

PRACTICAL CASE HISTORY : ISA CBA 1000 & CBA 2000 with BSG 1000

1. THE NECESSITY OF OPERATING SAFELY

The HV circuit breaker is the most important component of an HV substation, as it has the task, sometimes the terrible task, to remove the fault, no matter what is the fault current.

Even the nominal current could be difficult to be opened, as 2000 A on a 380 kV line means something close to half a Giga-Watt per phase; yet, this is not the worst case, when the current to be opened can be 20, 40 or even 80 times the nominal one. So,

when the matter of what should be tested in a substation is being discussed, nobody argues about the need of being pretty sure that the CB of the plant operate correctly.

On the other side, performing tests is an expensive task, demanding highly skilled engineers, strictly observed procedures, programming and a relevant test execution time. Laws and Standards dictate how the test should be performed in order to avoid any risk to people at work.

All this conflicts with the need of reducing time and the level of skill of people involved.

A frame agreement between ISA and RTE, the national French distribution company, has been signed since June 2008 for the supply of HV and MV circuit breaker analyzers. Both models CBA 1000 and CBA 2000 were supplied since then. In the next paragraphs the name CBA 1000 refers to both models.



1. CBA 1000 connected to BSG 1000

2. CIRCUIT BREAKER TESTING : BOTH SIDES CONNECTED TO GROUND

The most important tests performed on circuit breakers are:

- **main contacts timing:** it measures the opening and closing time of contacts. It must be the same for each of the three phases.

- **contact resistance:** it measures the contact resistance variations during the close movement.

The test set operates by injecting a test current across the poles, and measuring the voltage drop. If the pole is closed the voltage is zero; if it's open, the voltage is the circuit supply.

When the test set is connected, the operator safety is ensured by connecting to earth both sides of the test object. During the test, the safety grounding is removed at one side, because, otherwise, the test current would flow in the two ground connections: no timing test can be performed



2. Two breaks per phase circuit breaker connected to ground on both sides

This problem does not exist when performing contact resistance test, because the contact resistance is much less than the earth connections resistance.

This is the "de facto" practice, even if laws and standards would not allow it. The point is that when the contact is closed there is no risk, but when, during the test, the contact is opened, the risk is there: high voltage induction, no protection in case of fault.

Both Sides Grounded BSG 1000 is the answer to the need of operating safely when performing timing and synchronization tests, as it allows to connect to ground both circuit breaker sides.

3. ISA TEST SOLUTION

ISA for almost 70 years has been working side by side with power utilities personnel helping them performing their work safely and efficiently. ISA products can guarantee safe substation testing for the test engineers and, at the same time, they can make operation of utilities and service com-

panies more efficient. Our latest born equipments for testing Circuit Breakers, the CBA 1000 and CBA 2000 models, incorporate the main contact timing test and the contact resistance test, static or dynamic: this means reducing the test time. As all other test sets, time measurement cannot be performed unless only one side is grounded. Now they come along

with the BSG option, that stands for Both Sides Grounded, that allows to perform tests without removing the safety ground connections on both sides of the main contact. Working in this condition will bring all advantages described above, by removing the risk and the consequences of arc-flash and electrocution accidents.



3. BSG 1000 connected to CBA 1000 during a real test

The technology to measure the operating time of the circuit breaker, when it is grounded on both sides, is based on resistance measurement.

The BSG 1000 solution is based on **high current, short duration contact resistance measurement** :

- Current injection : at least 20 A ;
- Voltage measurement ;
- Resistance computing : the value of the resistance allows to un-

derstand if the contact is open or close.

In fact the resistance of an open contact is in the range of milliOhm, much more than a closed contact. BSG 1000 computes the resistance, allowing the performance of timing and synchroni-

zation tests.

The ground resistance can be programmed in two different ways : manually, by the operator, or automatically, thanks to TDMS software available on CBA 1000 and CBA 2000.

4. BSG SYSTEM DESCRIPTION

Two types of BSG1000 are available:

- **BSG 1000-1**, for testing one break per phase;
- **BSG 1000-2**, for testing two breaks per phase.

