ACT ALIGN CCUS Project No 271501

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Accelerating Low carboN Industrial Growth through CCUS

Deliverable Nr. D4.1.5

Certification and grant of operating permission

Dissemination level	Public	
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Executive summary

The ALIGN-CCUS demonstrator was erected and operated at the power plant site at Niederaussem, where also the CO_2-capture plant and a CO_2 compression and liquefaction unit is in operation. Because of the existing R&D infrastructure at this site, with several pilot plants and testing facilities and the connections of this R&D plants to the 1000 MW BoA1 unit of the power plant, a 24/7 operation of the ALIGN-CCUS demonstrator under real industrial conditions is possible. Beside this a maintenance team of the R&D department ensures a high availability of the pilot plants and testing facilities.

The ALIGN-CCUS demonstrator comprises a CO_2-conditioning unit, a compressor unit and a DME-synthesis unit delivered from Mitsubishi Power Europe GmbH (MPE) and the alkaline electrolyser consisting of two containers delivered from Asahi Kasei Europe GmbH (AKEU). MPE is responsible for the system integration and RWE for the operation of the plant.

All container modules were erected at the site from beginning of October 2019 in the vicinity of the CO_2 liquefaction unit.

As owner of the site and operator of the ALIGN-CCUS demonstrator, RWE is responsible for health and safety issues and for the operation of the plant according to German and European standards. At an industrial site it is a prerequisite for the start of the commissioning and the operation of the facilities to provide several documents like technical certificates and safety concepts. These documents and the completion of the assembly on site were inspected by a notified body to ensure a save commissioning and operation of the ALIGN-CCUS demonstrator.
The overall procedure from erection to operation comprises two milestones. After the erection of the plant the supplier has to fulfill some requirements before he receives the first time the consumables for the commissioning to achieve the first milestone “start of commissioning” and the second milestone “end of commissioning and start of operation”. After the commissioning and performance tests the plant operation is taken over from the RWE-operating staff on site for the 24/7 operation and to carry out the testing program.

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1 Introduction

The design, basic and detailed engineering of the plant has to be performed with regard to all relevant provisions of law, administrative regulations, ordinances and guidelines as well as in relation to the state of the art and the technical requirements of the operating site owner. This means in particular fire, explosion and occupational safety as well as plant safety conditions have to be considered. The suppliers of the demonstrator units are obliged to provide the necessary information.

The conformity with all relevant EU directives of a plant, which is put into circulation, must be authorized according to this and also marked, in pursuance of:

- 1st ProdSV, RL 2014/35 / EU Low Voltage Directive
- 9. ProdSV, RL 2006/42 / EG Machinery Directive, when machines or incomplete machines exist
- 11th ProdSV, RL 2014/34 / EU ATEX Directive
- 14th ProdSV, RL 2014/68 / EU Pressure Equipment Directive
- EMC law, directive 2004/108 / EG EMC Directive
- §§ 5 – 12 of the ordinance on safety and health protection when using work equipment, 07.01. 2015 / occupational health and safety ordinance - BetrSichV

The plant must be planned according to DIN EN / IEC 61508 in such a way that, in an event of insecure and critical operating conditions, it becomes automatically safe without manual intervention.
The necessary CE-declarations and certificates are approved by a notified body.

For ALIGN-CCUS this means explicitly, that the TÜV Rheinland has controlled the

- Electrolyser unit from Asahi Kasai
- Synthesis unit from MPE
- CO_2-conditioning unit from MPE and
- Connection lines/piping between the individual units, in the responsibility of MPE

regarding CE, ATEX Directive and Pressure Equipment Directive.

The documents which were necessary for the TÜV-inspection of the ALIGN-CCUS demonstrator were the following:

- PFDs of the whole process of the ALIGN-CCUS demonstrator and the process description with all volumes and pressures
- Documents to review the manufacturing according to the Pressure Equipment Directive (2014/68/EU)
- Declarations of conformity for assemblies or for constituent equipment respectively
- Hazard Analysis according to the Pressure Equipment Directive
- Preliminary operation manual
- Lightning protection concept

In addition, the fire protection concept was approved by the fire protection department of RWE.

The responsible district governments were informed about the intended erection and operation of this ALIGN-CCUS demonstrator by RWEs permission department.

