The First Operational Experiences with the New Load Frequency Control System Developed for SMM Control Block

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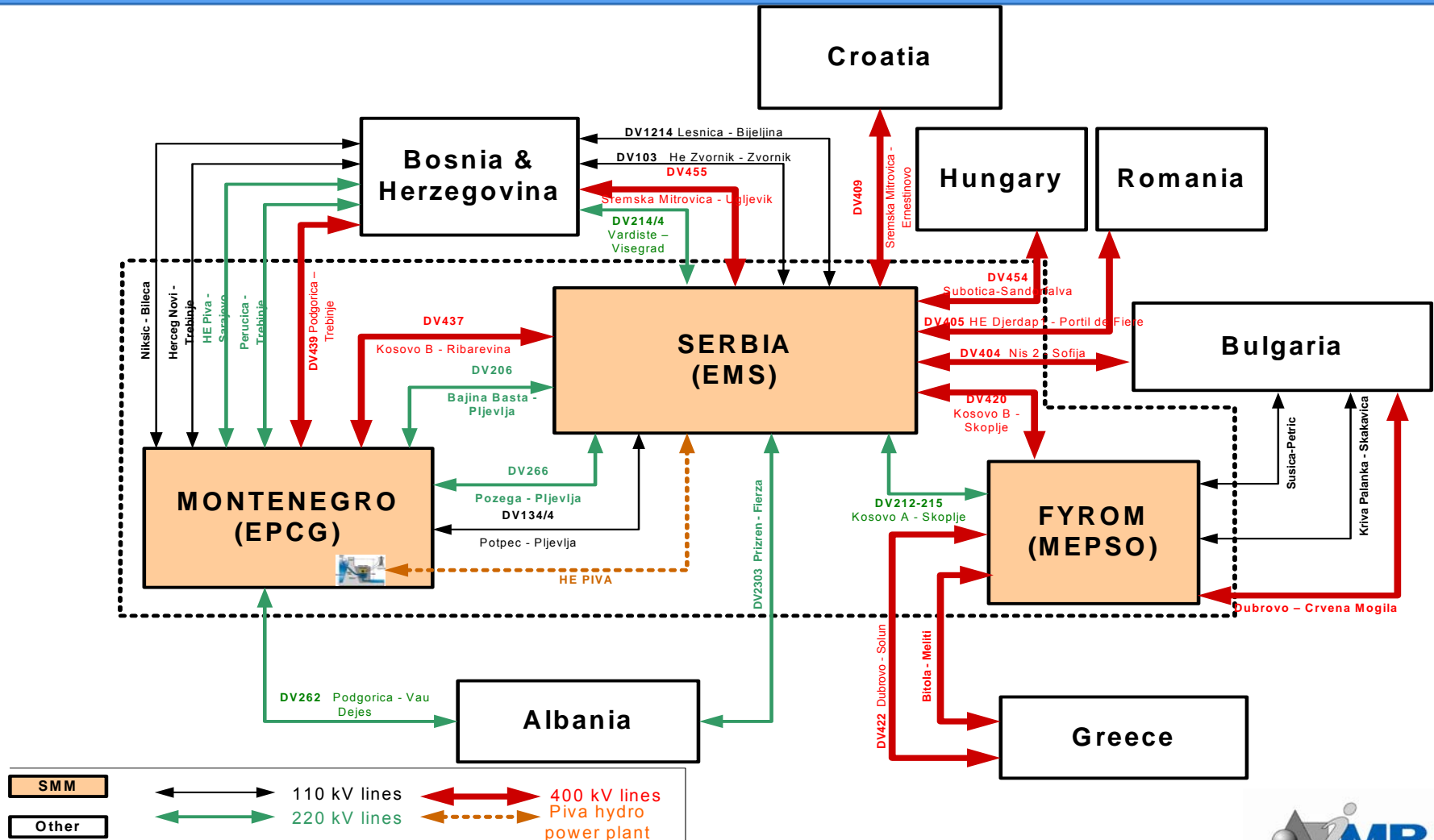**DEMSEE 2009**

