



FLARING MANAGEMENT PLAN - OFFSHORE FACILITIES

PLN - Plan

Document No.: X060-A1-PLN-60016
Security Classification: Unrestricted

Revision	Date	Status	Prepared	Endorsed	Approved
0	27/09/2016	Issued for Use	[REDACTED]	[REDACTED]	[REDACTED]

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1 Abbreviations and Acronyms

Abbreviation / Acronym	Definition
ALARP	As Low As Reasonably Practicable
CPF	Central Processing Facility
FMP	Flaring Management Plan
FPSO	Floating Production, Storage and Offloading (Facility)
HSE	Health, Safety and Environment
KPI	Key Performance Indicator
mmscfd	Million Standard Cubic Feet per Day
NOPSEMA	National Offshore Petroleum Safety and Environmental Management Authority
OIM	Offshore Installation Manager

2 Introduction

2.1 Purpose and Overview

The FPSO and CPF are provided with flare systems designed to cater for:

- Flaring for start-up
- Flaring due to equipment failure or process upset conditions;
- Pressure relief for individual items of equipment;
- Emergency depressurisation; and
- Manual blowdown for maintenance and inspections.

The use of these flare systems is required for continuous, safe operation of the Ichthys Offshore facilities. These are described further in Section 3.

Details of the control measures used to minimise these events flaring events are described in Section 4.

One key element is the use of an Adaptive Management Program. This program will be used to develop and continuously improve flaring targets for the Offshore facilities, and is further described in Section 5.

The purpose of this document is to describe how the Ichthys offshore facilities will manage flaring. In particular, the intent of this document is to:

- Provide an overview of control measures implemented to mitigate the potential environmental impacts of flaring from Offshore Ichthys facilities.
- Describe how an Adaptive Management Program will be applied to generate clear monthly and annual flaring targets.
- Detail how the flaring targets will be calculated, managed and reported.
- Provide specific instruction to the facilities on identified flaring scenarios, including approval levels required to exceed designated maximum flaring rates and volumes.

2.2 Scope

This document applies to the Ichthys CPF and FPSO for initial start-up and operations phase.

Phase 2 (booster compression) is excluded from the scope of this plan. The plan shall be revised in future to include it.

3 Flaring Scenarios

It is recognized that the flare systems are required to operate in some scenarios, to maintain the integrity of the facilities and to prevent harm to personnel, environment and equipment. The flare systems are designed to cater for:

- Flaring for start-up;
- Flaring due to equipment failure or process upset conditions;
- Pressure relief for individual items of equipment;
- Emergency depressurisation; and
- Manual blowdown for maintenance and inspections.

Flaring for start-up is required for several reasons. Firstly to avoid overpressure during the rapidly changing dynamics (flow in vs flow out) as high pressure gas is first introduced to the facility allowing steady state operating conditions to be safely reached. Secondly in order to condition (water dewpoint) the export gas prior to export via the 900km pipeline. Failure to correctly condition the gas will result in a significant corrosion risk which will greatly reduce the life of asset.

During steady state operations, continuous flaring is not expected. However, there are some scenarios where a process upset condition may require some flaring to prevent further escalation of the initiating event. For example, on the CPF, the off-gas recovery compressor system is provided to collect and recover off-gas from the facility to prevent continuous flaring. A trip within the system will result in temporary flaring until the initiating event is identified and resolved. A second example is a process upset condition of the CPF dehydration system causing the gas to exceed the required dew point specification for export. In such scenario, the gas is required to be flared temporarily while the issue is resolved, to protect the integrity of the downstream gas export pipeline. In both of these examples the short term process upset flaring results in a lower volume of gas burnt than initiating a trip and re-start.

Pressure relief and emergency blowdown flaring are provided to cater for process upset conditions and fire scenarios leading to high pressures within individual piping and equipment. The use of the flare system in this scenario is provided to prevent loss of containment from the process.

