Questions & Answers

Session 1 - Monday, 08 September 2014, 8:00 – 11:30 AM

1A - Managing SOS, POS and MOS to Minimize Major Incidents
Raghava Nayak , Venkat Pattabathula

Due to a family emergency, the author was not able to present this paper.

1A(sub) - Old doors, new views inside Steam Reformers
Brian Fuller

Q: Girish Patel, KBR
What percentage of reformer tubes can be covered by the gold cup method?
A: This depends on the style of furnace and the number of peep doors. In general for a terrace wall furnace typical numbers are 30 – 40%. For a large top fired furnace it is typically less than 10%

Q: Girish Patel, KBR
How many points of measurement will be carried out on the entire length of a single tube?
A: For the gold cup it is a single point of contact on the tube perpendicular to the bottom of the peep door.

Q: Rehman Hanif, Fatima Fertilizer Co., Ltd.
How the thermal images gets the accurate TMT reading of all reformer tubes with one correction factor of the existing factor?
A: The only way to get the exact temperature is to utilize the gold cup and contact the tubes that are reachable. A more elaborate correction factor can be applied to different zones of the furnace but typically we have found when comparing gold cup measurements to a single applied correction factor to either the thermal imager or a pyrometer achieves sufficient accuracy.

Q: Ken Wohlgeschaffen, Chevron USA
What is the typical cost for J-M Katalco to conduct an "enhance survey" using the "Reformer Imager" as described in the presentation and pg. 5-6 of the brochure 1431JM/04114/01PT?
A: Please discuss with your JM representative that handles your site, if you don't know who that is please feel free to contact me.

Q: Mike Anfony, Proplant Inc.
Can you use the camera (thermal Image System)to view and analyze the burners?
A: The wave length of the camera is such that it is not affected by the flame pattern. Because of this you cannot observe the flame in the video. Though what can be observed is when a burner is causing impingement on refractory or tubes that might not be visible with the naked eye.

Q: Mike Anfony, Proplant Inc.
Do we need any modifications to peep holes to use the camera?

A: No, the wand portion of the thermal imager is approximately 2.5 inches in diameter.

1B- Experiences with 2.25Cr-1Mo-Steel Equipment in the Ammonia Synthesis Loop after 30 Years in Service
Bernhard Geis, Hans-Jürgen Bassler

No questions recorded.

1C - Failure and Repair of the Liner of a High Pressure Carbamate Condenser
Shane Roysum, Johan Thoelen, Vincent Duponchel

Q: Rehman Hanif, Fatima Fertilizer Co., Ltd.
What management and inspection system failed to identify a probable leak before the actual leak occurred?
A: The liner should have been replaced when the corrosion allowance, 3 mm, was consumed. In 2012 inspection, some areas show 3.5 mm of corrosion. Small defects in the welds open up when the CA is consumed

Q: Rehman Hanif, Fatima Fertilizer Co., Ltd
Do you do Ni analysis and were there any findings before the leak occurred?
A: Ni analysis is done as a standard to monitor an increase in corrosion in the synthesis section. The corrosion process resulting finally in opening up the defects is still passive corrosion. Ni analysis will not be able to show a small increase in passive corrosion for such a small surface as the liner in the top of the condenser.

Q: Rehman Hanif, Fatima Fertilizer Co., Ltd.
What PMS or checks do you recommend to ensure the health of the leak detection system?
A: Basically, the leak detection system must be checked with a defined periodicity depending on the redundancy of installed equipment to reach the required level of availability. For Yara, the standard LDS is a pressurized system with carrier gas in combination with a flow detection and NH3 analyzer. For this kind of design, there is no dangerous undetected failure.
Control of the ammonia analyzer is done by replacing the carrier gas with nitrogen with a low ammonia concentration.
Control of the flow switch is done by isolating the line and controlling if the critical alarm is reported in the control room

Q: Maqsud Khan, IHI E&C
From hardware and cost points of view are there any benefits of implementing provision of LD program before a new plant is commissioned compared to implementing it in an operating plant?
A: A leak detection system must be in place and tested during the commissioning of the plant

1D - High Pressure Reforming – KBR Experience
Avinash Malhotra, Umesh Jain

Q: Maqsud Khan, IHI E&C:
From a NOx formation point of view, are you pushing more N2 to fuel gas and making more NOx in the furnace?
A: I mentioned in my presentation that the radiant duty of the primary reformer is reduced in the Purifier Technology compared to Conventional Technology. Therefore the total NOx will not increase.

