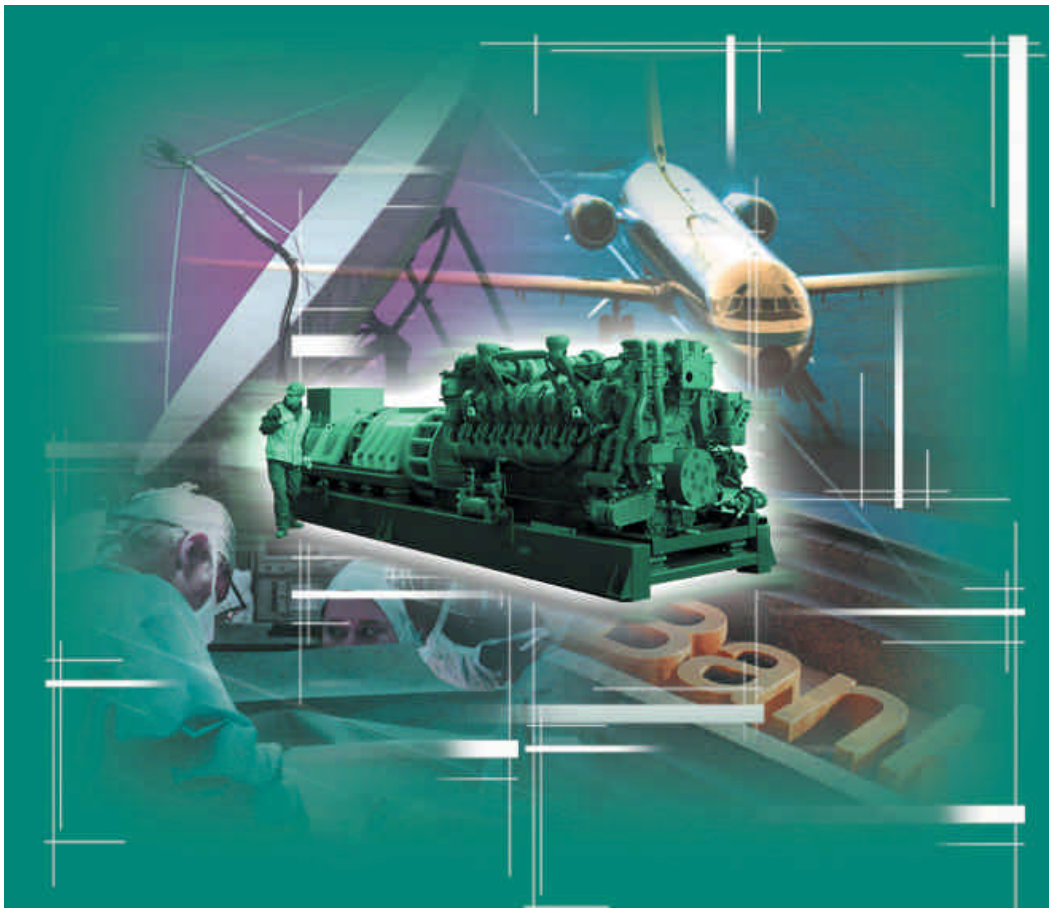
NO-BREAK KS®

Dynamic UPS system



PRESENTATION

EURO · DIESEL

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Chapter 1: Description of No-Break KS® System

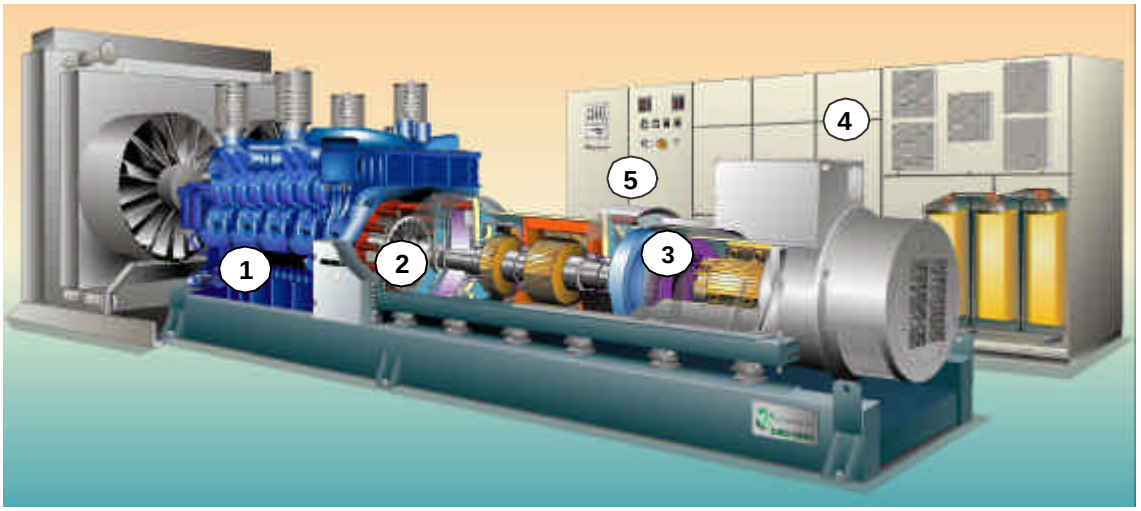


Figure 1

The main components, as shown in Figure 1, are as follows:

1. A diesel engine;
2. An electromagnetic brushless clutch;
3. A special brushless rotating machine, called a "stato-alternator", composed of:
   - 1 synchronous alternator
   - 1 kinetic energy accumulator with single excitation
4. A power cabinet containing the motorized breaker units and an inductance;
5. A control panel containing, a PLC, and the dedicated electronic circuit boards to control and monitor of operation the system.

