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Title: DOE and JAEA Field Trial of the Single Chip Shift Register (SCSR)

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Background

Los Alamos National Laboratories (LANL) has recently developed a new data acquisition system for multiplicity analysis of neutron detector pulse streams. This new technology, the Single Chip Shift Register (SCSR), places the entire data acquisition system along with the communications hardware onto a single chip. This greatly simplifies the instrument and reduces the size. The SCSR is designed to be mounted into the neutron detector head alongside the instrument amplifiers. The user's computer connects via USB directly to the neutron detector eliminating the external data acquisition electronics entirely.

JAEA, through the INSEP program, asked LANL to demonstrate the functionality of the SCSR in Tokai using the JAEA Epithermal Neutron Multiplicity Counter, ENMC. In late September of 2015 LANL traveled to Tokai to install, demonstrate and uninstall the SCSR in the ENMC. This report documents the results of that field trial.

Schedule

- Sept 29 AM : Perform baseline measurements
- Sept 29 PM : Replace derandomizer with SCSR
- Sept 30 AM/PM: Perform MOX sample measurements
- Oct 1 AM: Remove SCSR and reinstall derandomizer
- Oct 1 PM: Perform verification measurements.

Field Tests

Comparison measurments included four different MOX sources and background measurements. Long term stability was also evaluated. The four sources used are listed in Table 1.

Table 1.
MOX Sources

Sample ID	Declared Pu mass (g)
A0474	16.055
C1025-4	62.615
C1025-2	250.468
C1025-1	542.682

The comparison between the baseline measurements and the SCSR measurements identified a difference between the AMSR and the SCSR. This difference was expected and is due to the different clock speeds of the old AMSR, 4MHz, and the new SCSR, 50MHz. The new SCSR has a much finer resolution for recording the input pulses which results in a smaller effective predelay. This smaller effective predelay results in larger doubles and triples as seen in Figure 1.

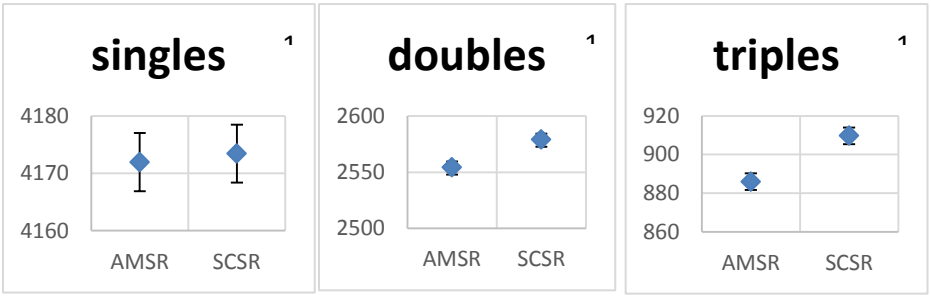

Figure 1. Initial AMSR to SCSR comparison measurement results.

The ENMC was then connected to the faster JSR-15 data acquisition module and comparison measurements resumed. Comparisons between the JSR-15 and the SCSR were successful and demonstrated that the SCSR had the same performance as the JSR-15. See Figure 2 for the comparison data.

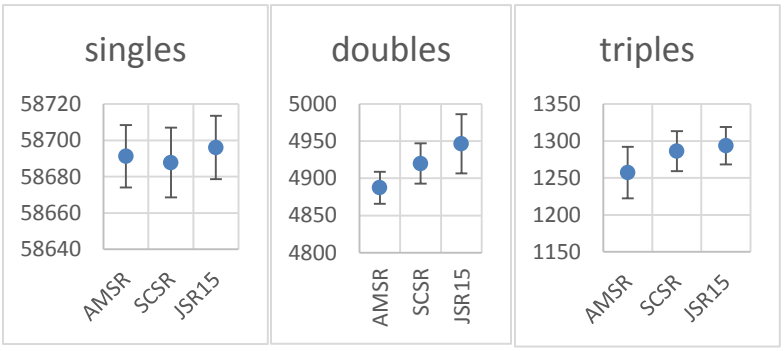

Figure 2. Comparison between AMSR, SCSR and JSR15 instruments.

To demonstrate the stability of the SCSR, an overnight measurement was performed. The measurement results for the overnight measurement are shown in Figures 3 – 5.