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SMM Control block

- Members:
  - Serbia (EMS)
  - Montenegro (EPCG)
  - FYR Macedonia (MEPSO)
- Established in 2007, as successor of JIEL control block

SMM block internal and external interconnections

Main responsibilities of SMM control block

- Coordination of secondary control (AGC) efforts
- Energy accounting
- Data exchange

- *In order to perform this tasks appropriate software has been developed*
  - SMM block LFC control software
  - Energy accounting software (EAS)

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Control algorithm

- UCTE SMM block applies hierarchical control scheme

- Block coordinator calculates ACE's of block members and of whole SMM block

- Two operation modes are possible:
  - Pluralistic (normally used)
  - Hierarchical

Control algorithm cont'd

- In **pluralistic** mode ACE's of each block member are calculated "as usual" :
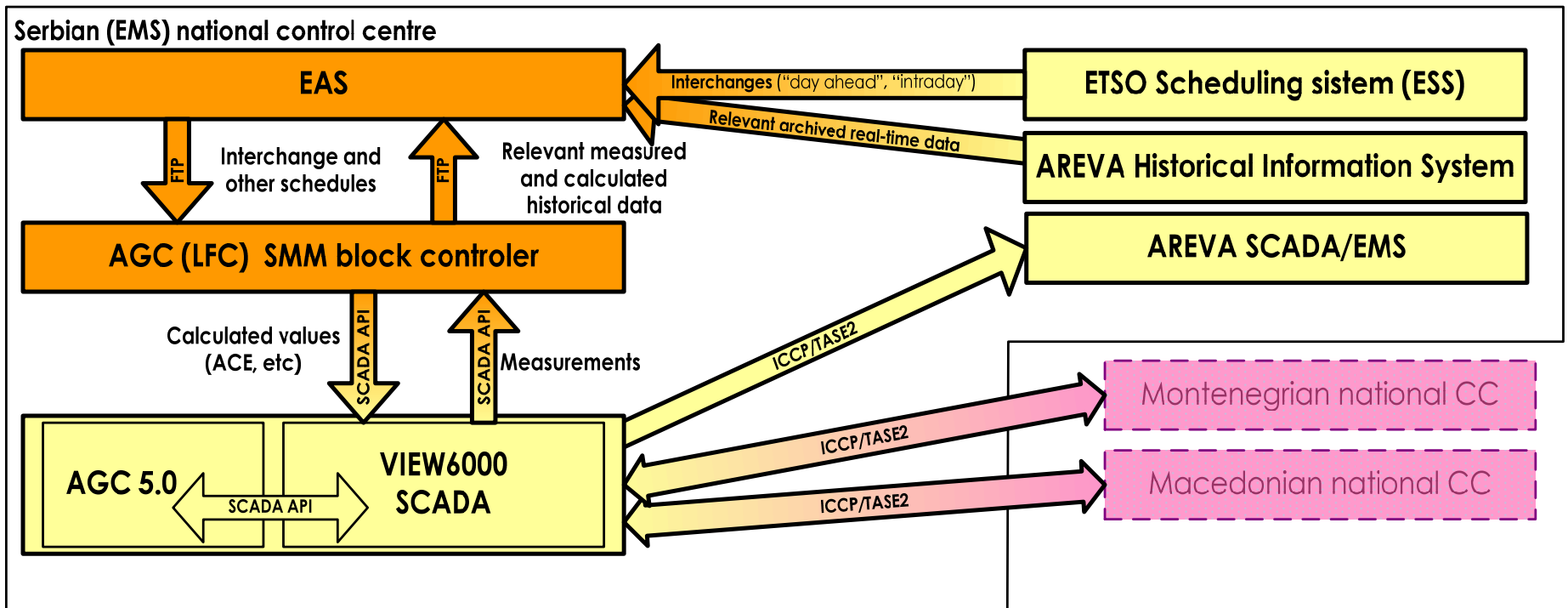
$$ACE_k = \left(P_k - P_{k0} \right) + B_{fk} \left(F - F_0 \right)$$