Chapter 2: Operation when mains power is available

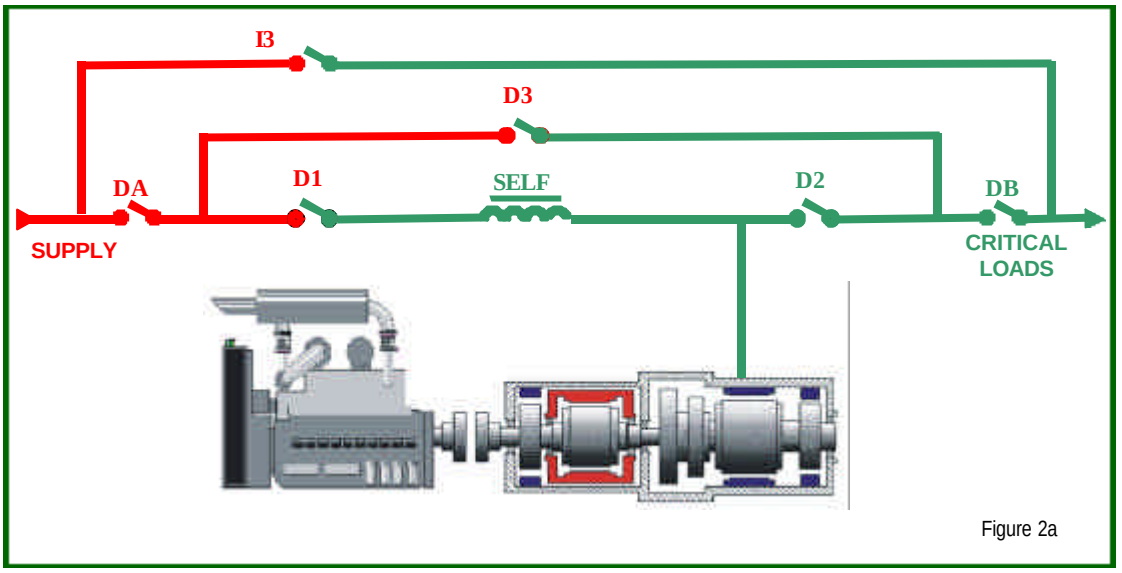


Figure 2a

During "Normal Operation" (mains supply available), the input (D1) and output breakers (D2) are closed, the automatic by-pass (D3) is open and the system supplies power to the critical loads via No-Break KS® System.
The synchronous alternator acts as a motor. The shaft of the stato-alternator rotates at 1500 rpm while the kinetic energy accumulator is held at a speed of 2950 rpm.

During this "Normal Operation", which usually represents 99.9% of the operating cycle time, the No-Break KS® System:

1. ELIMINATES ANY MICRO-BREAKS

All micro-breaks with a duration of less than 50 milliseconds are eliminated by the system, even under 100% load, and without starting up the diesel engine.

2. REGULATES THE SYSTEM VOLTAGE

Whenever there are fluctuations in the system voltage, the electronic voltage regulation system acts on the excitation current of the synchronous alternator. The voltage supplied is automatically maintained at ± 1% of its set value. Any variation in the supply voltage greater than ± 10% causes the input breaker to be opened and the diesel engine to start.

3. IMPROVES THE POWER FACTOR

Overexcitation of the synchronous alternator provides all the reactive power consumed by the load. This means that the power factor for the whole system is close to unity. The synchronous alternator is acts a perfect substitute for having the critical loads connected to a bank of condensers, while at the same time avoiding all their associated problems.

4. FILTERS OUT TRANSIENT PHENOMENA

The "inductance – synchronous alternator" system separates the system and the load when rapid or harmonic transient phenomena occur.

On the one hand, the load is protected from disturbances in the mains power supply voltage (overvoltage from lightning strikes, switching spikes, voltage harmonics etc.) and, even in the case of a very disturbed mains, allowing the loads to benefit from a very high quality supply.

On the other hand, power consumption peaks (motor starts, short-circuits etc.) and the harmonic currents caused by the load (in the event of non-linearity) are filtered out by the No-Break KS® System. Pollution of the supply by the critical load is thus greatly reduced.

All these “Power Quality” functions are provided while at the same time the system operates at very high efficiency levels (93 to 96,4% according to the exact model): in fact, the active power consumed by the load does not pass via the synchronous alternator (which operates simply as a free-running motor).

Chapter 3: Operation when power supply is disrupted.

