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APPLICATION NOTE #005
P522 and S550BE
Recommended Setup and Configuration Procedure
For
Sulfur Recovery unit (SRU)

Only an engineer experienced and familiar with furnace operation should carry out adjustment following plant guidelines for personal and equipment safety.
It is highly recommended to read instruction manuals for P522 and S550BE before making adjustments.

Background:
Sulfur recovery refers to the conversion of hydrogen sulfide (H_2S) to elemental sulfur. H_2S is byproduct of refining N. Gas and/or crude oil with high sulfur contact. The most common process used is referred as Claus process. Recovery of sulfur from the process is from 95-99%. In Claus process involves burning one third of H_2S with air in a reactor furnace to form sulfur dioxide (SO_2). From SO_2 further conversation takes place to element sulfur.

In Sulfur Recovery Unit (SRU), N. Gas or refinery gas is used at startup to elevate furnace temperature required for conversion to take place. When desired furnace temperature is reached, H_2S (also referred as acid gas or sour gas) is gradually introduced into the hot furnace. As the flow of Acid gas increases, N Gas flow is reduced to maintain furnace temperature.

Usually, SRU consists of two firing chambers. The first firing chamber includes one or more burners design to fire N. gas for start up and to elevate downstream temperature. The second chamber includes tangentially mounted Acid gas injectors. The logic system should be designed to prevent introduction of Acid gas until downstream temperature is in the range of 1200 to 1600^o F or as recommended by the vessel manufacturer.
Usually, the vessel manufacturer has factory installed sight pipes to vessel. These locations are not always optimum for flame sensing. However, making changes in the field is not economical or often possible due to ASME certifications. It is prudent to ask IRIS to help with scanner location during design stage.

Downstream of the system may include multiple reactors and condensers

The major factor in SRU is the difference in radiations from flame between N. Gas and H_2S firing. In startup condition before furnace temperature is achieved, firing N. gas, flame signal is mostly UV. As the acid gas is introduced, UV signal increasingly gets masked by re-circulating sulfur particulates. UV signal drops. IR is required to keep system from tripping. This transition point varies with each application. However, with IRIS S550BE (or U2) that includes dual sensor the changeover can be completely transparent to user.

Two sensors used are in above models. UVtron operates around 200 nm and IR sensor that operates around 1400 nm. The system uses digital signal processing and two sensors provide independent operation. Further, system uses only signal that is highest discarding the second signals. In addition to gain and filter, adjustable “Flame On” and “Flame Off” threshold provides means of higher level of discrimination. Pease refer to chart at the end of this note.

For very difficult application two user selectable configuration files are available. These two files can stores two sets of configuration that can be selected by Burner Management System to accommodate two dynamically different operating conditions.

Note: Not all application requires use of two files. However, it is recommended to make provision in Burner Management System (BMS) to permit selection of two different files. Two files will provide flexibility that may be required depending upon type of furnace and fuels.

Channel “A” is selected by default where as Channel B requires input to P522. The file “B” is selected by user by powering “Chan Set” by 24VDC. Power for “Chan Set” can be from incoming 24VDC for DC models of P522 or from terminals marked +24VDC out and GND . A BMS or DCS should provide normally open isolated contact. One side of the contact should be connected +24 VDC (marked “out” for P522 AC) and the other side to “CHAN SET +”.
Make sure “Chan Set (–)” is connected to 0VDC for P522 DC or to GND terminal for P522AC to complete the loop.

Note that each file will also stores the parameters for “Flame On”, “Flame Off”, UV gain, IR gain, IR filter, FFRT (flame failure response time), Flame On time delay and bar graph display “Gain”.

We recommend that N. Gas firing be stored in Channel “B” selected as indicated above. The reason is most of the time furnace will be on Acid gas firing and if channel interlock is lost during acid gas firing the channel selection will default to Channel A, which is very likely not correct configuration for acid gas firing.

<u>Recommend Setup Guideline using a single file</u>

When firing N. Gas only, mostly UV signal provides flame count. However, to accommodate transition from N. Gas to Acid gas, IR is also used.

Acid gas characteristic is different than N. gas and requires monitoring mostly IR but UV may also play some parts.

When the N.gas is cutoff and only Acid gas is firing, UV will be masked by sulfur dust surrounding the flame and thus requires IR to take over.

Usually, lower IR gain (or higher filter setting) may be required to ensure on hot shutdown background flame signals are ignored by the flame sensing system.

Make the following adjustments as a starting point.
The following are default values. It is always a good practice to check and set as follows before proceeding.
Adjust UV gain to 32
Adjust IR gain to 451
Select IR filter to 1(default is 3)
Gain for analog to 30% (default is 50%)
Adjust Flame Failure Response Time to 3 seconds unless it is not in compliance with local code or plant standard or delay is already incorporated in BMS. Total response time for flame failure should not exceed 4 seconds. This is requirement in USA. Requirement in other countries may vary.
Adjust Flame On time delay time to 0 second
Flame On threshold to 800 (default)
Flame OFF threshold to 600 (default)

Cold Startup

a) Light off pilot and observe Flame count. If the count is above 800, adjustment at this point is not necessary. Should count be below 800, increase gain until count is above 800 (recommend 900, this will provide a small margin). If flame count is above 1200, reduce UV gain to keep count around 1200.
Note: Flame count must be above Flame on Threshold (800) for flame relay to energize first time. Once the flame relay is energized, count may fall below Flame On(800) threshold without tripping flame relay but must remain above Flame off (600) threshold. If the count falls below flame Off (600), FFRT will start and if count does not increase above 600 before FFRT expires, the flame relay will be de-energized.

