

**The 19th International Conference on  
“Technical and Physical Problems of Engineering”  
ICTPE-2023  
31 October 2023  
*International Organization of IOTPE***



**NEW APPROACHES TO 110 kV SUBSTATION DESIGN FOR FIRST CATEGORY  
OF CONSUMERS**

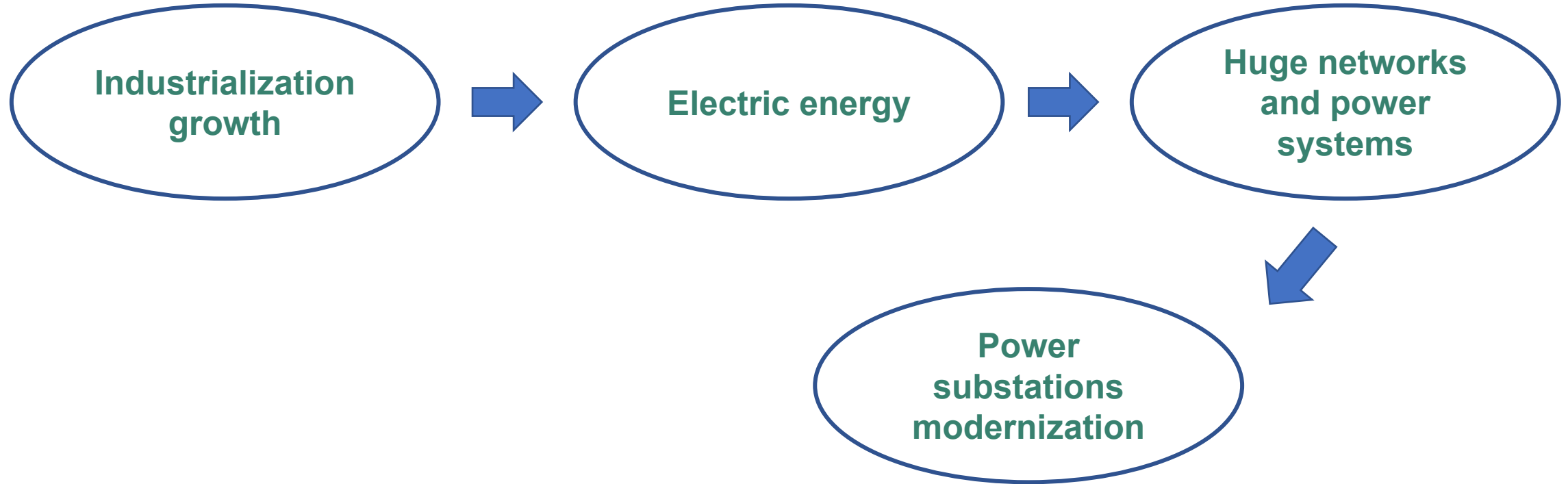
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## Introduction





