

# In-Pile Thermal Desorption® (IPTD®) of Dioxin Contaminated Soil and Sediment

Ralph S. Baker, Ph.D., Gorm Heron, Ph.D., Jim Galligan, P.E.,  
Steve McInerney and Stan Walker

(TerraTherm, Inc., Gardner, Massachusetts USA)

Niels Ploug

(Krüger A/S, Søborg, Denmark)

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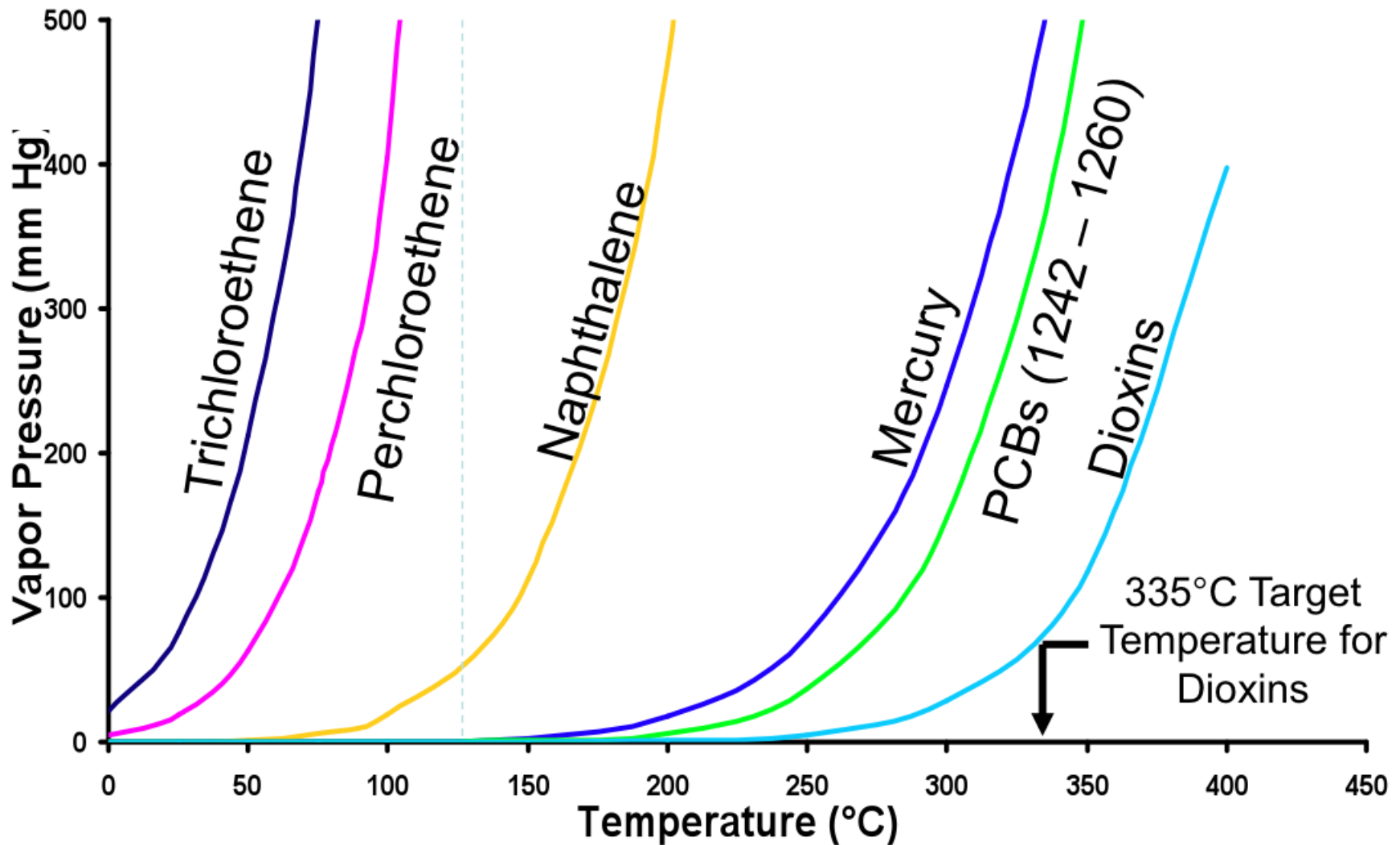


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# Overview

- Introduction to Thermal Conduction Heating and ISTD/IPTD® for Treatment of Dioxins
- MOE Japan IPTD® Demonstration
- USAID – Danang Airport, Vietnam IPTD® Project

