

## Shaping the energy revolution with AGS narrow power lines

The “energy revolution” is a major project, and it means that Germany is facing a substantial change in its energy production structure. According to the German Federal Network Agency, a lack of coordination between grid development and the increasing usage of renewable energies has noticeably delayed grid development for years. The discussion concentrates on continued energy revolution progress, i.e. on rapid grid expansion and on cost containment – two aspects that are not easily reconciled.

On the one hand, the legislator prioritised laying underground cables for the transmission of UHVDC (ultra-high-voltage direct current) at the end of 2015 – in order to make faster progress – but on the other hand, underground cables tend to be considerably more expensive than overhead power lines.

Politics and society are placing their hopes of

- a substantial increase in acceptance for general grid development
- a reduced exploitation of nature and countryside
- fewer blemishes on the scenery
- a reduction of potential health hazards

on underground cables as the supposedly better solution than overhead power lines. At first glance this may be true. Yet underground cables are not necessarily more resource-saving, especially if they are built through nature reserves, forests, water protection areas or agricultural land, in the projected width. Compared to overhead power lines, this even takes up more resources, and additionally, wide underground cable lines prevent synergies with other areas that are already affected.

The technology of AGS Verfahrenstechnik for laying underground cables with **active cooling (AGS+)** deals with the issues of consensus, sustainability and efficiency, in order to maintain the primary goal of safe power transmission in future – using narrow underground power lines with compactly installed underground cables.

With AGS, a tested procedure – that confirms the general priority for underground cables in a positive way, and goes beyond purely microeconomic investment considerations – is made available for general use.

For AGS, it is not only about meeting the latest legal and methodical requirements, but about achieving a greater consensus for underground cabling as a first-choice technology, through more degrees of freedom when it comes to finding the final power line paths. This in turn means greater planning security, which leads to faster expansion of the HVDC transmission grid.

In its core, AGS is an innovative cable-laying technology, proved and tested for construction and installation. But AGS also stands for the more extensive fundamental technology AGS+ that makes narrow power lines technically feasible. This is (not least) physically and technically advantageous.

AGS-Verfahrenstechnik GmbH takes the view that a legal precedence for narrow power lines would be a resolute and logical step, given the backdrop of a legal precedence for underground cables.

**AGS-Verfahrenstechnik GmbH, with its AGS/AGS+ technologies, has been nominated for the Hermes Award 2017.**

### **Technological degree of innovation**

AGS is a cable-laying technology for transmission grids, with an active cooling option (AGS+). Its main element is the so-called “buoyancy-supported slipping” system, in which a cable-carrying line pipe is inserted into a water-filled conduit using rollers. The following condition is roughly met for every line pipe section: buoyancy minus weight equals zero. The cable-laying process is free of tensile stress, enabling the laying of ultra-long sections. This allows for greater degrees of freedom when it comes to power line planning. Installation can be carried out in tight curves and in a meandering fashion. Ultra-long cable sections mean a significant reduction of the number of coupling sleeves, and of joint bays and coupling erections in the power line path.

Due to its specific cable arrangement, the active-cooling option (AGS+) permits ultra-narrow line pipes. This means that there are significant advantages when it comes to sustainability, efficiency, operational safety, compensation of electromagnetic fields, as well as the use of existing, already highly strained infrastructure. The technology’s reversibility means that future cable maintenance and replacements are a lot easier, without repeated and expensive ground works.

### **Technological creativity and quality**

Due to the massive increase in the use of wind energy in the north of Germany, there is a high demand for coherent concepts for rapid grid extension measures, and also for adequate grid extension technologies. This is the situation that led to the idea of “AGS” (“auftriebsgestütztes Slipping” – buoyancy-supported slipping – as well as actively cooled power transmission), in order to speed up grid development. AGS was to lead to a solution that is easily implemented, with a high level of public acceptance due to its good ecological quality. Institutes of the RWTH (“Rheinisch-Westfälische Technische Hochschule”) University in Aachen, Germany, were approached for operationalising these issues.

The combination and utilisation of commercially available materials and innovative installation technology for laying ultra-long and ultra-narrow UHVDC cables is the novelty that distinguishes AGS. It means that the functional and technical quality of e.g. cable or coupling sleeve makers can be accessed, while the special AGS process technology permanently enhances the application quality and operational safety of the supplier products.

