Battleground Energy Recovery Project

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HARC/Integral Power/Clean Harbors/DOW Chemical

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Executive Summary

- **Technology** — Waste Heat Recovery from hazardous waste incineration
- **Location** — Clean Harbors Environmental Services – LaPorte, TX
- **Project Cost** — $28 million
- **Output** — Steam: up to 100 mpph steam @ 600 psig / 750F
  Power: 10 MW capacity @ 12kV (by condensing STG)
- **Customers** — Clean Harbors (4-5 MW normal, 8MW max)
  Dow Chemical (40 kpph steam normal, up to 100 kpph)
- **Major Scope**
  - Specialized Waste Heat Recovery Boiler
  - 10 MW Steam Turbine-Generator, Condenser, Cooling Tower
  - 12 kV electrical interconnect to Clean Harbors substation
  - 600 psig steam pipeline to Dow Chemical incl. water return
- **Project Team** — Houston Advanced Research Center – Project Manager
  Integral Power – Project Developer
  Clean Harbors – Project Host, Electricity customer, equity investor
  DOW Chemical – Steam customer

Project Objectives

1. Prove Feasibility of Waste Heat Recovery Technology at a Hazardous Waste Incineration Complex
   - ✓ Only a couple U.S. haz waste incineration waste plants have waste heat recovery (unlike Europe where it is standard practice)
   - ✓ creates design and operating reference for this challenging service
2. Provide Low-Cost Electricity and Steam Using Waste Heat
   - ✓ produces 8 MW of zero emission electricity, demonstrating that base-load clean electricity can be produced on commercial scale without fossil fuels
   - ✓ reduces the cost of energy for both Clean Harbors and Dow, improving long-term profitability of both plants
3. Create a Showcase Waste Heat Recovery Demonstration Project
   - ✓ prove viability of WHR in this very 'dirty' flue gas environment
   - ✓ critical to spur to development of additional projects at similar facilities

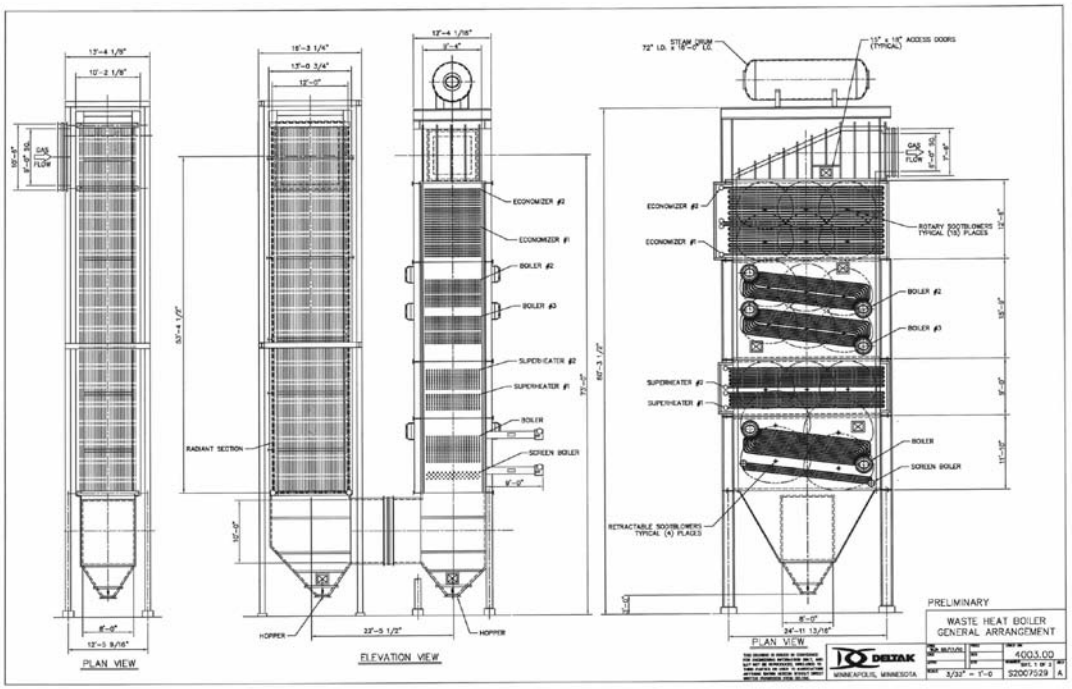
State of the Art

- The U.S. incineration industry has not previously adopted waste heat recovery boilers.
- Waste heat boilers are uniquely designed for a specific application.
- WHR is industry standard for incineration plants in Europe due to legislation, incentives and energy costs.
  - *Served by European boiler manufacturers such as Baumgarte, IBB and Alstom.*
  - *Installed greenfield with the overall facility, European boiler designs have the luxury of plot size and space.*
  - *provide quench and radiant section to reduce slagging and include water or steam sootblowers to reduce fouling.*

