The Behavior of the Algerian Network after the Loss of a VHV Substation

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ABSTRACT
Maintaining consistency in terms of electricity supply capacity should be the aim of any research in this area. Hence the concern of maintaining the stability of this great production-transport-distribution system, even when low probability major disruptions is to occur. The study of the operation of the national grid shows that it is adequately equipped to cope with such disruptions. Thus, the oscillations observed at that level are quickly reduced and hence the interconnected system maintains synchronization in case of loss of a VHV substation.

Keywords
Electrical network; protection; electrical interconnection; loss of synchronism; stability

1. INTRODUCTION
Several factors, both endogenous and exogenous, push the whole system with its different components to its limits of stability. Increasing loads, distances between the various centers of production, the state of transmission and consumption centers are the most notable. In these cases, power outages damaging for both for operators and consumer, may occur. [1] [2]

In this paper we describe a case study carried out at the level of the Department for Study and Forecast of the STATE COMPANY OF ELECTRICITY AND GAS (SONELGAZ) which includes the Algerian National Dispatching. The purpose of this paper is to show that the simulation of the loss of VHV substation determines the interconnections VHV substation role in improving the quality of service for the national network. [3] [4]

We would underline the importance of the present work on its application at any kind of renewable energy sources dotted with its proper substation connected to the main network. As the Algerian network is itself integrated to a higher network (the Mediterranean network), our present study is applicable to the whole.

2. IMPORTANCE OF THE ELECTRICAL NETWORK PROTECTION FOR ENERGY SUPPLY
A relay showing a faulty behavior can lead from a failure of some consumers to reach the population of an entire city, including sensitive facilities such as hospitals, fire etc ....

In case of a power outage of about 10 MW for a duration of 6 minutes it won't only mean a loss of 1MWh unsold energy, but several hours necessary for the manufacturer to restart. But it is mainly a disgruntled consumer who would have lost many hours of production or even in some cases an irreversible loss of some of his equipment consequently to this incident. [5] [6]

3. STUDY AND ANALYSIS OF OPERATION OF 400KV NETWORK

3.1 The SICRE Simulator
The purpose of the SICRE program is to provide the larger numbers of users with useful tools for analyzing, monitoring and training. It includes a set of simulation functions and analysis that can represent the dynamic behavior of power systems on different time scales in both normal conditions in emergency situations. From the point of view of its components modeled to a high degree of accuracy, the kit is fairly complete in that it shows the efficiency of algorithms as it is designed, based on the most advanced SW/HW technologies. Main application fields of SICRE:

3.1.1 Analysis and control
Evaluation of the overall performance of the system through dynamic analysis and daily control during planning and operational stages of functioning. .Reconstitution of serious incidents to better understand the dynamic of phenomena and events and to check the system components (protections, controllers, etc ...) and behavior.

Design and verification of new automatic defense actions to avoid incidents that have already occurred, or prevent further coming incidents or limit and / or master their consequences.

Checking restoration procedures.

3.1.2 Training
Simulation of scenarios aim at improving the comprehension of dynamic phenomena for training sessions addressed to system engineers and CC operators.

Simulation of scenarios of emergency conditions or restoration phases for accustoming operators to face critical operating conditions.

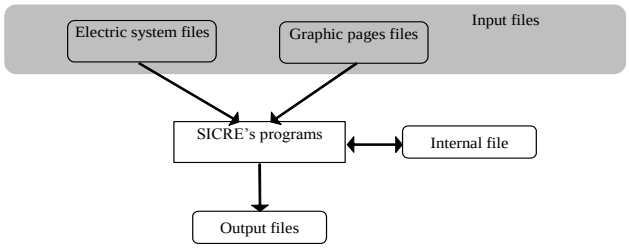

Fig 1: Schema of software SICRE [7]

3.2 Operating Criteria

3.2.1 Normal Situation

- +/- 5% on the 400 kV, (420 kV).
- +/-7% on the 220 kV.

3.2.2 Incident Situation

- +/- 5% on the 400 kV, (420 kV)
- +/-10% on the 220 kV.

3.3 Network configuration

It was considered the network to which are added the works for winter 2009.

Table 1. maximum powers called for 2009. [8]

Year	power (MW)
2009	7300

To determine the stability of the Algerian 400 kV network for the peak winter 2009, we use the software SICRE and the following simulations we carried out: [9] [10] [11]

The Behavior of the National Network after the loss of a VHV substation (all departures open).

