BARRIERS TO BETTER CRITICAL INFRASTRUCTURE PROTECTION

Ivan Benes, CITYPLAN, Jaroslav Pejcoch, T-SOFT

Abstract

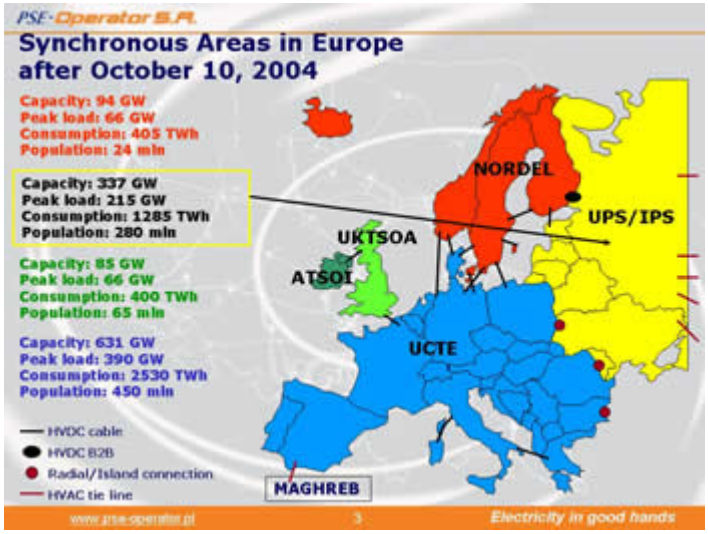
There are three research and development projects currently under way in the Czech Republic which are oriented to the critical infrastructure. (1) "Resilience of the distribution system during national grid blackout to improve safety of population" (RESPO - RESilient POwer) is the national research and development project that focus on more resilient power distribution. Aim of this project is to create bridge between liberalised power business and new challenges coming from human protection needs during blackouts. (2) “Black start” project is the national research and development project that focus on the ability to start municipal district heating plants separated from the national grid and facilitate the islanding of the distribution grid. (3) “Emergency power supply” project is the national research and development project that focus on the systemic solution to provide emergency energy services during blackouts. All three projects indicate range of barriers that should be overcome by the Public Private Partnership. The paper will present possible solutions.

Blackout - a nightmare of our society

Besides high price of energy and curtailment, the blackout is the most serious situation in energy system of each developed country. To compare oil and natural gas shortage where oil and natural gas reserves and storages give the government usually a chance to solve the problem, the unbalance of power generation and its consumption can evolve to the situation, when power company lose control over electric grid in 5 seconds (e.g. ENEL and Italian blackout in September 2003). Long term blackout can cause economic loss as well as death and people injury.

The power grid is the most decentralized artificial infrastructure that works as a one entity. The wall socket in the Czech Republic is interconnected with the wall sockets in many other European countries through UST system.

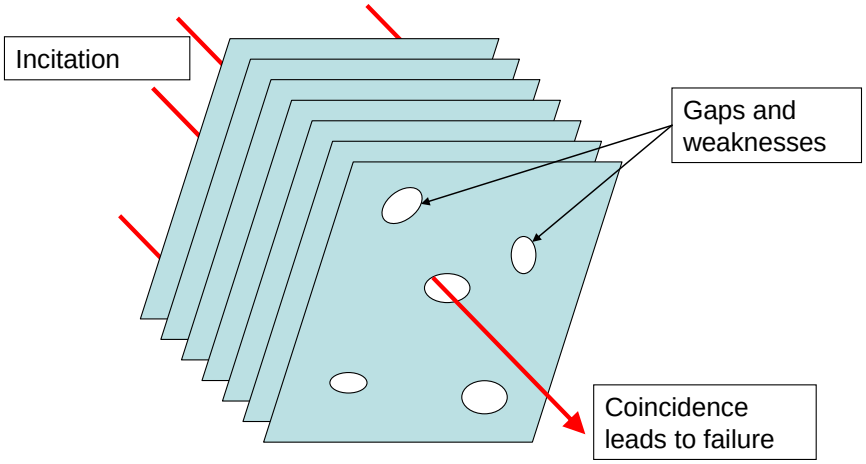
Figure 1 UCTE system



The power grid is designed according to N-1 practice. It means that power grid resilience is projected to survive only one single failure (or attack). There are rare exceptions to n-1. Higher standard e.g. N-2, is used typically for nuclear power plant connection.

Blackout is not necessary consequence of a failure. Most of blackouts were caused by the coincidence of couple technical weaknesses or human failures.

