



**GPCR– Annex to POPs Technology Specification and Data Sheet**

**Table 1: Technology Overview – Summary Technical Details**

Technology Provider	Technology	Scale+	Pest Comp. treated	Related comp treated	Validation project experience**	Applicability Ranking++	Additional Remarks	Others	
Eco Logic	GPCR	F	DDT and mixed	PCBs		DA	Commercial operation of full-scale GPCR plant treating DDT, PCBs and other organochlorine pesticides		
Eco Logic	GPCR	F	HCB			DA	Commercial-scale engineering trial treating increasing quantities of HCB		
Eco Logic	GPCR	F		PCBs		DA	Treatment of PCB-contaminated material including electrical equipment, oil (askarel), concrete, personal protective equipment, and other dunnage.		
Eco Logic	GPCR		DDT, DDD, DDE soil			DA	Treatability testing on pesticide-contaminated soil from the Naval Air Station Patuxent River Site, MD.		
Nippon Sharyo, Ltd., Tokyo Boeki Ltd.	GPCR	F		PCBs		DA	PCB Plant in Handa City, Aichi Prefecture, Japan, Oct 2006		
+Key: F - Full-scale applications completed					++Key: Applicability ranking for pesticides				
P - Pilot/Demonstration scale completed; no F-applications					DA – Direct applicable				
B - Bench/Laboratory scale completed; no P or F-applications					FS 1 – Full scale within reasonable period possible 0-2 years				
T - Theoretical applicable, no B, P, F applications					FS 2 – Full scale within considerable period possible 2-5 years				
* Vendor claims performance of demonstration, but no data provided					**Validation on the basis of info provided in Table 2 and 3				



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**Table 2: Overview Project Experience per Technology Supplier**

Location/project	Contaminants	Amount treated in tons	Results incl. DRE, Pre-treat, Post treat Emissions, energy consumption, costs*	Client References Name, address, contact person phone, Email, fax
Kwinana, Western Australia - Routine Operations and Regulatory Testing	DDT (in a toluene mixture); other organochlorine pesticides; PCBs	Approximately 500 tons pesticides, 1500 tons PCBs	Regulatory Testing Results: Destruction Efficiencies of 99.999984% and 99.999968 % for DDT and 99.999998% for PCBs (takes into account gaseous, liquid and solid outputs); no PCBs or DDT detected in outputs.	Please see list at end of tables.
Kwinana, Western Australia – Pilot- and Commercial-scale treatability testing	Pilot testing – Laboratory-scale study treating pure HCB solid and mixed hexachlorinated solid	Pilot Testing: Treatment of 2 sample types: pure HCB and solid containing 66% HCB, 17% HCBd, 2% HCE, 15% unknown  Engineering Trials: Total of 8 tons of HCB waste	Pilot Testing Results: Destruction Efficiencies for both waste samples was 99.99999% for HCB; no analysed hexachlorinated compounds were detected in post-test scrubber water.  Commercial-Scale Engineering Trial: Destruction and Removal Efficiencies for HCB in Tests 1, 2, and 3 respectively are 99.9999974%, 99.9999938%, and 99.9999922%	
General Motors of Canada Limited, Commercial-scale testing	Regulatory Testing - High-strength PCB oil  Routine Operations - PCBs	89 tons PCB oil and water waste, 576 tons electrical equipment and misc. bulk solids, 191 tons soil, concrete, and asphalt, 70 tons soil	Regulatory Testing Results: Destruction Efficiencies of 99.9999996%, 99.9999985%, and 99.9999808% for PCBs, 99.9999836%, 99.9999972%, and 99.9999971% for chlorobenzenes, and 99.999 to 99.9999% for polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans (takes into account gaseous, liquid and solid outputs).	
Brown & Root Environmental – testing conducted at Eco Logic’s test facility, Rockwood, Ontario	Treatability testing – pesticide-contaminated soil	Conducted 2 test runs treating 7.5 pounds per hour of soil for over 2.5 hours. Soil contained 690 and 440 ppm DDT for Runs 1 and 2, respectively.	Destruction and Removal Efficiency for DDT in the soil was 99.999987% and 99.999985% for Runs 1 and 2, respectively. No DDT was detected in the process outputs except for Run 2 treated soil, which contained 0.004 ppm DDT.	
PCB Plant in Handa City, Aichi Prefecture	PCBs PCDD+PCDF, Dioxin-like PCB’s			



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**Table 3: Overview detailed project information per project – Project name (from Table 2):**

