Non-Intrinsically Safe
NU	Node Unit

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OHVS	Offshore High Voltage Station
OPC	Open Platform Communications
OWS	Operator Workstation
PAGA	Public Address and General Alarm
P&ID	Piping and Instrument Diagram
PACO	Process, Automation, Control and Optimisation (PACO) is the term used to describe all functionality required for the monitoring and controlling of all process, safety and fire and gas systems selected for the project.
PCN	Process Control Network
PROJECT	HOLLANDSE KUST NOORD WIND PARK Project
PV	Photo Voltaic
PURCHASER	The organisation placed a purchase order for the supply of equipment or services for the Project. The Purchaser could be the Company or the Contractor or some other party appointed by the COMPANY or Contractor.
RVO	Rijksdienst voor ondernemend Nederland – The Netherlands Enterprise Agency
SART	Search and Rescue Transponder
SCADA	Supervisory Control and Data Acquisition
SCS	Safety Control System
SGSI	Shell Global Solutions International
SHALL	An absolute requirement.
SHOULD	This word indicates a recommendation that whilst preferred may not be implemented provided some equivalent is proposed and agreed by COMPANY. The full implications must be understood and carefully weighed before choosing a different course.
SIF	Safety Instrumented Function
SIL	Safety Instrumented Level
SIS	Safety Instrumented System
SNU	Safety Node Unit
SOLAS	Safety of Life at Sea
TB	Terminal Board

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TETRA	Terrestrial Trunked Radio
TSO	Transmission System Operator
TQ	Technical Query
UCP	Unit Control Panel
UHF	Ultra-High Frequency
UPS	Uninterruptible Power Supply
VENDOR	Manufacturer/Supplier of equipment and services to perform the duties specified by the Purchaser.
VHF	Very High Frequency
VLAN	Virtual Local Area Network
VNET	Virtual Network
WAN	Wide Area Network
WTG	Wind Turbine Generator

Table 1 – Definitions and Abbreviations

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4 Responsibility

Responsibilities for each party involved in the FAT are defined here-under to ensure that the FAT is carried out in accordance with an agreed procedure. It also ensures that there shall be authorized personnel(s) from CROSSWIND, ROSETTI MARINO and YOKOGAWA to facilitate any decisions and schedule changes resulted from the FAT.

4.1 CROSSWIND

The full participation of CROSSWIND in the FAT is essential. CROSSWIND shall appoint an Inspector cum Test Approver to witness the FAT. The Test Approver would have the authority to sign-off upon the successful completion of all tests. Once signed off, the test will be deemed accepted and the decision will be final. The Inspector shall participate in the test and observe the test results on a daily basis. The Test Approver shall approve the inspection items based on the approved specification and the test results recorded.

4.2 ROSETTI MARINO

ROSETTI MARINO shall appoint a FAT Manager for the FAT. The FAT Manager representing ROSETTI MARINO shall co-ordinate with CROSSWIND and YOKOGAWA FAT Managers and to facilitate the smooth implementation of the FAT activities and schedule. The role of the FAT Manager is also to resolve FAT issues on a regular basis.

ROSETTI MARINO representatives will participate in the FAT for the complex controls, sequences and logics. For PCS controlled equipment packages containing complex controls, sequences and logics, ROSETTI MARINO at their discretion, may invite their package equipment supplier representatives to participate in the testing.

4.3 MAC

YOKOGAWA as MAC shall appoint a Test Conductor to organize and manage all aspects of the FAT. YOKOGAWA shall carry out the testing and record the test results on a daily basis together with CROSSWIND Inspector and ROSETTI MARINO representative.

The Project Manager representing YOKOGAWA shall be the FAT Manager. The FAT Manager shall co-ordinate with ROSETTI MARINO's FAT Manager and shall amend the test schedule whenever necessary to ensure the smooth running of the FAT. The FAT Manager shall also ensure that all tests are conducted in accordance with the approved FAT documents. If changes/modifications are required in the implementation, the FAT Managers of Yokogawa and ROSETTI MARINO shall discuss and arrive at the action plan.

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5 General Administration

5.1 FAT Venue

All the PCS, SIS and FGS equipment's will be staged at YOKOGAWA Sub-contractor Staging area, equipped with all needs for FAT (Tools, Instruments, power supply, grounding connections, etc):

PREI srl

Via Pascoli, 150

22040 Alzate Brianza – COMO (Italy)

5.2 FAT Organization Chart

A specific detailed Organization Chart shall be issued for each project, with all positions and names filled in. In addition, a FAT roster of the participants shall be issued, with following details for each person; full name, company, responsibility, samples of the signature and initials, actual start and finish date of participation in the FAT. The FAT Managers (one from RM and one from Yokogawa) will be responsible for maintaining the roster and keeping it updated.

Refer to Appendix-1 for FAT organization chart and FAT roster.

5.3 Kick-off Meeting

An initial kick-off meeting will be held prior to starting the FAT to brief the participants, confirm the organization and responsibilities, and review the FAT schedule. At the same time, HSE briefing for all participants will be provided by YOKOGAWA. YOKOGAWA FAT Manager will prepare the presentation and explain the organization and work practices. All FAT documentation prepared by YOKOGAWA prior to FAT will be inspected for completeness.

5.4 Daily Working Schedule

The FAT will be conducted in YOKOGAWA premises from Monday to Friday (working days).

The following timing is recommended for the testing:

0915 to 1200 hrs	Inspection and test
1200 to 1300 hrs	Lunch
1300 to 1700 hrs	Inspection and test
1700 to 1730 hrs	Daily review meeting including next day's schedule planning

Table 2 – Daily Working Time

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5.5 Daily Review Meeting

YOKOGAWA FAT Manager shall conduct a daily review meeting at the end of each FAT day. The meeting will involve all the parties taking part in the FAT. The purpose of this review meeting is to update all parties the progress and status of the FAT.

The punch list will be reviewed during the daily meeting and the action to be taken will be discussed and finalized. If the recovery work involved is minor (identified in the daily meeting) and agreed by all parties, the work will be carried out on the same day and will be verified the following day by all the concerned parties and signed off in the punch list. If the recovery work involves major change/modification, The FAT Manager will advise the schedule for retesting.

Refer to section 6.4 for details in punch record.

The FAT Manager should also ensure that PCS Engineers make a backup of the application program to an external storage every day after the daily review meeting, so that old backups can be retrieved, if necessary.

5.6 Weekly Progress Meeting

YOKOGAWA FAT Managers shall conduct weekly progress meeting every Friday. The purpose of the weekly meeting is to report the progress of the FAT in the same week and planned activity the following week. It shall also be the forum for resolving any issue arises from punch list.

In the weekly progress meeting, The FAT Manager will present detailed weekly progress report, containing details of activities and achievements for the week, plan for the next week, area of concern, list of punches raised (solved and open) and detailed formal overall progress assessment. The format and content details of the weekly progress report and the underlining planning, progress monitoring and measurement methodology shall be in accordance with the FAT planning, Progress Monitoring Report. After the joint review in the weekly progress meeting and any necessary amendments, The FAT Manager will issue the weekly progress report.

All FAT roster will be invited to the meeting.

5.7 FAT Wrap-up Meeting

At the completion of the FAT, a final wrap-up meeting will be held. The overall status of the FAT shall be reported. Upon all parties' agreement that the FAT is completed satisfactorily, the FAT Completion Certificate and Shipping Release Notes shall be signed off by CROSSWIND/ROSETTI MARINO.

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5.8 Integrated Factory Acceptance Test (IFAT)

Upon completion of Hardware FAT, the testing moves to the next stage, the Integrated Factory Acceptance Test that will be part of Software FAT. At this stage, integrity of infrastructures or interfaces that are shared by multiple systems, components and/or applications within the scope of Yokogawa will be demonstrated. 3rd party sub-systems I/O mapping will be simulated using existing options in YOKOGAWA system/Tools for HMI and control functions. No dedicated IFAT shall be conducted, 3rd party Sub-systems connected with CI Server shall be simulated and demonstrated as a part of Software FAT.

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6 FAT Report Documentation

The Factory Acceptance Test (FAT) shall be conducted in accordance with the test procedures detailed in this document. The test results shall be recorded in the check sheet. To prevent from any check sheet getting lost, each Check sheet shall be given a unique reference number.

6.1 FAT Documentation

All FAT documentation shall be prepared by YOKOGAWA prior to the start of the FAT. All forms, check sheets, sign-off sheets, drawings, etc. as listed in this procedure shall be organized in indexed binders. A master index for the FAT will be provided and maintained by YOKOGAWA FAT Manager.

The documentation for hardware checks shall include all relevant documents for each individual cabinet in a separate indexed binder or a binder section. This shall include Internal hardware check and test records performed during internal Factory Hardware Test.

The documentation for software checks shall be organized by individual process units in indexed binders. The documentation for graphics checks shall also be organized, separately by individual process units in indexed binders.

All FAT reference documents (latest issue) as listed in this procedure originated by other parties (CROSSWIND, ROSETTI MARINO), which were issued formally to YOKOGAWA will form a part of the FAT documentation and shall be printed out, and organized in indexed binders by YOKOGAWA.

All FAT reference documents as mentioned above shall be stamped "FAT MASTER" on every page/sheet. Any additional documents that may be necessary and generated later during FAT shall also be stamped, and indexes amended accordingly.

The structure of the FAT folders and typical indices shall be defined by YOKOGAWA, issued for approval and included in the Appendix-8.3.

6.2 Internal Test/Pre-FAT

Prior to the FAT, YOKOGAWA shall conduct internal test (Pre-FAT) to verify the system and application software. The internal test shall be based on the approved FAT procedure and covers the complete system functionality check, hardware healthiness check and 100% I/O check of marshalled cross-wirings.

The internal test result will be recorded and documented. CROSSWIND/ROSETTI MARINO may review/reference the test records of these internal tests before or during the FAT.

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Complex control loops, specialized sequential controls and batch control applications shall also be completely tested during Pre-FAT. The result of the test shall be recorded and made available for reference before or during FAT.

As a part of the pre-FAT, the project team consisting of application engineers from YOKOGAWA, ROSETTI MARINO and CROSSWIND conduct electronic (paper) check using the PCS tag/tuning report generated from the system. During this paper check pre-FAT, ROSETTI MARINO/ CROSSWIND will verify the configuration parameters by using engineering documents. This will enable the FAT crew to concentrate on the control functions and Graphic functionality during the actual FAT and will also help in reducing the duration of the FAT.

Refer to PCS application software sections for detail procedure on paper check.

It is also preferred that CROSSWIND and ROSETTI MARINO representatives participate in the pre-FAT for complex controls, sequences and logics checks, especially in projects that has multiple equipments with identical control strategy, to facilitate smooth execution of the FAT.

6.3 Method of Testing

Detailed test procedure for each test item is described in this document. Check sheet shall be provided, listing the equipment to be tested. All test results shall be recorded in the Check sheets. The following color codes shall be used in the testing:

a) Yellow marker – Items that were checked and cleared

b) Pink marker – Items that were having problems.

c) Green marker – Items that were checked after completion of recovery.

The color marking will be used on the print-outs of the control drawings, graphics and supporting design documents such as P&IDs, narratives, etc.

For PCS Hardware, 10% I/O check shall be done for conventional I/O (including HART) using signal injector.

The internal test records will be inspected prior to FAT. In the event that the records are deficient, retest will be performed.

PCS, SIS and FGS Software Function Test will be conducted using Test Function tool, without connection to any physical I/O. Test Function will be used to simulate process input, digital signal and alarms to FCS so that typical loops, logic sequence blocks can be tested without connecting to physical input and output devices. Dynamic graphics check shall be a part of the PCS, SIS and FGS Software function test.

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6.4 Punch Record

All shortcomings found during the test shall be noted in the FAT Punch Record (Appendix-8.9). Each punch Record shall cover one punch item/fault. A Punch Record Ledger shall be used to summarize all the punch records.

Punch record items shall be classified as follows:

M = **Modification**, item is to be modified, deleted, added due to design input changes.

C = **Correction**, item is to be corrected by YOKOGAWA.

If the recovery work involves change/modification, it is to be recorded on the punch record and the recovery undertaken as soon as possible after the agreement of both the FAT Managers after signing of the punch record. YOKOGAWA shall clear all correction items (**Code C**) at factory before shipment, informing RM and CW for each solved items. For recovery work that involves modification (**Code M**), it will be regularly jointly reviewed by all parties involved in FAT, on at least weekly basis and resolved whether to be implemented during FAT or later, depending on complexity and potential schedule and/or cost impact. After verification, the same will be signed off by all concerned parties in the punch record.

The punch record will be reviewed during the daily meeting and the action to be taken will be discussed and finalized. If the modification request were deemed deviated from the original design, it would be considered as change order.

6.5 FAT Completion Certificate & Shipping Release Note

Upon completion of the FAT, FAT Completion Certificate and Shipping Release Note will be signed by CROSSWIND, ROSETTI MARINO and YOKOGAWA. The purpose of these two documents is to certify that the FAT has been completed and accepted by CROSSWIND. Both CROSSWIND and YOKOGAWA agree that the system is in order and can be released for shipment to site. However, if the tested system is to be shipped out in partial, CROSSWIND/ROSETTI MARINO shall advise and issue the Shipping Release Note accordingly. Refer to Appendix-8.10 for a FAT Completion Certificate and to Appendix-8.11 for a Shipping Release Note.

Note: Once the FAT completion certificate and Shipping release note signatures are in place, no internal cabinet wiring, labeling, reconfiguration, or hardware swap outs shall be carried out unless the signatory parties are notified in advance and given an opportunity to inspect any recommended changes.

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6.6 Test Equipment

YOKOGAWA will provide all test equipments (e.g. Digital Multimeter, Signal Generators etc.) for the FAT. The details of the test equipment for FAT with certification (if necessary) shall be provided using format attached in Appendix-8.4.

