Dear Lone

Sorry for the delay, we wished to make sure we had the details correct and to respond fully.

SIA did not respond further to Mr Bridle for two reasons. Firstly, his letter of 23 April provided no new information or issues. The issues he raised in this letter were the same ones he raised in previous letters (eg 26 February 2009) and which SIA addressed with evidence from the Nolan-ITU 2005 Report which we sent to you on 11 March 2009.

Secondly, Mr Bridle made clear in his 23 April letter that he considered there were "irreconcilable differences" between him and SIA and indicated that legal action would be forthcoming.

On this basis, there was little point in SIA continuing the correspondence.

Since then, SIA have not heard from Mr Bridle, nor has there been any sign of the legal action suggested by Mr Bridle. SIA stand by their conclusions as expressed in their 21 April letter.

The issues about the chlorine content and the HCB/CP content in the residues were amongst the issues addressed in our e-mail to you of 11 March 2009.

I have extracted the relevant material and it is in the attached file labelled "Responses to claims about the Gas Phase Chemical Reduction (GPCR) Process".

With the help of SIA, we also have provided responses specifically to your questions in your 25 September e-mail. These responses are in the attached file labelled "Response to Danish EPA 011009".

I hope this clarifies the matter for you. Please let me know if there is any more material that you need.

As indicated in an earlier e-mail from Damien, we would be happy to have a teleconference if that would be helpful to talk through any outstanding issues.

I will be overseas for most of the period 17 October to 11 November (Mercury in Bangkok and Montreal Protocol in Egypt) so the next two weeks would be a good time for a teleconference if one were needed.

Best regards

Barry

<<Responses to claims about the Gas Phase Chemical Reduction.doc>>
<<Response to Danish EPA 011009.doc>>

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RESPONSES TO QUESTIONS OF 25 September 2009 FROM THE DANISH EPA

Your general query was ***"Thank you very much. I have looked into the letters and I can see that Trevor Bridle has replied to SIA's letter of April 21. I can understand that they have a dispute about what kind of waste the GPCR technology has treated - high, medium or low chlorine concentration. As we use this criteria in our assessment I'm very interested in what kind of follow up you or SIA has made in connection with Trevor Bridle's letter of April 23 ?***

Both in connection with his argumentation with regard to the chlorine concentration in the waste as well as with regard to the HCB/CP content in the residues

QUESTION 1: *in connection with his argumentation with regard to the chlorine concentration in the waste*

Trevor Bridle's comments in his letter to SIA dated 23 April:

There is one fact in your report that is, without dispute, incorrect. This is your statement in Section 4.4.3 of the report that the Kwinana GPCR plant treated mostly low strength waste, such as contaminated soil. If you were to check the log of material treated by the facility you would see that most of the material was high-strength WA Scheduled Waste, including pure DDT, stock-piled the WA Dept of Agriculture and pure askarel fluids, stock-piled by Western Power. These wastes contained up to 50% by weight of chlorine, not that different to the Orica HCB waste stream. In fact, one of the draw-backs of the GPCR process is that it cannot economically treat low strength wastes due to the excessive hydrogen consumption for such wastes. This is the main reason for closure of the Kwinana plant, once Australia's high-strength Scheduled Wastes had been destroyed..

Response:

Text from the Independent Assessment Report by SIA: "Eco Logic facilities to date have processed waste streams with low to medium hydrocarbon and organo-chlorine contamination levels, such as contaminated soils, and this is the continuing projected market for the technology. The Orica HCB waste stockpile has highly concentrated high chlorine content and is a high organics (hydrocarbon) content material.

In total, the plant treated in excess of 2,000 tonnes of waste including PCBs, pesticides and other POP's, with up to 1,500 tonnes having been treated in the last two years of operation."