Q: VK Aurora, Kinetics Process Improvements (KPI) Inc.
If you could explain as to how you were able to re-use the existing synthesis gas compressor w/o any modifications for the same production while the front-end pressure was reduced from 66 bar to 51 bar?
A: Original ammonia plant of NFL was designed in 1970s. Over the last 40 years lot of improvement in the ammonia synthesis converter basket design and catalyst have reduced the synthesis loop pressure. KBR selected the higher front-end pressure of 51 bar in order not to modify the synthesis gas compressor. In case this higher pressure front-end design was not available, modification to synthesis gas compressor would be required.

Q: VK Aurora, Kinetics Process Improvements (KPI) Inc.
What was the suction flow & pressure of the synthesis gas compressor before and after the revamp?
A: Please refer to the following table:

	Before Revamp	After Revamp
Suction Flow NM^3/hr	107,088	112,332
Suction Temperature ^0C	27.6	1.7
Suction Pressure Kg/cm^2a	37.7	38.1
Discharge Pressure Kg/cm^2a	204.4	197.2

Q: Rehman Hanif, Fatima Fertilizer Co., Ltd.:
Are KBR improving the drier/filter design & performance to make the purifier in old plants become more reliable & give longer runs as the Purifier is very sensitive to moisture, dust and ammonia?
A: Purifier based ammonia plants have already achieved highest on stream days in the ammonia Industry e.g. refer to Yara's paper "Over 3 years of Continuous Operation of Unit D in Sluiskil – All Time Record " published in AIChE Ammonia Safety Symposium 2007. However KBR continues to improve the design of Drier/Filter to avoid any accidental carryover of moisture or dust to Cold Box.

Q: Klaus Noelker, Thyssen Krupp:
An energy consumption reduction by 0.13 to 0.16 Gcal/ton is claimed as a benefit of the higher front-end pressure. Have the following effects been considered when calculating this number?

a. Higher energy of the natural gas compressor and what is the natural gas supply pressure at BL?
b. Higher process steam pressure reduces the potential of steam to perform mechanical work in the turbines.

A: KBR has considered both factors mentioned above in calculating energy consumption per ton of ammonia.

Session 2 - Monday, 08 September 2014 1:30 – 5:00 PM

2A - Laser Based Ammonia Detection increases Performance and Reliability in Ammonia Compression Facilities - Hamish Adam, John Selby, Paul Valentine

Q: Jorge Camps, Jacobs Consultancy:
Is measurement affected by weather?
A: The "Open Path" or "Line-of-Sight" technique described requires a laser beam to travel from a Transceiver to a Retro-reflector and back to a photo-diode housed in the Transceiver. The laser energy incident on the photo-diode (Light Level) must exceed a minimum threshold (Low Light) to enable a valid measurement of gas in the path. The technique can endure a significant reduction (up to 95%) in Light Level from the maximum value before the Low Light threshold is reached. This means that rain, haze, dust, snow and mist typically do not result in a Low Light condition. However, more dense fog or sandstorms can result in Low Light. As a rule of thumb, if an observer standing at the Transceiver can see the Reflector with the aid of binoculars, then the atmosphere is sufficiently transparent to enable valid measurement of gas in the path.

Q: Girish Patel, KBR:
Is ammonia detection performance compromised due to:

1. Heavy Rain ?
2. Sand & dust storms?
3. Pollution & particulates?
4. Wind storms?

A: Please see previous answer for responses to the first three points. Regarding wind storms, a possible consequence is that the wind is so strong that it causes the mounting posts on which the Transceiver and/or Retro-reflector are mounted to deflect such that the outgoing laser beam "misses" the reflector target so that the system goes "out of alignment". Secure mounting posts for the Transceiver (in particular) and the reflector to a lesser degree will prevent this from occurring.

Q: Rehman Hanif, Fatima Fertilizer Co., Ltd:

a. Any impact on the performance of the detection system during day & night time?
b. Any bad effect on human beings working in the area of the laser?
c. Any impact on human eyes due to exposure to the laser?

A: See below:

a. The most common diurnal effect occurs when inadequate attention has been paid to the design of mounts for the Transceiver (primarily) and Retroreflector. If mounting structures are made from metal, for example, preferential solar heating on one side of the structure can result in metal expansion that gives rise to twisting of the mounting structure causing the system to go out of alignment. For this reason it is best to make mounting structures from concrete. If the use of metal cannot be avoided, then the metal must be lagged with insulation to prevent the effect described.

b. A far less likely diurnal effect can arise with long paths in hot climates, where surface heating results in mirage effects which can deflect the laser beam out of alignment. In Boreal's experience with long paths in the Abu Dhabi desert, if measurement paths are arranged to be more than 2.5m above the ground the mirage effect is avoided.

c. The laser used in Boreal Laser systems generates less than 20mW of laser power. At the wavelength where Boreal Laser systems measure NH3, the lasers are classified Class 1 according to the International Standard EN 60825-1 relating to eye safety of lasers.

