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Controlled Document

Quest CCS Project

Quest Process Design Changes 2017

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Signatures for this revision

Date	Role	Name	Signature or electronic reference (email)

Summary

This document summarizes the significant process design changes that occurred during the reporting period.

Keywords

Quest, CCS, process design

DCAF Authorities

Date	Role	Name	Signature or electronic reference (email)
		Add name	Actual signature
		Add name	Actual signature
		Add name	Actual signature

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1. SUMMARY OF CAPTURE UNIT CHANGES

- 2015: Addition of orifice plates on P-24610A/B (demin water booster pumps) discharge piping (MOC 25629)
    - Due to design issues with the demin water system for Quest, the suction pressure delivered to the demin booster pumps is 250 kPa higher than expected. This resulted in high demin water flows through the pumps when they are offline, creating a process safety issue in the case of high level in the de-aerator, and with the pumps online, the flow was too high for everyday operation of the system. This change allowed the system to operate within the designed control parameters by increasing the system pressure.
- 2015: Reconfiguration of CO_2 stripper reflux drum control (MOC 25759)
    - This change provided the operators with a more successful means to manage the amine unit water balance with fewer interventions required, controlling reflux drum level via reflux flow instead of the purge water stream to the wastewater treatment plant.
- 2015: Addition of amine flow ratio control (MOC 25776)
    - This change provided the operator with the means to maintain a settable, constant, CO_2 capture ratio while the hydrogen plant rates changed, by automatically modifying amine flow to each individual absorber on ratio control with the inlet raw hydrogen gas feed rate. The ratio control provided the benefits of constant CO_2 capture, which were witnessed via fewer disturbances of the HMU's tail gas flow/composition and to the Quest stripper V-24601 overhead temperature.
- 2015: Amine absorber flooding prevention controls (MOC 26033, 26335)
    - Due to absorber flooding/foaming issues, two independent changes were made to the absorber control system to protect the PSA adsorbent from harm due to amine carryover and to mitigate the impact of absorber foaming/flooding on hydrogen plant stability. The outcome was a series of modifications to controls/trip settings, and using the absorber bypass valve to partially bypass the absorbers when foaming/flooding were detected via pressure drop on the absorber trays.
- 2016: Stainless Steel Piping Upgrade on 8"-WP-285157 (MOC 27613)
    - A section of carbon steel piping was replaced with 304L stainless steel piping due to corrosion. Corrosion was caused by the low pH of water coming from the Quest regenerator reflux drum. Piping transported waste water from Quest plot to the Scotford Upgrader Water Treatment plant. Section of piping replaced was located in the Upgrader Cogeneration unit.
- 2017: Install permanent P-24611A/B suction strainers (MOC 28351)

- Suction strainers were installed on the cooling water pumps to prevent any debris from entering the pump which could cause pump damage or fouling in the downstream equipment.

- 2017: Install temporary caustic injection skid (MOC 28220)
  - The waste water caustic injection is not sized adequately to handle low PH water from Quest. A temporary Injection skid has been installed inside the Quest inter-battery limits in order to protect the biotreater and downstream carbon steel piping from the low PH water until a permanent solution can be implemented.
- 2017: Install butterfly valves on back flush connections for E-24604A/B & E-24605A/B (MOC 27840)
  - This change installed butterfly valves to provide double valve isolation points during the exchanger back flushing process that was completed in the Quest turnaround.
- 2017: Amine Stripper Temperature Control TC246013 and Level Control 246001A/B Modification (MOC 27898)
  - A change was completed to remove the feature of Stripper level control based on changing flows to the absorbers and use FC246009 (Waste water) for level control.
  - This MOC also changed the amine flow rate in the ratio controller to FI246075A (Total amine flow to Absorbers) instead of the flow meter downstream of the amine pump recycle valve.
- 2017: P-24612 Impeller Diameter Increase (MOC 28123)
  - This change increased the P-24612 impeller to the maximum size possible for the current pump casing in order to provide additional capacity as this pump was not able to empty the storm water sump fast enough resulting in storm water over flow during heavy rains.

