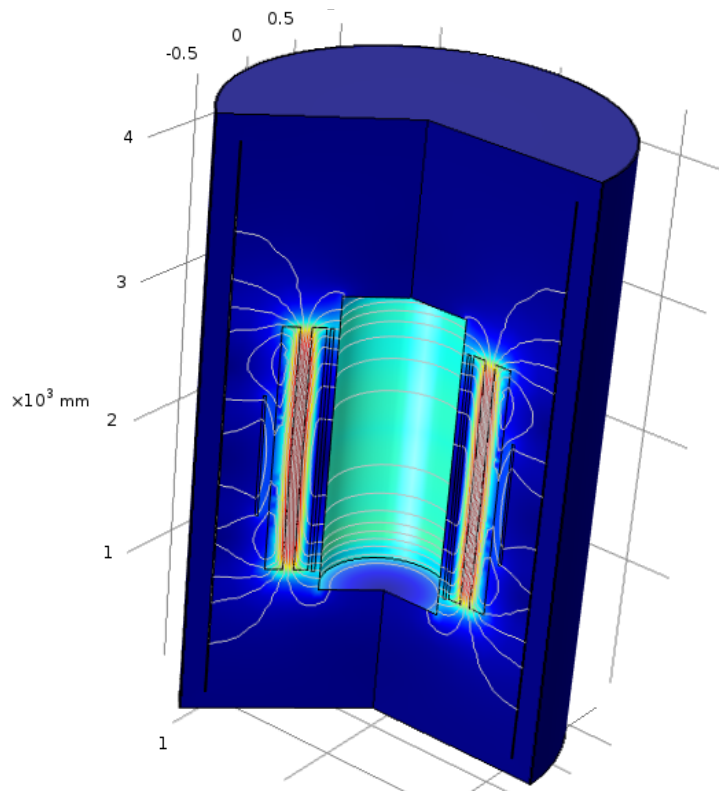


Power Transformer Design SERVICES

Engineering solutions up to 1200kV / 1000MVA



Design & Technology consultant power transformers

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INTRODUCTION

HV Trafo

Solutions is formed as a consulting/designing firm specialized on HV power transformers with the main office in Romania. We are working with experts with over 30 years experience and team members with average 15 years experience in designing, manufacturing and testing of power transformers up to 1000MVA 1200kV, who ensure practical solutions and precise optimal designs according to the customer specifications.

We are qualified for designing large power transformers:

- With unique insulation structure optimized for arrangement and voltage class for long term safe operation
- With optimized unique clamping, lead and winding design to withstand dynamic SC test and SC during the operation of the transformer.
- With smart solutions for mechanical design to reach optimized tank design and arrangement with considering assembly, transportation and installation.

Our mission is to support our clients with **power transformer designs** tailored for their technology, starting from design validation and analyses through manufacturing drawings, expertise and manufacturing procedure improvement, with a highly skilled **professional team** working together, using common sense, practical experience, theoretical knowledge and latest technologies of the field, leading by this to **smart solutions**.

We have **design experience** with the following specifications:

- **GCC specifications**, such as DEWA-Dubai; Pterofac-UAE; SEC, Saudi ARAMCO, SABIC -Saudi Arabia; MEW,KNPC-Kuwait
- **Middle Eastern specifications**, such as EETC-Egypt; Petrofac,ENKA,-Iraq; ONE, Cegelec-Morocco; Sonelgaz, CEEG-Algeria; MOE-Syria
- **African specifications**, such as Nigeria; Ghana; RNT-Angola
- **South American specifications**, such as Argentina, Peru, Acciona Energia, CGE-Chile
- **Asian specifications**, such as Sinha Power-Bangladesh; KESC,Wapda-Pakistan; NEA-Nepal; Iberdrola-Russia, KRG-MOE-Kurdistan
- **European specifications** such as EDP-Poland; IEE-Germany; Keppel Seghers-UK; Iberdrola,EDPR,Gas natural fenosa, Endesa- Spain; EDF, Cegelec-France; Transelectrica, Iberdrola-Romania; Terna-Greece, ELMŰ-Hungary, Terna-Italy

Learn about us and our services in the following pages...

OUR STANDARDS AND MOTIVATION

1. We believe to reach competitive, reliable transformer designs it requires knowledge, experience and unique talent.
2. We believe the transformer design can consider the raw material resources to reduce the excess material use and to take only what you need from the environment, so we fight for clever solutions and create optimized designs.
3. We believe the quality and reliability of the transformer not depends on the age, name or location of the factory.
4. We promote and fight for the way of work, where the factory can be confident about the manufactured transformer and where the customer is fully aware of the purchased transformer quality.
5. We are working to reform the transformer design, manufacturing and testing, by using the experience, knowledge and common sense combined with the latest technologies to design, validate and build transformers.
6. We are working to make the numbers along with common practices speak instead of just opinions and habits.
7. We believe there is a way to build strong cooperation between the factory and end user, where each party understands the needs and limitations of the other.
8. We believe there is a way, where the customers' transformer specification is committed to realistic requirements and the factories are committed to deliver the best quality product to fulfill the customer needs.
9. We believe the knowledge and experience are powerful and useful when it is shared.

Turning the motivation into action

1. We always keep our commitment, do our best and remain straight forward under any circumstances.
2. Our customer's success is our success.
3. We never stop extending our knowledge which is one of the reasons why our transformer designs are the most optimized, competitive and reliable.
4. We developed our software based on the most reliable, sophisticated calculation methods and technologies.
5. We earn our customers trust by giving quality work and support as much as we have from knowledge not as much as contractually.
6. We hire in our team who is working for the target not for the pay check or position.
7. We attract experts in our team, increasing the variety of backgrounds and experience.
8. We not go for the quantity but for the quality of our designs.
9. In our team always the best idea wins.
10. If possible, we always show our customer a way to improve.



