



INNOVATION OF THE BACK-UP POWER SUPPLY SYSTEM FOR THE NUCLEAR REACTOR VR-1

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The Department of Nuclear Reactors FNSPI CTU in Prague operates the low power training reactor VR-1 "Sparrow". The reactor power supply needs to be backed-up to assure the safety, respectively the operability of the reactor in the case of a break in the standard network power supply [1].

The contemporary power supply back-up system is divided into two parts – the 48 V DC supplies control rods and safety indicators, and the 220V DC provides energy to computers and electronics for the control and safety system. The 48V DC system is based on storage-batteries and appropriate charger; additionally, the 220 V AC system has a DC/AC convertor named "Tyristat" to get a AC signal from a DC one.

From the operational experiences with the contemporary power supply back-up system is to observe that there were no essential problems with the 48 V DC. More serious problems were found by the 220 V AC. The storage-batteries require expensive and time-consuming maintenance; their lifetime is short (about 3 years). Also, failures occurred in the DC/AC converter. According to these experiences, it was decided to innovate in the first step the 220 V AC.

There are two principal approaches to solve the power supply back-up system problem – either to use one high efficient back-up unit to supply the complete safety and control system, or to divide the system into smaller back-up units. The second approach was chosen for the innovation of the back-up system of the VR-1 nuclear reactor. The advantage of this solution is the possibility of diversification of the system to fulfill the single failure criterion for energy supply of the safety system.

As the back-up units uninterruptable power supplies (UPS's) for the personal computers were selected. Many UPS's are produced with the quality assurance according to ISO 9001, require a minimum of maintenance, are testable before and during the operation, and have high operational reliability. To fulfill the single failure criterion it is necessary to use 6 UPS's in the system. 4 UPS's will be used for measuring and emergency channels (safety system), one unit always for double measuring and emergency channels. Next, two UPS's will be connected with the control and information system. The failure of one UPS (single failure) in this arrangement cannot disturb the safety function of the control and safety system.

The Victron Micro RACKSAFE UPS's were selected for the innovated back-up system [2]. There are UPS's to provide 1.5 kVA for 7 minutes. In actual application the UPS's can supply power for 20 minutes with less power consumption. They work in the on-line mode, and through serial interface give information about its operation mode and status.

These units are intended to be mounted into 19-inch racks. Firma Victron is an ISO 9001 certified organisation.

The necessary changes will be done to the cable structure of the network supply for the UPS's and to the the power electronic part of the system. Further it is necessary to complete control channels for reading the status of the UPS's and to make changes in the software of the control channels to read status of the UPS's and evaluate them.

A detailed description of these changes was prepared together with the application for permission of this innovation from the State Office for Nuclear Safety (SONS). This description also deals with the operational reliability of the innovated back-up system and the estimates of the mean time between back-up system failures. We hope that we receive permission from SONS and begin with the construction of the innovation in the beginning 1997.

References:

- [1] *Selected law regulations from the area of peace usage of nuclear energy in the Czech Republic*, State Office for Nuclear Safety, 1994
- [2] *Rack Safe Series 19" UPS and interface systems*, Victron Company, 1996

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