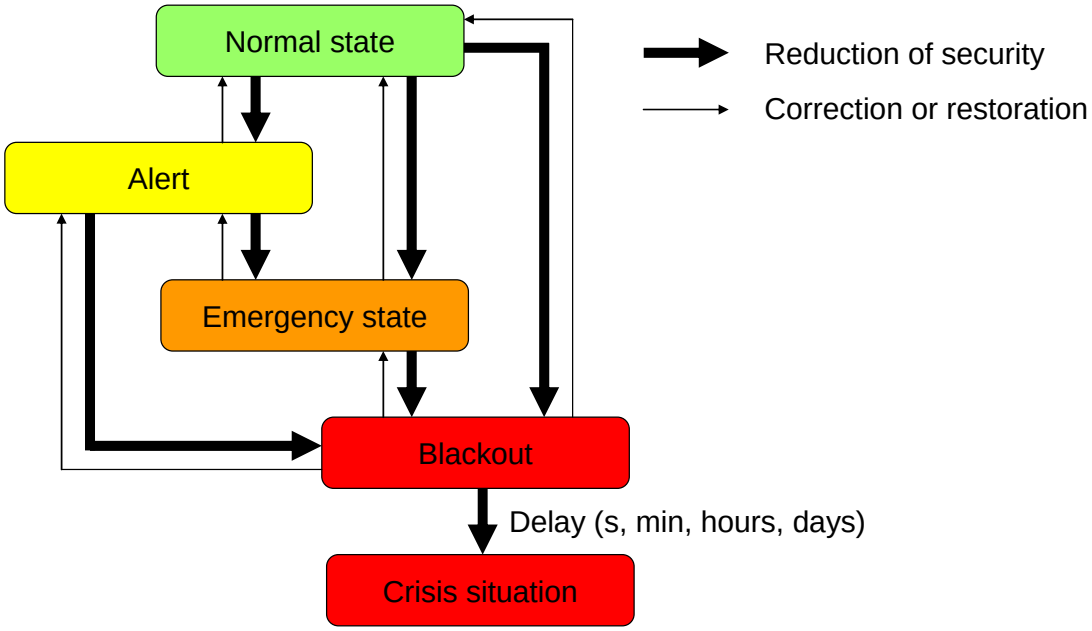
Figure 2 Coincidence of weaknesses leads to blackouts



Analysis of "Achilles heel"

Next figure can facilitate discussion about power system security and nature of blackout.

