Power Bridge Project

～ The 8th Japan – Russia Energy and Environment Dialogue in Niigata

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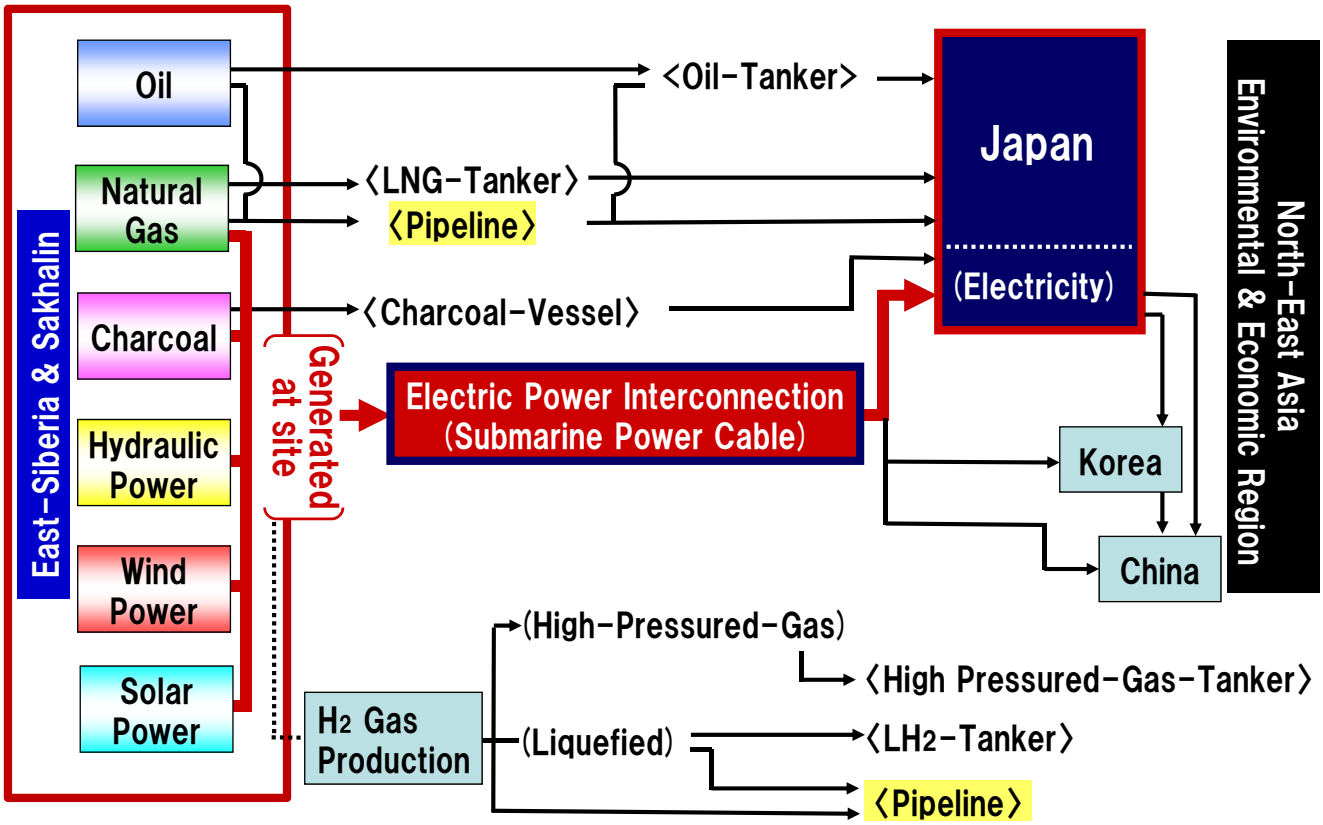
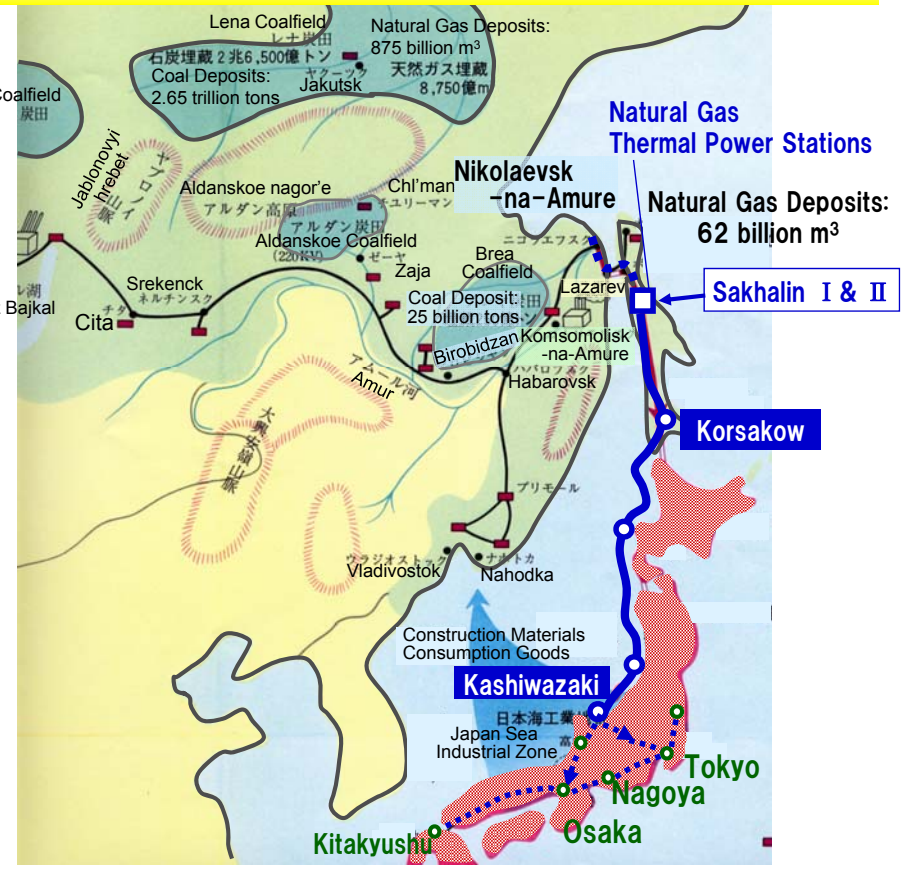
Utilization of Natural Resources in East-Siberia for Electricity



