cavendish nuclear

Cavendish Nuclear's novel neutron counting electronics technology.

PRODUCTS AND SERVICES:

Neutron Counting Electronics

OVERVIEW

Cavendish Nuclear's proprietary neutron counting electronics is a proven and reliable neutron detection signal collection and data processing technology that has been deployed on new instrumentation and is suitable for replacing obsolete or alternative neutron counting electronics systems.

KEY POINTS

- High reliability design
- Simple low-cost system
- Improved accuracy and sensitivity
- Scalability
- Ease of maintenance and diagnostics
- Flexible processing algorithms
- Safeguards applications
- New systems or upgrades to existing neutron detection systems

OUR SOLUTION IN BRIEF

The Cavendish Nuclear neutron counting technology allows each neutron detection event made by the system to be assigned a unique address indicating which detector recorded the event and also a precise time of detection using the Cavendish Nuclear timestamper card.

The acquired data is treated as a set of neutron multiplicity frequency histograms which may be processed within the system software to perform total neutron counting, neutron coincidence counting or neutron multiplicity analysis.

OUR PRODUCT IN DETAIL

Cavendish Nuclear's state of the art neutron counting technology has numerous advantages over other neutron counting systems, including:

- improved reliability
- simpler and lower cost system design
- improved accuracy and reliability
- scalability
- easier maintenance and diagnostics
- the wealth of information recorded by the hardware allows for greater flexibility in the data analysis algorithms

System Design and Operation

Three unique components are at the heart of Cavendish Nuclear's neutron counting electronics: amplifiers, hub units and a timestamper.

Head amplifiers are directly coupled to the detector tube. The signals from these amplifiers are then sent to hub units, used as a local node, where they are processed. The hub units also provide the low and high voltage supplies required by the amplifiers / detectors.

Each hub unit is capable of powering and receiving data from up to 8 amplifier/ detector units.

The hub unit converts the analogue signal into a digital address that references the detector in which the pulse originated. This digital address corresponding to the detection of a neutron is sent via a high speed fibre optic link to a timestamper unit that determines the precise time of arrival of the neutron signal.

The timestamper adds the time/date stamp to the address data so that the origin and time of detection of every neutron event is logged.

The timestamper is located in a PC known as the Data Acquisition Computer (DAC). The data is processed on the DAC to determine the number of single, double, triple and higher order neutron events. The data is then transferred via Ethernet connection to a Data Processing Computer (DPC) which processes these results for the specific application.

Key Features and Benefits

Improved Accuracy and Sensitivity

High count rates with very low dead-times are possible due to the system architecture and design. Each detector is fitted with an individual close-coupled amplifier, reducing pulse pile-up.

Event handling (de-randomising concurrent neutron events - important for coincidence and multiplicity counting) at each hub ensures that dead time losses are minimised.

Scalability

The system can accommodate up to 240 detectors distributed over 30 hubs on a single fibre optic data ring feeding into one DAC. Expansion beyond this point is possible using additional fibre optic rings and networked DACs.