2B - Stress Corrosion Cracking Issues in Syngas Plants That May be Missed by Risk Based Assessment

D. M. Firth, C. W. Thomas, Manoj Thakur, Peter Tait, Hotdo Pasaribu

Q: Pan Orphanides, Consultant:

Any scale formed during PHT of the bundle and not removed but accumulates on the bottom of the tube bundle be the reason of the repeated failures in the vertical WHB in synloops?

A: In the cases presented there was no evidence of scale formation due to any heat treatment and there was no evidence of any build up of chemical deposits on the tube sheet. The major issue was the incorrect choice of material in the use of alloy 600 that is prone to PWSCC rather than alloy 690. However, care has to be taken in operating vertical boilers and superheaters, where the steam is shell side, to ensure that there is no build of chemicals and deposits on the tube sheets as this can lead to issues with under deposit corrosion and tube overheating.

Q: Rehman Hanif, Fatima Fertilizer Co., Ltd.:

High chloride levels in cooling water cause the stress corrosion cracking of stainless steel equipment. What should be the maximum upper limit of chloride in cooling water at 60 degree C to avoid it?

A:API 581 Table 13.8m is a useful guideline to prevent SCC in stainless steels in cooling water

Table 13.3M – Susceptibility to Cracking – CLSCC

pH ≤ 10				
Temperature (°C)	Susceptibility to Cracking as a Function of Chloride ion (ppm)			
	1-10	11-100	101-1000	> 1000
38 – 66	Low	Medium	Medium	High
>66 – 93	Medium	Medium	High	High
>93 – 149	Medium	High	High	High
pH > 10				
Temperature (°C)	Susceptibility to Cracking as a Function of Chloride ion (ppm)			
	1-10	11-100	101-1000	> 1000
< 93	Low	Low	Low	Low
93 – 149	Low	Low	Low	Medium

However, the risk of SCC can vary from this as it is dependent on a number of factors including:

- *Presence of crevices in the design.*
- *Formation of deposits such as silt and calcium carbonate scales .*
- *The use of corrosion inhibitors.*
- *pH.*
- *Oxygen content.*
- *Temperature excursions.*
- *Chloride concentration by evaporation ,deposition or design features.*
- *Evidence that pitting and/or crevice corrosion already exists.*
- *Heavily cold worked and/or free machining grades of steel especially steel manufactured before 1970 with possible higher levels of impurities.*
- *Possibility of sensitisation from fabrication, heat treatment or welding.*
- *Mechanical deterioration of surface finish.*
- *Iron contamination of surfaces.*
- *Welding during manufacture, modification and repair.*

RR902 (see references in the paper) provides further explanation.

2C - Primary Reformer Incident That Ends in Catalyst Tube Failure

Charles Ormsbee, David Craig, Alan Roe, John Mason

Q: Rehman Hanif, Fatima Fertilizer Co., Ltd.

During no steam flow to the reformer tubes, why the panel operator did not trip the bottom terrace fuel?

A: The panel operator was under the assumption that he was in a stable situation with steam flowing thru the reformer tubes – similar to a start-up condition where he is warming up the furnace on steam. With other alarms and issues arising during this time, the operator missed that

the steam flow had gone to zero on the panel due to the higher vent pressure at the HTS than the 600# steam header.

Q: Rehman Hanif, Fatima Fertilizer Co., Ltd
Do you have any skill certification program for the operators?
A: Yes, we have a progression training program involving testing of competency. We are also finalizing development of an Operator Panel Training simulator(OTS) but this OTS was not in place at the time of this incident. The key is whether there is adequate training on abnormal situations which we believe the OTS will address.

Q: Rehman Hanif, Fatima Fertilizer Co., Ltd
Have your plant categorized the conditions of the radiant tubes before this incident occurs?
A: No, there had been no H scan completed on the tubes.

Q: Rehman Hanif, Fatima Fertilizer Co., Ltd
Maybe B or C category primary reformer tubes have failed?
A: The information is unknown on the condition of the tubes in this area before the incident. Examination of the tubes after the incident did indicate severe overheating, glassy appearance on the surface.

Q: Kang Xu, Praxair:
Please comment on stress relaxation cracking (>10 years)?
A: A lot of the literature speaks to stress relaxation cracking occurring shorty after fabrication or early in the service life. I have seen failures in alloy 800H vessels after 10 years of service and the failure mechanism is described as stress relaxation cracking as determined by a metallurgical laboratory. In my view, we can have stress relaxation cracking in austenitic stainless steels from either fabrication stresses or high localized stresses from service loads.

Q: Kang Xu, Praxair:
Is PWHT a routine practice in your company when welding 304H stainless steel?
A: It is when we are fabricating headers with fittings welded only one side of the header. This applies to headers made from any type of alloy.