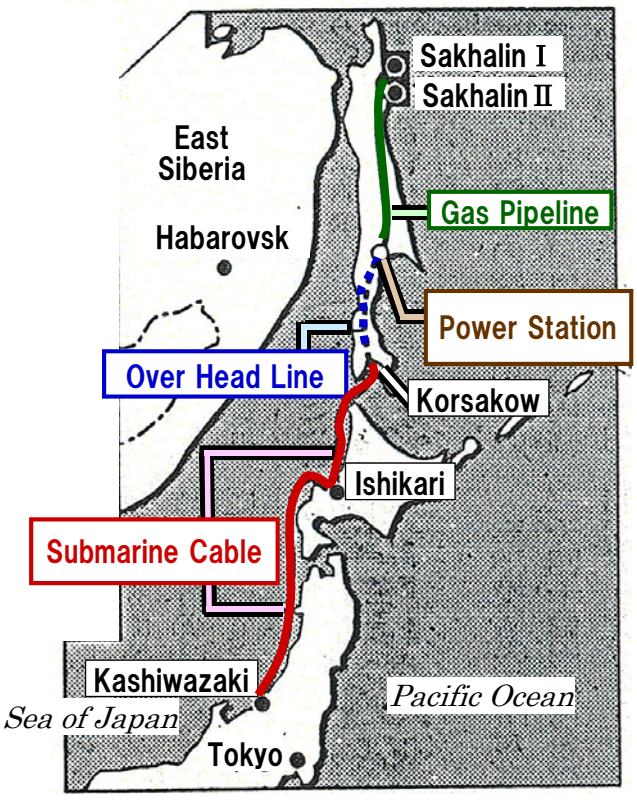
Plan of Electric Power Interconnection between Japan & Russia

Potential Hydro Power of Major Rivers in Siberia
(10 thousand kW)

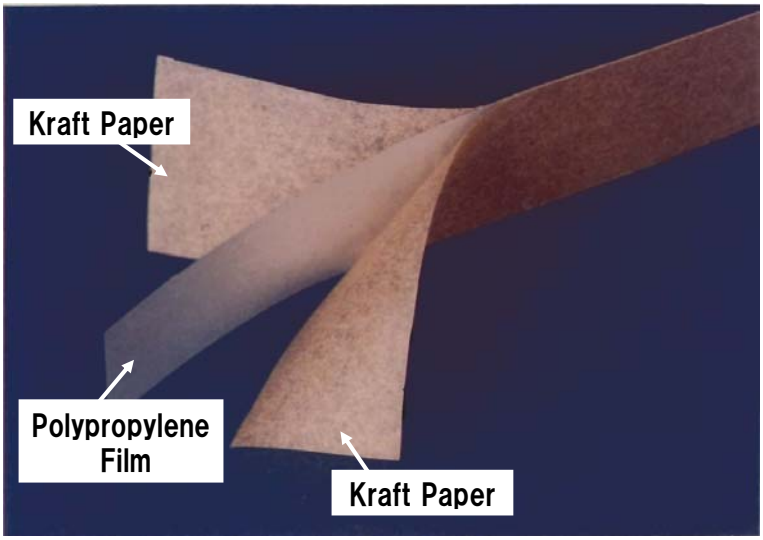
Lena	1840
Enisej	1820
Angara	1400
Amur	1000
Kolyma	810
Indigirka	620
Hatanga	610
Ob	570
Total	8670



