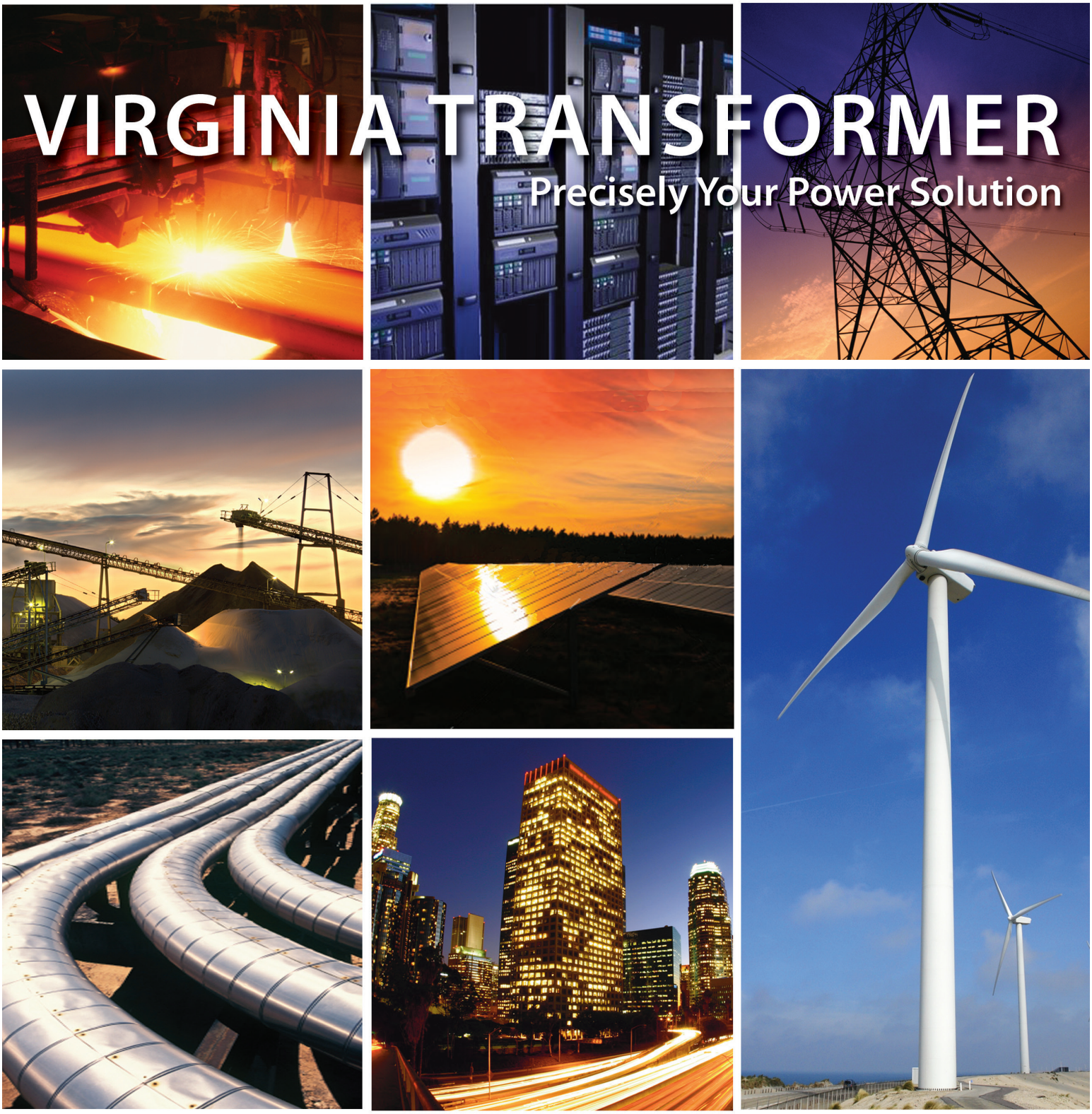
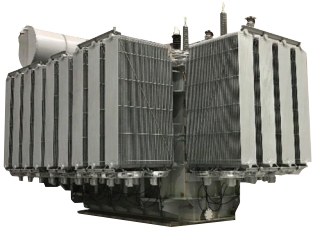