2 Grant of operation permission

The permitting procedure for the ALIGN-CCUS demonstrator by the responsible district governments is characterised by the facts/classification:

- The ALIGN-CCUS demonstrator is no associated secondary installation of the power plant, therefore it means no re-arrangement of the power plant according to §15 or §16 BImSchG (German Federal Immission Control Act)
- Appendix 1 of the 4. BImSchV (German Federal Immission Protection Ordinance) contains a list of facilities that require a permission (with public participation as the circumstances require). The authorities have defined the ALIGN-CCUS demonstrator to be listed, but there exists a special provision for research facilities in lab- or pilot-scale according to §1 (6) 4. BImSchV
- A public participation was not necessary for the permitting procedure, as the research facility is operated for <3 years
- Although the permitting authorities have classified the ALIGN-CCUS demonstrator as a research facility that is not subject to approval, the ALIGN-CCUS demonstrator has to satisfy several regulations and permitting procedures: building application, comprising the concept for fire-protection, lighting concept, technical instructions on air quality control, German ordinance on systems for handling water-polluting substances, quality, noise, health and safety etc.

After erection of the plant the phase of cold commissioning starts. To receive for the first time water or power for pressure tests of pipes and vessels or loop checks the manufacturers have to fulfill some requirements.

The most important documents that are required for the first connection of the switchgear are:

- EU-/EG-declaration of conformity by EU-directive 2014/30/EU („electromagnetic compliance -EMC“)
- EU-/EG- declaration of conformity by EU-directive 2014/35/EU („low-voltage directive - LVD“)
- Review certification by DGUV instruction 3 („BG-Unfallverhütungsvorschrift Elektrische Anlagen und Betriebsmittel“) and DIN VDE 0100 Teil 600 („Errichten von Niederspannungsanlagen - Teil 6: Prüfungen“).

After finalization of the cold commissioning the phase of hot commissioning follows. Start of hot commissioning means, that consumables like KOH-solution, H_2, N_2, CO_2 or demineralized water are made available to prepare the start of operation of the electrolyser unit and/or the synthesis unit.

Before RWE had provided the consumables, the suppliers MPE and AKEU had fulfilled the following points/tasks:

- The installation of the unit on site were ready (end of assembly)
- Remaining open technical issues from the assembly and deficiencies were listed and evaluated by the manufacturer (punch list)
- Readiness for commissioning was declared by the manufacturer
- Organisation for commissioning were implemented (organisational chart with responsibilities)
- Commissioning manager and team members were named (contact list and absence management)
- Risk assessments for commissioning were available on site
- Information about emissions, noise, water treatment, health and safety, explosion prevention and fire prevention were available on site
- Entire, preliminary technical documentation and operation manual were available on site
- All needed declarations of conformity were available on site and have been checked by an inspection agency
- Review of the technical documentation and inspection of the plant regarding pressure equipment and ATEX were done and certificated by an inspection agency/notified body.

At the end of the hot commissioning phase performance tests have to show, that the process and plant design allows an undisturbed operation within the design limits of the process parameters. Therefore, the manufacturers operate their units and at the end of the performance tests also the whole plant is operated in different modes. As soon as the following requirements are met, the operation of the ALIGN-CCUS

demonstrator is taken over by the RWE operating team in (24/7 shift system) and the scientific test program can start:

- Confirmation of successful completion of hot commissioning
- List of open points and deficiencies available and evaluated by the manufacturer
- RWE operating team named, organized and trained
- Performance test run successfully completed
- Preliminary technical documentation completed and available (the finalized “as build” documentation has to be available some weeks after the takeover of the plant operation)
- Risk assessments for plant operation are available on site
- Update of the information regarding emissions, noise, water treatment, health and safety, explosion prevention and fire prevention are available on site
- HSE (health, safety, environmental) manual is available on site (including alarm concept and emergency plan (figure 1))
- Maintenance concept is available
- Strategic spare parts are named, listed and procured
- Announcement of responsible persons completed
- Testing program (inclusive communication strategy and procedure regarding data evaluation) are available
- Organisation chart for trial operation is available on site.

