



Electricity Authority of Cyprus

« A World-Wide learning case: The miracle of Cyprus energy system restoration after the Mari Catastrophy”

**“Ένα παγκόσμιας εμβέλειας μάθημα:
Το θαύμα της αποκατάστασης
του ενεργειακού συστήματος της Κύπρου
μετά την ολοκληρωτική καταστροφή στο Μαρί»**

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21st October 2017

The situation until the 11/7/2011 05:48 a.m.



- Summer 2011 - expected for prolonged heat wave.
- In July, we usually expect the maximum demand.
- Major development projects are in progress.
- Every day, 300-400 people were working at the VPS.



Electricity Authority of Cyprus

The situation after the 11/7/2011 05:48 a.m.



21st October 2017

SFESE 9th international conference – Nicosia , Cyprus

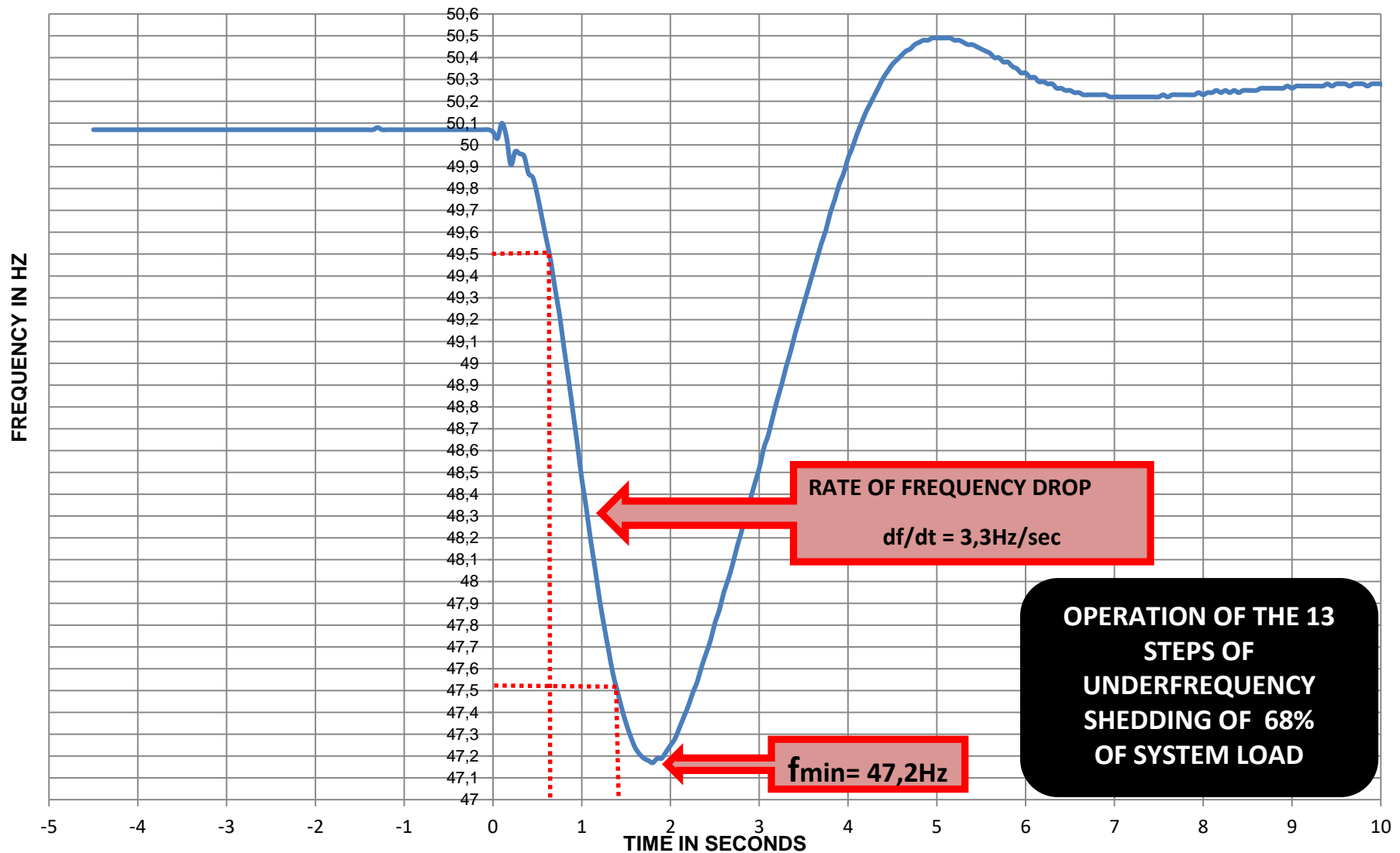
The situation after the 11/7/2011 05:48 a.m.



