

PETRONAS TECHNICAL STANDARDS

DESIGN AND ENGINEERING PRACTICE

MANUAL

DESIGN OF SEA WATER SYSTEMS AND UTILITY HEAT TRANSFER SYSTEMS FOR OFFSHORE INSTALLATIONS

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The objective is to set the recommended standard for good technical practice to be applied by PETRONAS' OPU/Divisions in oil and gas production facilities, refineries, gas processing plants, chemical plants, marketing facilities or any other such facility, and thereby to achieve maximum technical and economic benefit from standardisation.

The information set forth in these publications is provided to users for their consideration and decision to implement. This is of particular importance where PTS may not cover every requirement or diversity of condition at each locality. The system of PTS is expected to be sufficiently flexible to allow individual operating units to adapt the information set forth in PTS to their own environment and requirements.

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1. INTRODUCTION

1.1 SCOPE

This revised PTS specifies requirements and gives guidelines for the design of seawater systems and closed circuit heat transfer systems on offshore oil and gas production installations. Functional requirements are provided for the various components included in such systems, e.g., caissons, pumps, piping and valves, heat exchangers and instrumentation. The detailed technical specifications for the various components are covered by other PTSs.

Fire water systems and water injection facilities are excluded from the scope of this PTS.

This PTS is a revision of the PTS with the same title and number, dated November 1994. A summary of major changes to the previous PTS is given in [\(1.6\)](#).

1.2 DISTRIBUTION, INTENDED USE AND REGULATORY CONSIDERATIONS

Unless otherwise authorised by PETRONAS, the distribution of this PTS is confined to companies forming part of PETRONAS or managed by a Group company, and to Contractors and Manufacturers/Suppliers nominated by them.

This PTS is intended for use by all those involved in the design or modification of seawater systems or closed circuit heat transfer systems on offshore oil and gas production facilities.

If national and/or local regulations exist in which some of the requirements may be more stringent than in this PTS the Contractor shall determine by careful scrutiny which of the requirements are more stringent and which combination of requirements will be acceptable as regards safety, environmental, economic and legal aspects. In all cases the Contractor shall inform the Principal of any deviation from the requirements of this PTS which is considered to be necessary in order to comply with national and/or local regulations. The Principal may then negotiate with the Authorities concerned with the object of obtaining agreement to follow this PTS as closely as possible.

1.3 DEFINITIONS

1.3.1 General definitions

The **Contractor** is the party that carries out all or part of the design, engineering, procurement, construction, commissioning or management of a project or operation of a facility. The Principal may undertake all or part of the duties of the Contractor.

The **Manufacturer/Supplier** is the party that manufactures or supplies equipment and services to perform the duties specified by the Contractor.

The **Principal** is the party that initiates the project and ultimately pays for its design and construction. The Principal will generally specify the technical requirements. The Principal may also include an agent or consultant authorised to act for, and on behalf of, the Principal.

The word **shall** indicates a requirement.

The word **should** indicates a recommendation.

1.3.2 Specific definitions

Caisson Open-ended pipe section extending from the platform to below sea level and used for drawing water or for disposing of used water

Cooling medium Fluid for the removal of heat from process and utility equipment

Heating medium Fluid used to input heat to process and utility equipment

1.4 ABBREVIATIONS

ALARP	As Low As Reasonably Practicable
DN	Diameter Nominal
EHRU	Exhaust Heat Recovery Unit
HT	Heat Transfer
HVAC	Heating Ventilation and Air Conditioning
NPSH	Net Positive Suction Head
TEG	Tri-Ethylene Glycol

1.5 CROSS-REFERENCES

Where cross-references to other parts of this PTS are made, the referenced section number is shown in brackets. Other documents referenced in this PTS are listed in [\(7\)](#).

1.6 SUMMARY OF REVISIONS FROM PREVIOUS EDITION

The previous edition of this PTS was dated November 1994. The main revisions to this PTS have been to reduce the environmental emissions of hydrocarbons. A range of minor revisions has also been included to reflect recent operational experience.