OUR RESPONSE TO QUESTION 1:

With respect to the scale of operation, SIA saw this as an area of concern because there is no existing GPCR operation handling anything like the volume and chlorine content that would be involved in the treatment of the Orica HCB waste stream. This material is up to 100% HCB in most containers and HCB is 75% by weight chlorine of the complete stockpile.

Note that the SIA report in saying "<u>low to medium</u> hydrocarbon and organo-chlorine contamination levels" is doing so in relation to the Orica HCB waste, not in relation to all hydrocarbon and organo-chlorine compounds.

The following explanation is based on material provided by SIA.

The DDT and OC contaminated oil streams that were commercially destroyed in the Kwinana facility in Western Australia contained only a fraction of the chlorine content of this HCB waste.

HCB, C6Cl6 is 75% chlorine by weight.

DDT, C14H9Cl5 is 50% chlorine by weight.

Commercial DDT is usually dissolved in a solvent such as toluene for direct use in solution form with normal concentrations of 5 to 10%. This equates to just 2.5 to 5% chlorine content. SIA have informed the Department that there are records of 30.3 % DDT being processed at the Kwinana GPCR facility but no quantities or rates are given. Even so, that is only 15% chlorine by content. Therefore, in direct comparison to the Orica HCB stockpile which is 75% chlorine by weight, it is clear that the GPCR facility treated lower concentration chlorine wastes.

PCB wastes are usually in the form of transformer and electric power condenser, switchgear insulation and coolant fluid. In commercial volumes, the concentrations are usually 20 – 40% chlorine by content. However, by the mid to late 1990s when the GPCR Kwinana plant was in operation, the majority of Australia's transformers had been flushed with fresh PCB free oil and concentrations were down to hundreds or a few thousand parts per million. Please note that 1% is 10,000ppm meaning that the waste transformer oils being treated were well below the 1% level.

If the plant was still operating and if it could deal with the Orica HCB stockpiled waste, the decommissioned ELI Eco Logic plant in Kwinana could treat up to 0.66 tonnes per day (max) of the Orica HCB waste, requiring 100 plant years of operation to clear the HCB waste stream under consideration. To reduce this time frame a ten times scale up would be required as a minimum which introduces its own inherent engineering, technical and licensing issues.

Currently there are no GPCR facilities operating in Australia. There are no Eco Logic plants anywhere that have capacity to handle the Orica waste, simply because of its high chlorine content, and none with throughput capacity that could process this quantity of concentrated waste in anything like a reasonable period (say 5 years). The chlorine content would mean major changes to the volumes of hydrogen to be handled and the time, temperature and concentration parameters for a new development of both the thermal desorption step and off-gas handling.

QUESTION 2: *with regard to the HCB/CP content in the residues*

Trevor Bridle's comments from the letter dated 23 April:

The statement in your letter of 21st April that the residue from the processing of HCB waste would have a HCB/CP content in excess of 50 mg/kg is also incorrect. The data reported in the ELI report shows the measured levels for HCB ranged from 3 to 5.6 mg/kg.

SIA comment from their letter dated 21 April:
Thermal desorption has been stated to achieve 98% reduction in mass of original sample, and to have volatilized 99.9999% of HCB and other CBs. Taking this to mean that 0.0001% ends up in 2%, the contaminant level thus works out at 50ppm of HCB and CBs in the thermal desorption residue.

OUR RESPONSE TO QUESTION 2:

This answer requires two parts, the first dealing with (a) the issue of the 3-5.6 mg/kg HCB residue and the second with (b) the dispute over the 50 ppm - 50 mg/kg of chlorobenzene compounds.

(a) The factual analysis data on the residues from the Eco Logic 1999 report confirm that the residues contained HCB above the threshold level. They were not just inorganics:

Residues Mass:

0.4-2% (as % of the original HCB mass)

Chemical analysis:

I-TEQ	0.5-51 ng/g
Total Carbon	39-65 %
Chloride	2.3-3.1%
HCB	3-5.6 *microg*/g (3-5.6 mg/kg)

The first point to note is that both SIA and Mr Bridle agree that the Eco Logic 1999 report says that the HCB residue levels after Thermal Reduction Batch Processing were 3-5.6 mg/kg.