WHAT WE DO BEST

1. We are a team of transformer experts and designers from different countries and schools, our main activity is to design and validate all kind of core type power transformers.
2. As a benefit of our experience in transformer design and manufacturing we are able to support the production with smart solutions and knowledge.
3. Our experienced base design and manufacturing enhancements we offer through technology consultant services.
4. We offer testing related consultancy and test attending service of power transformer.
5. Our team's knowledge covers the entire manufacturing and testing process of core type power transformers. We offer end users and utilities to validate, review transformer designs or attend in process examination during transformer manufacturing.
6. We are doing certified SC design validation for any size and kind of core type power transformer.

Summarized in points:

- Design Review of all kind of core type power transformers for customers and manufacturers.
- Detailed electrical and thermal calculations of all kind of core type power transformers including:
 - a) Winding impulse voltage distribution analysis,
 - b) Electrostatic and electromagnetic analysis using FEM.
 - c) Clamping and tank steel structure forces due to short circuit, vacuum and pressure analyses using FEM.
- Final design with calculations and complete electrical and mechanical manufacturing drawings, considering the partner manufacturing technology or improving that in case of request
- Technology consultant
- End user and utility consultant
- Expertise
- Fault analysis with more than 20 years experience in power transformer filed
- Support of the design team to enhance and build their qualifications
- Support or design of the manufacturing process including the machinery selection

Follow our linked in page: <https://www.linkedin.com/company/hv-trafo-solutions/>

Follow our facebook page: <https://www.facebook.com/hvtrafo/>

Details of our services on the following pages.

HOW DO WE WORK?

Flexible

1. Project base:

- One time agreement for a specific project including electrical and mechanical design and validation or just partial undertaking from a project.(electrical or mechanical design or validation only)

2. Yearly contract base:

- Long term agreement, with specified continued job assignments, based on monthly payment.

3. Based on framework agreement:

- Long term agreement for cooperation, without specifying exact job assignments or payments. Job and payment conditions should be agreed separately on case-to-case basis. The difference between this and the first option is, for the framework agreement there is a reserved capacity for the customer, and the job will be started when it is assigned, while for the project base agreement, the start of the work depends on the available free capacity.

HOW DO WE COMMUNICATE?

Online - cost efficient, fast & documentary proved

1. Communication - e-mails/file sharing/ instant messages

Modern way of communication with the customers as well as with the team members.

2. Contracting - e-mails/currier/personally

The terms are agreed on-line, the final version in hard copy is delivered via currier or via company representative in case there is an agreed meeting at the same time.

3. Project and team management - on-line tools

The on-line project management tools are keeping the project flow organized and transparent, and the team members worked tracked.

4. Work delivery - on-line server sharing

The work results are shared between the team members as well as with the customers through secured on-line servers, where the data can be accessed through well controlled system and permissions only.

TEMPORARY CAPACITY OF YOUR TEAM

New service

There is an alternative solution for your **temporary design capacity increase**.

We offer you a **service** to be your **temporary capacity**, by the meaning of, when appears an unexpected extra load for your design team we can give a helping hand and be your design team extension for a defined period.

Benefits:

1. Economically it is better option, than hiring new engineers to your team.
2. Very flexible, as you ask our service only when you need, it can be for one project or for one period of time with more projects.
3. Fast results, as you are temporary extending your team with experienced professional designers always ready to help.

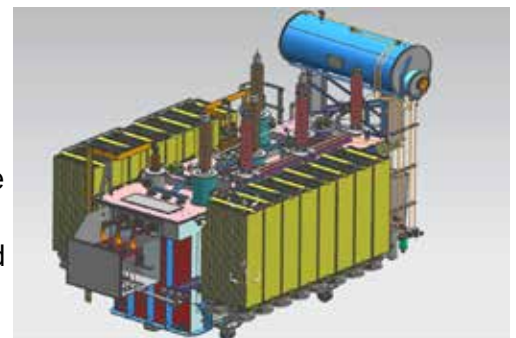
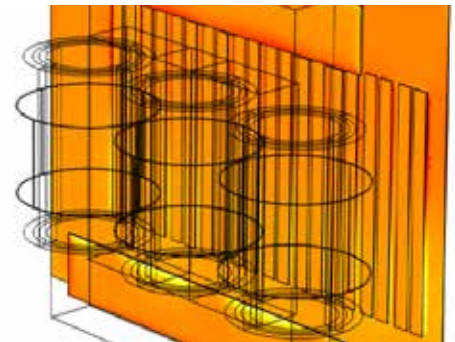
How does it works?

Simple and straight forward, You “receive” an Electrical or/and Mechanical team to support you, who will work from their usual office and will be guided by our experts and leaders to find you the best solution for the job you assign to us, they will communicate with your contact person on-line, and the work result will be added to your design team throughput, so you can plan your work with extra capacity.

The team will follow your technology or we will work with different technology which is feasible for your production capabilities.

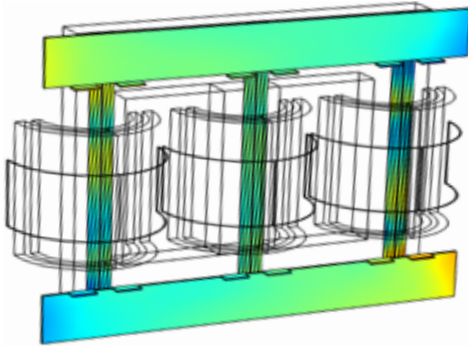
Job options:

Complete projects or suborders are accepted, as per all services available for selection and listed in the “Design” chapter(page 10-11).



DESIGN VALIDATION / DESIGN REVIEW

HV Trafo offers to support you with 2D & 3D numerical calculations of electromagnetic, electrostatic and thermal field.