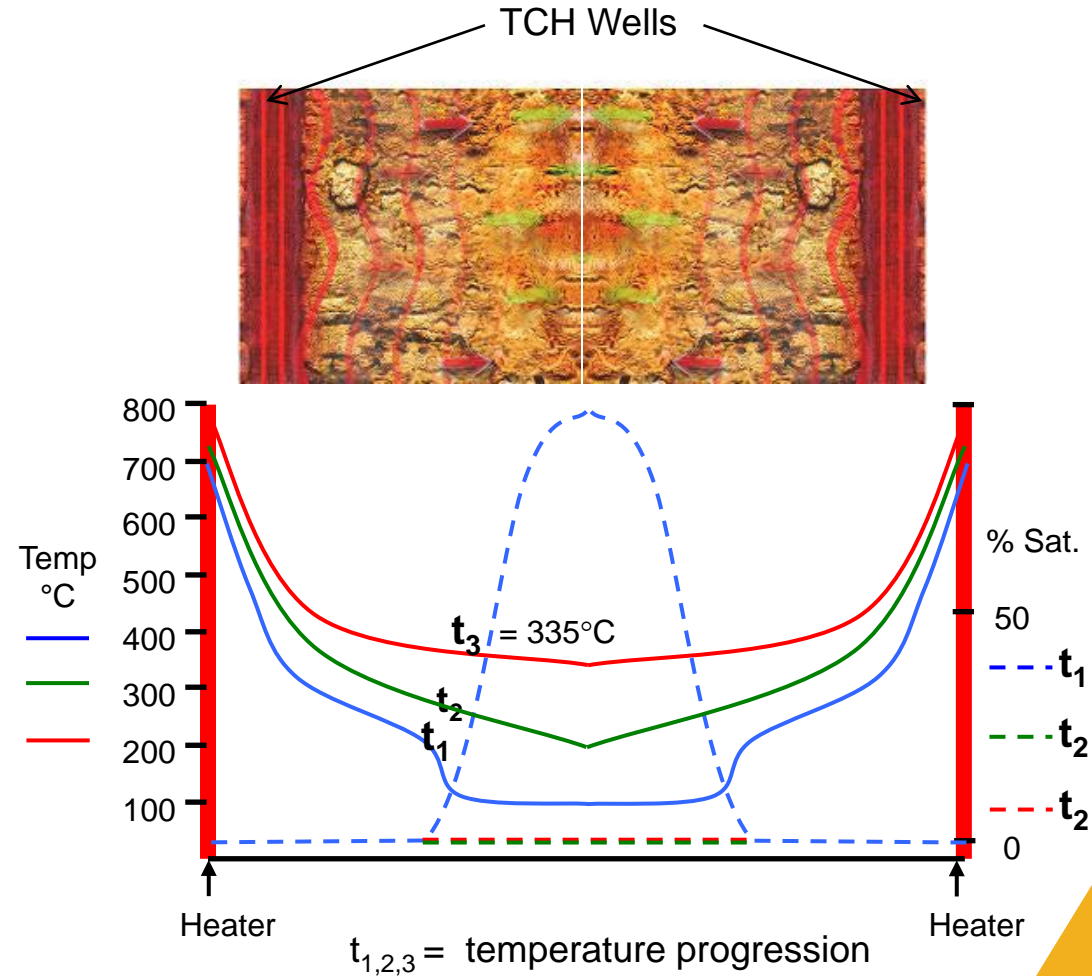
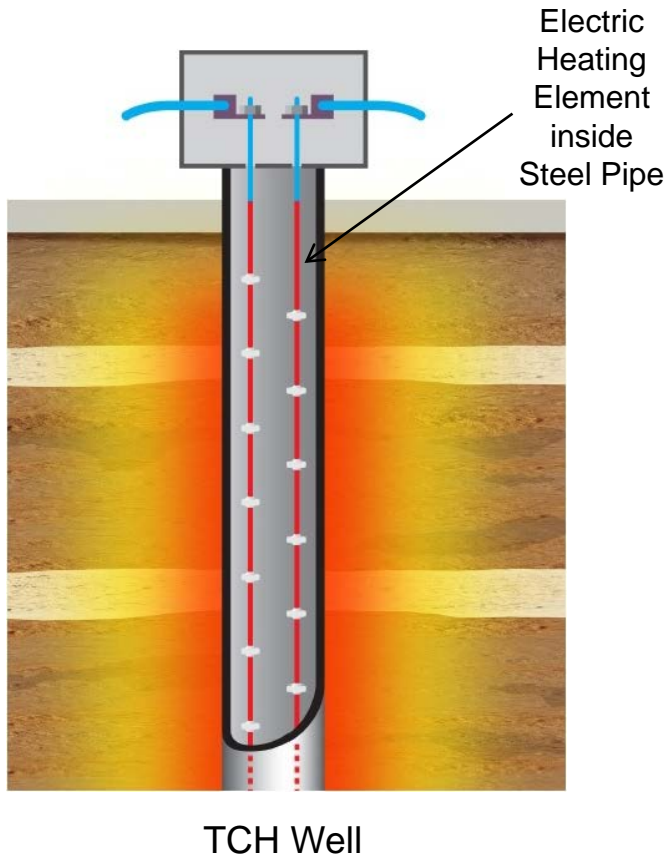




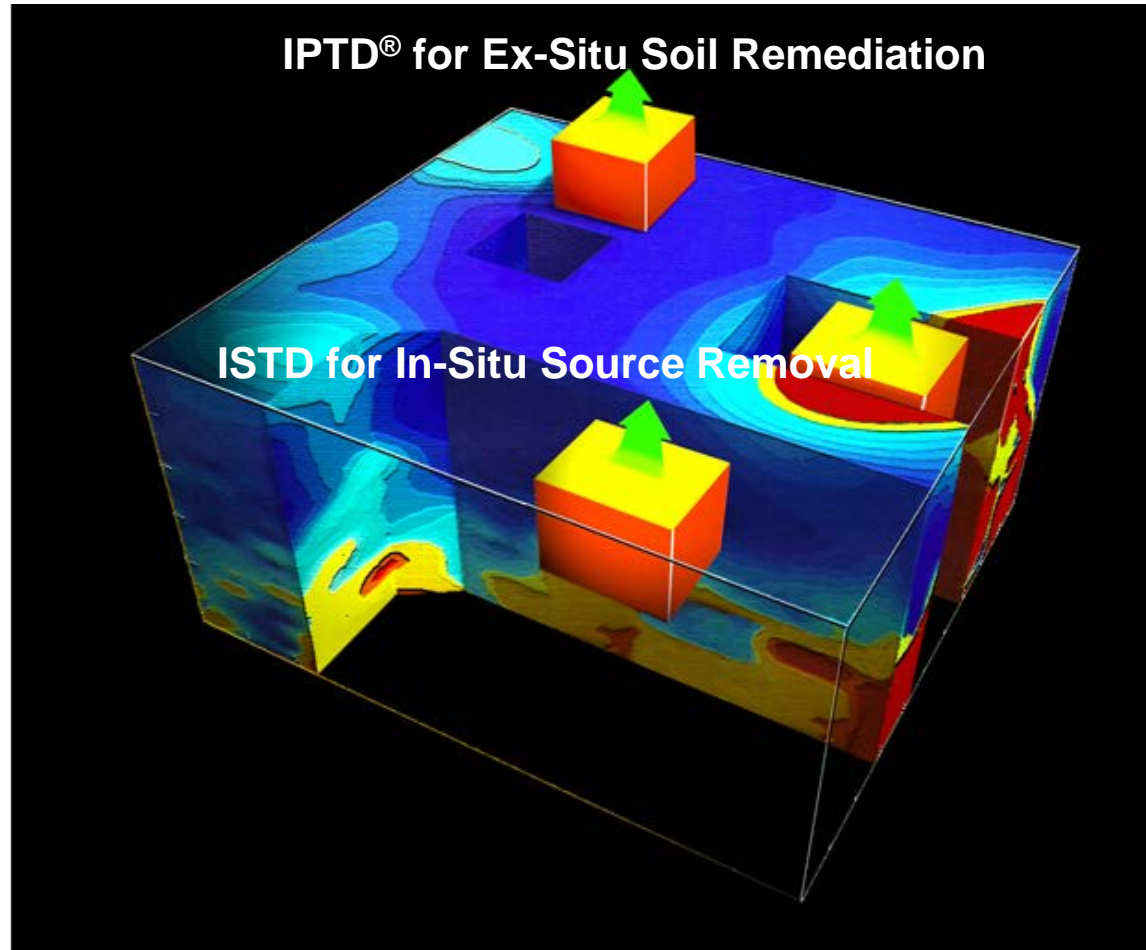
The vapor pressures of contaminants increase exponentially due to thermal conduction heating during the IPTD<sup>®</sup> process.