Manual blowdown of equipment is required to enable maintenance and inspections. These are critical to ensuring the long term integrity of the plant, and mitigate against harm to personnel, environment and assets from failures. Similarly, flaring may be required for flowlines or risers in order to inspect, repair or replace the risers or subsea equipment.

4 Control Measures to Minimise Flaring

The environmental impacts of flaring from the Ichthys Offshore Facilities are mitigated using the following measures to ensure that gas flaring is managed to a level required for safe and reliable production.

It is through the combination of these controls that the flaring levels will be reduced to lowest practical to operate the facilities.

Design and Commissioning

The facilities have been designed to minimise continuous flaring. Where flaring is required, flared gas will be combusted in an efficient manner and monitored at all times.

Systems will be leak tested prior to the introduction of hydrocarbons, such that systems are proved for leak tightness prior to commissioning or re-commissioning.

Systems have been provided to minimise the use of hydrocarbon gas for the flare systems and to improve the recovery of low pressure, low volume vent gas which on older facilities is continuously flared.

Procedures and Maintenance

Routine monitoring of the process plant will be undertaken by operators to identify external signs of potential damage to the processing equipment, and, if necessary, initiate appropriate management process.

Assets will be pro-actively managed using internal preventative maintenance and sparring strategies to ensure maximum availability of equipment required to reduce the amount of operational flaring.

The annual business plan cycle and management of the planned activities for the CPF and FPSO minimise the number of planned manual depressurisation events within the year by scheduling maintenance to minimise the number of shutdown events.

Start-up procedures have been developed with consideration to minimising flaring as far as practical.

Emission Monitoring and Reporting

Emissions will be monitored and reported in line with the National Greenhouse and Energy Reporting Act (2007)

Flaring Management Plan

Facilities will be operated in line with the Offshore Flaring Management Plan (this document), which comprises three types of controls:

1. Monthly flaring targets which are internal leading KPIs (non-reportable to regulator) and annual flaring target (reportable to the regulator);
2. Flaring Guidelines for specific identified events; and
3. Restriction on any continuous operational flaring for more than 72 hours without written approval from the [REDACTED].

➤ *Flaring Targets (Control 1 of Flaring Management Plan)*

An adaptive management program will be used to develop, monitor and continuously improve on flaring targets.

Regular reports against the monthly flaring targets will provide lead indicators of flaring performance, for internal review and management by INPEX. Monthly target exceedance will trigger an internal investigation, followed, if necessary, by an environmental risk assessment (to ascertain if the increase in flaring can result in environmental harm) and a review of flaring control measures.

The annual flaring target is a commitment, against which performance will be measured and reported to NOPSEMA.

Further detail on the adaptive management program is provided in Section 5.

➤ *Flaring Guidelines (Control 2 of Flaring Management Plan)*

In general, the intent is to provide the facilities with the flexibility to manage the assets as best possible in line with the flaring targets. However, it is recognised that there will be unplanned events which may require some flaring.

The Flare Management Plan provides guidance as to the volume and duration limits for different unplanned flaring events, the corrective action to be taken and the required approvals.

➤ *Restriction on Continuous Operational Flaring (Control 3 of Flaring Management Plan)*

There is a restriction on any continuous operational flaring for more than 72 hours without assessment of the risk and the written approval of the [REDACTED].

Notwithstanding the 72 hour restriction, the OIM shall take all reasonable steps to minimize flaring. The guidelines provided under the Flaring Management Plan support the OIM in determining the appropriate course of action in such scenarios. It is noted that prolonged flaring will lead to an exceedance of the monthly leading KPI, actions upon which are detailed above.

5 Adaptive Management Program

5.1 Adaptive Management Framework

The adaptive management framework proposed for the Flaring Management Plan uses an iterative process to support decision making and drive continuous improvement through the Ichthys Operations phase.

The adaptive management framework will be used to develop and drive continuous improvement outcomes that can be incorporated into offshore facility activities to reduce the likelihood of potential environmental impact occurring, thereby maintaining them as ALARP.



Figure 5-1 Concept of Adaptive Management Framework

Figure 5-1 illustrates how programs have been incorporated into an adaptive management framework. The activities associated with each of the phases shown are described in the following sections.