In electrical and in steel structure design we can identify the possible weak points to support your design process in order to reach better results (cost-optimization and reliable design).

We offer to propose solutions to:

- optimize your complete transformer design
- validate your design for the dynamic SC test and for the SC occurring during the operation of the transformer

Therefore we offer you the following services for:

Electrical

1. Short circuit design review and validation

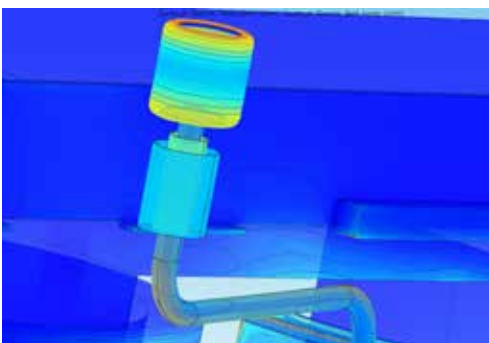
- Winding forces calculation
- Active part clamping system
- Lead dimensioning and fixation

2. Insulation design review and validation

- Analyses of the insulation structure design for clearance and arrangement optimization

3. Lead design review and validation

- Stress analyses for electrical clearance setup
- Stress analyses for SC fixation and support optimization



Mechanical

4. Shielding arrangement validation

- Time and frequency domain stray losses calculation
- Clamping shielding arrangement analyses
- Tank shielding arrangement analyses

5. Clamping system design review and validation

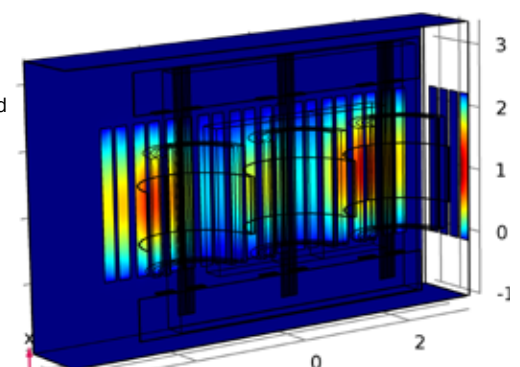
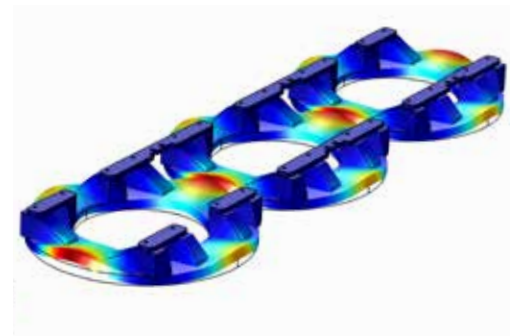
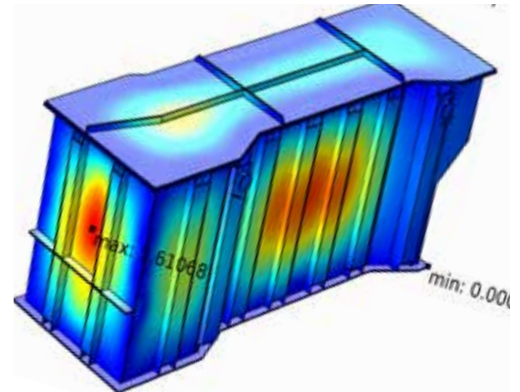
- Stress analyses for pressing and lifting forces
- Stress analyses for SC forces withstand ability

6. Tank design review and validation

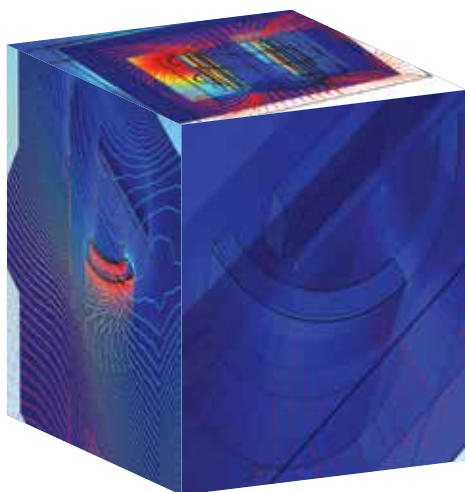
- Stress analyses for:
 - Stresses due to vacuum test
 - Stresses due to pressure test
 - Lifting stresses due to full transformer weight
 - Stresses due to jacking
 - Stresses due to transportation

*Design review(DR) - discovers only the problems if there are any in the calculations, and assuming the characteristics of the design calculation.

**Design validation(DV) - additionally to the design review, it also reviews the possible problems during the implementation of the design and offering solutions to treat them.



DESIGN

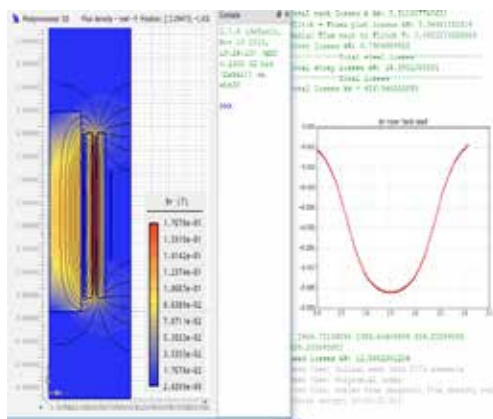


Design is always a challenge of the mind, where countless parameters, effects, ideas, techniques, requirements have to match in a perfect way.

We at the HV Trafo, start the design process by planning for each main requirement of the specification and competing the ideas for the implementation, this way we find the optimum. If we know the target and what we want to apply, the calculation is more efficient, the active part is safe and the transformer design is optimal. If we have a well-calculated and protected active part combined with the similarly designed steel structure we can reach a competitive transformer design.