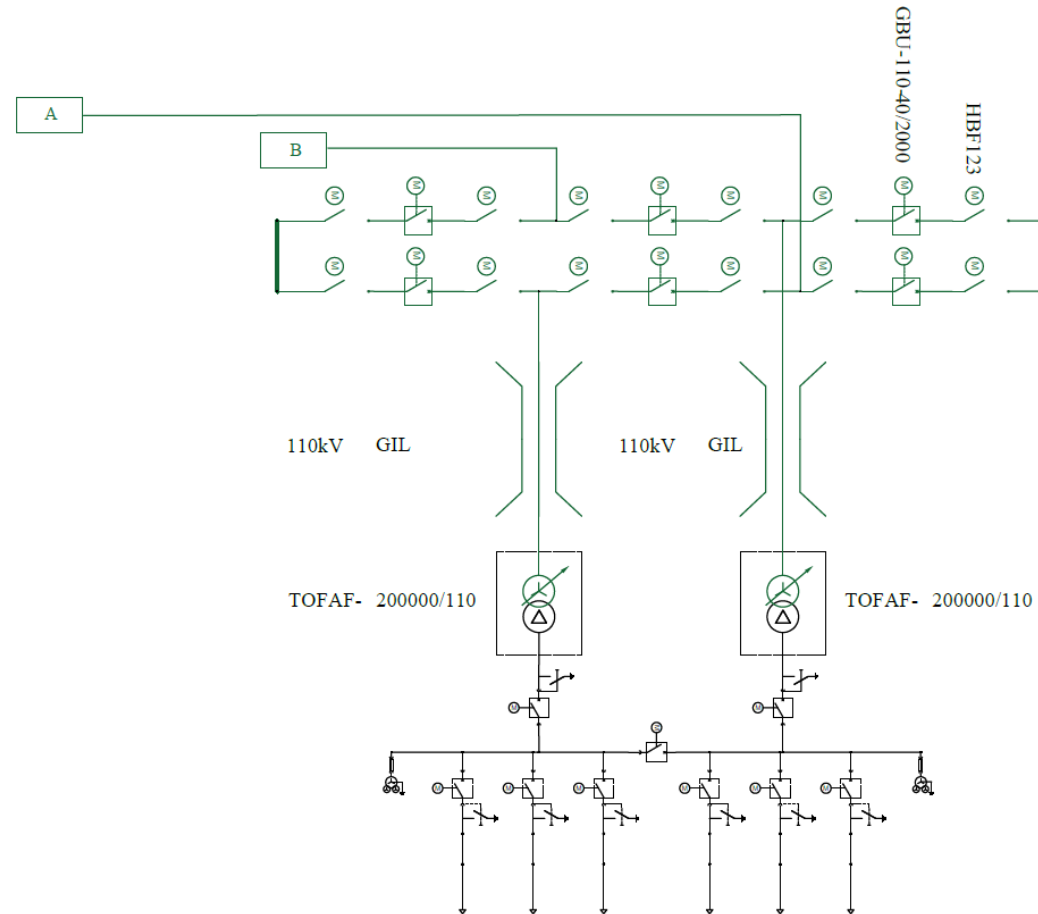
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## Advantages of GIS substations

1. Less footprint
2. Wide range of voltage level (72.5 – 800 kV)
3. High magnitude of rated current (up to 6300 A)
4. Rated short circuit breaking current (up to 80 kA)
5. Low failure rate
6. Life cycle cost less than 70%
7. Less environmental impact

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SLD diagram of the 110 kV switchyard of the first substation,  
110 kV GIL transmission line and second substation



