Transformers (Mobile Oil Regeneration) in Practice

Sharing practical knowledge and networking
within the „transformer family“

STARKE & SOHN GmbH
MINERALÖLWERK
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In exclusive partnership with:

FLUX
Transformer
Services

Seminar ”Transformers in Practice”
26th of January 2024 – Wageningen, NL
Mr. Dipl.-Ing. Dirk Flor (Managing Director)

Transformers in Practice – operation, control, maintenance

- Challenges for all transformer operators (asset management)
  - ensure the best performance and availability of assets (transformers)
  - supervise transformers (constantly, regularly, e.g. the oil, the „blood“)
  - evaluate the data, define actions, schedule & budget, find partners, & do it

- „The Maintenenace Bible“ - IEC 60422:2013
  - Mineral insulating oils in electrical equipment – Supervision and maintenance guidance
    - Limits for mineral insulating oils
      - » Recommended limits for mineral insulating oils after filling in new electrical equipment
      - » Recommended limits for the classification of the condition of oils in service

        „good“ => oil in normal condition; continue normal sampling

        „fair“ => oil deterioration detectable; more frequent sampling recommended

        „poor“ => oil deterioration abnormal; schedule effective actions

Transformers in Practice – IEC 60422 – actual recommendation

New Project of TC 10 - Webinars on new or updated standards

Our first Webinar is on

Mineral insulating oils in electrical equipment – Supervision and maintenance guidance (IEC 60422)

Date and Time

1.Feb. 2024 13:00 CET

Registration:

https://iec.zoom.us/webinar/register/WN_zoLnZd_cRL2_d--6_Wzr3A

REPLY NOTIFY

Notified from : https://collaborate.iec.ch/#pages/workspaces/95864/documents/

In Practice – What is Mobile Transformer Oil Regeneration ?

- comparable to a human „blood dialysis“
- bypass operation without production stop
- most effective & holistic system cleaning
- provides an oil which is originally conformed with IEC 60296 acceptable quality

- processes which remove physical and chemical contaminants (combination of filtration, vacuum drying, adsorption: physisorption + chemisorption)

In Practice: MRA Mobile Regeneration Asset – Technology

- longterm operational experience
- continous optimization
- own development & engineering
- constant investment, three assets / rigs

In Practice: guidlines – IEC 60422 – poor limits / guaranteed values / average reached values

	170 – 400 kV (category A)*	72,5 – 170 kV (category B)*	guaranteed values after MRA-regeneration	average values after MRA-regeneration
Breakdown voltage [kV]	< 50	< 40	>/= 75	80
Dielectric dissipation factor tanδ at 90 °C	> 0,2	> 0,5	</= 0,005** (0,01)	0,003
Acid number [mg KOH/g]	> 0,15	> 0,2	</= 0,01	</= 0,01
Surface tension [mN/m]	< 20 / < 22 uninhibited/inhibited	< 20 / < 22 uninhibited/inhibited	>/= 40	44
Water content [mg/kg]	> 20	> 30	</= 5** (10)	4
Corrosive sulfur	corrosive	corrosive	not corrosive	not corrosive
DBDS (mg/kg)***	>= 5	>= 5	</= 3	</= 1

*source: DIN EN IEC 60422:2013(VDE 0370-2), extract table 5, ***extract table 3, before operation: <5ppm

**if an oil temperature of >/= 45 ° C will be ensured during 70% of the oil regeneration process

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In Practice – services for the energy industy – some references

