OIL COMPANIES INTERNATIONAL MARINE FORUM

INERT GAS SYSTEMS

BLOCK AND BLEED VALVE ARRANGEMENTS FOR CHEMICAL TANKERS CARRYING CHEMICALS AND PETROLEUM PRODUCTS

Prevention of Inert Gas / Hydrocarbon Back-Flow

December 1999

The OCIMF mission is to be recognised internationally as the foremost authority on the safe and environmentally responsible operation of oil tankers and terminals.

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1.0 INTRODUCTION

This document presents the current requirements for Inert Gas Systems (IGS) block and bleed valve arrangements, examines their operation, identifies possible modes of failure and proposes minimum safety devices aimed at reducing the chances of hydrocarbon vapour back-flow from the cargo tanks into safe areas. The arrangements are allowed by SOLAS for chemical tankers in the chemical and oil products trade.

2.0 REQUIREMENTS FOR INERT GAS SYSTEMS FOR CHEMICAL TANKERS AND FOR TRANSPORTATION OF PETROLEUM PRODUCTS BY CHEMICAL TANKERS

The requirements for inert gas systems for chemical tankers are contained in Resolution A.567 (14) "**Regulations for Inert Gas Systems on Chemical Tankers**", adopted in November 1985 by the International Maritime Organization (IMO) Assembly at its 14th session. The Annex to this Resolution provides the requirements for the non-return devices installed in the inert gas systems for chemical tankers built on or after 1 July 1986. The regulations are included in IMO publication "Inert Gas Systems" (1990 edition) IMO-860E.

Chemical tankers built before 1 July 1986 are provided with systems complying with the "**Interim Regulations for Inert Gas Systems on Chemical Tankers Carrying Petroleum Products**" adopted by IMO by resolution A.473 (XII) in November 1981.

The framework for transporting **oil products** in **chemical tankers** is set out in SOLAS Chapter II-2, Part D, Regulation 55, Subparagraph 5 adopted by IMO by Resolution A.566 (14) in November 1985.

2.1 Requirements for Non-Return and Isolating Devices on the Inert Gas Main

The Annex to IMO Resolution A.567 (14) (Reference A) Paragraph 9.1 requires *"...At least two non-return devices, one of which shall be a water seal,...."* The same paragraph indicates *"...An Administration may permit an alternative arrangement or device providing a measure of safety equivalent to that of a water seal."*

Block and Bleed valve arrangements provide an alternative to the deck water seal. These arrangements are described in the Unified Requirement F20.3 "Inert Gas Systems on Chemical Tankers" of the International Association of Classification Societies (IACS).

Paragraph F20.3.3 of the IACS requirement indicates:
"As an alternative to the deck water seal in the inert gas line on deck, an arrangement consisting of two shut-off valves in series with a venting valve in between may be accepted (double block and bleed). The following conditions apply:

- *The operation of the valves is to be automatically executed. Signal(s) for opening/ closing is (are) to be taken from the process directly, e.g. inert gas flow or differential pressure.*
- *Alarm for faulty operation of the valves is to be provided, e.g. the operation status of "Blower Stop" and "supply valve(s) open" is an alarm condition".*

The Block and Bleed arrangement presented in Figure 1, item 3 of this document consists of two (2) block valves and one (1) bleed valve venting to atmosphere. The paragraph numbers referred to at the bottom of the Figure 1 and below in the text of this document refer to the text in Reference A.

Upstream of the Block and Bleed arrangement is the Gas Regulating Valve required by Paragraph 8.

Between the block and bleed valve arrangement and the first connection from the Inert gas main into the cargo tank is the non-return valve required by Paragraph 9.8. The non-return valve should have positive means of closure or, as an alternative, an additional valve (named Deck Main Isolating Valve), with positive means of closure, can be provided downstream of the non-return valve.

Paragraph 9.9 requires a Bleed to Atmosphere valve to be provided between the Deck Main Isolating valve and the Gas Regulating valve. Usually this bleed valve is placed between the Block and Bleed arrangement and the Gas Regulating valve. The size of the bleed valve should be such that it will not allow pressure build-up from back-flow of hydrocarbons in the event that the hydrocarbon blocking devices (in this case, the block and bleed arrangement and the non-return valve) fail to achieve their function. This, in essence, will provide a double Block and Bleed arrangement for increased safety.

2.2 Pressure Control Requirements

The IMO "Guidelines for Inert Gas Systems", PART I, Section 3.10 of Reference B indicates that the inert gas pressure control system should be designed to prevent automatically any back-flow of cargo gases in the event of:

a. A failure of the inert gas blower, scrubber pump, etc., or,

b. When the inert gas plant is operating correctly but the deck water seal (in our case the Block and Bleed arrangement) and mechanical non-return valve have failed and the pressure of gas in the tanks exceeds the blower discharge pressure.

The first function is fulfilled by the Gas Regulating Valve, which closes automatically upon system shutdown.

