

Study Committee B2

Overhead lines

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Development of lifting device for raising height of existing towers of overhead lines

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Motivation

Development of an innovative mechanical device for lifting an entire power tower.

The growing demand for electricity makes it necessary to build new and modernize the existing power lines. Many of existing power lines were built long time ago and need to be refurbished, some of them are very important in power system and it is difficult or even not possible to turned them off during maintenance. **Enlift** is an innovative device which can be used to uplift existing towers of overhead lines without switching of the voltage.

When operating power lines, it is sometimes necessary to increase the capacity of the line. This can be done by replacing the conductors with HTLS conductors, or it can be done by increasing the operating temperature of the conductors. In both cases, it may be necessary to make the towers higher. When it is necessary to increase the suspension height of the conductors above ground and the facilities below the line, the towers are raised by installing an additional lifting structure with an average height of 2 to 5 metres. This structure is installed between the foundations and the existing pole structure. In 2018 ENPROM started a research project to develop and implement a new technology that would allow tower elevations to be realised without line outages or line shutdowns for a short time or with very short connection readiness times. A key component of this technology is an innovative device to elevate the entire tower including live working wires. This device was designed within the NCBIR pool research project No. POIR.01.01.01-00-0257/18 entitled: Development of an innovative mechanical device for lifting the entire power pole. **The project, completed in 2021, was an interdisciplinary endeavour involving research and development in construction, mechanics, power hydraulics, automation and electrical engineering. The manufactured device, was given its own trade name – „EnUp”.**

Method/Approach

Technology basics

- Lifting of a tower with conductors **without line outages**.
- Lifting of **any type of tension and suspension towers** - transfer of vertical pushing and pulling forces and horizontal forces.
- Possibility of leaving the tower **elevated for a longer period** (extreme climatic loads).
- Possibility of installing a **lifting insert** under a raised column **without line outages** (operational and average climatic loads).
- **Ensuring the safety** for all workers involved in installation work.

Objects of investigation

Basic technical assumptions for the device

- **Stability in the operation of the system** through **simultaneous and corrected operation of all 4 jacks**, with the possibility of **manually adjusting the lifting height** of each jack.
- **Ensuring that the actuators** raising or lowering the frame **can be operated gently** - a few millimetres so that the lifting height for each leg of the column can be set independently with an accuracy of two millimetres.
- **The lifts** must be **reliable in operation** - a power outage or pump failure must not be an impediment to operation. Hence **the power supply from the generator**.
- Possibility of **mechanical locking of any lifting height** of the structure.
- Ability to **manually and safely lower the tower** in case of a power cut.
- **Health and safety provision for all workers** involved in the work of raising/lowering the tower.

Experimental setup & test results

Technical parameters of the EnUp

- Handling tension and suspension towers of **110, 220, 400 kV** of OHL.
- Handling of **steel lattice towers for telecommunications and observation** on three or four legs.
- Single-stage lifting height **up to 3.2 m**, two-stage **up to 4.4 m**.
- Weight of a typical structure to lift **up to 20 tonnes**. Lifting of **heavier structures** is possible.

Conclusion

The presented innovative device for lifting entire towers opens new possibilities in the field of technology for modernization works on overhead power lines. Its main advantage is the possibility of carrying out works related to raising towers on active lines (without outages) or with a very short time of switching them off.

The developed technology ensures the stability of the system through the simultaneous and corrected operation of all four lift segments with the simultaneous possibility of manual adjustment of the lifting height of each of them, the possibility of mechanical locking of any height of lifting the structure and the possibility of manual and safe lowering of the pole in the event of a power cut.

Technology to ensure health and safety to all employees involved in the assembly work when lifting and lowering the pole and during the assembly of the increasing structure.

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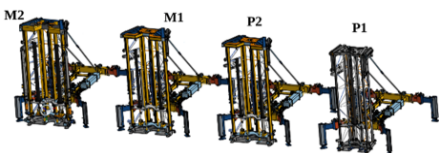
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continued

Device versions

In the end, **concepts for 4 units were developed**, which included:

- **two subtypes** designed for **two different groups of poles** ("M" tension and "P" suspension),
- **two subtypes differing in weight** ("1" lighter 110kV and 220 kV, "2" heavier 220kV and 400 kV.



Transport and preparation for work

The equipment is suitable for transport on standard and common truck trailers.



The unloading of the lift in place is achieved by extending the supports of the transport frame so that they rest on the ground and then raise the frame with the jack, allowing the trailer to leave.



The positioning of each jack under a particular pole leg can be done with:

- a crane,
- a lorry (off-road, maneuverable),
- a special crawler chassis.

The four jacks should be positioned around the pole, spread out and connected between each other by stays.



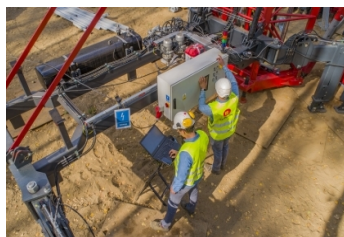
Connection of the lift to the foundation

- The connection of the jack to the foundation can also be realised by means of a friction connection to the foundation anchor.
- The connection has been tested under laboratory conditions at the Silesian University of Technology and verified on ENPROM's testing ground.



Lift control

- The lifts are **electrically controlled hydraulic system from a single control panel**.
- However, a manual control is also provided to ensure full control of the lift in the event of an electrical control failure. Each lift has its own individual control panel.
- The panels can be interconnected and four lifts can be controlled from one panel.
- **A computer can be plugged into the control system.**



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continued

Selected photos from the field tests

tower raised by added
construction 4m high

lift in working position

lift in storage position



Lifting tower positions



Internal workspace.

Visible:

- piston rod fixing base (lower grey platform),
- movable platform for mounting the piston rod (upper yellow platform).

