

GENERAL SPECIFICATION

FIELD OPERATIONS

GS EP EXP 137

OCWR specification

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1. Scope

1.1 Purpose

This specification describes the minimum requirements for an Overall Control of Wells and Risers (OCWR) system. OCWR is a generic term which covers a set of control algorithms implemented in the Process Control System (PCS) to assist the operator in the control and production of complex subsea systems.

This specification has to be considered in conjunction with project documents which describe the subsea and topside systems, the Operating philosophy for the field, and the extent of automatic sets to be developed for the operation of a subsea system. These documents shall provide additional inputs to this specification to supplement it by a detailed specification which describes all the functional requirements, operating logics and constraints which are specific of a given subsea field.

1.2 Application

This document describes the minimum functionalities of an OCWR system.

This specification only covers subsea production systems which are designed as production loops.

This specification does not cover the case where subsea production wells produce into subsea processing modules (separator, multiphase pump...).

Methanol is considered as the hydrate inhibitor. The use of glycol or low dosage hydrate inhibitor is not developed in this document.

2. Reference documents

The reference documents listed below form an integral part of this General Specification.

External Documents

Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and supplements, is the latest revision published at the effective date of this document.

Reference	Title
Not applicable	

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Total General Specifications

Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and supplements, is the latest revision published in the applicable yearly collection.

Reference	Title
GS EP INS 134	Design and supply of integrated control and safety systems
GS EP INS 150	Design method for system configuration - Standard Functions
GS EP INS 198	Safety and Fire & Gas Standard Functions

3. Glossary

For the purpose of this document, the following terms and definitions apply:

3.1 Abbreviations

AMV	Annulus Master Valve
CCR	Central Control Room
CIV	Chemical Injection Valves
DHP	Down Hole Pressure
DHSV	Down Hole Safety Valve
ESD	Emergency Shutdown
GIWCM	Gas Injection Well Control Module
GL	Gas-Lift
HMI	Human Machine Interface
ICSS	Integrated Control and Safety System
IMV	Injection Master Valve
IWV	Injection Wing Valve
LPCM	Loop Preservation Control Module
MeOH	Methanol
MLV	Manifold Loop Valve
OCWR	Overall Control of Wells and Risers
PCS	Process Control System
PLFR	Production Liquid Flow Rate
PSS	Process Shutdown System
PMV	Production Master Valve
POCM	Production Overall Control Module
PRCM	Production Riser Control Module

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PWCM	Production Well Control Module
PWV	Production Wing Valve (Control and Safety)
RBP	Riser bottom pressure
RCHK	Riser head Choke valve(s)
SCU	Subsea Control Unit
SD	Shutdown
SDV	Shutdown Valve
SLD	Safety Logic Diagram
WCHK	Well Choke valve
WHP	Well Head Pressure
WIOCM	Water Injection Overall Control Module
WIWCM	Water Injection Well Control Module

3.2 Terminology

Branch: generic term which describes a set consisting in one riser, its allocated wells and the associated flow lines.

Gas-Lifted (riser): a riser in which Gas-Lift (GL) is injected at riser base, for start-up, activation or stabilization purpose.

Gassing: massive GL injection at riser base with Riser head Choke valve(s) (RCHK) closed to pressurize it.

Kick off: following to “gassing” operation; RCHK is quite opened and GL injection is maintained in order to unload the riser of its liquid content prior to the ramp-up step.

Load shedding: OCWR strategy which consists in a succession of risers and/or wells closure according to a predefined order to prevent a topside safety trip in case of topside capacities saturation.

Module: part of the OCWR system implemented into the PCS. A module manages a dedicated field element (production well, production riser, water injection well, production loop for preservation sequences...).

Natural (riser): non Gas-Lifted riser is defined as “natural”.

Parameter: element which has to be programmed and initialized in automate, mainly by an operator or an engineer (depends of level access).

Preservation: set of operations to be performed on subsea systems (production well, flow line and riser) to prevent hydrate risk for planned and unplanned shutdown (SD) scenario.

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Process limitation: specific process constraints on topside systems which can lead to a safety trip.