As pointed out in our e-mail to you of 11 March 2009, this level is in excess of Australia's HCB Waste Management Plan specification that any solid residues will contain less than 2mg/kg of scheduled chemicals expressed as chlorine.

The GPCR process as tested, therefore, was unsatisfactory. As described in our e-mail of 11 March 2009 extensive modification of the plant would be necessary to try to deal with this problem:

"The HCB drum pre treatment process therefore requires development of a separate process for handling and treating the solid residues still contaminated with the organo-chlorine compounds. The problem is the variety of compounds and physical forms of the Orica HCB waste, ranging from slurries to polymer gels and rubbers, requiring a wide range of evaporation temperatures and retention times.

SIA has indicated that this has been found to be a problem with any thermal desorption process and only the higher temperatures of incineration are capable of vaporizing or gasifying all the organic components of waste such as the Orica HCB material. Hence, the combination of thermal desorption (e.g. TBRP) and GPCR with high efficiency waste gas

scrubbing, would require a second stage of thermal destruction (e.g. HTI) for the various solid residues arising from all three steps of the GPCR treatment process."

These possible solutions, which might or might not be successful, would require major re-engineering of waste pre-treatment equipment and extensive trials, resulting in lengthy delays in the development of a new facility to treat the Orica HCB waste stockpile.

(b)

The second issue is the dispute over the 50 ppm - 50 mg/kg of chlorobenzene compounds. This appears to result from Mr Bridle not appreciating that SIA are referring to the total amount of a chlorobenzene contamination in the residue, not just the HCB. As discussed above, SIA were fully aware that the HCB residue levels were 3-5.6 mg/kg.

SIA quite correctly have pointed out that the GPCR process must safely deal with all the dangerous chemicals in the Orica HCB waste if it is to be considered a suitable method for safely destroying the waste. The 50 ppm calculated by SIA refers to the possible total of all the chlorobenzene compounds that could remain in the residue, not just the HCB.

SIA have calculated the estimated upper limit of contamination (50 ppm or 50mg/kg, based on weight measures, both are the same) based on the Eli EcoLogic reported 98% reduction in mass and 99.9999% volatilization of HCB and other chlorobenzenes. The Eli Eco Logic report on the HCB trials reported 5.01 – 22.2 mg/Kg of total chlorinated benzenes identified in the solid residue of the treated waste. The amount of HCB was 3.0 – 5.6 mg/Kg while the rest was made up of other chlorobenzenes such as penta, tetra, tri & di chlorobenzene. Other waste streams from the trials contained polychlorinated dibenzodioxins (PCDDs) and furans (PCDFs) up to 3.4 mg/Kg. The presence of such a range of chlorinated benzenes in the residual solid and treated waste are also of concern due to their toxic nature and the requirement of additional steps to treat the residues and contaminated steel drums. Taken that 16,000 tonnes of highly variable, high concentration chlorinated waste requires treatment, including tars, liquids and solids, the upper limit of 50 mg/Kg of chlorobenzene present in residual waste is likely to occur.

Therefore, on the basis of the trials conducted on the Orica HCB waste, the GPCR facility failed to reduce either the amount of HCB or the amount of total chlorobenzene compounds in the residue to an acceptable level.

Responses to claims about the Gas Phase Chemical Reduction (GPCR) Process:

The SIA report was looking specifically at the ability of existing technologies and facilities to deal in a realistic timeframe with the Orica HCB wastes which are unusually complex and difficult to handle, largely because of their heterogeneity.