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7 Testing Description for Hardware

7.1 General Hardware Check – Earthing Check (valid for all cabinets)

Outline	The Earthing connections shall be verified in all the System/Marshalling cabinets and Network/Server.
Objective	Verify that all Earthing connections are wired as per the specification.
Reference	SIS/FGS, EMCS and PCS System/Marshalling Cabinet GA/IA Drawing Refer Appendix 8.3 - Approved Document List
Procedure	This test shall be carried out using a Multimeter or Ohm-meter to confirm the continuity of the following: a. P.E. – Protection earth • To verify continuity between the earth and all part of the cabinet including instrument chassis. b. IE - Instrument Earth • To verify continuity between the instrument earth bar connection and instrument cable screens. c. I.S.E. – Intrinsically Safe Earth (if present) • To verify continuity between the instrument safe earth bar connection and instrument safe cable screens. The test can be considered acceptable if the resistance measured is < 1 Ohm. Also using a Multimeter or Ohm-meter the P.E., I.E. and I.S.E. earth bars are to be confirmed isolated from each other. I.E. and I.S.E. bars must be isolated from the external cabinet chassis. The test can be considered acceptable if the resistance measured is > 10 MOhm.
Test Record Reference	- GA/IA Drawings - Refer Appendix 8.5 – FAT Check sheet

TEST RESULT: PASS / FAIL

YOKOGAWA Representative : _____ Date: _____

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ROSETTI MARINO Representative	:	Date:	
CROSSWIND Representative	:	Date:	

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7.2 PCS Physical Hardware Check

7.2.1 PCS System/Marshalling Appearance, Construction and Wiring Check

Outline	All the System/Marshalling cabinets and installed components are to be checked and verified for their appearance and construction.
Objective	- Verify that all the cabinets are manufactured as per the specification. - Verify that all the components and accessories installed in the cabinets are manufactured as per the specification. - Verify cabinet high temperature alarm. - Verify proper functioning of the redundant power supply units. This test ensures that the interface board functions properly upon Power up.
Reference	- Bill of Material - PCS System/Marshalling Cabinet GA/IA Drawing Refer Appendix 8.3 - Approved Document List
Procedure	Visually check that all the SYSTEM/MARSHALLING CABINET are as per the GA/IA drawings. Check items as follows: 1. General Cabinet Construction – lifting construction, Plinth, cabinet color and side panel (if applicable). - enclosure damages (scratches, dents) - cleaning and absence of burning marks or other residue - connection tightness (spot-on pull test) - labeling of devices and cables - IP rating - wiring separation (different voltage levels as per specs) 2. Layout – components layout on the front, rear and sides of cabinet. • FCU – mounting and termination. • ESB Node Unit – I/O module quantity. • Power Supply Unit (PSU) rating. 3. Interface Boards – mounting, termination, installed spare and space for spare. 4. Doors – handle, lock with key and document pocket. 5. Labeling – cabinet, terminals, devices, earth bars, attention symbols and cable marker.

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6. Earthing – bolt types, location, wiring type, screen terminals, grounding of devices and doors.
7. Cable handling – routing, trays/duct, clamp rails and termination.
    - Control Bus (Vnet/IP)
    - ESB Bus, Optical ESB Bus
    - System cables
    - Field cables from junction boxes
8. Signal termination
    - Terminal – terminal and wiring types, installed spare and space for spare.
9. Power distribution – isolator and circuit breakers rating, fused terminal types and wiring sizes.
10. Others: Fans, thermostat and if applicable, utility socket.

Temperature Alarm Check

11. Note Thermostat setting in the cabinet. Check that the contact at the terminal is closed circuit.
12. Set the Temperature setting of thermostat to a lower setting (e.g. 18 DegC).
13. Check that the contact is now open. Verify alarm at the OWS.
14. Recover the alarm by setting the temperature setting back to above room temperature.

Power Supply Check

15. Take measurement of voltage output from PSU individually. The voltage should be 24 ~ 26VDC.
16. Measure voltage output from PSU02 and switch "OFF" circuit breaker for PSU01.
17. The voltage measured at PSU02 output should remain within the voltage limit (24 ~ 26VDC). Verify PSU fail alarm at the OWS.
18. Measure and record the DC voltage ripple with an oscilloscope.
19. Recover PSU01. Verify PSU alarm recovery at the OWS.
20. Repeat test for PSU01 by switching "OFF" PSU02.

Functional Check (for all equipments)

21. Switch on the 24VDC power supply to the interface board one-by-one.
22. Observe the LED indication on the interface board.

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	23. Check that the contact is now returned to closed position. Verify alarm recovery at the OWS.
Criteria	The quantity, type and location of all the cabinets and installed components should match the Bill of Material, GA/IA Drawings and I/O Assignment without any scratches and deformations.
Test Record Reference	- GA/IA Drawings - Refer Appendix 8.5 – FAT Check sheet

The above checks are conducted for all Field Control Station cabinets and witnessed by the following representatives.

TEST RESULT: PASS / FAIL

YOKOGAWA Representative : _____ Date: _____

ROSETTI MARINO Representative : _____ Date: _____

CROSSWIND Representative : _____ Date: _____

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7.2.2 Field Control Station (FCS) Module Assignment Check

Outline	All ESB Bus Node Units, I/O Modules (for FIO), ESB Bus Coupler Modules and ESB Bus Repeater Modules are assigned according to the I/O assignments. The position and quantity of these items in the Field Control Station and expansion cabinets shall be verified.
Objective	- Verify that all the ESB Bus Node Units, I/O Modules (for FIO) and ESB Bus Coupler Modules and ESB Bus Repeater Modules are correctly supplied and installed.
Reference	- I/O Assignment Documents Refer to Approved Document List
Procedure	Visually check that all ESB Bus Node Units, I/O Modules (for FIO), ESB Bus Coupler Modules and ESB Bus Repeater Modules are installed in each of the Field Control Stations according to the PCS I/O Assignments for various areas as per reference documents.
Criteria	The quantity, type and location of all ESB Bus Node Units, I/O Modules (for FIO), ESB Bus Coupler Modules and ESB Bus Repeater Modules including the spares must match the approved I/O Assignment documents.
Test Record Reference	- I/O Assignment Documents

The above checks are conducted for all Field Control Stations and witnessed by the following representatives.

TEST RESULT: PASS / FAIL

YOKOGAWA Representative : _____ Date: _____

ROSETTI MARINO Representative : _____ Date: _____

CROSSWIND Representative : _____ Date: _____

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7.2.3 PCS System Architecture and BOM Check

Outline	The PCS System is configured as per System Architecture Drawing and the associated BOM is derived accordingly.
Objective	- Verify that the PCS System staged for testing is as per the System Architecture Drawing and corresponding BOM.
Reference	- System Architecture Drawing - BOM Refer to Approved Document List
Procedure	1. Visually check that all the PCS components are staged as per System Architecture. 2. Verify the BOM. • PCS Hardware • PCS Software
Criteria	The quantity and model of the components should match the BOM.

The above checks are conducted for all PCS equipments and witnessed by the following representatives.

TEST RESULT: PASS / FAIL

YOKOGAWA Representative : _____ Date: _____

ROSETTI MARINO Representative : _____ Date: _____

CROSSWIND Representative : _____ Date: _____

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7.2.4 PCS System Cables Check

Outline	The PCS System cables are supplied as per the PCS System Cable Schedule document. The supplied cables are to be physically checked.
Objective	- Verify that the PCS System cables are supplied and installed as per the System Cable Schedule document.
Reference	- PCS System Cable Schedule Refer to Approved Document List
Procedure	1. Visually check that all the PCS System Cables are supplied and installed as per the System Cable Schedule. The following shall be checked: • Cable Model • Length • Cable markers
Criteria	The Cable model, length and markers shall be as per the PCS System Cable Schedule.

The above checks are conducted for all PCS System Cables and witnessed by the following representatives.

TEST RESULT: PASS / FAIL

YOKOGAWA Representative : _____ Date: _____

ROSETTI MARINO Representative : _____ Date: _____

CROSSWIND Representative : _____ Date: _____

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7.3 PCS Standard System Function Check

7.3.1 System Start-up Test (FCS and EWS/OWS)

Outline	Field Control Stations (FCS) and Operator Work Stations (OWS) go to the operating state automatically upon powering up, provided that all application software and image are properly loaded in the system.
Objective	- Verify that the above components automatically boot up when going from 'stop' state to 'operating' state.
Reference	- System Architecture Drawing Refer to Approved Document List - CENTUM VP Instruction Manual
Procedure	1. Power down components individually or for the whole system. 2. Power up each component individually and observe its boot up sequence. 3. Check station status from EWS0164 System Maintenance panel when each station boots up. Note: For each FCS, verify the random IO state and tuning data prior to power down. After power up, verify that the FCS initializes the application program as desired and retains the tuning data.
Criteria	1. Each component must boot up automatically. 2. Station status indication on HIS(EWS0164) System Maintenance panel should change from red to green.
Test Record Reference	- Refer Appendix 8.5 – FAT Check sheet

The above checks are conducted on random basis for selected FCS/HIS(EWS0164) and witnessed by the following representatives.

TEST RESULT: PASS / FAIL

YOKOGAWA Representative : _____ Date: _____

ROSETTI MARINO Representative : _____ Date: _____

CROSSWIND Representative : _____ Date: _____

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7.3.2 FCS CPU Backup Function Test

Outline	The two CPUs in the FCS back up each other. During operation, one CPU is active while the other CPU is on hot standby. The standby CPU is updated at every memory write-cycle.
Objective	- Verify that FCS operation is uninterrupted when the active CPU fails and the standby CPU takes over.
Reference	- CENTUM VP Instruction Manual
Procedure	1. Display a tuning panel of a selected PID tag (from related FCS) And change the output value (MV) to view tuning trend. 2. Display FCS station status panel (system maintenance panel) on OWS. 3. Stop the active CPU by using the 'Start/Stop' button on the front panel from FCS. 4. Check the system alarm messages at the OWS. 5. Check the tuning panel data for the selected tag to confirm FCS control functions are normal. 6. Check the actual output at the I/O module. 7. Start the CPU by using the 'Start/Stop' button on the front panel from FCS 8. Wait for the copy to finish. 9. Repeat the test for other CPU module.
Criteria	1. FCS control functions should be unaffected. 2. All data in the related FCS should be unaffected. 3. All control loops continue to perform normally. 4. FCS run status remains unaffected as observed at HIS (EWS0164) System Maintenance panel. 5. The output of I/O module will remain unaffected.
Test Record Reference	- Refer Appendix 8.5 – FAT Check sheet

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The above checks are conducted on random basis for selected FCS and witnessed by the following representatives.

TEST RESULT: PASS / FAIL

YOKOGAWA Representative	:	_____	Date:	_____
ROSETTI MARINO Representative	:	_____	Date:	_____
CROSSWIND Representative	:	_____	Date:	_____

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7.3.3 FCS ESB Bus Redundancy Test

Outline	1. The ESB Bus that facilitates data communication between FCU and each of the ESB Bus Node Unit is dual redundant. 2. The ESB Bus Coupler module (EC401 or EC402 in FCU) and ESB Bus Interface Slave module (SB401 in Local ESB Bus Node Unit) facilitate data communication between the FCU and each local ESB Bus Node Unit. The following operations apply : - Normally, redundant ESB Buses are used in an alternating fashion. - If an error occurs in a ESB Bus module on one side, the error is notified to the user via a diagnostic information message. If both interface modules fail, the error is treated as a node failure. - If an error occurs in one ESB Bus or ESB Bus module, the FCU continues communication using the other normal ESB Bus. - An erroneous ESB Bus is monitored for recovery at regular intervals.
Objective	- Verify that FCS operation is uninterrupted when one ESB Bus module fails and the other interface module takes over.
Reference	- CENTUM VP Instruction Manual
Procedure	1. Disable one of the EC401 or EC402 (ESB Bus Coupler module) by removing it from the FCU. 2. Check the system alarm messages at the OWS. 3. Check the FCS control functions are normal. 4. Revive the ESB Bus to normal condition. 5. Repeat the test for the other ESB Bus Coupler module. 6. Disable one of the SB401 (ESB Bus Interface Slave module) by removing it from the node. 7. Check the system alarm messages at the OWS. 8. Check the FCS control functions are normal. 9. Revive the ESB Bus to normal condition. 10. Repeat the test for the other SB401. 11. If necessary, repeat the above procedures for the pair of Optical ESB Bus Repeater modules.
Criteria	1. Operation shall not be affected when either one of the ESB Bus fails. 2. The FCS control function should not be interrupted.
Test Record Reference	- Refer Appendix 8.5 – FAT Check sheet

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Note	- EC40x is installed in FCU - SB401 is installed in Local ESB Bus Node Unit

The above checks are conducted on random basis for selected FCS and witnessed by the following representatives.

TEST RESULT: PASS / FAIL

YOKOGAWA Representative : _____ Date: _____

ROSETTI MARIN Representative : _____ Date: _____

CROSSWIN Representative : _____ Date: _____

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7.3.4 FCU/Node Unit Power Supply Module Redundancy Test

Outline	The dual redundant power supply modules on the Field Control Unit and the ESB Node Unit supply power to the respective nodes.
Objective	- Verify the redundant functionality of the power supply modules.
Reference	- CENTUM VP Instruction Manual
Procedure	1. Wire up one control loop, output to input, to make a closed loop. (*Recommendation is to use long jumper yellow wire that can be easily identified)* 2. Display the tuning panel for this tag to observe the control action. 3. Put the loop in "AUTO" mode. 4. Change the set point and observe the control action of the controller. 5. Remove the power to the FCU power supply module by removing the power from UPS power source. 6. Check the system alarm messages at the OWS. 7. Check the control action of the test controller at the OWS, to confirm FCS control functions are normal during removal of power supply. 8. Revive the Power supply module to normal operation condition. 9. Repeat for the other FCU power supply module by removing the power from UPS power source. 10. Repeat the test for ESB Node Unit power supply modules.
Criteria	1. The FCS should be unaffected by the failure of any one power supply module. 2. FCS control functions should remain unaffected. 3. STATUS LED on each I/O module should remain ON.
Test Record Reference	- Refer Appendix 8.5 – FAT Check sheet
Note	Power Supply Unit for CPU Node/ESB Node Unit - PW482 (220-240V AC)

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The above checks are conducted on random basis for selected FCS and witnessed by the following representatives.

