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GoalArt System Proven During Outage

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Abstract

A system for Intelligent Alarm Processing, IAP, based on GoalArt's technology for Root Cause Analysis, is monitoring the Croatian transmission grid. Acceptance tests were successfully conducted in October 2013, operator training commenced in March 2014, and the system was fully in service when a regional outage occurred in May 2014. This gave ample opportunity for the IAP system to prove its value by correctly identifying the root cause of the event.

Background

HOPS d.o.o., Croatian Transmission System Operator Ltd., is the sole electricity transmission system operator in the Republic of Croatia, and the owner of the entire Croatian transmission network (400 kV, 220kV and 110kV). As part of a comprehensive modernization project HOPS contracted the major Croatian consulting firm KONČAR to bring in a new SCADA/EMS system. GoalArt was awarded a subcontract to deliver Intelligent Alarm Processing based on its technology for Root Cause Analysis.

The GoalArt IAP software processes alarms received from the SCADA/EMS system and partitions them into Root Causes – or Root Alarms – and Consequences, i.e., alarms that are generated as a consequence of the "real" fault in the power system. As a pre-processing step to root cause analysis, alarms are grouped to a relevant grid object such as a line. This means that the IAP system will present a line trip alarm as opposed to individual breaker alarms. The underlying SCADA alarms are still available for display by simply selecting any grouped alarm.

By combining grouping and root cause analysis, the GoalArt IAP system achieves its design goal – to display one alarm per independent fault in the power system, even during alarm cascades resulting from, e.g., a voltage collapse – thereby providing true situational awareness.

Unique features of the GoalArt system is its ability to create its internal rule base from existing models such as a power system CIM and its ability to deliver analysis results in real time during ongoing cascades.

May 14th event

As described in the online Transformers Magazine a regional black out occurred on May 14th, 2014, about 9 a.m. The article states: “The entire city of Osijek, a large part of Slavonija and almost the whole of Baranja lost power supply,” and further “At about 10 a.m., the power supply to all areas was re-established, according to Nada Kolega, a spokeswoman for Croatian Transmission Utility (HOPS).”

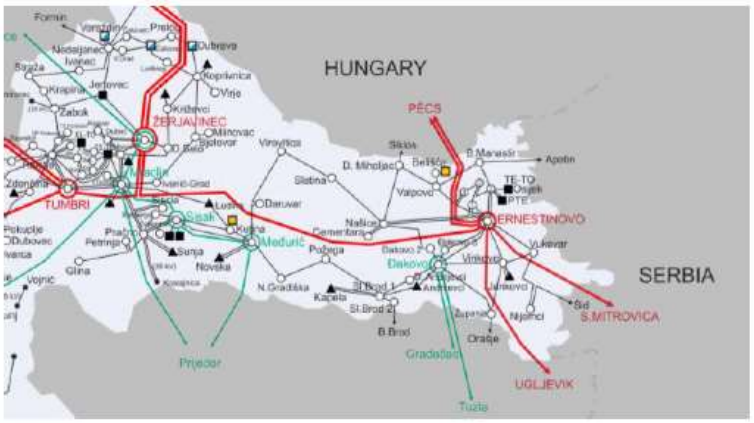

Figure 1, relevant part of the Croatian grid, source

According to the article, the initiating event was a power transformer trip in the 400 kV Ernestinovo substation. Subsequent analysis by HOPS identifies that one bus bar protection relay on the 110 kV side of the Ernestinovo substation was triggered, effectively clearing one of the main buses. About three minutes after the initiating event an important transmission line at the 220 kV level south of Ernestinovo tripped. This in turn led to a regional voltage collapse with several more line trips until stable conditions were reached. Figure 1 shows the relevant part of the Croatian grid.

Results

In case of the May 14th event, the root alarm is the alarm indicating the Ernestinovo bus bar protection relay action. The GoalArt IAP system can present analyzed alarm situation both as traditional alarm lists grouped into Root Cause and Consequences and in graphical form. For HOPS, the graphical display is based on a map similar to the one in Figure 1. On the map, alarms are marked by small, white squares and coloring of the otherwise gray-on-gray map. Root causes are marked with lightning strike symbols. The IAP display is updated within seconds from the arrival of alarms on the SCADA side.

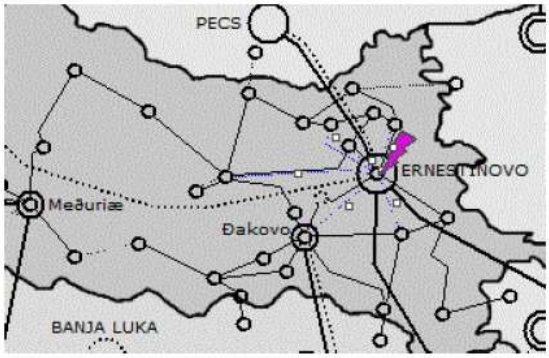

Figure 2, seconds after the initiating event

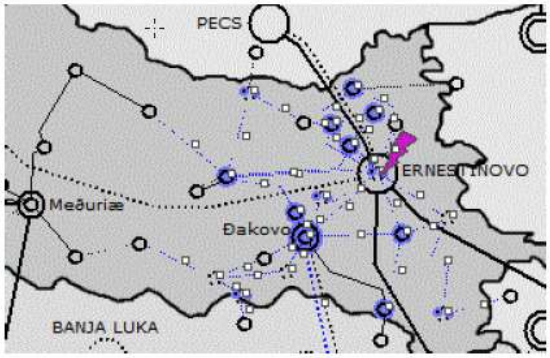

Figure 3, after four minutes

The two screen shots in Figures 2 and 3 illustrate the alarm situation in the relevant region a few seconds after the initiating event and about four minutes into the outage. There are much more than 100 SCADA alarms (breaker trips, protection relays, low voltages, overloads etc.) during the initial five

minutes of the event. On the IAP display the entire event is attributed to a single root cause, the Ernestinovo bus bar protection, and 77 grouped, consequential alarms (line trips, low voltage buses etc.). The illustrations were created by replaying the actual, saved SCADA data from the event.

At HOPS, Ms. Ksenija Žubrinić-Kostović, MSc, responsible for the IAP implementation, gave appraising feed-back on the GoalArt system performance: “We are very satisfied with the IAP system results from the incident. This will boost operator confidence in the tool.”

Links and Contact info

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HOPS d.o.o., Croatian Transmission System Operator Ltd., http://www.hops.hr

KONČAR Group, http://www.koncar.com

Transformers Magazine article, http://www.transformers-magazine.com/component/k2/item/738-power-supply-in-slavonija-and-baranja-repaired-after-transformer-incident.html

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