SIREx: Instrumentation System for Research Reactors

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Incentive

The Nuclear Reactor RA-0 is a critical facility located in the Facultad de Ciencias Exactas, Fsicas y Naturales (FCEFyN) Universidad Nacional de Crdoba (UNC), in the city of Cordoba Argentina. The RA-0 has an authorized power of 1W. The installation main purposes ranging from education, where different courses related to the subject are taught; research; and the development of electronics for nuclear instruments.

In recent years, the reactor had the need to renew the instrumentation, thus resulting in the possibility of start the development of new instrumentation for experimental reactors. This development involves the studio of improvements that can be introduce in the design, the new challenges that brings incorporating new technologies in nuclear instrumentation, the definition of the philosophy of this new instrumentation, and finally the design of the electronics required.

Objectives

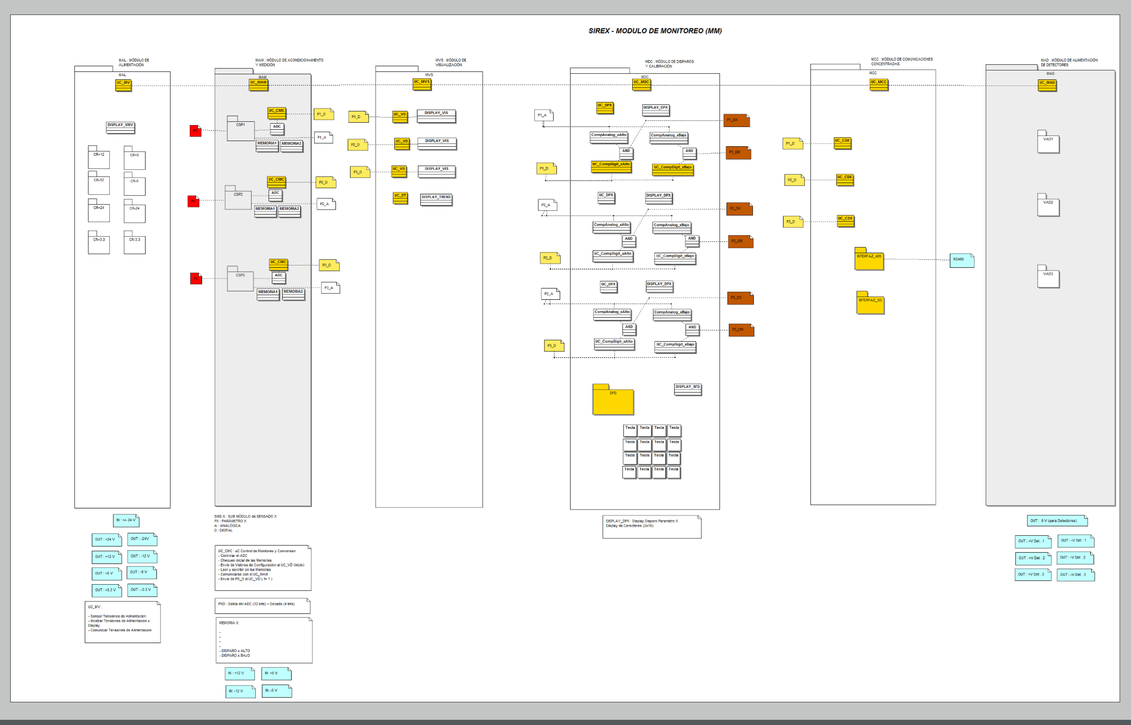
The Instrumentation System for Experimental Reactors (**SIREx**) is a new approach in the development of instrumentation that seeks to provide a new paradigm for the development of instrumentation. The current instrumentation of the reactors have a great part of analogical technology, necessary for conditioning many of the sensors, but a great part of this one can be changed by digital technology, with many more benefits and flexibility to meet these and more features (display, safety/trip signals, communications). From the possibility to introduce new technology in the nuclear instrumentation and from the use of nuclear instruments (the development team of the **SIREx** is also the part of the operation team of the Nuclear Reactor RA-0) emerge the improvements proposed in the **SIREx**