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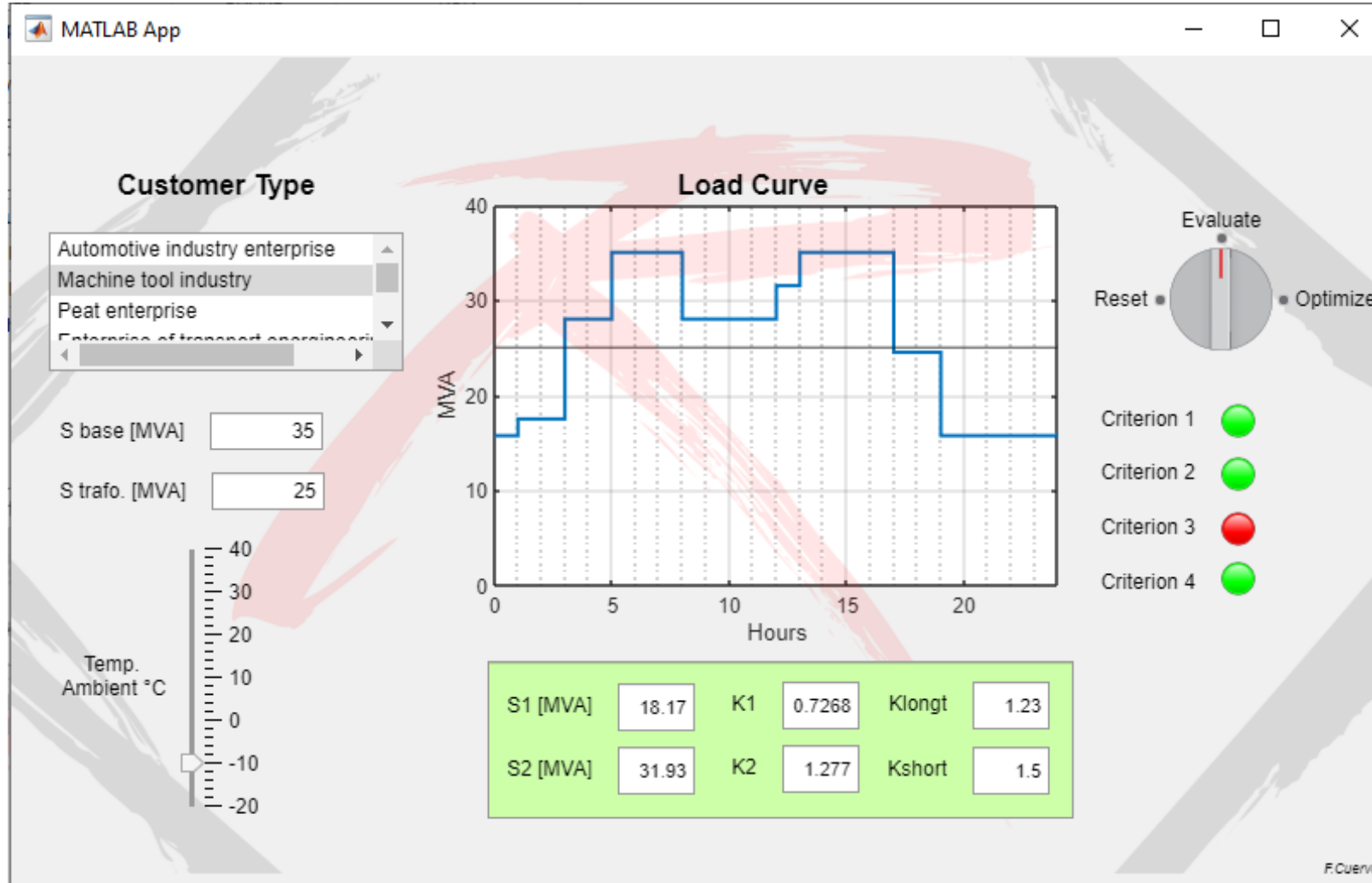
## GIL, XLPE and OHL comparison and analysis

| <b>Term of analysis</b>               | <b>OHL</b>       | <b>XLPE</b>           | <b>GIL</b>          |
|---------------------------------------|------------------|-----------------------|---------------------|
| Cost                                  | 100%             | 150%                  | 250%                |
| Efficiency<br>(loss per<br>kilometer) | More than 0.2%   | 0.2%                  | 0.1%                |
| Environmental<br>impact               | High             | Low                   | Very low            |
| Voltage drop                          | 3% per kilometer | 0.5% per<br>kilometer | 1% per<br>kilometer |
| Safety                                | Risky            | Very low risk         | Low risk            |
| Durability                            | 25-30 years      | 30-40 years           | More than 50        |
| Flexibility                           | High             | High                  | Very low            |

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Transformer modeling according to the load curve.

MATLAB application.



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## GIT advantages and application

### Advantages

Inflammable and non-explosive

Reduction of substation footprint and height.

Layout flexibility.

Easy install

### Disadvantages

Expensive

Lower permissible duration of overloads.

Example: For Food Inc Enterprise.  
Transformer chosen: 2 x 25MVA GIT



## Conclusions

1. Developed scheme is the best solution for 1<sup>st</sup> category of consumers
2. Longer life-time of equipment
3. Minimized outage time
4. Minimized costs for maintenance
5. Minimized footprint
6. Minimized CO<sub>2</sub> emission