Severe slugging: periodic multiphase flow phenomenon with accumulation of liquid at riser base which results in large fluctuations of pressure, and liquid and gas feed to the topside facilities.

Strategy: predefined operating logic which reflects the systems constraints and specificities.

Tracking: OCWR control module operating phase where OCWR commands are realigned with safety status.

4. OCWR objectives & development principles

4.1 Objectives

OCWR is a tool whose main objectives shall be:

- To support Central Control Room (CCR) operations for complex subsea production and injection networks, and to reduce the overall workload of the CCR operators.
- To improve subsea production operations in terms of reliability and efficiency by performing systematic and recurrent actions which take into account the specificities and constraints of a given field and subsea infrastructure.

The main OCWR objectives shall be as follows:

For production operations:

- To help to sustain a maximum regular production rate to the topside during steady state conditions and during transient operations such as flow increases and decreases, by:
 - Limiting flow instabilities as far as possible.
 - Preserving the near well bore area by preventing significant pressure variations.
 - Protecting subsea equipments against excessive wear.
 - Avoiding hydrate formation during wells start-up and preservation stages.
- To assist the operator in the management of flow assurance issues.
- To facilitate more efficient loop and field start-ups by assisting the operator via automatic management of key tasks.
- To help to minimise the frequency of topside installations trip, thanks to preventive corrective actions (load shedding).

For gas and water injection operations:

- To maintain an injection rate target for each well, while :
 - Taking topside facilities availability into account.
 - Preserving the near well bore area.
 - Protecting subsea equipments.

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- To help to minimise the frequency of topside installations trip, thanks to preventive corrective actions (load shedding).

For preservation operations:

- To facilitate more efficient loop and field preservation by assisting the operator via automatic management of key tasks.

4.2 Development principles

The main OCWR design principles shall be as follows:

- OCWR shall be a set of control algorithms to be implemented in the PCS. It shall systematically reproduce the operations that an operator would execute during manual operations.
- The information gathered by subsea and topside sensors shall enable OCWR to act on relevant actuators through :
 - Predefined established logics, integrating each system's constraints and specificities.
 - Parameters tables, allowing the operator to select options and to improve settings according to practical experience.
- OCWR should not require more sensors or actuators than actually needed for remote operation of subsea systems.
- It shall not have any status in term of performing safety-related functions. In all cases, safety functions shall supersede any OCWR actions. Yet safety logics shall be acknowledged by OCWR to realign the sequence accordingly.
- It shall manage neither subsea valves interlocks nor topside valves interlocks.
- It shall not manage the interlocks for the hydraulic supply to subsea systems.
- It shall be structured into distinct control modules which correspond to the equipments it has to control. In particular, each well and riser shall be controlled by its own control module.
- An overall control module (supervision module) shall monitor topside capacities to allow synchronisation of the actions between wells and risers.
- For specific cases where excessive complexity of subsea systems (methanol (MeOH) network for example) calls for an automation and supervision, specific modules could be developed to prevent undesirable operation of valves or systems.
- For each control module:
 - A set of parameters with a specific access shall allow adapting the OCWR strategies to life of field constraints.
 - A set of commands shall allow the operator to control the corresponding module and to activate selected functions.
- The operator shall be able to deactivate OCWR modules or strategies and to directly perform control actions.

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4.3 Strategies

Several strategies are defined into specific project documents: flow assurance strategy, sand management strategy, preservation strategy, production strategy ...

As detailed in § 3.2, for the OCWR point of view a strategy is a predefined operating logic which reflects the systems constraints and specificities.

Several OCWR strategies can be implemented according to projects requirements. Within the most important, production wells start-up strategy and hydrate inhibition strategy at production wells start-up shall be developed whatever the project.

4.3.1 Production wells start-up strategy

OCWR main aim for production loops shall be to manage branches start-up, one by one.

An automatic branch start-up consists in the simultaneous start-up of a riser and of its allocated wells, with respect of each equipment constraints.