b) ***Record UV gain and Lowest Flame count***

c) Light off main fuel and observe the count. Usually it should increase as the main flame is larger than igniter flame. Should Flame On count reduces below Flame On (800) threshold, increase gain until it Flame count is above Flame On Threshold (800).

d) Record UV gain and Lowest Flame count

When furnace reaches required temperature, acid gas is gradually introduced and N.gas is reduced to maintain vessel temperature. During this transition from N.gas to Acid gas, operator must make sure display count remain above Flame Off Threshold (600) (ideally Flame Count should be above Flame On Threshold (800). If necessary, adjust IR gain to keep Flame count above 20% above Flame on Threshold (In case of Flame on threshold set at 800 average signals should be about 1200.
Note 1: P522 automatically selects higher of two signals, one form UVtron and second from IR sensor. These two signals are not added. One of the signals must remain above 600 counts.
Note 2: Based on default value of Flame On threshold set at 800 and Flame Off threshold set at 600 counts: If the Flame count is higher than 1200, adjust filter setting first before adjusting gain. Set filter to higher setting. Do not increase filter setting above 3, instead after increasing filter to 3, decrease gain to achieve "Flame On" count around 1200.
Note 3: Some application may require file or Channel change at this point but most application do not require use of two channels.

e) ***Record UV Gain, IR Gain, IR filter and flame count.***

f) During next few hours observe and record the Flame Count –if it remains above Flame on Threshold, no adjustment is necessary. If flame count falls below Flame On threshold, adjust IR gain.

Shutdown

a) To complete setup procedure, it is most important to note Flame count as the acid gas is gradually reduced. Observe the Flame count and when acid gas flow is zero with N. gas, Flame count should fall below Flame Off Threshold. If it is not, adjust Flame Off threshold to value 10% above minimum count observed. For example, minimum count observed is 650, increase "Flame Off" count to about 700. At this point, you may want to go back and increase "Flame On" setting for Channel "A" to 900.
NOTE: Often when H_2S firing is reduced to zero, flame sensor may still show flame on condition for few seconds. This may be due to residual fuel burning off.
If the after shutdown, Flame relay remains energized for longer than few seconds, increase flame off threshold setting. Reducing Flame Failure Response Time (FFRT) may trip the system during normal operation.

b) ***Record UV Gain, IR Gain, IR filter and flame count.***

c) On next start up, check the system operation as minor adjustment may be necessary.

HOT STARTUP

a) If the furnace trips and immediate restart is necessary, wait until flame count is below Flame Off threshold. Start pilot and observe that Flame count is above Flame On threshold setting. As furnace characteristic has changed from Cold startup, minor adjustment may be necessary. If Flame On threshold is lowered, do not change Flame Off point. One of the reasons for two files/channels is to accommodate such a condition.

For future reference and use record the following for each condition – cold start up on natural gas, natural gas and acid combination firing, acid gas only firing, operator initiated shutdown, trip and hot startup.

1. UV gain
2. IR Gain
3. IR Filter
4. Average Flame On display
5. Maximum Flame Off display

An additional interlock used by some users include Pyrometer output set to energize an internal relay above 1600 F (870 C). The relay contacts input to BMS/DCS system to operate in parallel with flame on contacts from P522.

The following illustrates how two sensors operate independently.
The blue line shows N. Gas firing and Red shows H_2S.
The "X" axis is firing rate for two fuels with N. Gas above the line and H_2S below the line.
"Y" axis is the flame count.
Two examples are shown for transitioning from N. Gas to H_2S

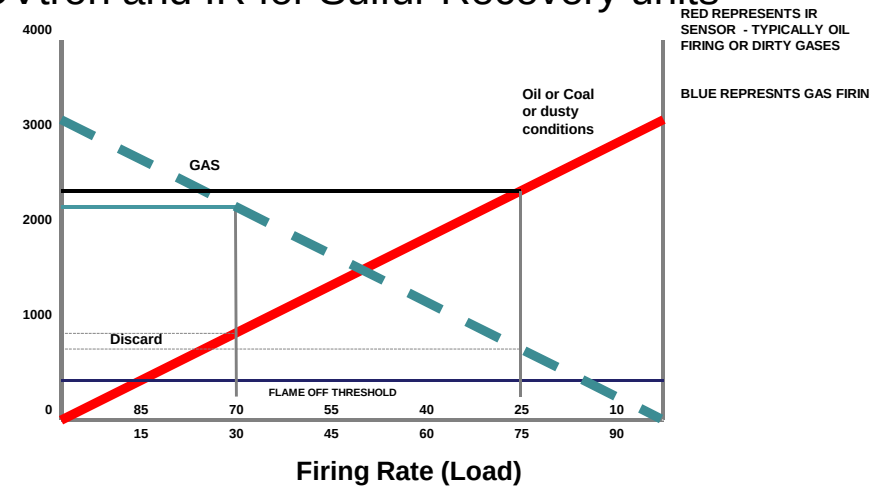
1. At 70% N. Gas and 30% H_2S, Flame count from UVTron is about 2100 and from IR is about 800. Only count from UVtron of 2100 is used for signal processing.
2. When N. gas is reduced to 25% and H_2S is increased to 75%, flame count from UVtron is about 700 and from IR is 2300. UVtron signal is discarded and only IR signal is used.

If system includes S550B or BE, the viewing head at the back will indicate contribution from UVTron (green) and IR (red).Note two most significant of four numbers are indicated i.e. if P522 shows varying count from 2201 -2299 count, one of the two (green or red) will indicate 22 and other shows lower number that is discarded.

Discriminating Flame Monitoring Systems Honeywell

Combination oil and gas fuel firing

UVtron and IR for Sulfur Recovery units



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