TEST RESULT: PASS / FAIL

YOKOGAWA Representative : _____ Date: _____

ROSETTI MARINO Representative : _____ Date: _____

CROSSWIND Representative : _____ Date: _____

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7.3.5 I/O Module Redundancy Test (for FIO)

Outline	The PCS I/O modules are configured as redundant depending on the project requirement. Typically, all I/O related to control points are assigned to redundant modules and I/O related to Indication only are assigned to non-redundant modules. In an FCS for FIO, it is possible to mount input/output modules of the same type in two adjacent slots to make them redundant. In the case of redundant configuration, one side becomes the control side and the other becomes the standby side. Switching of the control right is performed by input/output modules. The switching has no influence on the application program.
Objective	- Verify the redundant functionality of the redundant modules.
Reference	- PCS I/O Assignment Refer to Approved Document List - CENTUM VP Instruction Manual
Procedure	1. Wire up one control loop (input and output) device to the I/O module and setup the controller to be in AUTO mode and normal operation. 2. Remove one of the redundant modules from the FCU or ESB Bus Node Unit. 3. Check the system alarm messages at the OWS. 4. Check that the status of the controller on the OWS is maintained. 5. Install back the removed I/O module. 6. Check the I/O module recovery messages at the OWS. 7. Repeat the test by removing the other redundant module.
Criteria	1. The FCS should be unaffected by the failure of one of the redundant modules. 2. FCS control functions should remain unaffected.
Test Record Reference	- Refer Appendix 8.5 – FAT Check sheet

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The above checks are conducted on random basis for selected pair of I/O modules in each FCS and witnessed by the following representatives.

TEST RESULT: PASS / FAIL

YOKOGAWA Representative	:	_____	Date:	_____
ROSETTI MARINO Representative	:	_____	Date:	_____
CROSSWIND Representative	:	_____	Date:	_____

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7.3.6 Vnet/IP Bus Redundancy Test

Outline	The Vnet/IP bus is the communication channel for communication between the HIS(EWS0164) and the FCS. The Vnet/IP bus is dual redundant. This test will be carried out for the PCS system that is set up as per system configuration.
Objective	- Verify the redundant functionality of the system communication network Vnet/IP bus.
Reference	- CENTUM VP Instruction Manual
Procedure	For FCS: 1. For FCS CPU-1: Remove the cable that is connected to Bus-1. 2. Check the system alarm messages at the OWS. 3. Observe whether there is any break in trend gathering for any signal. 4. Re-connect the cable and check that the Bus-1 is healthy. 5. Repeat the above tests for CPU-1 Bus-2 and for CPU-2 Bus-1/2. For HIS(EWS0164): 1. For HIS(EWS0164): Remove the cable that is connected to Bus-1. 2. Check the system alarm message at the OWS. 3. Observe whether there is any break in trend gathering for any signal. 4. Re-connect the cable and check that the Bus-1 is healthy 5. Repeat the above for Bus-2. For Layer2 switch: 1. Fail one of the L2 switches that is connected on Vnet/IP Bus-1. 2. Check the system alarm messages at the OWS. 3. Observe whether there is any break in trend gathering for any signal. 4. Power back the L2 switch and check that the switch and the connected Vnet/IP network are healthy. 5. If applicable, repeat the test for the other L2 switch that is connected to Vnet/IP Bus-1. 6. Repeat the test for the L2 switch connected on Vnet/IP Bus-2.
Criteria	1. The HIS(EWS0164) should be able to monitor and operate loops in the FCS without interruption even on a single Vnet/IP bus. 2. System alarm messages should be correctly displayed. 3. There should not be any break in trend gathering for any of the signals.

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Test Record Reference	- Refer Appendix 8.5 – FAT Check sheet

The above checks are conducted on random basis for selected FCS/HIS/L2SW and witnessed by the following representatives.

TEST RESULT: PASS / FAIL

YOKOGAWA Representative : _____ Date: _____

ROSETTI MARINO Representative : _____ Date: _____

CROSSWIND Representative : _____ Date: _____

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7.3.7 FCS Resource Capacity Check

Outline	FCS Resources refers to the FCS memory usage. Sufficient spare capacity for future expansion should be available at each FCS. The Field Control Station resource usage depends on the application software configured in that particular FCS.
Objective	- Verify that overall FCS resource capacity is sufficient. This result can be used as a reference while checking the FCS memory usage at the completion of commissioning.
Reference	- PCS Technical Specification - PCS FDS Software Refer to Approved Document List
Procedure	1. The check will be carried out for the related FCS. 2. Call up the FCS resources information panel at the engineering station. 3. Confirm the FCS resources consumed and the remaining resources available at the related FCS.
Criteria	The overall FCS resources consumed should meet project requirement.
Test Record Reference	- The printout from the system for each FCS resources. - Refer Appendix 8.5 – FAT Check sheet

The above checks are conducted for all FCS and witnessed by the following representatives.

TEST RESULT: PASS / FAIL

YOKOGAWA Representative : _____ Date: _____

ROSETTI MARINO Representative : _____ Date: _____

CROSSWIND Representative : _____ Date: _____

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7.3.8 FCS CPU Loading Check

Outline	The loading of the CPU of the Field Control Station depends on the application software configured in the FCS and communication loads with other devices (HIS/FCS/OPC). CPU loading of the FCS is an important factor for deciding the system performance.
Objective	- Record the loading of the CPU of the FCS at the completion of FAT. This result can be used as a reference while checking the FCS CPU idle time at the completion of commissioning.
Reference	- PCS Technical Specification - FDS Software Refer to Approved Document List
Procedure	1. Select an FCS for which the CPU load needs to be verified. 2. On each of the HIS, belonging to that FCS operation group, call up 4 Graphic windows (no screens configured in EWS0164 so Not Applicable), a faceplate or a tuning window. The selected Graphic windows should predominantly have tags from the selected FCS for which the CPU load is being measured. 3. Call up the status display of the FCS, for which the CPU idle time is being measured and note down the displayed CPU idle time 4. Printout a hardcopy of the FCS status display for records.
Criteria	The CPU idle time shown on the System Maintenance panel for each FCS should meet project requirement.
Test Record Reference	- Refer Appendix 8.5 – FAT Check sheet

The above checks are conducted for all FCS and witnessed by the following representatives.

TEST RESULT: PASS / FAIL

YOKOGAWA Representative : _____ Date: _____

ROSETTI MARINO Representative : _____ Date: _____

CROSSWIND Representative : _____ Date: _____

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7.3.9 FCS Online/Offline Loading Test

Outline	During the course of plant operation, it may become necessary to modify certain tag definitions, parameters, loop configurations, sequence tables, etc. There are two types of loading procedures. These are: • On-line loading • Off-line loading (save tuning parameters) Modifications made at the engineering station followed subsequently by on-line loading to the FCS have no effect on FCS operation. The modifications become effective on completion of the loading procedure. Modifications made at the engineering station followed subsequently by off-line loading to the FCS will cause the FCS to go off-line for the duration of the loading procedure. The modifications become effective on completion of the loading procedure, and the FCS returns to normal on-line status.
Objective	- Verify FCS on-line and off-line loading function
Reference	- CENTUM VP Instruction Manual
Procedure (On-line)	1. Modify any of the parameters permitted for on-line loading. 2. Execute FCS on-line loading via engineering workstation. 3. Observe FCS trend, look for any effect to FCS operation during FCS on-line loading. 4. Confirm that the modified parameters are loaded and functioning properly. 5. Confirm that all the HIS(EWS0164) are equalized properly.
Criteria (On-line)	1. There should be no effect on FCS operation during FCS on-line loading. 2. The modified parameters should be loaded without any errors and the post download changes are reflected as desired.
Procedure (Off-line)	1. Modify any system parameters (e.g. FCS properties). 2. Change some tag tuning parameters (e.g. alarm setting) and the execute FCS off-line loading via engineering workstation. 3. When “Save tuning parameters of project” prompt appear, click “Yes” to save tuning parameters. 4. Observe FCS fail status from system panel during off-line loading. 5. Confirm that the modified FCS parameters are effectively loaded and functioning properly. 6. Verify the new alarm setting is retained, which confirms that the tuning parameters were successfully saved by the system. 7. Confirm that all the HIS(EWS0164) are equalized properly.

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Criteria (Off-line)	1. The modified FCS parameters should be effectively loaded and functioning properly. 2. The tuning parameters was successfully saved and loaded to the FCS.
Test Record Reference	- Refer Appendix 8.5 – FAT Check sheet

The above checks are conducted on selected FCS and witnessed by the following representatives.

TEST RESULT: PASS / FAIL

YOKOGAWA Representative : _____ Date: _____

ROSETTI MARINO Representative : _____ Date: _____

CROSSWIND Representative : _____ Date: _____

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7.3.10 Media Backup/Restore Function Test (VP Project)

Outline	The CENTUM VP EWS PC is equipped with backup storage device for application program backup onto backup storage/media.
Objective	- Verify that the backup storage/media will back-up/restore CENTUM VP project database.
Reference	- CENTUM VP Instruction Manual - Workstation/Server Instruction Manual
Procedure (Backup)	Backup the project application database in EWS PC to backup storage/media.
Criteria (Backup)	The project folder is copied onto the backup storage/media without interruption and any errors.
Procedure (Restore)	Restore the project application database backup files in the backup storage/media to EWS PC.
Criteria (Restore)	The project folder is restored back to the desired location in EWS PC without interruption and any errors.
Test Record Reference	- Refer Appendix 8.5 – FAT Check sheet

The above checks are conducted the CENTUM VP project folder and witnessed by the following representatives.

TEST RESULT: PASS / FAIL

YOKOGAWA Representative : _____ Date: _____

ROSETTI MARINO Representative : _____ Date: _____

CROSSWIND Representative : _____ Date: _____

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7.4 Other Cabinets

7.4.1 Server/Network Cabinet Check

Outline	The Server/Network Cabinet contains Rackmount Workstation/ Server PCs, KVM Console/Extender, FO converter, Switches and other Network components.
Objective	- Verify that the Server/Network Cabinet is manufactured as per the specification. - Verify cabinet high temperature alarm. - Verify functioning of redundant AC power source - Verify that FO Converters and all other Network components are functioning properly.
Reference	- Server/Network Cabinet GA/IA Drawing. - System Architecture Drawing Refer to Approved Document List
Procedure	A. Visual Check Visually check that the Server Cabinet is as per the GA/IA drawings. Check items as follows: 1. General Cabinet Construction – lifting construction, Plinth & Bakelite, cabinet color and side panel (if applicable). - enclosure damages (scratches, dents) - cleaning and absence of burning marks or other residue - connection tightness (spot-on pull test) - labeling of devices and cables - IP rating - wiring separation (different voltage levels as per specs) 2. Layout – components layout on the front, rear and sides of cabinet. • Rackmount Workstation/Server PCs • KVM Console/Extender • Network Components 3. Doors – handle, lock with key and document pocket. 4. Labeling – cabinet, terminals, devices, earth bars, attention symbols and cable marker.

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5. Earthing – bolt types, location, wiring type, screen terminals, grounding of devices and doors.
6. Cable handling – routing, trays/duct, clamp rails and termination.
   - System cables – Vnet, Vnet/IP, Ethernet etc.
   - Power supply cables.
7. Signal termination
   - Terminal – terminal and wiring types, installed spare and space for spare.
8. Power distribution – isolator and circuit breakers rating, power sockets/receptacles, fused terminal types and wiring sizes.
9. Others
   - For FO/Network – mounting and termination.
     - FO converter
     - Ethernet Switches.
     - L2/L3 switches
     - Fiber Optic Patch Panel

B. Power Supply Check

1. Remove UPS power source to Server Cabinet by turning off UPS feed circuit breaker.
2. Verify power supply 1 fail indication on all server PCs and other network components that is powered from UPS source.
3. Verify power supply fail on L2/L3 Switches that is powered from UPS source and check for appropriate messages at the OWS.
4. Turn ON the UPS feed circuit breaker; check the power supply recovery on Server PCs and L2/L3 switches.

   Repeat the test for Normal power source by turning ON & OFF the Normal feed circuit breaker.

C. Functional Check (for KVM Console/Extender)

1. KVM Console: Verify monitoring and operation of the selected workstation/server from KVM Console.
2. KVM Extender: Verify monitoring and operation of the KVM extended workstation/server from remote KVM via KVM Extender.

D. Functional Check (for Network)

1. Ethernet Switches

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	- Verify the Port connection is as per design, connection/speed LED is lit. - Execute "ping" command between two OWS connected to the Ethernet switches. a. Ethernet switch powered "ON": Normal reply from the OWS. b. Ethernet switch powered "OFF": Time out reply from OWS. If applicable, c. FO convertor powered "ON": Normal reply from the OWS. d. FO convertor powered "OFF": Time out reply from OWS. 2. L2 /L3 Switches (Vnet/IP) - Verify the Port connection is as per design, connection/speed LED is lit. - Disconnect each cable from port and verify system alarm and System Status Overview on EWS/OWS.
Criteria	Server PCs, L2/L3 switches, FO converter and all other network components should function properly.
Test Record Reference	- Refer Appendix 8.5 – FAT Check sheet

The above checks are conducted for all server/network cabinets and witnessed by the following representatives.

TEST RESULT: PASS / FAIL

YOKOGAWA Representative : _____ Date: _____

ROSETTI MARINO Representative : _____ Date: _____

CROSSWIND Representative : _____ Date: _____

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7.5 PCS I/O Check

7.5.1 PCS I/O Check Procedure

Outline	Functionality of All I/O modules installed in the Field Control Station. During internal test, 10% sample checks for selected I/O will be conducted without marshalled cross-wiring. With marshalled cross-wirings, 100% I/O tests are carried out and records for the same are maintained. During FAT, these records will be reviewed and 10% sample checks for selected I/O will be conducted. The I/O check is performed to verify circuit integrity within individual panels and also between panels. The I/O check is also performed to verify that the I/O is correctly assigned in the FCS.
Objective	- Verify Pre-FAT record to confirm all I/O modules are checked. - Perform random IO check (1 channel per module).
Reference	- I/O Assignment Documents Refer to Approved Document List
Procedure	1. Input signals to be simulated from terminals at MDF. 2. Output measurements to be taken from terminals at MDF. 3. Refer to procedure below.
Criteria	- For Analog Inputs: Reading should be within +/- 0.1 of scale*. - For Analog Outputs: Reading should be within +/- 0.3 of scale*. - For Digital Inputs: The correct faceplate indication to be checked on the OWS. - For Digital Outputs: The correct contact status/voltage to be checked at the MDF field terminals. Note*: Accuracy of Yokogawa I/O Modules at normal condition (23°C ± 2 °C)
Test Record Reference	- Pre-FAT Test Record (Internal I/O check test record) Refer Appendix 8.6 – I/O Check sheet (Check sheet are generated from master database to ensure that there is no I/O tags been left out).

