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Performance Monitoring for Nuclear Safety Related Instrumentation at PUSPATI TRIGA Reactor (RTP)

Abstract

The Reactor TRIGA PUSPATI (RTP) at Malaysia Nuclear Agency is a TRIGA Mark II type reactor and pool type cooled by natural circulation of light water. This paper describe on performance monitoring for nuclear safety related instrumentation in TRIGA PUSPATI Reactor (RTP) of based on various parameter of reactor safety instrument channel such as log power, linear power, Fuel temperature, coolant temperature will take into consideration . Methodology of performance on estimation and monitoring is to evaluate and analysis of reactor parameters which is important of reactor safety and control. And also to estimate power measurement, differential of log and linear power and fuel temperature during reactor start-up, operation and shutdown .This study also focus on neutron power fluctuation from fission chamber during reactor start-up and operation. This work will present result of performance monitoring from RTP which indicated the safety parameter identification and initiate safety action on crossing the threshold set point trip. Conclude that performance of nuclear safety related instrumentation will improved the reactor control and safety parameter during reactor start-up, operation and shutdown.

Introduction

The Reactor TRIGA PUSPATI (RTP) at Malaysia Nuclear Agency is a TRIGA Mark II type reactor and pool type cooled by natural circulation of light water. The reactor uses solid fuel elements in which the zirconium-hydride moderator is homogeneously combined with 19.9% enriched uranium. Demineralised water acts both as coolant and neutron moderator, while graphite acts as a reflector. fuel. The reactor core sits at the bottom of a 6.5m aluminium tank and has 127 locations for positioning fuel elements, control elements and irradiation facilities.

Fuel temperatures were measured in various locations throughout the core with the use of the instrumented fuel element at different power levels. Three new processes for reactor power measurement by thermal ways were developed as a result of the experiments. These processes make it possible on-line or off-line evaluation of the reactor power and the analysis of its behaviour.

Methodology

Performance monitoring involves data acquisition, data qualification and data analysis. These aspects each depend on whether the data is used for dynamic condition monitoring application. There are several possibilities for obtaining data such as retrieve the data manually, retrieve the data that is already viable in the plant computer. Performance monitoring is used for dynamic performance monitoring application such as log and linear power, fuel temperature, water temperature and other nuclear related safety instrument.

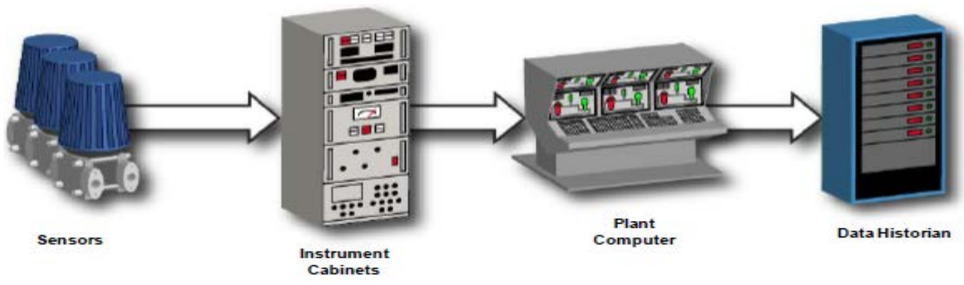

Fig.1: Sensor Data Flow to The Plant Computer and Data Historian

The data can be retrieved either directly from the operator workstation which is located in control room at TRIGA Reactor PUSPATI. The measured values are converted to engineering units before stored in the operator workstation (OWS) to facilities easy understanding by operator

1	$Time	RTP_LF_FP_LIN_PWR_CHC
18958	10:37:58 AM	75.33467
18959	10:37:58 AM	74.80964
18960	10:37:59 AM	75.22388
18961	10:38:00 AM	75.01677
18962	10:38:00 AM	74.9108
18963	10:38:01 AM	74.48212
18964	10:38:01 AM	74.55435
18965	10:38:01 AM	74.75184
18966	10:38:02 AM	74.62179
18967	10:38:02 AM	74.74221
18968	10:38:03 AM	74.90116
18969	10:38:03 AM	74.95415
18970	10:38:04 AM	74.70368
18971	10:38:04 AM	75.09865
18972	10:38:05 AM	75.10346
18973	10:38:05 AM	75.11311
18974	10:38:06 AM	75.09865
18975	10:38:07 AM	74.97342