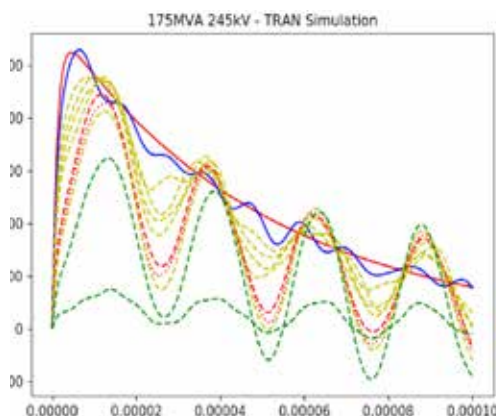
Electrical design package

Which includes calculation of active part and cooling system, design and analyses of main insulation, lead and windings with manufacturing drawings for units above 245kV and with optional FEA analyses for units below 245kV.



Job options:

- Active part calculation including cooling for conventional and special active parts
- Main insulation structure design with validation report and manufacturing drawings up to 1200kV
- Lead connection design(LD) with manufacturing drawings up to 1200kV
- Complete active part design with manufacturing drawings and FEA report above 220kV, and optional FEA report below 220kV, including(ED):
 - Windings for all the possible types
 - Main insulation for:
 - + Conventional winding arrangements
 - + Special auto TR winding arrangements
 - + Middle entry winding arrangements
 - + Special Auto TR winding arrangements
 - Lead connection for:
 - + Conventional TR
 - + TR with multiple tap changers
 - + TR with high current(above 5kA)
 - + UHV TR up to 1200kV
 - + Reconnectable TR with DTC or manual tap
 - + TR with reactor windings

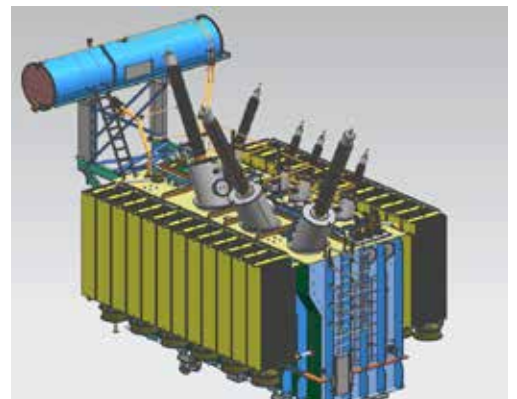
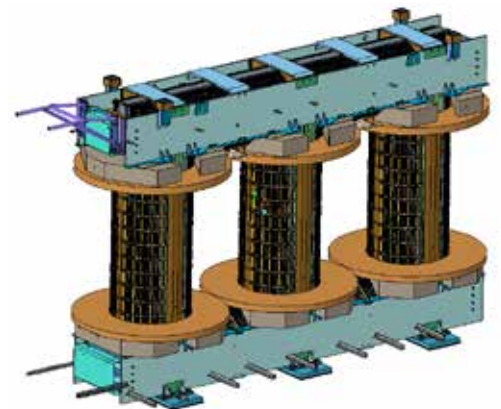
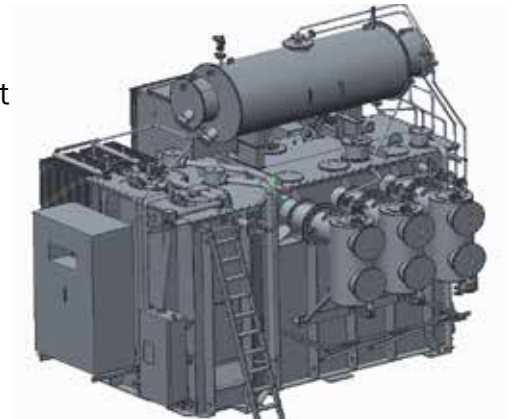


Mechanical design package

Which includes clamping system, tank and accessories design with manufacturing drawings with FEA analyses (as described on page 7) for units above 100MVA, with optional FEA analyses report for units below 100MVA.

Job options:

- Tank and accessories design with manufacturing drawings and FEA report:
 - Oil-Oil connection
 - Oil-Air connection
 - Oil-SF6 connection
 - TR with separate cooling bank
 - Mobile TR
 - TR with multiple tap changers
- Clamping system design with manufacturing drawings and FEA report (CLD)
- Complete steel structure design with manufacturing drawings and FEA report (MD), including:
 - Clamping systems with reduced stray losses
 - Tank and accessories
 - + Conventional tank
 - + Bell type tank
 - + Special shaped tank types



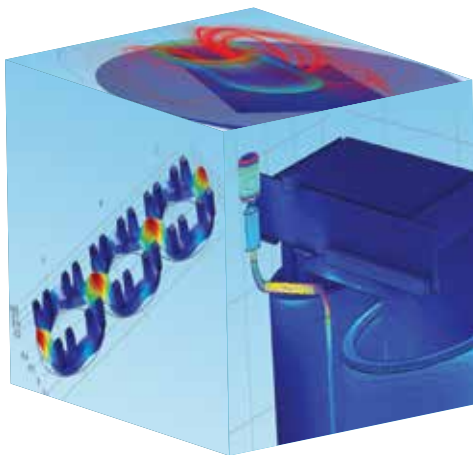
TECHNICAL CONSULTANCY

Design & Production

We are supporting the technical and the production teams by designing, consulting, advising, investigating, analyzing and guiding for improvement and development.