The adaptive management framework will be used to develop, monitor and continuously improve on:

- Monthly leading indicators which will be used to drive performance;
- Annual flaring target which the facilities will reported on and be assessed against; and
- Flaring Guidelines for Operations for specific identified events.

The timing and process of determining the flaring targets and guidelines is discussed in Section 5.2.

5.2 Plan Phase

5.2.1 Calculation of Monthly and Annual Targets

The monthly and annual targets will be generated based on known maintenance activities, as well as a reasonable allowance for unplanned events.

The flaring associated with planned activities will include fixed depressurisation volumes for maintenance of specific equipment, as well as the flaring resultant from given equipment items being out of service (e.g. the CPF off-gas recovery compressor). The flaring calculated from planned activities will also include an estimate of flaring that will occur upon restart following a planned shutdown. These numbers will be generated based on the INPEX planned activities for the period.

The flaring associated with unplanned activities will include fixed volumes for facility blowdowns resultant from trip scenarios. These will be estimated based on the INPEX internal reliability studies and known plant performance.

An allowance will be included for flaring resultant from process upset conditions based on operational experience.

Both monthly and annual targets are to be established during the Plan Phase, timing as described in Section 5.2.3. These targets are unmovable unless authorisation given by the [REDACTED].

5.2.2 Determination of Flaring Guidelines for Operations

To assist the OIMs to achieve the flaring targets, guidelines for allowable rates and durations not to be exceeded associated with distinct known flaring events are to be developed as part of the Plan Phase. The OIM is to consider the scenario at hand, consequences and practicalities of restart and the flaring targets and take action accordingly.

The guidelines are to be developed based on the process design limitations for the listed scenarios. The intent is to allow sufficient time for the facilities to rectify the situation without escalation or process shutdown.

In defining these guidelines, it is recognized that in some cases, flaring is essential to maintain the integrity of the plant (e.g. during start-up to get the gas dew point on spec prior to directing flow to the Gas Export Pipeline). It is also noted that in scenarios, prolonged events of low volume flaring provides a lower environmental impact than shutting down (e.g. CPF Off Gas Compressor unavailability causes flaring at a low rate, with the alternative of a production shutdown resulting in greater flaring during the inevitable restart).

The guidelines will form part of the Plan Phase Deliverables (See Section 5.2.4), and will be refined with increased operating experience.

An indicative sample of the guidelines is provided in Appendix A.

5.2.3 Timing of Plan Phase

Each year, the Plan Phase will occur throughout Q4 of the calendar year.

This has been selected to enable three months to develop the annual and monthly targets, which will allow for review time by the relevant internal stakeholders.

The timing has been selected to enable the leanings from Q1-Q3 to be considered developing the flaring targets for the subsequent periods.

5.2.4 Plan Phase Deliverables

Following Completion of the Plan Phase, the Flaring Management Plan will be re-issued with an Annex detailing the following:

- The monthly internal flaring targets for the coming calendar year for the CPF and FPSO;
- The annual flaring target reportable to the regulator for the CPF and FPSO combined; and
- Guidelines for the facilities associated with flaring in start-up and operating conditions.

5.3 Implement Phase

The output from the Plan Phase described in Section 5.2 will be distributed to appropriate stakeholders within the organization. This includes the OIM, who is ultimately responsible for managing the day-to-day operations of the facilities in light of these guidelines and targets.

In addition, the flaring targets calculated in the Plan Phase will be communicated to the Offshore Facilities via the Production Guidelines issued monthly.

The facilities shall follow the flaring guidelines and restrictions in the Flaring Management Plan strictly.

5.4 Monitor Phase

A monthly report will be issued from each facility including:

- Total volume of flaring for the month.
- If flaring volume exceeds target for month, report to include detail on cause or event leading to excursion and corrective actions taken.
- Detail specific cases where approval sought to exceed flaring guidelines, including duration of flaring and justification for exceedance.