Design Criteria

The design criteria that emerged in the initial meetings to build a system instrumentation arises out of the use of instrumentation that is currently in the reactor RA-0 and suggestions for improvements upon or modules that are needed and currently are not implemented.
Among the main criteria we can enumerate:

- Modularization
- Security Signals Management
- Use of Engineering Units in the Operation

The safety analysis of equipment with digital technology is a highly complex factor. On this basis it is proposed that the management of the safety signals keeps being in analogue form and to add the possibility of a parallel digital analysis.
Another important factor in the SIREx is handling engineering units on all matters related to the equipment. Some of the current equipments require for the set of the level on security signal, curves that relate a number of divisions on a knob and levels of the signal. This makes the trip signal setting process unintuitive, and human errors can add up. Friendlier use for the operator interfaces and managing the magnitudes in the appropriate units is one of the conditions that development SIREx proposed.



Conditioning

It's the only module different between channels, is responsible for normalizing the signal delivered by different detectors/sensors to a voltage level and wherein it will be realized the subsequent signal digitization.

Display

This module will show any visual indication of the range of the signal.

SCARM Security Module

The SCRAM module will take care of three highly significant factors for nuclear instrumentation: send the signals to produce SCRAM, setting the safety levels for the corresponding signal, and the calibration of the equipment.

Communication

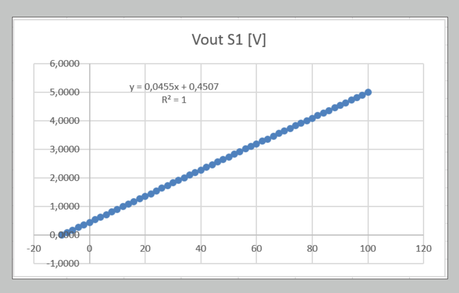
Module intended to communicate the signal to repeaters or data acquisition systems.

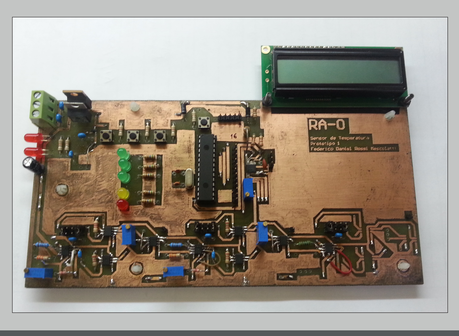
Module Design and Testing

Although there are still certain blocks of SIREx defined, certain conditioning modules have been designed and tested, that are the basis on which the SIREx will be defined and implemented. The two modules currently designed and in testing process are:

Temperature monitor

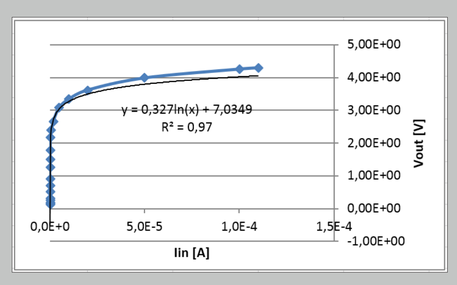
The temperature sensor is based on a resistance temperature detectore PT-100. The new circuit topology changes the desig from a Wheatstone bridge to an Anderson loop.

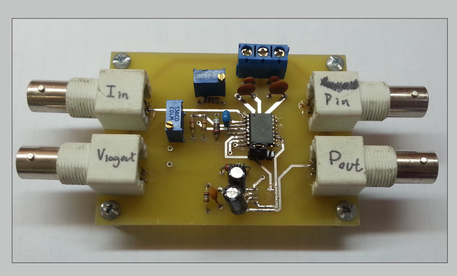




Logarithmic amplifier

The logarithmic amplifier is the first stage in the development of a completely instrument related with measurements of neutron flux, and also related to monitoring important variables in the reactor certainly included in safety circuits.





Future Work & Conclusions

As can be inferred from what is presented in this work, generate a new model for the development of instrumentation, coupled with the incorporation of new technologies into the design, it is a very hard work. Require that the team in charge consider factors ranging from thinking how the instrumentation interrelate with reactor safety, foresee a basic design that does not limit further advances in technology, propose verification and validation processes for these new introduced technologies, and show by the same processes that the addition of these technologies in the implementation does not introduce an increase in the probability of failure of equipment.

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