4. RESULTS OF THE SIMULATIONS

4.1 Normal Situation

In a normal situation, the network operates without constraints. Voltages at 400kV substations and active transits (MW) on the lines 400kV are presented on the following figures:

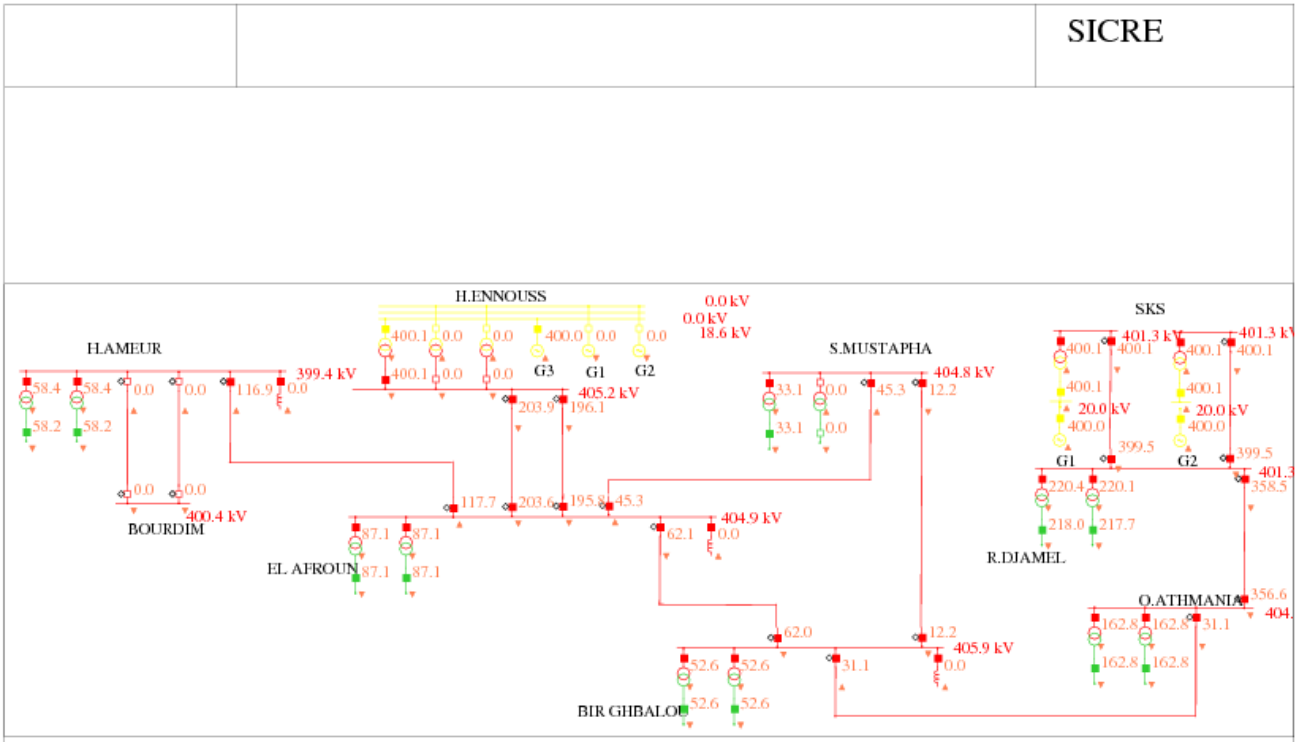

Fig 2: Voltages at 400kV substations and active transits (MW) on the 400kV lines

4.2 Loss of 400/220kV Substation at Ramdane Djamel (all departures open)

The loss of this substation does not cause loss of synchronism of the interconnected system