Design/manufacturing experience of:

- Network TR
- Generator TR
- Mobile TR
- Traction TR
- Furnace TR
- Rectifier TR
- Booster TR with 2 cores
- Auto TR with CFVV and VFVV
- Phase shifter TR with Single and Two cores
- Single phase Auto and UHV TR
- UAT TR
- SC TR
- Reactors



Job options:

- Design team support
- Production and QC support
- Testing support
- Failure analyses
- Guiding/clarifications/solutions for design/production problems
- In production inspection
- Special transformer assembly instructions
- SC proof winding pressing procedure
- SC proof active part assembly procedure
- Workshop efficiency and arrangement optimization

End users & Utilities

We are offering complete engineering and consulting services of power transformer designs, manufacturing and testing. We are committed to support the end users of the transformers with a level of technical and practical knowledge which only the manufactures posses.

We have the knowledge and understanding of the critical status and importance of transformers quality in providing reliable energy flow.

HV Trafo team can support to mitigate the risk of transformer failure by assisting your company in preparing transformer specifications, auditing individual factories for technical capabilities, evaluating proposals/quotations, preparing design reviews, manufacturing in-process inspections, failure analyses and witnessing factory tests.

Why to hire HV Trafo as your transformer consultant?

- ✓ To be confident about the transformer and it's active part quality and condition before it leaves the factory to avoid high cost and delays with field repair or short term replacement.
- ✓ To be represented by experienced and highly skilled engineers in designing, manufacturing and testing of power transformers.
- ✓ To order your transformers according to latest technologies and evaluating criteria.
- ✓ To evaluate technically your suppliers.
- ✓ To increase the reliability of your network.
- ✓ To ensure clear technical communication and common understanding with the manufacturer.
- ✓ To have a third party with independent opinion from specification writing stage until factory dispatch.

Job options:

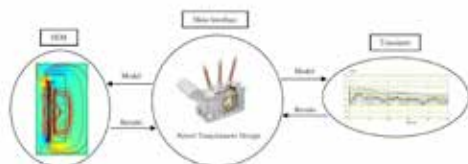
1. Specification writing and review.
 - Updating recent requirements based on new adaptive technologies.
 - Validity of the requirements.
 - Defining the new requirements for new substations
2. Factory in process inspection order by order to ensure the unit meets the specification.
 - Windings in process inspection.
 - Active part assembly inspection.
 - Active part tanking inspection.
 - Test witnessing and acceptance.
3. Transformer design review:
 - Short circuit withstands.
 - Dielectric withstands.
 - Cooling.
 - Pressure, vacuumed lifting, jacking and operation mode against tank deflection withstand.
4. Handling and clear all the technical communications.
 - Tendering stage.
 - Ordering stage.
 - Manufacturing stages.
 - Testing stages.
 - Dispatching stage.
5. Failure investigations.
 - During FAT.
 - During Energizing.
 - During Operation.
6. R&D partner specially for building new projects with special requirements.
 - Offshore TR.
 - UATs TR.
 - Furnace TR
 - Phase shifting TR.
 - HVDC TR.
 - Earthing TR.
 - Rectifier TR.
 - Shunt reactor TR.
 - Auto TR. (CFVV, VFVV)
7. Technical training courses:
 - Transformer design.
 - Transformer testing.
 - Transformer failure investigations.
 - Transformer safe operation.

DESIGN CALCULATIONS

Power Transformer Design Software

How reliable are the calculated values? This is a very important question.

Our answer is, 100% as there are tools in the modern technology which can simulate the transformer design in a perfect way, if the production will follow the design, the deviation between the calculated and tested value is very small.



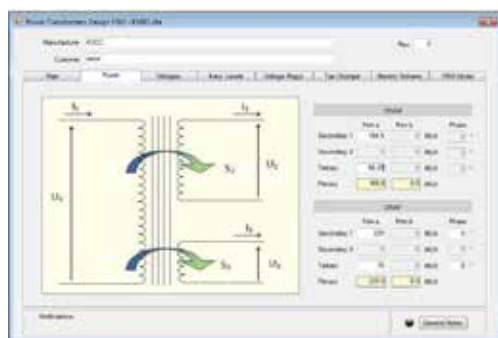
Here we would like to present you a special tool, designed and built based on long years of practical experience and wide range of theoretical knowledge. This design software can give trustworthy feedback about every part of the transformer active part calculations including the clamping system design.



Main properties:

1. Includes:

- Complete active part design calculations with flexible winding arrangement
- End insulation and interlayer insulation design
- SC calculations including currents, forces
- Over-voltage calculations, including LI, AC applied, AC induced with/without PD
- Dielectric stress LI, AC applied, AC induced with/without PD
- Thermal stress
- Cooling calculation
- Winding verification according to the calculated SC forces
- Automatic clamping system design sized according the calculated SC forces
- Tank dimension calculation
- Automatic weights calculations including oil and accessories weight