[rbaker@terratherm.com](mailto:rbaker@terratherm.com)

# What is Thermal Conductive Heating (TCH)?



# Two Ways to Apply TCH: In Place (In-Situ) or Aboveground (Ex-Situ)



# Examples of ISTD and IPTD® Field Project Results for the Remediation of Dioxin in Soil and Sediment

Site	Treated Volume	Before treatment	After treatment	Source test
		Mean Soil Concentration	Mean Soil Concentration	Exhaust gas
	[m³]	[pg-TEQ/g]	[pg-TEQ/g]	[ng-TEQ/Nm³]
<i>Missouri Electric Works Superfund Site, Cape Girardeau, Missouri USA</i>	5.7	6,500	3.2	0.0029
<i>Former US Naval Facility Centerville Beach, Ferndale, California USA</i>	765	3,200	7.3	0.0055
<i>Southern California Edison AOC-2, Alhambra, California USA</i>	12,615	18,000	110	0.0071
<i>Ministry of Environment, Yamaguchi, Japan</i>	1.0	1,800	67.75	0.000018

Presented at  
**intersol'2007**,  
Paris

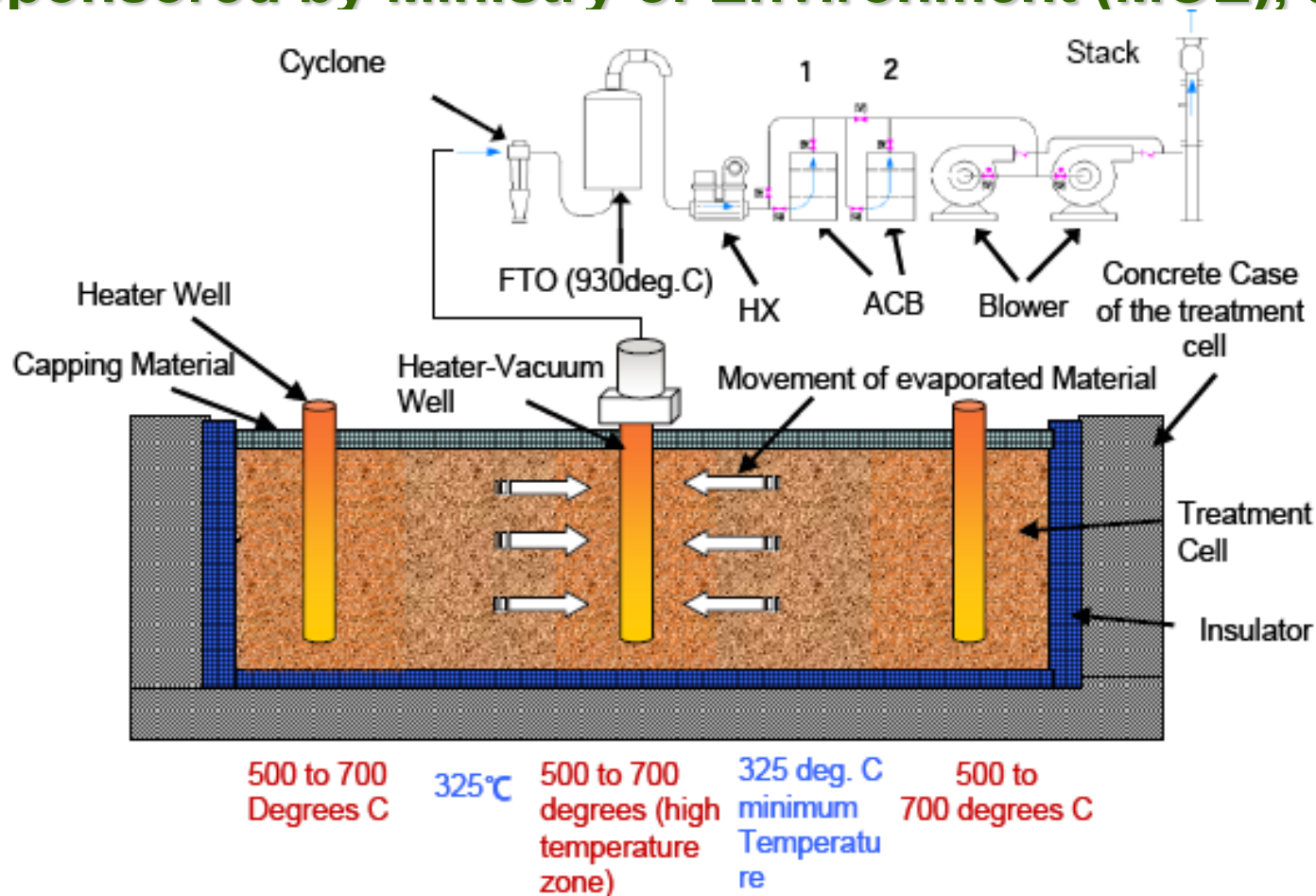
TEQ = 2,3,7,8-Tetrachlorodibenzo-dioxin Equivalents (WHO)