2D - The Importance of Catalyst Design in Managing the Impact of Transient Operating Conditions in Ammonia Plants
Peter Farnell, Mikael Carlsson

No Questions Recorded

2E - In-service Inspection of Welds in Atmospheric Ammonia Storage Tanks
Giuseppe Franceschini, Arie de Bruijne, Johan Thoelen, Vianney Amrhein, Olav Storkaas, Ole Nørrekær Mortensen, Jens Erik Olsen

Q: Harrie Duister, OCI Fertilizers:
Yara showed a "crack growth as a function of time" graph. Is that graph valid for all oxygen concentration and all tank materials?
A: The model is applicable for carbon steel material and all oxygen concentration. It is assumed that water is not present in the liquid ammonia. The used growth rate in the model depends on temperature and on the stress intensity factor at the crack tip.

Q: Ahmed Nurruddin, GPIC:
The technique addresses the integrity of the tank walls. What about the integrity of the tank flooring?
A: The technique is applied on shell welds (longitudinal, circumferential, "T" cross welds). Being NH3-SCC a general phenomenon, if the tank is free from indications in the shell welds (where both, the primary and the secondary loads are higher) the bottom as well is considered free from indications.
In case of findings on the shell further evaluations are made, considering the size of the indications Vs the defined acceptance criteria. Eventually, the tank is opened in order to do a full internal inspection including the bottom welds.

2F - Commissioning and Start-up of QAFCO 5 and 6
Ali Abdi Jama

Q: Ken Wohlgeschaffen, Chevron USA
What was the root cause of the failure of the inlet tube sheet joints, refractory damage and broken ferrules in A5 waste heat boiler and what were the learnings?
A: Inlet tube joints: failure mode was brittle fracture in HAZ of welds repaired before operation, due to high residual stresses and high hardness. The unit had a complex design in terms of materials selection, length of tubes, thin tube sheet combined with thick shell/bypass pipe. It was subjected to local PWHT in work shop. Temperature and quality parameters were difficult to control.

Q: Ken Wohlgeschaffen, Chevron USA
What were the root causes of the 2nd and 3rd failure in A5 WHB and what were the learnings?
A: No proper control of manual repairs on site. Several defects like excess/lack of penetration, lack of fusion, carburization and root undercut, which are difficult to detect with UT, especially on tube side were experienced.
Refractory damage and broken ferrules:
Result of tube failure, and not the cause. Refractory broke due to water/steam pressure impact
Ceramic ferrules have high thermal resistance but are mechanically not strong.

Choose more conservative design, with easy to control PWHT (if possible furnace PWHT). Choose metal alloy instead of ceramic ferules for this application of high temperature/pressure with relative thin tube sheet (and where there is always a chance of leaking tubes.

- *2nd failure was due to stress corrosion, in area's around welded tube plugs with high remaining stresses and local (phosphate) deposition in crevices (inside tube around plug, possible due to pressure equalization holes from water to plugged gas side)*
- *3d failure was due to insufficient stress relieve of repaired weld on earlier repaired tube (which was in difficult to reach area of tube sheet)*
- *Improved stress relief during site repair and avoid local crevices*

Q: Rehman Hanif, Fatima Fertilizer Co., Ltd.

a. What turn-over mechanism was followed after commissioning to have reliable & sustained plant operations?
b. Who was given the lead to give, call & lead the PSSR?
c. What was the TRIR of the projects?

A: see below:

a. Our Contractors was made responsible for the commissioning and start-up of the plants with the provision that they use our operators and our maintenance engineers/technicians during this period.
b. The Pre-Startup Safety Review was the Contractor's responsibility.
c. The project used Total Accident Frequency Rate (TAFR) = Number of Accidents x 1,000,000) / Total Worked Man-hours and the final for Q5 and Q6 were 25.5 and 12.1 respectively.

Q: Harrie Duisters, OCI Fertilizers
How are the Udhe/TKIS advisory services organized? Part of the overall contract or on a re-imburseable basis where the client asks for the service?
A: Udhe/TKIS services were part of the overall EPCC contract

Session 3 - Tuesday , 09 September 2014 , 8:00 – 11:30 AM

3A -Safe Start-up of Ammonia / Urea Plants under Challenging Circumstances
Klaus Noelker

Q: Pan Orphanides, Consultant:
In projects where TKIS was involved in BE & commissioning, what was TKIS involvement in the management of MC punch lists, which are usually very long?
A: In the lump-sum turnkey projects where TKIS was the main contractor, complete punch list handling was included in TKIS' scope. Punch lists were administered by using the mechanical completion (MC) management tool (e.g. ICAPS software) on site. MC check sheets filled out by subcontractor, vendor or owner were all collected and data entered into this data base. The MC

management tool easily gives an overview on the status of open and cleared punch items in each subsystems and thus allows for planning of punch list clearing prior to start-up.