In Practice: > 555 projects, > 18.300 t, range: 35 to 600 MVA

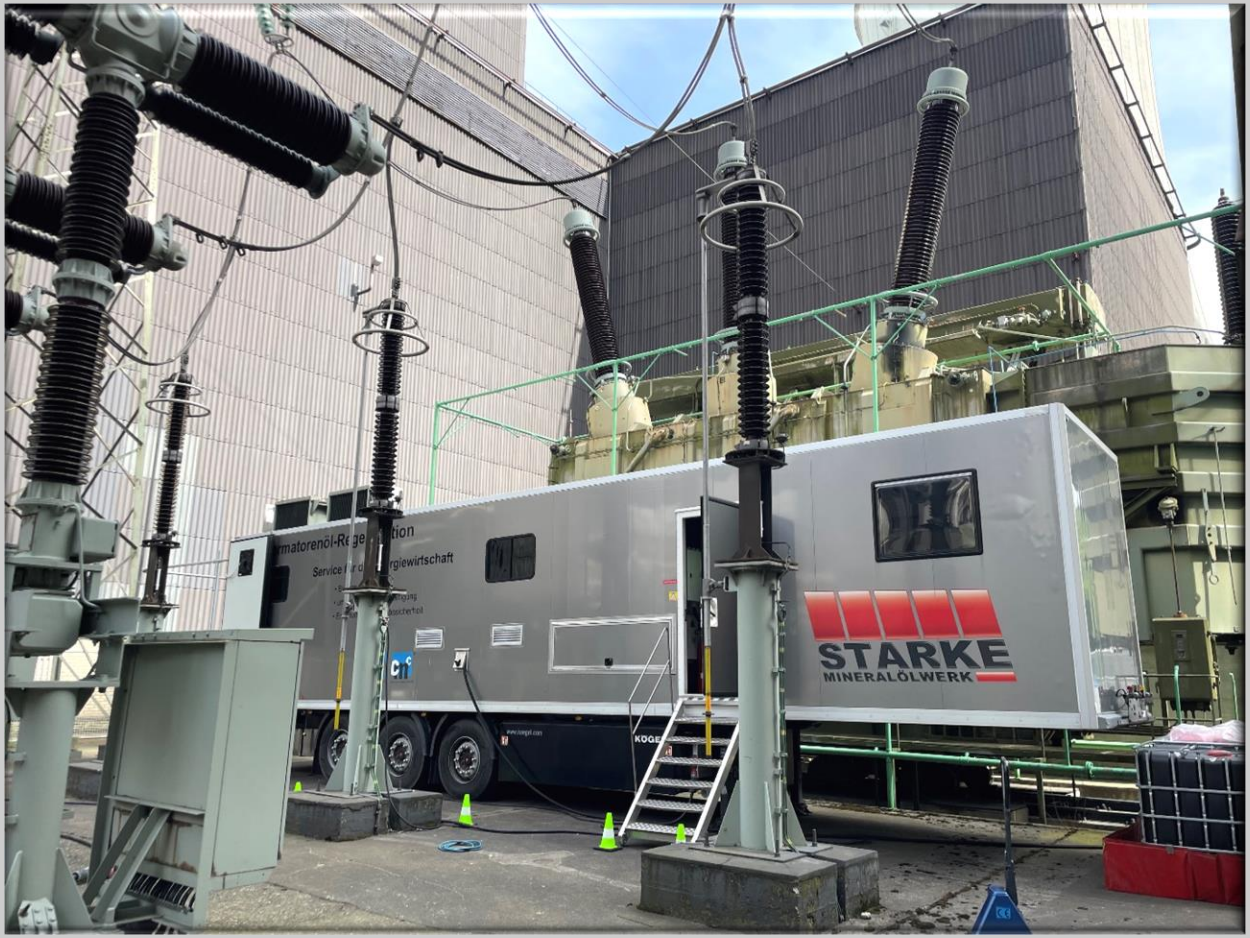
updated reference list - realized projects MRA-Technology			
power-, generator step-up-, network intertie-transformers, reactors, projects between 2010 - 2022			
number - Anzahl	**system voltage - Bemessungs - Spannung OS [kV]**	**power range - Bemessungs- Leistung [MVA]**	**effective action - Art der Behandlung**
> 80	> 380	200 - 600 MVA	regeneration &/or DBDS-elimination
> 120	> 220	100 - 550 MVA	regeneration &/or DBDS-elimination
> 140	> 110	30 - 200 MVA	regeneration &/or DBDS-elimination
> 100	> 30	3 - 80 MVA	regeneration
> 115	< 30	1,6 - 35 MVA	regeneration

please note:

* more than 555 projects has been successfully realized since 2010
* more than 18.300 tons of transformer oil mobile regenerated since 2010
* all kinds of assets within the system voltages & power ranges has been covered
* all kinds of different locations has been served: power plants (nuclear, conventional, hydro), substations, railway lines, steel-, aluminium-, paper- & chemical plants and many more...