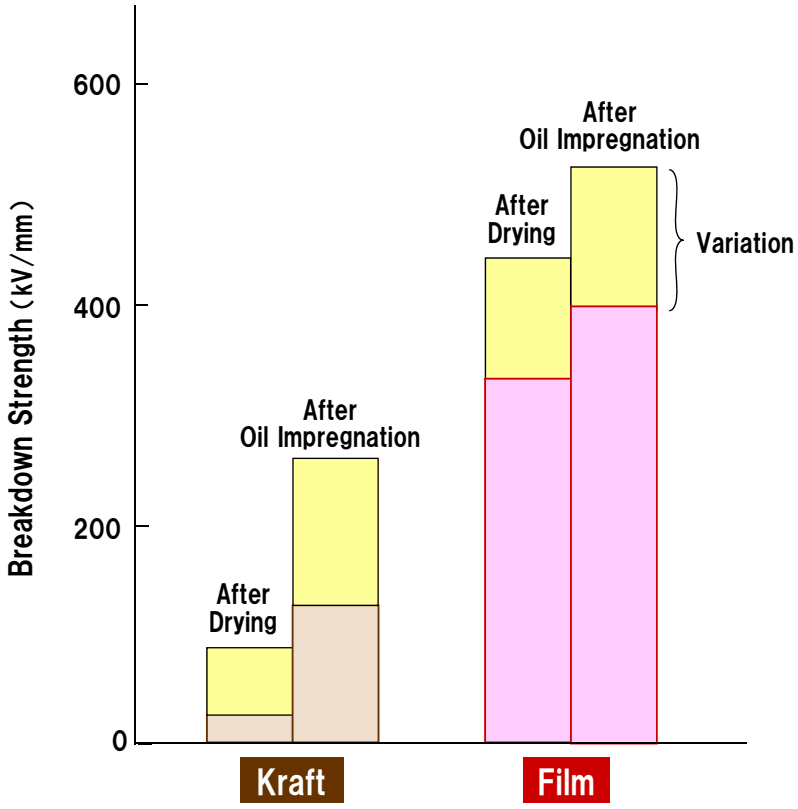
Electric Interconnection of 4GW between Sakhalin and Japan
— Power Bridge Project —



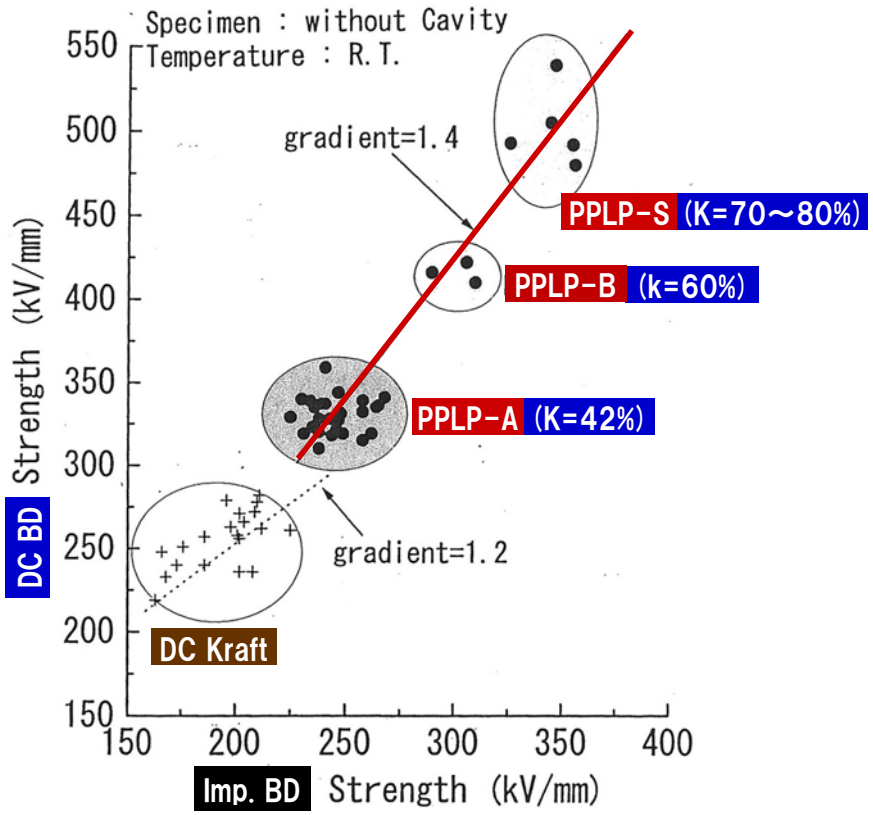
PPLP
(Polypropylene Laminated Paper)