In other projects where TKIS' responsibility was limited to supply of some critical equipment and advisory services for (pre-)commissioning), the overall handling of MC and punch lists was with the main contractor. TKIS involvement was limited to working with punch lists for equipment supplied by TKIS and making sure no "A" items were pending when commissioning started.

When setting up a contract, the customer is free to decide in whose scope he puts the management of MC punch lists. A good choice is to have it with the main contractor. If the party responsible for (pre-)commissioning is not identical with the main contractor, this party should have access to the system to read the status of each system in order to be able to plan the (pre-)commissioning.

3B - Overview of China Ammonia Industry
Cai Zeng

Q: Maqsud Khan, IHI E&C
Since ammonia plants in China are mostly part of a coal gasification plant that has multiple syngas products, isn't ammonia plant growth dependent on other chemicals for cost justification?
A: Most new coal based ammonia plants are stand-along units that solely produce urea as end product.

Q: Maqsud Khan, IHI E&C
How do you explain ammonia growth opportunity in China?
A: The ammonia growth in China is primarily driven by the on-going industry consolidation, leading to the new modern plants being built and in parallel the closure of small plants.

Q:Jorge Camps, Jacobs Consultancy:
What new projects are forthcoming in China?
A: Most new ammonia project information can be found in the open publications e.g. FINDS

3C - Convection Section Failure Analysis and Fitness-for-Service Assessment
James R. Widrig, Neil Schroetlin

Q: Mike Antony, Proplant Inc.
Did you consider to change the metallurgy of the heating coil from cast HK-40 to wrought SS 310?
A: The change in metallurgy would normally have been considered in a reliability assessment of the coil. The scope of work perform by Quest Integrity group did not include this assessment.

Q: Mike Antony, Proplant Inc.
What is the equivalent room temperature hydro pressure for the coil design of 530 psig at 1482 degree F?
A: The hydrotest pressure per API 560 is the 1.5 times the design pressure multiplied by the ratio of the allowable stress at 100F to the allowable stress at the design temperature. The minimum test pressure as shown in the presentation is 1460 psig.

3D - Sustained Operating Performance of Lutianhua Ammonia Plant After 50% Capacity Increase Through Revamp

Jiming Chen, Annie Jing

Q: Rehman Hanif, Fatima Fertilizer Co., Ltd.
What strategy followed to minimize the down time (during turn around) to complete all retrofit modifications?
A: LTH strategy to minimize the down time was to complete revamping work before shutdown as far as possible. Installations for all the new items (like new parallel air compressor, LTS reactor, and all the new equipment for CO2 removal system, syngas dryer system as well as PGRU etc.) was all completed and tested/commissioned if possible before revamp shutdown. Also the modified piping was placed into the plant as far as possible before the plant shutdown for revamp turnaround. Thus, the larger portion of revamp work was done before plant shutdown. During turn around, only limited part of the total revamp work left (such as furnace convection, radiant burners, HTS, and converter internals etc.) plus the routine shutdown work (such as overhaul of rotation equipment, etc.) were needed to be done. To shorten revamp turn around schedule, detailed planning and coordination between revamp work and routine work as well as the work by sections were carefully made by LTH with assistance from KBR and synergic effort from construction companies, which allowed LTH achieving 45 days of ammonia-to-ammonia.

Q: Rehman Hanif, Fatima Fertilizer Co., Ltd.
Whether hot or cold passivation of aMDEA CO2 removal system was being followed before heavy corrosion was observed in the CO2 removal system?
A: During revamp commissioning/startup, thorough cleaning of the system was done, but the hot passivation was not followed before heavy corrosion was observed in the CO2 removal system. The hot passivation including both static and circulation were done after heavy carrion was found.

Q: Maqsud Khan, IHI E&C
Was there any consideration given for reformer tube retrofit like increasing ID?
A: LTH re-harped the reformer tubes in 1997 with larger ID and thinner wall HP Modified tubes. The tubes were in good conditions, the catalyst volume was sufficient, and the tube design temperature margin was also maintained for the revamp operation, therefore radiant tube retrofit was not required.

Q: Maqsud Khan, IHI E&C
Why typically KBR doesn't consider process modification of the primary reformer?
A: Whether or not reformer tube modification to be considered or included in a revamp scheme, depending upon the existing tube conditions, revamp capacity as well as revamp operation conditions etc. Specific for LTH, since their radiant tubes were adequate for revamp operation, therefore, radiant tube modification was not included /considered in the revamp scheme.