(Heron et al. 2010; Baker et al. 2008; USEPA 1998; Conley and Lonie 2000)



# IPTD<sup>®</sup> Demonstration 2009

Sponsored by Ministry of Environment (MOE), Japan



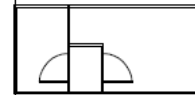
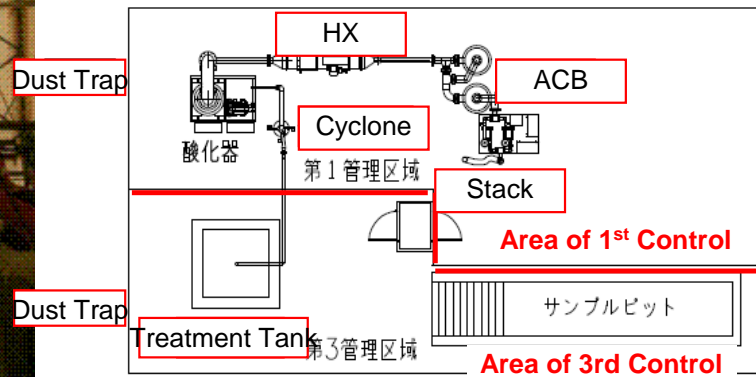
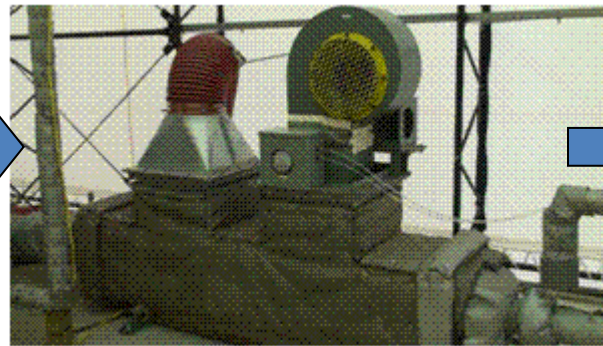
*A joint project of TerraTherm, Inc. and SheGoTec Japan, Inc.  
(Heron et al. 2010)*



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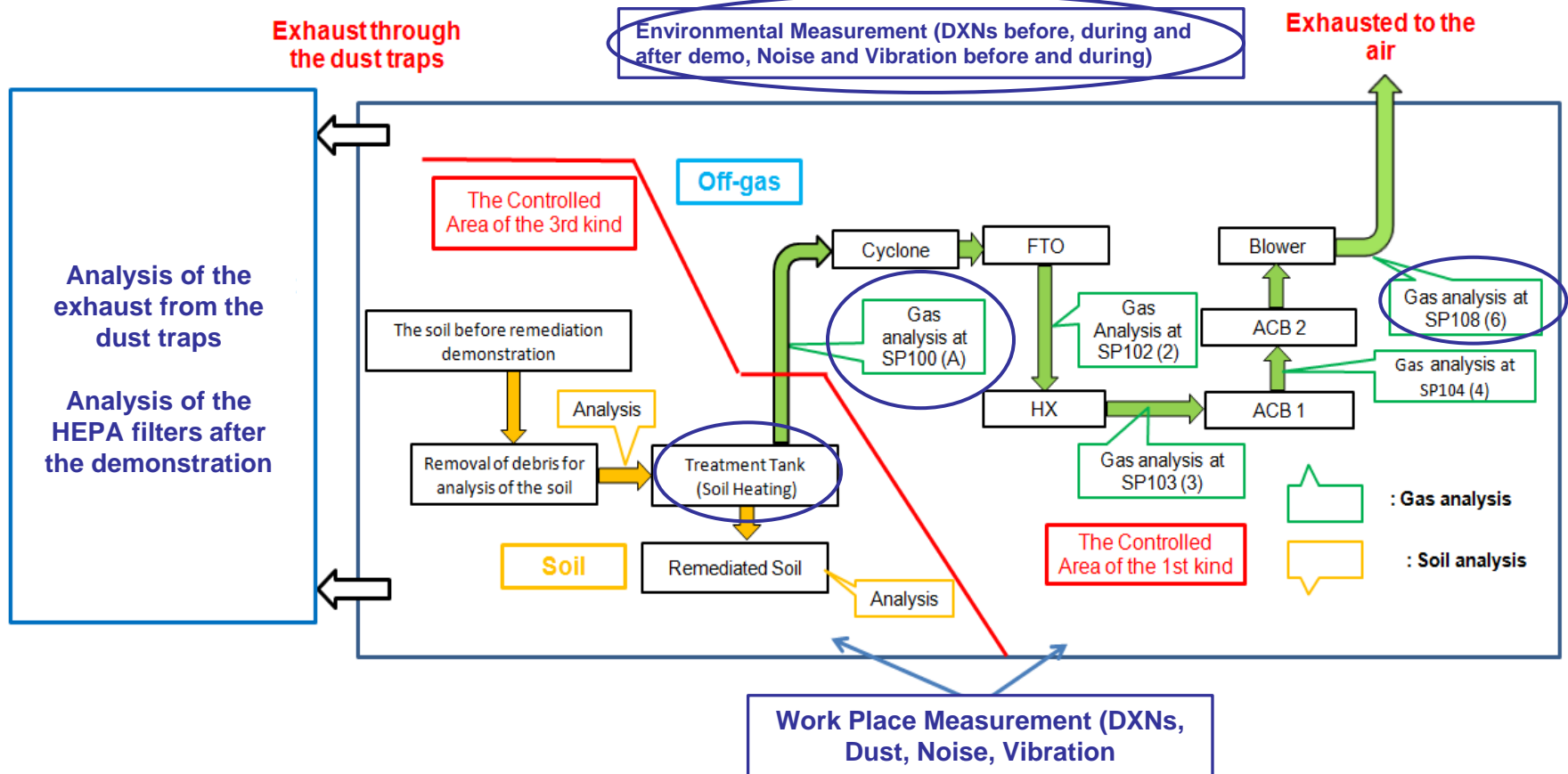
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# Monitoring Program