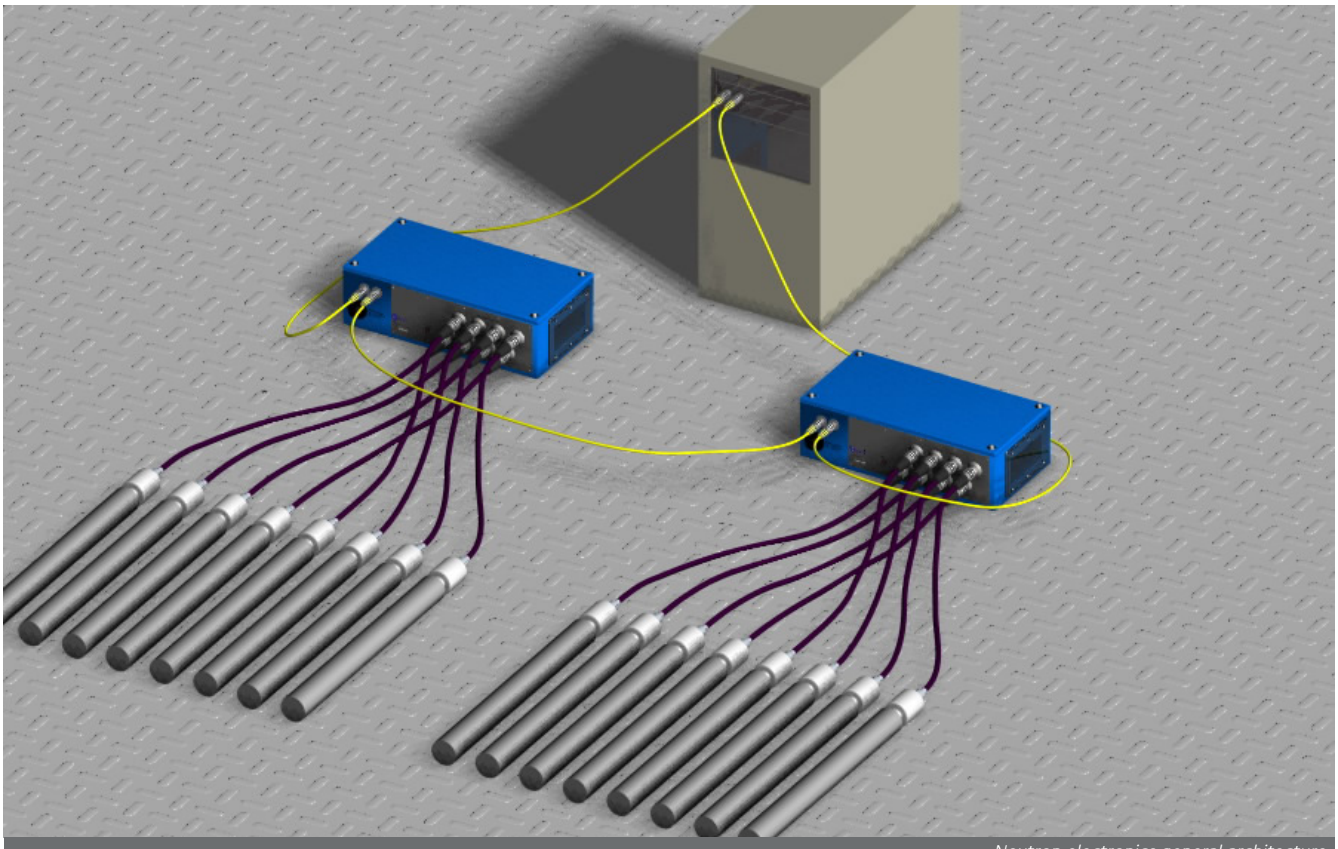
Flexibility

The system offers a flexible configuration and application using only three standard modules. Detectors are grouped in any configuration and many types of counting analysis can be performed.