As stated in the SIA report:

> *"It must be clearly noted that the assessment of these technologies (which are all proven technologies) is to determine their viability for treatment of the significant stockpile of high concentration HCB waste stored at Botany. This assessment does not apply to any other waste stream and should not reflect positively or negatively on whether the process is technically or commercially feasible in the treatment of other hazardous waste streams or even smaller and/or less concentrated volumes of Hexachlorobenzene (HCB) waste. The scale and concentration of the Orica HCB is unique and there are significant factors to consider in the safe and effective treatment of this stockpile as distinct from the treatment of other hazardous wastes.*
>
> *The scope of this assessment does not incorporate evaluation of these technologies for treatment of other waste streams and may well provide different outcomes and results in those cases."*

Question 1

In section 4.4.3 of the report SIA state that GPCR treated primarily "low concentration" OC wastes. This is not true, with most of the wastes treated being pure DDT and high-strength PCB wastes.

Mr Bridle's claim:

In section 4.4.3 of the report, SIA state that the GPCR process treated primarily "low concentration" OC wastes. This is not true; most of the WA wastes treated were pure DDT and high-strength PCB wastes. In fact, during its operational life, the GPCR facility in Kwinana treated much of Eastern Australia's high-strength Scheduled Wastes, after obtaining WA DEP approval to do so.

Actual wording in SIA report:

> "Eco Logic facilities to date have processed waste streams with low to medium hydrocarbon and organo-chlorine contamination levels, such as contaminated soils, and this is the continuing projected market for the technology. The Orica HCB waste stockpile has highly concentrated high chlorine content and is a high organics (hydrocarbon) content material.
>
> In total, the plant treated in excess of 2,000 tonnes of waste including PCBs, pesticides and other POP's, with up to 1,500 tonnes having been treated in the last two years of operation."

Response to Question 1

With respect to the scale of operation, SIA saw this as an area of concern because there is definitely no existing GPCR operation handling anything like the volume and chlorine content involved for the treatment of this particular HCB waste stream. This material is up

to 100% HCB in most containers and HCB is 75% by weight chlorine of the complete stockpile.

Note that the SIA report in saying "low to medium hydrocarbon and organo-chlorine contamination levels" is doing so in relation to HCB.

The DDT and OC contaminated oil streams that were commercially destroyed in the Kwinana facility in Western Australia contained only a fraction of the chlorine content of this HCB waste.

HCB, C6Cl6 is 75% chlorine by weight.

DDT, C14H9Cl5 is 50% chlorine by weight.

Commercial DDT is usually dissolved in a solvent such as toluene for direct use in solution form with normal concentrations of 5 to 10%. This equates to just 2.5 to 5% chlorine content. SIA have informed the Department that there are records of 30.3 % DDT being processed at the Kwinana GPCR facility but no quantities or rates are given. Even so, that is only 15% chlorine by content. Therefore, in direct comparison to the Orica HCB stockpile which is 75% chlorine by weight, it is clear that the GPCR facility treated lower concentration chlorine wastes.

PCB wastes are usually in the form of transformer and electric power condenser, switchgear insulation and coolant fluid. In commercial volumes, the concentrations are usually 20 – 40% chlorine by content. However, by the mid to late 1990s when the GPCR Kwinana plant was in operation, the majority of Australia's transformers had been flushed with fresh PCB free oil and concentrations were down to hundreds or a few thousand parts per million. Please note that 1% is 10,000ppm meaning that the waste transformer oils being treated were well below the 1% level.

If the plant was still operating and if it could deal with the Orica HCB stockpiled waste, the decommissioned ELI Eco Logic plant in Kwinana could treat up to 0.66 tonnes per day (max) of the Orica HCB waste, requiring 100 plant years of operation to clear the HCB waste stream under consideration. To reduce this time frame a ten times scale up would be required as a minimum which introduces its own inherent engineering, technical and licensing issues.

Currently there are no GPCR facilities operating in Australia.

Question 2

In section 4.4.4 SIA report that the commercial HCB trial was not successful in that the process left an organic residue. This is not true as the residue in the SBV was the inorganics present in the mixed HCB waste. Again SIA incorrectly say that GPCR was used to treat predominately low strength wastes.