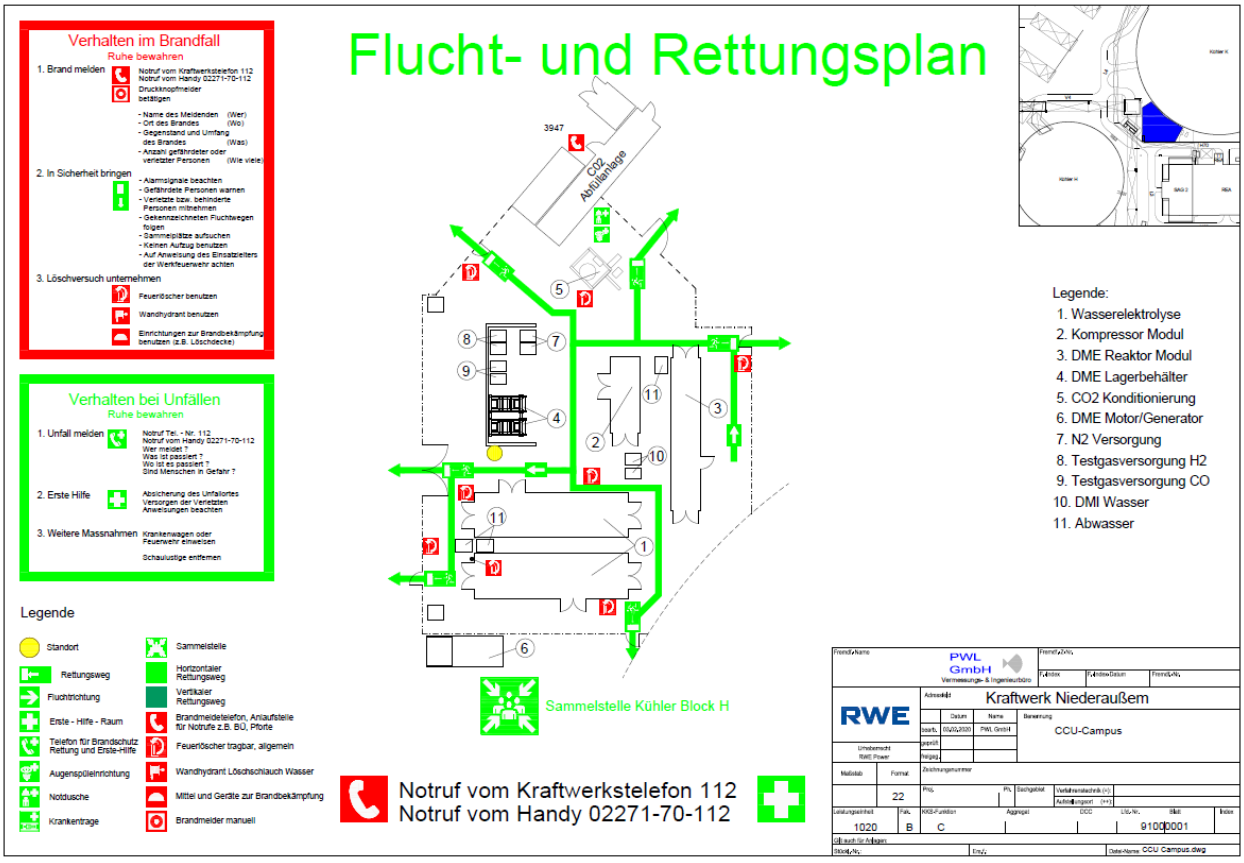


Figure 1: Escape and emergency routes plan

3 Certification

TÜVRheinland®
Genau. Richtig.

Bericht Nr.:
Bericht-Nr.: 640-125790938-01-MHPSE-ALIGN CCUS-2020-Rev.01

**Prüfbericht zur Bewertung der Sicherheit
für die Pilotanlage ALIGN CCUS
am RWE-Standort Kraftwerk Niederaußem
für einen ca. 6-monatigen Betrieb
in Anlehnung an die BetrSichV**

Betreiber	Mitsubishi Hitachi Power Systems Europe GmbH Schifferstr. 80, 47059 Duisburg
Gegenstand der Begutachtung	Pilotanlage ALIGN CCUS
Standort	RWE-Kraftwerk Niederaußem Werkstrasse, 50129 Bergheim vor dem Kühlturm Bl. K
TÜV-Auftrags-Nr.	125790938
Begutachtende Stelle	TÜV Rheinland Industrie Service GmbH
Gutachter	Georg Vogt - Explosionsschutz Thomas Breidenstein und Jörg Hendricks - Druckgefährdungen
Untersuchungsdatum	Dez. 2019 bis Juli 2020
Erstelldatum	09.07.2020

Beurteilung

Die Prüfungen durch die TÜV Rheinland Industrie Service GmbH haben ergeben, dass die Aufstellung, die Herstellung und die geplante Betriebsweise der ALIGN-CCUS-Pilotanlage der Fa. MHPSE am RWE-Standort Kraftwerk Niederaußem den Anforderungen der Betriebssicherheitsverordnung entspricht, wenn die unter 5.6 erforderlichen Maßnahmen umgesetzt werden.
Die vorgesehenen sicherheitstechnischen Maßnahmen sind zum jetzigen Zeitpunkt geeignet, die Anlage bei Einhaltung der in der Betriebsanleitung genannten Maßnahmen in den Probebetrieb mit den Medien H2, CO2, N2 und weiterer Hilfsstoffe nehmen zu können.