The following are the main changes to the 1994 edition:

Old section	New Section	Change
4.3.5	4.3.5	Text revised on fluid velocity limits; reference to PTS 39.01.10.11;
4.4	4.4	Reference to PTS 39.01.10.11 for use of corrosion resistant alloys;
-	4.5	New section on control and instrumentation
-	5.4.7	New section on personnel protection
Figures	-	Figures have been incorporated into text

2. OVERALL GOALS AND SPECIFIC OBJECTIVES

2.1 INTRODUCTION

The scope of this PTS is the supply of seawater to users on offshore platforms. Some users consume water, e.g., the pressurised water ring main, wash down facilities, water maker units, water injection facilities, drilling mud makers and potable water making units. Other users, such as process heat exchangers and equipment coolers, do not consume water. These users, sometimes called "once-through users", return the water to the sea with no change except in temperature.

This document also addresses closed-circuit heat transfer systems that are used for heating and cooling duties in process and utilities equipment.

It is essential to segregate hazardous users from non-hazardous users. At the initial design stage it shall be determined whether the user is hazardous or not. A hazardous user is one where, if the equipment fails, the seawater, or the medium of the closed circuit heat transfer system, can be contaminated with a flammable or toxic substance. Hazardous users typically include process heat exchangers, such as crude oil coolers, gas coolers, etc.

2.2 OVERALL GOALS

The goal of a seawater lift and distribution system is to provide a safe, stable, and reliable supply of seawater, at the required pressure and flow, to all onboard users.

The goal of a heat transfer system, whether a direct seawater cooling system or a closed circuit heat transfer system, is to provide a safe, stable, and reliable supply of heat transfer medium at the required temperature, pressure and flow to all relevant heating or cooling loads.

The system shall ensure that the fluid, be it seawater or heat transfer medium, is of sufficient quality so as not to cause blocking, fouling, contamination or undue corrosion of user equipment and the system itself. The system shall be designed to provide ease of operation and maintenance, and have a design life that meets the needs of the facility, taking account of lifecycle economics.

2.3 SPECIFIC OBJECTIVES

The following is a list of specific objectives for the design of seawater lift and distribution systems and heat transfer systems:

- designs should take into account the demands of present and planned future users;
- all necessary considerations and good engineering practice should be applied to ensure that the system can be operated safely without hazard to any personnel, plant and equipment on the installation;
- hazardous users shall be segregated from non-hazardous users;
- designs should comply with the environmental constraints of the locality;
- suitable materials and corrosion protection should be used in all aspects of the design in order to attain the expected design life of the system;
- systems should be designed to allow for ease of operation and maintenance;
- adequate provision should be made in the design of system vessels and pipework to allow for fluid expansion during heating;
- vessels and heat exchangers shall be protected with over-pressure protection devices;
- means should be provided to detect hydrocarbon leaks in heat exchangers.

3. SEGREGATION OF USERS

3.1 INTRODUCTION

In seawater and closed circuit heat transfer systems, certain modes of equipment failure may result in the ingress of a hazardous substance into the system. If there is no segregation, the system may allow the substance to migrate and be released into an unprotected non-hazardous area on the installation. Failure of the barrier between the hazardous process stream and the utility stream may cause the ingress of such substances, including hydrocarbons and hydrogen sulphide. The consequences of this may be subsequent ignition, explosion, poisoning or asphyxiation.

Hazardous and non-hazardous users shall be segregated to prevent the possibility of hazardous substance migration into non-hazardous areas/users.

3.2 NEW INSTALLATIONS

The means of achieving segregation for new installations shall be as follows:

- Complete segregation of hazardous users from non-hazardous users. A separate utility system serves each of the two user categories, see Figure 1, or:
- An intrinsically safe system as shown in Figure 2. A single seawater lift system supplies non-hazardous users and cools a closed circuit heat transfer system serving hazardous users.

