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**ESTIMATION OF THE
DISCRIMINATION VOLTAGE
AND POLARIZATION OF
THE FISSION CHAMBER
IN THE START-UP CHAINS
OF THE RP10 NUCLEAR
REACTOR**

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Abstract: This paper presents the results of tests to calculate the integral curve and saturation curve of fission counters installed in the RP-10 Nuclear Reactor, which allows the polarization voltage of the detector and the discrimination level of the start-up amplifier to be determined.

Keywords: Integral Curve, Saturation Curve, Polarization Voltage, Discrimination Level.

INTRODUCTION

In a nuclear reactor, the evolution of the neutron flux is monitored and controlled by neutron detectors. For the initiation stage, neutron detectors of the fission counter type are used in conjunction with neutron instrumentation called start-up chains [1].

For optimal measurement of the number of neutrons, the polarization voltage must be within its saturation curve and the discrimination level must be within its integral curve [2].

New bias voltages and new discrimination levels were determined after more than 30 years since the first criticality due to the new commissioning and change of fuel elements from uranium oxides to uranium silicides.

INTEGRAL CURVE (DISCRIMINATION PLATEAU)

Curve that allows the level of discrimination in the start-up amplifier to be determined. This adjustable voltage level allows noise to be discriminated, as well as neutrons with energies that have a Gaussian pulse amplitude lower than the discrimination level [3].

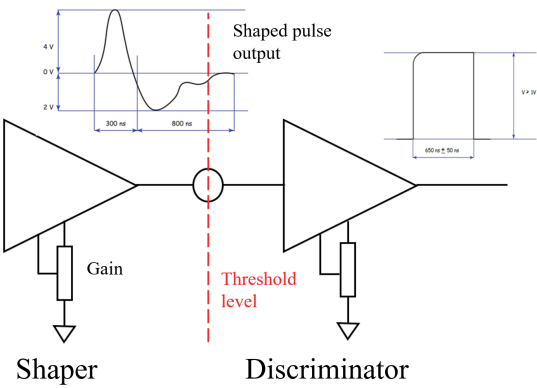


Figure No. 1: Discrimination in the start-up amplifier

SATURATION CURVE (VOLTAGE PLATEAU)

Curve that allows the polarization voltage of the fission chamber to be determined. As the fission chamber is an ionization chamber, it is necessary to determine the plateau of the ionization region [4].

EXPERIMENTAL DEVELOPMENT

EQUIPMENT

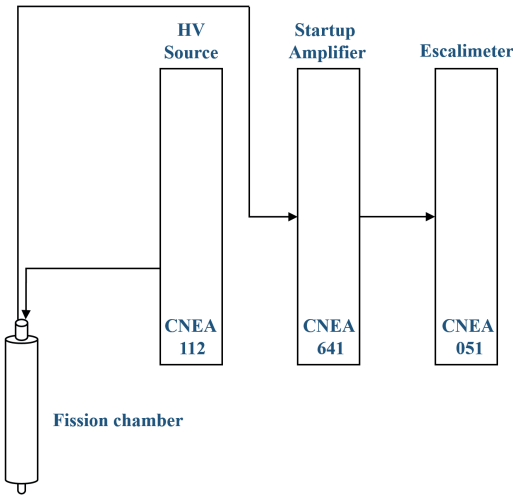


Figure 2: General diagram

METHOD

An oscilloscope was used to verify and adjust the amplitude at the output of the Gaussian pulse shaper to 4V.

The time constant of the escalimeter was set to 2 seconds.

Data was collected from the residual neutrons, with all safety and control rods inserted in the reactor.

Using a potentiometer, the discrimination level was varied from 0.1 volts to 5 volts in the start-up amplifier and the Escalimeter count values were recorded.

The new discrimination level is adjusted and the Escalimeter is recorded at different voltage levels between 10 and 550 volts with the high-voltage source, and the saturation curve is plotted to determine the polarization voltage.

RESULTS

RESULTS OF THE INTEGRAL CURVE

The data is recorded to plot the integral curve of the start-up chains.

Voltage Discr. (Volt)	Count Register N°										Average
	1	2	3	4	5	6	7	8	9	10	
0.10	479k	487k	485k	485k	488k	479k	483k	483k	476k	478k	482k
0.15	299k	298k	298k	298k	298k	296k	298k	298k	297k	299k	298k
0.20	166k	167k	167k	167k	168k	168k	166k	164k	166k	167k	166k
0.25	72k	74k	73k	75k	74k	74k	74k	76k	73k	75k	74k
0.30	28k	27k	28k	27k	28k	27k	27k	27k	28k	27k	27k
0.35	9639	9361	9504	9733	9468	9509	9661	9650	9876	9918	9632
0.40	3162	3060	3046	3229	3061	3155	3161	3328	3150	3194	3155
0.50	416	460	407	406	459	473	421	383	388	408	422
0.60	192	182	201	187	190	176	179	176	165	191	184
0.80	148	160	154	155	150	156	152	161	158	153	155
1.00	160	140	143	155	145	148	160	143	127	164	149
1.25	145	148	141	143	147	166	129	171	147	152	149
1.50	139	125	139	119	143	124	136	139	129	133	133
1.75	127	115	118	134	137	102	109	133	120	112	121
2.00	86	89	85	106	94	97	108	95	89	78	93
2.25	68	74	69	69	67	71	65	66	69	66	68
2.50	64	52	48	42	58	58	61	43	61	46	53
2.75	40	32	31	45	40	39	38	47	43	37	39
3.00	26	28	29	24	15	35	27	18	23	17	24
3.25	20	25	23	20	20	17	18	21	18	18	20
3.50	14	9	9	12	11	15	8	18	11	18	13
3.75	10	6	10	8	14	18	9	10	7	9	10
4.00	4	9	5	10	3	10	8	4	8	7	7
4.50	0	0	0	0	0	0	0	0	0	0	0
5.00	0	0	0	0	0	0	0	0	0	0	0