In Practice: mobile regeneration at hard coal power plant

transformer project: Acec 1969 (refilled 1993), 438 MVA, 220kV, 100 t oil, 11 days



In Practice: mobile regeneration at hard coal power plant

see feature: special collection trays for IBCs with process oil and top-up oil

In Practice: mobile regeneration at a run-of-river power plant

transformer project: ELIN 1991 , ….MVA, …kV, 38,5t oil, 9 days

In Practice: mobile regeneration at a run-of-river power plant

special challenge: crossing the river Danube by crane with mobile rig to reach location

In Practice: mobile regeneration at a brown coal power plant

plant project: 26 transformer, 25-600 MVA, 20-110 kV, 20-90 t oil, 3 rigs, few weeks, 24/7

In Practice: mobile regeneration at a brown coal power plant

special challenges: size of rigs & local spaces

In Practice: mobile regeneration at a brown coal power plant

special challenges: size of rigs & local space…in combination with local traffic..

In Practice: mobile regeneration at a brown coal power plant

special attention: health & safety…also with regard to local traffic..

In Practice: mobile regeneration at a brown coal power plant

expected result: …all service technicians & rigs „survived“ & customer satisfied…

In Practice: mobile regeneration at a TSO substation

transformer project: ELIN 1973, 333 MVA, 38O kV, 50 t oil, 12 days

In Practice: mobile regeneration at a TSO substation

special challenge: „critical inspectors“ on site

In Practice: mobile regeneration at a TSO substation

result: conviction, confirmation & business partnership

In Practice: mobile regeneration at a DSO substation

transformer project: SGB 1990, 40 MVA, 120 kV, 14 t oil, 7 days

In Practice: mobile regeneration at a DSO substation

see action: sometimes customers providing helping hands

In Practice: mobile regeneration at DSO „inhoused“ transformers

transformer project: BBC 1979, 40 MVA, 110 kV, 21 t oil, 6 days

transformer project: Lepper Dominit, 31,5 MVA, 110 kV, 22 t oil, 9 days

challenges:
in the middle
of the city

In Practice: mobile regeneration at railway transformers

transformer projects: several in row, 3918 kVA, 15 kV, ca. 1 t oil/each, 1-2 days

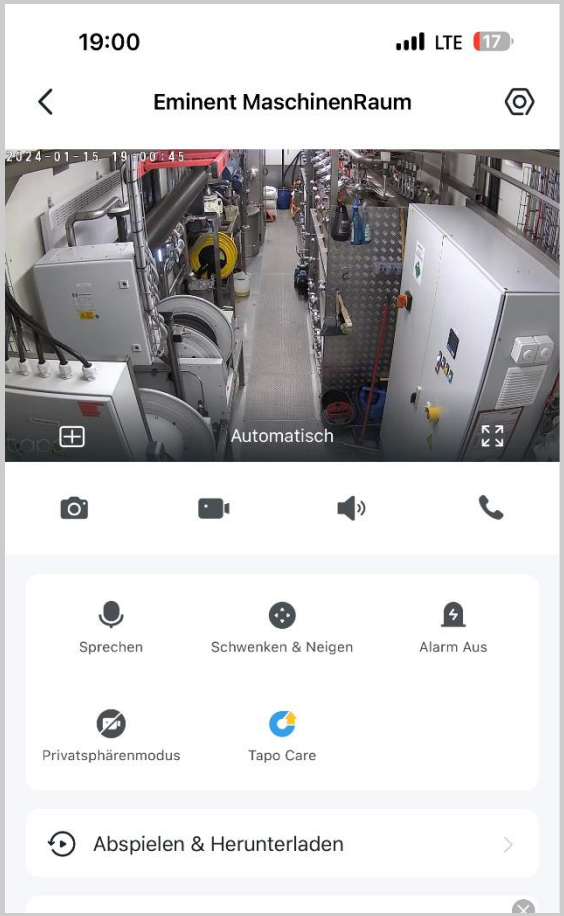
In Practice: mobile regeneration at railway transformers