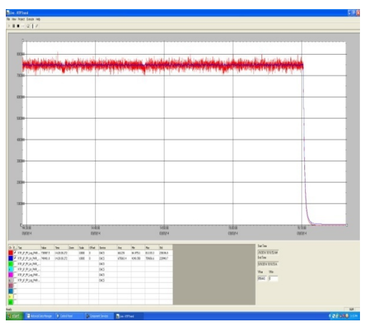

Fig.2: Typical Data From The Operator Workstation(OWS)

Result

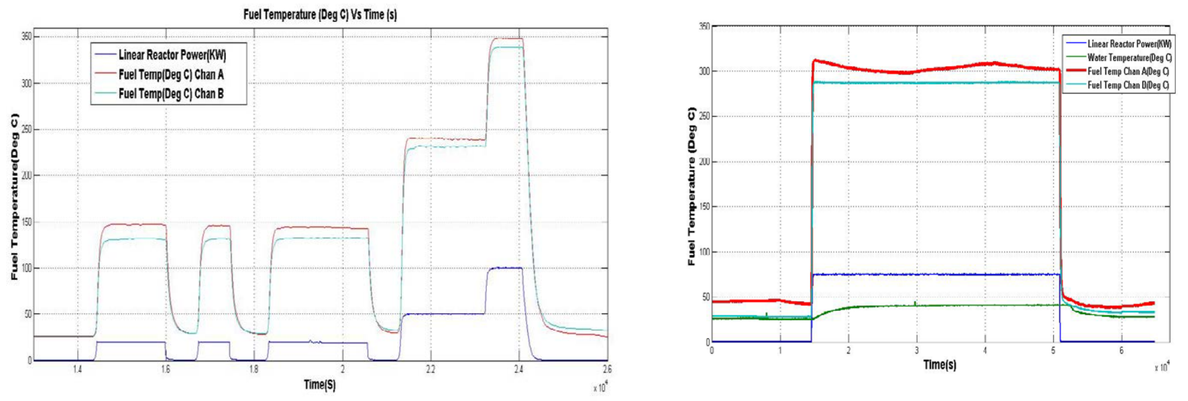

Fig.3: Fuel Temperature Patterns in the reactor pool at 750kW and I MW thermal power during semi annual maintenance and normal operation day

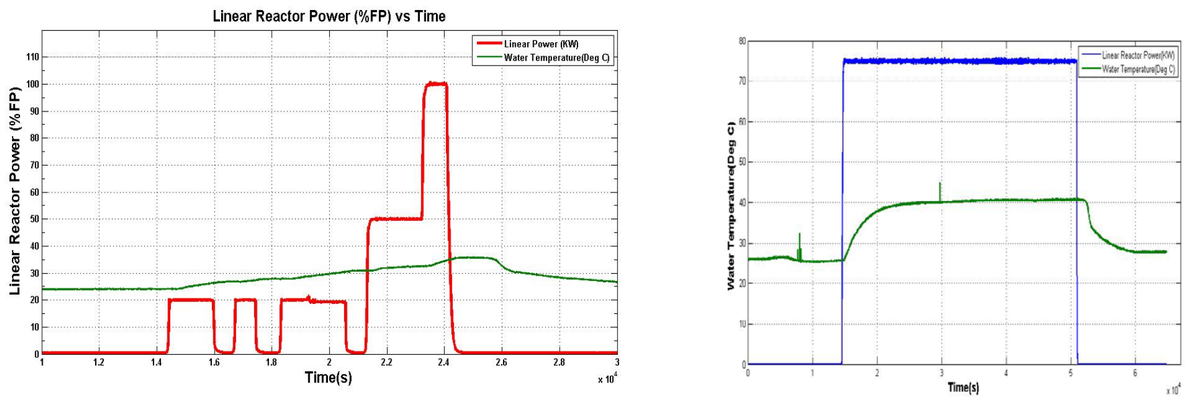

Fig.4: Water Temperature patterns in the reactor pool at 750kW and 1MW thermal power during semi annual maintenance and normal operation day

