Engineering Standard

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Process Heaters Safety Systems

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Saudi Aramco DeskTop Standards

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1 Scope

1.1 This Standard prescribes minimum mandatory requirements governing the design and installation of safety systems for natural draft, gas fired process heaters. These systems shall be designed based on API RP 556 and by the requirements in this document.

1.2 A heater safety system is considered a "Level 3 Emergency Shutdown System - Equipment Isolation System", as defined in SAES-J-601. As such, the process heater safety system shall meet all requirements specified in SAES-J-601.

2 Conflicts and Deviations

2.1 Any conflicts between this standard and other Saudi Aramco Engineering Standards (SAESs), Materials System Specifications (SAMSSs), Standard Drawings (SASDs), or industry standards, codes and forms shall be resolved in writing by the Company or Buyer Representative through the Manager, Process & Control Systems Department of Saudi Aramco, Dhahran.

2.2 Direct all requests to deviate from this standard in writing to the Company or Buyer Representative, who shall follow internal company procedure SAEP-302 and forward such requests to the Manager, Process & Control Systems Department of Saudi Aramco, Dhahran.

3 References

The selection of material and equipment, and the design, construction, maintenance, and repair of equipment and facilities covered by this standard shall comply with the latest edition of the references listed below, unless otherwise noted.

3.1 Saudi Aramco References

Saudi Aramco Engineering Procedure

SAEP-302	*Instructions for Obtaining a Waiver of a Mandatory Saudi Aramco Engineering Requirement*

Saudi Aramco Engineering Standards

SAES-B-058	*Emergency Isolation, Shutdown, and Depressuring*
SAES-F-001	*Process Fired Heaters*
SAES-J-601	*Emergency Shutdown and Isolation Systems*
SAES-J-901	*Instrument Air Supply Systems*

SAES-L-008 *Selection of Valves*

Saudi Aramco Materials System Specifications

34-SAMSS-634 *Local ZV Shutdown Cabinets and Smart ZV Systems*

34-SAMSS-820 *Control Panel, Indoor*

34-SAMSS-821 *Control Panel, Outdoor*

Saudi Aramco Drawings

AC-036456 *Burner Safety System, Natural Draft Furnaces*

3.2 Industry Codes and Standards

American Petroleum Institute

API RP 556 *Instrumentation and Control Systems for Fired Heaters and Steam Generators*

4 Process Heater Safety System Design

4.1 General

4.1.1 Process heater safety systems shall be designed based on requirements specified in this standard, SAES-B-058, and in drawing AC-036456.

4.1.2 A pressure regulator shall be installed in a bypass around the main fuel gas control valve to maintain minimum firing conditions.

4.2 Control Panels

4.2.1 All process heater control/shutdown panels shall comply with Saudi Aramco Materials System Specification 34-SAMSS-820 for indoor and 34-SAMSS-821 for outdoor use.

4.2.2 The process heater local control/shutdown panel shall be located so that the power operated fuel gas emergency isolation valves (EIV, also called a ZV) can be seen.

4.2.3 Local shutdown panels for power operated emergency isolation valves (ZVs) shall meet requirements specified in 34-SAMSS-634, "Local ZV Shutdown Cabinets".

4.3 Pilots

4.3.1 All burners shall be equipped with pilots. For heaters with a large number of burners where use of pilots may not be practical, an alternative burner light-off step-by step procedure, approved by the proponent, may be accepted with prior written approval from the General Supervisor, Process Instrumentation Division, Process & Control Systems Department, Dhahran. The alternative burner light-off step-by-step procedure and justification must be submitted with the request for acceptance.

4.3.2 Pilots shall burn continuously under all operating conditions. Pilots shall have stable burning properties at all burner firing and combustion draft rates. Pilot burners shall be removable for maintenance and inspection.