VIRGINIA - GEORGIA TRANSFORMER
ONE SOURCE–ONE COMMITMENT

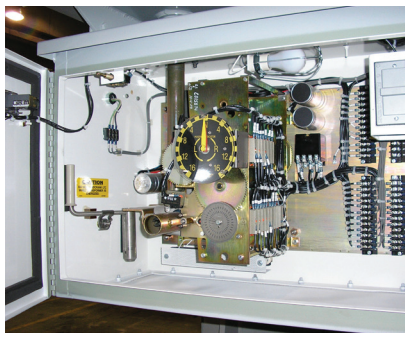


Liquid Filled Transformers
Load Tap Changing Transformers
Three-Phase Voltage Regulators

Liquid-Filled Transformers for Precisely Your Application

Full Range of Liquid-Filled Transformers

Virginia Transformer manufactures a full range of liquid-filled transformers from 500 kVA to 1,400 MVA up to 500 kV class, from 45° C rise to 65° C rise.



OLTC transformer, available up to 500 MVA

Virginia Transformer Three-Phase Voltage Regulators up to 50 MVA throughput and 69 kV

On-Load Tap Changing (OLTC) Transformers

Tap Changer Types: Virginia Transformer offers resistive-type OLTC or reactive-vacuum-type systems. We will custom engineer your transformer with the OLTC switch connected on the high-or low-voltage winding according to your specifications.

Three-Phase Voltage Regulators

Virginia Transformer voltage regulators are used in distribution applications throughout North America to maintain voltage over transmission lines.

Virginia Transformer Liquid-Filled Transformers:
Powering Industrial, Commercial, and Utility Operations Throughout North America

Engineered and Custom Built to Your Precise Requirements

Our expert sales team helps you specify your individual transformer requirements. Our engineering and manufacturing staff transforms your specifications into a unique, top quality, efficient, and long-life solution for your application. Virginia Transformer will customize units for special requirements. Common options and accessories are available for system protection, reliability and hassle-free maintenance.

Virginia Transformer brings more than 50 years of transformer engineering experience to each new assignment. We have amassed an archive of more than 15,000 designs and test data, serving as an exclusive resource for the development of new solutions...perhaps yours.

Virginia Transformer liquid-filled transformers are integral to industrial, commercial, and utility operations, but don't let that limit your thinking. We build custom units for specialty segments such as mining, transit, oil & gas, marine, government, data centers, storage facilities, and export markets.
Think about your precise requirements. We do.

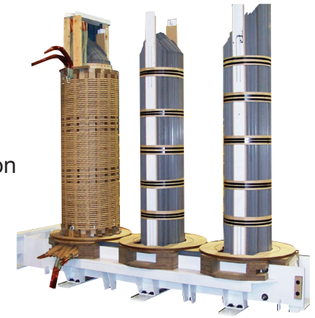
Circular Coil Windings for Short-Circuit Stability

Virginia Transformer uses disc and/or helical winding types for both HV and IV windings, using either copper or aluminum conductors, as specified. Windings are made in temperature- and pressure-controlled environments. We typically provide circular coils, which are more stable than rectangular coils and can better withstand short-circuit forces.

Rectangular coils tend to become circular when exposed to strong short-circuit conditions; this transformation can lead to internal damage.

Core-Stacking Configurations to Optimize Cost, losses, and Sound levels

Virginia Transformer engineers select from a variety of core-lamination materials based on your specifications that are made from high-grade, grain-oriented silicon steel to optimize cost, losses, and sound levels.



Virginia Transformer uses mitered-joint and/or step-lap core construction with an appropriate grade of cold-rolled, grain-oriented silicon steel laminations for optimum efficiency and

Choice of Oil Preservation Systems

Virginia Transformer offers three types of oil preservation systems based on your specification for liquid-filled transformers: sealed tanks, conservators and automatic (nitrogen) positive-pressure systems.

Conservator tanks are custom designed primarily for environments with extreme variations in ambient temperatures, most often in severe cold and winter climates.

VCM (Virginia Control Module) Transforms Control and Management

Monitor your transformer's performance remotely with wired (Modbus, DNP3 and Fiber) or wireless connection VCMs from Virginia Transformer. The VCM is a proprietary PLC-based monitoring and diagnostic module to track and record topoil temperature, winding temperature indicator, gas pressure, rate-of-rise pressure, and liquid level. The device sends real-time, solid-state contact outputs, and data to supervisory controls. VCM analhzes and detects abnormal conditions and provides data for trend analysis and historical review.

VCM Transformer Monitoring and Diagnostic Module connects through the internet remotely for a real-time view of transformer conditions.