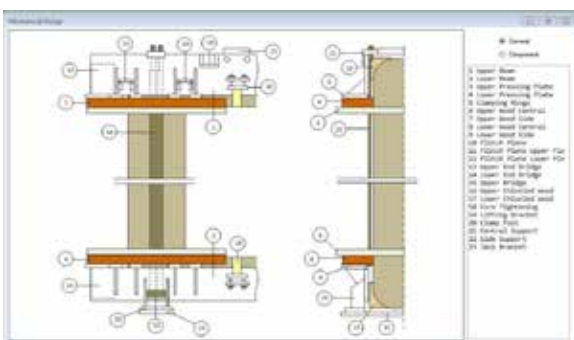
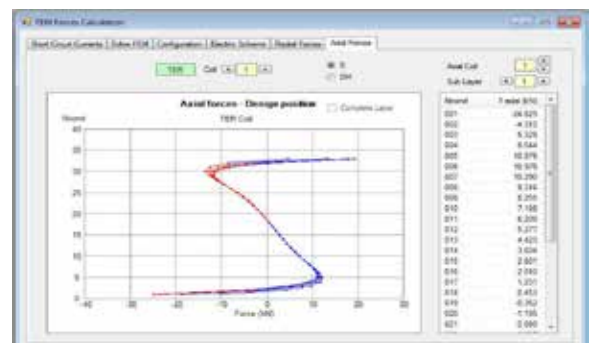
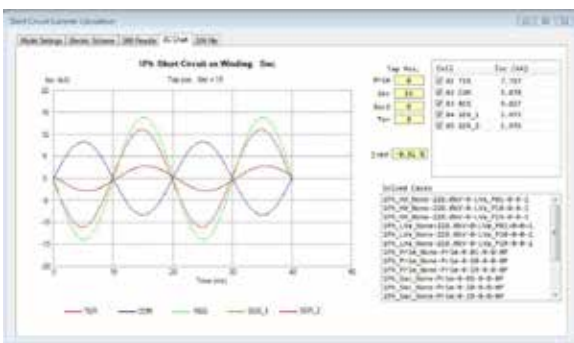
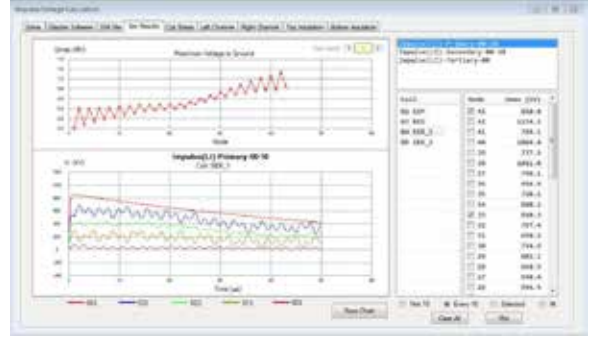
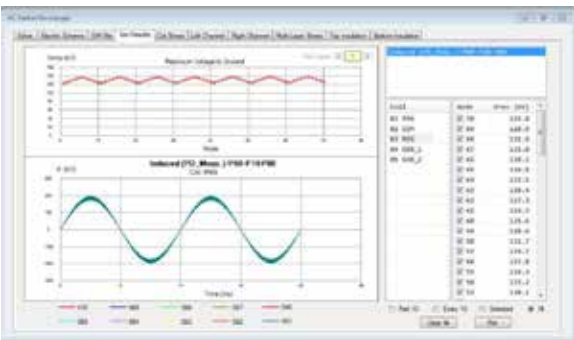
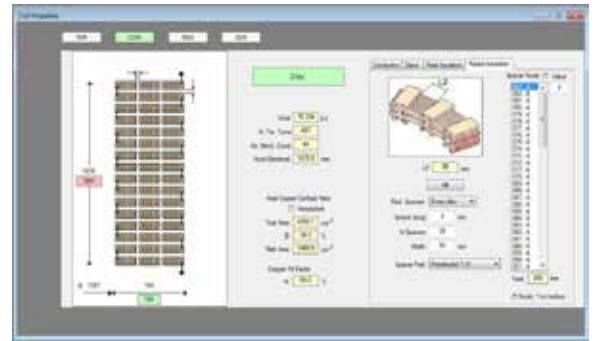
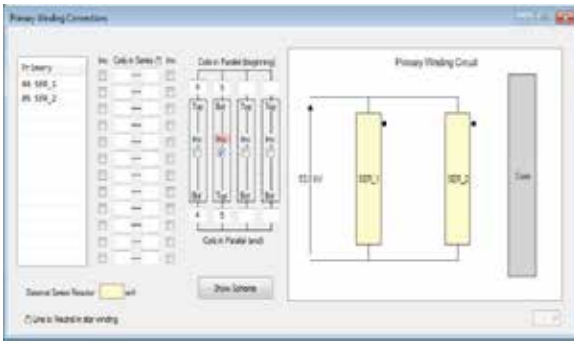
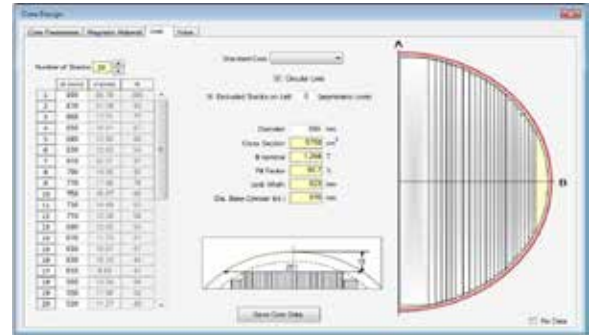
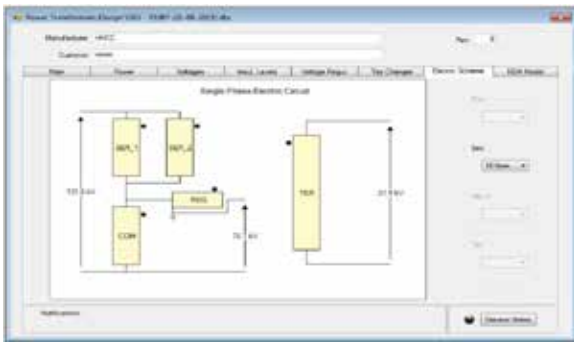
2. FEM calculations for high accuracy results of:

- Impedance
- Eddy losses
- SC forces
- Hot spot temperature rise



3. Can be exported to an automatically generated report the active part parameters as this software is dedicated for verification purposes as well, as it is verifying the three main aspects of a design:

- Dielectric stresses
- Mechanical stresses
- Thermal stresses



REFERENCE LIST

Task	Transformer type	Year	Country
Expertise			
Extra loss source investigation 3D FEM	245kV 175MVA	2017	Egypt
Reactor winding	eddy loss heat transfer effect investigation 3D FEM	2016	Algeria
Failure analyses	Step up 400kV	2016	Italy
Extra loss source investigation	36kV 20MVA	2016	Saudi Arabia
Manufacturing procedure	Improvement of factory technology for SC proof manufacturing	2016	Egypt
Extra loss source investigation	17kV 31.5MVA	2016	Saudi Arabia
Partial discharge source investigation	145kV 30MVA	2016	Kuwait
Production support	245kV 125MVA	2016	Egypt
Manufacturing procedure	Improvement of factory technology for SC proof manufacturing	2016	Saudi Arabia
Failure analyses	145kV 30MVA	2016	Egypt
Fiber optic sensor positioning	SEC transformers	2015	Saudi Arabia
Manufacturing procedure	Improvement of factory technology for SC proof manufacturing	2013	Bangladesh
Capacitor bank internal arc energy	12kV capacitor bank internal arc failure scenarios	2013	Norway
Power transformer internal arc energy	160MVA 300kV failure scenarios	2013	Norway
Manufacturing procedure	Improvement of factory technology for SC proof manufacturing	2013	Spain
Power transformer internal arc energy	445MVA 415kV failure scenarios	2011	Portugal
Failure analyses of substation	involving explosion of 3.3 kV switchgear, 18 MVA aux. 200 MVA 400 kV TR	2011	Mexico
Design Validation(DV)/ Design Review(DR)			
DR	24kV 20MVA	2017	Dubai
DR	220/33kV 125MVA	2017	Egypt
DR	132/13.8/6.6 67MVA	2017	Saudi Arabia
DR	34.5/11.5 35MVA	2017	Yemen
Lead DV by 3D FEM	1200kV main lead of a single phase 150MVA TR	2017	India
DR	HVDC 400kV AC 500kV DC	2016	Germany
DR	60/31.5kV 50MVA	2016	Angola
DR	63/11.5kV 70MVA	2016	Angola
DR	245kV 125MVA	2016	Egypt
DR	13.8/6.7kV 31.5MVA	2016	Saudi Arabia
DR	220/24/24kV 75MVA	2016	Egypt
Tank and clamping DV by 3D FEM	245kV 200MVA	2016	Denmark
DR	220/27.5kV 10MVA Traction TR	2016	France
DR+DV	28MVA rectifier +(3.75°) booster TR	2015	Italy
DR	145kV 66.5MVA	2015	Saudi Arabia
DR	33/13.8kV 20MVA	2015	Saudi Arabia
DR	230/115/34.5kV 75MVA	2015	Portugal
DR	220/23kV 110MVA	2015	China
DV & DR for SC	220/72.5/12 175MVA	2015	Egypt
DR for SC	115/13.8 67MVA	2015	Saudi Arabia
DR	132/13.8 66.5MVA	2015	Saudi Arabia
DR	66/33kV 20MVA	2015	Sudan
DR for SC	161kV 30MVA	2015	Ghana
DR	33/13.8kV 20MVA mobile	2015	Saudi Arabia
DR	50MVA Rectifier TR	2015	Denmark
DR	6MVA Furnace TR	2015	Hungary
DR	400/500kV Single phase 340MVA Auto	2014	Ethiopia
DR	145kV 30MVA	2014	Kuwait

Task	Transformer type	Year	Country
DR	420/21kV 540MVA	2014	Iran
DR	400/230/20 200MVA	2014	Iran
DR	230/27.5-27.5kV 40MVA Traction TR	2014	France
DR for SC	Single phase transformer	2013	Spain
DR	150MVA 500kV	2013	China
DR	400/275/13kV 950MVA Auto	2013	South Korea
DR	66/11kV 50MVA	2013	Egypt
DR	161/34.5kV 33MVA	2013	Ghana
DR	145kV 50MVA	2013	Dubai
DR for SC	145kV 50MVA	2013	Ghana
DR	22MVA Furnace transformer	2012	Finland
DR	25MVA transformer	2012	Colombia
DR	69/10.5-10.5 80MVA	2012	Egypt
DR	60/31.5kV 40MVA	2012	Algeria
DR for SC	132/11kV 75MVA	2012	Bangladesh
DR	12MVA Rectifier TR	2012	Pakistan
DR	415-230/19-21kV 550 MVA	2010	Spain
DR	1000/500kV AC TR	2007	China
DR	800 kV DC conversion TR	2007	China
Electrical Design (ED)/Mechanical Design (MD)/Lead design(LD)/Clamping Design(CLD)/Complete Design (CD)			
ED	132/33/15kV 50MVA	2017	Ethiopia
ED	132/12kV 40MVA	2017	Dubai
ED	110/13.8kV 50MVA	2017	Saudi Arabia
ED	220/33kV 200MVA	2017	Egypt
ED	66/6.8-6.8kV 50MVA	2017	Egypt
ED	132/12 60MVA	2017	Dubai
ED+CLD	225/90kV 100MVA	2017	Ivory Coast
ED	225/63/11kV 150MVA	2017	Morocco
MD	36kV 20MVA	2017	Saudi Arabia
MD	145kV 67MVA	2017	Saudi Arabia
MD	36kV 30MVA	2017	Saudi Arabia
MD	145kV 67MVA	2016	Saudi Arabia
ED+CLD	289/231/15kV 340MVA Single ph Auto TR	2016	Romania
ED	132/15kV 50MVA	2016	Italy
MD	123kV 67MVA	2016	Saudi Arabia
ED	225/63/11kV 100MVA	2016	Morocco
ED	400/21 273MVA Single phase TR	2016	Greece
MD	145kV 66.6MVA	2016	Saudi Arabia
ED	132/33kV 90MVA	2016	UAE
MD	123kV 12.5MVA	2016	Saudi Arabia
ED	132/13.8kV 40MVA	2016	Saudi Arabia
ED	220/30kV 50MVA	2016	Spain
MD	145kV 100MVA	2016	Estonia
ED	115/13.8kV 50MVA	2015	Saudi Arabia
ED+CLD	230/19kV 533MVA Generator TR	2015	Poland
ED	18/13.8/4.16kV 50MVA	2015	Saudi Arabia
MD	145kV 60MVA	2015	Ukraine
ED	115/13.8kV 25MVA	2015	Saudi Arabia
ED	245kV 250MVA Auto TR	2015	Pakistan