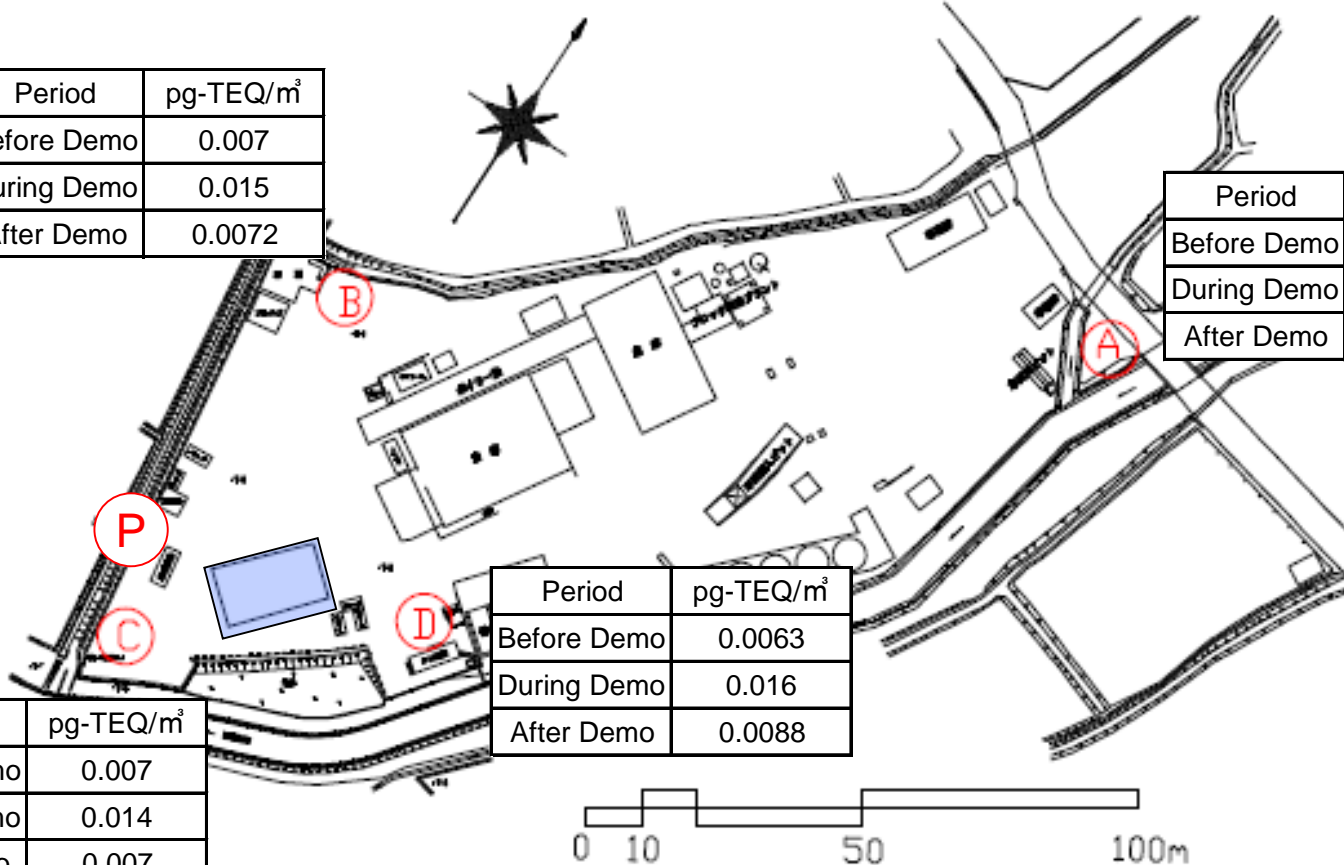
# Monitoring the Surroundings

Period	pg-TEQ/m <sup>3</sup>
Before Demo	0.007
During Demo	0.015
After Demo	0.0072

Period	pg-TEQ/m <sup>3</sup>
Before Demo	0.0053
During Demo	0.015
After Demo	0.009

Period	pg-TEQ/m <sup>3</sup>
Before Demo	0.0063
During Demo	0.016
After Demo	0.0088

Period	pg-TEQ/m <sup>3</sup>
Before Demo	0.007
During Demo	0.014
After Demo	0.007



 : Demonstration Tent

**(A) to (D)** : DXN monitoring Points

Environmental Std.: 0.6pg-TEQ/m<sup>3</sup>

**(P)** : Noise/Vibration monitoring Points



# Effectiveness of the IPTD® Technology

## (Soil, before vs. after heating)

Removal Ratio	%	DXNs concentration before remediation (pg-TEQ/g)	DXNs concentration after remediation (pg-TEQ/g)
		1,800	67.75