Equipped For Heightened Performance

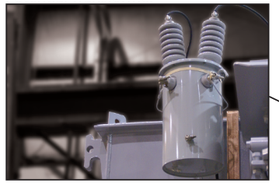
Virginia Transformer Standard Features

Range – 500 kVA to 1,400 kVA up to 500 kV class
Loading – Designed to deliver rated current and MVA in all tap positions
Service – Outdoor or indoor
Basic Impulse Level (BIL) – Per ANSI standard / CSA standard - or per spec
Impedance – ANSI standard/CSA standard - or per spec
Coils – Aluminum or copper conductor, circular construction, utilizing helical or continuous disc design
Cooling Fluid – Type II mineral oil or less-flammable oils including biodegradable fluids
Fluid Preservation System – Sealed tank, conservator with bladder, nitrogen preservation
Cooling Radiators – Panel type, galvanized standard
Gauges and Accessories – Liquid-temperature gauge, liquid-level gauge, vacuum-pressure gauge, drain valves, filter press connections (top and bottom), automatic pressure relief device, control wiring for indoor/outdoor
Paint – ANSI 61/70 epoxy, polyurethane, high-performance paint on sandblasted surface; special colors available

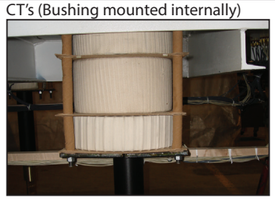
Nameplate – Stainless steel, engraved
Bushings – Cover or side-mounted in air chambers
Removable manhole covers
Provisions on base for skidding

Radiator Mounted Fans

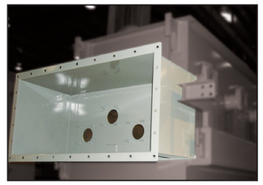
Potential Transformer



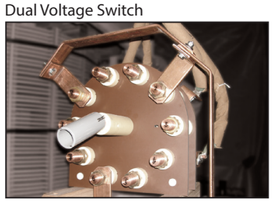
CT's (Bushing mounted internally)



