INTERNALLY CONTROLLED COMPACT KIOSK-TYPE TRANSFORMER STATION GRÄPER

BKS-2000

Basic technical specifications:

- HV nominal voltage: 3 AC 22 kV, 50 Hz
- LV nominal voltage: 3/PEN AC 420/242 V, 50 Hz / TN-C,
- Frequency: 50 Hz
- Transformer nominal power: to 2x1 000 kVA
- HV bus-bars nominal current: regarding HV distributor´s type to 630 A
- LV bus-bars nominal current: to 1 500 A
- HV / LV distributor nominal insulation voltage: 24 kV / 1 000 V
- HV distributor short-time / dynamic current: 16 kA / 40 kA
- LV distributor short-time / dynamic current: do 30 kA / do 60 kA
- LV distributor cover: IP 20
- Whole station cover: IP 23D
- Cover class: K 20
- Empty skeleton weight: ~~e~~ca 24 500 kg
- External dimensions (LxWxH): 5 000x3 100x3 450 mm
- Environment: 3.1.1. basic ~~(within~~(inside the kiosk-type TS room~~s~~),
  4.1.1. external, ordinary (outside the TS room~~s~~)
- Exp. class: for internal components: XC1; for external components: XC4, XF1, XA1.
- Operating conditions: ambient temperature –40°C ≤ t ≤ + 40°C
  altitude up to 1 000 ~~MASL~~m asl

Note: If the transformer substation is used in different climate and operating conditions, the TS supplier ~~is~~must ~~needed to~~ be consulted.

Electrical current injury prevention: (STN EN 33 3201, STN EN 33 2000-4-41)

- in normal operation mode (of the live parts): in HV system by: 4.1.1 – out of reach ~~location~~placement
  4.1.1 – live parts insulation
  4.1.1 – ~~block~~barrier, cover
  in LV system by: 3.7.1. live parts insulation
  3.7.2. ~~blocks~~barriers or covers
  3.8.5. out of reach ~~location~~placement (position)
– in case of ~~accident~~failure (of dead parts): in HV system by: 4.2.5. automatic feed disconnection with quick IT networks disconnections to be off (with low imped. neutral TR grounding)
4.2.9. bonding – uniform potential installation
in LV system by: 3.2. automatic feed disconnection
3.6.1. additional protection by residual current device (TS install.)
3.6.2. additional protection – additional protecting bonding

~~Building part~~Station construction:

Internally controlled compact kiosk-type transformer substation is ~~solved~~partially ~~as semi~~ flush-mounted ~~one~~, with external ~~plan~~dimensions of 5 000x3 1000 mm, total height of 3 450 mm, clear height of the technological part is 2 290 mm, clear height of the cable ~~cellar~~space is 680 mm, ground sinking

depth of 760 mm, over ground height of 2 690 mm (with ~~terraced~~flat roof). ~~Solid~~Station construction is self-supported and ~~structure is~~ standardly made of reinforced concrete Gräper LC25, if wished so, of reinforced lightweight concrete Gräper LB25~~,~~. This ensures ~~providing that~~that the transformer substation ~~meets~~will meet all requirements concerning rigidity while keeping low ~~the structural firmness to have lower~~er weight and better thermal and acoustic insulation properties ~~comparing~~ in comparison with kiosks made of ~~from~~ ~~classical~~basic concrete. The ~~S~~steel reinforcement ~~structure~~ is composed of ~~formed by~~ steel bars and mats ~~i~~welded together ~~s bilaterally welded~~ ~~and~~into a single conductive structure ~~conducingly connected together~~ and ~~takes~~serves as a part of the bonding, grounding, or even lightning ~~rod~~protection system.~~ ~~ The installation of the station skeleton does not require any ~~re is no need to build~~ foundations, but only a well flushed and rammed cu~~ up the basement in order to sink the TS, the cutting flushed up and rammed in advance remains sufficient.~~t. The ~~T~~transformer substation is type~~ ~~approved, ~~it correspond~~confs~~orming~~ to the STN EN 62271-202 norm and ~~regarding~~meets ~~PEHLA directive it meets~~ the resistance tests against internal arcing fault of the German PEHLA (Prüfung Elektrischer Hoch-Leistungs-Apparate) directive**.**

~~**Structure**~~**Station construction ~~solution~~** forms a compact unit consisting ~~in~~of ~~two~~four monolithic parts: basement tank ~~with~~, sidewalls, floor and a flat roof.