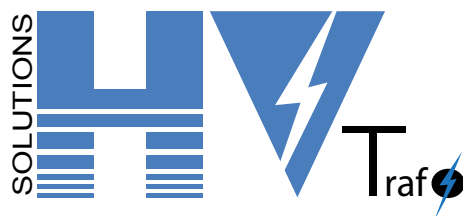
REFERENCE LIST

Task	Transformer type	Year	Country
MD	145kV 60MVA	2015	Saudi Arabia
ED	245kV 140MVA	2015	Algeria
ED	230/6.3-6.3kV 34MVA	2015	Russia
MD	145kV 66.5MVA	2015	Saudi Arabia
ED+CLD	132/11.5kV 30MVA	2015	Kuwait
ED	66/11.86kV 48MVA	2015	Saudi Arabia
ED	110/33kV 120MVA	2015	Romania
LD	300kV 150MVA	2015	Norway
ED	525/17kV 390MVA	2015	Uzbekistan
CD	220/72.5/12kV 175MVA	2015	Egypt
ED + CLD	115/13.8kV 67MVA	2015	Saudi Arabia
ED	220/66/10kV 75MVA	2015	Peru
LD	170kV 180MVA	2015	Belgium
ED	220/63kV 120MVA	2015	Angola
ED	220/33kV 100MVA	2015	Peru
MD+LD	380/20kV 540MVA	2015	Saudi Arabia
MD+LD	145kV 40MVA	2014	Germany
ED	400/225/33kV 550MVA Auto TR	2014	Romania
ED	220/34.5/11kV 62.5MVA	2014	Bahrain
ED	220/60kV 40MVA	2014	Algeria
CD	330/115/10.5kV 250MVA	2014	Latvia
ED+CLD	500/230/10.5kV 500MVA Auto TR	2014	Russia
ED	230/121/10.5kV 250MVA Auto TR	2014	Russia
ED	230/11-11kV 100MVA	2014	Russia
ED	132/34.5kV 90MVA	2014	Oman
MD+LD	420kV 90MVA	2014	Saudi Arabia
MD+LD	420kV 315MVA	2014	Spain
ED	140/34.5-10.5kV 40MVA	2014	Sweden
ED	400/33kV 200MVA	2014	Iran
ED	132/33 120MVA	2014	Bangladesh
ED	110/22kV 25MVA	2014	Romania
ED	132/11.5 40MVA	2014	Pakistan
ED	220/132/33 250MVA	2014	Uganda
ED	4MVA 10kV/0.2kV SC TR	2013	Hungary
ED	115/6.3/10.842kV 32MVA	2013	Cuba
ED	123kV 40MVA	2013	Germany
ED	132/11kV 169MVA	2013	Iraq
MD	245kV 120MVA	2013	Netherlands
ED	132/33/11kV 63MVA	2013	Nepal
ED	400/110/33kV 550MVA	2013	Romania
LD	245kV 420MVA	2013	Netherlands
ED	132/33kV 125MVA	2013	Oman
ED	220/132kV 200MVA	2013	India
ED	69/13.8kV 40MVA	2013	Saudi Arabia
CD	400/34.5-34.5kV 200MVA	2013	Iraq
ED	132/20kV 75MVA	2013	Bangladesh
MD+LD	245kV 30MVA Traction TR	2013	France

Task	Transformer type	Year	Country
ED	132/33kV 100MVA	2013	Saudi Arabia
ED	138/11kV 50MVA	2013	UAE
ED	132/33kV 30MVA	2013	Nepal
ED	132/22kV 25MVA	2013	UAE
MD	145kV 63MVA	2013	Hungary
ED	400/15kV 165MVA Generator TR	2013	Iraq
ED	36kV 65MVA Booster TR	2013	Ethiopia
ED	132/11kV 75MVA	2012	Bangladesh
ED	132/33kV 41MVA	2012	Bangladesh
ED	230/11kV 45MVA	2012	Bangladesh
ED	33/11.55kV 20MVA	2012	Yemen
CD	245/72.5/12kV 125MVA	2012	Egypt
MD	145kV 100MVA	2012	Denmark
ED	132/6.3kV 40MVA	2011	Pakistan
ED	132/11.5kV 26MVA	2011	Pakistan
ED	176/18.7kV 50MVA	2011	Egypt
ED	225/27.5kV 60MVA Traction TR	2011	France
CD	400/121/34kV 350MVA Auto TR	2011	Slovenia
MD	420kV 250MVA	2011	Hungary
ED	33/11.55kV 12MVA	2011	Bangladesh
LD	170kV 330MVA	2011	Belgium
LD	245kV 25MVA Traction TR	2011	France

SHORT-CIRCUIT REFERENCE LIST

Power [MVA]	Voltage [kV]	Country
120	245kV	Spain
60	245kV	Spain
75	245kV	Portugal
50	145kV	Ghana
26	145kV	Portugal
30	245kV	Spain
75	145kV	Indonesia
45	245kV	Netherlands
350	420kV	Slovakia
140	245kV	Algeria
30	145kV	Kuwait
67	123kV	Saudi Arabia
40	72.5kV	Ghana
125	245kV	Egypt
30	123kV	Malaysia
40	72.5	Egypt
75	145kV	Bangladesh



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