Each BSG 1000 is made of the following elements:

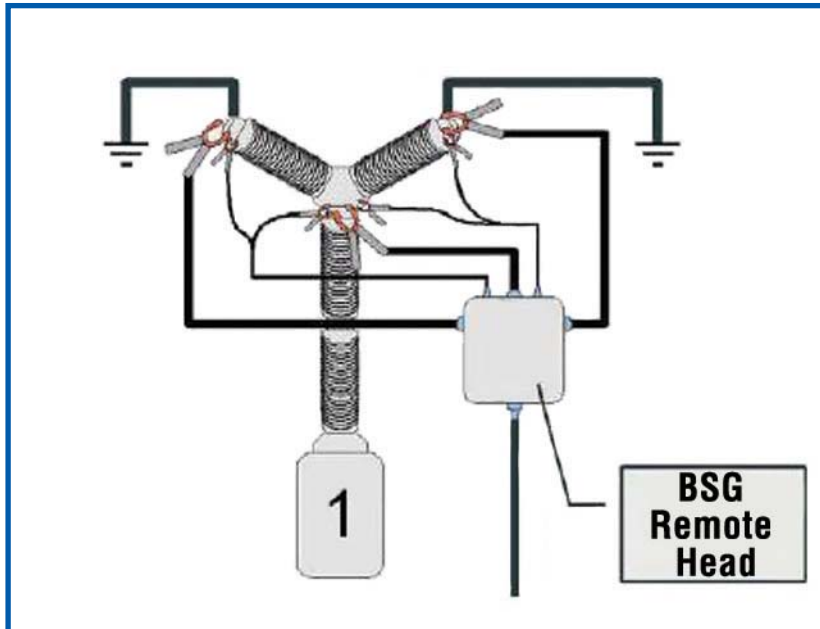
- **Three BSG Remote Heads**, types 1 or 2. They are connected close to the main breaker contact, and include the current generator and the two level resistance comparator, that communicates the result in digital form to the Main unit. Each head has two cables: one for the connection of the test current to the CT under test, and the other one (shielded) for the open / close detection of the CB contacts.
- **One BSG Main unit**, that includes the microprocessor supervising the heads, and the DAC's for CBA inputs. It is connected to the heads and to the CBA 1000 by a cable kit.



4. BSG 1000 - Remote Head, type 1

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5. Connection between circuit breaker and BSG remote head

This **connection scheme** shows how the BSG remote head is connected to the circuit breaker pole. High current connections are shown with bold lines in the picture, and the voltage measurement cables are shown with light lines .

5. CONNECTION BETWEEN CBA 1000/2000 AND BSG 1000

The connection is made of two cables.

- **Driving cable** : it allows to CBA

1000/2000 to drive the BSG 1000 module and gather, process and report test results.

- **Circuit breaker contact cable:** when connected, CBA 1000/2000 detects active poles. As the process of these data is numeric, all

contacts must be connected, even if some of them are not meant to be used during the test (for example, during a maintenance test of a single break per phase).



6. BSG 1000 connected to CBA 1000 during a test in a substation

Once the cables connection is performed, the test proceedings are identical to the ones used when using CBA 1000/2000. The timing measurement is simpler as BSG 1000 interface is easier for the operator. The test setting and the result reading is allowed by the local control and the wide graphical display, available of the front panel on CBA 1000/2000.

Both CBA 1000/2000 and BSG module were designed and manufactured to be fully ope-

ration and easy to use in severe environment and substation conditions.

Besides, the coil control, which allows to open and close the circuit breaker coils, is BSG independent. Its connection is the same as CBA 1000/2000 operated alone.

Furthermore, the extreme and severe conditions (EHV substations) are not issues to be worried about when using these test equipments. For further information, please refer to the technical specifications.



7. Operator using CBA 1000 in a substation test

6. BSG REMOTE HEADS CONNECTION TO THE CIRCUIT BREAKER POLES

The three BSG remote heads must be connected to each circuit breaker pole. BSG remote head can be easily connected thanks to a multipolar connector and to four measurement clamps. They can be described as follows :

- **Injection clamps** (red and black) : clipped to the poles to be tested, they create a closed ring and generate the current needed to perform the test.

- **Measurement clamps** (red and black) : their task is to measure the voltage drop of the circuit breaker contact.

As the test is a resistance test, it's mandatory that their contact point is as closer as possible to the circuit breaker break in order to avoid stray voltages.