Throat for Non-Segregated Bus



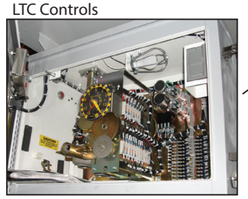
Dual Voltage Switch



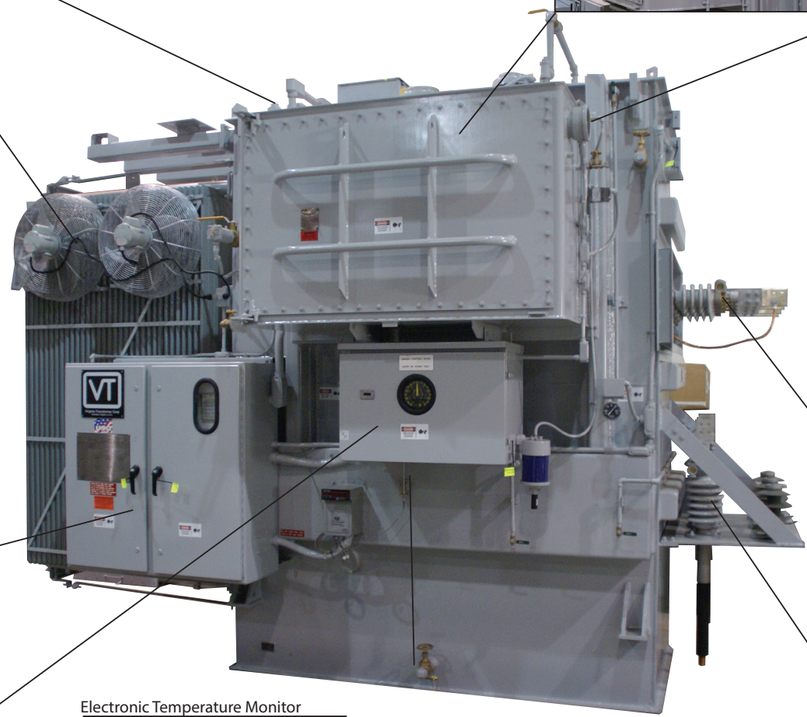
Nitrogen Preservation System

Control Cabinet

LTC Controls

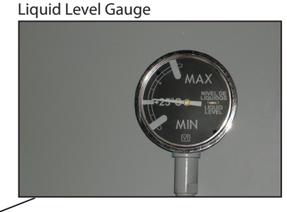


FIVE (5) MANUFACTURING PLANTS IN NORTH AMERICA

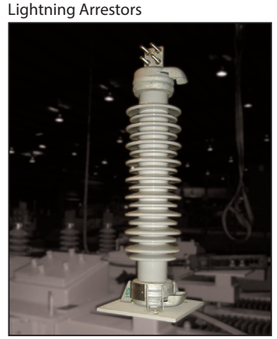


Load Tap Changer

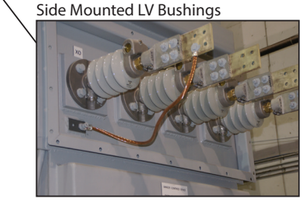
Liquid Level Gauge



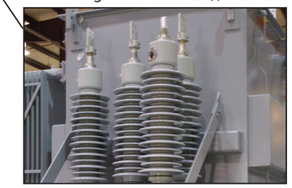
Lightning Arrestors



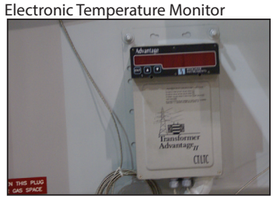
Side Mounted LV Bushings



HV Bushings & Arrestors (Shipped demounted)



Electronic Temperature Monitor

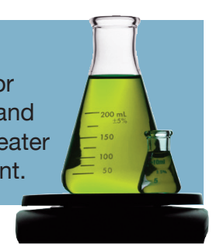


Custom Options

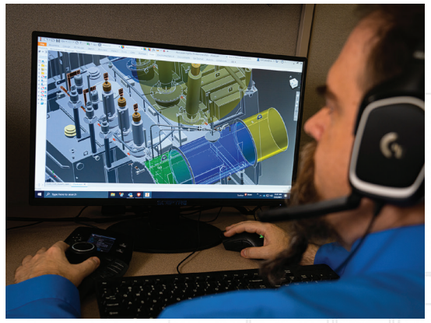
- Nitrogen supply for oil preservation
- Reconnectable windings
- Non-standard impedance
- High-performance paint in your choice of color
- Demountable radiators with isolation valves
- Stainless steel radiators
- Air terminal throats and chambers
- Explosion-proof control box
- Sloped or dome top cover
- Multi-stage fan cooling for increased MVA
- Thermally upgraded insulation system 120° C
- Customer-specific controls and relays
- Stainless-steel junction box
- Less-flammable fluids – natrual and synthetic ester
- Low-temperature oils – I suminol
- Control wiring – rigid, or flexible conduits

Fluid Choices

Virginia Transformer uses natural and synthetic esters to lower the risk of fire or explosion in equipment located indoors or near buildings or hazards. Natural and synthetic esters are less-flammable transformer fluids that provide an even greater flash/fire point and are biodegradeable to lessen the impact on the environment.



Engineered for Your Precise Requirements



Sophisticated AutoCAD® design systems drive down costs and optimize performance

Custom engineeering is our calling card at Virginia Transformer. We provide more than a dozen transformer types for industrial, commercial and utility operations plus variations for mining, cement, marine, export, transit, oil & gas, government facilities and data center specialities. Our engineering strength extends to every discipline of transformer design including electrical, mechanical, thermal and materials engineering.

The design and engineering process at Virginia Transformer is ISO-9001-2015 Certified and delivers quality assured transformers for customer applications demanding performance, efficiency and long-life at the lowest possible cost.

Controlled Manufacturing Environments

Virginia Transformer is in the leader of transformer manufacturing processes and technology. We produce the world's finest liquid-filled transformers in controlled environments at our five plants in North America.

Test Proof

Virginia Transformer performs complete, in-house production testing per ANSI C57.12.90 and customer specifications as applicable, including:

- Ratio
- Resistance Measurement
- Impedance & Load loss
- Induced Potential
- Polarity & Phase Relation
- Excitation Current & No-load loss
- Applied Potential

Other testing facilities are available including

- Power Factor*
- Lightning Impulse Test*
- Switching Surge
- Sweep Frequency Response Analysis (SFRA)
- Sound level Measurement
- Partial Discharge*
- Front of Wave
- Temperature Rise Test
- Short-Circuit Test (Outside lab)
- Thermal Imaging during Temperature Rise Test

** Becomes routine test for Class II Power Transformers*

Shortest Industry Lead Times

Linked design, engineering, and manufacturing systems help us produce and deliver custom-built transformers with the industry's shortest turnaround times for both drawing submittals and production.

