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## The SAKUMA HVDC System

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<b>Interconnection between</b>	The 50 Hz 275 kv AC system at Sakuma Japan.	The 60 Hz 275 kv AC system at Sakuma Japan.
<b>AC System Frequency</b>	50 Hz	60 Hz
<b>AC System Voltage</b>	275 kV	275 Hz
<b>Power Co.</b>	Electric Development Co,Ltd. Tokyo, Japan	
<b>Manufacturer</b>	Toshiba Corporation, Japan for the valve equipment (50 Hz) and the smoothing reactor. Hitachi Ltd. Japan for the valve equipment (60 Hz) Mitsubishi Electric Corporation, Japan for the converter transformers. Nisshin Electric Co., Japan for the AC filters.	
<b>Commissioned</b>	10 th October 1965 with mercury arc valves manufactured by ASEA, Sweden and decommissioned 4th May 1993. 12th June 1993 refurbishment by thyristor valves with the same capacity.	
<b>Main Purpose</b>	Supply of energy between the two AC systems in case of AC network disturbances, lack of energy or economical exchange in either of the systems.	
<b>Main data</b>	300 MW at $\pm 125$ k DC and 2400 A. Overload capacity : None	
<b>A.C. Networks</b>	<p>The converter station is situated about 1 km from the Sakuma Power Station. This station is connected to the 60 Hz, 275 kV AC network via Nagoya with interconnections to Osaka and the Western area.</p> <p>The station is also connected to the 50 Hz Network with interconnections to the Northeastern area.</p> <p>In the vicinity of the Sakuma power systems some hydro power plants are connected to the 50 Hz and 60 Hz systems with a total capacity of approximately 700 MW and 900 MW respectively.</p>	

	<p><u>Converter transformer nos. 1 and 2 :</u> 60 Hz, 2 x 187 MVA, 275 ± 10% / 55 kV (one 4.5 MVA, 275/3.3 kV for auxiliary supply. The three transformers are housed in one tank and they are ordinary 2 winding transformers with separate transformer cores. Min. short circuit capacity = 1750 MVA.</p> <p><u>Converter transformer nose 3 and 4 :</u> 50 Hz, 2 x 183 MVA, 275 ± 10%/54 kV The two transformers are housed in separate tanks. Min. short circuit capacity = 1220 MVA.</p> <p>The 50 Hz and 60 Hz transformers have a sound absorbing metal cover respectively.</p>																																																												
HVDC System	<p>Due to the station design (back to back) there are no transmission lines.</p> <p>The LIWL across the valves is 350 kV.</p>																																																												
Submarine Cable																																																													
Electrodes																																																													
A.C. Filters	<p>Harmonic filters are provided on the 50 Hz and 60 Hz side:</p> <table><tr><th>Har m</th><th>MVA r</th><th>C=μ F</th><th>L=m H</th><th>R=Ω</th><th>Har m</th><th>MVA r</th><th>C=μ F</th><th>L=m H</th><th>R=Ω</th></tr><tr><td>5</td><td>20.8</td><td>0.842</td><td>480</td><td>15.1</td><td>5</td><td>17.4</td><td>0.585</td><td>480</td><td>18.1</td></tr><tr><td>7</td><td>10.4</td><td>0.429</td><td>480</td><td>21.2</td><td>7</td><td>8.7</td><td>0.3</td><td>480</td><td>25.3</td></tr><tr><td>11</td><td>11.7</td><td>0.488</td><td>171</td><td>11.9</td><td>11</td><td>9.8</td><td>0.34</td><td>171</td><td>14.2</td></tr><tr><td>13</td><td>13.0</td><td>0.541</td><td>111</td><td>9.1</td><td>13</td><td>10.8</td><td>0.375</td><td>111</td><td>10.9</td></tr><tr><td>HP</td><td>35.4</td><td>1.49</td><td>14</td><td>100</td><td>HP</td><td>44.3</td><td>1.55</td><td>14</td><td>100</td></tr></table>	Har m	MVA r	C=μ F	L=m H	R=Ω	Har m	MVA r	C=μ F	L=m H	R=Ω	5	20.8	0.842	480	15.1	5	17.4	0.585	480	18.1	7	10.4	0.429	480	21.2	7	8.7	0.3	480	25.3	11	11.7	0.488	171	11.9	11	9.8	0.34	171	14.2	13	13.0	0.541	111	9.1	13	10.8	0.375	111	10.9	HP	35.4	1.49	14	100	HP	44.3	1.55	14	100
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DC Filters	No DC filters are installed.																																																												
HVDC Valves	<p>Direct light triggered and water cooled thyristor valves are used. The valves are self supported, air insulated and they are installed in the existing valve hall.</p> <p>The valve group consists of two 6 pulse converter units and configured in 12 pulse as quadrivalves.</p> <p>Each valve section has 7 thyristors rated at 6000 V and 2500 A in series and none in parallel.</p>																																																												

	This makes a total of 28 thyristors per valve section or 168 thyristors per 6 pulse converter unit.
<b>Valve Cooling</b>	
<b>D.C. Reactor</b>	The smoothing reactor is designed for 125 kV and 0.12 H at 2400 A.
<b>References</b>	<p>"Electra" no. 63 1979, "AC Harmonic Filter and Reactive Compensation for HVDC"</p> <p>A General Survey by SC14 - WG 03. "Upgrading of HVDC Systems" by D.A. Woodford et al., CIGRE International Colloquium on HVDC and FACTS, Wellington, New Zealand, September 1993.</p>
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# THE SAKUMA HVDC SYSTEM

Geographic map