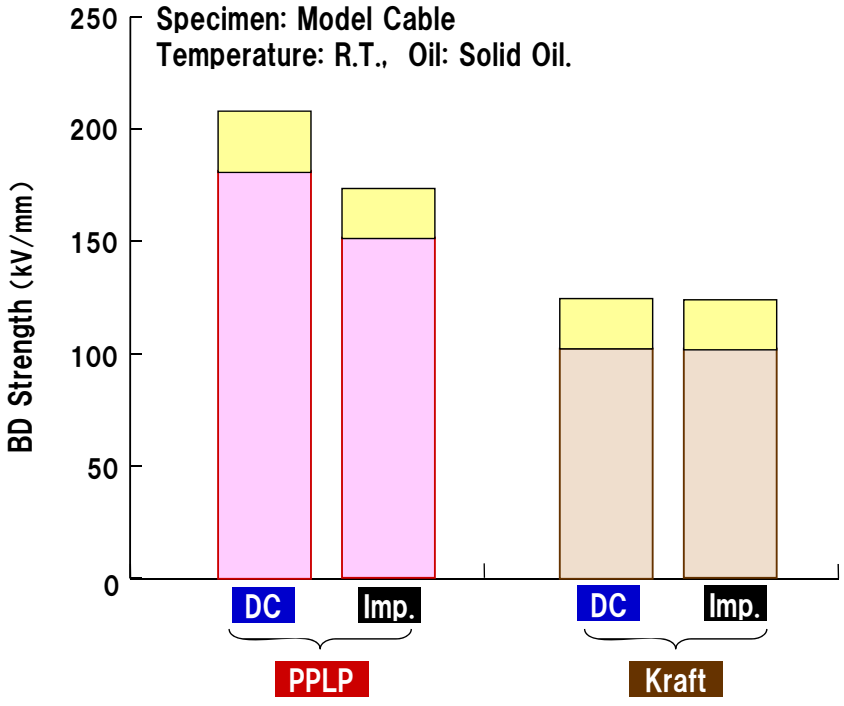
Comparison of Electric Breakdown Strength between Kraft and Film



