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Log-N/Period Sensitivity Analysis

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Joshua David Lepus

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Idaho National Laboratory
Idaho Falls, Idaho 83415

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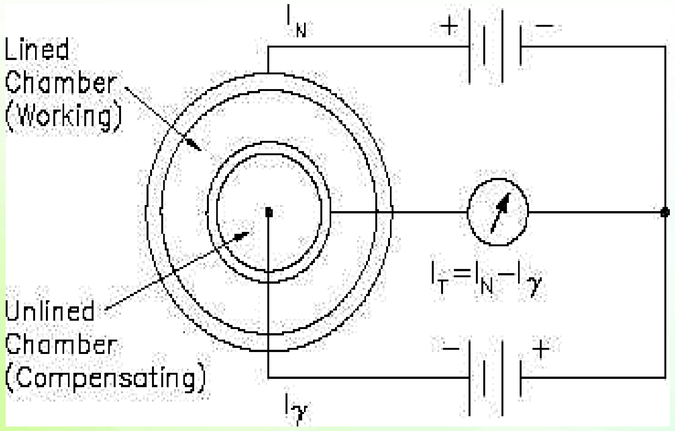
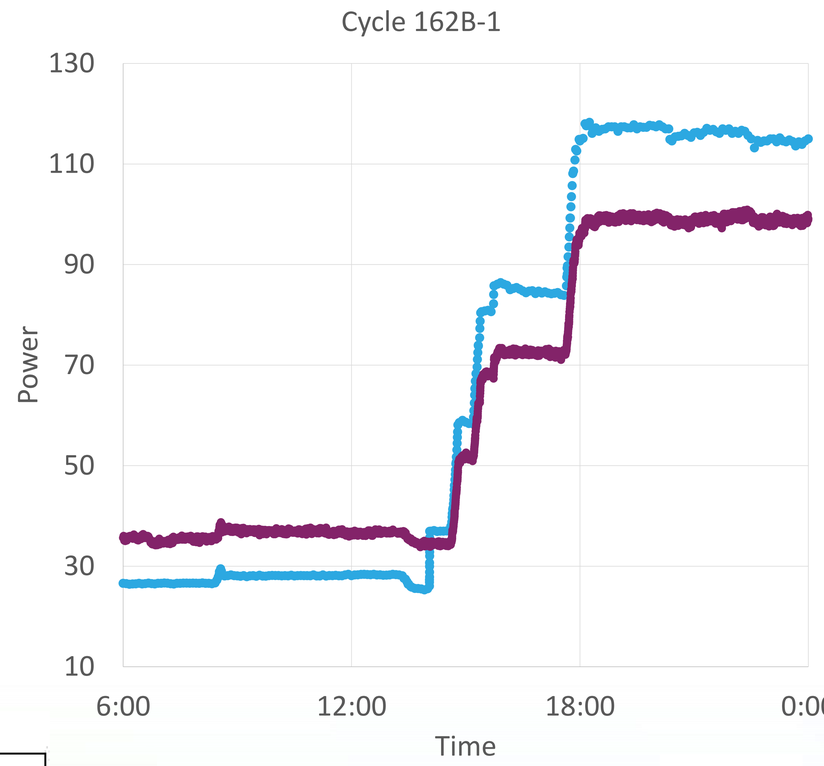
By: Joshua Lepus
Weber State University
Organization: G411
Mentor: Adam Gerth

How It works.

The Log-N/Period system uses a compensated ion chamber to measure power in the reactor core. The detector is made of two concentric chambers that are filled with a gas. One chamber is coated so that the chamber gas is ionized by neutrons and gamma rays. The other chamber is unlined resulting in ionization by gamma rays only. When the gas in the chambers is ionized a current is produced. The difference between the currents from the lined and unlined chambers is equal to the current produced from neutron radiation. This current is then used to provide indication to operators.



Simplified diagram of a compensated ion chamber. This diagram is from https://nuclearpowertraining.tpub.com/h1013v2/css/Figure-20-Compensated-Ion-Chamber-With-Concentric-Cylinders-60.htm



This graph shows the Log-N channel 4 indication and Waterpower calculator trendlines for cycle 162B-1. An accurate indication for Log-N during this cycle would align perfectly with the indication from Waterpower Calculator. Log-N indicates in units of N_L which is equal to 1% of full power. Full power for this cycle is approximately 100 MW.

What it tells us.

The Log-N/Period system has two functions. First, it indicates power in the reactor while in the intermediate range. The intermediate range is between startup power and full power. Second, it shows the rate at which power in the reactor is increasing by a factor of e, also called the reactor's period. The reactor's period is important for identifying when the reactor has gone critical.

Why is it important?

The Log-N/Period system is used to determine when the reactor has gone critical. Having a more accurate value for sensitivity allows engineering to more accurately determine where the power off set potentiometer should be set to provide a more accurate indication.

Cycle	Power Offset Turns	Lobe Power	Log-N Indication	Sensitivity (µAmps/MW)
169A-1	3.88	6.987	33.26	2.93
168B-1	4.06	7.355	34.75	2.77
168A-1	4.15	6.629	32.76	2.83
166B-1	3.97	7.925	36.01	2.73

This table contains a subset of the data used as well as the resulting sensitivity values for the given cycles for Log-N channel 4.

$$Sensivity = \frac{(1.8E-11)10^{\left[\log(Indication)+5-\frac{Power\ Offset}{(6.66*1.25)}\right]}}{Lobe\ Power}$$

Average Old Sensitivity (µAmps/MW)	3.77
Average New Sensitivity (µAmps/MW)	2.81

This table contains the old and new sensitivity values for Log-N channel 4 .

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