

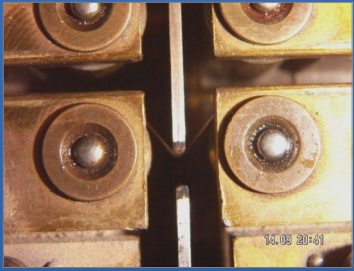
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Ageing Physical Processes and the Technical
Condition Assessment of Power Cables with
Paper-Impregnated Insulation

Dominating Ageing Mechanisms of Paper-Impregnated Insulation



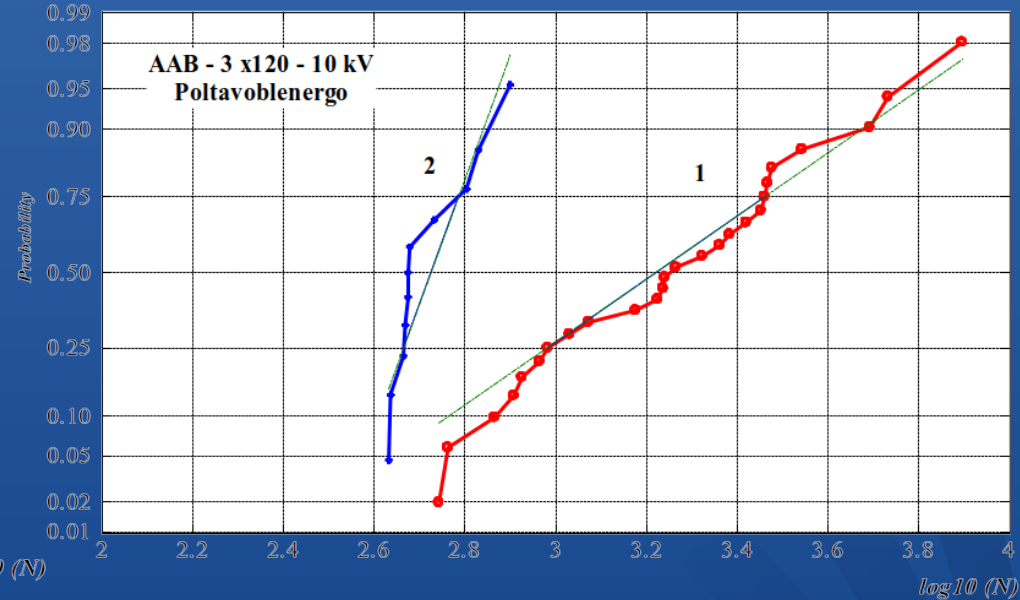
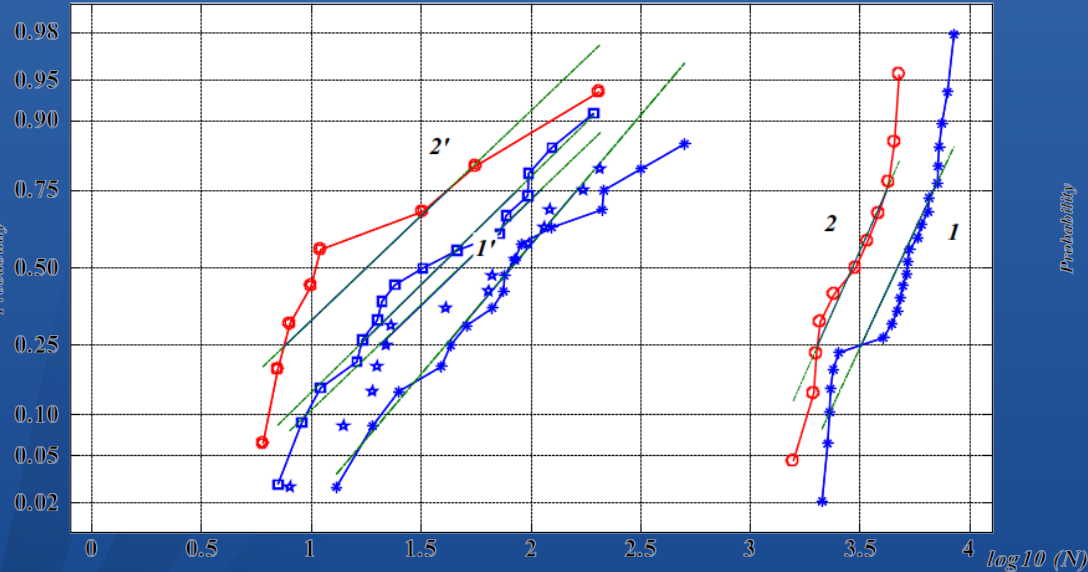
Cross section of a PILC (PIAC) cable sample from NPP



The Limit Paper Insulation State Criteria According to Mechanical Characteristics

Normal Probability Plot

Normal Probability Plot



Double bends number integral distribution functions of the power cables phase and belt insulation of the NPP and the electric network