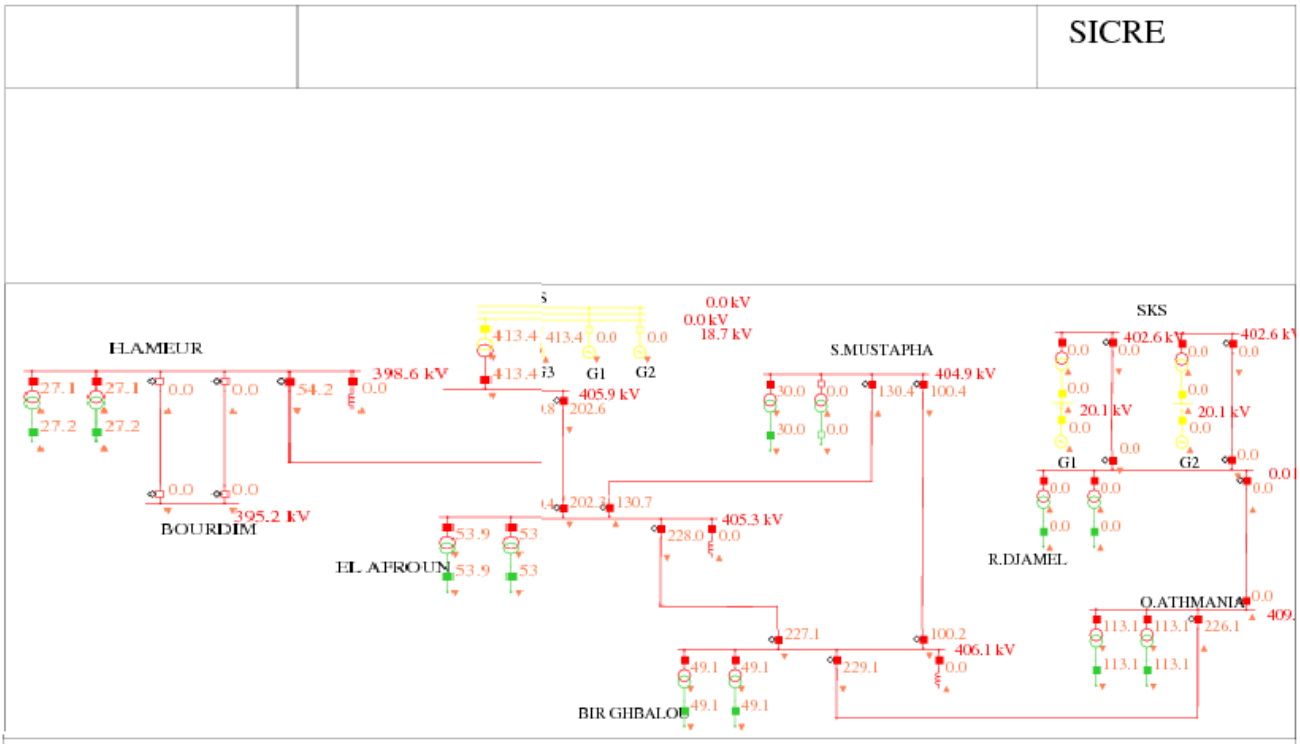

Fig 3: Voltages at 400kV substations and active transits (MW) on the 400kV lines

4.3 Loss of 400/220kV Substation at Oued Athmania (all departures open)

The loss of this substation does not cause loss of synchronism of the interconnected system