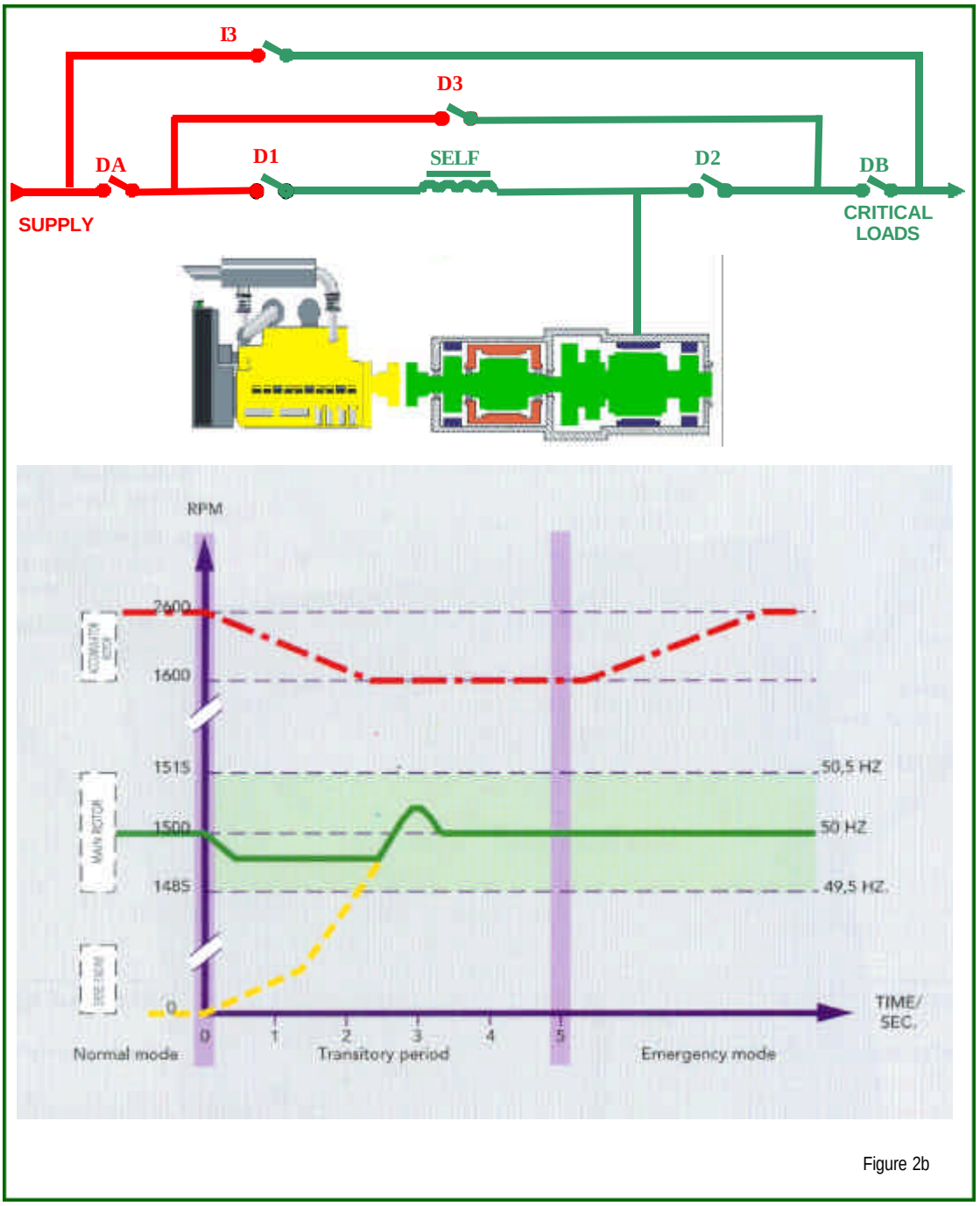


Figure 2b

During normal operation (mains supply present):

- The diesel engine is stopped (clutch open)
- The shaft of the stato-alternator turns at 1500 rpm.
- The kinetic energy accumulator turns at 2950 rpm.

The input breaker opens as soon as a failure in the mains power supply is detected.

Instantaneously, the synchronous alternator which was operating as a motor reverts to an alternator while the control panel modulates the inductive coupling between the main shaft and the accumulator rotor, the supply to the critical loads is maintained without any major disturbance to the voltage (less than 5 % in voltage value and less than 1 % in frequency).

At the same time that the input breaker opens, the electric starter motor cranks over the diesel engine.

Approximately one second later, the electromagnetic clutch slowly closes, thus establishing a mechanical link between the diesel engine and the stato-alternator.

The diesel engine rapidly takes up the load and the electronic speed governor holds the speed constant, supplying the mechanical power needed for the active electrical power required by the load.

From this moment onwards, the kinetic energy accumulator is progressively brought back to its set speed.

Once the mains power supply returns to normal, and provided that the kinetic energy accumulator has come up to speed, the system returns to normal operation. The diesel engine runs without any load in order to cool before shutting down.

GUARANTEE THAT THE DIESEL ENGINE WILL START

Experience gained in the field of generators demonstrates that one of the weak points in their application is the absence of any guarantee that the diesel engine will start. The causes of these starting failures are normally starter motor defects, battery fault, maintenance problems etc. The No-Break KS® System solves this weak point with an original solution providing a redundant start-up sequence.

Even if the diesel engine does not start when the input breaker has opened, the clutch will still close and mechanically connect the stato-alternator to the diesel engine. The kinetic energy accumulator then forces the diesel engine to start. This forced start-up sequence can occur occasionally and has no detrimental effect on the clutch or the diesel engine.

Chapter 4: Description of No-Break KS® Systems, type KS-SB

The No-Break KS® Systems comprise synchronous alternators that are largely oversized. This means that by modifying the diesel engine and the clutch it is possible to supply essential loads after a brief interruption. Normally the essential loads must not be greater than the critical load.

This type of KS-SB system allows a single system to supply a complete computer center (typically supporting computers, air conditioning, lighting, lifts, etc.).

Various configurations are possible:

Figure 3: No-Break KS® System, type KS-SB2

Figure 4: No-Break KS® System, type KS-SB1

Figure 5: No-Break KS® System, type KS-SB0

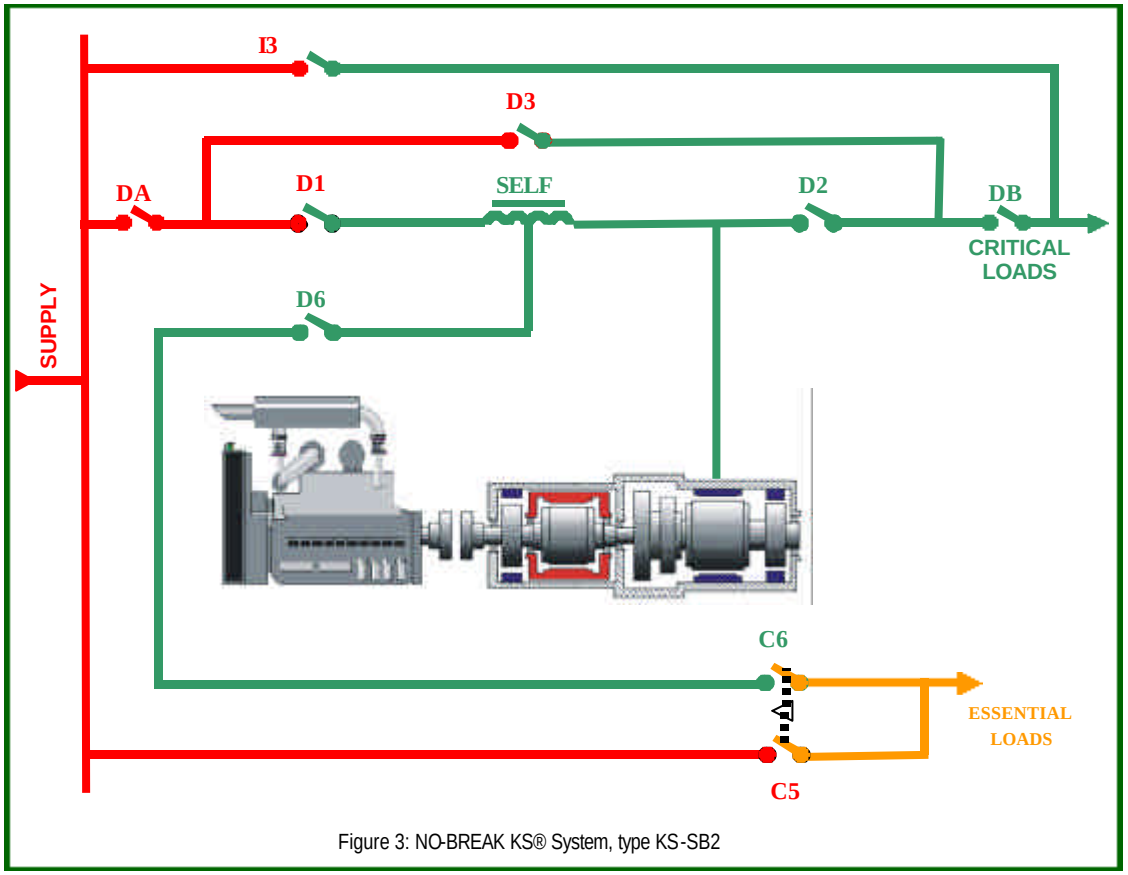


Figure 3: NO-BREAK KS® System, type KS-SB2

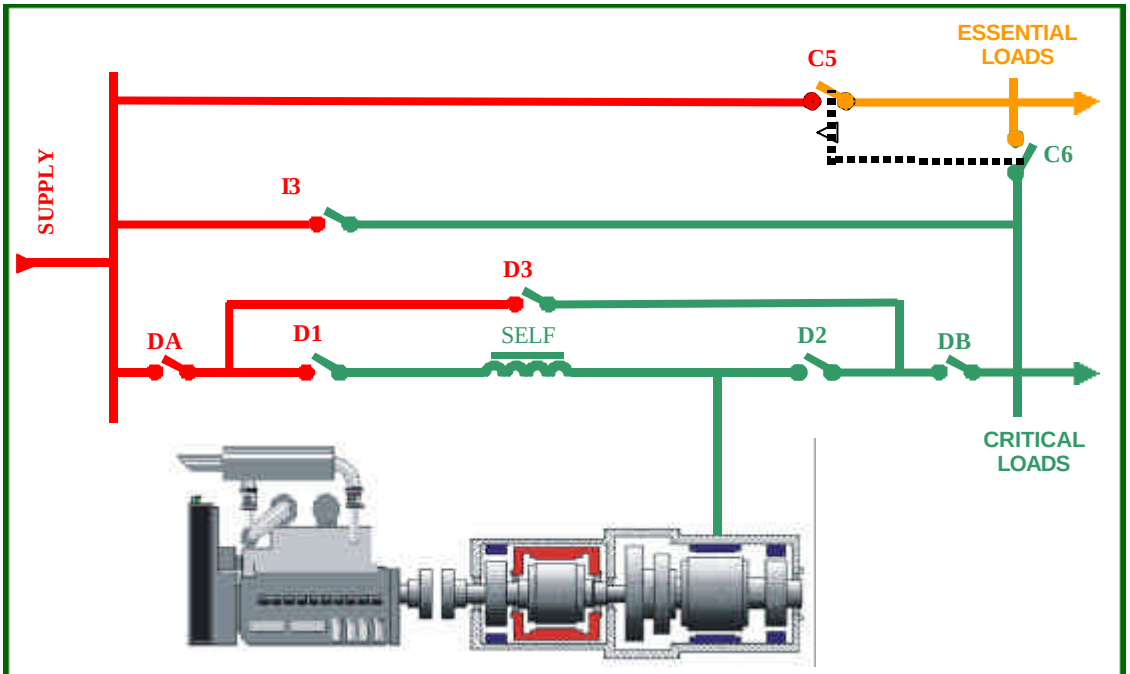


Figure 4: NO-BREAK KS® System, type KS-SB1

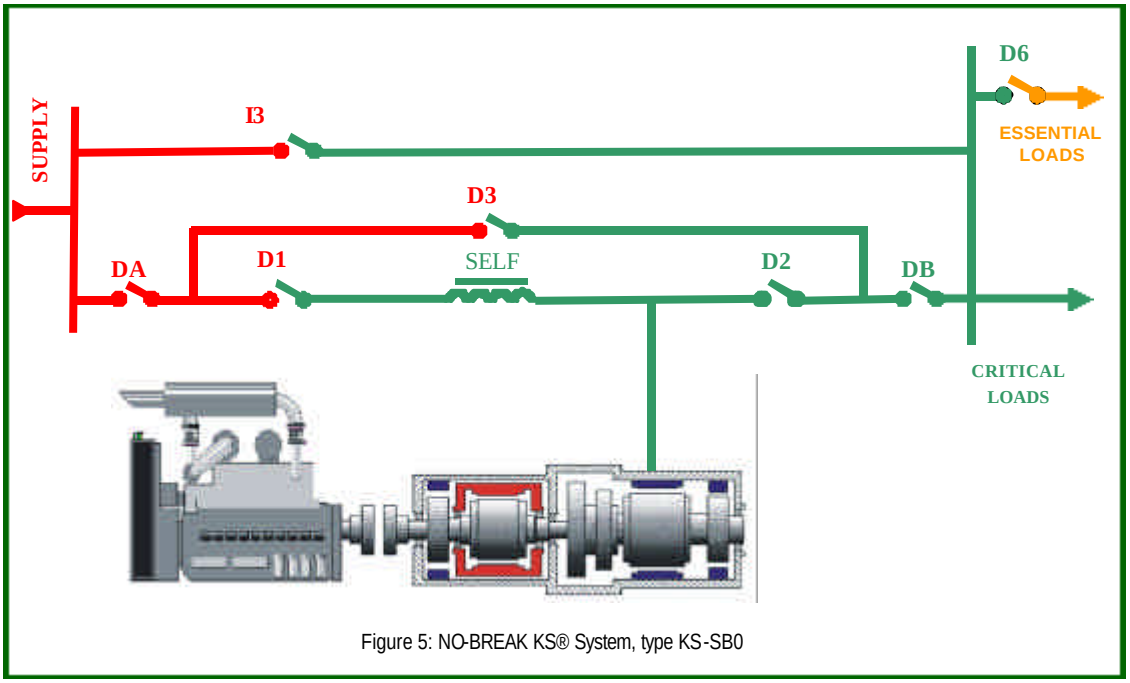


Figure 5: NO-BREAK KS® System, type KS-SB0

Chapter 5: Resilience

The aim of resilience is to create two sets of downstream breakers configured such that the failure of one has only a limited effect on the other.

Figure 6 shows how this aim is achieved in the case of a No-Break KS® system.

It should be noted that this resilience can be usefully exploited by the incorporation of static switches allowing a critical load to be supplied from two almost independent breakers.