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➢ Analog input (Conventional 4 to 20mA):

Simulate appropriate analog input signals to the PCS using the portable calibrator and record PCS reading displayed in the corresponding faceplate at the OWS.

For Analog Input points, 3 input signals shall be simulated:

- Signal 1 = 4.00mA, corresponding to 0% at OWS.
- Signal 2 = 12.00mA, corresponding to 50% at OWS.
- Signal 3 = 20.00mA, corresponding to100% at OWS.

The result shall be recorded in I/O Check sheet Appendix-7 Analog.

Note: If applicable, verify the FIO Analog IO module dip switch setting for all 4 wire transmitters. Instrument Index to provide the list of all field powered transmitters.

➢ Analog output:

From the faceplate at the OWS, set the output (MV) of the tag and measure the corresponding signal output at the output terminals using an ammeter. For Analog Output points, 3 output signals shall be set:

- Signal 1 = 0.1%, corresponding to 4mA at output terminals.
- Signal 2 = 50%, corresponding to 12mA at output terminals.
- Signal 3 = 99.9%, corresponding to 20mA at output terminals.

The result to be recorded in I/O Check sheet Appendix-7 Analog.

➢ Digital input:

Open or close the input point at the input terminals and record the PCS status indication for the corresponding tag faceplate at the OWS. For Digital Input points, 2 input states shall be simulated:

- Signal 1 = 0 or open contact input signal.
- Signal 2 = 1 or close contact input signal.

The result to be recorded in I/O Check sheet Appendix-7 Digital.

➢ Digital output:

Set or reset the PCS output point through the faceplate at the OWS and observe the status of the output point on the PCS IO module. The channel number shall be displayed on the PCS IO module when that channel is turned ON. For Digital Output points, 2 output states shall be set:

- Signal 1 = 0 or open contact output signal.
- Signal 2 = 1 or close contact output signal.

The result to be recorded in I/O Check sheet Appendix-7 Digital.

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Note: For non-Yokogawa terminal boards, verify the board jumper settings for each channel to ensure the channels are properly set for wet or dry contact depending on the application requirement. Instrument Index to provide the list of all PCS and field powered field devices.

The above checks are conducted for the randomly selected I/O (one channel per module).

TEST RESULT: PASS / FAIL

YOKOGAWA Representative	:	_____	Date:	_____
ROSETTI MARINO Representative	:	_____	Date:	_____
CROSSWIND Representative	:	_____	Date:	_____

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7.6 SIS & FGS Physical Hardware Check

7.6.1 System/Marshalling Cabinets Appearance, Construction & Wiring Check

Outline	All the System/Marshalling cabinets and installed components are to be checked and verified for their appearance and construction.
Objective	1. To verify that all the System and Marshalling cabinet are manufactured as per the specification. 2. To verify Cabinet high temperature alarm. 3. To verify the proper function of the redundant power supply units. 4. This test ensures that the interface boards function properly upon power up.
Reference	System and Marshalling cabinet GA/IA Drawing. - Refer Appendix 8.3 - Approved Document List
Procedure	A. Visual Check. (all cabinets) Visually check that all the Marshalling cabinet are as per the GA/IA drawings. Check items as follows: 1. General Cabinet Construction – lifting construction, Plinth & Insulation, cabinet color and side panel (if applicable). - enclosure damages (scratches, dents) - cleaning and absence of burning marks or other residue - connection tightness (spot-on pull test) - labeling of devices and cables - IP rating - wiring separation (different voltage levels as per specs) 2. Layout – components layout on the front, rear and sides of cabinet. • Power Supply Unit (PSU) rating. • Interface Boards – mounting, termination, installed spare and space for spare. • I.S./Proximity Switch interface board. 3. Doors – handle, lock with key and document pocket. 4. Labeling – cabinet, terminals, devices, earth bars, attention symbols and cable marker. 5. Earthing – bolt types, location, wiring type, screen terminals, grounding of devices and doors. 6. Cable handling – routing, trays/duct, clamp rails and termination. • System cable. • Field cables from junction boxes. • Power supply cables. 7. Signal termination.

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	• Terminal – terminal and wiring types, installed spare and space for spare. • Surge arrestor (if applicable) – termination, installed spare and space for spare. 8. Power distribution – isolator and circuit breakers rating, fused terminal types and wiring sizes. 9. Others: Fans, thermostat and if applicable, utility socket. B. Temperature Check (for all cabinets) 1. Note Thermostat setting in the cabinet. Check that the contact at the terminal is closed circuit. 2. Set the Temperature setting of thermostat to a lower setting (e.g. 18 ^{0}C). 3. Check that the contact is now open. 4. Recover the alarm by setting the temperature setting back to above room temperature. 5. Check that the contact is now returned to closed position. C. Power Supply and (if applicable) ELM Check 1. Take measurement of voltage output from PSU individually. The voltage should be 24 ~ 26VDC. 2. Measure voltage output from PSU02 and switch "OFF" circuit breaker for PSU01. 3. The voltage measured at PSU02 output should remain within the voltage limit (24 ~ 26VDC). 4. Measure and record the DC voltage ripple with an oscilloscope. 5. Recover PSU01. 6. Repeat test for PSU01 by switching "OFF" PSU02. 7. Reset ELM alarm if any. Ensure that the contact is closed. 8. Activate earth fault by using a jumper wire to short one of the field connection terminals to earth bar. 9. Check alarm status at ELM and verify open contact. 10. Remove the jumper wire and reset the ELM as necessary. 11. Ensure the alarm status at ELM and contact returns to close. D. Functional Check (for all equipment) 1. Switch on the 24VDC power supply to the interface board one-by-one. 2. Observe the LED indication on the interface board.
Criteria (Expected Results)	1. Quantity, type, Model and location match with the approved / final GA/IA Drawings 2. Cabinet temperature switch contact opens when thermostat is set to a lower setting

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	3. PSU voltages remain within the voltage limit (24 ~ 26VDC) in single operation. 4. ELM is activated on a simulated ground fault. (if ELM is applicable) 5. The LED indication on the respective interface board is lighted up, when 24V is applied.
Test Record Reference	GA/IA Drawings (Approved Document List) Refer Appendix 8.7 – FAT Check sheet

The above checks are conducted for all SCS Cabinets and witnessed by the following representatives:

TEST RESULT: PASS / FAIL

YOKOGAWA Representative : _____ Date: _____

ROSETTI MARINO Representative : _____ Date: _____

CROSSWIND Representative : _____ Date: _____

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7.6.2 Safety Control Station (SCS) Nest Loading Check

Outline	All Safety I/O nodes and modules are assigned according to the I/O assignments. The position and quantity of these items in the Safety Control Station shall be verified.
Objective	To verify that all the Safety I/O nodes and modules are correctly supplied and installed.
Reference	I/O Assignment Documents Refer Appendix 8.3 - Approved Document List
Procedure	Visually check that all the Safety I/O nodes and modules are installed in each of the Safety Control Stations according to the I/O Assignments for various areas as per reference documents.
Criteria (Expected Result)	The quantity, type and location of all the Safety Control Units (SCU), Safety I/O nodes and modules including the spares must match the approved / Final I/O Assignment documents.
Test Record Reference	I/O Assignment Refer Appendix 8.7 – FAT Check sheet

The above checks are conducted for all Safety Control Stations and witnessed by the following representatives:

TEST RESULT: PASS / FAIL

YOKOGAWA Representative : _____ Date: _____

ROSETTI MARINO Representative : _____ Date: _____

CROSSWIND Representative : _____ Date: _____

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7.6.3 EWS/SOE Workstation Check

Outline	The EWS/SOE PC is supplied in accordance with the Bill of Materials along with applicable system software licenses.
Objective	To verify the EWS/SOE PC is supplied in accordance with the approved Bill of Materials and installed with applicable system software licenses.
Reference	- Bill of Material - System Architecture Drawing - Software Licenses Refer Appendix 8.3 - Approved Document List
Procedure	Visually check that the EWS/SOE PC is as per the Reference documents and verify the following. • Domain and Station Number • Quantity, Model number, Make, Type, Revision • System software revisions • Installed System software • Installed Software Licenses
Criteria (Expected Results)	1. Domain and Station settings must match the Approved / Final System Architecture Drawing. 2. Installed software revision numbers must be as per the Approved / Final BOM. 3. Installed /Assigned software license must be as per the Approved / Final BOM. 4. Model number of the EWS/SOE workstation must be as per the Approved / Final BOM
Test Record Reference	Bill of Material. Refer Appendix 8.7 – FAT Check sheet

The above check will be conducted for all EWS/SOE PCs and witnessed by the following representatives:

TEST RESULT: PASS / FAIL

YOKOGAWA Representative : _____ Date: _____

ROSETTI MARINO Representative : _____ Date: _____

CROSSWIND Representative : _____ Date: _____

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7.6.4 System Architecture and BOM Check

Outline	The SIS system is configured as per the System Architecture Drawing and the associated BOM is derived accordingly.
Objective	Verify that the SIS system staged for testing is as per the System Architecture Drawing and corresponding BOM.
Reference	- SIS BOM - System Architecture Drawing - Safety Validation Plan (SVP) Refer Appendix 8.3 - Approved Document List
Procedure	1. Visually check that all the SIS components are staged as per the System Architecture. 2. Verify the BOM. • SIS Hardware. • SIS Software. 3. Verify Domain and Station numbers according to System Architecture. 4. Confirm that components (Model/Revision numbers) as built are in accordance with reliability calculation of SVP for specified SIFs.
Criteria (Expected Results)	1. SIS components staged must be as per the approved / Final System Architecture drawing. 2. Components (Model/ Revision numbers) used for SIFs should be in accordance to the SVP reliability calculations 3. Make and Model of SIS hardware and SIS software must match the approved / final BOM and SVP
Test Records	Refer Appendix 8.7 - System Architecture and Bill of Material. (BOM checks are done separately for hardware and Software) Refer Appendix 8.7 – FAT Check sheet

The above check has been conducted for all SIS equipment's and witnessed by the following:

TEST RESULT: PASS / FAIL

YOKOGAWA Representative : _____ Date: _____

ROSETTI MARINO Representative : _____ Date: _____

CROSSWIND Representative : _____ Date: _____

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7.6.5 System Cables Check

Outline	The System cables are manufactured as per the System Cable Schedule document. The manufactured cables are to be physically checked.
Objective	Verify that the SIS System is manufactured as per the System Cable Schedule document.
Reference	System Cable Schedule Refer Appendix 8.3 - Approved Document List
Procedure	Visually check that all the System Cables are manufactured according to the specification. The following shall be checked: • Cable Model. • Length. • Cable markers
Criteria (Expected Results)	1. Cable model and length must be as per the final Cable schedule. 2. Every cable must have cable markers at both ends.
Test Records	System Cable Schedule Refer Appendix 8.7 – FAT Check sheet

The above checks are conducted for all SIS System Cables and witnessed by the following representatives:

TEST RESULT: PASS / FAIL

YOKOGAWA Representative : _____ Date: _____

ROSETTI MARINO Representative : _____ Date: _____

CROSSWIND Representative : _____ Date: _____

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7.7 Standard System Function Check

7.7.1 System Start-up Test (SCS and I/O cards)

Outline	Each of the Safety Control Stations and its I/O cards shall go to their operating mode 'Waiting' automatically upon powering up, provided that the application software is properly loaded in the system. Regardless of the duration of a power failure, the initial cold start processing is performed when power is supplied to the CPU nodes. On SCS power up, input/output module startup processing is performed, and the operating mode shifts to the Waiting mode and '0' is output from the DO modules. The user should perform the output enable operation from the EWS after confirming that all output modules have been started successfully. Once the output enable operation is completed, output values of the application logic are output to the field. When all outputs are placed in the Output Enable status, the operating mode shifts to the Running mode.
Objective	To verify that the above components automatically boot up when going from power-off state to 'Waiting' mode.
Reference	- System Architecture Drawing - ProSafe-RS Instruction Manual (Safety Control Station) - SIS Instruction for Operation and Maintenance Refer Appendix 8.3 - Approved Document List
Procedure	1. Power down the whole system. 2. Power up and observe its boot up sequence until 'Waiting' mode is confirmed. 3. Check status/operating mode from SCS State Management panel on EWS PC after each station completes the boot up. 4. Check one or two IO loops by hardwired signal injection to check the status of the system after boot-up is completed. 5. Perform output enable operation after all output modules have been started successfully
Criteria (Expected Results)	1. System should boot up automatically. 2. System status indication on SCS State Management panel should show 'Ready'/'Waiting'. 3. The status of IO loops after system boot up must reflect the signal values injected and changes thereafter.
Test Record Reference	Refer Appendix 8.7 – FAT Check sheet

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The above checks are conducted on random basis for selected SCS and witnessed by the following representatives:

TEST RESULT: PASS / FAIL

YOKOGAWA Representative : _____ Date: _____

ROSETTI MARINO Representative : _____ Date: _____

CROSSWIND Representative : _____ Date: _____

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7.7.2 SCS CPU Backup Function Test

Outline	The two CPUs in the SCS back up each other. During operation, one CPU is active while the other CPU is on hot standby. The standby CPU is updated at every memory write-cycle.
Objective	To verify that SCS operation is uninterrupted when the active CPU fails and the standby CPU takes over.
Reference	- ProSafe-RS Instruction Manual (Safety Control Station)
Procedure	1. Wire up one test logic block with trip reset / latch function, inject hardwired signal input, and measure / monitor the output. 2. Display the POU in Debug mode on EWS PC for this logic block as applicable to observe the logic control action and status. 3. Energize the logic block (i.e. create status "trip") 4. Stop the active CPU by using the 'Start/Stop' button on the front panel (Switchover the CPU). 5. Check the diagnostic information message on the EWS or the system alarm message from the OWS. (If the system is integrated with the PCS) 6. Check the "trip" status of the test logic block on the EWS to confirm SCS logic functions are normal. 7. Revive the CPU to normal operation mode. 8. Repeat for the test for the other CPU card.
Criteria (Expected Results)	1. The SCS Logic functions and data must be unaffected on simulation of active CPU failure. 2. SCS State Management panel shows SCS status.
Test Record Reference	Refer Appendix 8.7 – FAT Check sheet