special challenge: schedule several locomotives in a row

In Practice: mobile regeneration – special safety equipment

supervision, control & operating: videos and alert systems, 24/7, 2 fixed & mobile video systems per rig, failure allerts per SMS, VCN – Virtual Network Computing

Video

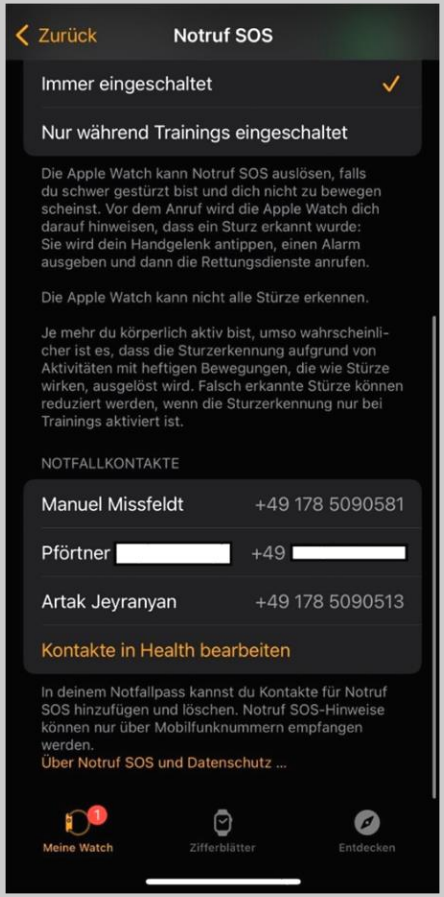


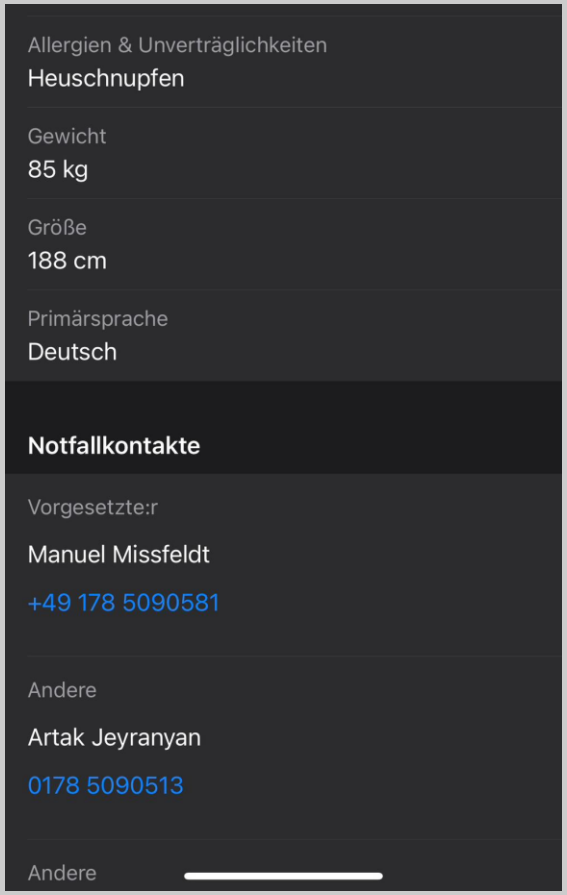
SMS

In Practice: mobile regeneration – special safety equipment

supervision, control & operating: alert systems for staff/technicians, 24/7, in case of overthrows (SOS-customer-manager)