- In **hierarchical** mode ACE's contain component proportional to whole block ACE

$$ACE_k = \left(P_k - P_{k0} \right) + B_{fk} \left(F - F_0 \right) + h_k ACE_{SMM}$$

Software implementation

- Distributed application
  - *Control* ("real time") *component* (**Linux C/C++** app)
  - *Database* with configuration and dynamic data (schedules & real-time data) − (**MySQL 5.0.45**)
  - *User interface* (Microsoft Windows app's based on **.NET Framework 2.0/3.5**)

Software implementation cont'd

Serbian (EMS) national control centre

EAS

Interchanges ("day ahead", "intraday") → **ETSO Scheduling sistem (ESS)**

Relevant archived real-time data → **AREVA Historical Information System**

FTP — Interchange and other schedules

FTP — Relevant measured and calculated historical data

AGC (LFC) SMM block controler

SCADA API — Calculated values (ACE, etc)

SCADA API — Measurements

AGC 5.0 ← SCADA API → **VIEW6000 SCADA**

AREVA SCADA/EMS

ICCP/TASE2 → Montenegrian national CC

ICCP/TASE2 → Macedonian national CC

Performance of SMM control block

- Criterions developed by UCTE ad-hoc group in 2004 (ACEσ_{90} and ACEσ_{99})
- Additional criterion used within SMM control block (Hourly average ACE within ±20 MW margin)

ACEσ_{90} and ACEσ_{99} criterion's

- Indicators use hourly average values of ACE on monthly level
- ACEσ_{90} should not be exceeded more than 10% of time
- ACEσ_{99} should not be exceeded more than 1% of time

ACEσ_{90} and ACEσ_{99} criterion's

- Each control block should have his own value of σ90 and σ99.

$$\sigma_{90} = 0,01645 \frac{20788\sqrt{total\_load_{control\_block}}}{\sqrt{total\_load_{UCTE}}}$$

$$\sigma_{99} = 0.02576 \frac{20788\sqrt{total\_load_{control\_block}}}{\sqrt{total\_load_{UCTE}}}$$

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ACEσ_{90} and ACEσ_{99} criterion's

SMM Control block for the period April – June 2008

	calculated limits [MW]		Period of allowed excursions [% of time]		Period of excursions [% of time]	
	σ_{90}	σ_{99}	σ_{90}	σ_{99}	σ_{90}	σ_{99}
April 2008	48,39	75,77	10	1	30	19
May 2008	48,39	75,77	10	1	14	15
June 2008	48,39	75,77	10	1	21	4

ACEσ_{90} and ACEσ_{99} criterion's

- **SMM block was not able to fulfill criterion during observed period**

- **Reason:**
    - SMM block relies only on hydro power plants for secondary control.
    - Inflow was huge and capacity for control low

- **Solution:**
    - Serbian TSO (EMS) has started preparations (together with Serbian Power Utility - EPS) to introduce thermal units into secondary control

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Performance criterion based on 20 MW error margin

- Control area must maintain its hourly average ACE within ±20 MW margin or cross zero every 10 minutes during this hour
- This is most relaxed criterion used in SMM block

Performance criterion based on 20 MW error margin

NUMBER OF HOURS WITH FULFILLED CRITERION

	Number of hours with fulfilled criterion [%]		
	April 2008	May 2008	June 2008
Serbia	94	96	95
Montenegro	80	93	87
FYR Macedonia	63	83	69

