EnvID/BAT Workshop KEA CCS Concept – Technip FMC/Shell Cansolv
KEA Project Site 15.6.2017

MINUTES OF MEETING – No. 2017-183-MOM-02

PURPOSE OF MEETING:

Purpose of this workshop was to review and discuss the detailed design of the Carbon Capture Plant as per vendor, Technip FMC design. The workshop aimed to identify and if possible quantify the emissions, discharges, utility consumptions, chemical consumptions and waste generation related to the CC plant. Further, the workshop aimed to discuss relevant interfaces to identify both potentials and possible BAT assessments to be recommended performed in the upcoming FEED phase.

ATTENDED BY:	**DISTRIBUTION:**
Technip FMC: Jonathan Marriot. Technical Mng Matthew Cheadle, Project Mng **Gasnova**: Magne Østlund Prestholdt, Senior Advisor **KEA Project Team:** Petter Thorbeck, Technical Mng Johan Fagerlund, CCS Mng Lars Magnus Homstvedt, Regulatory Mng Emil Hoffmann, HSEQ/Risk Mng Lene Nesbjørg, Process Engineer Sunil Jonh, Environmental Engineer Anders Nordling, COO Hege-Ann Lie, Facilitator	All Attendees

ITEM	DISCUSSIONS	ACTION BY	DATE NEEDED
1	**General**		
1.1	**Presentation of EnvID/BAT Process for KEA Concept Phase** EnvID – Environmental Identification Workshop ◦ Emissions and discharges – planned and potential accidental ◦ Energy consumption – energy optimisation, interfaces to existing plant ◦ Chemical consumption – type, volume, alternatives, measures ◦ Waste generation – type, volume, alternatives, handling ◦ Project interfaces to existing plant – risk, opportunities, optimisation Workshop with identical agenda and duration planned with both potential vendors of the CCS Plant.	**Info**	
1.2	**Agenda** 0830: Welcome by KEA 0845: Introduction to workshop/agenda by HMS DU 0900: Design presentation (PFD, layout etc) by Technip 0930: Envid/BAT review and discussions 1200: SumUp	**Info**	
2	**Presentation of vendor concept – EnvID discussions**		
2.1	**System overview description**	**Info**	

	The system proposed by Technip FMC consist of following main components; - Pre-treatment unit (booster fans and pre-scrubber) - CO2 Capture unit (single absorber tower, water wash section, stripper column, Absorbent Recirculation system, Absorbent Filter Unit, Thermal reclaiming unit, additional to tanks and vessels, associated pumps and heat exchangers) - Liquefaction, Conditioning, Storage and Export Unit (if truck transport: liquification unit where CO2 is compressed, dried and liquefied and intermediate storage. Loaded to ships at Oslo Harbor. If pipeline: CO2 is only compressed and dried at KEA facilities, liquefaction and storage at Oslo Harbor prior to loading to ships)		
2.2	**Utility consumption** The CCS plant will require following utilities: - Steam - Demineralized water - Process water - Electricity - Instrument air - Plant air - Nitrogen - Hydrogen - Condensate return to KEA plant system The interfaces between the new CCS plant and the existing facilities are being discussed both in the VIP register and by several studies performed related to heat and mass balance, water demand studies and need further detailing in the upcoming engineering phases. Several of these items are considered relevant documented as BAT items, and this will be further discussed within the KEA project team. A recommended list for BAT evaluations and documentation will be included in the final documentation for the concept phase.	**Info**	
2.3	**Absorbent** The absorbent product information is restricted and confidential and documentation of the product could not be reviewed. As per vendor information and drawings, the absorber is handled in a closed system, reused in the process. The system includes top up as the absorber will degenerate in the process. The amounts of absorber follow the flue gas is expected very low. The degenerated absorber will, together with other fine particles from the process, be separated and the waste is considered hazardous waste.	**Info**	
2.4	**Caustic Soda** 47wt% caustic soda is planned stored in atmospheric tanks and diluted to 20% during pumping to consumers. The caustic solution is used for the Thermal Reclaiming Unit and the Water Treatment Plant. Safety shower and bunded area at delivery point. Electrical heated to prevent freezing. Klemetsrud is currently using a 50% caustic soda (Brenntag). Common system for existing plant and new CCS could be considered in the upcoming engineering phases.	**KEA**	
2.5	**Heat pump transfer medium**	**Info**	