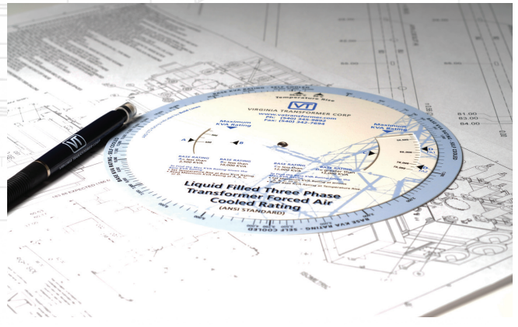
Field Service for Installation and Maintenance

We offer complete installaiton and maitenance support for transformers produced in our facilities, including assembly, oil filling, pre-commisioning testing, repair services, replacement parts, oil handling, hot-oil processing and testing services, periodic inspection, and technical support.

Call 540.345.9892 for around-the- clock emergency response.

Commitment to Customer Satisfaction

Each transformer is installed under the watchful eye of our Customer Service Center. They will know the status of your transformer project at every stage of production from start to finish. You will have your own single point of contact for contracts and logistics. You will be kept informed and up to date. Your total satisfaction is both our goal and commitment.



Virginia Transformer On-Load Tap Changer (OLTC) Solutions

Individualized Solutions for Precisely the Transformer You Need

Virginia Transformer designs OITC transformers for your specific application. Resistive-type or reactive-vacuum-type systems are available. You can configure your transformer with the OLTC connected on the high-or low-voltage winding, depending on your application.

A tap range of +/- 10 percent in 5/8 percent increments is typical, but increased adjustment ranges and incremental steps are available, as directed by your requirements.

OLTC Transformers available from 500 kVA to 1400 MVA in liquid filled units up to 500 kV class.

Control System Alternatives to Fit Your Operations

Virginia Transformer offers local or remote, automatic or manual control systems for single or multiple (parallel) applications. line monitoring, time delays, supervisory control and interfaces are available as required.

Additional opitons are available for this application, including remote indication of tap position via selsyn, current-loop analog output, digital position indicator, multi-contact position indicator, and more.

Long Life and Reliability Means You Keep the Power On

Virginia Transformer utilizes coil-winding designs and bracing to maximize short-circuit strength. The core and coil designs are also optimized to the customer's loss evaluation profile. Hot spots are calculated to ensure the transformer runs at a consistent and appropriate temperature, with additional cutting-edge equipment available to monitor transformer health.

Transform Your LTC into an Intelligent Transformer

With the available VICM, your ITC transformer will talk to you. VICM provides alarm contacts for the 16L, 16R, Nominal and Off Tap positions and operational counter information on its PIC screen and on your PC screen via remote or direct access. Electronic contacts replace mechanical switches common in other devices for greater reliability and lower cost.

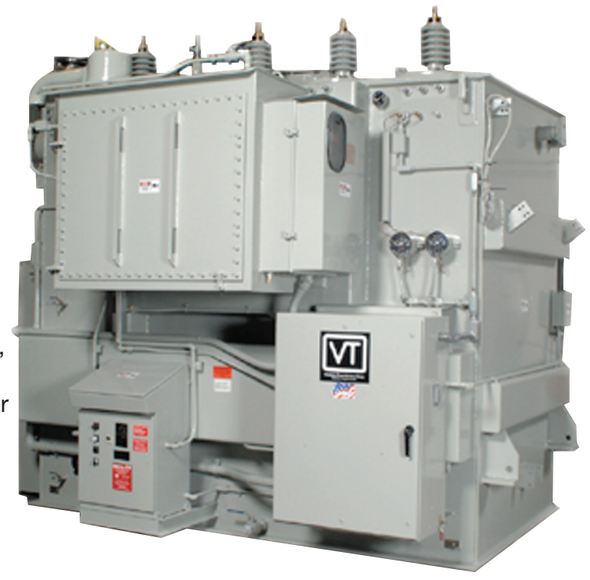
Isolation view of VLCM with accessible PLC.
Direct or remote access to data with optional wired connection (wireless network).

VLCM installs neatly inside the LTC motor cabinet.