FIGURE 1 SEAWATER SYSTEM WHERE HAZARDOUS USERS AND NON-HAZARDOUS USERS ARE ENTIRELY SEGREGATED

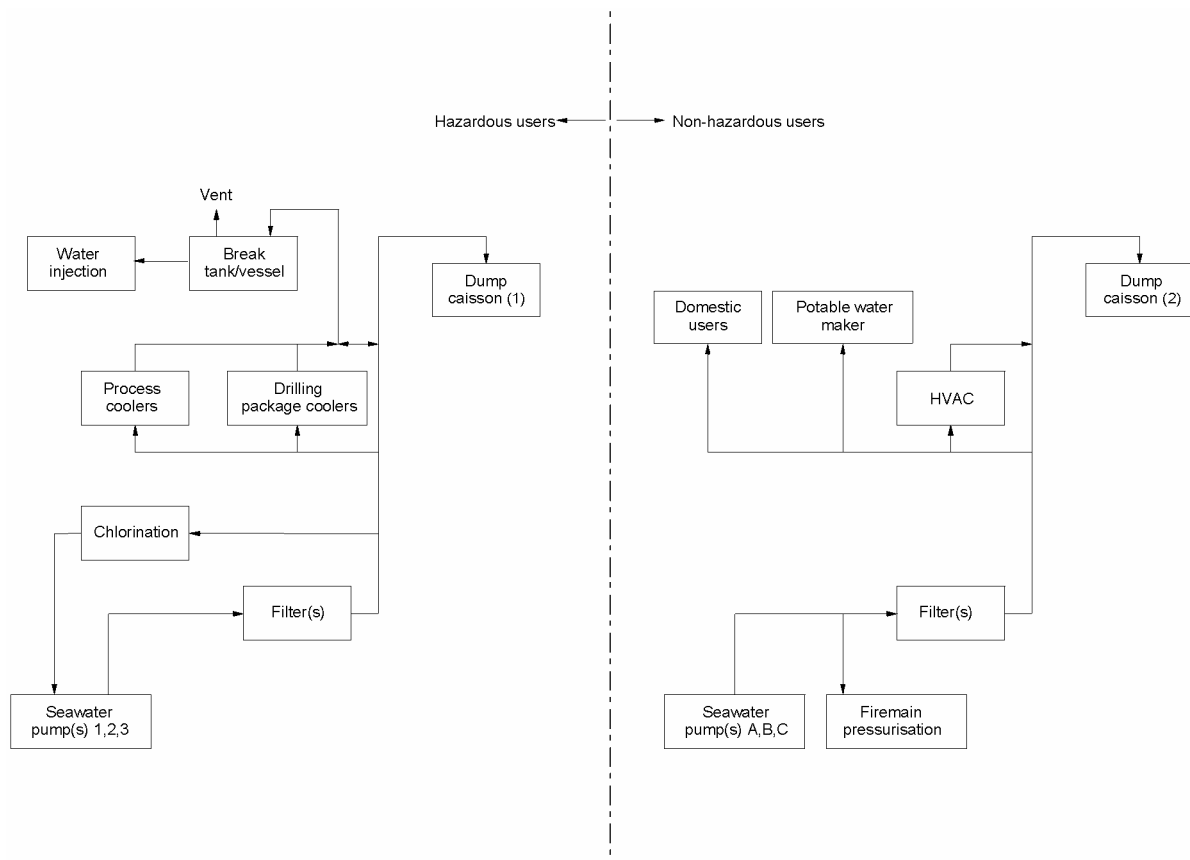
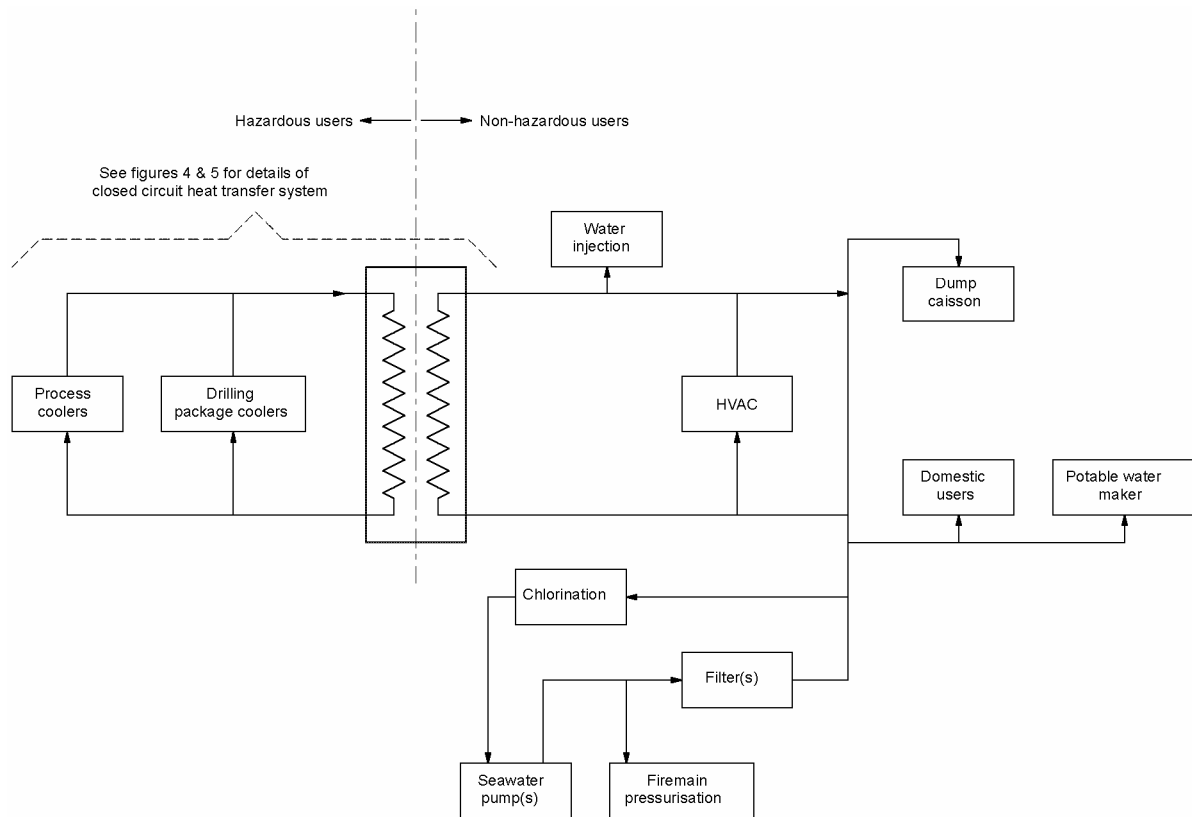