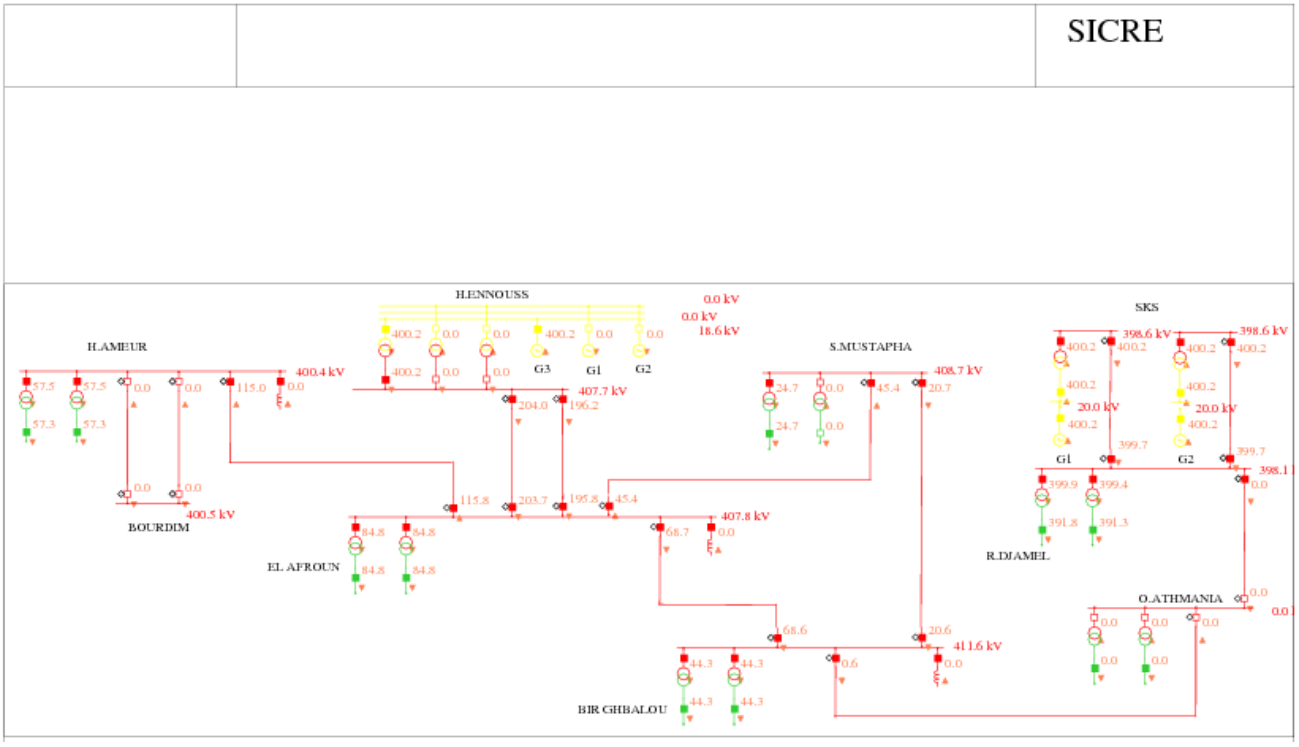

Fig 4: Voltages at 400kV substations and active transits (MW) on the 400kV lines

4.4 Loss of 400/220kV Substation at Bir Ghbalou (all departures open)

The loss of this substation does not cause loss of synchronism of the interconnected system.