Average hourly values of ACE (MWh/h) distribution on 20 MW intervals

Serbia

Montenegro

FYR Macedonia

April 2008.   May 2008.   June 2008.
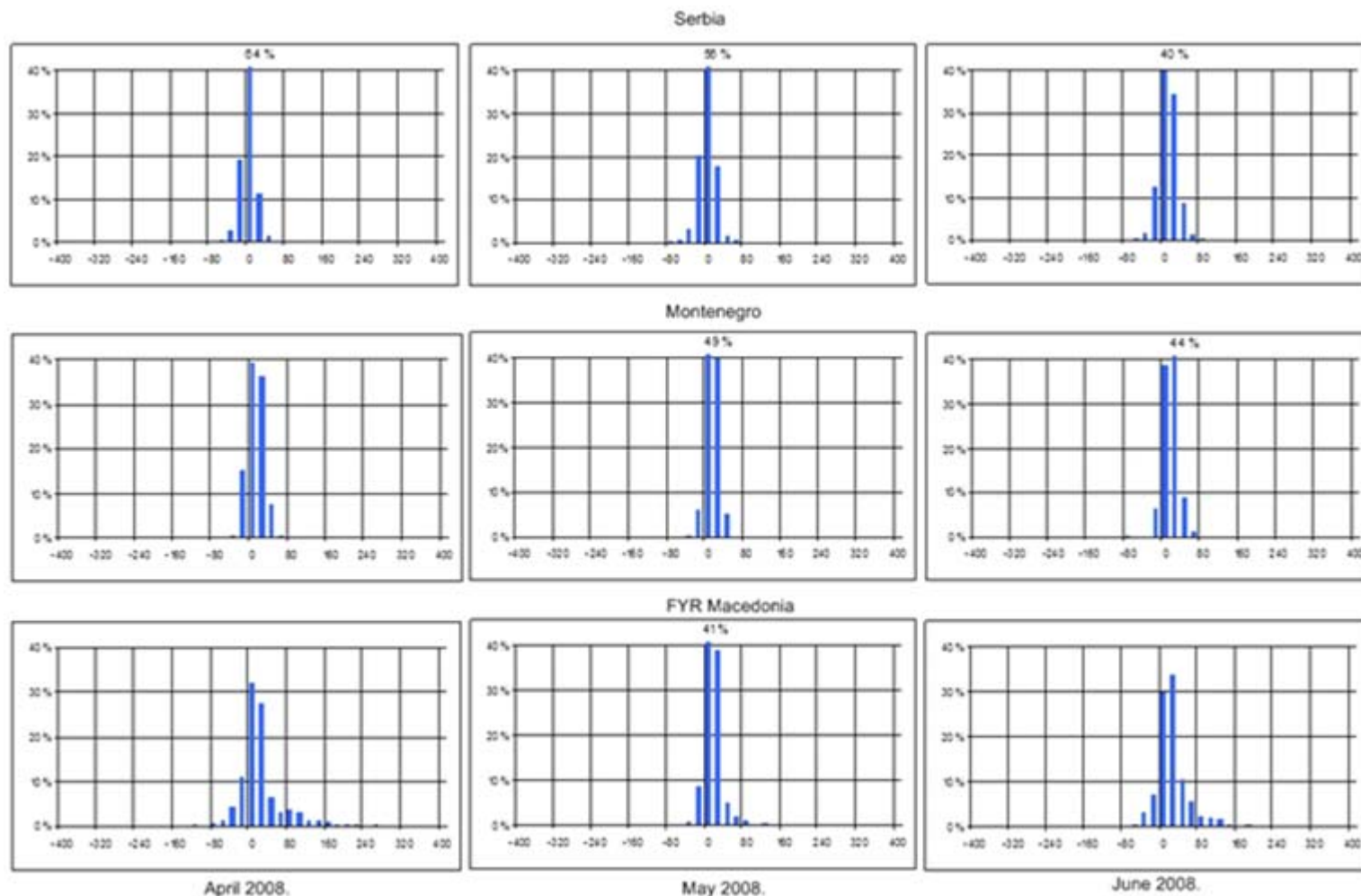
Conclusions

- LFC System, developed for SMM Control block has proved his functionality, reliability and performance

- Current drawbacks are full dependence on hydro units, and still developing market environment.

- Additional improvement could be expected after the beginning of operation of thermal units in secondary control, and improvements in market mechanism

Thank you for attention

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