highest requirements for ensuring the safety of production. The whole world remembers the accident at the Fukushima-1 nuclear power plant, which occurred in 2011. This led to radioactive contamination of the adjacent territories, as well as water and air in the whole of Japan.

Undoubtedly, the possibility of implementing the announced development program is still controversial. In the world, there are two opposite trends in the development of the nuclear industry. While the developed countries are trying to reduce the number of nuclear power plants and power units, switching to alternative energy sources, developing countries, on the contrary, are launching the construction of new plants.

So, perhaps, if the program "Harmony" did not exist, it would be worthwhile to come up with. After all, often a clearly marked goal, flavored with a humanistic message, even if it seems too ambitious, is capable of leading oneself.

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PENETRATION OF RENEWABLE SOURCES IN MICROGRIDS: EFFECTS OF MILP BASED CONTROL STRATEGIES

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Abstract: The rapid growth of the Distributed Generation (DG) concept has given technical issues regarding the integration and control within the grid nodes. A predictive control strategy integrating renewable and non-renewable sources as well as energy storage within the grid, is a potential solution to face with the mentioned issues. The behavior of a smart building of 30 apartments has been considered in this work. The Hybrid Renewable System has been controlled by a Model Predictive Control (MPC) strategy. The HRS includes sub-systems for the conversion of renewable energy sources as well as non-renewable ones connected to the main grid. Several scenarios have been tested under different weather conditions and in terms of renewable sources penetration. Results obtained with the MPC control strategy have been compared with a Rule Based Control (RBC). Results show that the use of MPC improves the integration of the residential microgrid with the renewable sources connected to the grid thanks to the predictive system smoothing out the energy demand

profile and absorbing the peak production from the photovoltaic and wind farms, even in the cases of higher penetration.

Residential Microgrid

The design of Microgrid power systems is a crucial and complex aspect that is highly affected by local weather [1] of each subsystem within the Microgrid. The MicroGrid layout here considered is based on a battery bank is connected directly to the DC Bus, which in turn controls the system voltage. The residential load and the power grid are connected to the DC Bus through an AC/DC converter and the FC and PV are connected to the DC bus through DC/DC converters.

The definition of the residential load is crucial, depending on appliance technology and individual scheduling strategies, as well as on social factors, household occupation, regional culture, lifestyle, etc. Therefore, special attention was given to the definition of residential load, through the use of probabilistic data, in relation to the most common household appliances found, the probability of use and usual hours in the areas around Rome Italy, considering lighting, electric boiler, electric oven, refrigerator, microwave oven, PC, TV-set, dishwasher, washing machine and dryer.

Control Models

Rule-based management system (RBC)

The RBC strategies have been extensively investigated when dealing with microgrid power management for their simplicity and robustness consisting in rules based on threshold values and pre-established operating constraints. A voltage based model was implemented and validated against experimental data.

Model predictive control (MPC)

The MPC strategies with MILP formulation have been tested, obtaining outstanding performances, in experimental microgrids in Athens or in the Savona campus. The results have shown a good performance and computational processing capacity of the proposed algorithm, and there is still room for improvement.

Forecasts

The sun radiation forecast for Rome/Italy, related to the period of simulation, has been implemented into the MPC algorithm via data provided by CNMCA (Italian Air Force Meteorological Service) and the real weather data, has been measured at the weather statDue to the lack of real historical data for residential applications, the daily simulations of the load profile of a model house have been defined with a random simulator for a period of 4 years, subtracting from the profile generated, the curves of the house appliances controlled by the MPC algorithm. The procedure adopted to determine the errors is based on a simple linear regression of the two-data series, composed of the meteorological forecasts error at time k and at time, k + 1.

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