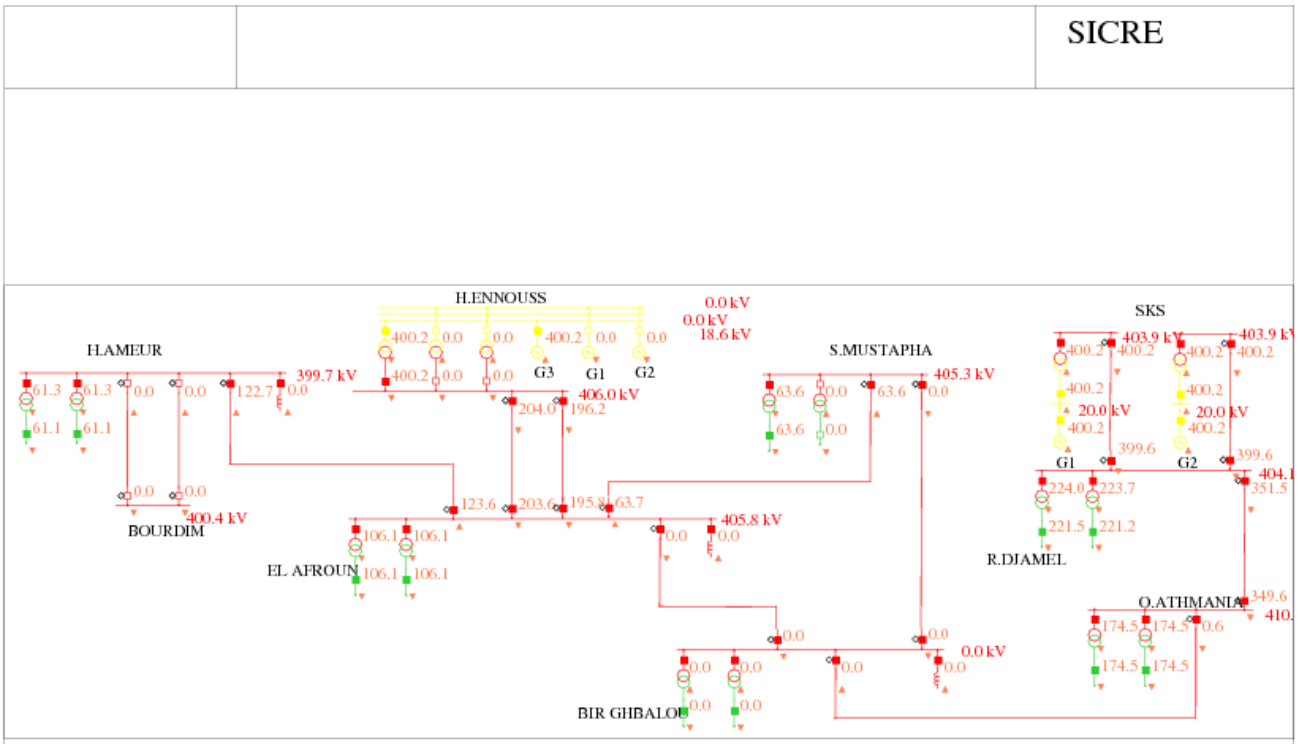

Fig 5: Voltages at 400kV substations and active transits (MW) on the 400kV lines

4.5 Loss of 400/220kV Substation at Si Mustapha (all departures open)

The loss of this substation does not cause loss of synchronism of the interconnected system.

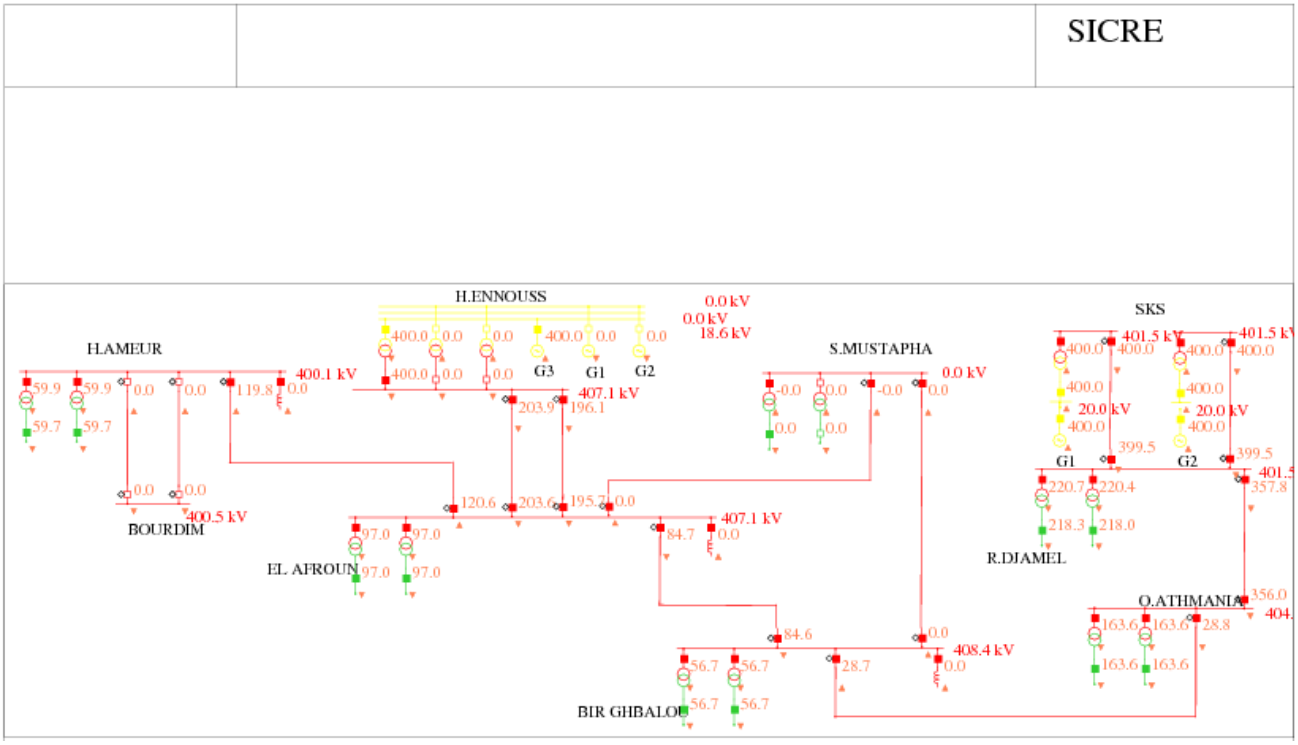

Fig 6: Voltages at 400kV substations and active transits (MW) on the 400kV lines

4.6 Loss of 400/220kV Substation at El Afroun (all departures open)

The loss of this substation does not cause loss of synchronism of the interconnected system.