Location project	Pre-treat mg/kg	Post-treat mg/kg	DREs	Emissions 1. Air (HCl, Dioxins & furans etc) 2. Water, 3. Waste (slags)	Energy consumption	Costs(Capital, operating costs)	Others, remarks
Kwinana, Regulatory Testing	July 1995: 30.3% DDT  February 1996: 5.6% DDT	Stack Gas: < 1.7 µg/m <sup>3</sup> (1995); < 0.80 µg/m <sup>3</sup> (1996)	99.999984 % (1995)  99.999968 % (1996)  Note: includes all outputs, not just stack gas	Waste-specific compounds non-detect in air, solid and liquid outputs; no slag created; detailed data no longer available		Prototype plant - cost data not valid; current estimates are approximately US\$2500 - \$3000 per tonne for bulk solid and liquid waste feeds; approximately US\$200 and up (depending on quantity) for soil and sediment feeds	
Kwinana, – Pilot- and Commercial-scale treatability testing	Waste Input: 514kg–Test 1 1584kg–Test 2, 4610kg–Test 3	Treated Solids: 2kg-Test 1 23kg-Test 2 94kg-Test 3	HCB: 99.9999974% 99.9999938% 99.9999922% Chlorobenzene: 99.9999897% 99.9999863% 99.9999869%			See above	
General Motors of Canada Limited, Regulatory testing	50% PCBs 30% Chlorobenzenes		PCBs: 99.9999996%, 99.9999985%, 99.9999997% for Tests 1, 2, and 3, respectively. Chlorobenzenes 99.9999842% 99.9999985% 99.9999977% for Tests 1, 2, and 3, respectively.			Demonstration plant only, and so cost data not applicable to commercial operations. See information on Kwinana site above.	
Brown & Root Environmental – testing conducted at Eco Logic’s test facility, Rockwood, Ontario	Untreated Soil: 690 and 440 ppm DDT for Runs 1 and 2, respectively.	Treated Soil: <0.006 and 0.004 ppm DDT for Runs 1 and 2, respectively.	DRE DDT: 99.999987% and 99.999985% for Runs 1 and 2, respectively.			Demonstration plant only, and so cost data not applicable to commercial operations. See information on Kwinana site above.	
PCB Plant in Handa City, Aichi	<i>Low concentration insulating oil:</i>			Exhaust gas: 1.4 ng/m <sup>3</sup> N		Trail run October 2006 Feed 4.2 g/min	



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Prefecture	PCB: 120 mg/kg			Waste water: 6.6 ng/L			
	<i>Low concentration insulating oil:</i> PCB: 66 mg/kg			Exhaust gas: 1.1 ng/m <sup>3</sup> N Waste water: 0.65 ng/L			Trail run October 2006 Feed 4.27 g/min
	<i>High concentration insulating oil:</i> PCB: 6.2 %			Exhaust gas: 42 ng/m <sup>3</sup> N Waste water: 0.35 ng/L			Trail run October 2006 Feed 4.13 g/min
	<i>High concentration insulating oil:</i> PCB:5.9 %			Exhaust gas: 0.65 ng/m <sup>3</sup> N Waste water: 0.16 ng/L			Trail run October 2006 Feed 4.18 g/min
PCB Plant in Handa City, Aichi Prefecture	<i>PCDD+PCDF, Dioxin-like PCB's (low concentration insulating oil)</i>						
	PCCD+PCDF: 0.019 ngTEQ/g			Exhaust gas: 0.00021 ng-TEQ/m <sup>3</sup> N Waste water: 0 (<0.00080) ng-TEQ/L			PCB 120 mg/kg
	Dioxin-like PCBs: 2.6 ngTEQ/g			0.0000073 ng-TEQ/m <sup>3</sup> N 0.000038 ng-TEQ/L			
	PCDD/Fs+ Dioxin-like PCBs: 2.6 ngTEQ/g			0.00022 ng-TEQ/m <sup>3</sup> N 0.000038 ng-TEQ/L			
	PCCD+PCDF: 0.010 ngTEQ/g			- ng-TEQ/m <sup>3</sup> N 0.00065 ng-TEQ/L			PCB 66 mg/kg
	Dioxin-like PCBs: 1.4 ngTEQ/g			0.0000044 ng-TEQ/m <sup>3</sup> N 0.00019 ng-TEQ/L			
	PCDD/Fs+ Dioxin-like PCBs: 1.4 ngTEQ/g			- ng-TEQ/m <sup>3</sup> N 0.00084 ng-TEQ/L			
PCB Plant in Handa City, Aichi Prefecture	<i>PCDD+PCDF, Dioxin-like PCB's (high concentration insulating oil)</i>						PCB 6.2%
	PCCD+PCDF: 9.7 ngTEQ/g			0 (<0.016) ng-TEQ/m <sup>3</sup> N 0 (<0.00080) ng-TEQ/L			
	Dioxin-like PCBs: 1320 ngTEQ/g			0.00027 ng-TEQ/m <sup>3</sup> N 0.0000028 ng-TEQ/L			