21st October 2017

FREQUENCY VARIATION DURING THE FAULT

11th JULY 2011 TIME: 05:48

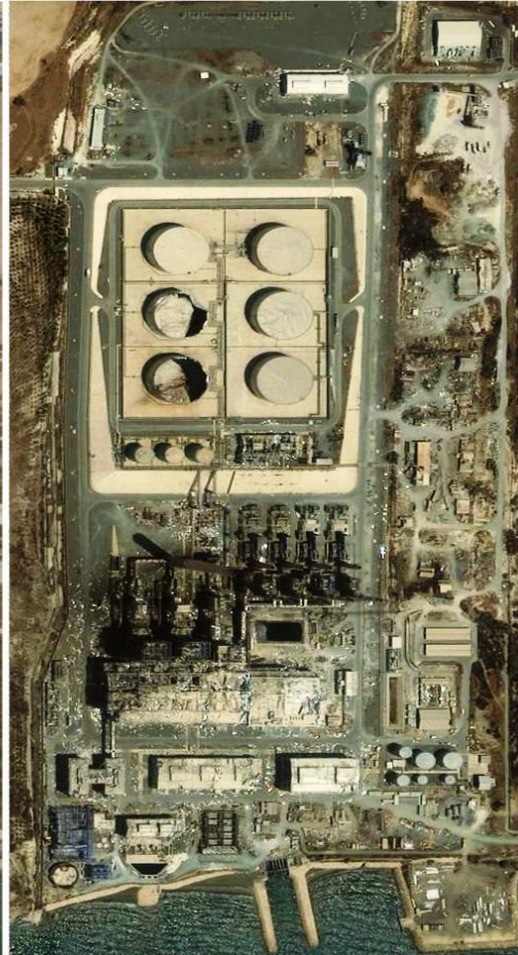


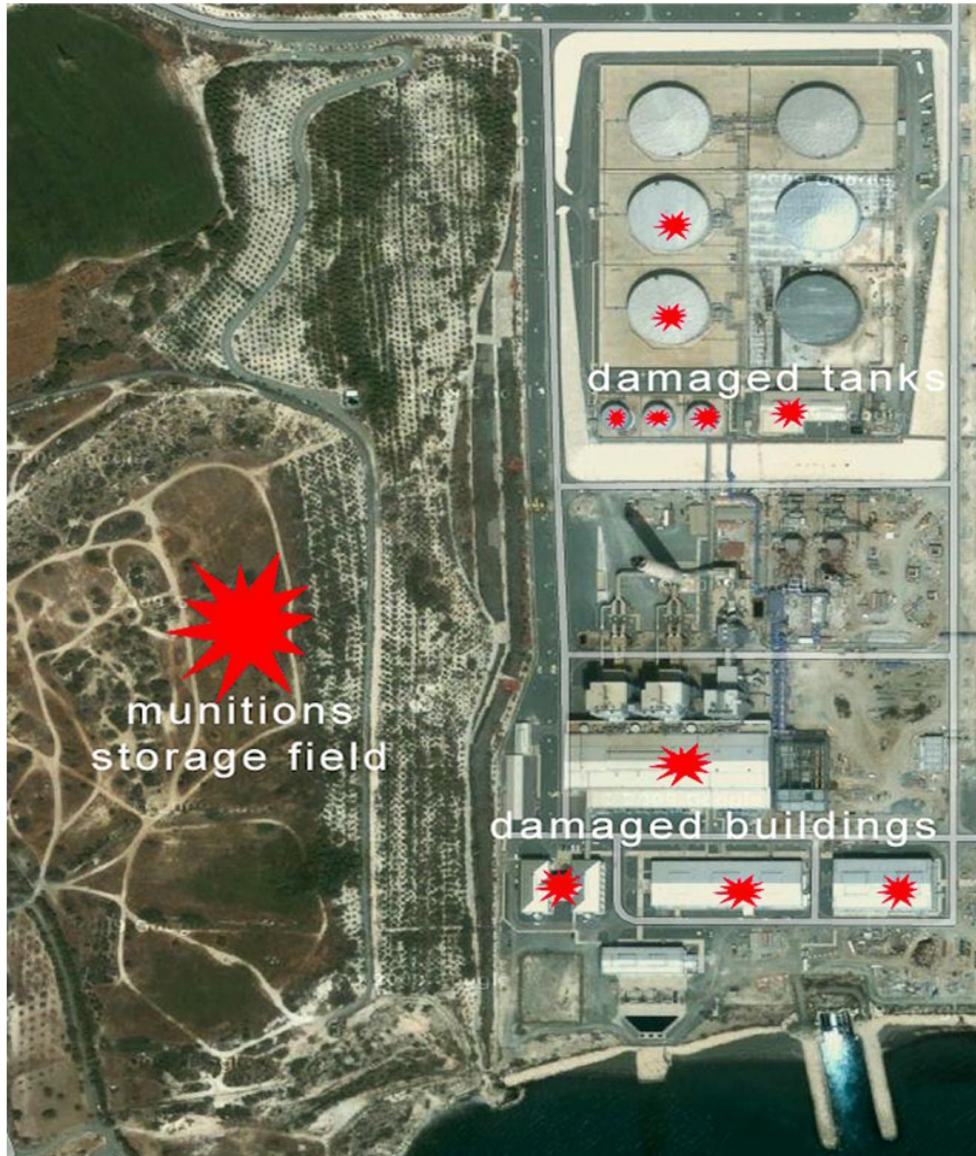
Aerial view of Vasilikos Power Station

Before



After





Affected regions at the Vasilikos Power Station



The day of the disaster

- The consequences of the tragic incident on 11th of July 2011:
 - 13 people died
 - 1 man was serious injured
 - Many people (EAC employees) have several injuries
 - Huge damages
- For the National energy and economy the consequences were:
 - Loss of 53% of the installed generating capacity,
 - Collapsing of National economy **and energy** production and supply, the most severe after the Turkish invasion of 1974

Cyprus power generation system



Vasilikos Power Station

- The largest and most modern power station in Cyprus
- The largest infrastructure project of Cyprus, **in** regards to both cost and complexity

Units 1 &2	260 MW	1999
Black start gas turbine	38 MW	1999
Unit 3	130MW	2004
CCGT unit 4	220 MW	2009
CCGT unit 5 (under construction by that date)	220 MW	2011

Cyprus power generation system

Generating units	Nominal capacity	Before the explosion	After the explosion
VASILIKOS			
Steam units	3 × 130 MW	390	0
Gas turbine	1 × 38 MW	32	0
Combined cycle gas turbines	1 × 220 MW	220	0
Combined cycle gas turbines (under construction)	1 × 220 MW	150	0
DHEKELIA			
Steam units	6 × 60 MW	360	360
Internal combustion engines	2 × 50 MW	100	100
MONI			
Steam units	6 × 30 MW	54	135
Gas turbines	4 × 38 MW	128	128
Sum		1434	723

Cyprus Power Generation Before and After

- Small isolated Electricity generation system
- No interconnection exist
- Installed capacity on 10/07/2011: 1.434 MW
- Generation capacity loss (Vasilikos PS): 792 MW
- Available generation capacity on 11/07/2011: 723 MW
- Expected peak demand for 2011 : 1155 MW
- Generation capacity deficiency: 432 MW

Crisis Management

- **Immediate measures**
 - Immediate crisis response to meet the energy requirements of the summer 2011
 - Winter peak demand, 2011 – 2012
- **Mid-term measures**