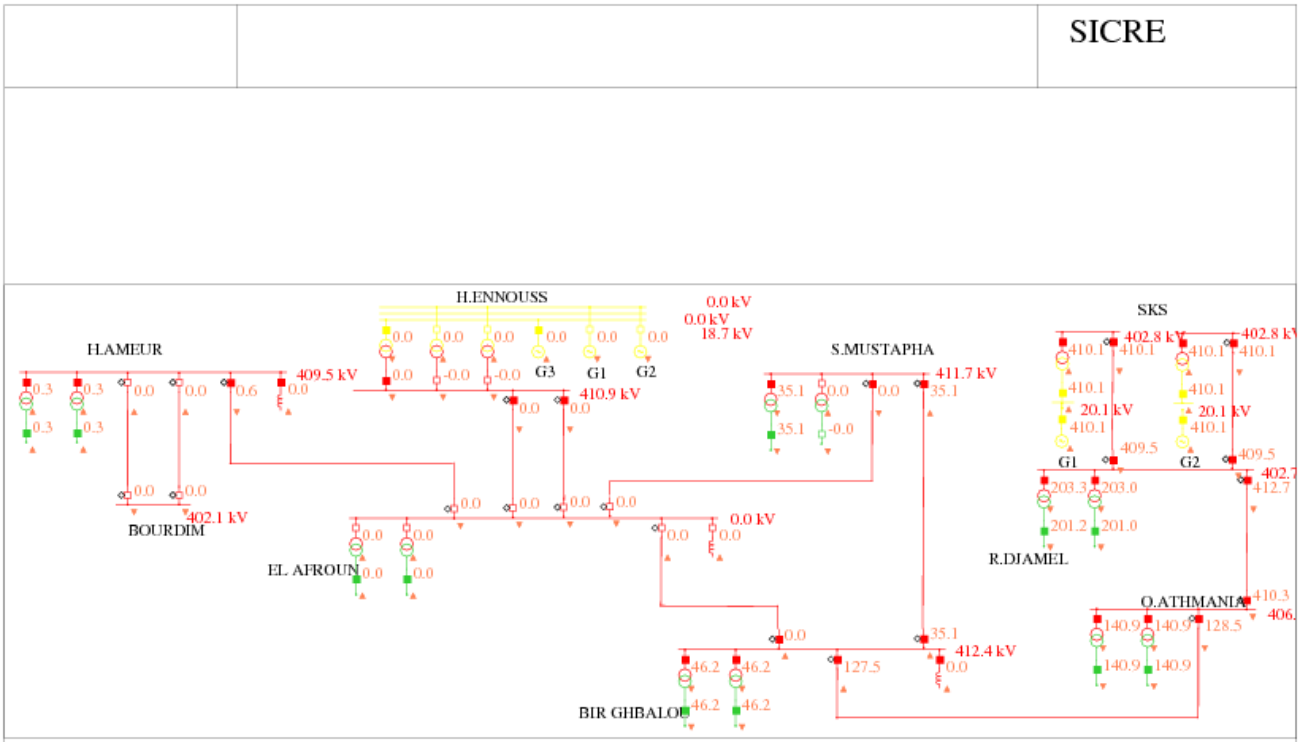

Fig 7: Voltages at 400kV substations and active transits (MW) on the 400kV lines

4.7 Loss of 400/220kV Substation at Hassi Ameur (all departures open)

The loss of this substation does not cause loss of synchronism of the interconnected system.