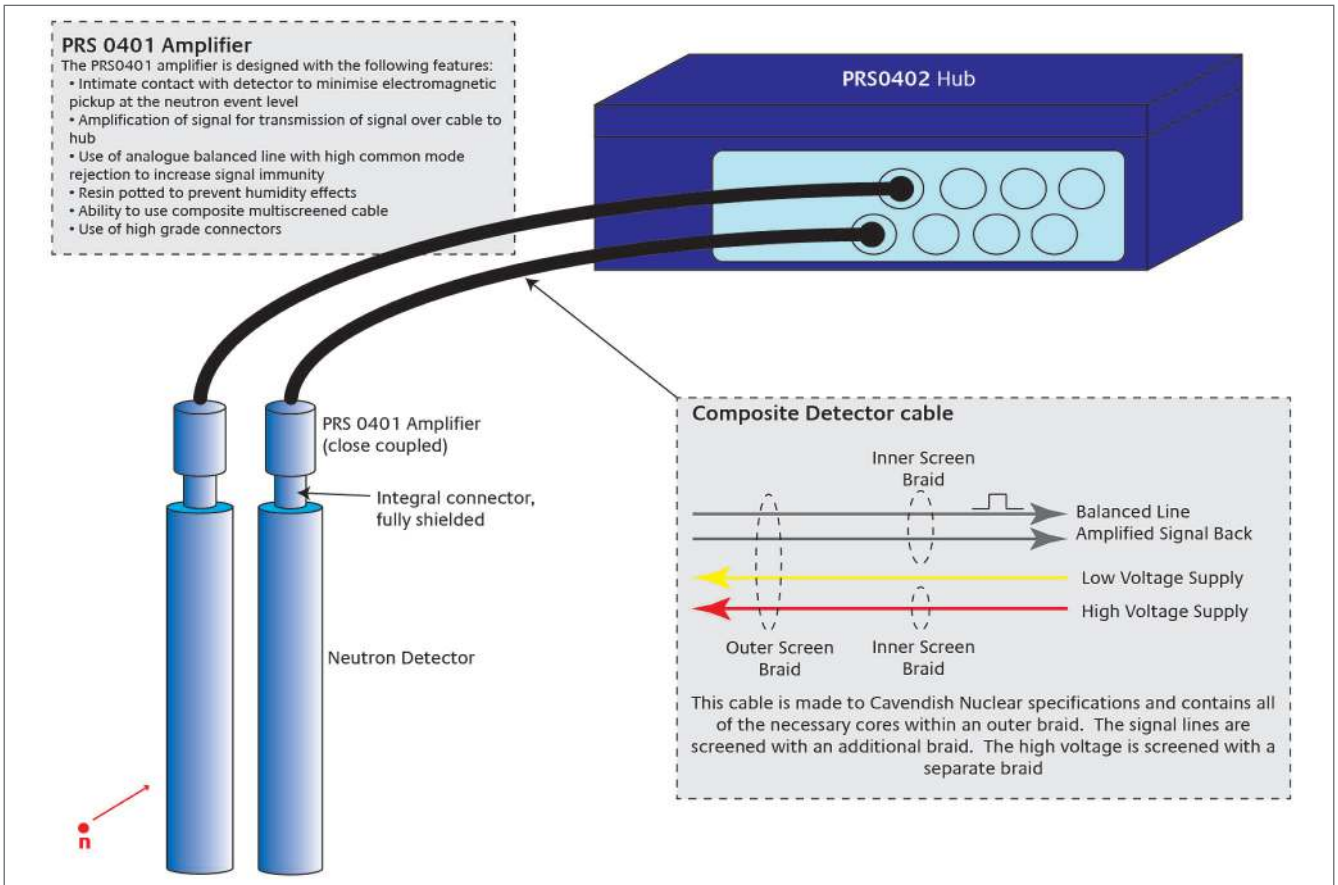
Data can be acquired individually for each detector, combined into detector groups, or as a system total. Each individual detector can be used in more than one grouping, with all data processing and analysis being performed within the application software

The system can be configured to perform total, coincidence or multiplicity analyses without the need for alternative or additional hardware.

Changes to processing algorithms may be made and the data reanalysed without the need for hardware changes or to reacquire the raw data.



Neutron electronics general architecture



Features of the neutron amplifier and associated cabling.

Amplifier.

Hub unit.

Timestamper.

Cost Savings

Installation costs and disruption to plant are significantly reduced by the use of a single fibre optic loop replacing the multiple detector-amplifier cables typical of older systems.

Simplification of the detector cabling topology by the use of a composite detector cable enables power to the amplifiers and return signals from the amplifiers to be made over a single cable.

The use of close-coupled slim-line amplifiers means that there is no need for separate equipment racks dedicated to housing banks of amplifiers. Similarly, the use of software based data acquisition and processing removes the need for dedicated counting cards, time correlation analysers and signal splitting hardware.