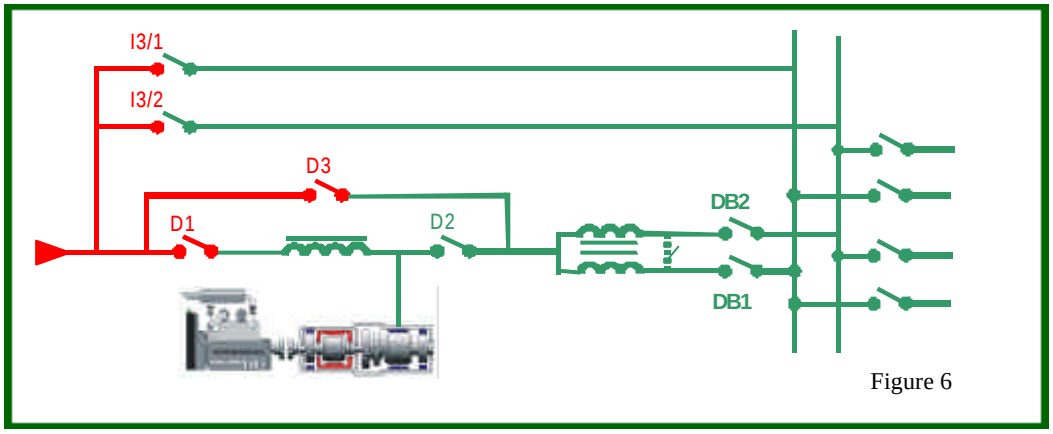


Figure 6

Chapter 6: "Single-redundancy" type installations

The No-Break KS® Systems can be combined in order to create a "single-redundancy" type installation, as shown in figure 7.
In this type of installation, the redundant No-Break KS® system may be used to instantaneously substitute for any other system.
As a variation, the essential loads can also be connected to each of the down stream breakers.

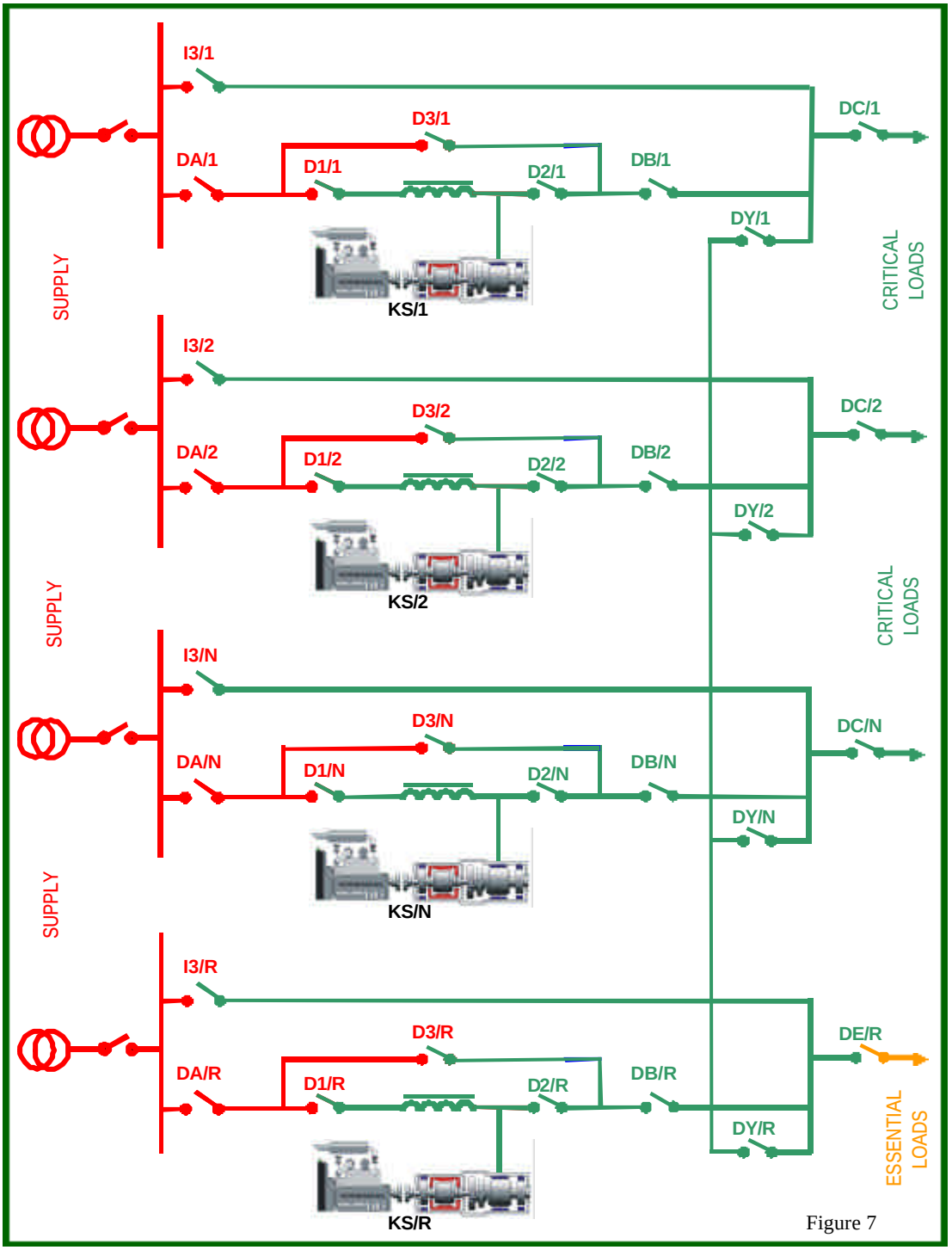


Figure 7

Chapter 7: Parallel installations

1. PARALLEL CONNECTION OF SEVERAL No-Break KS® SYSTEMS
   The No-Break KS systems and the type KS-SB No-Break KS systems can be installed in parallel (figures 8a and 8b). This layout allows the installation to be easily adapted to the load and to evolve with it. In parallel systems, the maximum power that the installation can provide is equal to N times the nominal power rating of a single system (N being the number of systems installed in parallel).