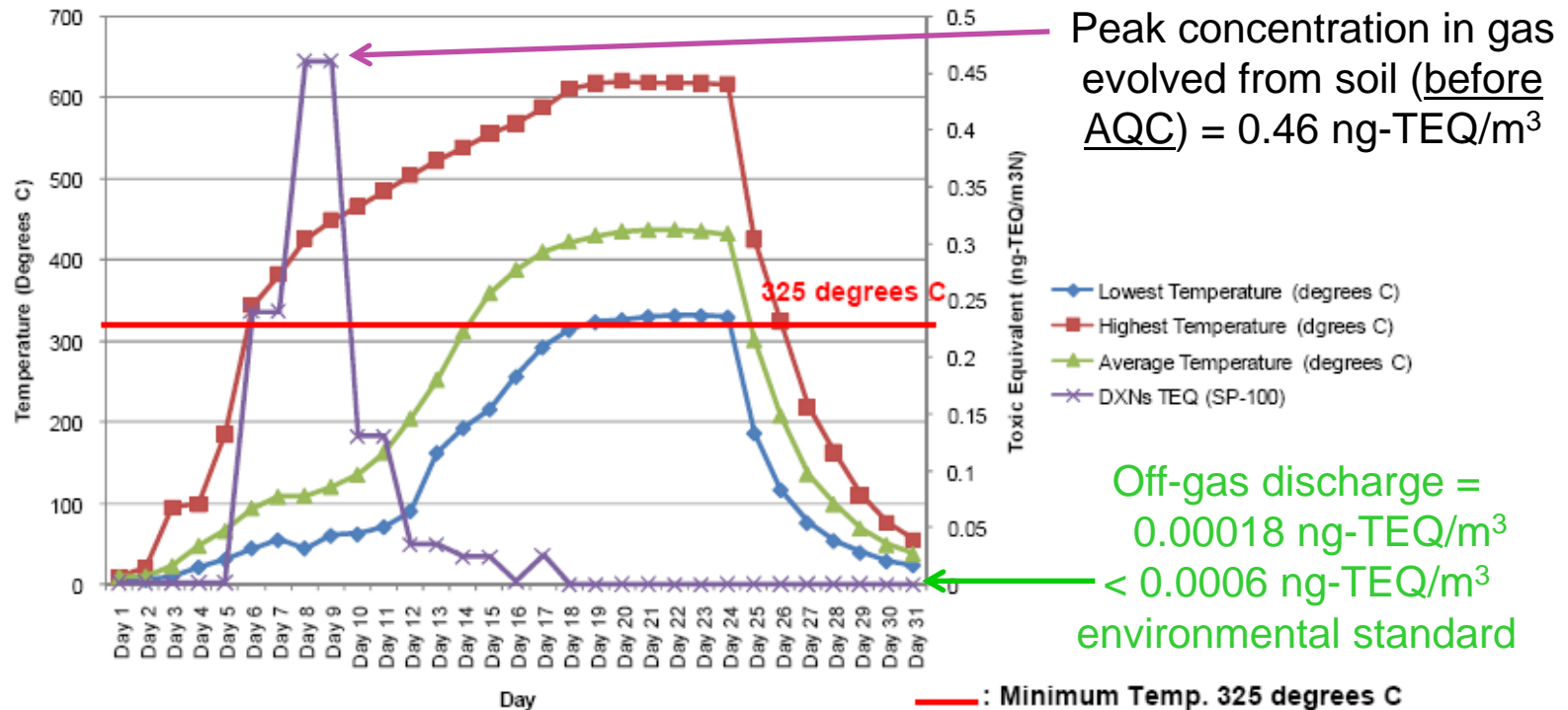
**67.75 pg-TEQ/g << Japan standard of 1,000 pg-TEQ/g**



**No changes in soil characteristics were observed**

# MOE IPTD® Demonstration Results

Temperature of the soil and the evolution of DXNs



⇒ IPTD® approved for treatment of dioxin-contaminated soil or sediment in Japan





# Examples of ISTD / IPTD® Projects for Treatment of Dioxins:

## 3. Danang, Vietnam





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**VIETNAM**

(Sorenson et al. 2011)

Sen Lake and  
Wetland:  
31,000 m<sup>3</sup>

Central Area:  
6,000 m<sup>3</sup>

Drainage Ditch:  
11,000 m<sup>3</sup>

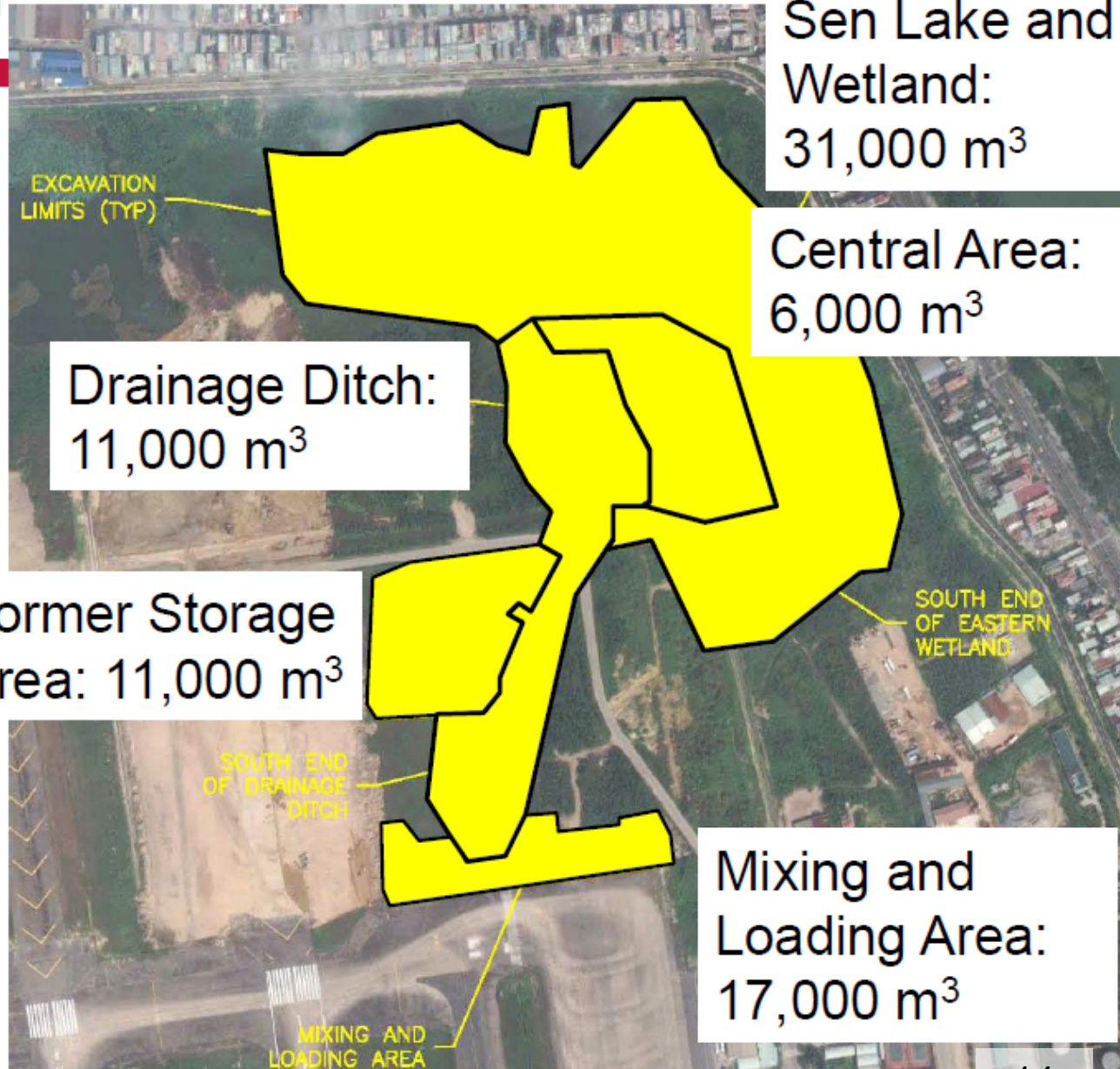
Former Storage  
Area: 11,000 m<sup>3</sup>