Mr Bridle's claim:

In section 4.4.4 of the SIA report it is stated that the commercial HCB trial was not successful in that the process left an organic residue. This is not true as the residue from the process was the inorganics present in the mixed HCB waste. In all the HCB trials the GPCR process achieved in excess of 99.99999% destruction of HCB and the inorganic residue from the process met regulatory requirements for landfill disposal. In this section SIA again say incorrectly say that GPCR was used to treat predominately low strength wastes.

Actual wording in SIA report:

"The Eco Logic process was established with a hydrogen vaporization front end. Trials with Orica's HCB waste stockpile were disappointing and not all of the Chlorinated Hydrocarbons (CHCs) were volatilized. The residual material in the drums had transformed during the soaking process into a hard, not volatile char-like substance that would require a further treatment step. There were many other practical issues related to the use of hydrogen."

Response to Question 2

The factual analysis data on the residues from the Eco Logic 1999 report confirm that the residues contained HCB above the threshold level. They were not just inorganics:

Residues Mass:

0.4-2% (as % of the original HCB mass)

Chemical analysis:

I-TEQ	0.5-51 ng/g
Total Carbon	39-65 %
Chloride	2.3-3.1%
HCB	3-5.6 *microg*/g (3-5.6 mg/kg)

The results indicate that the level of HCB in the residue after Thermal Reduction Batch Processing was in excess of the HCB Waste Management Plan specification that any solid residues will contain less than 2mg/kg of scheduled chemicals expressed as chlorine.

Possible solutions have been suggested that would require, as indicated in the SIA report, major re-engineering of waste pre-treatment equipment and extensive trials, resulting in lengthy delays in the development of a new facility to treat the Orica HCB waste stockpile.

Question 3

In section 4.4.5 SIA again do not state that the high dioxin emission result was generated when the processing rate exceeded the capacity of the scrubber to remove HCl, which when combusted, generated the dioxins. It appears that the GPCR information was obtained from Orica, with no attempt to verify the Orica statements by comment from Doug Hallett, who owns the technology.

Mr Bridle's claim:

In section 4.4.5 of the report, SIA do not state that the one high dioxin emission result occurred when, at the request of Orica, the processing rate exceeded the capacity of the scrubber to remove the HCl generated by the process. It was the presence of this HCl, which when combusted, that generated the dioxins. It appears that this GPCR information was obtained from Orica, with no independent attempt by SIA to verify these Orica statements, for example, with input from Dr Doug Hallett. Extensive independent testing and analysis has confirmed that dioxin emissions from the GPCR process are ***well*** *below international standards.*

Actual wording in SIA report:

"The technology is not suitable in its present state for treating HCB waste, primarily due to the wide range of melting and boiling points of the compounds present in the waste.

With further development, however, the technology could no doubt be suited to the destruction of the HCB waste. Some preliminary testing on the Orica HCB waste stockpile produced an off-gas with dioxin content 10 times the generally acceptable level. Further processing of the off-gases would have to be considered."

In addition from Section 4.4.6, SIA states:

"The major concerns with Gas Phase Chemical Reduction (GPCR) were the demonstrated high dioxin level in stack emissions (0.85-1.59ng/m3) compared to the 0.1 ng level required, the resulting solid residues which did not meet landfill criteria (HCB> 2mg/Kg), and the production of "black tarry material" in the scrubbing system.

Orica engaged trials for treatment of the HCB waste stockpile at the Kwinana facility and Kvaerner Engineering, who observed the trials, recommended major modifications to the plant – including additional scrubbers, column packing changes, and burner /combustion condition changes; and

The plant at Kwinana did not meet the 0.1 ng (TEQ)/m3 limit for dioxins/furans during the HCB tests. Eco Logic questioned the accuracy of these results. Eco Logic suggested that more effective scrubbing, changes to gas reticulation rates and changes to auxiliary burner design would enable the process to meet emission criteria; and

The main advantage of the Eco Logic process , in theory, is that it avoids the de novo synthesis of dioxins/furans. In practice, dioxin/furans were found in Eco Logic residuals and in the gaseous discharge."