 - Summer 2012 peak demand
- **Long-term measures**
 - Restoration of Vasilikos power station (out of the scope of this presentation)

Actions taken on the DAY 1

**Despite the shock, we had to respond rapidly and targeted.
We worked hard and decisively to achieve quick restoration.**

- **The first measure**
 - Rotating power cuts according to u/f scheme groups twice a day of about 2hrs duration each
- **National Crisis Team was formed to manage the crisis**
 - Regulator
 - TSO
 - Government / Ministry
 - EAC – GM + Executive Managers of Generation and Networks
- **EAC Crisis Team was formed to manage crisis within EAC**
- **Annual leaves were recalled– Worked extensive hours**

Actions taken on the Day 2

- Load management was the first short term measure in place. The prime aim was to secure supply to the industry and other sectors contributing the most to the national economy and other vital services, so as to minimize the impact on the economy. Priority dispatch was in place:
 - Vital government offices, services and other units such as hospitals were exempted from load shedding
 - Industrial Areas were also exempted
 - Touristic areas were supplied without any interruption
- Vassilikos North s/s was put into operation after very hard work of our people, enabling the connection of South-West regions with the rest of transmission system
- Expediting of procedures
 - EAC board approval for the use of expedited procedures, within existing legal framework (JULY 12th)
 - Elimination of bureaucracy

Actions taken on the Week 1

- Load/Demand management was finalized
- Interconnection with the Turkish Cypriot utility was in place contributing 50MW (peak average)
 - interconnection of the two systems was completed on 16/7 and synchronisation was effected on the 18/7. An alternative interconnection was completed on the 2/8
- The 4 semi-retired generating units were reconditioned and put back to the system in a very short time, thanks to our people who worked uninterruptedly (contributing about 100 additional MW to the generating capacity)