Figure 2: Excerpt of the TÜV inspection report of the synthesis unit and the connection lines/piping of the ALIGN-CCUS demonstrator

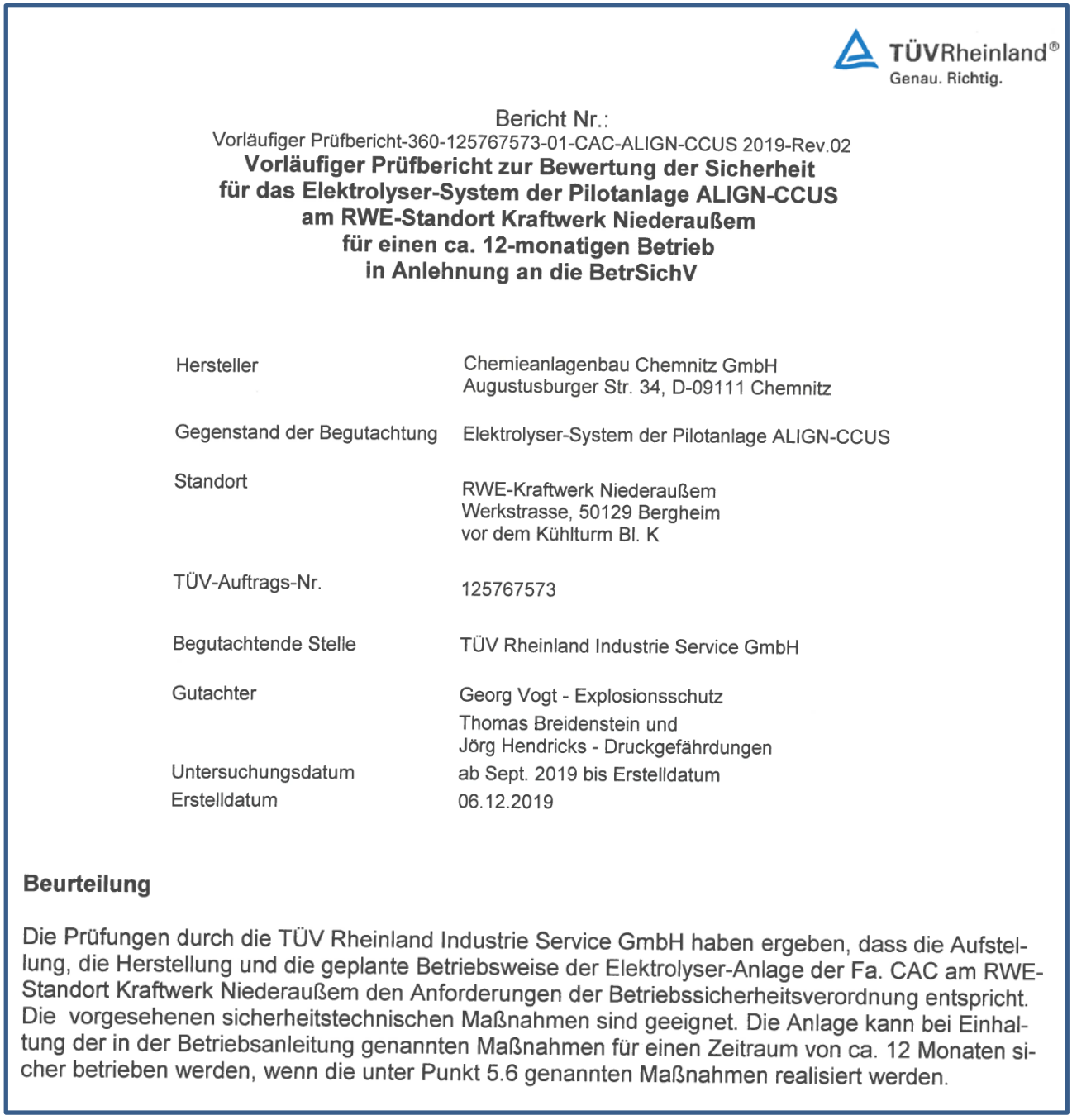
Figure 2 shows an excerpt of the report regarding the certification of the ALIGN-CCUS demonstrator from TÜV Rheinland. For the inspection report TÜV Rheinland evaluated the hazards “pressure and explosion” for the test operation of the ALIGN-CCUS demonstrator based on the industrial safety regulations as

described in chapter 1. This report is necessary to ensure a safe start of the hot commissioning and the operation with consumables like H_2, CO_2, N_2 and others.
The following documents were considered for this inspection report:

- Pressure equipment list
- Lightning protection concept
- Technical documentation including maintenance manual for the DME-reactors
- Preliminary operational manual of the synthesis unit, the CO_2 conditioning unit and the electrolyser unit
- High level manual of the ALIGN-CCUS demonstrator
- Conformity declaration of MPE
- Explosion protection document
- ATEX-zone plans
- Fire protection documents
- Intrinsic safety document
- Reports regarding leak testing's, loop checks, earth resistance measurements and emergency stop testing.

The inspection includes the following components/units:

- CO_2-conditioning unit
  - MPE is the supplier of the CO_2-conditioning unit. This unit prepares the CO_2 which is provided by a storage tank of RWE for further use within the synthesis unit. The CO_2-conditioning unit has been certified as assembly with a CE-declaration of conformity by the manufacturer. On site it has been erected and installed by MPE. The final approval tests have been done in 2019.
- Electrolyser unit
  - Asahi Kasai is supplier of the alkaline electrolyser system, in which oxygen and hydrogen are produced from demineralized water. For the electrolyser unit itself a separate inspection was carried out by the TÜV Rheinland in 2019 (figure 3)
- DME-synthesis unit
  - MPE is the supplier of the DME-synthesis unit. The system was almost completely assembled / installed on site, including the necessary welding work and the electrical wiring including all safety-related equipment and the control system. The TÜV Rheinland has checked the technical completion on site and compared it with the documents made available with regard to the fulfilment of the technical requirements and the operational safety regulations for the construction and operation of the system (concerning "pressure and explosion" hazard).
- Interconnecting piping
  - The completion on site as well as the created welding- and inspection documentation from MPE was inspected.
- Overall system of the ALIGN-CCUS demonstrator
  - The completion of the overall plant was inspected and compared with the entire documentation of the overall system with special regard to the Ordinance of safety and health as well as the directives regarding "pressure and explosion" hazard.



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Genau. Richtig.

Bericht Nr.:
Vorläufiger Prüfbericht-360-125767573-01-CAC-ALIGN-CCUS 2019-Rev.02

Vorläufiger Prüfbericht zur Bewertung der Sicherheit für das Elektrolyser-System der Pilotanlage ALIGN-CCUS am RWE-Standort Kraftwerk Niederaußem für einen ca. 12-monatigen Betrieb in Anlehnung an die BetrSichV

Hersteller	Chemieanlagenbau Chemnitz GmbH Augustusburger Str. 34, D-09111 Chemnitz
Gegenstand der Begutachtung	Elektrolyser-System der Pilotanlage ALIGN-CCUS
Standort	RWE-Kraftwerk Niederaußem Werkstrasse, 50129 Bergheim vor dem Kühlturm Bl. K
TÜV-Auftrags-Nr.	125767573
Begutachtende Stelle	TÜV Rheinland Industrie Service GmbH
Gutachter	Georg Vogt - Explosionsschutz Thomas Breidenstein und Jörg Hendricks - Druckgefährdungen
Untersuchungsdatum	ab Sept. 2019 bis Erstelldatum
Erstelldatum	06.12.2019

Beurteilung

Die Prüfungen durch die TÜV Rheinland Industrie Service GmbH haben ergeben, dass die Aufstellung, die Herstellung und die geplante Betriebsweise der Elektrolyser-Anlage der Fa. CAC am RWE-Standort Kraftwerk Niederaußem den Anforderungen der Betriebssicherheitsverordnung entspricht. Die vorgesehenen sicherheitstechnischen Maßnahmen sind geeignet. Die Anlage kann bei Einhaltung der in der Betriebsanleitung genannten Maßnahmen für einen Zeitraum von ca. 12 Monaten sicher betrieben werden, wenn die unter Punkt 5.6 genannten Maßnahmen realisiert werden.

Figure 3: Excerpt of the TÜV inspection report of the electrolyser unit of the ALIGN-CCUS demonstrator