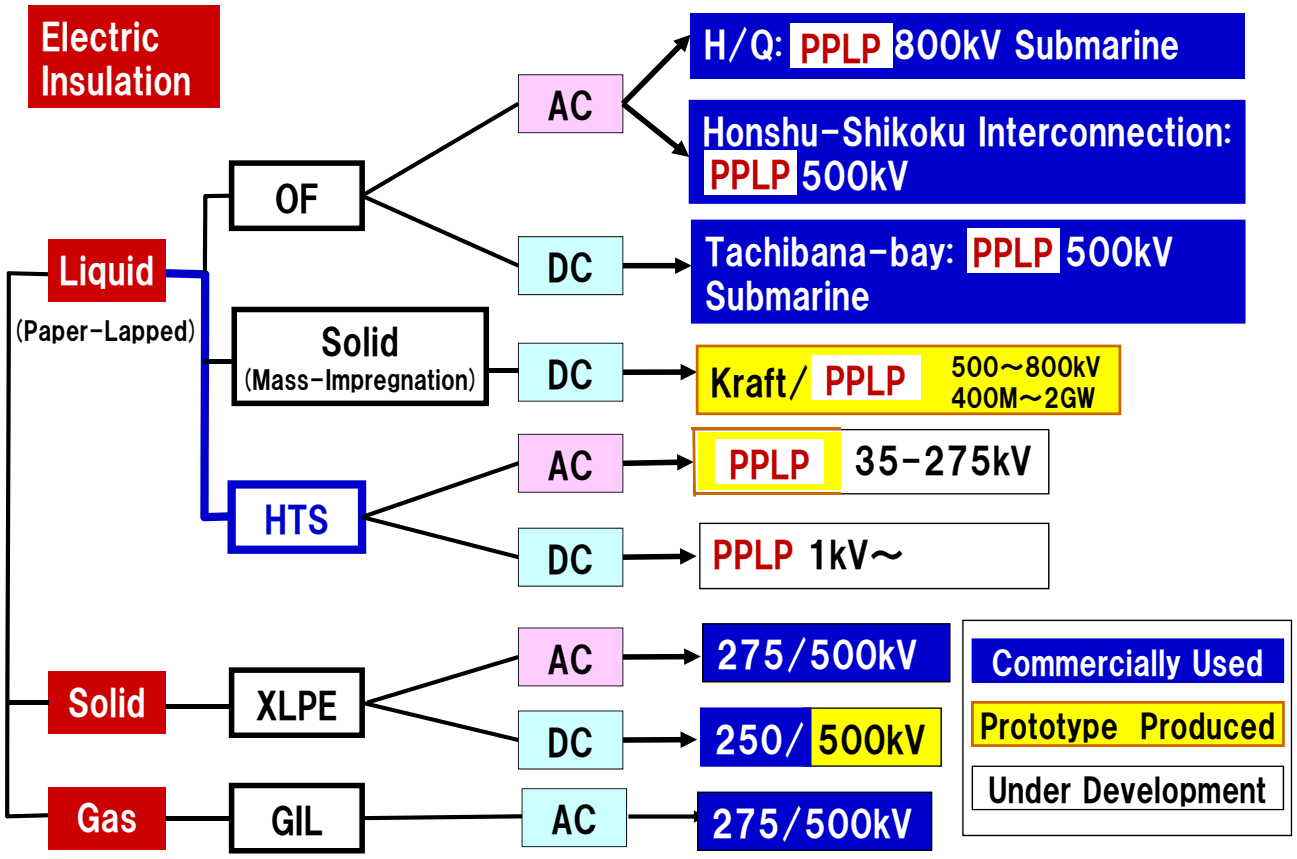
Relation between Imp. BD and DC BD



DC & Imp. BD Strengths of PPLP & Kraft



Underground Transmission Cables



Test on PPLP 800kV Solid (MI) DC Cable at SEI's Kumatori Testing Station

Construction

- ＊Cond.: 2,000mm^2
- ＊Insulation: Kraft/PPLP-A(PP ratio: 40%)/Kraft
- ＊Thickness: 24mm
- ＊Insulation Oil: Medium Viscosity Oil

	Conventional Kraft Solid	PPLP Solid
Max. Voltage (kV)	450	600-800
Max. Current (A)	1,300	2,000
Capacity (MW)	600	1,200-1,600
Target	600kV : 1,200MW In Case of PPLP, Possibly ≒ 800kV 2,000MW	

Test Results

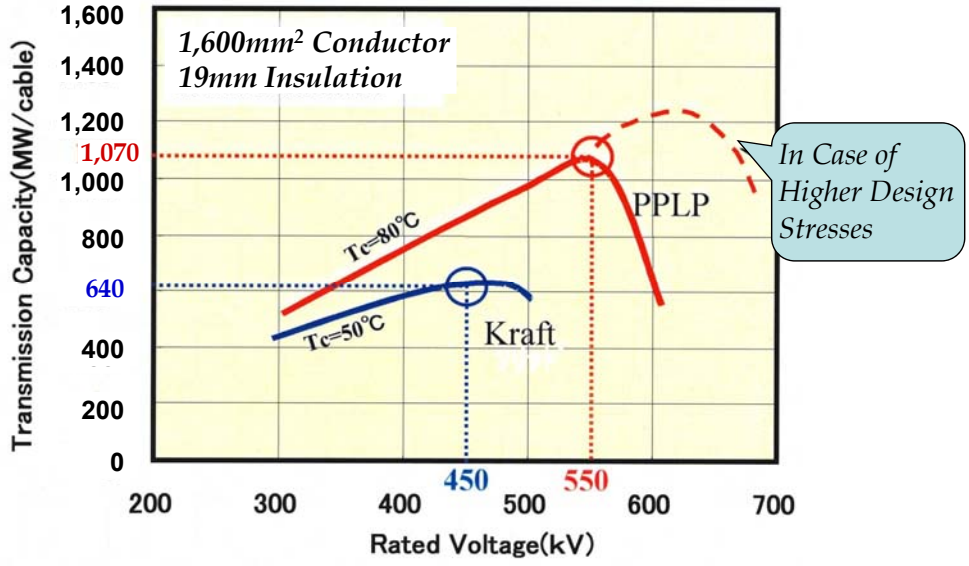
- ＊100℃ Heat Cycle
- ＊DC -800kV OK

Future: PPLP with higher PP Ratio (≒80%) shall be tested

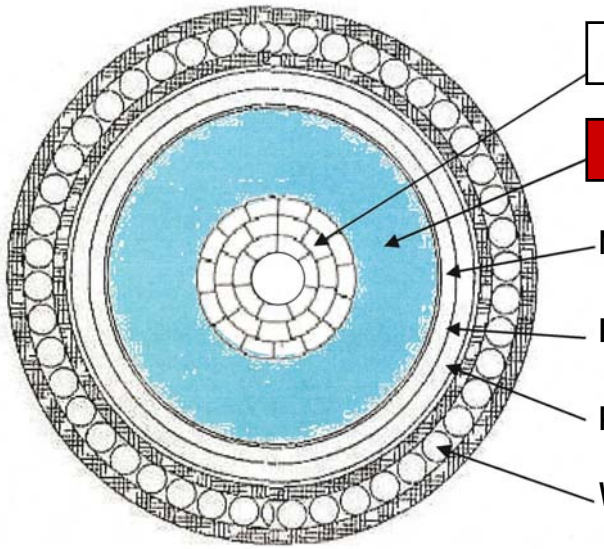
Target and Possible Transmission capacity of PPLP MI Cable