Table No. 1: Results of data taken from start chain 3.

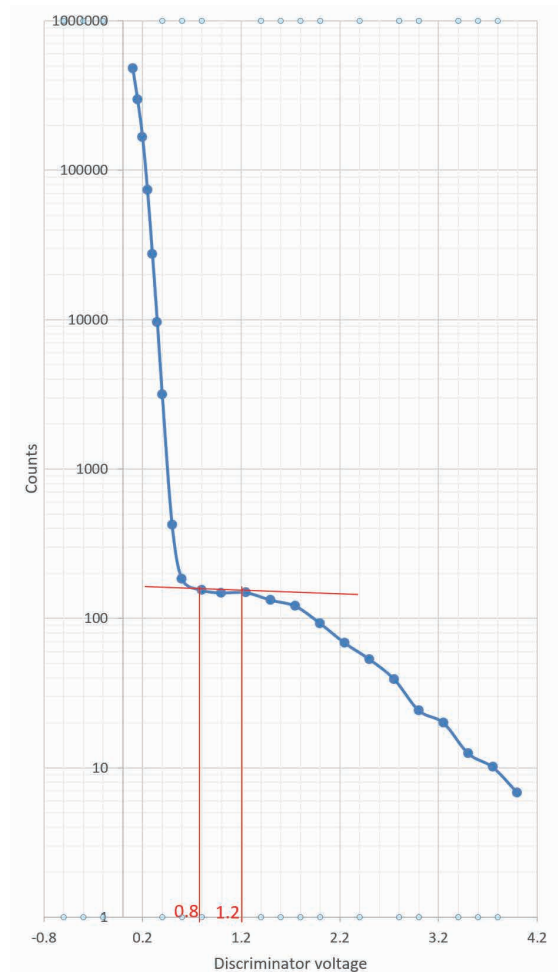


Figure No. 3: Representation of the data obtained from start chain 3.

Graph No. 3 represents the integral curve of start chain 3. To determine the discrimination voltage, an average of the plateau limits is taken. The curves for start chains 1 and 2 were graphed in the same way, yielding the following summary table.

Chain	Previous voltage	Discriminator Voltage
CN401	1.2	1.15
CN402	1.7	1
CN403	1.9	1

Table No. 2: Discrimination voltage

SATURATION CURVE RESULTS

The data is recorded and the saturation curve of the startup chains is plotted.

HV (Volt)	Count Register N°										
	1	2	1	4	1	6	1	8	1	10	1
10	0	0	0	0	0	0	0	0	0	0	0
50	7	6	6	5	9	12	4	7	6	8	7
100	146	130	122	120	132	109	129	132	129	113	126
150	155	151	130	144	127	150	148	134	149	129	142
200	132	149	148	152	146	143	133	155	144	166	147
250	161	148	156	140	132	148	142	152	140	141	146
300	129	144	135	143	170	144	150	145	153	151	146
350	136	139	157	161	146	137	121	138	163	163	146
400	144	148	129	162	169	135	143	165	141	132	147
450	131	156	139	141	152	148	158	150	160	161	150
500	150	139	148	152	160	144	146	144	152	143	148
550	147	152	148	160	155	142	143	149	152	140	149

Table No. 3: Results of data taken from startup chain 3

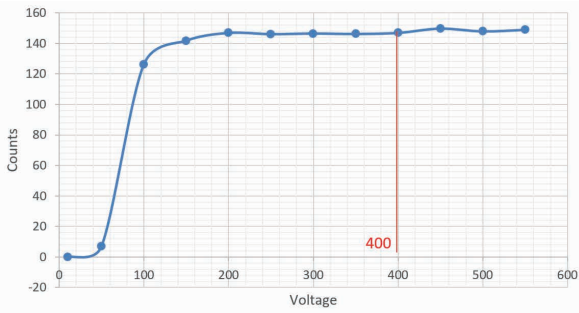


Figure 4: Representation of data obtained from startup chain 3

Graph No. 4 shows the polarization curve of startup chain 3, and the voltage is determined from the graph. Similarly, the voltage curves of startup chains 1 and 2 were graphed, yielding the following summary table.

Chain	Previous voltage	Discriminator Voltage
CN401	400 V	450 V
CN402	400 V	450 V
CN403	400 V	400 V

Table No. 4: Polarization voltage

CONCLUSIONS

The integral curve and saturation curve were successfully represented, and the new discrimination voltages and polarisation voltages of the start-up chains of the RP10 nuclear reactor were determined.

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