The novelty also lies in the integration of highly strained infrastructure, e.g. in order to enable underground cables under the hard shoulder of or right next to a motorway – the public would not be affected.

### **Unique selling points**

- *Ultra-long cable laying (> 2 km), without the influence of tensile forces on the cable, supported by a new onshore cable transport procedure for ultra-long HV-cables.*
- *No additional, expensive construction roads for transporting heavy-duty cable drums.*
- *Significant reduction of the number of coupling sleeves, joint bays and coupling erections*
- *Enhanced long-term operational safety and environmental friendliness with passive AGS water cooling*
- *Ultra-narrow installation (< 2 m power line width) with active water cooling (AGS+)*
- *Use of waste heat for heat contracting (e.g. motorway service stations or business parks).*
- *Reversibility: Extracting the cable line pipe section is carried out in the same way as the installation: buoyancy-supported, without new construction sites or ground works.*
- *Cables can be laid in meandering protective line pipes.*
- *Marginal demand on nature*
- *High public acceptance expected*
- *High efficiency*
- *High flexibility; can be implemented quickly*
- *Can be used along existing, highly strained infrastructure due to its compactness*
- *Minimisation of possible health burdens from electromagnetic fields – especially if used with three-phase current – due to optimised cable arrangement*

### **Technology**

*Technologically, AGS is a universally useable process innovation for laying cables – especially high-voltage underground cables – that requires integration into an interconnected technical system. Its great advantage is that future cable technology adaptations and developments can be carried out with minimal effort by replacing the cables, and that the technology guarantees the compatibility of its technical components and processes with existing and future laws and regulations, today and in future. Furthermore, AGS opens the possibility of joining competences from hitherto vastly different industries and technological areas.*

*The AGS secondary infrastructure “empty line pipe” is ideally suited for merging power transmission and the Federal Highways infrastructure. By installing it under or along roads – which is possible thanks to narrow power lines and AGS+ technology – the expansion of broadband internet cables (digital highway), charging stations for electric cars, autonomous driving and load-based power supply for commercial vehicles (electromobility) can be developed simultaneously. It is also possible to utilise the cables’ waste heat.*

### **Eco-compatibility and socially relevant characteristics**

*In the course of a study, the environmental impact of AGS and AGS+ was examined in great detail. It is very minor in extent, scope and intensity, especially considering the backdrop of infrastructure bundling. And thanks to narrow power lines, the absence of construction roads, and the small number of joint bays, land use is significantly reduced. The German Federal Nature Conservation Act (BNatSchG, "Bundesnaturschutzgesetz") is met due to the possibility of bundling with other infrastructures: first-time use and repurposing of undeveloped areas can be minimised, further landscape fragmentation counteracted, and ecosystem disturbance kept at a bare minimum.*

*In the case of active cooling (AGS+), ground warming can be prevented. Thermal foundation, i.e. the introduction of foreign bodies into the ground, does not happen. Electromagnetic fields are compensated because cables are positioned in close proximity to one another and in an optimised arrangement. This in turn meets Administrative Regulation 26 of the German Federal Immissions Protection Act (BlmSchVVwV, "Verwaltungsvorschrift der Bundesimmissionsschutzverordnung"). Taking all this into account, a considerable increase in public acceptance for underground cables is expected.*

### **Efficiency**

*When it comes to power transmission technologies, the main concern are the possible benefits to society. The legal precedence for underground cables for HVDC transmission will make the "energy revolution" a lot more expensive, putting further financial strain on society and economy. AGS is considerably cheaper in comparison to conventional cable-laying technologies. The lower investment costs can be traced back to lower expenses for ground works and landscaping, land acquisition or lease, as well as the AGS-specific lower number of joint bays, coupling erections, construction roads and protective systems.*

*A further advantage: Reduced power transmission downtime because of repairs. Moreover, replacement works are possible at any time and at a comparatively low price, due to the high reversibility of the process (no repeated ground works or construction roads). If intangible effects – such as landscape damage, use of resources, or health effects of electromagnetic fields – were to be included in a calculation of the investment costs, the commercial advantage of laying cables using the AGS process technology may well increase even further.*