	PPLP Solid	Kraft Solid
DC working (Uo)	40kV/mm	25～30kV/mm
Superimposed Imp. Voltage	100kV/mm	85～90kV/mm
Max. Conductor Temp.(Tc)	80℃	50～55℃
Transmission Capacity／cable	＞1GW	＜600MW

(PP Ratio: 40%)



Construction of DC ±500kV 1GW PPLP Solid Cable



		(kV)
Voltage	±500	±550
		(mm²)
Conductor	1,800	1,600
		(mm)
PPLP Insulation	16.5	19

(PP Ratio: 40%)

Metal Sheath

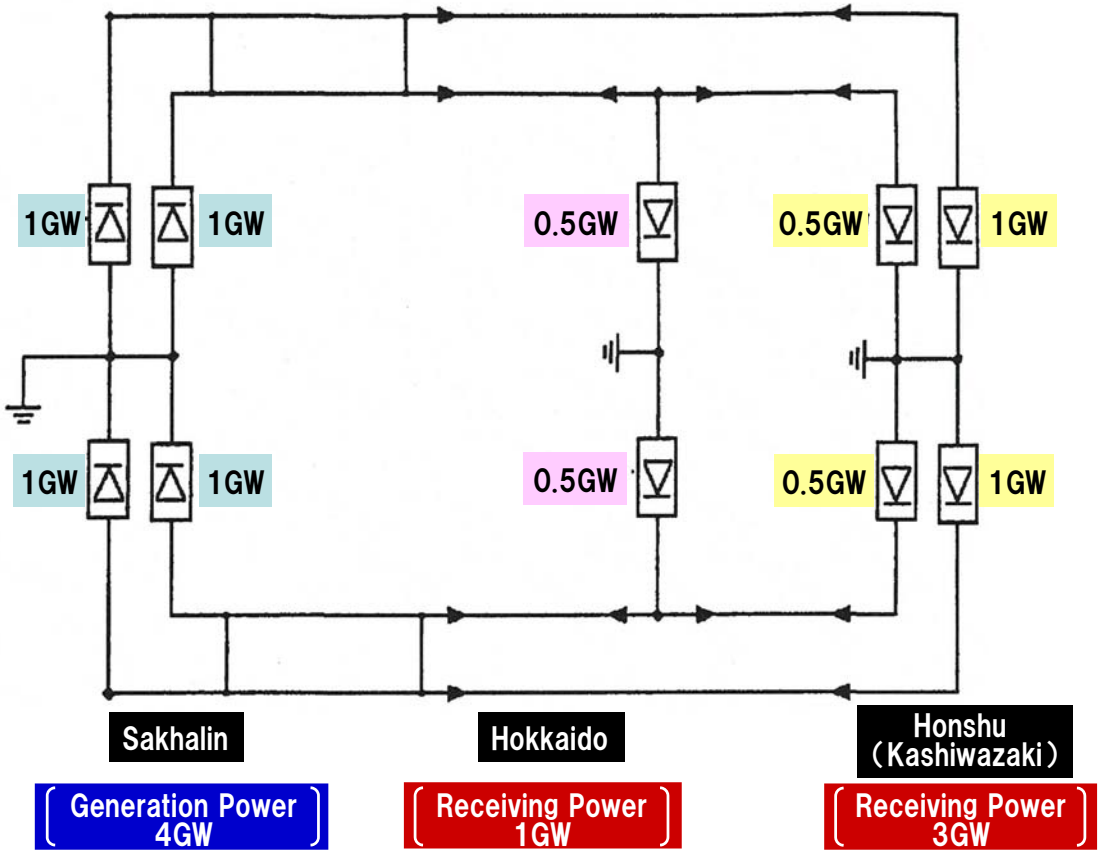
Reinforcement

PE Jacket

Wire Armor

Diameter: Approx.135mm Weight: Approx.52kg/m

[Power Bridge Project]
DC Transmission Cable Circuit



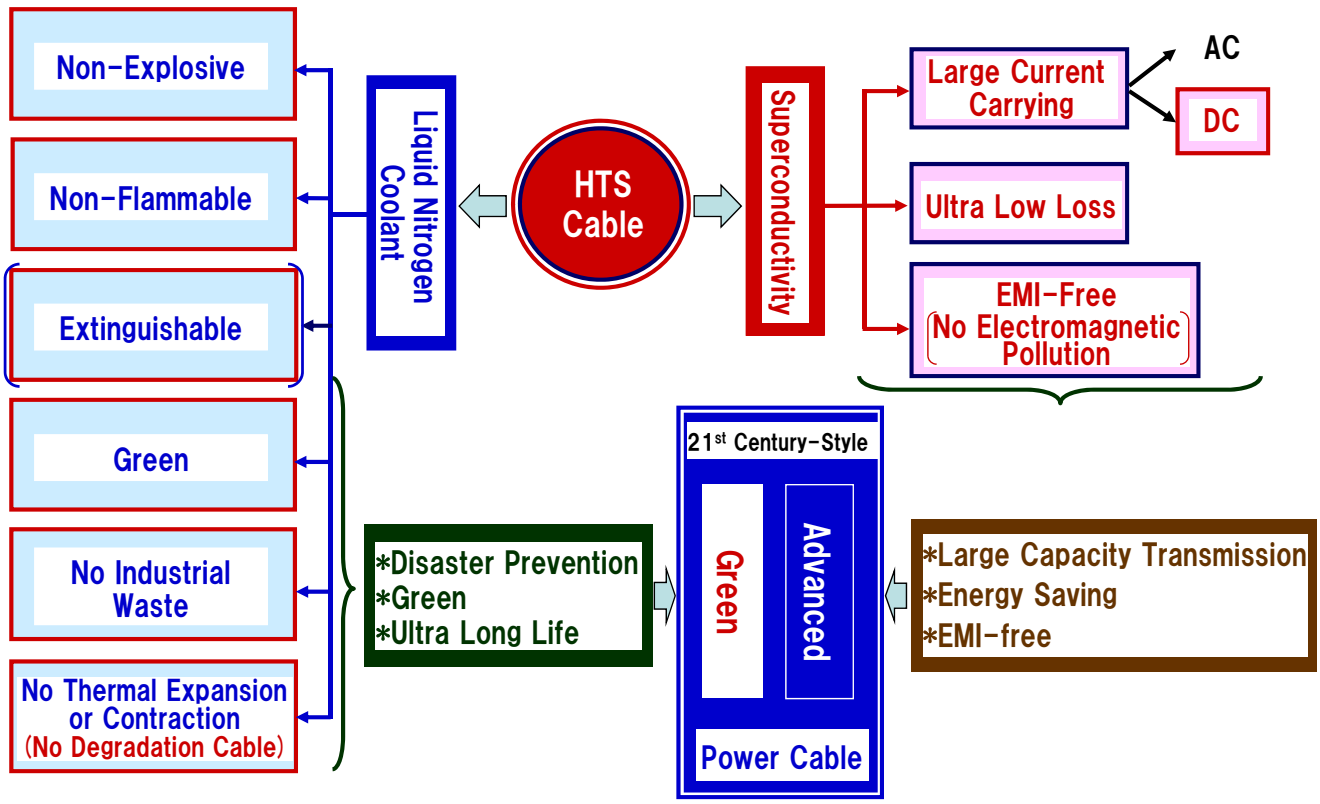
Electric Power Interconnection between Sakhalin and Japan in "Power Bridge Project"

Item	Contents
Inter-connection	Sakhalin ～ Ishikari ～ Kashiwazaki (410km+990km) ・・・ PPLP Solid DC Submarine Cables
Transmission Capacity	Sakhalin～Ishikari: 4GW (500MW×4Cables+1GW×2Cables) → 1GW to Hokkaido Ishikari～Kashiwazaki: 3GW (500MW×2Cables+1GW×2Cables → 3GW to Honshu
Participants	F.S. (United Energy Systems (RAO) from Russia: Sumitomo Electric, Marubeni and Sumitomo Corporation form Japan)
Total Project Cost	1 Trillions yen (P/S, Inverter/Converter, Cable & Construction) ≒9B$
Commissioning	Project Started in 2002～2003(Studied in late 1990s) 2010: 2GW ⇨ 2012: 4GW
Submarine Cable	〈1GW: ±750kV×1334A/cable(or ±500～550kV×2,000A/Cable→1,800mm²)〉 1,500mm²(Cu)+High-tension Square Copper Contrahelical Wire-armoring Insulation: Solid PPLP32.5mm Cable-Dimensions: Outer Dia.170mm, Aerial Weight in 70kg/m
Cable Installation	At Shallow Sea: Burial of Submarine Cables by Water-Jet Trenching Machine