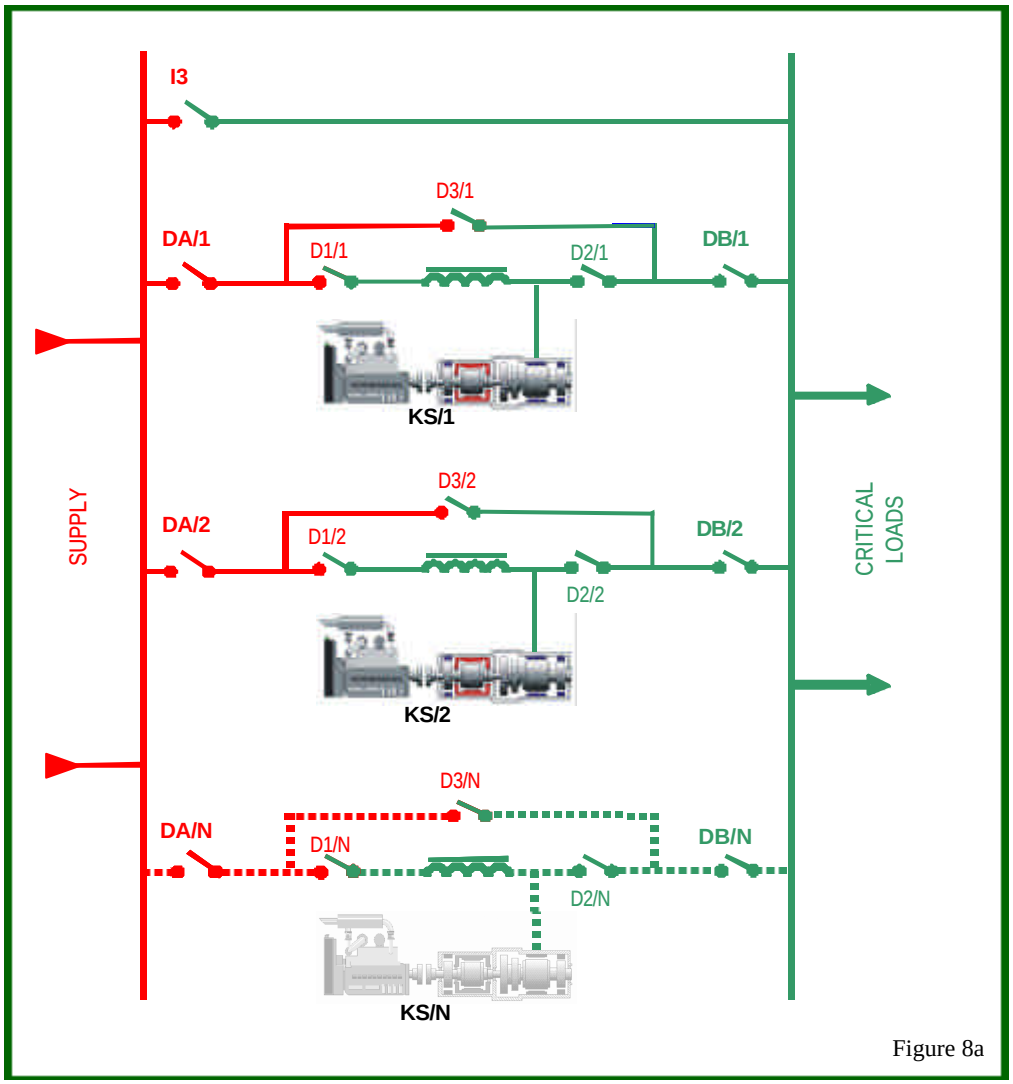


Figure 8a

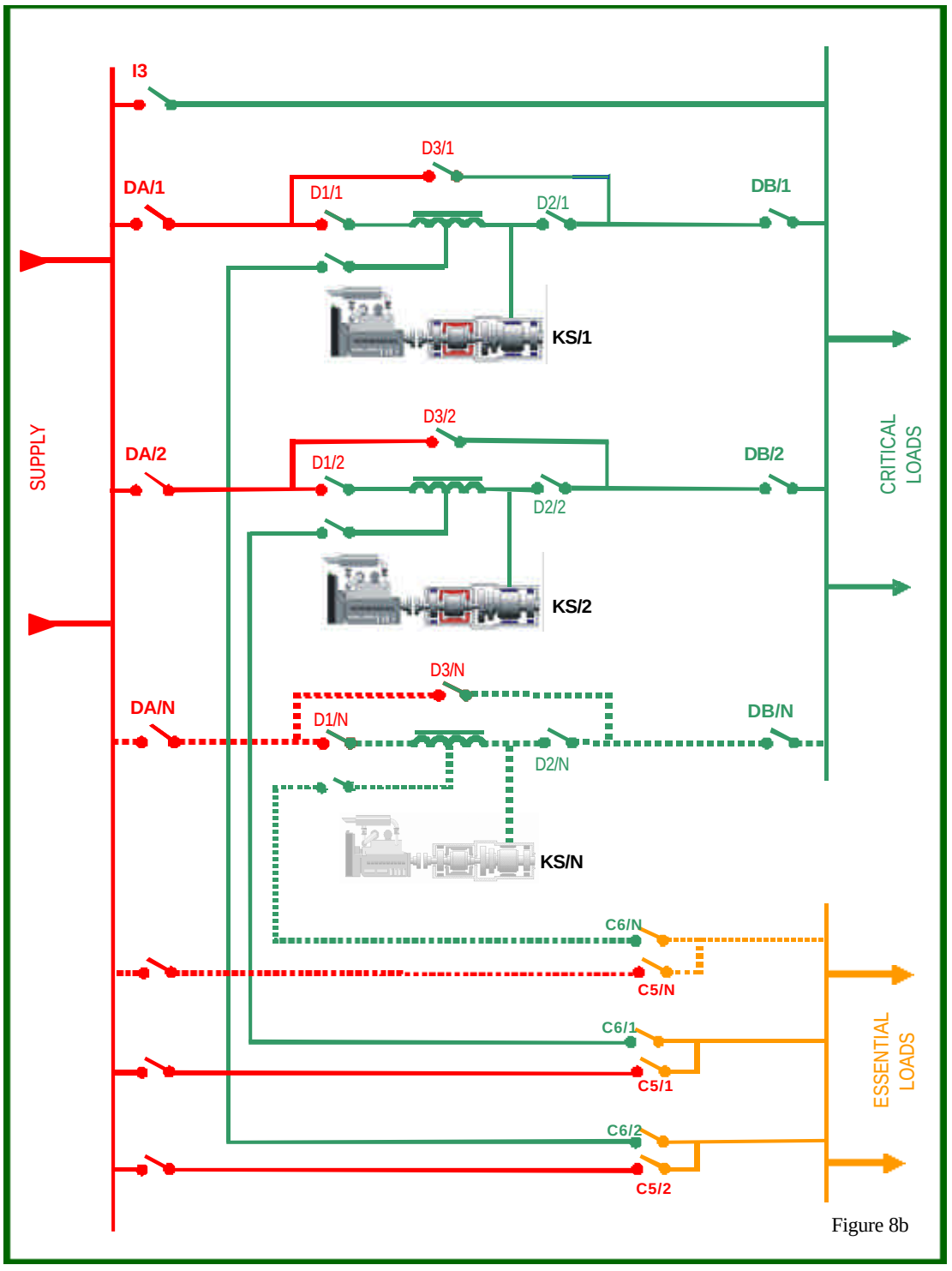

I3
D3/1
DA/1
D1/1
D2/1
DB/1
KS/1
SUPPLY
D3/2
DA/2
D1/2
DB/2
D2/2
CRITICAL LOADS
KS/2
D3/N
DA/N
D1/N
DB/N
D2/N
KS/N
C6/N
C5/N
C6/1
C5/1
C6/2
C5/2
ESSENTIAL LOADS

Figure 8b

2. PARALLEL REDUNDANT INSTALLATIONS
Redundancy is achieved by installing one or more systems in addition to the N systems strictly necessary to supply the loads.