SOS-contacts





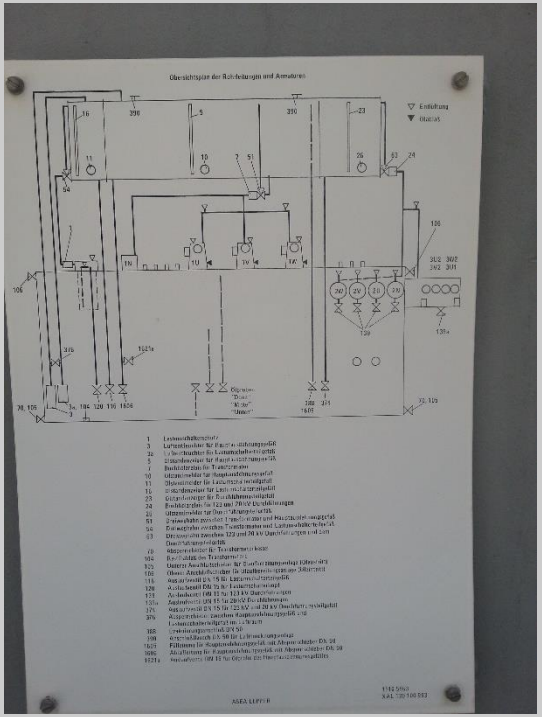
personal hints

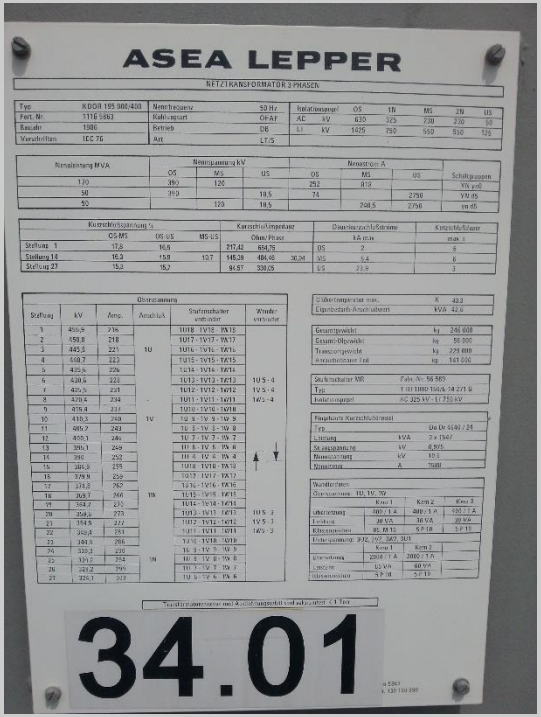
In Practice: mobile regeneration – special safety equipment

especially for PCB containing oils: additional exhaust treatment units

In Practice: mobile regeneration – what to do in advance ?