Mixing and  
Loading Area:  
17,000 m<sup>3</sup>

## Areas Requiring Excavation

Total Area:  
approximately  
190,000 m<sup>2</sup>

Total Volume  
(with Pacer Ivy  
Storage Area to  
the south):  
77,000 m<sup>3</sup>





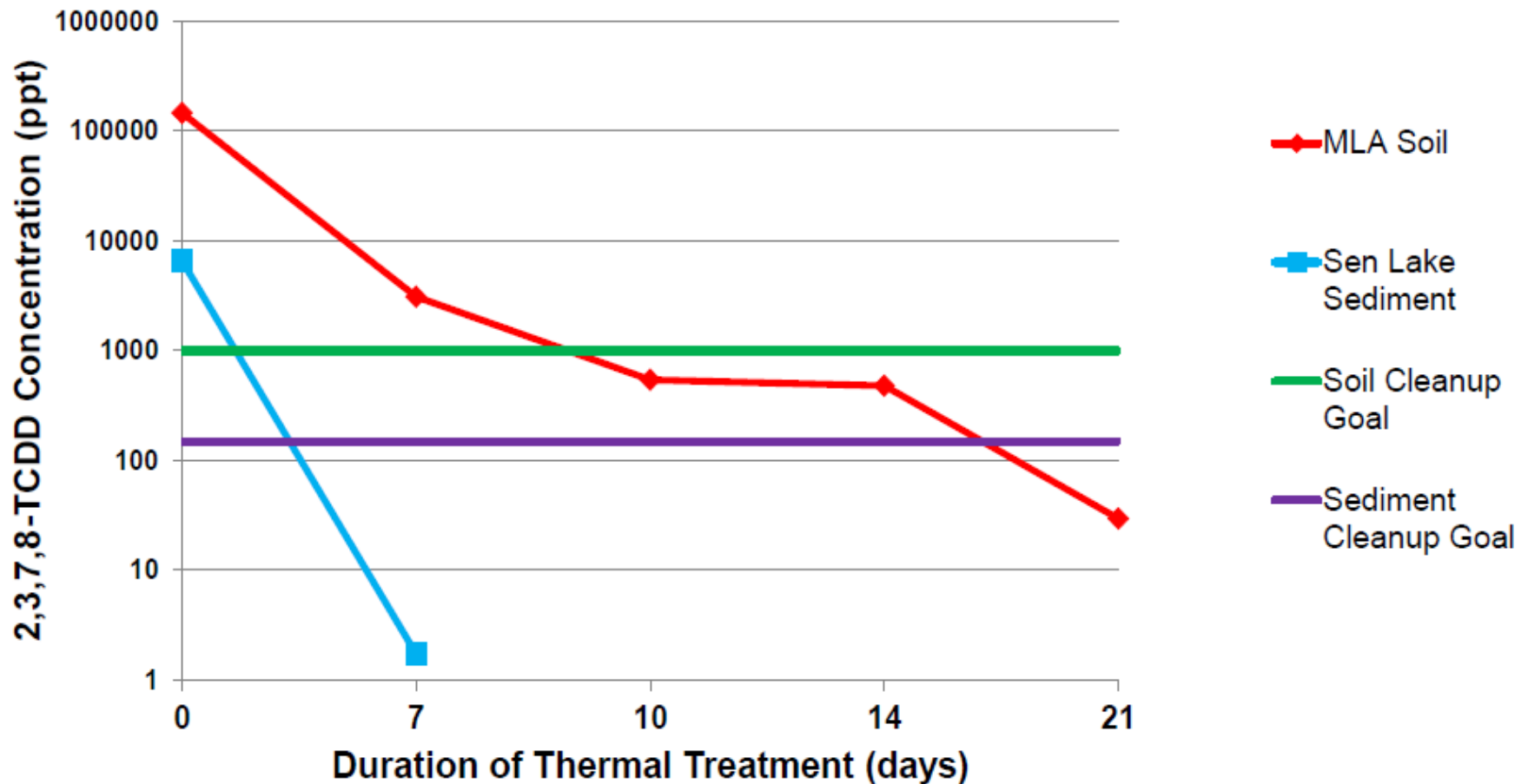
(Sorenson et al. 2011)