3. PARALLEL INSTALLATIONS (REDUNDANT OR NOT) WITH RESILIENCE
It is possible to install No-Break KS® systems in parallel each with a twin set of resilient down stream breakers (figure 9).

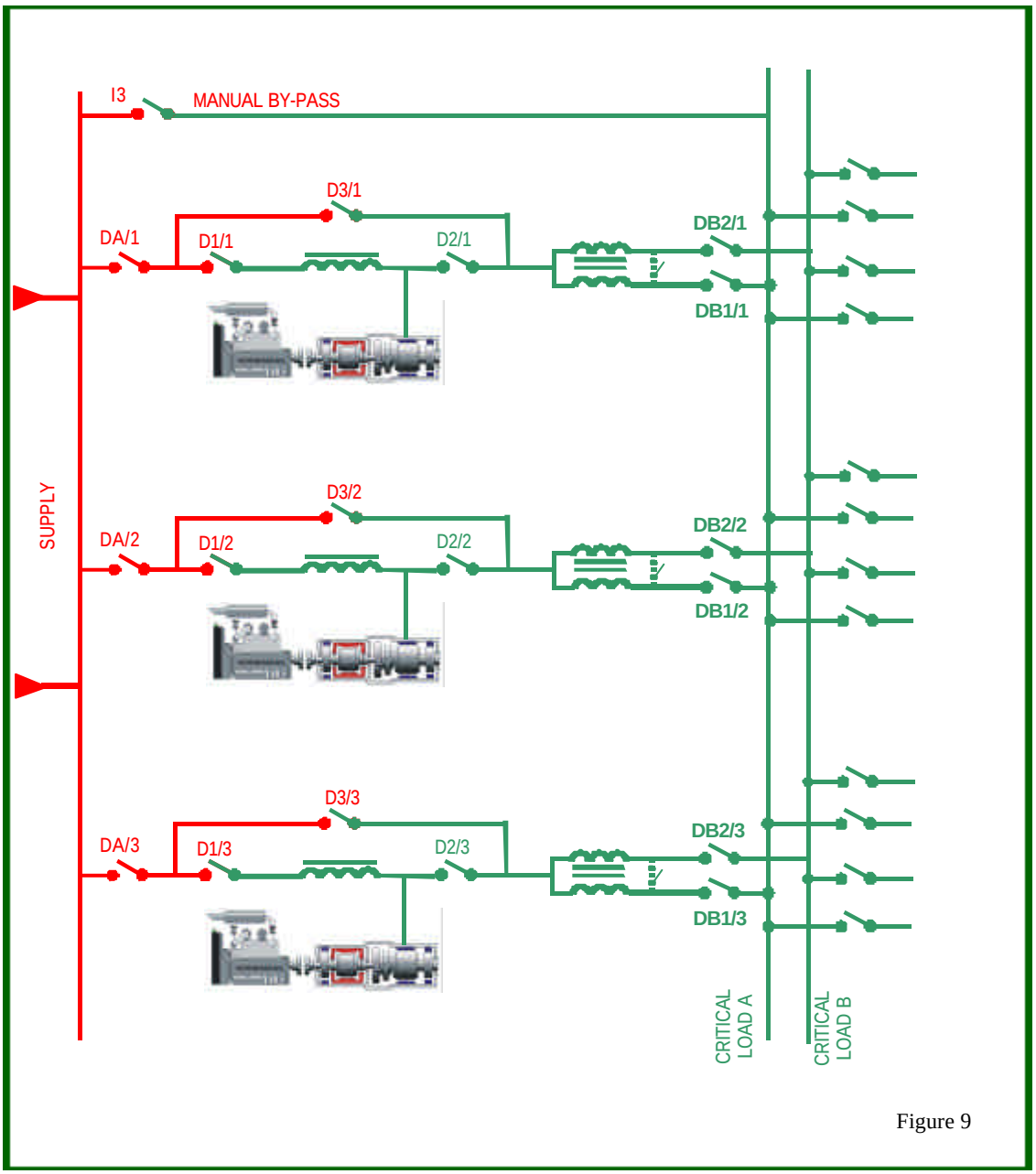


Figure 9

Chapter 8: Medium voltage No-Break KS® Systems

Where the supply is medium voltage (generally required for power ratings above 5 MVA), the No-Break KS® systems provide a technically superior solution (figure 10).

The inductance and the breaker components operate at medium voltage levels. Conversely, the low voltage stato-alternator is connected to the medium voltage via a reversible transformer.
One of the advantages of this solution is that under normal service operation a high level of efficiency is attained and therefore low operating costs are guaranteed.