The second function is fulfilled by the Gas Regulating Valve on the basis of a proper setting when the valve is on automatic control mode. If the pressure in the main IG line reaches the pressure setting, the regulating valve closes and the Vent to Atmosphere Valve opens. Pressure control considerations and the prevention of overheating of the blower may dictate that the Gas Regulating Valve and the Vent to Atmosphere Valve are only partially open when the tank pressure approaches the pressure set point.

2.3 Block and Bleed Control Functions

One of the Block and Bleed control options indicated in the Unified Requirement F20.3.3 of the International Association of Classification Societies (IACS) is the differential pressure control. Alternative options, based on sensing the gas flow, operate on the same parameters, except that the operation of the block and bleed arrangement is triggered by zero flow condition.

Differential Pressure Arrangement
The differential pressure arrangement will sense the difference between the pressure in the line upstream of the pressure regulating valve and the pressure in the IG main. If the pressure in the IG main is higher than the pressure upstream of the control valve, the system will close the gas regulating valve and shut down automatically. Indication of this condition should be provided in the Engine Control Room and the Cargo Control Room. The measuring points should be arranged to preclude bypass of hydrocarbons from the tanks into the engine room via the sensing lines by, for example, using secondary 3 to 15 p.s.i. loop signal in lieu of direct signal or by using other suitable electronic sensors. A timing mechanism, providing a few seconds delay, should be included into the starting sequence to permit the blower to start while the pressure in the tanks is higher than the pressure at the blower discharge.

Other arrangements of Block and Bleed controls may be permitted if they provide an equivalent level of safety.

3.0 OCCURRENCE OF BACK-FLOW ON BLOCK AND BLEED ARRANGEMENTS

The effectiveness of the Block and Bleed devices depends on their ability to sense the “process” fluid (Inert Gas) pressure or flow. In some instances, systems have been built with Block and Bleed arrangements which do not sense the “process” fluid but rely on the blower operational “on” / “off” status to operate the Block and Bleed valves and achieve the sealing function.

For Block and Bleed arrangements which do not have differential pressure or flow sensing devices, it is possible that, during periods of cargo discharge operation with the blower operational, the tank pressure may increase to a point higher than the inert gas generator discharge pressure. In this case, cargo gases back-flow into the machinery space could occur if the Non-Return valve was defective. Thus, when the Block and Bleed arrangements depend on the blower “on” / “off” condition, there is effectively only one protective non-return device in the system, namely the Non-Return valve. Such arrangement does not conform with Reference A Paragraph 9.1 allowing alternative arrangement or device providing a measure of safety “**Equivalent**” to that of a water seal.

4.0 MINIMUM OCIMF RECOMMENDATION FOR BLOCK AND BLEED ARRANGEMENTS

The minimum hardware recommended for proper Block and Bleed arrangement are indicated below. The control and monitoring functions are those specifically related to the block and bleed sensing mechanism. Other shut down and alarm functions required by SOLAS regulations, Reference A, are not included herein.

4.1 Control Functions

1. Block and Bleed control to be based on signals from a differential pressure or flow sensing detector of the “process” fluid, Inert Gas.
2. Provision of an audible and visual alarm for low differential pressure or low flow if the block valves remain open.
3. Provision of an audible and visual alarm for faulty operation of the block and bleed valves. Blower “stop” and supply valves “open” should be an alarm condition.
4. Audible and visual alarm to be provided if valve position is mismatched (i.e. if Block Valves and Bleed Valve are closed) – this function to be provided with a time delay.

5. Provision of indication in the Cargo Control room of “open” and “closed” status of the block and bleed valves, the Gas Regulating valve, and Bleed to Atmosphere valve.
6. Provision of control air for the Block and Bleed Valves to be via an independent solenoid valve arrangement from the solenoid supplying the Regulating Valve (Bulkhead Valve).
7. The pressure sensors used for the block and bleed control should be independent from the pressure sensor required by SOLAS Regulation 62.16.1.1 (equivalent Regulation 14.1.1 on Reference A)
8. Provision of interlock to ensure that Blower shutdown will close the Block and Bleed arrangement and that the Block and Bleed arrangement cannot be opened unless blower power is on. Also, the blower should be arranged so that it cannot start unless the block valves are closed.

Note on Alternative Block and Bleed Control Arrangements:
Some systems utilise blower power elements instead of “on” / “off” signal to operate the Block and Bleed valves. This arrangement is indirectly related to “process” fluid but the system cannot distinguish the differential pressure between the deck main and the blower discharge. Risk assessment is recommended on a case-by-case basis to determine that the block and bleed arrangement will operate properly with this arrangement.

4.2 Equipment (See Figure 1)

- One (1) Regulating Valve (per Ref. A, Para. 8)
- One (1) Bleed to Atmosphere valve (Ref. A, Para. 9.9)
- One (1) Block valve (Ref. A, Para. 9. 1)
- One (1) Bleed valve (Ref. A, Para. 9. 1)
- One (1) Block valve (Ref. A, Para. 9. 1)
- One (1) Non-Return valve (Ref. A, Para. 9.8)
- One (1) Deck Main Isolating valve (Ref. A, Para. 9.8)

5.0 MAINTENANCE

The Block and Bleed valves, require proper maintenance at regular intervals. It is recommended that the valves (Regulating valve, Block valves, Bleed valve, Non-Return valve and the Deck Main Isolating valve) be regularly tested for proper operation and tightness.