The above checks are conducted on random basis for selected SCS and witnessed by the following representatives:

TEST RESULT: PASS / FAIL

YOKOGAWA Representative : _____ Date: _____

ROSETTI MARINO Representative : _____ Date: _____

CROSSWIND Representative : _____ Date: _____

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7.7.3 SCS ESB Bus Redundancy Test

Outline	The dual redundant ESB Bus interface modules, allow I/O data to be communicated between the Safety Control Unit and each Safety Node Unit. The following operations apply : - Normally, redundant ESB Buses are used in an alternating fashion. - If an error occurs in an ESB Bus interface module on one side, the error is notified to the user via a diagnostic information message. If both interface modules fail, the error is treated as a node failure. - If an error occurs in one ESB Bus or interface module, the SCU continues communication using the other normal ESB Bus. - An erroneous bus is monitored for recovery at regular intervals. - Errors in communication with all I/O nodes, except CPU node, are related to ESB Bus error.
Objective	To verify that SCS operation is uninterrupted when one ESB Bus interface module fails and the other interface module takes over.
Reference	- ProSafe-RS Instruction Manual (Safety Control Station)
Procedure	1. Wire up one test logic block with trip reset / latch function, inject hardwired signal inputs, and monitor the output, preferably in the Safety Node Unit than in the Safety Control Unit Node. 2. Display the POU in Debug mode on EWS PC for this logic block as applicable to observe the logic control action and status. 3. De-Energize or Energize the logic block (i.e. create status "trip"). 4. Disconnect the connector unit of one of the ESB Bus interface module in the SCU. 5. Check the diagnostic information message on the EWS or the system alarm message from the OWS. (If the system is integrated with the PCS) 6. Check the "trip" status of the test logic block on the EWS to confirm SCS logic functions are normal. 7. Revive the ESB Bus to normal operation condition. 8. Repeat the same test procedure by disconnecting the connector unit of the other ESB Bus Interface module.
Criteria (Expected Result)	The SCS Logic functions and data must be unaffected on simulation on single ESB Bus failure.
Test Record Reference	Refer Appendix 8.7 – FAT Check sheet

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The above checks are conducted on random basis for selected SCS and witnessed by the following representatives:

TEST RESULT: PASS / FAIL

YOKOGAWA
Representative : _____ Date: _____

ROSETTI MARINO
Representative : _____ Date: _____

CROSSWIND
Representative : _____ Date: _____

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7.7.4 SCS Power Supply Module Redundancy Test

Outline	The dual redundant power supply modules on the Safety Control Unit and the Safety Node Unit supply power to the respective nodes.
Objective	To verify the redundant functionality of the power supply cards.
Reference	- ProSafe-RS Instruction Manual (Safety Control Station)
Procedure	1. Wire up one test logic block, with hardwired signal injection input, and monitor the output. 2. Display the POU in Debug mode on EWS PC for this logic block as applicable to observe the logic control action and status. 3. De-Energize or Energize the logic block (i.e., make status "trip"). 4. Remove the power to the active CPU nest power supply card by removing power from the UPS power source. 5. Check the diagnostic information message on the EWS or the system alarm message from the OWS. (If the system is integrated with the PCS) 6. Check the "trip" status of the test logic block on the EWS to confirm SCS logic functions are normal. 7. Revive the Power Supply Card to normal operation condition. 8. Repeat for the other CPU nest power supply card by removing the power from normal power source. 9. Repeat the test for Safety Node unit power supply cards.
Criteria (Expected Result)	The SCS Logic functions must be unaffected on simulation on failure of single Power Supply module in SCS.
Test Record Reference	Refer Appendix 8.7 – FAT Check sheet

The above checks are conducted on random basis for selected SCS and witnessed by the following representatives:

TEST RESULT: PASS / FAIL

YOKOGAWA Representative : _____ Date: _____

ROSETTI MARINO Representative : _____ Date: _____

CROSSWIND Representative : _____ Date: _____

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7.7.5 I/O Module Redundancy Test

Outline	The SIS I/O modules are configured as redundant for all I/O. In an SCS, it is possible to mount input/output modules of the same type in two adjacent slots to make them redundant. In the case of redundant configuration, one side becomes the control side and the other becomes the standby side. When control side fails, the standby automatically takes over, when standby module fails, it will be alarmed.
Objective	To verify the redundancy of I/O modules.
Reference	- I/O Assignment - ProSafe-RS Instruction Manual
Procedure	1. Wire up one test logic block with trip reset / latch function, inject hardwired signal input, and monitor the output. 2. Display the POU in Debug mode on the EWS PC for this logic block as applicable, to observe the logic control action and status. 3. De-Energize or Energize the logic block (i.e., create status "trip"). 4. Remove the active I/O module which has the I/O that has been set up for the logic block function monitoring as per Step 1. 5. Check the diagnostic information message on the EWS or the system alarm message from the OWS. (If the system is integrated with the PCS) 6. Check the "trip" status of the test logic block on the EWS to confirm SCS logic functions are normal. 7. Install back the removed I/O module. 8. Check the I/O module recovery messages at the OWS. 9. Repeat the test by removing the other IO module
Criteria (Expected Result)	The SCS Logic functions must be unaffected on simulation of failure of active IO module in a redundant configuration.
Test Record Reference	Refer Appendix 8.7 – FAT Check sheet

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The above checks are conducted on random basis for selected SCS and witnessed by the following representatives:

TEST RESULT: PASS / FAIL

YOKOGAWA Representative : _____ Date: _____

ROSETTI MARINO Representative : _____ Date: _____

CROSSWIND Representative : _____ Date: _____

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7.7.6 Field Power Supply Redundancy Test

Outline	SIS 24V DC Field Power supplies provide power to field input and output devices. The Field power supplies are installed in redundant configuration with each field power supply designed to cater field power to 100% of the IO in that cabinet
Objective	To verify the redundancy of 24V DC Field power supplies Refer Appendix 8.3 - Approved Document List
Reference	- SIS Cabinet power distribution drawings
Procedure	1. Select an SCS controller and reset all logics in that controller. 2. Remove AC power input to one of the 24V DC Power supply 3. Verify that the power to Terminal Board (TB)/Field IO is still normal. 4. Verify SIS System common trouble alarm in OWS is normal. 5. Revive AC power input and verify recovery of system common trouble alarm. 6. Repeat the test by removing AC power input to other 24V DC power supply.
Criteria (Expected Result)	Field power to SCS IO must be unaffected on simulation on failure of single 24V DC Field Power Supply unit.
Test Record Reference	Refer Appendix 8.7 – FAT Check sheet

The above checks are conducted for all Marshalling cabinets equipped with 24DC power supplies.

TEST RESULT: PASS / FAIL

YOKOGAWA Representative : _____ Date: _____

ROSETTI MARINO Representative : _____ Date: _____

CROSSWIND Representative : _____ Date: _____

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7.7.7 System Key Function Test

Outline	The SIS systems are equipped with a System Key. The System Key provides protections against unauthorized access and modification to system logics. • System key is normally set to Disable position. The ProSafe-RS logic security level is set and locked in at level 2, which is read only mode. • When System key is set to Enable position, security level remains at 2 but can be changed by user to 1 or 0 for online or offline download respectively. When System key is switched from Enable to Disable position, the logic will enable all locked or disabled variables then set security level back to 2. Enabling disabled variables is necessary to ensure that System key input will not be kept in locked state which will cause security level and variable enable locked down.
Objective	To verify: System key REMOTE (Disable) & PROGRAM (Enable) functionality
Reference	SIS Cabinet wiring drawings Refer Appendix 8.3 - Approved Document List
Procedure	1. Verify security level is set to 1 and at least one variable is locked. Turn System key position to DISABLE (REMOTE) position. • Verify lock variable is enabled and security level is set to 2 • Verify that the System Common Trouble alarm is cleared. 2. Return System key position to ENABLE (PROGRAM) position. • Verify security level remains at 2 • Verify System Common Trouble alarm in OWS 3. Change security level to 1 and verify that online download is possible. 4. Change security level to 0 and verify that offline load is possible.
Criteria (Expected Result)	SCS Security level change is possible only in Enable position. Switching from Enable to Disable position enables all locked or disabled variables and set security level to 2.
Test Record Reference	Refer Appendix 8.7 – FAT Check sheet

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The above checks are conducted for all SCS Controllers and witnessed by the following representatives:

TEST RESULT: PASS / FAIL

YOKOGAWA				
Representative	:		Date:	
ROSETTI MARINO				
Representative	:		Date:	
CROSSWIND				
Representative	:		Date:	

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7.7.8 Vnet/IP Bus Redundancy Test

Outline	The Vnet/IP bus is an important communication channel for communication between the EWS/OWS and the SCS/FCS. It also provides peer-to-peer communication between SCS/FCS. The Vnet/IP bus is dual redundant. This test will be carried out for the SIS system that is set up as per system configuration.
Objective	To verify the redundant functionality of the system communication network Vnet/IP bus.
Reference	ProSafe-RS Instruction Manual. Centum VP Instruction Manual
Procedure	For SCS: 1. For SCS CPU-1: Remove the cable that is connected to Bus-1. 2. Check the diagnostic information message on the EWS or the system alarm message from the OWS. (If the system is integrated with the PCS). 3. Observe whether there is any break in trend gathering for any signal. 4. Re-connect the cable and check that the Bus-1 is healthy. 5. Repeat the above tests for CPU-1 Bus-2 and for CPU-2 Bus-1/2. For Layer2 switch: 7. Fail one of the L2 switches that is connected on Vnet/IP Bus-1. 8. Check the diagnostic information message on the EWS or the system alarm message from the OWS. (If the system is integrated with the PCS) 9. Observe whether there is any break in trend gathering for any signal. 10. Power back the L2 switch check that the switch and the connected Vnet/IP network are healthy 11. If applicable, repeat the test for the other L2 switch that is connected to Vnet/IP Bus-1. 12. Repeat the test for the L2 switch connected on Vnet/IP Bus-2.
Criteria (Expected Results)	1. The SCS should be monitored from EWS and/or OWS without interruption even on a single Vnet/IP bus. 2. System alarm messages should be correctly displayed. 3. There should not be any break in trend gathering for any of the signals.
Test Record Reference	Refer Appendix 8.7 – FAT Check sheet

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The above checks are conducted on random basis for selected SCS/L2SW/L3SW and witnessed by the following representatives:

TEST RESULT: PASS / FAIL

YOKOGAWA
Representative : _____ Date: _____

ROSETTI MARINO
Representative : _____ Date: _____

CROSSWIND
Representative : _____ Date: _____

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7.7.9 SCS Resource Capacity Check

Outline	SCS Resources refers to the SCS memory usage. Sufficient spare capacity for future expansion should be available at each SCS. The Safety Control Station resource usage depends on the application software configured in that particular SCS.
Objective	To verify that overall SCS resource capacity is sufficient. This result can be used as a reference while checking the SCS memory usage at the completion of commissioning.
Reference	- ProSafe-RS Instruction Manual (Engineering Guide) - SIS FDS Software Refer Appendix 8.3 - Approved Document List
Procedure	1. The check will be carried out for the related SCS. 2. Call up the SCS Information panel at the EWS. 3. Confirm the SCS resources consumed and the remaining resources available at the related SCS.
Criteria (Expected Result)	The overall SCS resources consumed must meet project requirement.
Test Record Reference	The printout from the system for each SCS Information. Refer Appendix 8.7 – FAT Check sheet

The above check will be conducted for all SCS and witnessed by the following representatives:

TEST RESULT: PASS / FAIL

YOKOGAWA Representative : _____ Date: _____

ROSETTI MARINO Representative : _____ Date: _____

CROSSWIND Representative : _____ Date: _____

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7.7.10 SCS CPU Loading Check

Outline	The loading of the CPU of each Safety Control Station depends on the size and complexity of the application software configured in that particular SCS, the specified scan cycle and communication loads with other devices (EWS / OWS / FCS / SCS). CPU loading of the SCS is an important factor for deciding the system performance.
Objective	To record the loading of the CPU of the SCS at the completion of FAT. This result can be used as a reference while checking the SCS CPU idle time at the completion of commissioning.
Reference	- ProSafe-RS Instruction Manual (Engineering Guide) - SIS FDS Software Refer Appendix 8.3 - Approved Document List
Procedure	1. Select an SCS for which the CPU load needs to be verified. 2. (If the system is integrated with the PCS), on each of the OWSs, belonging to that SCS operation group, call up 4 Graphic windows, a faceplate or a tuning window. The selected Graphic windows should pre-dominantly have tags from the selected SCS for which the CPU load is being measured. 3. Call up the status display of the SCS, for which the CPU idle time is being measured and note down the displayed CPU idle time 4. Printout a hardcopy of the SCS status display for records.
Criteria (Expected Result)	The CPU idle time shown on the System Maintenance panel for each SCS should meet the project requirement.
Test Record Reference	Refer Appendix 8.7 – FAT Check sheet

The above check will be conducted for all other SCSs.