4.3.3 Process heater pilot-gas supply shall be taken from a reliable gas source independent of the main fuel gas supply. A "reliable gas source" shall meet the following criteria:

a) Separate from the main fuel gas supply so that both supplies are not simultaneously interrupted by a single contingency such as power or instrument failure.

b) Available during start-up.

4.4 Manual Shutdown

All process heaters shall have manual shutdown push/pull buttons located in the control room and on the local heater control/shutdown panel.

4.5 Shutdown System Actuating Devices

4.5.1 All shutdown signals shall be initiated by a primary device dedicated to the ESD function as specified in SAES-J-601.

4.5.2 All shutdown actuating devices shall meet the requirements specified in SAES-J-601.

4.6 Shutdown System Bypasses

4.6.1 Bypass switches and bypass alarms shall be provided for all shutdown system initiating devices, as specified in SAES-J-601.

4.6.2 Emergency manual shutdown switches shall not be bypassed, as specified in SAES-J-601.

4.7 Emergency Isolation Valves

4.7.1 Each process heater shall be provided with power operated emergency isolation valves (ZVs) in the main fuel and pilot fuel gas headers. These ZV valves will be independent from the supervisory cock valves or any optional BMS controlled safety shutoff or vent valves.

4.7.2 Emergency isolation valves shall also be employed in heater process hydrocarbon fluid lines, as specified in SAES-B-058.

4.7.3 Emergency isolation valves shall be designed and selected as required in SAES-J-601 and SAES-L-008. The heater safety system and emergency isolation valves (ZVs) shall operate as quickly as valve design permits. When closed, the valves shall prevent the leakage of fuel gas into the furnace by utilizing tight shutoff design.

4.8 Supervisory Cocks and Blinds

4.8.1 Each burner shall be equipped with a supervisory cock valve, complete with a position switch to indicate the closed position. The supervisory cocks shall be interlocked with the heater safety system based on the logic described in Saudi Aramco Drawing AC-036456, such that, on heater start-up, all supervisory cocks must be closed before the main fuel gas ZV can be opened. Either electrical or pneumatic supervisory cocks and logic system may be used.

4.8.2 For heaters with a large number of burners, where a supervisory cock logic system may not be practical, an alternate safety light off method may be used with prior written approval of the General Supervisor, Process Instrumentation Division, Process & Control Systems Department, Dhahran. The alternate heater safety light off system may employ a pressure sensing method to infer all burner fuel gas valves are closed prior to opening the main fuel ZV.

Commentary Note:

Alternate heater safety light off systems used in lieu of supervisory cocks will typically incorporate an ESD logic system to automatically pressure test the main fuel gas header. The procedure will typically include the following steps:

1) Pressure up the fuel gas header between the fuel gas ZV and the individual burner fuel gas isolation valves with fuel gas by temporarily opening the ZV.

2) Close the ZV and monitor the header pressure.

3) If fuel gas pressure is maintained, the header and all burner isolation valves are assumed closed and the light off procedure

may advance. If the pressure decays, the system test fails and operations must find and eliminate the fuel gas leak.

4.8.3 In all cases, a blind shall be used immediately downstream of the last burner and pilot valve to provide positive fuel isolation from the heater.

4.9 Start-Up Sequence and Logic

4.9.1 Unless otherwise stated in the scope of the project, the burner safety system shall be designed based on the following typical procedure for lighting process heater burners.

a) The main burner supervising cocks are checked closed. This check is an operator and logic function.

b) The pilot and main fuel gas emergency isolation valve (ZVs) are checked closed. This check is an operator and logic function.

c) The stack damper (if furnished) is in proper open position. This check is an operator function.

d) The individual burner registers are placed in their correct position. This action is an operator function.

e) The process fluid flow is established and all passes are proven to be carrying minimum flow. These conditions are logic functions.

f) The individual pilot burner manual valves are checked closed. This check is an operator function.

g) When steam is used for purging, it is introduced into the process heater combustion box until the heater is entirely clear of combustibles. If natural draft purging is used the process heater combustion box is vented until the heater is clear of combustibles. These actions are operator functions.