Voltage Regulators

Three-phase voltage regulators are used in distribution and transmission applications to maintain steady voltages. The voltage ratio of a regulator is nearly one to one as its basic design differs from that of an OITC transformer, in that it is wound as an auto-transformer.

Many critical applications require a more controlled voltage delivered at the load terminals. Three-phase voltage regulators can perform this duty by employing a load tap changer, which is operated by sensing the load voltage. Our designs utilize the Reinhausen RMVII tap changer. Normally, about +/-10percent voltage is required to be corrected and therefore employing an auto-transformer configuration would result in ten times the throughput power for the same sized transformer.



Transformer Facts

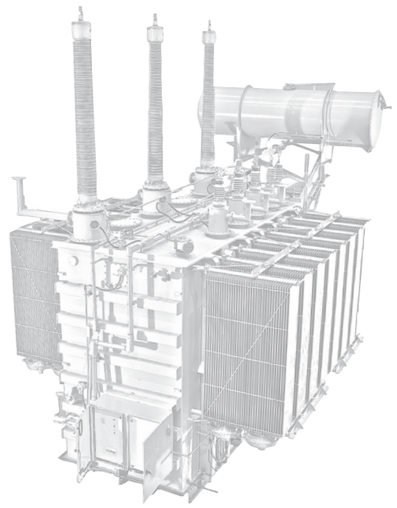
Dimensions and weights are typical and should not be used for design purposes. For exact dimensions and weights, contact factory. Smaller or matching dimensions may be possible.

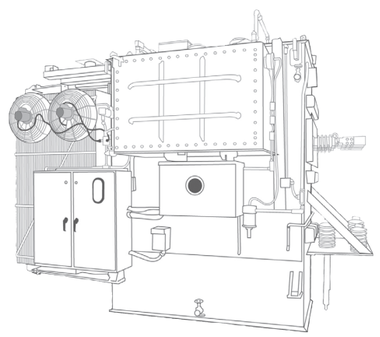
TYPICAL DIMENSIONS

15 and 35 kV Classes, Two-winding, Copper					46 and 69 kV Classes, Two-winding, Copper, Circular					115 kV Class				
KVA	H″	W″	D″	Wt. Lbs.	KVA	H″	W″	D″	Wt. Lbs.	KVA	H″	W″	D″	Wt. Lbs.
500	57	43	55	7,600	1500	120	84	78	15,600	5000	80	145	124	53,000
750	59	46	62	9,500	2000	125	88	84	19,000	7000	185	147	138	65,000
1000	64	49	64	10,700	2500	125	90	88	22,200	10000	189	160	141	72,000
1500	73	53	64	14,000	3750	130	96	94	28,500	12000	190	170	150	80,000
2000	76	53	80	16,000	5000	130	100	98	34,200	15000	195	170	160	85,000
2500	79	55	108	19,000	7500	135	106	106	44,200	20000	196	180	165	107,000
3750	82	61	110	24,100	10000	135	112	112	54,000	25000	210	195	180	130,000
5000	89	78	109	32,300	12000	140	115	115	60,500	36000	210	220	200	160,000
7500	93	86	114	39,300	15000	140	120	122	70,000	50000	240	260	220	200,000
10000	110	94	117	46,100	20000	165	140	160	90,000	–	–	–	–	–
12000	118	97	118	54,200	25000	180	160	180	105,000	–	–	–	–	–
15000	124	103	124	63,000	33000	192	220	190	140,000	–	–	–	–	–

TYPICAL DIMENSIONS

138 kV Class					161 kV Class					230 kV Class				
KVA	H″	W″	D″	Wt. Lbs.	KVA	H″	W″	D″	Wt. Lbs.	KVA	H″	W″	D″	Wt. Lbs.
7500	195	155	140	70,000	10000	215	156	175	100,000	15000	250	240	180	123,000
10000	202	160	150	80,000	–	–	–	–	–	20000	–	–	–	–
12000	209	165	160	875,000	15000	230	180	175	119,000	25000	250	280	195	175,000
15000	213	170	180	100,000	25000	240	210	200	160,000	37500	290	290	200	220,000
20000	220	180	190	120,000	–	–	–	–	–	40000	302	310	240	235,000
25000	220	200	200	135,000	36000	256	230	220	175000	50000	298	300	230	250,000
36000	225	220	205	165,000	50000	260	280	235	225000					
50000	248	270	225	215000										