Basement tank ~~with~~and sidewalls: ~~m~~Made of waterproof and oil proof concrete (~~opening width of the cracks~~ crack width is guaranteed up to 0,2 mm) as an oil catch tank~~,~~. The construction resistance against strong chemical ~~influence~~action of the liquids, soils and vapours ~~corresponds~~conforms to the DIN (German Institute for Standardization) directive. The tank space ~~creates~~is divided by a vertical oil-resistant separation ~~a dividing~~ wall ~~against oil catching~~ into a compartment under ~~, all height long transversely divided into a part under~~the transformers and ~~part~~a compartment under the ~~-~~HV and LV distributors. Th~~, th~~e space under the distributors is equally divided into separate sections with the HV and LV cable~~s enter~~ entry holes ~~in~~. The tank serves ~~for~~as the basis of the non-freezing ~~warm water part as a basis~~ and ~~lifts~~allows station lifting ~~the whole station~~ by means of 4 anchor~~age~~ points (sealed chasing nuts) RD 36, placed in the shorter sides of the TS (~~as~~see figures ~~viewed on~~ „B“, „D“). In order to join the external grounding two M12 points of HV/LV switchgear are led from the sidewalls of the station. The bell casting method was used to construct the tank and ~~It is made together with~~ cable exchange label bodies, thus creating a monolithic unit ~~by a so called bell casting method, then a body with necessary~~ which meets requirements for the impermeability of ~~properties concerning~~ water and oil substances ~~permeability is produced~~. All ~~the~~surfaces ~~cases of the~~ of the transformer substation~~,~~ touching the ground and cable ~~place of the cables~~ feeder entry and exit seals may ~~and outlet as well can~~ be painted by two layers of ~~the~~ black penetrating insulation paint, if ~~wished~~required by the ~~so by customer~~ customer. ~~, t~~The inside of the tank can also be ~~handled~~treated by waterproof and impermeable paint ~~from internal side too~~.

HV and LV cable entry holes ~~In the lower part of the body~~ are made on production in the lower part of the body (HV or LV distributor´s side) ~~the apertures for the HV and LV cable line in-and outlet are already made during the production~~. ~~When~~After cable installation, the entry holes are sealed by ~~cables are pulled in and connected and in order to protect them against water penetration by exchange labels~~ Hauff press fittings (HSI 150, HSI 90)~~, these apertures are sealed~~. The ~~space of the~~ basement tank ~~is~~is fully divided by a separation wall ~~by width of the TS divided in its full profile by a wall in order to~~to catch possible transformer´s oil ~~release~~leakage in order to protect ~~the oil to get into~~ the space under the HV and LV distributors from the leaking oil.

Internal walls are ~~standardly~~treated ~~adjusted~~with ~~by~~ white washable paint by default~~, ~~. The surface ~~treatment~~finish of the external walls~~,~~ is available in the following selection ~~if wished so by customer, can be the following one~~:

- ~~concrete with bare filler (~~ exposed aggregate concrete~~)~~ with 8/12 granularity,
- raw concrete in final finish colour according to the RAL ~~palette of~~ colour~~s~~ palette,
- from plastered concrete with material (scraped finish), or material Rollputz (~~pl~~rolled on plaster ~~laid on by a roller~~), in final finish colour ~~according~~ from ~~to~~ the RAL colour palette ~~of colours~~,
- stone facing (~~for~~e.g. ~~example~~ Dupa-Stone), ~~facing~~facade bricks, wood of other material as required by customer.

Floor: ~~sealed~~cast from reinforced concrete LC25, ~~width of~~ 120 mm thickness, in the ~~part of~~ HV and LV distribution plant compartment, there is a feed opening into the cable cellar (~~between~~ floor space) ~~and~~, with

pressure balancing lidcover to balance the pressure.