Q: Maqsud Khan, IHI E&C
Can you comment on CAPEX/OPEX/Schedule?
A: CAPEX: the total revamp cost for the ISBL ammonia plant was about 50million US dollar; For OPEX: please refer to our paper and presentation: specific energy reduction was 0.47Gcal/MT after revamp in comparison with before revamp; Schedule: though the project was within budgetary cost, the project schedule was delayed about 4 months due to 2003 SARS (severe acute respiratory syndrome) epidemic in China.

3E - Operating Urea Plants with Small Leaks Poses Potential Safety Risks
Alex Scheerder

Q: Maqsud Khan, IHI E&C:
How would you design a hydrogen conversion system upstream of the CO2 compressor if the CO2 may occasionally have spikes of H2 exceeding design limits which may damage hydrogen converter catalyst?
A: The design of the hydrogen converter will take into account the expected hydrogen content in the CO2 feed. If hydrogen will have spikes, hydrogen will slip through and enters the synthesis section. In order to reduce the risk of Loss of Containment due to a (unlikely) explosion event, Stamicarbon has other features incorporated in its design.

Q: Rehman Hanif, Fatima Fertilizer Co., Ltd.
How the leak detections system over-looked when it indicated the leak in the urea reactor liner leak?
A: The leak detection system is designed in such a way that leaks can be located in which liner compartment (most probably leak will be located in the liner weld of the said compartment)

Q: Rehman Hanif, Fatima Fertilizer Co., Ltd.
What protocols and review process followed for doing temporary repair on drain header & man way box-up?
A: Drain header was replaced by an pipe with improved corrosion resistance and proper schedule.

Q: Mark Schreiber, KOCH Fertilizer
Does loss of O2 for passivation cause an automatic trip after time delay?
A: Not necessarily; depends on the system lay-out.

Q: Mark Schreiber, KOCH Fertilizer
If no H2 converter in service, what is the max. H2 percentage at which we should trip the plant?
A: Depends on the combination of concentration of ammonia, hydrogen and oxygen (explosive limits). Needs to be assessed for each plant.

3F - Reforming Furnace Reliability: Engineered Refractory Solutions
Malcolm Peirson, Dan Millsaps

Q: Jorge Camps, Jacobs Consultancy:
Can you comment about furnace specifications?
A: Thorpe is not aware of any comprehensive refractory specification in the market place for various types of reformers from various manufacturers. For this reason, most End Users must carefully select refractory suppliers and/or contractors to provide guidance and supplement their in-house experience.

Session 4 - Wednesday , 10 September 2014 - 8:00 – 11:30 AM

4A - Metallurgical and Catalyst Effects from Airflow Condition into HTS
Sean Ukele, Shawn Carnine, Zachary Singer, Scott Osborne

Q: David Firth, Quest Integrity
The inspection carried out on the vessel would not detect HTHA. Was there any specialized UT testing carried out to detect HTHA? The vessel was likely to have a thin layer of carburization that caused the pto.
A: Hardness and Replication were performed and the results indicated Martensite formation. No additional UT testing was conducted during this short outage. Stress relieving was performed to reduce the hardness indications.

Q: Alfredo Medina, Jacobs Consultancy:
Was a common practice to use C ½ Mo in several equipment's in ammonia plants. In addition to the HTS have you reviewed if other equipment are still C ½ Mo? Revisit of the methanator is suggested.
A: Yes, Ammonia 1 Methanator and Ammonia 2 HTS. Ammonia 2 was 1.25 Cr ½ Mo. AUBT was utilized in our Ammonia two unit on Methanator and HTS with no indication of HTHA.

4B -Failure of Methanator Feed Effluent Exchanger Tubes due to Benfield Solution Carry over from CO2 Absorber
Anwar Mahmood Shahid
– note this paper was not presented as the authors were unable to attend the conference. A substitute presentation

4B Sub - Management Systems: Correcting for Wear and Tear
Jatin N. Shah of Baker Risk
No *Question Cards presented for follow-up.*

4C - The Rupture of a Liquid Ammonia Storage Tank Study
Alireza Orooji, Sajjad Hosseininia

Q: Dorothy Shaffer, Baker Risk
PSM elements such as HAZOP with review of PSV sizing and Management of Change and equipment deficiency reviews may have pointed out issues on the system. Are these elements part of the changes made?

A: Yes, HAZOP Review was done on the ammonia tanks system. Increase the number of PSV's on the ammonia tanks is in program. Install a new temperature transmitter indicator in the ammonia product line near the tanks inlet and also solenoid valve in the turbine condense water line to ammonia product line is done now. Asset integrity system is conducted specially for PSV's , Vacuum Breakers, Flame Arrester on the tanks flare, Emergency boil off gas compressors, ammonia loading (Export to ship) and vapor return lines. PSM and MOC systems are conducting in the plant now.