TEST RESULT: PASS / FAIL

YOKOGAWA Representative : _____ Date: _____

ROSETTI MARINO Representative : _____ Date: _____

CROSSWIND Representative : _____ Date: _____

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7.7.11 SCS Online/Offline Loading Test

Outline	During the course of plant operation, it may become necessary to modify certain tag definitions, parameters and logic configurations etc. There are two types of loading procedures. These are: • On-line loading. • Off-line loading Modifications (within specified restrictions as per engineering guide) made at the EWS followed subsequently by on-line loading to the SCS have no effect on SCS operation. The modifications become effective on completion of the loading procedure. Modifications made at the EWS followed subsequently by off-line loading to the SCS will cause the SCS to go off-line for the duration of the loading procedure. The modifications become effective on completion of the loading procedure, and the SCS returns to normal on-line status.
Objective	To verify SCS on-line and off-line loading function.
Reference	- ProSafe-RS Instruction Manual (Engineering Guide)
Procedure. (On-line Load).	1. Modify any of the parameters permitted for on-line loading. 2. Execute SCS on-line loading via the EWS. 3. Observe whether any effect to SCS operation during SCS on-line loading. 4. Confirm that the modified parameters are loaded and functioning properly.
Criteria. (Expected Results) (On-line).	1. SCS operation is not affected during SCS on-line loading. 2. The modified parameters should be loaded without any errors and the post download changes are reflected as desired
Procedure. (Off-line Load).	1. Modify any of the logics required for off-line load. 2. Execute SCS off-line loading via the EWS. 3. Observe SCS fail status from the system panel during off-line loading. 4. Confirm that the modified logics are effectively loaded and functioning properly.
Criteria. (Expected Result) (Off-line).	The modified parameters should be loaded without any errors and the post offline load changes are reflected as desired.
Test Record Reference	Refer Appendix 8.7 – FAT Check sheet

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The above checks are conducted on a selected SCS and witnessed by following representatives:

TEST RESULT: PASS / FAIL

YOKOGAWA Representative : _____ Date: _____

ROSETTI MARINO Representative : _____ Date: _____

CROSSWIND Representative : _____ Date: _____

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7.7.12 Media Backup/Restore Function Test (ProSafe-RS Project)

Outline	The ProSafe-RS EWS PC is equipped with backup storage device for application program backup onto backup storage/media.
Objective	- Verify that the backup storage/media will back-up/restore ProSafe-RS project database.
Reference	- ProSafe-RS Instruction Manual
Procedure (Backup)	Backup the project application database in EWS PC to backup storage/media.
Criteria (Backup)	The project folder is copied onto the backup storage/media without interruption and any errors.
Procedure (Restore)	Restore the project application database backup files in the backup storage/media to EWS PC.
Criteria (Restore)	The project folder is restored back to the desired location in EWS PC without interruption and any errors. There should be no effect on ProSafe-RS generation after restoration
Test Record Reference	Refer Appendix 8.7 – FAT Check sheet

The above checks are conducted the ProSafe-RS project folder and witnessed by the following representatives.

TEST RESULT: PASS / FAIL

YOKOGAWA Representative : _____ Date: _____

ROSETTI MARINO Representative : _____ Date: _____

CROSSWIND Representative : _____ Date: _____

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7.8 SIS & FGS I/O Check

7.8.1 I/O Check Procedure

Outline	During the internal test, 100% I/O tests are carried out and records for the same are maintained. During FAT, 100% IO checks are performed to verify that the I/O is correctly assigned in the SCS.
Objective	1. To verify all the SIS input and output signals and circuits and their assignment in the SCS. 2. To verify IO parameter settings in the SCS with I/O tag list. 3. To verify Trip points /Dead band /Range of analog signals on logic sheet against project requirement. 4. To verify Tag number, tag comment, range, and engineering unit on OWS faceplate (If the system is integrated with the PCS). 5. To verify SOE records on the SOE viewer installed in the EWS PC.
Reference	- I/O Assignment - Termination Wiring Drawing Refer Appendix 8.3 - Approved Document List
Procedure	1. Analog Input signals to be simulated at test panel or at the Marshalling terminals using signal generators (For redundant modules, switch over to standby module and test redundant path). 2. Digital Input signals to be simulated using test panel and/or switches hardwired to terminals at Marshalling (For redundant modules, switch over to standby module and test redundant path). 3. Digital Output signals shall be tested by forcing the output from the EWS and observing the LEDs on test panel and/or voltage hardwired to terminals at Marshalling (For redundant modules, switch over to standby module and test redundant path).
Criteria (Expected Results)	1. The circuit for every I/O point is completed from simulator test panel (or terminals at Marshalling if test panel is not used) to SCS. 2. Signal values of all I/Os are correct. 3. Tag number, tag comment, alarm/trip settings, range and engineering units are configured correctly and match the data in Instrument Index.
Test Record Reference	1. Pre-FAT Test Record (100% of I/O). 2. Refer Appendix 8.8 – I/O Check sheet (Check sheet are generated from master database to ensure that there is no I/O tag been left out).

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Analog input:

Simulate appropriate analog input signals using the hardware simulation test panel or the signal generator and record SCS reading displayed in the corresponding workbench at EWS and/or faceplate at the OWS. For Analog Input points, the following signal levels shall be injected and verified:

- Signal 1 = 0%
- Signal 2 = 50%
- Signal 3 = 100%
- Out of range IOP+
- Out of range IOP-
- Trans+
- Trans-

Additional points for FGS Detectors:

- Calibration
- Beam block
- Dirty Optics

Verify the tag number, tag comment, range and engineering unit on OWS faceplate.

Verify the Process Alarms on the OWS.

Verify the alarm & trip related setting, transmitter fault, failsafe value, etc. on the EWS and annunciation of the same on the OWS.

Verify alarm and trip signals on the SOE and time stamps as applicable.

The result shall be recorded in the I/O Check sheet.

Note: If applicable, verify the IO card dip switch setting for all 4 wire transmitters. Instrument Index to provide the list of all field powered transmitters.

Analog output:

From the workbench at EWS, force the output (MV) of the tag and measure the corresponding signal output at the output terminals using an ammeter. For Analog Output points, 3 output signals shall be set:

- Signal 1 = 0.1%, corresponding to 4mA at output terminals.
- Signal 2 = 50%, corresponding to 12mA at output terminals.
- Signal 3 = 99.9%, corresponding to 20mA at output terminals.

The result to be recorded in I/O Check sheet.

Digital input:

- Open or close the input point using the toggle switches on the Simulator test panel and record the input status indication in the corresponding logic display at EWS. For Digital Input points, the following input states shall be simulated:
  - Signal 1 = 0 or open contact input signal.
  - Signal 2 = 1 or close contact input signal.

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- Signal Fault : Wire break and / or short circuit as applicable for line monitored inputs
- Verify the Trip Signals on the SOE and SOE time stamps as applicable.
- The result to be recorded in the I/O Check sheet.

Digital output:

Using EWS, force the Digital output point to ON and confirm that the LED on the test panel is turned ON. Force the Digital output point to OFF and confirm that the LED on the test panel is turned OFF. Short the wires at the LED and confirm that the System automatically disables the DO channel.

If applicable, verify the Trip Signals on the SOE and SOE time stamps.

The result to be recorded in the I/O Check sheet.

The above check will be conducted for 100% of the IO and witnessed by the following representatives:

TEST RESULT: PASS / FAIL

YOKOGAWA Representative : _____ Date: _____

ROSETTI MARINO Representative : _____ Date: _____

CROSSWIND Representative : _____ Date: _____

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8 EMCS Physical Hardware Check

8.1 Test purposes

The tests covered in this document are related only to acquire and generate the IO hardwired signals provided by EMCS and the hardware redundancy.

8.2 Test prerequisites EMCS

The test must check:

- the correct wiring of the signals of the IO card to terminal strips
- the correct acquisition of input signals (digital and analog) by the control system
- the correct generation of output signals (digital and analog) by the control system
- the hardware redundancy in case of one control system fault or network failure

To perform the test, Yokogawa will use laptop PC to connect, through software to programming SEL Industrial PC, at the control system with the scope to verify the correct internal status of the signals.

Availability of documents concerning the communication interface is a necessary prerequisite, in order to proceed with the actual test. The minimum provided information is :

- Communication parameters (IP address, subnet mask, device parameters, device tag when applicable, communication speed when applicable).
- IO signal maps, specifying for each signal to be tested :
  - Tag
  - Address
  - Description
  - Data type
  - Data access (read/write)
  - Range
  - Scale
  - Offset
  - Engineering Unit (if applicable)

8.3 Hardware link validation

This chapter describes the tests that will be executed during the “Hardware Link Communication tests”. The following tests shall be performed for each IO card in the EMCS and for each control system component.

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8.3.1 TEST Form 1.1 - **Communication and configuration check**				
Vendor REFERENCE :				
PROJECT :		**System :**	EMCS	Rev. 0
Item Description:	Communication and configuration check			
PRELIMINARY				
SCOPE	Verify the correct connectivity between EMCS and Engineering Workstation interface.			
REF. DOCUMENTS				
PROCEDURE	After the connection, using Engineering Workstation interface, is established, verify that the connections are Healthy and permanent for each component of the EMCS.			

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EXPECTED RESULT	Observe that there is no communication fault on each component of the EMCS. For each component, diagnostics information indicates no errors.			
TEST RESULTS	PASS ☐		FAI☐	
COMMENTS				
TEST DATE :				
CLOSED DATE :				
	Vendors			
	Signature	Signature	Signature	Signature

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8.3.2 TEST Form 1.2 - **Hard Link Digital Input/Output test**				
Vendor REFERENCE :				
PROJECT :		**System :**	EMCS	Rev. 0
Item Description:	Hard Link Digital Input/Output test			
PRELIMINARY				
SCOPE	Verify the communication for all digital signals acquired and generated by EMCS on Engineering Workstation interface. Verify that it is possible to read and write signals as specified in Signal List: • "read" signals will be generated/forced by an external electrical jump on the terminal strip and checked the corresponding internal signal on Engineering Workstation interface. • "write" signals will be generated/forced through Engineering Workstation interface and checked, using proper electrical instrumentation, the status of the signal on the corresponding terminal strip.			
REF. DOCUMENTS				
PROCEDURE	Verify that each digital input signal value corresponds to the same internal signal value on Engineering Workstation interface. Verify that each digital output			

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	signal value generated on Engineering Workstation interface corresponds to the value measured on corresponding terminal strip.			
EXPECTED RESULT	No mismatch occurs during acquisition and generation of digital signals.			
TEST RESULTS	PASS ☐	FAI☐		
COMMENTS				
TEST DATE :				
CLOSED DATE :				
	Vendors			
	Signature	Signature	Signature	Signature

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8.3.3 TEST Form 1.3 - **Hard Link analog Input/Output test**				
Vendor REFERENCE :				
PROJECT :		**System :**	PAS	Rev. 0
Item Description:	Hard Link analog Input/Output test			
PRELIMINARY				
SCOPE	Verify the communication for all analog signals acquired and generated by EMCS on Engineering Workstation interface. Verify that it is possible to read and write signals as specified in Signal List: • "read" signals will be generated/forced by an proper electrical instrumentation on the terminal strip and checked the corresponding internal signal on Engineering Workstation interface. • "write" signals will be generated/forced through Engineering Workstation interface and checked, using proper electrical instrumentation, the status of the signal on the corresponding terminal strip.			
REF. DOCUMENTS				

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PROCEDURE	Verify that each analog input signal value corresponds to the same internal signal value on Engineering Workstation interface. Verify that each analog output signal value generated on Engineering Workstation interface corresponds to the value measured on corresponding terminal strip.			
EXPECTED RESULT	No mismatch occurs during acquisition and generation of analog signals.			
TEST RESULTS	PASS ☐ FAI☐			
COMMENTS				
TEST DATE :				
CLOSED DATE :				
	Vendors			
	Signature	Signature	Signature	Signature

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8.3.4 TEST Form 1.4 - **Redundancy EMCS test**				
Vendor REFERENCE :				
PROJECT :		**System :**	EMCS	Rev. 0
Item Description:	Redundancy EMCS test			
PRELIMINARY	The EMCS is composed by two different Control System working in redundant mode.			
SCOPE	Verify the EMCS can work properly during a fault of one of its control system. Verify that the alive control system ensures the proper operations of the EMCS trying to write digital and analog output signals and check, using proper electrical instrumentation, if the signals are generated properly.			
REF. DOCUMENTS				
PROCEDURE	Write the digital and analog output signals through Engineering Workstation interface and verify that them are generated properly, measuring them with an			

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	electrical instrumentation on terminal strip.			
EXPECTED RESULT	No mismatch occurs during generation of digital and analog output signals.			
TEST RESULTS	PASS ☐ FAI☐			
COMMENTS				
TEST DATE :				
CLOSED DATE :				
	Vendors			
	Signature	Signature	Signature	Signature

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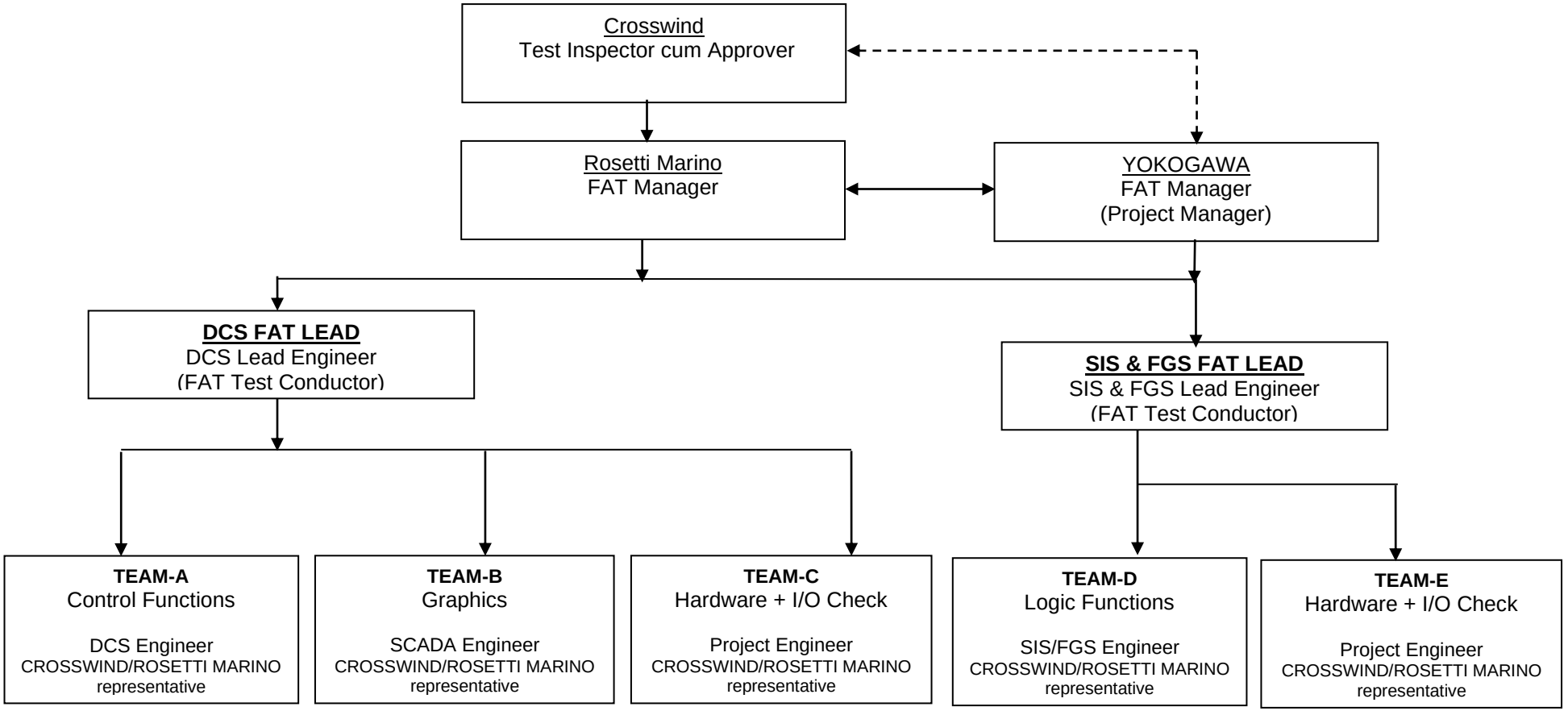
9 Appendices