With respect to the adaptive management framework, the monthly reports are used in the Evaluate Phase (See Section 5.5).

The monthly reports serve as lead indicators, whereby an exceedance of the monthly flaring target will trigger an internal review.

Exceedance of the annual flaring target is a lag indicator, with non-compliance reported to NOPSEMA.

5.5 Evaluate Phase

The purpose of the Evaluate Phase is to evaluate the flaring actuals against the previously set targets and make recommendations for changes to drive continuous improvement.

The Evaluate Phase will be formalised through quarterly reviews of collated monthly reports and associated plant or operability issues relating to flaring. These reviews will involve key stakeholders including but not limited to:

- ██████████ (FPSO and CPF)

- [REDACTED] (from Operation support team)
- [REDACTED] (from Operations Engineering team)
- [REDACTED] (from Operations HSE)

The intent of these reviews is to assess whether changes need to be made to the facility operating parameters, maintenance activities or future period flaring targets.

Recommendations from the Evaluation Phase are expected to include but not be limited to:

- amended flaring targets based on operational experience;
- amended flaring guidelines based on operational experience;
- design changes to mitigate process upsets and resultant flaring; and
- maintenance plan changes to reduce flaring from planned activities.

Recommendations from the Evaluation Phase will be carried forward into the Adapt Phase.

5.6 Adapt Phase

In the Adapt Phase, the recommendations from the Evaluate Phase are developed and implemented in accordance with the applicable INPEX business processes.

6 Commencement of the Flaring Management Plan

Flaring monitoring commences immediately with gas production (nominally June 2017) and includes initial start-up and ongoing plant operation. The flaring guidelines and internal approvals will also apply throughout this period. However, the flaring targets and triggers will not apply in the period from initial start-up until steady state operations. For the purpose of this document, steady-state is defined as the point in time at which overall plant performance tests have been completed on both the FPSO and CPF. This period is expected to be approximately 12 months post start-up.

The decision to not apply flaring targets and restrictions in initial start-up has been arrived at after careful consideration of the relevant risks.

For the Ichthys Offshore facilities, the immediate risk to the environment associated with flaring activities is low. Nevertheless, the Flaring Management Plan will be implemented over the life of the project in order to proactively manage greenhouse gas emissions.

For initial start-up, there a number of uncertainties associated with plant performance and lack of operating history to support optimisation of response. The effect of these uncertainties is twofold.

Firstly, it is difficult to predict a reasonable flaring volume with a good degree of accuracy. The volume of flaring will primarily depend on the time takes to stabilise the process trains including conditioning the gas to achieve the dewpoint specification, as well as commissioning and subsequent availability of the Gas Export Compressor and Flash Gas Compressors. In addition, the frequency of unplanned trips and blowdowns in this phase is expected to be significantly higher in the first 12 months than would be typical in steady state operations.

Secondly, there is an increased risk of incidents with potential to harm personnel and the environment during the initial start-up period. It will be the first time the process plant and equipment is used as an integrated facility; the operators though trained and assessed will have limited experience specific to the facility; and it will be the first time that the operating procedures are used. A number of mitigations are implemented to mitigate these effects. Notwithstanding these mitigations, a greater degree of focus needs to be applied to each of the start-up activities conducted to minimise the number of incidents during this phase. This will result in greater durations for start-up with increased volumes flared.

On balance, the risk to the environment from flaring during the initial start-up period is outweighed by the desire to conduct all start-up activities with a high focus on safety to minimise incidents. Flaring targets during this phase are not only difficult to define with a good degree of accuracy, but their implementation may be detrimental to the overall mitigation of risks to personnel and the environment during this period. Flaring will be considered and managed throughout the planning and implementation of the start-up activities. However, some delay to start-up activities and an associated increase in flaring volume is preferred to rushing through the planned activities in order to meet pre-defined flaring limits. On this basis, the flaring targets will not be defined or implemented for the initial start-up period.