Reliability

As the amplifiers are mounted directly onto the neutron detectors, there is a greatly reduced susceptibility to noise interference on the unamplified signal. The amplified signal passes through a double-screened cable and is highly noise-immune due to the amplification process and common mode noise rejection techniques employed.

Data is transmitted digitally from the hubs to the DAC using fibre optics so there is complete noise immunity from electromagnetic interference.

The highly robust amplifiers are potted in resin to protect against environmental effects including moisture, minimising any effects on the signal (e.g. condensation).

Maintenance and Diagnostics

The system is modular with only three components. All components are interchangeable.

The power supplies for the amplifiers and high voltage for the detectors are integrated into the hubs. There are no user serviceable or adjustable parameters necessary at the amplifiers either during commissioning or normal operations.

Remote diagnostic data and status signals are sent back from the hubs to the DAC allowing automatic system monitoring and alarming of malfunctions or abnormal conditions.

Control of the hub operation can be performed remotely from the DAC without the need for local plant access. This allows the operator to configure

system settings, turn on or off detector high voltage, etc. without the need to enter the process areas of the plant.

Tamper-proofing for Safeguards Applications

The low cost amplifiers are potted in an electrically insulation resin that prevents access to the internal circuitry. This prevents the injection of spurious or misleading signals into the amplification stage. Close coupling of the amplifiers onto the detectors prevents spurious pulses from being injected into the amplifier input.

The use of hubs means that smaller and fewer sealable enclosures are needed to cover distributed systems. The hub design has been optimised to permit their incorporation into safeguardable enclosures.

The fibre optic ring used to transmit data from the detection systems to the data analysis computers is continually monitored for continuity and tampering using a watchdog signal. This improves the tamper-proofing of the system and enhances its applicability within regulatory environments.

The technology used can meet the additional requirements of safeguards authorities, particularly the International Atomic Energy Agency (IAEA). Control and configuration of the system may be performed remotely, subject to appropriate security controls, via the fibre optic data ring without the need for the operator to access these components directly. This alleviates the problem of breaking and re-making seals in the regulatory environment

Applications

The neutron counting technology can be deployed on any system which requires the high speed processing of neutron generated pulses from detectors. Systems already deploying the technology range from a waste assay system with 12 detectors to a large distributed system with 140 detectors located throughout a process plant.

The system provides benefits for large distributed neutron systems providing a high noise immunity system with simple cable topology. It also improves the measurement performance for specialist instruments such as neutron multiplicity or coincidence counting systems by providing a low dead-time, multi-group counting platform.

Upgrading Old Electronics

The neutron counting electronics on any system has the potential to be upgraded with Cavendish Nuclear's neutron counting electronics. Cavendish Nuclear supply all of the hardware building blocks (amplifiers, hubs and timestampers) plus the software for the DAC to collect and process the timestamped neutron pulses.

The DAC software interfaces to the application software on the DPC which can be supplied by Cavendish Nuclear or from other systems.

For new systems the amplifiers are directly coupled onto the HN connectors of the neutron detectors although alternative couplings can be used for other detector tubes.

Performance

- Maximum of 8 detectors per hub unit
- Maximum of 30 hubs per fibre optic ring
- Maximum of 240 detectors per fibre optic ring
- Maximum of 1,000,000 neutron events per second per fibre optic ring
- Mains supply voltage of 90-240Vac for hubs

EMC Testing

Hub and head amplifier tested to:

- BS EN IEC 61326: Electrical equipment for measurement, control and laboratory use, EMC requirements

Timestamper card tested to:

- BS EN 55022: Class A Limit Information Technology Equipment, Radio disturbance characteristics. Limits and methods of measurement
- BS EN 55024: Information Technology Equipment, Immunity, characteristics. Limits and methods of measurement).

This technology is covered by an International Patent: International Publication Number - WO 00/67044.

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