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	PCDD/Fs+ Dioxin-like PCBs: 1330 ngTEQ/g			0.00027 ng-TEQ/m <sup>3</sup> N			
	PCCD+PCDF: 9.3 ngTEQ/g			0 (0.00080) ng-TEQ/L - ng-TEQ/m <sup>3</sup> N			PCB 5.9%
	Dioxin-like PCBs: 1260 ngTEQ/g			0 (<0.00080)ng-TEQ/L			
	PCDD/Fs+ Dioxin-like PCBs: 1270 ngTEQ/g			0.0000028 ng-TEQ/m <sup>3</sup> N 0.00000061 ng-TEQ/L - ng-TEQ/m <sup>3</sup> N			
				0.00000061 ng-TEQ/L			

\* "-" in the table shows "non-measurement" or "non-recording".

\* Conformity to emission standards shows as follows. (emission standard; exhaust gas (0.1 ng-TEQ/m<sup>3</sup>N), waste water (10 pg-TEQ/L)

\* N.D criteria for Treated oil are not clear



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**Table 4: Client References for GPCR Plant in Australia and Japan**

<b>Organization</b>	<b>Contact</b>	<b>Description/Notes</b>
Western Australia Department of Environmental Protection (DEP)	Local Rep - Paul Byrnes, Manager Kwinana Branch Tel 61-8-9419-5500 Perth Rep - Adam Parker, Director Waste Management Division Tel 61-8-9222-7160	<ul style="list-style-type: none"> <li>- General knowledge of our Kwinana operation</li> <li>- in 1999/2000 oversaw the processing of several hundred tonnes of Chemical Collection pesticide waste from Western Australia</li> </ul>
CSPB	Nathan Dixon - Manager Laboratory Tel 61-8-9411-8221	<ul style="list-style-type: none"> <li>- Chemical manufacturer</li> <li>- Supplied PCB waste for destruction</li> </ul>
Nufarm	Chris Lee - Plant Manager Tel 61-8-9411-4000	<ul style="list-style-type: none"> <li>- Agricultural chemical manufacturer</li> <li>- Supplied over 100 tonnes of 2,4-D, other phenoxy acetic acids, and other miscellaneous pesticides, including DPE, rubbish, soils, old drums, etc., for destruction</li> </ul>
Western Power	Roman Mandyczewsky - Principal Scientific Officer Tel 61-8-9326-4895	<ul style="list-style-type: none"> <li>- Western Australia's electricity generation and distribution company</li> <li>- supplied mostly PCBs, but also roughly 40 tonnes of Dieldrin contaminated sludge, oil, residue from old tanks of 'pole-mix' (power pole insecticide)</li> <li>- Mr. Mandyczewsky is also aware of the original DDT work performed for the Dept. of Agriculture</li> <li>-</li> </ul>
HATLAR Environmental	George Hatzimihalis - Managing Director Tel 61-3-9629-5300	<ul style="list-style-type: none"> <li>- HATLAR Environmental managed many of Western Australia's used pesticide collection and redrumming operations</li> <li>- Used the GPCR plant exclusively for destruction</li> <li>-</li> </ul>
Bridle Consulting	Trevor Bridle - Technical director Tel +618 93282527	<ul style="list-style-type: none"> <li>- Member of Australia's National Advisory Board</li> </ul>
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**Table 5: Utilities Required for High-strength Pesticide Waste Treatment**

<b>Utility</b>	<b>Units</b>	<b>Quantity required per tonne of waste input</b>	<b>Quantity required per month (Semi-mobile plant)</b>	<b>Quantity required per month (Full-scale plant)</b>
Electricity	MWh	2.5	175	700
Caustic	T	1.4	98	392
Hydrogen*	Nm <sup>3</sup>	1000	70,000	280,000
Nitrogen	Nm <sup>3</sup>	75	5,250	21,000
CO <sub>2</sub>	Kg	20.1	1,407	5,628
Steam	Kg	1500	105,000	420,000
Natural Gas	Nm <sup>3</sup>	600	42,000	168,000
Cooling Water	m <sup>3</sup>	500	35,000	140,000
Processing Rate	kg/min		2	8
	Tonnes/month		70	280
	Tonnes/yr		840	3360

\*assumes hydrogen is recovered from the product gas



BASEL CONVENTION

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**Table 6: Comparison of Worldwide Incinerator Air Emission Standards with GPCR Results**