BIL AND PERCENT IMPEDANCE VOLTAGES AT SELF-COOLED (ONAN) RATING

High Voltage BIL (kV)	Without LTC	With LTC
≤110	5.5	-
150	6.5	7.0
200	7.0	7.5
250	7.5	8.0
350	8.0	8.5
450	8.5	9.0
550	9.0	9.5
650	9.5	10.0
750	10.0	10.5

AUDIBLE SOUND LEVELS

kVA	Sound Level (dBA)
700	57
1000	58
1500	60
2000	61
2500	62
3000	63
4000	64
5000	65
6000	66
7500	67
10000	68
12500	69
15000	70
20000	71
25000	72
30000	73
40000	74
50000	75

Above 15000 kVA consult factory. Data are based on OA rating for oil-immersed power transformers are per NEMA TR-1 standard.

COMPARISON OF PROPERTIES OF LESS-FLAMMABLE FLUIDS

		Mineral Type II	Luminol Bi	Beta -51	FR-3	Silicone
Dielectric	Dielectric Strength kV	30	44	40	45	35
	Dielectric Constant	2.2	2.2	2.1	3.2	2.7
	25 ºC	>0.05	<0.0001	0.05	0.08	0.01
	100 º C	>0.30	0.0001	0.1	0.59	0.9
Physical	Specific Gravity 25º C	0.91	0.835	0.87	0.92	0.96
	Interfacial Tension 25º C (dynes/em) Neutralization	40	48	38	24	31
	Total Acid Number (mgKOH/gram)	0.4	<0.01	0.01	0.02	0.01
Viscosity	0 º C	76	48	195	190	90
	40 º C	12	9.0	108	34	38
	100 º C	3.0	2.4	12	88	16
Thermal	Flash Point º C	145	>160	284	316	300
	Fire Point º C	173		308	360	370
	Pour Point º C	-40	<-40	-24	-21	-55

DIELECTRIC INSULATION LEVELS FOR CLASS II POWER TRANSFORMERS

LOW FREQUENCY TEST LEVELS						
Nominal System Voltage (kV)	Basic lightning impulse insulation level (BIL) (kV crest)	Chopped wave level (kV crest)	Switching impulse level (BSL) (kV crest)	*Induced-voltage test (phase to ground)*		Applied voltage test level (kV rms)
				One hour level (kV rms)	Enhancement level (kV rms)	
115	350	385	280	105	120	140
	450	495	375	105	120	185
	550	605	460	105	120	230
138	450	495	375	125	145	185
	550	605	460	125	145	230
	650	715	540	125	145	275
161	550	605	460	145	170	230
	650	715	540	145	170	275
	750	825	620	145	170	325
230	650	715	540	210	240	275
	750	825	620	210	240	325
	825	905	685	210	240	360
	900	990	745	210	240	395

IEEE Std C57.12.00-2006
IEEE STANDARD FOR STANDARD GENERAL REQUIREMENTS FOR LIQUID-IMMERSED DISTRIBUTION, POWER, AND REGULATING TRANSFORMERS

DIELECTRIC INSULATION LEVELS FOR DISTRIBUTION TRANSFORMERS AND CLASS I POWER TRANSFORMERS

Application	Basic lightning impulse insulation level (BIL) (kV crest)	Chopped-wave impulse levels		Induced-voltage test		Low-frequency test level (kV rms)
		Minimum voltage (kV crest)	Minimum time to flashover (μs)	Minimum voltage (kV crest)	Specific time to sparkover (μs)	
	Column 1	Column 2	Column 3	Column 4	Column 5	Column 6
Distribution	30	36	1.0	––	––	10
	45	54	1.5	––	––	15
	60	69	1.5	––	––	19
	75	88	1.6	––	––	26
	95	110	1.8	––	––	34
	125	145	2.25	––	––	40
	150	175	3.0	––	––	50
	200	230	3.0	––	––	70
	250	290	3.0	––	––	95
Power	350	400	3.0	––	––	140
	45	50	1.5	––	––	10
	60	66	1.5	––	––	15
	75	83	1.5	––	––	19
	95	105	1.8	165	0.5	26
	110	120	2.0	195	0.5	34
	150	165	3.0	260	0.5	50
	200	220	3.0	345	0.5	70
	250	275	3.0	435	0.5	95
	350	385	3.0	580	0.58	140