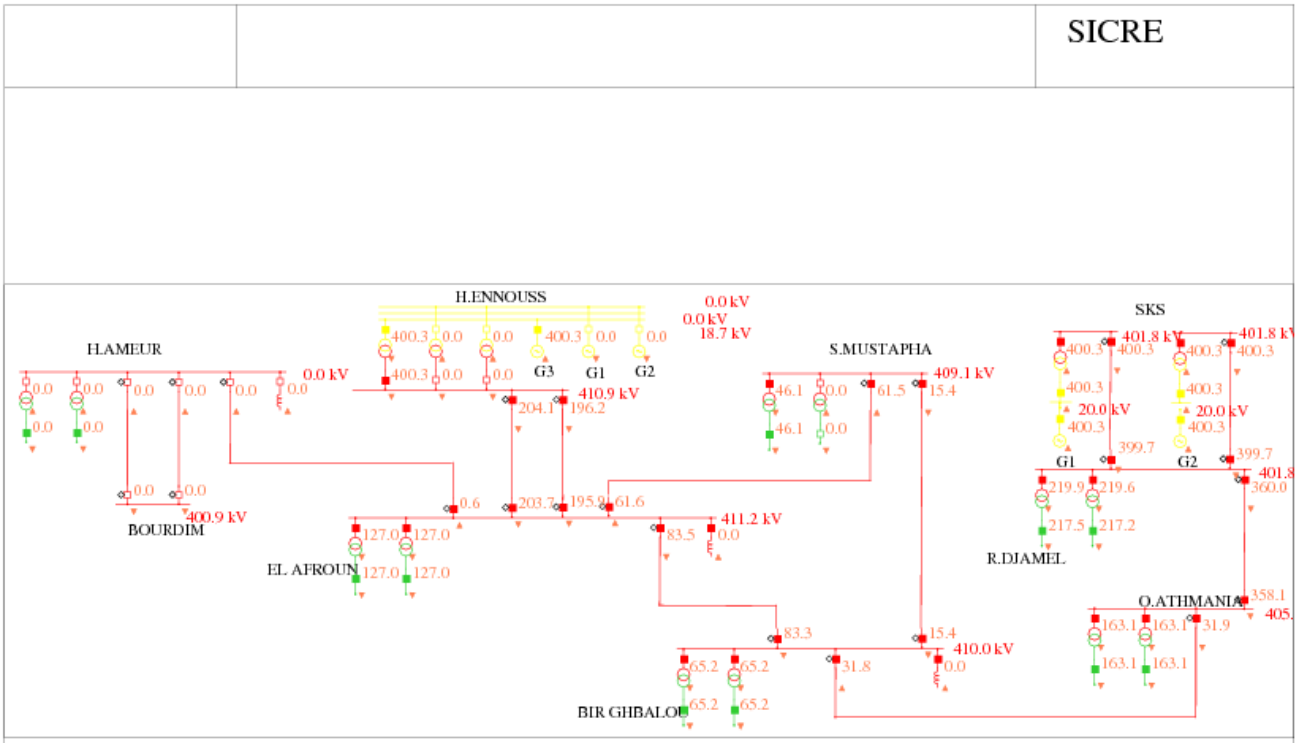

Fig 8: Voltages at 400kV substations and active transits (MW) on the 400kV lines

4.8 Simulation Summary

Table 2. voltages at 400kv substations

Loss of 400/220kV Substation (all departures open)	Substation	Voltage at 400kV substation
Loss of Ramdane Djamel Substation	Ramdane Djamel	0
	Oued Athmania	409
	Bir Ghbalou	406
	Si Mustapha	404
	El Affroun	405
	Hassi Ameur	398
Loss of Oued Athmania Substation	Ramdane Djamel	398
	Oued Athmania	0
	Bir Ghbalou	411
	Si Mustapha	408
	El Affroun	407
	Hassi Ameur	400
Loss of Bir Ghbalou Substation	Ramdane Djamel	404
	Oued Athmania	410
	Bir Ghbalou	0
	Si Mustapha	405
	El Affroun	405
	Hassi Ameur	399
Loss of Si Mustapha Substation	Ramdane Djamel	401
	Oued Athmania	404
	Bir Ghbalou	408
	Si Mustapha	0
	El Affroun	407
	Hassi Ameur	400
Loss of El Affroun Substation	Ramdane Djamel	402
	Oued Athmania	406
	Bir Ghbalou	412
	Si Mustapha	411
	El Affroun	0
	Hassi Ameur	409
Loss of Hassi Ameur Substation	Ramdane Djamel	401
	Oued Athmania	405
	Bir Ghbalou	410
	Si Mustapha	409
	El Affroun	411
	Hassi Ameur	0

The network operates without constraints. Voltages at 400kV substations are acceptable in the limits of permissible values +/- 5% on the 400 kV, (420 kV) and there is no overvoltage.

5. CONCLUSION

The objective of this work is to demonstrate the positive developments of the national network, especially the 400 kV. We demonstrated the power of electrical connection within the transmission substations of the National Network and, on the other hand, that any deficiency in power will be compensated directly from another transmission substation.

The main purpose of constructing of the 400kV network is to widen the electric national network as well as between the Mediterranean countries.

6. REFERENCES

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