Pollutant	EU Standard <sup>1</sup>	United States (HWC MACT proposed rule, July 1999, new sources)	Canada (Federal Mobile PCB Treatment Standards, 1990)	Ontario (Municipal Waste Incinerators - 2001)	Measured GPCR Levels	
					Concentration	Project/Waste Stream
Total Dust/ Particulates	10 mg/m <sup>3</sup>	34 mg mg/m <sup>3</sup>	50 mg/m <sup>3</sup>	17 mg/m <sup>3</sup>	0.35 - 0.94 mg/m <sup>3</sup>	General Motors of Canada Ltd (PCB Oil - 3 tests)
Total Organic Carbon	10 mg/m <sup>3</sup>	10 ppmv (hydrocarbons, reported as propane)	NL	100 ppmv (expressed as equivalent methane)	0.4 - 2.3 ppm (Only Data Total Hydrocarbons)	General Motors of Canada Ltd
HCl	10 mg/m <sup>3</sup>	21 ppmv	75 mg/m <sup>3</sup>	18 ppmv (27 mg/m <sup>3</sup> )	< 0.00007 - 0.0025 mg/m <sup>3</sup>	General Motors of Canada Ltd
HF	1 mg/m <sup>3</sup>	NL	NL	NL	No Data Available	
SO <sub>2</sub>	50 mg/m <sup>3</sup>	NL	NL	21 ppmv (56 mg/m <sup>3</sup> )	0 to 1 ppm	General Motors of Canada Ltd
NO <sub>x</sub>	200 mg/m <sup>3</sup>	NL	NL	110 ppmv	63 - 79 ppm	General Motors of Canada Ltd
PCDD/ PCDF <sup>2</sup>	0.1 ng/m <sup>3</sup>	0.20 ng/m <sup>3</sup>	12 ng/m <sup>3</sup>	0.14 ng/m <sup>3</sup>	0.018 - 0.020 ng/m <sup>3</sup>	General Motors of Canada Ltd
					0.000011 - 0.00041 ng/m <sup>3</sup>	New Bedford Harbor (Dioxin-contaminated sediment - 4 tests)
					0.0027 ng/m <sup>3</sup>	Japanese Regulatory Testing (Dioxin-contaminated solids)
CO	50 mg/m <sup>3</sup>	100 ppmv	NL	NL	0.00013 - 0.00065 ng/m <sup>3</sup>	US Army Testing (Pentachloro-phenol-contaminated wood)
					0 to 1.5 mg/m <sup>3</sup>	US Army Testing (treatment of chlorinated polyethylene)
					1 - 5 ppm	General Motors of Canada Ltd
Semivolatile Metals	NL	24 µg/m <sup>3</sup>	NL	NL		
Low Volatile Metals	NL	97 µg/m <sup>3</sup>	NL	NL		
Cadmium	0.05 mg/m <sup>3</sup>	NL	NL	0.014 mg/m <sup>3</sup>	0.00019 - 0.000093 mg/m <sup>3</sup>	General Motors of Canada Ltd
Thallium	0.05 mg/m <sup>3</sup>	NL	NL	NL	< 0.0042 - < 0.0048 mg/m <sup>3</sup>	
Mercury	0.05 mg/m <sup>3</sup>	0.045 mg/m <sup>3</sup>	NL	0.020 mg/m <sup>3</sup>	< 0.0000048 - 0.00099 mg/m <sup>3</sup>	
Antimony	0.5 mg/m <sup>3</sup>	NL	NL	NL	0.0012 - 0.0021 mg/m <sup>3</sup>	
Arsenic	0.5 mg/m <sup>3</sup>	NL	NL	NL	< 0.00014 - < 0.00016 mg/m <sup>3</sup>	
Lead	0.5 mg/m <sup>3</sup>	NL	NL	0.142 mg/m <sup>3</sup>	0.00053 - 0.0029 mg/m <sup>3</sup>	
Chromium	0.5 mg/m <sup>3</sup>	NL	NL	NL	0.0056 - 0.009 mg/m <sup>3</sup>	
Cobalt	0.5 mg/m <sup>3</sup>	NL	NL	NL	< 0.00014 - < 0.00016 mg/m <sup>3</sup>	
Copper	0.5 mg/m <sup>3</sup>	NL	NL	NL	0.00081 - 0.0016 mg/m <sup>3</sup>	
Manganese	0.5 mg/m <sup>3</sup>	NL	NL	NL	0.00084 - 0.0018 mg/m <sup>3</sup>	
Nickel	0.5 mg/m <sup>3</sup>	NL	NL	NL	< 0.000080 - 0.0021 mg/m <sup>3</sup>	
Vanadium	0.5 mg/m <sup>3</sup>	NL	NL	NL	< 0.00035 - < 0.00041 mg/m <sup>3</sup>	

(1) Based on daily average, except PCDD/PCDF which is based on 6 to 8 hour average, and metals, which are based on a 30 minute to 8 hour average

(2) Toxic equivalents calculated using the international method NL = Not Listed