Load/Demand management

- **Reduce demand by 10% energy saving campaign (Immediate commencement, continuous announcement through the media, significant consumer contribution)**
- **5% generation from private stand by units (Regulator mandatory operation decree- support by EAC)**
- **300MW load management**
- **Circulate information for customers through Internet and sms notifications**

300MW Load Management

- **2/3 of the load demand was classified in 22 groups**
- **Rotating power cuts basically 2 hrs per day and an additional hour late afternoon if required**
- **Close cooperation between TSO, DSO and the 4 Areas**
- **The Areas worked out which feeders could be included in the scheme based on the set criteria**
- **Talking with major or sensitive customers, time constraints were noted for certain feeders (e.g. shopping areas to be cut between 1-4 afternoon)**
- **TSO grouped the feeders accordingly sizing each group to about 30MW**
- **Groups were publicised through press and internet**

Announcements/sms notifications

- TSO/DSO were in close collaboration every day to forecast next day's power cut needs. The requirements were uploaded to the internet and sent to press at about 2 o'clock
- About 60.000 customers were registered to the sms notification scheme. Thanks to CYTA and MTN this service was f.o.c.
- Customers were receiving sms for the exact time of the power cut a few minutes before the cut
- Very effective system. Forecasts announced the day before were 90% true and were fine tuned by the sms system

Other measures just after first days

- Big industries stopped for summer holidays a week earlier to reduce demand
- The Vassilikos South s/s was repaired by 5th August enabling the connection of 70MW mobile generators from Greece (very intensive work by our people and Contractor)
- Additional mobile generators were energised on the 26/8 and 3/9 increasing the generating capacity by 95MW
- Reducing the voltage at the MV B/B by 200-300V, the power demand was reduced at about 3%



1^η Σεπτεμβρίου 2011

**Προσωρινή
εγκατάσταση
ηλεκτρογεννητριών
δυναμικότητας
60MW στον ΗΣ
Δεκέλειας στη βάση
της ενοικίασης.**

Availability after short term measures

	18/8/2011	1/9/2011	12/9/2011
Dhekelia ST	360	360	360
Dhekelia ICE	100	100	100
Dhekelia ICE (rental)	0	60	60
Moni ST	120	120	120
Moni GT	125	125	125
Moni ICE (rental)	0	0	35
Vassilikos ICE (rental)	70	70	70
Vassilikos Black Start	30	30	30
Buying of energy	50	50	50
Σύνολο	855	915	950

The first stage of the ... success

- On 14th of August 2011 the load shedding was ended
- EAC survived...
Tourist industry survived...
Economy survived...
Cyprus survived
- Reputation from inside and outside
 - ✓ Individuals
 - ✓ Organised groups and Bodies (Cyprus Hotel Association, etc)
 - ✓ National Grid of UK (successful learning case for all)

EU Civil Protection Mechanism

- European Civil Protection Mechanism
 - Energization of mechanism on July 13th.
 - Mobilization of expert team and arrival on site on July 16th
 - The largest expert team assembled by EUCP: 15 experts from 8 countries
 - Evaluation of
 - Health and safety issues
 - Damage assessment
 - Cost assessment
 - Final report submitted on July 26th.

Restoration schedule

Unit	Capacity	Date
Gas turbine 52	75 MW	June 2012
Gas turbine 51	75 MW	July 2012
Steam turbine 50	70 MW	September 2012
Gas turbine 42	75 MW	November 2012
Gas turbine 41	75 MW	December 2012
Steam turbine 40	70 MW	November 2012
Unit 3	130 MW	January 2013
Unit 1	130 MW	June 2013
Unit 2	130 MW	June 2013

The Key Success Factor (KSF)

- The KSF in this story is EAC's people who:
 - ✓ Cancelled their annual leaves and summer holiday plans even by paying financial cost in order to join the collective efforts to take successful immediate measures and to rebuild the energy infrastructure of this country
 - ✓ Showed extraordinary will to contribute to any recovery activity even if being out of their duties
 - ✓ Worked intensively and for long hours, even without being paid an extra cent, not only to meet time and quality targets but to exceed them
 - ✓ In all, behaved patriotically beyond anyone's expectations...accomplishing the miracle.....

Conclusions

- After the catastrophic explosion at Mari EAC has been successful at:
 - handling the immediate effects of the energy crisis
 - Many simultaneous measures for effective results were taken
 - power interruptions ceased one month after the explosion
 - handling the medium term effects of the energy crisis
 - sufficient power generating capacity was in place during the summer peak period of 2012
 - all temporary generating units contracts terminated by September 2012
- Never put your eggs in one basket