It's very important to take care of the connection direction : during the test, the measurement clamps must be positioned inside the current ring created by the injection clamps.

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8. BSG remote head connection to a circuit breaker by crocodile clamps

7. CIRCUIT BREAKER CONNECTION

The cable connection is the most relevant issue when performing a test with microhmmeter. The measured voltage values are small (mV) and a high accuracy is hence needed. The final result can be influenced by disturbing elements such as contact oxidation and unstable contact.

We strongly recommend you to be aware of the importance of a good connection, else the results can be wrong or difficult to be understood.

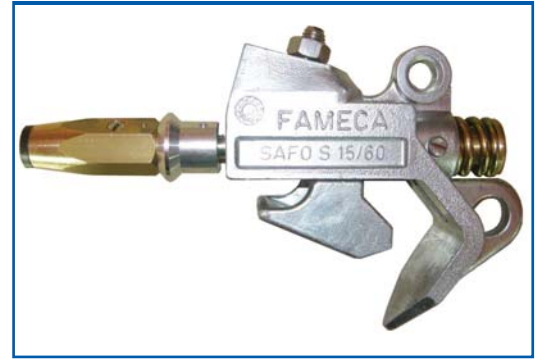


9. Clamps terminated by crocodiles supplied with BSG 1000, in action during a real test

BSG is always supplied with clamps terminated with crocodiles, which can assure a strong and tight lock on the contacts. When properly fit, the operator can perform the test being sure that oxidation won't cause any problems or wrong results.

Unfortunately, this kind of clamp can't be mounted directly from the ground. This is why ISA can provide other clamps, which are :

- **SAFO clamp** : thanks to its telescopic bar, it can be directly mounted and connected to the circuit breaker contacts. It also squashes the pole oxidation when being installed. Besides, the locking system assures a good accuracy and stability of the contacts during the test.



10. SAFO clamp

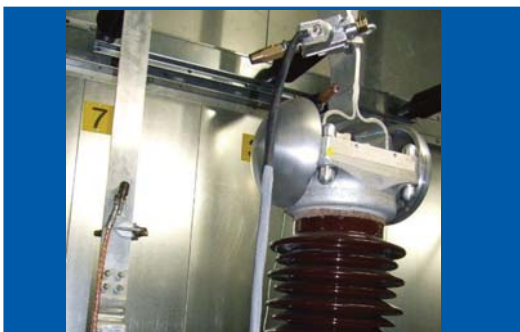
- **Arc clamp**: thanks to its hooks, the operator can easily connect it to the circuit breaker poles from the ground. The steadiness and performance are perfectly guaranteed. The most important characteristic of this kind of clamp is that it perfectly fits any circuit breaker. The operator has to pull the clamp cranks to get a good connection and avoid oxidation problems.



11. Arc clamp with connection cable (without telescopic crank)



12. Arc clamp mounted on a real circuit breaker (with telescopic cranks)



13. SAFO clamps used for the equipment in AMEPS Béziers

These two type of clamps were **validated on site by RTE and by CNER during the tests performed in 2009 and 2010**. EDF test sets are equipped with these clamps and perform this kind of connection on regular basis.

As you can easily understand, **connection is hence the most important issue when performing tests on circuit breakers**. If the connection is not accurate, you may get misleading or even wrong results.

The operator can use BSG 1000 with other connection clamps, if they can assure an accurate connection to the breaks. The choice depends on the type of circuit breaker to be tested.