Figure 3 Power grid system state model

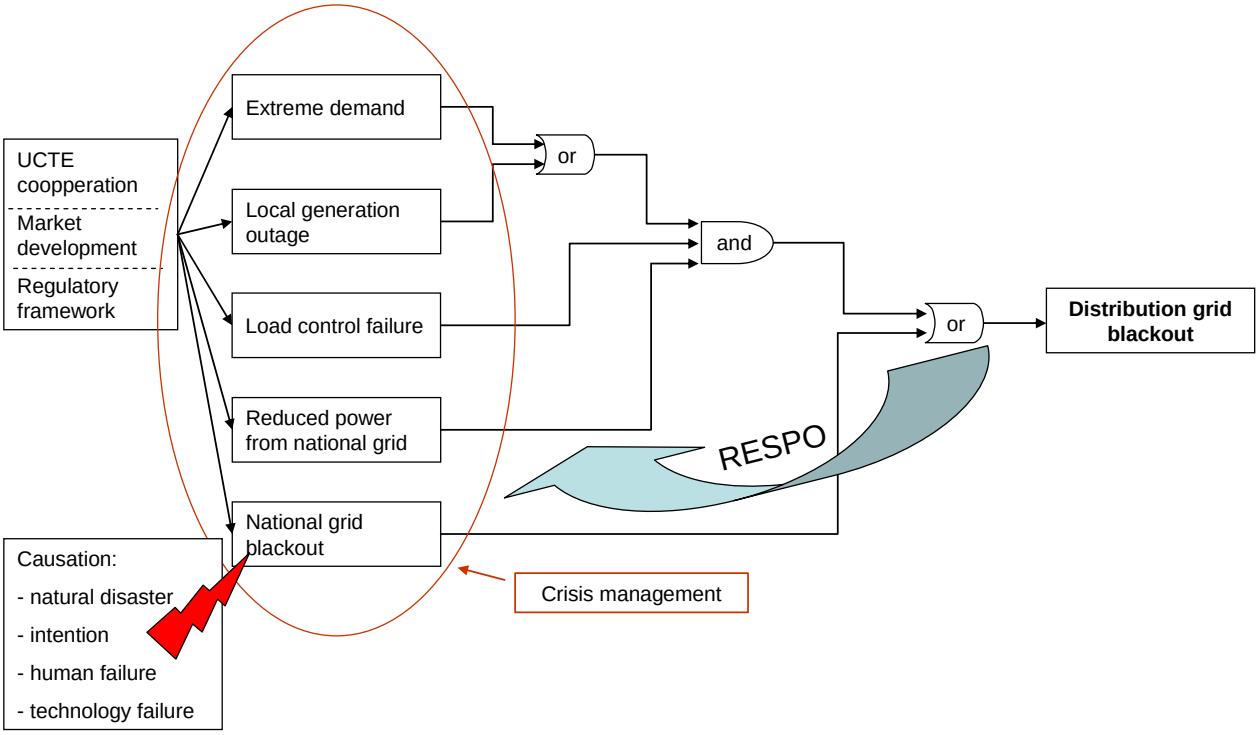


Event tree is suitable tool to describe possible causes, dependencies and consequences of blackout. The distribution grid operation is commonly very sensitive to the operation of national grid. Most of ancillary services are ensured on the national grid level. So National grid is commonly responsible for system services, it means for power and frequency balances.

Once there is the power shortage on the distribution level, then the self-acting automation is initiated. There are frequency plans as well as switch-off plans in place. The result can be a rolling blackout, when end user receives electricity just couple of hours per day.

But if there is the system failure that leads to national grid blackout, then most of European distribution grids will follow this blackout as well immediately. The reason is that distribution grid is not able to balance its demand with local power generation alone. This situation is shown on the following event tree.

Figure 4 Event tree of current blackout threat



Resilience to blackout

The arrow in the figure shows how the RESPO project will solve the blackout resilience. Capability to cope with the national grid blackout as well as power shortage means that the distribution grid must be able to utilize just local decentralized power generation and balance it with consumption (figure 5). Such a solution is impossible without crisis demand side real time management.

This idea resulted from process management approach to critical infrastructure functions as a basis for crisis management (figure 6). The main goal is population protection, human safety assurance and prevention of vast material loss.