## DETAILED EVALUATION: SUMMARY OF EA FINDINGS

Alternative	Final Remedy to Meet Clean Up Goals	Implementable	Potential Environmental Impact	Estimated Cost
No Action	No	Yes	Highest	Externalized
Active Landfill	Uncertain	Yes with challenges	Second highest	\$31M
Passive Landfill	No	Yes with challenges	Third highest	\$36M
ISTD/IPTD	Yes	Yes with challenges	Lowest	\$34M



## Treatability Testing Results (Sorenson et al. 2011)







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**Vietnam: Environmental Remediation of  
Dioxin Contamination at Danang Airport**

# **3-D Simulation of IPTD® System Construction and Operation**



(Courtesy of USAID and CDM Smith)



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# Vietnam: Environmental Remediation of Dioxin Contamination at Danang Airport

## Under Construction



*Pile containment structure*

*(Photo: TetraTech)*



*Installing heaters into pile structure (Photo: CDM Smith)*

<http://www.usaid.gov/vietnam/environmental-remediation>



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## Vietnam: Environmental Remediation of Dioxin Contamination at Danang Airport

**Progress Report: January 1, 2014 to January 31, 2014**

### Construction Nearing Completion



*Containment structure and liquid/vapor treatment system*

*(Photo: Tetra Tech)*

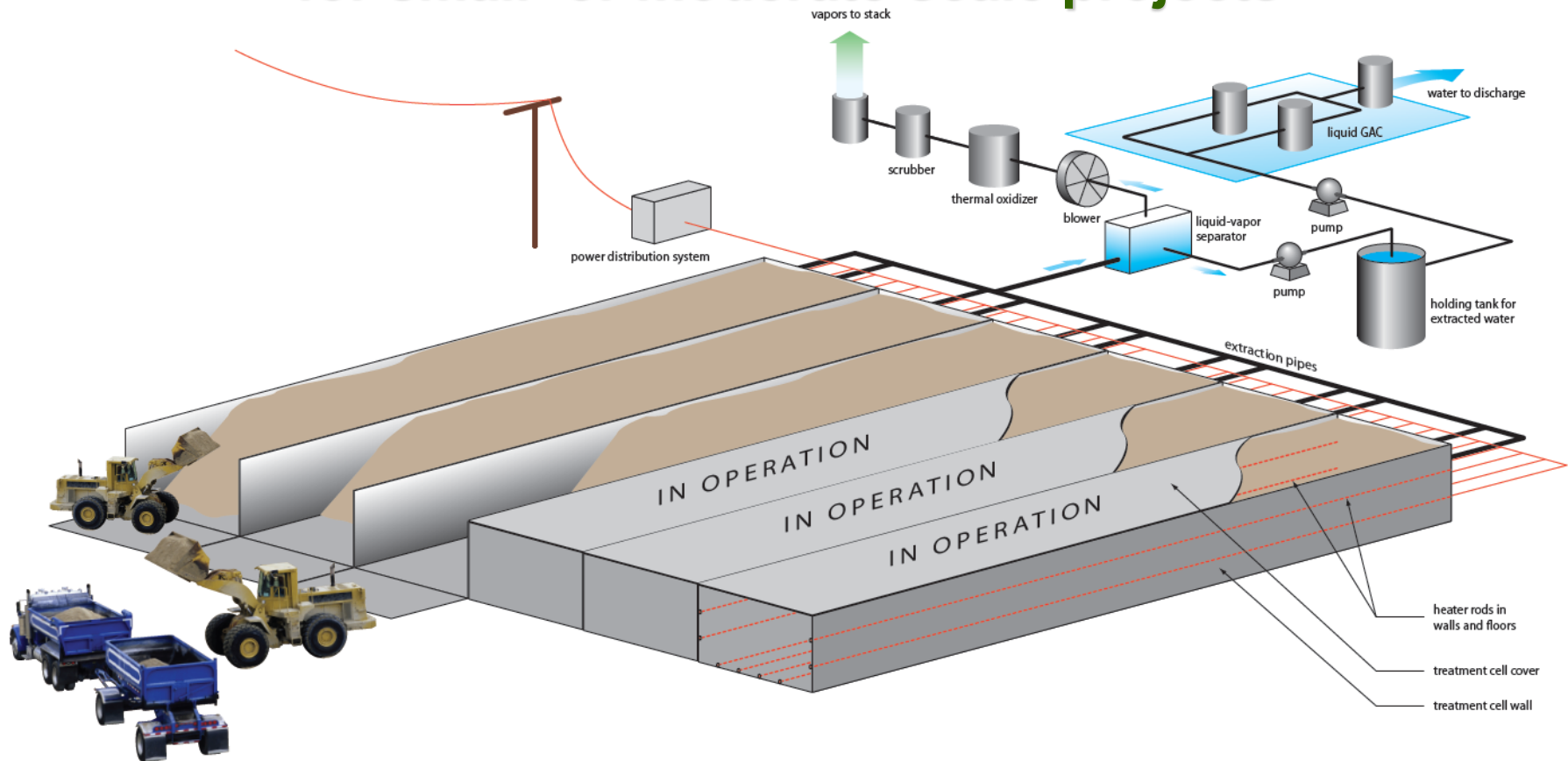
# Current Status

- Construction nearly complete
- Commission: March-April 2014
- Phase 1 Heating: April – August, 2014
- Phase 2: 2016.





# IPTD<sup>®</sup> Adapted for Mobile or Fixed Ops for small- or moderate-scale projects



**Drive in / Drive out capability. Load / unload with no obstructions!**  
***U.S. Patents 8,348,551 and 8,562,252 issued in 2013.***  
***International patents pending.***



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# **IPTD® is More Sustainable than Off-Site Thermal Desorption or Landfilling**

**IPTD®:**

- Eliminates transportation back and forth to a treatment facility:
  - saves fuel and resources
  - Reduces neighborhood impacts and risk of spreading of hazardous dust/particulates.
- Eliminates long-term management at landfills where the soil/sediment is stored.
- Requires less energy than kiln-style treatment, for which the heat losses are higher.



# Questions?

## References

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