Roof: connected to the walls withinfrom inside, at in 4 points by means of the screws and itoverlapping laps over the the walls contour by 9 cm. The roof can be lifted by It is possible to lift the wall by means of 4 anchorage points (sealed chasing nuts) RD 16, standardly corniced with width of by 9 cm all around, thus providing additional protection of the joints between vertical walls and the roof are additionally protected. If the TS is built next to already existing construction or next to another building, the roof gutter can be partially or totally eliminated, or if required, the width of the roof gutter can be bigger than 9 cm. Drainage is madeensured by means of inbuilt rain drains from plastic material, being placed under the attic (atin stations with gutter) or on attic´s side (stations without gutter) connected with downpipes outside the station body. In order to increase the protection of the concrete surface against humidity, the upper roof is completedcovered with by additional hydrophobic dustsheetcoating, which obstructsfills capillary pores and thus works acts against the hygroscopic properties of the concrete.

Surface treatment of the roof can be made of the concrete with bare filler (exposed aggregate concrete), or fair-face concrete with rough surface and paint according to the RAL colour palette of colours. , tThe shape of the roof (terracedflat, saddle, cradle,)) is optional as well.

Door: aAll the metal parts likeincluding doors, frames, and ventilating parts are standardly made made by default of hot-dip galvanized sheet steel galvanized on fire with width of 1,5 mm thick, sheet steel, basic paint and two layers of the finish paint in RAL 7032 colour palette of colours. The door is equipped with armour madeincluding up by external knob and internal handle with plastic lock cover of the lock and facilitya pawl for fixing to fix up (arrest) the door in its open position underat thea angle of 95° angle. For arrestment – the locking, bob weights and point-to-point bars are used within each door wing frame (four-point locking system Gräper). The lock is adapted tofor build in a standard profilelock inserts filler. External The outer side of the door is covered by warning boardsplates in terms of the valid EN.

If wished soOptionally, it is possible to make the door and ventilating parts can be made of from anodized aluminium and concerning2 lock inserts can be used the lockout the 2 fillers for double lockout are possible to use.

Transformer substation has oThe access to the n the side of HV and LV switchgear of the substation is provided by a common single wing door without ventilating aperture and with internal dimensions WxH of 1 000x2 000 mm, m. The door on the HV/LV transformer´s side the door has a ventilating aperture and with internal dimensions WxH of 1 100x2 000 mm. The Ddoor is equipped with an facilityarresting pawl to arrestfix the the door in an open position and door wings are connected with the frame through a copper conductor with 16 mm^2 cross-section of 16 mm^2 area.

Air ventingexchange: Air vents for the transformer space are located in the entrance door and in transformer chamber´s walls. There are 2 air vents with internal dimensions WxH of 1000x800 mm. The vents´ dimensions are proposeddesigned in orderto ensure to provide for a sufficient air ventingventilation and transformer cooling. Air vents are equipped with grid (lamellas - blinds Gräper with the level of protection followingwith safety level DIN 40 050 V2A) and a net against foreign bodies (insect)insects.

Grounding:

Composition of the TS internal groundingInternal ground of the TS is made of:

- **bonding bar** (BB) Cu 30x4 mm with M12 clips M12, located on the spreader insulator 1 kV, which is directly connected with all the technological components of the TS (vessel of the TR distributors tanks of the HV, LV, metal shield of the HV cables, branch bar PEN) and with individual mounted components (construction components – tank and roof armouringreinforcement, frames, door, grate, conducting „U"-bearerbeams of the transformer, bearing structures of the distributors...) byusing the Cu conductor with S_{min} 30 mm^2. Each conductor of the grounding connected to the BB is labelled.
- **earth artery** is made of implemented by a FeZn strip conductor Fe with S_{min} 125 mm^2, being part of the TS armouringsteel reinforcement and it is sealedcast directly in the external walls and kiosk´s beam, servingwhich serves as for the connection of the common points of the grounding. Flexible parts are connected by appropriate to the frame with copper (Cu) stripe frame copper line or Cu grounding Cu cable with min. cross-section area of 16 mm^2.
- **2 nodes of the grounding feeder** by Hauff HDE-M12/X to connect the external grounding (in general line FeZn stripe 30x4 mm) to the bonding bar (formfrom the internal part of the node throughby a connecting screw M12-St 37 Zn, formfrom the external part of the node through **test clips** of the **SZ1, SZ2** grounding with screw M12). Grounding feeder nodes are generally lead taken out onf the opposite sidewalls of the station space for HV and LV distributor.