Response to Question 3

The physical testing data relating to stack emissions from the three trials carried out indicate that emissions for dioxins/furans were in a range of 0.852 – 1.59 ng/m^3 I-TEQ. This does not meet the 0.1 ng/m^3 (TEQ) limit for dioxins/furans established for the HCB trials.

Note that these results are those provided by Eco Logic in their 1999 report to Orica, they are not figures produced by Orica as inferred by Mr Bridle.

The results of trials indicate that emissions scrubbing suffered badly due to carry over of tars from the treatment process. This was seen as a serious issue by SIA, estimated to require considerable process and equipment development, firstly to contend with the tar precipitation on scrubber internals and secondly to manage the tar and soot, solids residues extracted from the scrubbers, which would themselves be contaminated with organo-chlorine compounds.

SIA accurately states in its report that emissions could be reduced but only with major modifications to plant machinery.

Question 4

In section 4.4.6 SIA state that the residues contained more than 2 mg HCB/kg. We believe this is NOT correct, but will again re-confirm with Doug Hallett that *Only 2% of the input mass was present following treatment. This material was tested and found to be silicon and carbon residue. The HCB was destroyed in the reactor with a DE >99.9999% for all tests.*

Mr Bridle's claim:

In section 4.4.6 of the SIA report it is stated that the residues from the GPCR process, when processing Orica's HCB waste, contained more than 2 mg HCB/kg. I believe this is NOT correct but have been unable to source the reference material from Orica to confirm where this value comes from.

Actual wording in SIA report:

> "The major concerns with Gas Phase Chemical Reduction (GPCR) were the demonstrated high dioxin level in stack emissions (0.85-1.59ng/m3) compared to the 0.1 ng level required, the resulting solid residues which did not meet landfill criteria (HCB> 2mg/Kg), and the production of "black tarry material" in the scrubbing system.
>
> Orica engaged trials for treatment of the HCB waste stockpile at the Kwinana facility and Kvaerner Engineering, who observed the trials, recommended major modifications to the plant – including additional scrubbers, column packing changes, and burner /combustion condition changes.
>
> In addition, there were several residual streams which may be difficult to reprocess and would need further assessment and possible treatment before disposal. There are also the unresolved problems of dealing with the black tarry material formed in the dechlorination process."

Response to Question 4

The level of destruction efficiency achieved is not in question. However, the 1999 Eco Logic test results clearly indicate that residual material was found in the drums after Thermal Batch Reduction Processing (TBRP). The concentrations of HCB in the residual mass from the drums processed were 3-5.6 *microg*/g (3-5.6 mg/kg) (see response to Question 2).

This exceeds the HCB Waste Management Plan specification that any solid residues will contain less than 2mg/kg of scheduled chemicals expressed as chlorine.

Again, these figures are the test results provided in the Eco Logic 1999 report.

The HCB drum pre treatment process therefore requires development of a separate process for handling and treating the solid residues still contaminated with the organo-chlorine compounds. The problem is the variety of compounds and physical forms of the Orica HCB waste, ranging from slurries to polymer gels and rubbers, requiring a wide range of evaporation temperatures and retention times.

SIA has indicated that this has been found to be a problem with any thermal desorption process and only the higher temperatures of incineration are capable of vaporizing or gasifying all the organic components of waste such as the Orica HCB material. Hence, the combination of thermal desorption (e.g. TBRP) and GPCR with high efficiency waste gas scrubbing, would require a second stage of thermal destruction (e.g. HTI) for the various solid residues arising from all three steps of the GPCR treatment process.