APPENDIX A: TYPICAL OPERATIONAL GUIDELINES ON FLARING

Table A-1 Typical Operational Guidelines – CPF

Cause of Flaring/Venting	Maximum Flaring Rate	Allowable Duration	Approval to Exceed	Corrective Action	Remarks / Justifications
Restart after shutdown	236,000 Sm ³ /hr (~200 mmscfd)	12 hours	█	Reduce production rates to eliminate flaring	Some flaring is required to stabilise process trains and achieve gas dewpoint specification prior to export to ensure GEP integrity not compromised
		72 hours	██████████	Alternate / additional mitigations to be considered	
Process upset condition: - pressure relief to flare - gas dewpoint off spec - equipment trip - Passing valves	236,000 Sm ³ /hr (~200 mmscfd)	4 hours	█	Identify source of flaring Reduce production rates to eliminate flaring if appropriate	-
		72 hours	██████████	Alternate / additional mitigations to be considered	
Off-gas Recovery Compressor package trip	5,000 Sm ³ /hr (~4 mmscfd)	24 hours	█	Identify cause of unavailability of Off-Gas compressor. Initiate repair process	Note that operation for 30 days without the off gas recovery compressor will result in overall approximately equivalent flaring to that expected during facility restart.
		72 hours	██████████	Alternate / additional mitigations to be considered	
Loss of flare nitrogen purge	< 1200 Sm ³ /hr (<1 mmscfd)	72 hours	██████████	Identify cause and rectify	The flare purge volume is insignificant compared with the volume of gas flared upon restart

Note: Table provided is indicative only. To be revised and issued formally as part of Plan Phase of adaptive management program.

Table A-2 Typical Operational Guidelines – FPSO

Cause of Flaring/Venting	Maximum Flaring Rate	Allowable Duration	Approval to Exceed	Corrective Action	Remarks / Justifications
Restart after shutdown	95,000 Sm ³ /hr (~80 mmscfd)	12 hours	█	Reduce production rates to eliminate flaring	Some flaring is required to stabilise flash gas compressor trains
		72 hours	██████████	Alternate / additional mitigations to be considered	
Process upset condition: - pressure relief to flare - equipment trip - Passing valves	236,000 Sm ³ /hr (~200 mmscfd)	4 hours	█	Identify source of flaring. Reduce production rates to eliminate flaring if appropriate	-
		72 hours	██████████	Alternate / additional mitigations to be considered.	
Flaring to maintain fuel gas transfer line minimum turndown rate	13,000 Sm ³ /hr (~11 mmscfd)	24 hours	█	Adjust fuel gas consumption on FPSO using alternate means to meet the required MTDR.	11mmscfd required to avoid slugging in transfer line to maintain integrity of line
		72 hours	██████████	Alternate / additional mitigations to be considered.	
VOC offline	8,000 Sm ³ /hr (~6.8 mmscfd)	24 hours	█	Identify cause of unavailability of VOC system. Initiate repair process as appropriate	
		72 hours	██████████	Alternate / additional mitigations to be considered.	
Flash gas compression offline	115,000 Sm ³ /hr (~98 mmscfd)	12 hours	█	Reduce production rates to eliminate flaring	2 x 100% design. Flaring limits relate to 2 trains offline. For 1 x flash gas compressor train trip, switch to standby train and refer to 'Process Upset Conditions' above for flaring limits.
		72 hours	██████████	Alternate / additional mitigations to be considered	
FPSO fuel gas system trip and flash gas route to CPF not available	36,000 Sm ³ /hr (~30 mmscfd)	24 hours	█	Identify cause of unavailable systems and implement repair process as appropriate	Note that operation for 6 days flaring flash gas will result in overall approximately equivalent flaring to that expected during facility restart.
		72 hours	██████████	Alternate / additional mitigations to be considered.	
Loss of flare nitrogen purge	< 1200 Sm ³ /hr (<1 mmscfd)	72 hours	██████████	Identify cause and rectify.	The flare purge volume is insignificant compared with the volume of gas flared upon restart

Note: Table provided is indicative only. To be revised and issued formally as part of Plan Phase of adaptive management program.