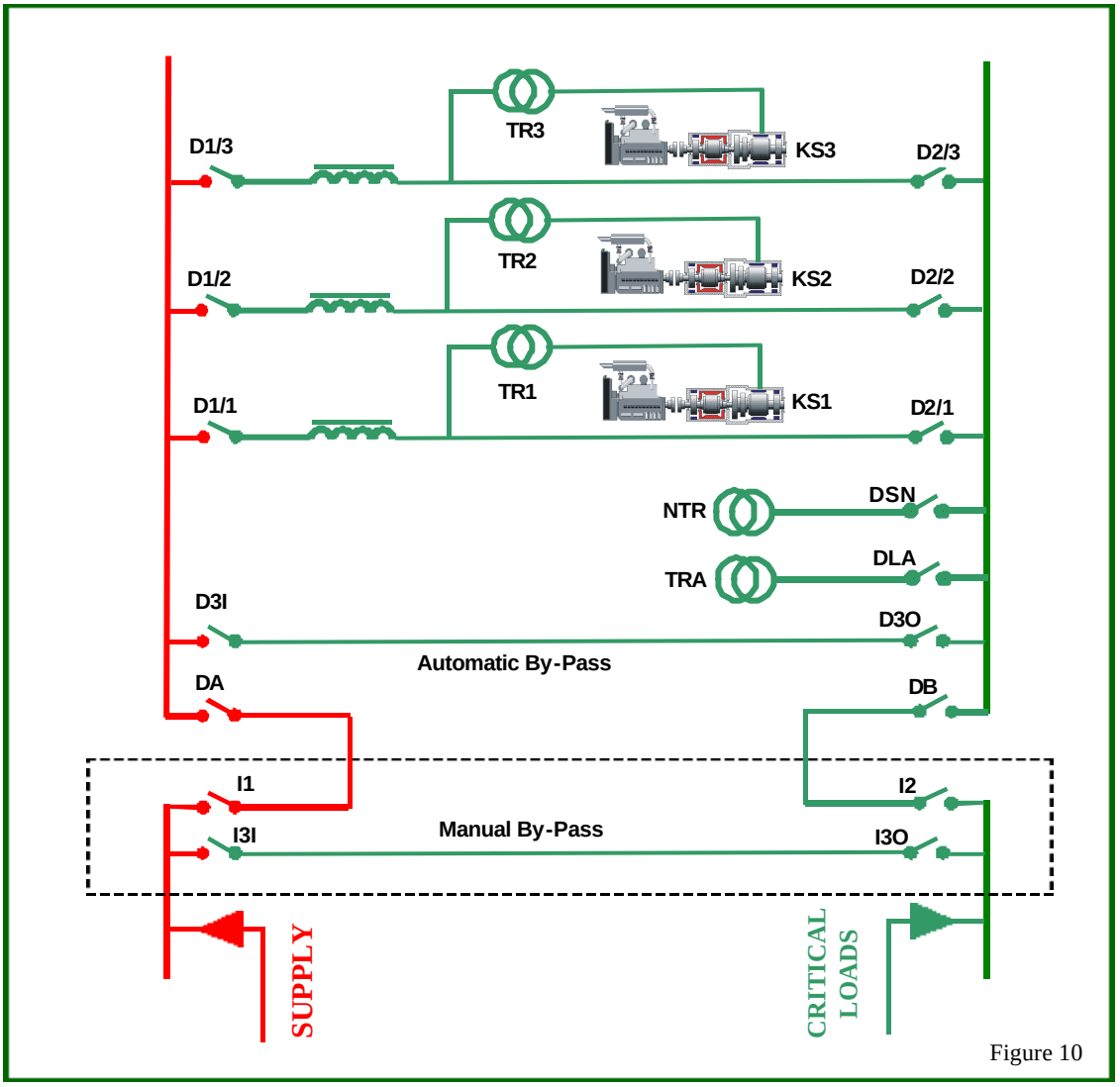
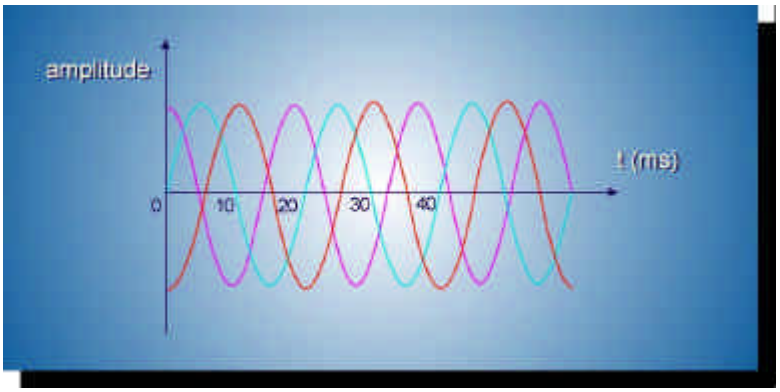


Figure 10

Chapter 9: Performance

SUPPLYING USERS WITH IDEAL VOLTAGE AND FREQUENCY VALUES



1. **VOLTAGE**

   1.1. Voltage regulation under steady state conditions .....± 1%
   1.2. Voltage variations induced by load steps of:
   - 10 %.....± 1%
   - 50%.....± 3%
   - 100%.....± 5%

   (The voltage is restored to ± 1% in less than 1 second)

   1.3. Temporary voltage variation during
   - Mains supply failure .....± 5%
   - Mains supply return.....± 1%

   1.4. Voltage regulation with 25% imbalanced load .....± 2%

2. **PHASE ANGLE**

- With balanced load: 120° ± 0 degree
- With 25% imbalance: 120° ± 1 degree

3. **FREQUENCY**

   3.1. Frequency regulation with steady state load .....± 0,2%
   3.2. Frequency variation induced by load steps of:
   - 10%.....± 0,5%
   - 50%.....± 1%

   3.3. Temporary frequency variation during
   - Mains supply failure and 100% of the load being taken up .....± 1%
   - Mains supply return.....± 0,2%

4. **EFFICIENCY**

In normal operation: 93 to 96.4 %

5. **OVERLOAD ALLOWED**

- In normal operation: 10% for 1 hour
  25% for 10 minutes [1]
  50% for 2 minutes [1]
- In emergency operation: 10% for 1 hour

6. **TOTAL HARMONIC LEVELS**

Less than 2% for a linear load

7. **SHORT-CIRCUIT CURRENT**

- Upstream: 3 In
- Downstream: 12 to 20 In

8. **RADIO INTERFERENCE**

Conforming to VDE – level K

9. **CERTIFICATE ACCORDING TO EMC DIRECTIVE**

[1] Percentage of rated output power

Chapter 10: Summary of main advantages

1. Reliability.
2. Monobloc unit.
3. Unique system, completely free of rings and brushes.
4. Absolute guarantee that the diesel engine will start using the kinetic energy of the accumulator should the conventional starting system fail.
5. Accumulation of kinetic energy before returning to normal service; this allows successive power supply failures to be handled.
6. Bearing replacement every 10 years.
7. Life of No-Break KS® System of at least 20 years.
8. A single unit to handle both types of load: critical and essential.
9. Service production able to cope with long term power supply failures.
10. Efficiency up to 96,4 % under full load which minimizes operating costs.
11. Small size and may be installed in an area without air conditioning and without anti-acid treatment.
12. Electrical control panel composed mainly of simple components (only 8 dedicated circuit boards).
13. Harmonic filtration and acceptance of deforming loads.
14. Elimination of micro-failures during normal operation.
15. Voltage stabilization at the terminals for the load.
16. Immune to up-line and down-line perturbations such as:
    Short-circuits
    Voltage spikes due to lightning strikes of operator error
    Calls for current
    Etc.
17. Automatic supply of reactive power, guaranteeing a power factor close to unity up-line of the No-Break KS® installation.
18. Operation and maintenance can be carried out by a technician without any special training.