Figure 5 Resilience against national grid blackout

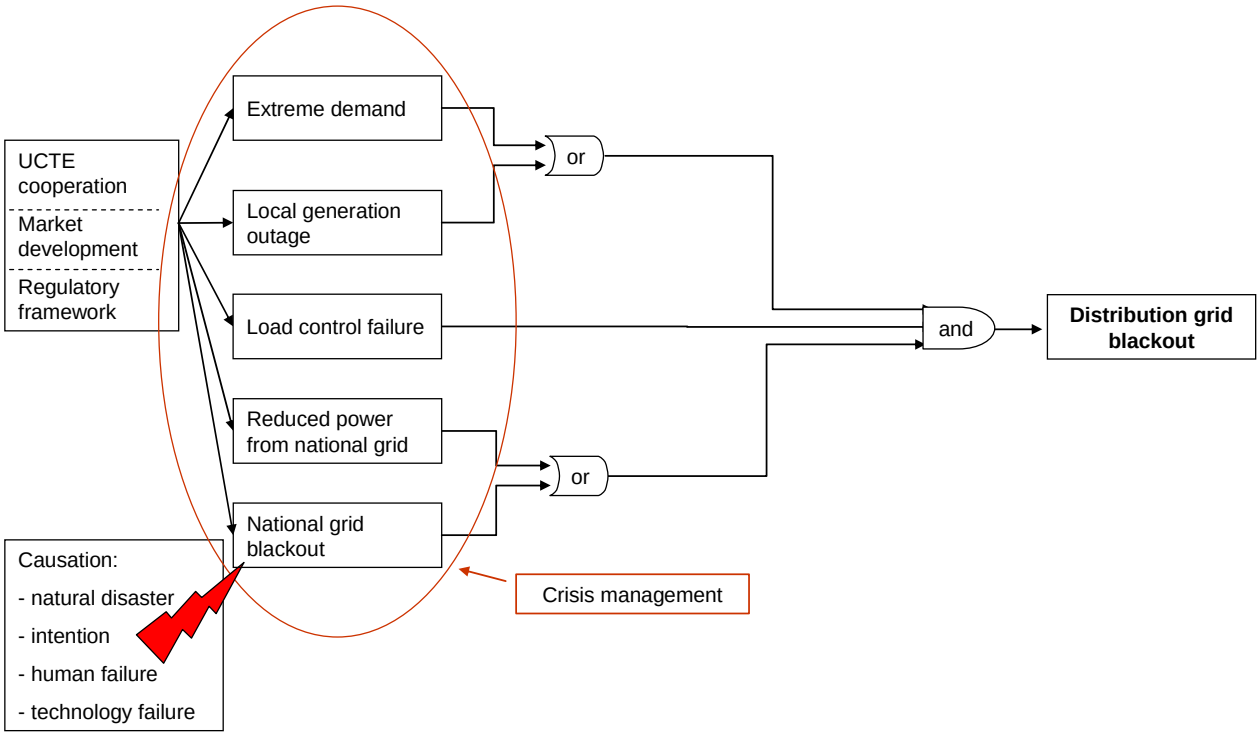
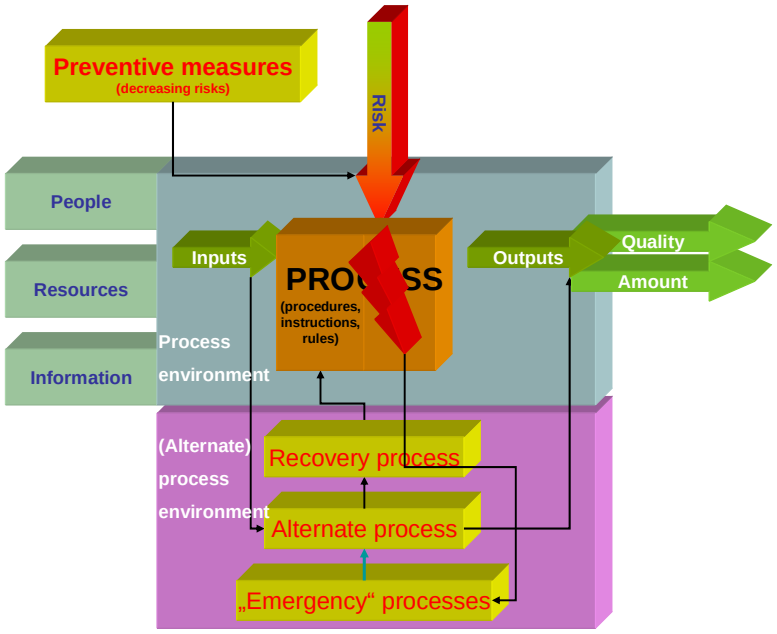


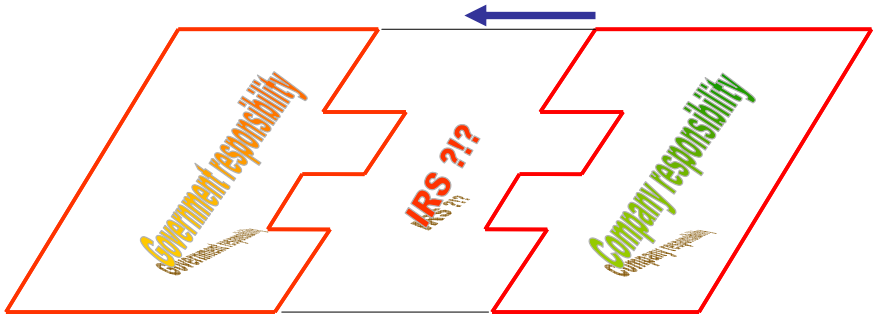
Figure 6 Process approach to critical infrastructure



Overcoming barriers

The main barrier to reach higher resiliency comes from liberalized energy markets. Once the critical infrastructures were privatized and liberalized, we may observe a different approach of private and public sector to the security supply. This difference is natural and fundamental – the goals of public government and business are different. This situation can weaken the security of supply and cause a gap. Possible crisis situation from this gap is currently solved only by handling of consequences by Integrated Rescue Services. There is no effective link to the power distribution system. We recognized that this gap can be broken only by the modification of the legislative environment.

Figure 7 Possible gap in the security supply after privatization and liberalization



Conclusion

Based on the research and development studies we have initiated a broad discussion with all stakeholders in the Czech Republic (general directorate of fire and rescue services, utilities, Czech regulatory body, politicians from Czech parliament, politicians from ministries, consumers associations, etc.).

We are proud to announce that such open and genuine discussion based on facts and common national interests was successful and it will result with an adaption of respective laws.