2. SUMMARY OF COMPRESSION UNIT CHANGES

- 2015: CO_2 compressor C-24701 resolution to compressor reverse issue (CP 511)
  - Due to reverse rotation of the compressor during the initial shutdown, a detailed engineering study was conducted resulting in the addition of additional compressor blow-off capacity. Additional blow-off lines were added to the compressor's 4^{th}, 5^{th}, and 6^{th} stages that open automatically on a compressor shutdown to quickly reduce the volume of compressed CO_2 in the compressor interstage piping and knockout vessels, reducing the braking force applied on the compressor and decreasing the chances of reverse rotation of the impellars/motor.
- 2015: Compressor discharge pressure de-rate and control changes (MOC 26109)
  - Testing of the compressor after the blow-off modifications were completed revealed that reverse rotation of the compressor was still possible when the

discharge pressure was above 12 MPag. This change reduced the high discharge pressure trip on the compressor from 14 MPag to 12 MPag to mitigate the reverse rotation issue, and reduced the automatic blow-off point of the compressor 8th stage from 13.5 MPag to 11.5 MPag.

- 2015: Re-route V-24702 knock-out water to V-24701 (MOC 26168)
    - Knockout water from the compressor second stage knockout drum V-24702 was intended to be routed to the stripper reflux drum, but due to hydraulic limitations, was re-routed to the first stage knockout drum (V-24701) en-route to the amine drain drum (path of less resistance). This change necessitated more frequent makeup of water from the amine drain drum back to the CO_2 stripper.
- 2016: AT-247002 Quest analyzer alteration for Carbon Dioxide purity analysis improvement (MOC 27575)
    - To improve stability and reliability of the Quest Analyzer for CO_2 measurements, the following was implemented under this MOC:
        - Install flow regulating valves upstream of analyzer to decrease the internal pressure in the analyzer and allow the system to equalize to atmosphere quicker before the injection cycle.
        - Install pressure gauge downstream analyzer injection system to check/verify internal pressure during block and bleed function.
        - Install Valco diaphragm valves inside analyzer oven to increase the mean time between rebuilds for original manufacturer slide type switching valves.
        - Adjust analyzer parameters and timing to compensate for lower pressure/flow through analyzer.
- 2017: Extend Compressor (C24701) Casing Drains (24) and Suction Piping Drains (4) to Grade (MOC 25113)
    - This change extended the Compressor(C24701) Case drains (24) and Suction Pipe Drains (4) down to grade by installing additional tubing, valves and plugs. This was done to ensure operations can safetly manipulate the casing drains without the use of a ladder.
- 2017: Install vent on 1st stage compressor (C-24701) suction blow down piping (MOC 25357)
    - This change modified C-24701 1st stage suction piping so that the blowdown piping vents outside the building to eliminate potential CO2 exposure.
- 2017: AT-247002 Quest analyzer barometric pressure compensation for Carbon Dioxide purity analysis improvement (MOC 28056)
    - This change added barometric pressure compensation for the CO2 analyzer AT-24702 to ensure accuracy. Pressure compensation was done

using PT-250004 in the Cogeneration unit as Quest did not have a dedicated transmitter.

- 2017: Installation of an absolute pressure transmitter inside analyzer shelter R-24704 (MOC 28212)
    - This change installed a dedicated pressure transmitter Quest alleviating the need to use the barometric reading from Cogen (PT-250004). The dedicated barometric pressure transmitter was added to the Quest analyzer building to increase reliability and ensure accuracy of the composition measurements on AT-247002.
- 2017: C-24701 Re-rate to 14Mpa Discharge Pressure (MOC 28171)
    - This change removed the orifice plates in the Quest CO2 compressor to allow for additional gas to flow through the blow off lines. The removal of the orifice plates allowed for the compressor to be re-rated to 13.58 MPa which could be required in the future if well injectivity declines or pressure drop increases.

3. SUMMARY OF DEHYDRATION UNIT CHANGES

None to note for the reporting period.

4. SUMMARY OF PIPELINE AND WELLSITE CHANGES

- 2016: Upgrade Quest LBV Site 1-6 Power Supply (MOC 27477)
    - The power supply for Quest LBV sites consists of a solar charger and a battery bank. There have been occasions when the battery voltage has depleted significantly resulting in near-miss pipeline trips and one actual pipeline trip. Methanol fuel cells were installed at the LBVs to improve power supply reliability at the sites.

5. REFERENCES

The remainder of the process design is largely the same as indicated in the BDEP Appendix 12 P&ID listing.