When a riser is into its start-up phase, the OCWR shall initiate a wells start-up strategy. This strategy shall:

- Run in parallel with the opening of the RCHK.
- Manage start-up of the required wells (**NOTE**), one by one, according to an order defined into a parameters table.

Branch start-up is considered finished when both the riser and all the required wells have finished their own start-up phase.

Once it is finished, riser and wells are in production phase and they try to reach their functional set point.

When riser is in production, wells start-up strategy shall still be active for wells that are not started yet.

NOTE:

Wells start-up strategy shall give start-up order to wells under OCWR control, that are allocated to this riser and ready to start (please refer to § 5.1.2.2).

4.3.2 Hydrates inhibition strategy at production wells start-up

Hydrate inhibition during production well start-up shall be based on:

- The monitoring of temperatures along the whole branch.
- And the knowledge of production wells water cut.

In case of warm start-up or water free start-up, no methanol injection is required.

Else, the MeOH rate requirement shall be defined as a function of hydrate inhibition strategy.

The MeOH flow rate injected is a combination of the type of valve chosen, or the number of valves to be open, or its opening if adjustable injection valve and the MeOH network pressure vs. well flowing pressure.

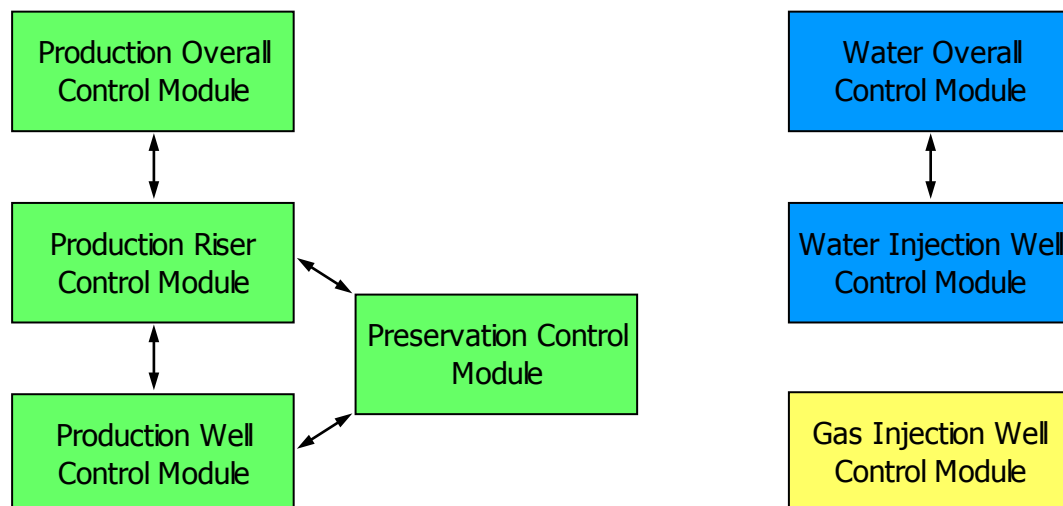
It shall be the operator responsibility to define the flow rate injection set point and the well methanol injection valves (MIV) to be used for production water inhibition at start-up.

OCWR shall neither control nor guarantee MeOH injected quantity.

OCWR shall only manage the opening of the well MIV at start-up and their closure when temperature monitored along the flow path from Xmas tree to topside riser is high enough.

5. OCWR specification

The main OCWR structure shall be as defined in the following diagram:



Arrows represent information exchanges and / or command orders.

NOTES:

- A “Gas Overall control Module” may be developed according to gas injection network complexity and the number of gas injection wells.

5.1 Production Well Control Module (PWCM)

One module shall be developed per production well.

5.1.1 Objectives

The main PWCM objectives shall be:

- To assist the operator in the reopening of well shutdown valves (SDV): Down Hole Safety Valve (DHSV), Production Master Valve (PMV), and Annulus Master Valve (AMV).
- To start the well (opening of Production Wing Valve (PWV)) and ramp-up the well according to predefined criteria for full respect of reservoir, sand control, flow assurance and topside limitations.
- To maintain a predefined production target which accounts for reservoir, flow assurance and topside limitation.