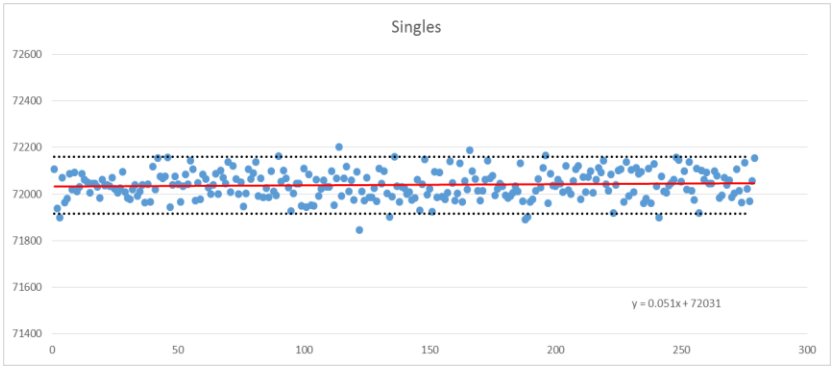

Figure 3. Overnight singles measurement results.

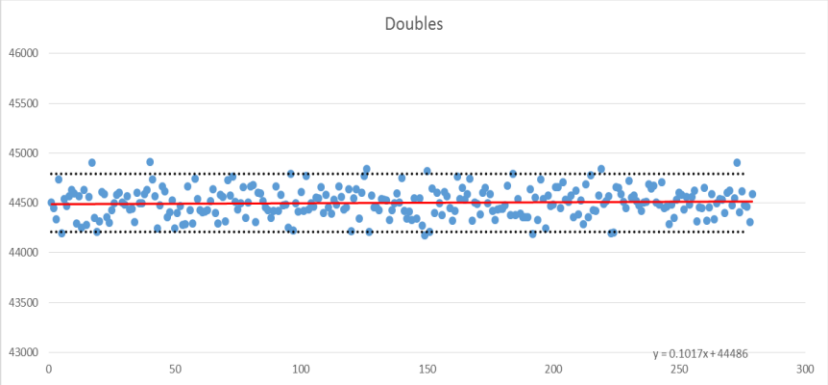

Figure 4. Overnight doubles measurement results.

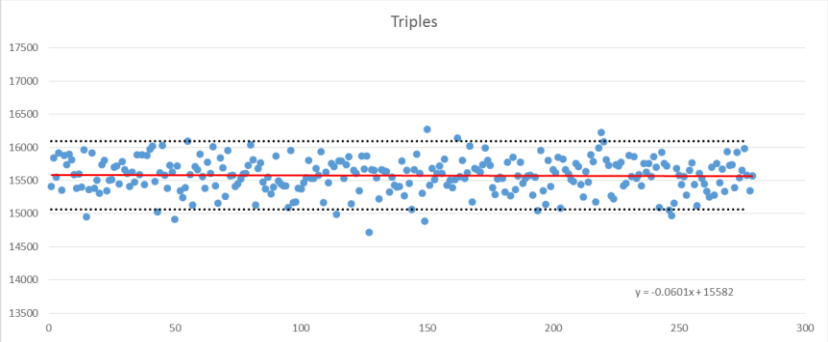

Figure 5. Overnight triples measurement results.

Summary

The field trial performance demonstration of the SCSR in the JAEA ENMC was successful in demonstrating the consistent performance of the new SCSR device when compared to the IAEA accepted JSR-15. The count rates obtained with the SCSR and the JSR-15 were consistent for all four MOX samples and the long term stability of the SCSR was confirmed. Ease of installation when replacing the existing derandomizer with the new SCSR was also proven. The new SCSR easily installed into the position of the existing derandomizer.

Future work

Future work with the SCSR and the ENMC may include a permanent replacement of the ENMC derandomizer with the new SCSR. The SCSR has all the outputs necessary to run the ENMC without any changes to the data acquisition system. A permanent installation may include improved HV wiring with a direct connection from the SCSR to the HV section of the ENCM without external cabling. Other work on the ENMC that does not involve the SCSR may be include combining the 27 amplifier channels into one serial string and then transmitting those 27 serialized signals out though a single copper connection. The 27 signals could be de-serialized externally and used to connect to a list mode time stamping data acquisition system.