Applicable Standards

ANSI – American National Standards Institute
IEC – International Electrical Commission
IEEE – Institute of Electrical and Electronic Engineers
CSA – Canadian Standards Association
C57.12.00 – Standard General Requirements for Liquid-Immersed Distribution, Power and Regulating Transformers
C57.12.90 – Standard Test Code for Liquid-Immersed Distribution, Power and Regulating Transformers and Guide for Short Circuit Testing of Distribution and Power Transformers
C57.93 – Guide for installation of Liquid-Immersed Power Transformers
C57.98 – Guide for Transformer Impulse Tests
C57.100 – Standard Test Procedure for Thermal Evaluation of Oil-Immersed Distribution Transformers

Ever Expanding Markets and Applications

Utility

Power Generation

Substations
Voltage Regulator
Auto-Transformer
Grounding Transformer
Sub Transmission
Bi-Directional

Generator Step Up (GSU)
Unit Auxiliary Transformer (UAT)
Station Service Transformer (SST)
Excitation
Generator Start Up

Reserve Auxiliary Transformer
Solar & Wind Power
Geo Thermal
Bio-Mass

Virginia Transformer maintains professional relationships with engineering consulting firms and keeps a large archive of engineering solutions complete with Utility customer profiles to facilitate your specification and purchasing process.

Industrial Applications

Rectifier Duty
Paper & Cement Mills
Steel Mills
Motor Start
Fan, Pump, & Compressor Operation
Data Centers
Bitcoin Mining
EV Charging Stations

Hoists
Mining
Drive Isolation (AC, DC)
Chemical Plants/Ethanol
Oil & Gas: Refineries, Pipelines, Storage, etc.

Zig-Zag Transformers
Special Fluid Transformers
– Natural and Synthetic Ester Fluids

Chemical/Hazardous Environment
– Class I, Division II, Group C & D
Coastal Environment/Offshore

Commercial/Institutional

Hospitals, Universities, Hotels, Offices, Airports, Unit Substations

Transit & Large Drive

Extra Heavy Duty Traction (RI9)
ANSI Circuit 25, 26, 25 & 26, 31, 41
Up to 5000 kW Rectifier
Up to 20,000 HP, AC, DC
Liquid Filled - 55° C or 65° C Rise
Dry Type – 80° C, 115° C, 150° C Rise

Switch Gear Match Up for

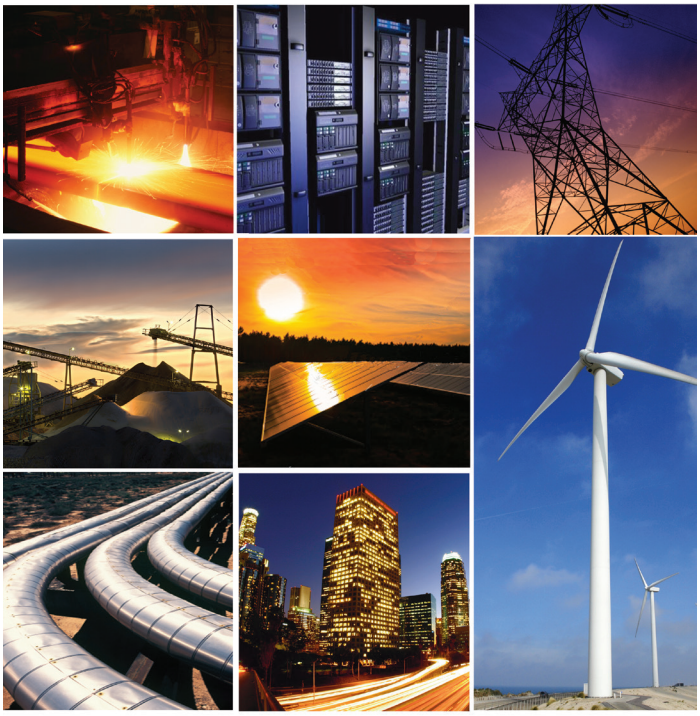
General Electric
Cutler-Hammer
Siemens
Square D
Others

Qualifications

Five ISO-9001 - 2015 Certified Manufacturing Plants in North America.
UL Listed Dry-Type up to 500 kVA, 35kV Class 220° C Insulation System, NEMA 1 or 3R.
UL Listed Liquid-Filled up to 100 MVA, 69 kV Class
IEEE, ANSI, CSA, IEC, RUS

VIRGINIA TRANSFORMER

Precisely Your Power Solution



VIRGINIA - GEORGIA TRANSFORMER

ONE SOURCE–ONE COMMITMENT