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9.1 FAT Organization Chart

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FAT ORGANIZATION



Note: Team C & E shall conduct Hardware FAT

9.2 FAT Schedule

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PSC, SIS and FGS FAT Schedule

Task Name	Duration	Start	Finish
FAT HW	1wk	04/10/24	11/10/24

9.3 Approved Document List (Detail Design Specification)

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A Input Document

S/N	DOCUMENT TITLE	DOC. NO.	REV NO.
A.1.1	Electrical Control, Protection and Metering Diagrams	123A90-DDL-EL-DG-20014	01
A.1.2	Overall-Key Single Line Diagram	123A90-DDL-EL-DG-20158	02
A.1.3	Electrical Single Line Diagram HV Systems	123A90-DDL-EL-DG-20185	01
A.1.4	BASE LOAD POWER HUB (BLPH) - 66kV Switchgear (GIS) - Single line diagram	1723001595-EL-DG-00013	03
A.1.5	SG-100D1 HV SWBD 6,6kV - ELECTRICAL SINGLE LINE DIAGRAM	1723002197-EL-DG-00010	02
A.1.6	SG-200N1 LV SWBD 400-230V ELECTRICAL SINGLE LINE DIAGRAM	1723002197-EL-DG-00011	03
A.1.7	SG-200D2-LV SWBD 800V-ELECTRICAL SINGLE LINE DIAGRAM	1723002197-EL-DG-00012	02
A.1.8	DC UPS - SINGLE LINE DIAGRAM and INTERCONNECTING DIAGRAM	1724000372-EL-DG-00006	01
A.1.9	AC UPS - SINGLE LINE DIAGRAM and INTERCONNECTING DIAGRAM	1724000372-EL-DG-00007	00
A.1.10	BASE LOAD POWER HUB - OFFSHORE ITER - EQUIPMENT LAYOUT	123A90-DDL-IN-DL-40012	02
A.1.11	Master Alarm Database	123A90-DDL-IN-LIS-40027	00
A.1.12	Instrument I-O List	123A90-DDL-IN-LIS-40089	03
A.1.13	SG-200N1 IO LIST - Lv Switchgear	1723002197-EL-LIS-00042	01
A.1.14	DC UPS IO LIST	1724000372-EL-LIS-00014	02
A.1.15	IO LIST - INSTRUMENT AIR PACKAGE	1724000428-IN-LIS-00016	03
A.1.16	IO LIST - NITROGEN GENERATION PACKAGE U-64000	1724000437-IN-LIS-00015	03
A.1.17	PACKAGE PID - INSTRUMENT AIR PACKAGE	1724000428-PR-PID-00019	02
A.1.18	PACKAGE PID - NITROGEN GENERATION PACKAGE	1724000437-PR-PID-00018	02
A.1.19	WATER TREATMENT PACKAGE-PID DIAGRAM	1724000448-PR-PID-00013	01
A.1.20	BLPH UTILITY FLOW DIAGRAM WATER TREATMENT PLANT	ROSMA-INN-BPH-DWG-00008	01
A.1.21	BLPH UTILITY FLOW DIAGRAM INSTRUMENT AIR AND NITROGEN SYSTEMS	ROSMA-INN-BPH-DWG-00009	01
A.1.22	BLPH UTILITY FLOW DIAGRAM VENT SYSTEMS	ROSMA-INN-BPH-DWG-00010	01
A.1.23	BLPH PIPING AND INSTRUMENTATION DIAGRAM GENERAL NOTES	ROSMA-INN-BPH-DWG-00031	02

S/N	DOCUMENT TITLE	DOC. NO.	REV NO.
A.1.24	BLPH PIPING AND INSTRUMENTATION DIAGRAM PIPING SYMBOLOGY	ROSMA-INN-BPH-DWG-00032	02
A.1.25	BLPH PIPING AND INSTRUMENTATION DIAGRAM ELECTROLYSER PACKAGE	ROSMA-INN-BPH-DWG-00033	02
A.1.26	BLPH PIPING AND INSTRUMENTATION DIAGRAM FUEL CELL PACKAGE	ROSMA-INN-BPH-DWG-00034	02
A.1.27	BLPH PIPING AND INSTRUMENTATION DIAGRAM HYDROGEN STORAGE VESSELS HEADER (INLET)	ROSMA-INN-BPH-DWG-00035	02
A.1.28	BLPH PIPING AND INSTRUMENTATION DIAGRAM HYDROGEN STORAGE VESSELS HEADER (OUTLET)	ROSMA-INN-BPH-DWG-00036	02
A.1.29	BLPH PIPING AND INSTRUMENTATION DIAGRAM HYDROGEN STORAGE VESSEL A	ROSMA-INN-BPH-DWG-00037	02
A.2.1	BLPH PIPING AND INSTRUMENTATION DIAGRAM SEA-WATER INTAKE SYSTEM SHEET 1	ROSMA-INN-BPH-DWG-00038	02
A.2.2	BLPH PIPING AND INSTRUMENTATION DIAGRAM SEA-WATER INTAKE SYSTEM SHEET 2	ROSMA-INN-BPH-DWG-00039	02
A.2.3	BLPH PIPING AND INSTRUMENTATION DIAGRAM WATER TREATMENT PLANT SHEET 1	ROSMA-INN-BPH-DWG-00040	02
A.2.4	BLPH PIPING AND INSTRUMENTATION DIAGRAM WATER TREATMENT PLANT SHEET 2	ROSMA-INN-BPH-DWG-00041	02
A.2.5	BLPH PIPING AND INSTRUMENTATION DIAGRAM WATER DISPOSAL SHEET 1	ROSMA-INN-BPH-DWG-00042	02
A.2.6	BLPH PIPING AND INSTRUMENTATION DIAGRAM WATER DISPOSAL SHEET 2	ROSMA-INN-BPH-DWG-00043	02
A.3.1	BLPH PIPING AND INSTRUMENTATION DIAGRAM INSTRUMENT AIR PACKAGE	ROSMA-INN-BPH-DWG-00044	02
A.3.2	BLPH PIPING AND INSTRUMENTATION DIAGRAM HYDROGEN VENT HEADER	ROSMA-INN-BPH-DWG-00045	02
A.3.3	BLPH PIPING AND INSTRUMENTATION DIAGRAM Instrument air distribution header	ROSMA-INN-BPH-DWG-00046	02
A.3.4	BLPH PIPING AND INSTRUMENTATION DIAGRAM instrumentation SYMBOLOGY	ROSMA-INN-BPH-DWG-00047	02
A.3.5	BLPH PIPING AND INSTRUMENTATION DIAGRAM HYDROGEN VENT DRUM	ROSMA-INN-BPH-DWG-00061	02
A.3.6	BLPH PIPING AND INSTRUMENTATION DIAGRAM HYDROGEN STORAGE VESSEL B	ROSMA-INN-BPH-DWG-00062	02
A.3.7	BLPH PIPING AND INSTRUMENTATION DIAGRAM HYDROGEN STORAGE VESSEL C	ROSMA-INN-BPH-DWG-00063	02
A.3.8	BLPH PIPING AND INSTRUMENTATION DIAGRAM HYDROGEN STORAGE VESSEL D	ROSMA-INN-BPH-DWG-00064	02
A.3.9	BLPH PIPING AND INSTRUMENTATION DIAGRAM HYDROGEN STORAGE VESSEL E	ROSMA-INN-BPH-DWG-00065	02
A.3.10	BLPH PIPING AND INSTRUMENTATION DIAGRAM HYDROGEN STORAGE VESSEL F	ROSMA-INN-BPH-DWG-00066	02
A.4.1	BLPH PIPING AND INSTRUMENTATION DIAGRAM -	ROSMA-INN-BPH-DWG-	00

S/N	DOCUMENT TITLE	DOC. NO.	REV NO.
	OPEN DRAIN SYSTEM	00306	
A.4.2	BALLARD - BLPH Project - P&IDs	K559-2254-CWIWP4202202-C03-001	04
A.4.3	ELOGEN BLPH Project - Process and Instrumentation Diagrams	K559-2254-CWIWP4202302-C03-001	07
A.4.4	Process Safety Cause and Effect Matrix	ROSMA-INN-BPH-REG-00007	02
A.4.5	Fire and Gas Cause and Effect Matrix	ROSMA-INN-BPH-REG-00021	01

B Yokogawa Deliverables

S/N	DOCUMENT TITLE	DOC. NO.	REV NO.
B1.	Bill of Material	1724000594-IN-LIS-00003	02
B2.	PCS and Safety System IO List (HW and SW)	1724000594-IN-LIS-00004	03
B3.	EMCS IO List (HW and SW)	1724000594-IN-LIS-00005	00
B4.	Power Consumption and Heat Dissipation	1724000594-IN-CA-00006	01
B5.	Systems Cables List	1724000594-IN-LIS-00007	01
B6.	Safety Controller loading estimation	1724000594-IN-RE-00008	01
B7.	PCS CABINETS GENERAL ARRANGEMENT DRAWINGS AND INTERNAL LAYOUT	1724000594-IN-DA-00009	02
B8.	SAFETY SYSTEMS CABINETS (SIS AND FGS) GENERAL ARRANGEMENT DRAWINGS AND INTERNAL LAYOUT	1724000594-IN-DA-00010	01
B9.	NETWORK AND SERVER CABINETS IN ITER ROOM GENERAL ARRANGEMENT DRAWINGS AND INTERNAL LAYOUT	1724000594-IN-DA-00011	02
B10.	NETWORK AND SERVER CABINETS IN OER ROOM GENERAL ARRANGEMENT DRAWINGS AND INTERNAL LAYOUT	1724000594-IN-DA-00012	02
B11.	EMCS CABINETS GENERAL ARRANGEMENT DRAWINGS AND INTERNAL LAYOUT	1724000594-IN-DA-00013	01
B12.	Project Execution Plan (PEP)	1724000594-PM-PL-00014	01
B13.	System Architecture	1724000594-IN-DD-00015	03
B14.	Network Connection Diagram	1724000594-IN-DG-00016	01
B15.	PAS Hardware Functional Design Specification (FDS-HW)	1724000594-IN-SP-00017	01
B16.	PCS and SAFETY SISTEMS Software Functional Design Specification (FDS-SW)	1724000594-IN-SP-00018	01
B17.	EMCS Software Functional Design Specification (FDS-SW)	1724000594-IN-SP-00019	02
B18.	PCS CABINETS WIRING DIAGRAMS AND TERMINAL STRIPS	1724000594-IN-DG-00020	01
B19.	SAFETY SYSTEMS CABINETS (SIS AND FGS) WIRING DIAGRAMS AND TERMINAL STRIPS	1724000594-IN-DG-00021	01

S/N	DOCUMENT TITLE	DOC. NO.	REV
B20.	NETWORK AND SERVER CABINETS IN ITER ROOM WIRING DIAGRAMS AND TERMINAL STRIPS	1724000594-IN-DG-00022	01
B21.	NETWORK AND SERVER CABINETS IN OER ROOM WIRING DIAGRAMS AND TERMINAL STRIPS	1724000594-IN-DG-00023	01
B22.	EMCS CABINETS WIRING DIAGRAMS AND TERMINAL STRIPS	1724000594-IN-DG-00024	01
B23.	Logic diagram print out PCS	1724000594-IN-DG-00025	00
B24.	Logic diagram print out SIS and FGS	1724000594-IN-DG-00026	00
B25.	Logic diagram print out EMCS	1724000594-IN-DG-00027	00
B26.	HMI screens print out	1724000594-IN-DD-00028	01
B27.	Safety Validation Plan (SVP)	1724000594-IN-PL-00029	00
B28.	HW FACTORY ACCEPTANCE TEST (FAT) PROCEDURE	1724000594-QC-PRO-00030	01
B29.	SW FACTORY ACCEPTANCE TEST (FAT) PROCEDURE	1724000594-QC-PRO-00031	00
B30.	Site Acceptance Test (SAT) PROCEDURE	1724000594-QC-PRO-00032	00
B31.	THIRD PARTY COMMUNICATION TEST PROCEDURE	1724000594-IN-LIS-00003	02
B32.	INSTALLATION, OPERATING AND MAINTENANCE MANUAL (IOM)	1724000594-IN-MAN-00037	01
B33.	SPARE PART INDEX REGISTER (COMMISSIONING AND 2-YEARs OPERATION)	1724000594-COM-LIS-00039	01
B34.	ATEX REGISTER	1724000594-IN-LIS-00036	01
B35.	VENDOR ASSET AND TAG REGISTER	1724000594-IN-LIS-00040	00
B36.	Instructions for Operation and Maintenance for ProSafe-RS	1724000594-IN-MAN-00038	01
B37.	Cyber Security Risk Assessment REPORT	1724000594-IN-RE-00035	01
B38.	Cybersecurity Workshop Preparation	1724000594-IN-RE-00041	00
B39.	CYBER SECURITY SETTINGS	1724000594-IN-RE-00043	00

S/N	DOCUMENT TITLE	DOC. NO.	REV
B40.	SUPPLIER MASTER INDEX REGISTER (SMIR)	1724000594-MD-LIS-00001	04
B41.	MANUFACTURERS RECORD BOOK (FINAL DOSSIER)	1724000594-QC-DB-00033	00
B42.	INSPECTION AND TEST PLAN	1724000594-QC-ITP-00002	01
B43.	MANUFACTURERS RECORD BOOK (FINAL DOSSIER) - INDEX	1724000594-QC-LIS-00034	01

Note: Refer to Vendor Doc list document, document no. 1724000594-MD-LIS-00001 for all other list of Yokogawa project documents.