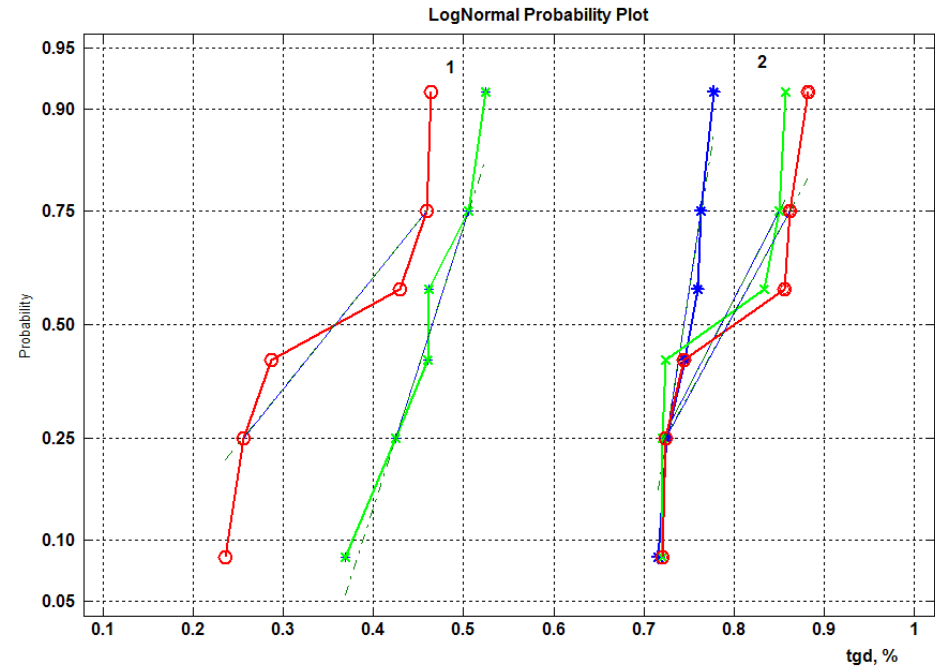
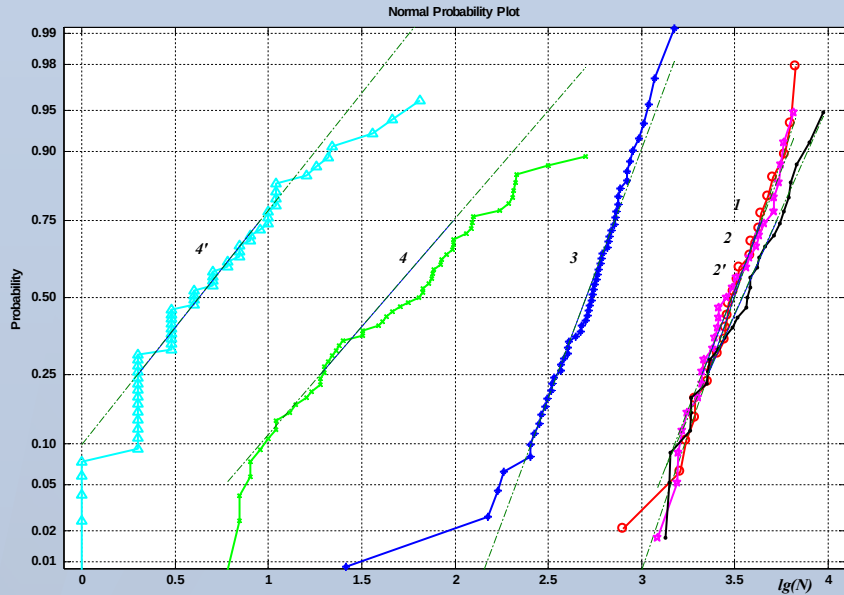
Individual Insulation Components Dielectric Losses Characteristics

Cumulative $tg\delta$ (%) values according to the measurements scheme at the frequency				Restored $tg\delta$ (%) values in insulation components based on the cumulative measurements results			
Scheme	Frequency measurements, kHz			Insulation component	Frequency measurements, kHz		
	0,1	1	10		0,1	1	10
Phase A – relative to the other two and the metal shell	0,435	0,507	1,089	Phase insulation on the phase A	0,4745	0,4927	0,9809
Phase B – relative to the other two and the metal shell	0,444	0,449	0,818	Phase insulation on the phase B	0,4915	0,3831	0,4687
Phase C – relative to the other two and the metal shell	0,467	0,466	0,838	Phase insulation on the phase C	0,5350	0,4152	0,5065
Three phases – relative to the	0,423	0,507	1,088	Belt insulation	0,3337	0,8378	2,4994

Individual Insulation Components Dielectric Losses Characteristics

Insulation component	Test voltage at a 50 Hz frequency					
	1 kV		2 kV		5 kV	
	Capacity C , nF	$tg\delta$, %	Capacity C , nF	$tg\delta$, %	Capacity C , nF	$tg\delta$, %
Individual parameters of the power cable phase insulation before repair						
Phase A	636,3	1,00	616,5	0,891	840,1	1,39
Phase B	639,9	0,99	618,4	0,896	839	1,61
Phase C	damaged					
Individual parameters of the power cable phase insulation after repair						
Phase A	500,756	0,764	501,063	0,8341	504,2875	0,8624
Phase B	498,256	0,777	498,163	0,8511	502,1875	0,8570
Phase C	497,756	0,760	497,463	0,8582	501,5875	0,8830

Correlation Between Individual Mechanical and Electrical Parameters



Linear regression equation between the double bends number and $tg\delta$ at 50 Hz frequency:

Phase insulation: $tg \delta_{ph} = 1.2703541 - 0,000340764 * N, \%$

Belt insulation: $tg \delta_{bl} = 1.2932 - 0,0003 * N, \%$

Thank you for your attention!