Q: Julia Lindland, Yara International
Does the tank have bottom discharge/bottom pipe penetration? If yes, what condition was this pipe connection in?
A: There is no discharge line in the bottom of the tank, (Concrete foundation). But a line is considered as siphon drain line for draining and decommissioning of the tank for inspection. This line enters the tank about 50 cm up to bottom of the tank from the wall and bend toward down in the tank and continue to 5 cm of the bottom. Draining the tank with this line is very hard and depends on take place of siphoning phenomenon. Decommissioning of this type of tanks is a project alone.

Q: Julia Lindland, Yara International
What part of the design was the main reason for limiting the consequence?
A: Main reason which limiting the consequence was the weaker shell to roof joints in comparison with shell to bottom joints based on API 620 & 650 standards. Therefore if sudden overpressure had been occurred, shell to roof joints fail faster than bottom joints and the pressure released, prevent liquid ammonia slippage.

Q: Mukund Bhakta, Flour Corporation
a. Why did the PSV's fail due to the over pressure in the ammonia storage tank?
b. Did the PSV's lift?
c. Why not the relieving pressure?

A: See below:
a. The PSV's were not failed and were popping during the incident.
b. yes, they were lifted. Also after incident, they were tested in the shop and were operating correctly.
c. The amount of vapor was enter and also formed in the tank was over than PSV's evacuating capacity. Such these causes did not consider in PSV's sizing scenarios. The calculation scenarios which are considered are:
Case1: Tank Boil Off (Heat in-leak) +Vapor displacement during filling

Case2: Tank Boil Off (Heat in-leak) +Drop in barometric pressure + Vapor displacement during filling

Case3: Tank Boil Off (Heat in-leak) +Boil off due to fire exposure

4D- The Revamping of CF Industries #5 NH3 Plant: Application of Casale's Isothermal Technology and Clariant's AmoMax®-10 Catalyst

Michael Dean, Davide Carrara, Tim Rembold

Q1- Dirk Blomme, YARA:
When, as a rule of thumb, should the isothermal reactor be considered? (based on economic consideration)
A: The isothermal reactor can be applied both in revamping projects and in new plants. The isothermal technology gives higher performances when compared to standard adiabatic converters.
Nevertheless the actual benefit is evaluated case by case according to the peculiarities of the plant and the Client's needs.

4E - Enhancing Reliability in Plants Operating Significantly Above Nameplate Capacity

Bhaskar Rani, Mahesh Gandhi, Robert Burlingame

Q: David Firth, Quest Integrity:
For the design of the wasteheat boilers how do you ensure there is no metal dusting?
A: KBR design practice is to check the design for Steam to Carbon Ratio; Composition; operating temperatures etc. to ensure no probability of metal dusting. Selection of materials is such that it takes in to account metal dusting.

Q: David Firth, Quest Integrity:
Have KBR ever seen metal dusting in these types of boilers?
A: This exchanger has been inspected after fifteen years of service with no signs of metal dusting.

Q: Maqsud Khan, IHI E&C:
What is the impact of new design in terms of physical size? Were the Height and diameters are changed? By what percent, just as a rule-of-thumb, by considering lay-out requirement?
A: Since the new exchanger does the duty of three exchangers (101-CA/CB and 102-C) it is larger and taller. KBR approach to the new exchanger is to install out-side the structure on a new foundation. Both the diameter and height are increased. The change percentages depend on the Heat Transfer requirements and future capacity considerations of the Ammonia Plant.

Q: VK Arora, KPI Inc.
With increased head & lower pressure drop of the new 101-C, have you taken advantage of lowering the height of the steam drum?
A: In revamps you do not change the elevation of the existing steam drum in retrofit application – in new plants this is considered.

Q: VK Arora, KPI Inc.
How does the heat flux compare for the new 101-C vs. the old design?
A: Since the process parameters are about the same, so the expected heat flux is comparable.
Q: VK Arora, KPI Inc.
If the new 101-C design will permit higher proven inlet temperature – what is the maximum?
A: Since KBR design is with refractory lining and water jacketing higher temperatures are not an issues. KBR recommends operators to not to exceed 1,860 Deg F (1,016 Deg C) on a continuous basis.

4F - Unusual Reformer Events and Modeling
Dorothy F. Maxwell Shaffer, Anthony Sarrack, Kelly Thomas

Q: Matthew Humphrys, Johnson Matthey
Would you agree that new, reliable in tube temperature measurement (Cat-Tracker) provides an extra layer of protection during transients, like start-ups, when other measurements are not dependable?
A: I'm very encouraged about how companies are responding to the need for better technologies that assist in monitoring the reformer on a continuous basis, and especially those that are valid at shutdowns and startups. These include technologies such as the internal tube temperature thermocouples and continuous furnace monitoring cameras. A number of the incidents could have been avoided if the operators knew the tubes looked hot or had accurate temperatures during low or no flow conditions.