9.4 FAT Test Equipment Records

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Test Equipment Record

No.	Test Equipment Description	Manufacturer And Model	Serial No.	Test Cert. No.	Expiry Date
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					

COMMENTS:

Verified By: _____ Date: _____
Crosswind / Rosetti Marino

9.5 FAT Check sheet for PCS Hardware

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Reference No: _____

System Cabinet Check

Cabinet Number :

Description	NA	Checked		Remarks / Punch No.
		Front	Rear	
1 FCS Appearance and Construction Check				
1.1 General Construction				
- Lifting Construction, Plinth, Bakelite				
- Color				
- Side Panel				
1.2 Internal Layout				
- FCU Mounting and termination				
- ESB Bus Node Unit - IO module quantity				
1.3 Doors				
- Handle and document pocket				
1.4 Labeling				
- Cabinet				
- Devices & interface boards				
- Terminals, Earth bars etc.				
1.5 Earthing				
- Bolt type & locations				
- Wire types				
- connection to doors and devices				
1.6 Cable Routing				
- Vnet/IP Bus				
- ESB Bus, Optical ESB Bus				
- N-ESB Bus				
- System Cable (e.g., KS1, AKB331 and AKB336)				
1.7 Signal terminations				
- Terminal and wiring types, spare				
1.8 Power Distribution				
- Isolators and Circuit Breakers				
- Fuse terminal and rating				
1.9 Others				
- Fan and thermostat				
2 FCS Nest Loading Check				
- FCS Station No. (Front): _____				
- FCS Station No. (Rear): _____				
3 System Startup Test				
4 CPU Backup Test				
- Left CPU				
- Right CPU				
5 FIO Bus Redundancy Test				
- ESB Bus1				
- ESB Bus2				
- N-ESB Bus1				
- N-ESB Bus2				
- F-SB Bus1				
- F-SB Bus2				

Responsible Party	Representative	Date:	Signature
YOKOGAWA			
ROSETTI MARINO			
CROSSWIND			

System Cabinet Check

Cabinet Number :

Description	NA	Checked		Remarks / Punch No.
		Front	Rear	
6 FCS Power Supply Module Redundancy Test				
6.1 FCU Power Supply				
- PW48x Left				
- PW48x Right				
6.2 ESB Node Power Supply				
- Node 2 (FIO)				
- Node 3 (FIO)				
- Node 4 (FIO)				
- Node 5 (FIO)				
- Node 6 (FIO)				
6.3 N-IO Node Interface Unit				
- Node 1 (N-IO)				
- Node 2 (N-IO)				
- Node 3 (N-IO)				
- Node 4 (N-IO)				
- Node 5 (N-IO)				
- Node 6 (N-IO)				
7 Vnet/IP Bus Redundancy Test				
Vnet/IP Bus1				
Vnet/IP Bus2				
8 FCS Resource Capacity Test				
FCS Front Capacity : %				
FCS Rear Capacity : %				
9 FCS CPU Loading Tests				
FCS Front Capacity : %				
FCS Rear Capacity : %				
10 Online / Offline Loading Test				

Responsible Party	Representative	Date:	Signature
YOKOGAWA			
ROSETTI MARINO			
CROSSWIND			

Reference No: _____

Marshalling Cabinet Check

Cabinet Number :

Description	NA	Checked		Remarks / Punch No.
		Pass	Fail	
1 Physical Check				
1.1 General Construction				
- Lifting Construction, Plinth, Bakelite				
- Color				
- Side Panel				
1.2 Internal Layout				
- Interface Board				
- Accessories				
1.3 Doors				
- Handle and document pocket				
1.4 Labeling				
- Cabinet				
- Devices & interface boards				
- Terminals, Earth bars etc.				
1.5 Earthing				
- Bolt type & locations				
- Wire types				
- connection to doors and devices				
1.6 Cable Routing				
- System cables				
- Field cables from Junction Boxes				
1.7 Signal terminations				
- Terminal and wiring types, spare				
1.8 Power Distribution				
- Isolators and Circuit Breakers				
- Fuse terminal and rating				
1.9 Others				
- Fan, thermostat, Telephone jack & Utility Socket				
2 Cabinet Temperature Check				
3 Power Supply and ELM check				
- Power Supply (Front)				
Voltage Check (PSU1only) : VDC				
Ripple Check (PSU1 only) : mV				
Voltage Check (PSU2only) : VDC				
Ripple Check (PSU2 only) : mV				
ELM Check				
- Power Supply (Rear)				
Voltage Check (PSU1only) : VDC				
Ripple Check (PSU1 only) : mV				
Voltage Check (PSU2only) : VDC				
Ripple Check (PSU2 only) : mV				
ELM Check				
4 Functional check				
4.1 LED Check				

Responsible Party	Representative	Date:	Signature
YOKOGAWA			
ROSETTI MARINO			
CROSSWIND			

Reference No: ____________________

Media Backup/Restore Function Test

Description		NA	Checked		Remarks / Punch No.
			Pass	Fail	
1	**Media Backup Function Test**				
1.1	Start Back-up				
1.2	Backup completed				
	Error Message (if any):				
2	**Media Restore Function Test**				
2.1	Start Restore of data				
2.2	Restore completed				
	Error Message (if any):				

Responsible Party	Representative	Date:	Signature
YOKOGAWA			
ROSETTI MARINO			
CROSSWIND			

Reference No: _____

Server Cabinet

Cabinet Number :

Description	NA	Checked		Remarks / Punch No.
		Pass	Fail	
1 Physical Check				
1.1 General Construction				
- Lifting Construction, Plinth, Bakelite				
- Color				
- Side Panel				
1.2 Internal Layout				
- Interface Board				
- Accessories				
1.3 Doors				
- Handle and document pocket				
1.4 Labeling				
- Cabinet				
- Devices & interface boards				
- Terminals, Earth bars etc.				
1.5 Earthing				
- Bolt type & locations				
- Wire types				
- connection to doors and devices				
1.6 Cable Routing				
- System cables				
- Field cables from Junction Boxes				
1.7 Signal terminations				
- Terminal and wiring types, spare				
1.8 Power Distribution				
- Isolators and Circuit Breakers				
- Fuse terminal and rating				
1.9 Others				
- Fan, thermostat, Telephone jack & Utility Socket				
2 Cabinet Temperature Check				
3 Functional check				
3.1 KVM Console/Extender test				
- Selection of PC / Server from KVM Console				
- KVM extension via KVM Extender				

Responsible Party	Representative	Date:	Signature
YOKOGAWA			
ROSETTI MARINO			
CROSSWIND			

Reference No: _____

Network Cabinet

Cabinet Number :

Description	NA	Checked		Remarks / Punch No.
		Pass	Fail	
1 Physical Check				
1.1 General Construction				
- Lifting Construction, Plinth, Bakelite				
- Color				
- Side Panel				
1.2 Internal Layout				
- Interface Board				
- Accessories				
1.3 Doors				
- Handle and document pocket				
1.4 Labeling				
- Cabinet				
- Devices & interface boards				
- Terminals, Earth bars etc.				
1.5 Earthing				
- Bolt type & locations				
- Wire types				
- connection to doors and devices				
1.6 Cable Routing				
- System cables				
- Field cables from Junction Boxes				
1.7 Signal terminations				
- Terminal and wiring types, spare				
1.8 Power Distribution				
- Isolators and Circuit Breakers				
- Fuse terminal and rating				
1.9 Others				
- Fan, thermostat, Telephone jack & Utility Socket				
2 Cabinet Temperature Check				
3 Power Supply and ELM check				
- Power Supply (Front)				
Voltage Check (PSU1only) : VDC				
Ripple Check (PSU1 only) : mV				
Voltage Check (PSU2only) : VDC				
Ripple Check (PSU2 only) : mV				
4 Functional check				
4.1 Ethernet switch test				
- L2 Switch				
- L3 Switch				
4.2 FO converter test				

Responsible Party	Representative	Date:	Signature
YOKOGAWA			
ROSETTI MARINO			
CROSSWIND			

9.6 FAT Check sheet for SIS & FGS Hardware

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Reference No: ____________________

EWS/SOE Workstation Check

Station Number :

Description	NA	Checked		Remarks / Punch No.
		Pass	Fail	
1 PC Model				
Monitor				
Vnet/IP interface card (VI702)				
Domian:				
Station:				
Operation System (OS)				
Product Key				
Prosafe-RS system				
Version:				
License ID:				
License Details:				

Responsible Party	Representative	Date:	Signature
YOKOGAWA			
ROSETTI MARINO			
CROSSWIND			

SIS System Architecture and BOM Check

Description	NA	Checked		Remarks / Punch No.
		Pass	Fail	
1 System Architecture Check				
(As per reference document)				
2 Bill of Materials Check				
(As per reference document)				

Responsible Party	Representative	Date:	Signature
YOKOGAWA			
ROSETTI MARINO			
CROSSWIND			

SIS IO Nestloading and System Cable schedule Check

Description	NA	Checked		Remarks / Punch No.
		Pass	Fail	
1 IO Assignment/Nest Loading Check				
(As per reference document)				
2 System Cable Schedule Check				
(As per reference document)				

Responsible Party	Representative	Date:	Signature
YOKOGAWA			
ROSETTI MARINO			
CROSSWIND			

9.7 FAT Punch Record Ledger & Punch Record Form

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FAT PUNCH RECORD	Punch Record No.	Date
Process Area:	**System:**	

Please enter all fields or indicate 'Not Applicable' where appropriate

Test reference / item:	**Classification :** **Correction (Code C)** ☐ **Modification (Code M)** ☐

Punch Item description: **(Attach Separate sheets/attachments, if necessary)**

Related to: **Hardware** ☐ **Software** ☐ **Documentation** ☐

Details of change required: **(Attach Separate sheets/attachments, if necessary)**

Tester (Name)	**Signature**	**Date**
Witness (Name)	**Signature**	**Date**

Repeat the test? : **YES** ☐ **NO** ☐

If NO, reason: _____

Resolution: **(Attach Separate sheets/attachments, if necessary)**

FAT CLOSURE APPROVAL SIGNATORIES BY :

	Names	Company	Signatures	Date
Prepared By		YOKOGAWA		
Witnessed By		ROSETTI MARINO		
Approved By		CROSSWIND		

SAMPLE

FAT PUNCH LEDGER

Customer Group: _____
Project: _____
Record Date: _____

Recorded By: _____
Witnessed By: _____

Punch Record No.	Punch Description	Cause (C/M)	Initiated by	Action By	Date of Completion	Re-test By (MAC)	Witnessed by (EPC/End-User)

Legend for cause column:
C = Correction, items is to be corrected by YOKOGAWA
M = Modification, items is to be modified, deleted or added due to design input changes

SAMPLE

YOKOGAWA	Appendix 8.9 - FAT Punch Record (SIS FGS) SIS Punch Record	Ref. No.

Project No.		Project Name	
Contractor			
EPC Subcontractor			
Employer			
System		Proc.Area/Unit	
Stage		Controller No.	

Punch Description

Noted By		Approved By		Date		Category	
Proposed/Agreed Solution						Action By	

Impact Analysis

Impacted Aspects	☐ Hardware	☐ Software	☐ Documentation	☐ Graphics	☐ Other Non-Safety Items	☐ No Impact

Safety Related		Re-Test Required?		Impact Analysis By	

Impacted Documents and Revision Details

Punch Record Status

Status			
Implemented By		Verified/Tested By	
Implemented Version (VC)			

Yokogawa	Sign		Rosemetti Marino	Sign		Crosswind	Sign	
	Name			Name			Name	
	Date			Date			Date	

Notes:
1) Safety Impact defined by any hardware or software change in the safety path of the applicable SIF.
2) Detailed Impact analysis shall be elaborated in Impact analysis section including Impacted Documents with Revision Details.
3) Punch Description should include summary of the issue including deviations to project specifications - if any.

YOKOGAWA

SIS Punch Record Summary

Project No.		Project Name	
Contractor		EMPLOYER	

Sl. No.	Punch Record Reference No	Date	Stage	System	Punch Description	Category	Action By	Safety Related	Proposed / Agreed Solution	Punch Status

Yokogawa **Rosematti Marino** **Crosswind**

9.8 FAT Completion Certificate

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FACTORY ACCEPTANCE TEST COMPLETION CERTIFICATE

JOB NAME	:	BASE LOAD POWER HUB
END USER	:	CROSSWIND
CUSTOMER	:	ROSETTI MARINO
PLANT	:	OFFSHORE HKN WIND FARM
SYSTEM DESCRIPTION	:	PCS/SIS/FGS INTEGRATED WITH CI SERVER

This is to certify that it is mutually agreed by all parties that the Factory Acceptance Test for PCS/SIS/FGS [Hardware] has been completed to the satisfaction of all parties concerned.

[Remarks]

_____

_____

_____

Signed in agreement by;

YOKOGAWA : _____ Date: _____

ROSETTI MARINO : _____ Date: _____

CROSSWIND : _____ Date: _____

9.9 Shipping Release Note

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SHIPPING RELEASE NOTE

JOB NAME	:	BASE LOAD POWER HUB
END USER	:	CROSSWIND
CUSTOMER	:	ROSETTI MARINO
PLANT	:	OFFSHORE HKN WIND FARM
SYSTEM DESCRIPTION	:	PCS/SIS/FGS INTEGRATED WITH CI SERVER

This is to certify that the FIO equipment's for this project can be released for shipment.

[Remarks]

_____

_____

_____

Signed in agreement by;

Crosswind/Rosetti Marino : _____ Date: _____