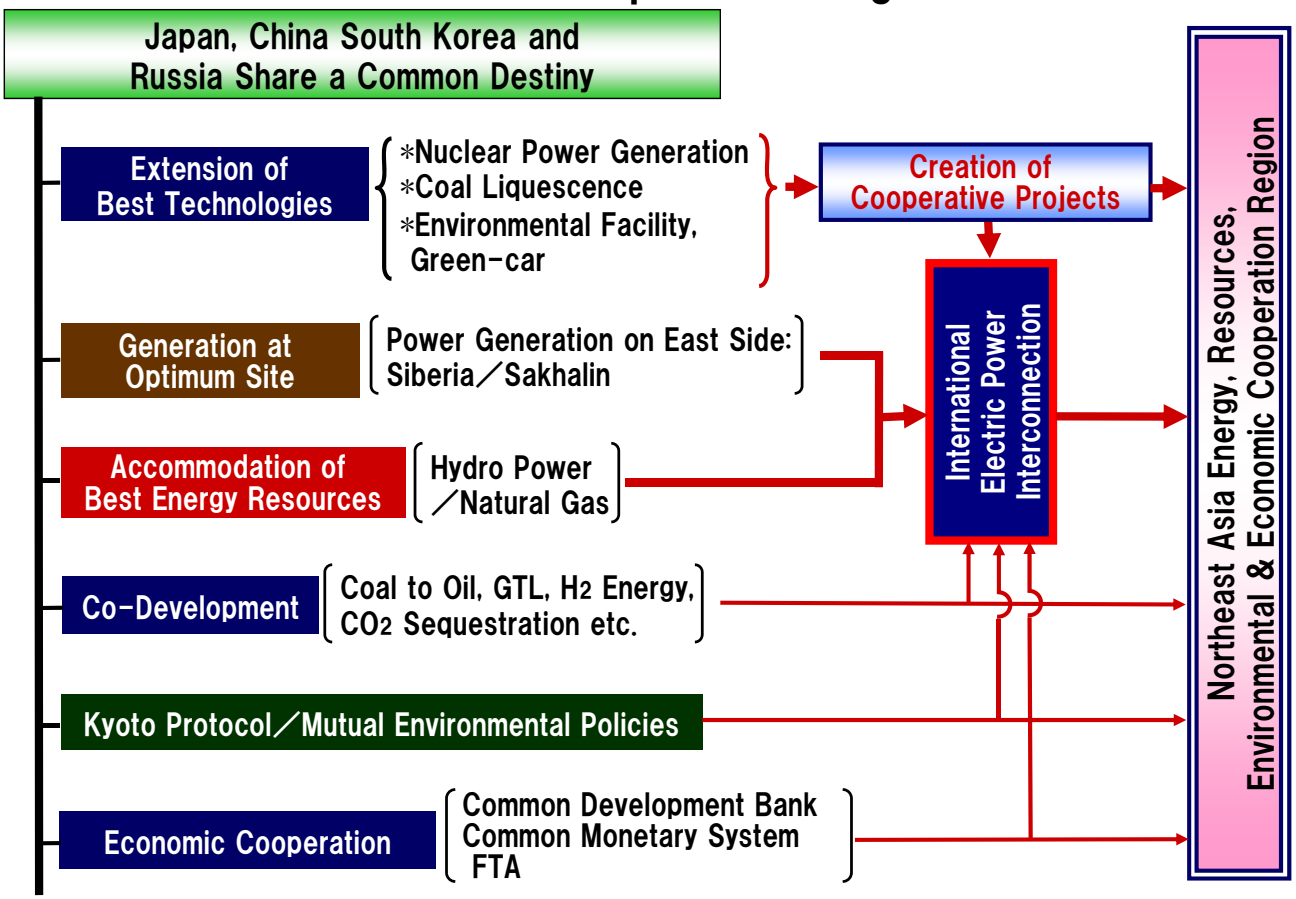
Essential Points for Long-distant DC Submarine Cable

(1)	High Voltage	*Larger Carrying Capacity; *Compact Cable
(2)	Compact & Light Cable	*Longer Cable for Transportation *Cable for Deep Sea → Weight Endurance while Installation
(3)	Toughness against External Sea-water Pressure	*Under 1,000m in Depth, External Sea-water Pressure is 100kg/cm^2 ; Liquid Insulation
(4)	Easy Production	*Cost-Reduction; *Shorter Production Period *Stable High Quality Assurance on Cable
(5)	Easy Splicing	*Shorter Splicing Time on Vessel *Stable High Quality Assurance on Splice
(6)	No Water Invasion when Something Happens	*When Damaged, Easy Definition of Replacing Length of Cable; *Easy Repair; To Fill Conductor with Liquid Insulation to Stop Sea-Water Invasion to Conductor
(7)	Fishing-Activity	*Deeper (1000m or more) Installation *No Sea-Return-Current; *Parallel "Go & Return" Cable near Shore

Merits of HTS Cable



Northeast Asia Energy, Resources, Environmental and Economic Cooperation Region



Key Points for DC Submarine Cable for the Power-Bridge Project

Item	Contents	Countermeasures
[A] Fishing-Activity	For Fishermen's Union (No sea-return-current)	①Installation to 1000m or more in depth (3 sea-miles far from Japan archipelago) ②Liquid Insulation with the specific gravity equivalent to sea water
[B] Quality-Assurance	①Ultra long-distant cable ②Installation to deep sea ③Many splicing on the vessel	①Cable easy to produce ②Joint easy to splice ➪Tough & simple tape-lapping Cable
[C] Repair	①Localization of damaged point ②No sea-water-invasion ③Suspending cable-weight while repairing	①Optical-fiber composited cabel ②To fill spaces in conductor with oil ③Tough, compact and light cable
[D] Compass Error	①Against submarines ②Against vessels near seashore	①Narrow way for submarine cables ②Parallel installation of "Go & Return" cables near seashore

PPLP Solid DC Cable