h) Immediately after the purge is completed the combustion box is checked manually for the presence of combustibles using a gas sniffer. This check is an operator function. If combustibles are detected another purge is required.

i) The pilot gas emergency isolation (ZV) valve is opened, pressurizing the pilot header up to the individual pilot burner valves. This action is an operator function.

j) Immediately after removing the pilot blind, a hand torch is lit and placed near the pilot burner in the combustion box. The pilot manual valve is opened and the pilot flame is established and verified. These actions are operator functions.

k) If the pilot burner does not light within 30 seconds the pilot header valves shall be closed, the blind reinstalled, and the cause of the failure determined. After the difficulty is corrected, it is necessary to repeat the purge cycle and check for an explosive mixture in the furnace. These actions are operator functions.

l) When the pilot has been lit the main burner may be fired. The main fuel gas emergency isolation (ZV) valve is opened. The supervisory cock is manually opened. Immediately after removing the burner blind, the manual valve at the burner is opened. The main burner flame is established and visually verified. Manual draft adjustments are made as required. These actions are operator functions.

4.9.2 To light subsequent burners or groups of burners the appropriate steps listed under 4.9.1 shall be followed unless otherwise specified in the furnace operations manual.

4.9.3 Main burners shall not be lit from other main burners.

4.10 Alarms

All shutdown conditions shall be preceded by regulatory control alarms to alert operations to an impending process heater shutdown. As a minimum, the following pre-shutdown alarms shall be indicated on the main control room annunciator or distributed control system display assigned to the furnace controls.

a) Fuel gas knock out drum high liquid level.

b) Pilot gas header low pressure.

c) Pilot gas header high pressure.

d) Main fuel gas header low pressure.

e) Main fuel gas header high pressure.

f) Instrument air low pressure.

g) Process fluid high outlet temperature.

h) Process fluid low flow.

Pre-shutdown alarms may be initiated by transmitted or computed input signals.

4.11 Shutdown Conditions

4.11.1 Any one of the following conditions shall automatically shutdown the process heater by closing the emergency isolation (ZV) valve on the main fuel gas supply (and on the pilot gas supply, when appropriate):

a) Main fuel gas header low low pressure.

b) Main fuel gas header high high pressure.

c) Main burner header low-low pressure.

d) Pilot fuel gas burner header low-low pressure.

e) Instrument air supply to the plant low-low pressure. See SAES-J-901.

f) Manual shutdown, field.

g) Manual shutdown, main control room.

h) Process fluid low-low flow. Where low pass flow can cause high tube temperature, coking, and ultimate tube failure, each and every pass shall be monitored separately. Low-low flow sensors shall be dedicated for ESD only. For heaters with a large number of passes where individual low pass flow shutdowns may not be practical, an alternative low charge flow shutdown method may be accepted with prior written approval from the General Supervisor, Process Instrumentation Division, Process & Control Systems Department, Dhahran. The alternative low charge flow shutdown method and its justification must be submitted with the request for acceptance.

4.11.2 The following conditions shall initiate an alarm or shutdown when the furnace or process design indicates their requirement.

a) Stack flue gas high temperature.

b) Process fluid high temperature.

c) Heater tube skin high temperature.

d) Heater draft low pressure.

e) High combustible concentration in stack.

f) Loss of electric power.

4.11.3 After automatic shutdown of the process heater, the operator shall manually close all burner and pilot hand valves and reinstall burner and pilot blinds, in addition to closing all burner manual FM supervisory cocks.

4.12 Communications

A sound powered telephone or other suitable voice communication link shall be provided between the following 3 locations:

a) Field Process heater.

b) Main control room.

c) Shutdown logic cabinet.

Revision Summary

26 October 2005	Revised the "Next Planned Update". Reaffirmed the contents of the document, and reissued with minor changes.