	A heat pump solution has been included to take the waste heat rejected by the CCS plant and upgrade it for use in the district heating system. The transfer medium proposed used is ammonia. A separate heat pump study has been performed and documented (not reviewed as a part of this workshop).		
2.6	**Water Treatment Plant** The water treatment plant is designed to take effluent from pre-scrubber blow down and condensate from the dehydration package. The flue gas from Klemetsrud will contain ammonia that follows the condensed water, and calculations shows that the water treatment plan is required to reduce the level of ammonia in the water within requirement (60 ppm). Based on calculations, the level without the WWTP will be 66 mg/l. It was discussed in the meeting the possibility of using water from existing plant for dilution of the condensed water and removing the water treatment plant in the CCS unit and gain a reduction in both cost and area demands. If removing a water treatment unit, and allowing the water to be diluted prior to discharge to municipal sewage, the decision is recommended systematically reviewed and documented. Items from the discussion in the workshop included; - Ammonia content in existing condense water? - It treated; can the water from the CCS unit be re-used at the facility instead of discharged? Are streams for no-tap water identified? - How will the setup of the discharge permit for CCS be? - As a contract requirement, Technip FMC is obligated to deliver a CCS unit that alone is in line with all authority requirements - What is the cost of the water treatment plant (and hence the potential cost reduction?) - Flue gas from Line 1 and 2 are the ones with highest ammonia content as line 3 (and potential line 4) has lower content. Can the inlet configuration be optimized to reduce the content in the condensed water? - Water balance calculations are for final checking both at KEA and Technip Topic could not be solved in this workshop. Consider a separate activity/study for review and documentation of this topic.	**KEA**	
2.7	**Treatment of flue gas after absorber** The water wash section in the absorber tower will remove most of the absorber following the flue gas, very small amounts may follow the flue gas emitted. The flue gas will be analyzed prior to release, if above required limits, gas will be routed back in the system for further cleaning. Emitted gas will be well above due point and no visible flume at the top of the stack. Will an additional flue gas treatment system prior be required installed from start-up, or is reserved space required? Mist removal can be included. Dispersion studies are ongoing. To be reviewed at end of concept phase.	**KEA**	
2.8	**Storage area** Technip FMC informs that it/when a line 4 is introduced from KEA, additional area requirements for storage. Reserved space for additional storage should be confirmed.	**TechFMC**	

2.9	**Flue gas treatment upstream CCS plant:** The CC process has systems to handle temperature changes etc in received flue gas, but system is sensitive to SO2 content, increases the amine degradation. Consider possible pre-cleaning to ensure as low SO2 content as possible in the flue gas from existing lines. Reference is made to VIP-Tech-05.	**KEA**	
2.10	**Reclaimer waste** Handling method of reclaimed waste not decided. Planned disposal is burning as hazardous waste, preferable at Klemetsrud, alternatively at Brevik. As disposal method in any case seems to be burning, risk associated to transport should be included in the assessment. Expected waste amount: around 20 kg/hr KEA has an expert engaged to assess the potential hazards by burning the reclaimed waste. Results and recommendation will be fed back to the CCS project.	**KEA**	
2.11	**Absorber consumption** The amine based absorber will degenerate in the process and need top-up-Consumption will depend on among others the SO2 content in the received flue gas. Consumption of absorber is not quantified at this stage. The system is designed as a closed system, also with respect to maintenance. Vents are routed to a common closed vent.	**Info**	
2.12	**Risk - leak of absorber** Low risk of leakages via flanges, as content mainly liquids. Small risk for leak of absorber/amine in the pre-scrubber. Assumed oxygen content in flue gas 8-9%, temp approx. 70 deg. Initial assessment has been performed by KEA to assess identify risk of leak/aerosols, concluded acceptable.	**Info**	
2.13	**Risk of leak/tank rupture** Storage tanks are designed with double walls. This is OK with respect to smaller leaks, but authority expectations will be additional bunded area for collection and handling of larger spills/overfill scenario. To be included in the design.	**Technip**	
2.14	**Drain system** Closed drain system is included in the CC plant design. The closed drain system will be designed to take discharge from plant area with potential for chemical contamination.	**Info**	
2.15	**Utility Chemicals** The CC Plant will require process chemicals already used at Klemetsrud (lube oil, caustic, hypochlorite). Optimization of combined used can be assessed in the FEED/detailed design stage.	**Info**	
2.16	**Noise impact** Noise issues related to the multistage compressor train will be handled by enclosures. Noise internally inside the CCS plant compartments not covered in this workshop.	**Info**	
2.17	**Lube oil / waste** Lube oil, filters and lube oil waste for the compressors – follows system in place for existing compressors at the facility.	**Info**	
2.18	**Use of variable speed drive (VSD)**		

	As per design, variable speed drive (VSD) is not included. Booster pumps have a potential for reducing energy consumption by VSD, mapping not done at this stage An initial analysis of potential could be considered done as a part of the BAT assessment for FEED.	**KEA**	
2.19	**Cooling medium** Cooling medium not concluded. Air coolers/fin fan coolers have higher energy consumption than water cooling. Air cooling is the preferred method by KEA. As is, the design results in negative energy – using more energy to get rid of the produced energy. Ongoing interface action, ref. VIP-TEC-7.	**Info**	
2.20	**Location for emitting CO2 free flue gas** Ref. VIP-TEC-9 and discussions related to emitting CO2 cleaned gas directly from stripper, removing the Gas Gas Heat Exchanger and ducting back to existing stacks (cost reductions). Flume will then be visible. Consider to include in a BAT assessment for FEED.	**KEA**	
2.21	**Heat integration study** Heat integration study planned late concept phase/early FEED	**Info**	
2.22	**Discharge permit** Way forward related to discharge permit is most likely to update the existing permit with a section related to the CC plant incl. storage and transport.	**Info**	
3	**BAT – recommendations for FEED**		
3.1	**BAT assessments** Items recommended subject for BAT evaluations in FEED will be discussed with KEA project team and included in BAT report as relevant.	**Info**	