The ~~T~~transformer substation in standard finish does not have external lightning ~~rod~~protection system, as it is a ground object mostly located close to other higher objects. All the metal ~~skeletons~~reinforcement built-in to the ~~appropriate~~corresponding ~~parts~~~~component~~ of the TS (roof, walls, false ceiling, basement tank) are welded into a ~~whole~~single unit~~,~~ using Parts of the skeleton are welded together using conducting joints (e.g. Cu lines 35 mm^2)~~. They are mutually connected ready to use elements of the skeleton,~~ thus ~~they make~~forming Faraday´s cage and ~~when~~after ~~the~~ roof mountaing is mounted they are ~~completely~~fully connected to the grounding. If customer wishes otherwise, it is possible to equip the transformer substation with external lightning rod with one collector and two ~~leakages~~wires connected to the common TS grounding via test clips in terms of the valid STN.

For each transformer station ~~For the transformer substation c~~ a common grounding system for HV and LV facilities must be ~~made~~constructed~~,~~. ~~I~~Its ~~proposal~~design needs to take into account the operati~~on ng~~ conditions – fault current value of the distributi~~ng~~on network in the given regio~~n a given locality, , way of node~~ power transformer node operation mode and local soil conditions (STN EN 33 3201, STN EN 33 2000-5-54,)

Installation:

The internal installation of the station ~~involves~~includes interior lighting ~~of the TS~~, ~~consisting~~including an ~~in~~ oval incandescent 60 W lamp fitting with gate switch lighting in the distributor´s space of high and low voltage of the transformers and in the cable cellar, and one-phase socket of 230 V. The ~~C~~circuits ~~to~~ feeding the lighting and socket installation are led out from the main LV distributor via installation breakers, or combined with ~~current~~residual current circuit breaker ~~protector~~.
Further ~~facilities~~equipment – as specified by customer.

Internal space of the TS is horizontally divided by concrete floor into two ~~parts~~compartments: cable cellar in the basement tank and technological space over the ground ~~of the~~holding the transformers, HV and LV distributors ~~are placed in;~~. The ~~-~~over ground part of the TS is ~~made~~composed of ~~by~~ two vertically divided ~~rooms~~spaces – HV/LV switchgear space and transformers´ space.

Transformer:

Oil, hermetic or dry-type transformers up to the power of 1 000 kVA may be commonly used in the substation, ~~being~~ ~~located~~placed on rails and ~~the~~ vibration ~~“~~absorbers~~”~~ ~~of the system~~made by Gräper~~, are not possible to use in transformer substation in a standard way~~. In case of ~~the~~ oil ~~release~~leakage the ~~site~~seat of the transformer is ~~solved~~designed as ~~as~~ an impermeable oil catch tank. If the transformer is equipped with bolster, it is ~~assured~~fixed against ~~its dislocation on the site~~side movement. ~~I~~Transformer insertion and removal can be performed through~~t is possible to be put in and removed from the transformer substation through~~ an entrance door ~~by means of the~~or by crane ~~when~~if roof ~~the roof of the station~~ is removed. Max. dimensions of the TR (LxWxH) are c~~c~~a 1 800x1 200x2 000 mm.
Transformer cooling is ~~natural~~atmospheric. Air renewal is provided by air vents at the bottom of the door of the transformer substation (on the transformer´s side) and in the transformer chamber´s walls. Transformer´s protection against over current, or ~~cut off~~shortcut is provided:
a) ~~on~~ HV side – by plugs or by switch with safety relay
b) ~~on~~ LV side – by air breaker

High voltage distributor:

~~In transformer substation it is possible to use a~~All ~~the~~ types of the commonly produced covered HV gas insulated distributors SF6 can be used in the transformer substation (~~f~~e.g.~~or example~~ GA, GA-C by Moeller, 8DJ10, 8DJ20 by Siemens, RM6 by Merlin Gerin,...), or type-approved vacuum distributors ~~ones approved by pattern into the~~up to width of cca 2 800 mm. Nominal current of the distributors according to the type ~~is~~may be up to 630 A, ~~shorting~~shortcut resistance (nominal short-time withstand current 1 s) to 20 kA, optionally ~~if wished, up~~ to 25 kA. ~~It is possible to deliver the customers the~~ The HV distributor can be provided by the customer, or by Gräper company including the facility to decrease the pressure in the arcing fault in the HV distributor corresponding to STN EN 62271-200 (PEHLA standards). Max. dimensions of the HV distributor (WxHxL) are cca 2 800x2 200x1 000 mm.