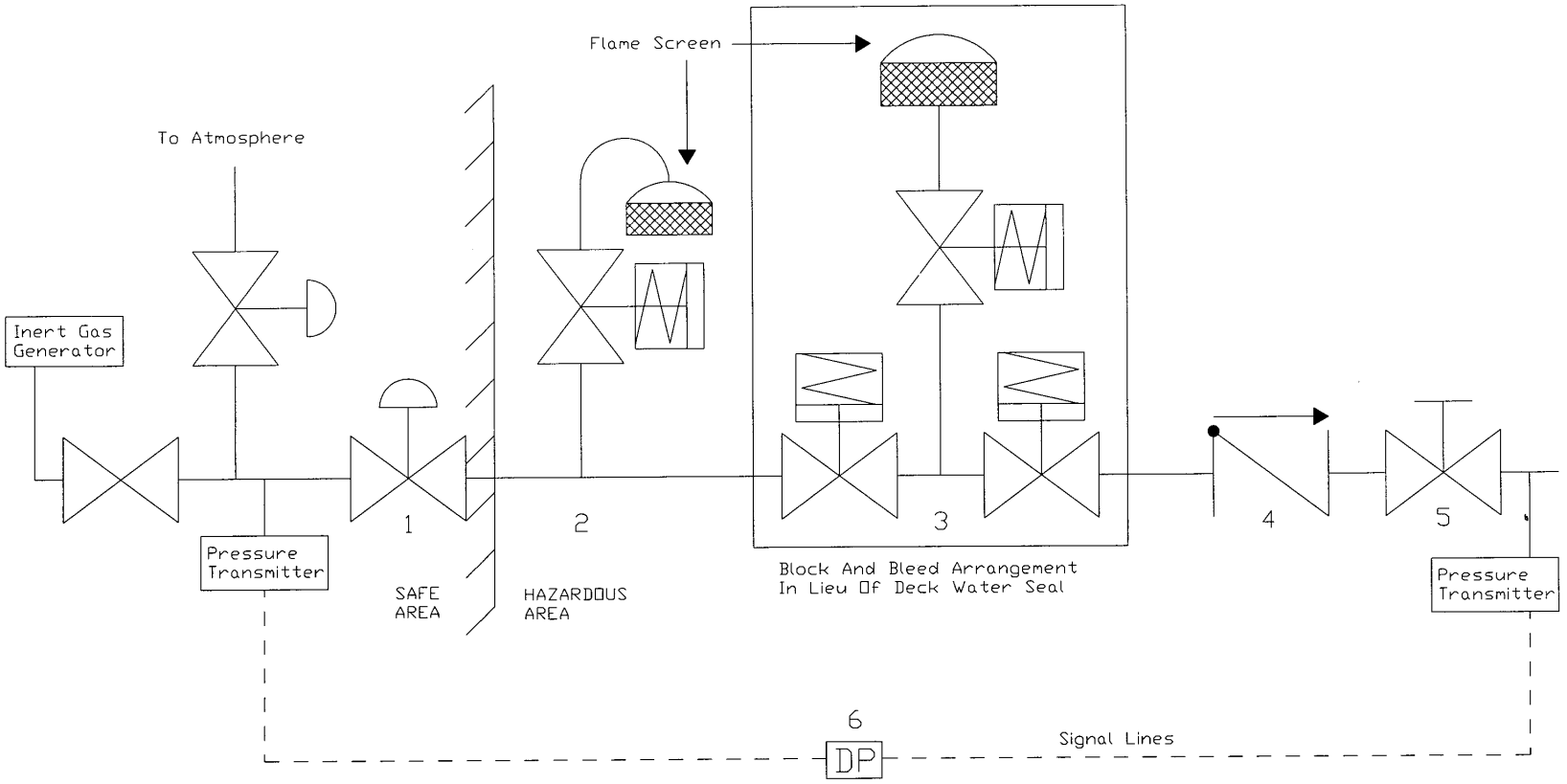
6.0 REFERENCES

Reference A:
IMO Resolution A.567 (14) - Annex “Regulation for Inert Gas Systems on Chemical Tankers” - Adopted by the IMO Assembly, fourteenth session, 20th November 1985

Reference B:
IMO “Inert Gas Systems” 1990 Edition, Publication IMO-860E (Includes Reference A)

Unified Requirement F20 (Rev. 3 May, 1998) of the International Association of Classification Societies (IACS)

Figure 1. Block And Bleed Arrangement



1. Gas Regulating Valve (Paragraph 8)
2. Bleed To Atmosphere Valve (Paragraph 9.9) (Recommended to be power operated)
3. Block And Bleed Arrangement (Paragraph 9.1)
4. Non Return Valve (Paragraph 9.8)
5. Deck Main Isolating Valve (Paragraph 9.8)
6. Differential Pressure Device (IACS F20.3)

NOTE: Paragraphs Indicated Above Refer To IMO Resolution A.567(14) - Annex

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