FIGURE 2 SEAWATER SYSTEM WHERE HAZARDOUS USERS AND NON-HAZARDOUS USERS ARE SEGREGATED BY A CLOSED CIRCUIT HEAT TRANSFER SYSTEM



3.3 EXISTING INSTALLATIONS

On existing installations, hazardous and non-hazardous users should be segregated to prevent the possibility of hazardous substance migration into non-hazardous areas/users.

If hazardous users and non-hazardous users are supplied from a common header, the following methods, in order of preference, shall be employed to prevent the migration of hazardous substances. For whichever method selected, it shall be demonstrated that that the chosen method for segregation reduces the risk to As Low As Reasonably Practicable (ALARP).

- The installation of a dedicated system for non-hazardous users.
- The insertion of elevated break tanks in the appropriate lines as shown in [Figure 3](#). The water flow should enter the tank above the water level. The tank shall be continuously vented by a vent which is self-draining with no low points and has sufficient capacity to handle the maximum rate of gas produced in case of a leak or failure of the hazardous users, e.g., failure of one tube in shell and tube heat exchangers. The tank shall be sized to ensure full degassing. If toxic gas, e.g., containing hydrogen sulphide, may be present, venting is not permitted and instead the gas shall be routed to the installation's relief system. If a high concentration of toxic gas may be present, an in-depth analysis should be carried out to ensure that it is not possible for toxic gas to migrate to the safe users through the break tank. There shall be suitable protection to maintain the integrity of the liquid seal.