Session 5- Wednesday , 10 September 2014 1:30 – 4:30

5A - Plant Preservation: Issues & Remedies
Asim Rasheed Qureshi, Syed Ali Raza Sani
Note this paper was not presented as authors were unable to make it to the conference.

5A (SUB) - Better Understanding of Chemical Reactors,
Omar Al-Masori of Clariant Corporation,
There were no question cards turned in for the presentation

5B - CO2 Capture from Steam Methane Reformers – Understanding the Options
Christine Kandziora, Ken Lamb, Goutam Shahani

Q: Rehman Hanif, Fatima Fertilizer Co., Ltd:
Is there any live example of CO2 removal in PSA plants from flue gas?
A: Linde has supplied numerous PSA units for CO2 removal from the off gas associated with the direct reduction of iron (DRI) and tail gas from a hydrogen PSA. These units range in size from

6,600 Nm3/h to 520,000 Nm3/h of feed gas. The units are in commercial operation in Asia, Europe, and North America. We have not supplied any PSA units for CO2 removal from flue gas.

Q: Rehman Hanif, Fatima Fertilizer Co., Ltd.
What is the maximum capacity and purity that can be achieved?
A: There is no limit to maximum capacity as multiple trains of CO2-PSA can be employed. The purity is typically 90% and it depends on the feed gas composition.

Q: Harrie Duisters, OCI Fertilizers
To what pressure is the gas compressed when you adsorp the CO2 from the flue gas?
A: Typically, CO2 PSA units operate at 6 to 16 bar (g). Desorption is at ~0.3 bar(g)

Q: VK Arora, KPI Inc.
GPIC Bahrain is one reference who have implemented CO2 recovery from reformer flue gases. The recovered CO2 is being used in methanol & urea plants. They use Mitsubishi technology. Any others?
A: Linde has built a number of CO2-PSA for reformers. However, these are based on the tail gas from a H2 PSA; and not flue gas.

Q: VK Arora, KPI Inc.
What is the maximum economical size for a CO2-PSA unit?
A: There is no technical limit to the size of a CO2-PSA unit. However, the economic maximum size depends on the cost of the alternative, namely amine absorption. This evaluation depends on the relative cost of power versus steam availability and cost. Another factor that will favor absorption is the greater economy of scale achieved with absorption columns

5C - Prevention of a Potential Catastrophic Failure of a High Pressure Condenser in a Urea Plant
Roberto Gorza

There were no question cards submitted for this paper.

5D - Lessons Learned from High Pressure Process Boiler Failure
Larry Walker, Keith Wilson

There were no question cards submitted for this paper.

5E - Cost Effective CO2 Capture from Flue Gas for Increasing Methanol Plant Production
Satish Reddy, Mukund Bhakta, John Gilmartin, Joseph Yonkoski

Q: Mike Antony, Proplant Inc.
Can this technology be economically applied for increasing urea production?
A: Yes, this technology can be economically applied in a ammonia /urea complex wherein all of the ammonia produced cannot be converted to urea due to the shortfall of CO2. Many plants in India which are currently converting from a naphtha based feed to natural gas feed are encountering this situation.

Q: Mike Antony, Proplant Inc.
Inputting CO2 at the reformer inlet will affect CO/CO2 ratio (shift equilibrium). How this will impact the benefit?
A: Injecting CO2 at the reformer inlet will impact the shift equilibrium whereby the production of hydrogen is suppressed and an optimum syngas feed composition is achieved.

In an SMR-based plant, the syngas feed to the methanol plant typically has about 30 % excess hydrogen and the stoichiometric number (SN) of the syngas feed is 2.95. SN is defined as below:

SN = (H2-CO2)/(CO + CO2)

When CO2 is injected in the feed to the SMR, hydrogen production is suppressed, CO is preserved, and SN is reduced to about 2.05, which is optimum for the Methanol plant.

Q: Ken Wohlgeschaffen, Chevron USA
a. What is the material of construction for the plant equipment, stainless steel or …?
b. What is the reliability of the three SMR plants (% on stream time)?
c. Is Piperazine the activator in the MEA?
d. Is a corrosion inhibitor also used?
A: See below:
a. Primarily stainless steel
b. > 99%
c. The constituents of the solvent are proprietary
d. The constituents of the solvent are proprietary.

Q: VK Arora, KPI Inc.
Addition of CO2 in methanol plants results in higher levels of by-products leading to increased demand on distillation. It is regardless of CO2 injection point – either in reformer or at make-up gas suction. Do you agree?
A: We found that adding CO2 into the steam reformer feed gas results in a higher ratio of CO to CO2 in the make-up gas that results in less water production in the crude methanol stream. This is compared to the option wherein CO2 is directly injected into the make-up gas to the methanol plant.