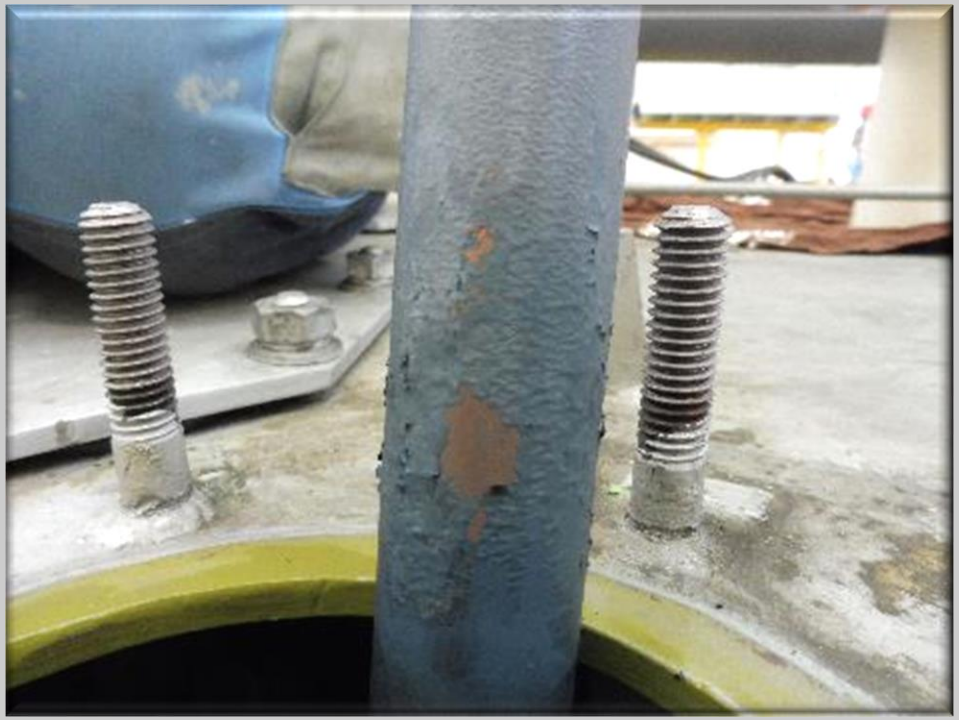
- For all transformer projetcs
  - check oil analysis figures & PCB, refer to IEC 60422
  - check transformer data (trafo plate, piping plan, drawings)
  - check location – accessibility & power supply – site visit free of charge





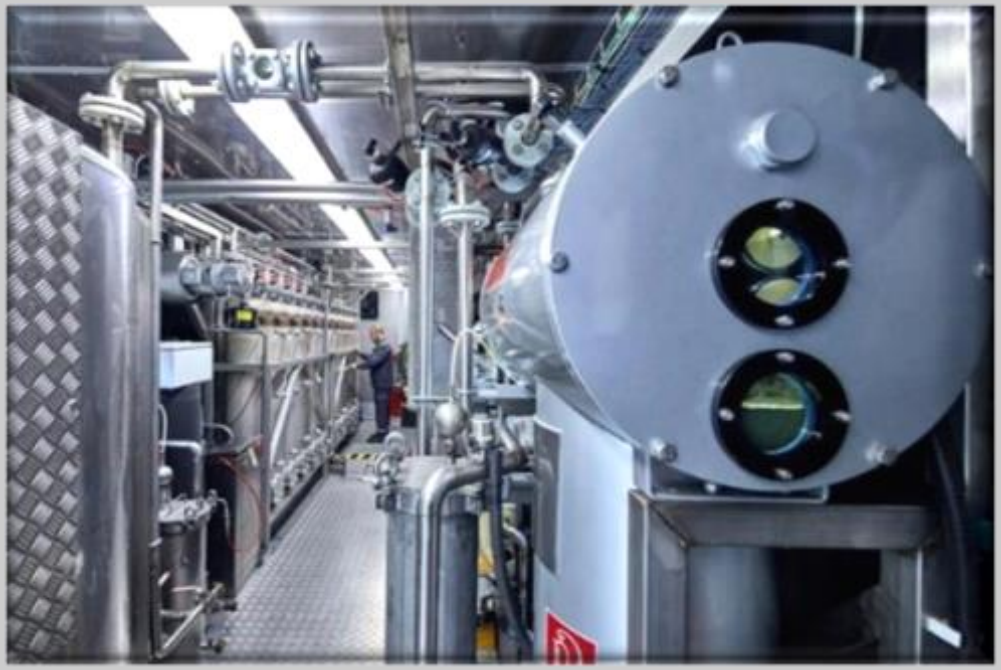
In Practice: mobile regeneration – please do not forget DBDS

- for all transformer projects
  - check oil analysis figures, including DBDS, see IEC 60422 (or you might be suprised)



In Practice: mobile regeneration – in the Netherlands

transformer project: you still have the choice to be the first one !



Thank you very much for your attention