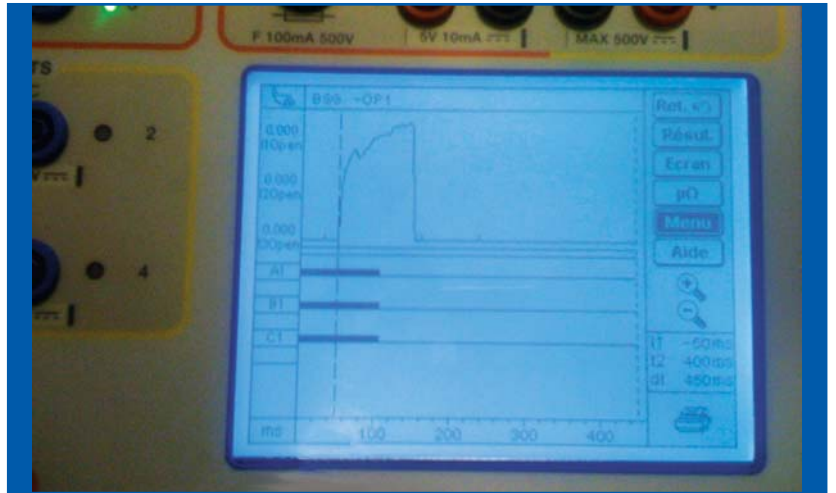
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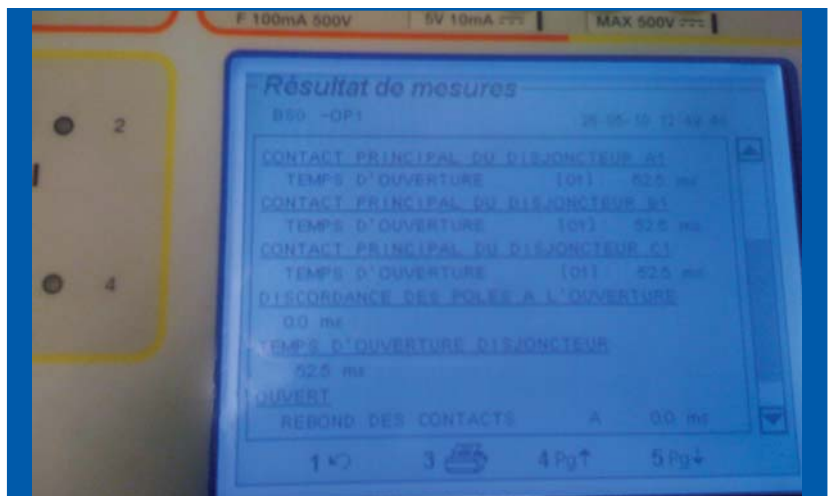
8. RESULTS ON SITE

The synchronism test results obtained by BSG 1000 are the same obtained by CBA 1000/2000 alone. Even the results display and interpretation is identical. You can find below an example of an Opening cycle of an ALSTOM FL 245 circuit breaker, during an ordinary maintenance test, performed by BSG 1000 connected to CBA 1000.

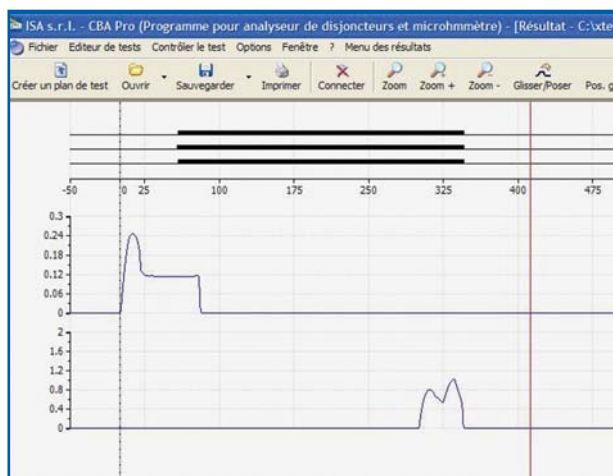


14. BSG 1000 test result : opening cycle

The display and the difference between open or close status contacts is the same of CBA 1000/2000.



15. Test result of an opening cycle



16. TDMS test result, ready to be saved and printed

All the results displayed on CBA 1000/2000 screen can be easily saved and exported by the operator. Results can be saved in the local memory or in the USB key supplied with CBA 2000. They can be uploaded in a notebook or PC and processed by TDMS software, licensed together with CBA 1000/2000. Then, test results can be saved and printed.

9. CONCLUSION

The most important advantages obtained by the use of BSG 1000 is the possibility of performing test safely, thanks to the double ground connection of

the circuit breaker and the accurate yet simple connection to the circuit breaker.

10. REFERENCES

The pictures of this document were taken during a real maintenance test performed in Niort substation (GET Nord-Ouest) in March 2010. The tested circuit breaker is Alstom FL 245 model.

ISA – User manuals : CBA 1000, CBA 2000 & BSG 1000

ISA – Application manuals : CBA 1000 & CBA 2000

ISA – Technical specifications : CBA 1000, CBA 2000 & BSG 1000



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