Low voltage distributor:

The ~~P~~papanel version of the LV distributor is covered with IP 20. The feeder is equipped with air breaker depending on the transformer´s power~~, there~~. Outlets are equipped with ~~are sank~~ breakage bar switches (12-13 outlets with switches to 400 A and ~~building~~construction width of 100 mm for one TR, or adequate number of outlets with switches up to 160 A and ~~building~~construction width of 50 mm), or breakers with attachment of ~~max. joinable~~ cables with max. cross-section area of 300 mm^2. Nominal current of the distributor is standardly to 1 500 A, ~~shorting~~shortcut resistance (short-time nominal withstand current 1 s) up to 25 kA. ~~Except~~Besides ~~for~~ this, the distributor can include electricity ~~energy~~ consumption ~~measurement~~monitor, circuits ~~to plug the~~for station light~~n~~ing ~~of the station~~ and service socket. The clips can be grounded on the main breaker´s feeder („ball pivots“) ∅ 25 mm, which allow to ~~ensure~~protect ~~–~~ the working place during ~~the~~maintenance ~~works on~~of the ~~–~~ LV distributor via grounding ~~tool~~system (shorting set). Max. dimensions of one LV distributor (WxLxH) are c~~c~~a: 1 300x2 000x500 mm.

Note: The number of LV outlets is limited by customer´s demands for additional ~~-~~ LV distributor equipment such as monitors ~~to be equipped with further devices such as measurement,~~ etc.

The distributors meet the ~~–~~ STN EN 60439-1 norm and also DIN VDE 0660, part 500, VDE 0100, VDE 0414, UVV standard requirements.

Cable connections:

~~They~~Cable connections include HV distributor connection with transformer 24 kV by single-core cables 24-N2XSY 3x1x35 mm^2 and LV distributor connection with transformer 1 kV by cables 1-NYY-O 1x150 mm^2, ~~resp~~or~~.~~ 1x240 mm^2.

~~Within the production process the c~~Cable connections for high voltage are checked in each production phase. Filed tests ~~, it is also possible to make file TE tests~~ of the TE fractional discharges in Gräper company´s own test-room can be carried out , following VDE 0434, VDE 0472 technical norms. According to the regulations the ~~prescribed~~ maximum allowed value for ~~is~~ TE is ≤ 20pC. The real achieved value is ≤ 5 pC.

~~Final Finishing~~Transformer station construction options:

The station is ~~made~~constructed ~~up~~ according to the norms and rules of STN EN, DIN, UVV etc., ~~concretely~~directly following the ~~valid~~bellow given ~~version of~~ normative standards ~~as described below~~:

Cellular concrete	- DIN 4219
~~Armoured~~Reinforced concrete	- DIN 1045
VDE Directives ~~VDE~~	- DIN 0141, 0101, 0100
Directive on the protection of ~~under~~ground waters ~~protection~~	- GwSchV
Federal directive on waste disposal~~garbage~~	- BimSchV
~~Emissions´´ testing for electromagnetic~~ Electromagnetic radiation compliance	- BimSchV č.26

Individual structural components of the transformer substation are made of uninflammable materials, fire ~~endurance~~resistance of the ~~building~~station construction ~~structure~~ meets STN 73 0821 (fire ~~endurance~~resistance class required is F90, class documented is F120).

Delivery, assembly, ~~cutting~~ ground cut for ~~to sink the~~ station placement:

The ~~K~~kiosk-type transformer station is delivered ~~to the site~~ assembled and prepared for HV, LV cable connection and grounding. It is installed by ~~means of the~~ crane into ~~pre~~a~~-~~ prepared ~~building~~ pit with compressed and flat surface ~~regarding~~according to the design project of the transformer substation´s producer – Gräper company (dimension of the ~~cutting~~ground cut ~~bottom~~: 276x250 cm, cutting depth: 88 cm, compressed layer width: min. 20 cm).