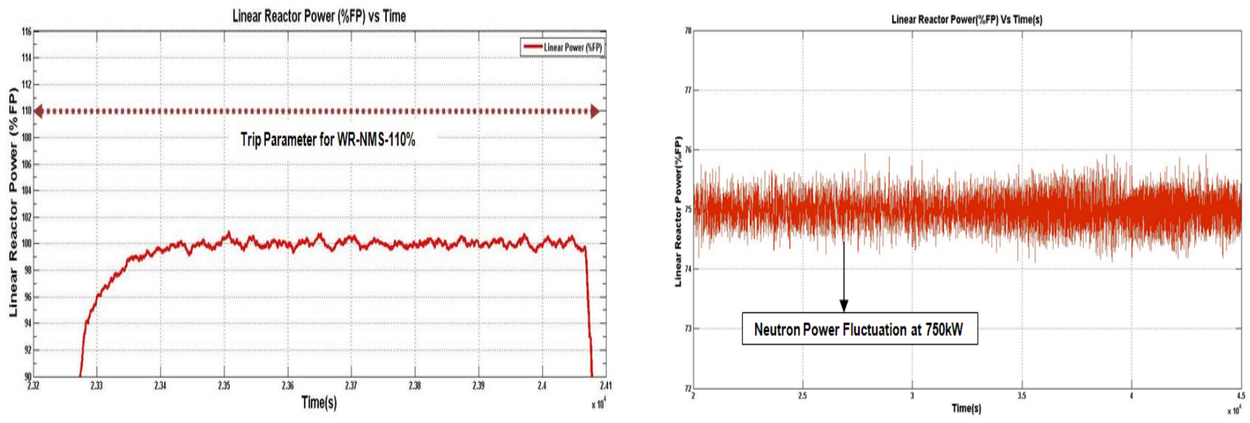

Fig.5: Linear power WR-NMS as a function of Reactor Protection System

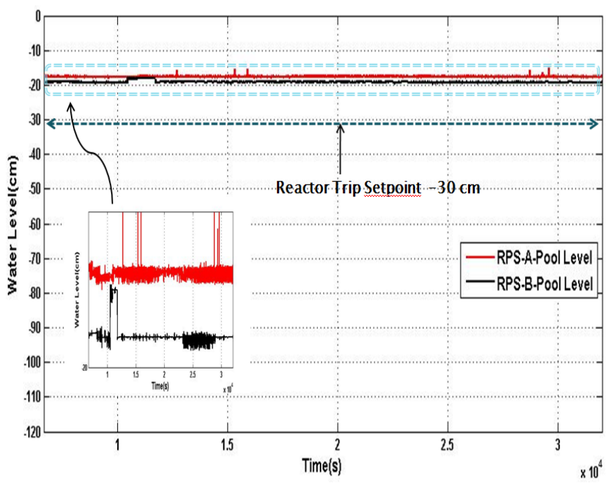

Fig.6: Water Level as a function of Reactor Protection System(RPS)

Discussion

Performance monitoring based on linear power, fuel temperature, water level and water temperature is evaluate to identify any abnormal condition happen during semi annual maintenance and normal operation at 750kW and 1MW thermal power in PUSPATI TRIGA Reactor (RTP)

Conclusion

This project is just purpose of monitoring performance of safety related instrumentation which the noise is high in WR-NMS channel A&B compared to Channel C. for water temperature detector RTD have response error when trip test which is not part of trip parameter testing.
For further study will focus on artificial neural network for fault detection in reactor I &C.

Reference

Improved instrumentation & control maintenance techniques for research reactor using a plant computer, CRP report, May 2015, IAEA