Technical Approach

- Boiler Design – retrofit, plot constrained design utilizes a water-cooled, refractory lined pre-chamber to quench “slag” prior to entering primary boiler
- Project team and equipment suppliers have significant process know-how and capabilities.

- ✓ Pre-chamber reduces flue gas temperature below 1650F to eliminate sticky slag from flue gas.
- ✓ Vertical flue gas path decreases plot requirement and duct losses.
- ✓ Steam soot blowers incorporated with bottom hoppers for ash removal
- ✓ Bare tube design includes generous tube spacing.



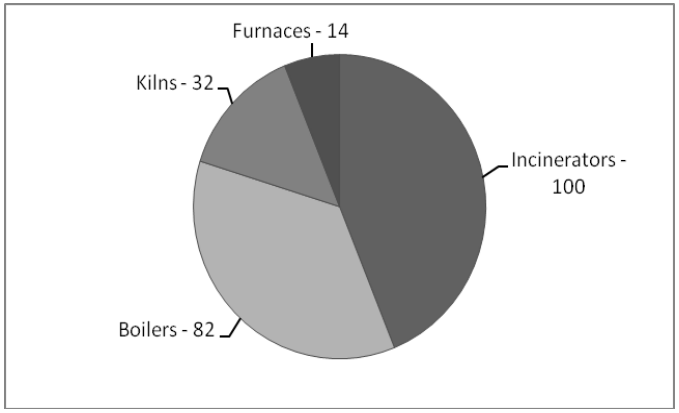
Technical Approach

- A project of this type has not been previously implemented within the U.S.
  - boiler engineering and design issues must be successfully implemented without significant proof-of-performance on an existing prototype.

- Boiler retrofit into an existing facility places significant design, permitting, and construction constraints and operating risks on the project.

Transition and Deployment

- EPA estimates 125 U.S. incineration facilities that could host 1,000 MW of waste heat projects nationally.
  - Broader industrial WHR market is estimated at over 1.5-1.7 Quads annually including kilns, furnaces, boilers, and incinerators.



- Successful implementation of the Battleground Project would create a case study to push WHR into other less demanding flue gas environments.
  - Provide a model demonstration site for others
- Expand WHR marketing nationally and internationally.
  - Project will generate know-how for U.S. developers and boiler manufacturers to compete for overseas business

Measure of Success

1. Prove Feasibility of Waste Heat Recovery Technology at a Hazardous Waste Incineration Complex
   - This project must make money and be financially viable.
2. Provide Low-Cost Electricity and Steam Using Waste Heat
   - This project must enhance the competitiveness of both Clean Harbors and DOW Chemical.
3. Create a Showcase Waste Heat Recovery Demonstration Project
   - This project is strategic. In targeting the hazardous waste incineration application – the most difficult flue gas environment – a successful project will enhance the perceived viability of waste heat recovery and support broad market adoption in cement, calcining, lime, and other 'dirty' flue gas industries.

Benefits

- Energy Savings:

600,000 MMBtu/yr ; 12 million MMBTU over 20 year project life

Assumptions:

- offset 80% efficiency natural gas boiler; offset natural gas combined cycle power plant with 6300 Btu/kWh heat rate

- Water Savings:

37 million gals/yr; 740 million gals over 20 year project life

Environmental Benefits (assuming 4.1 MW net power + 40 kpph steam sale)	**Annual NOx (lbs)**	**Annual SO_2 (lbs)**	**Annual CO_2 (lbs)**
Reductions due to Electricity Generation	74,107	205,491	53,043,781
Reductions due to Natural Gas Boiler Offset	38,544	0	44,980,848
Total	**112,651**	**205,491**	**98,024,629**

CO2 savings: 8718 passenger cars taken off the road every year for twenty years

Assumptions:

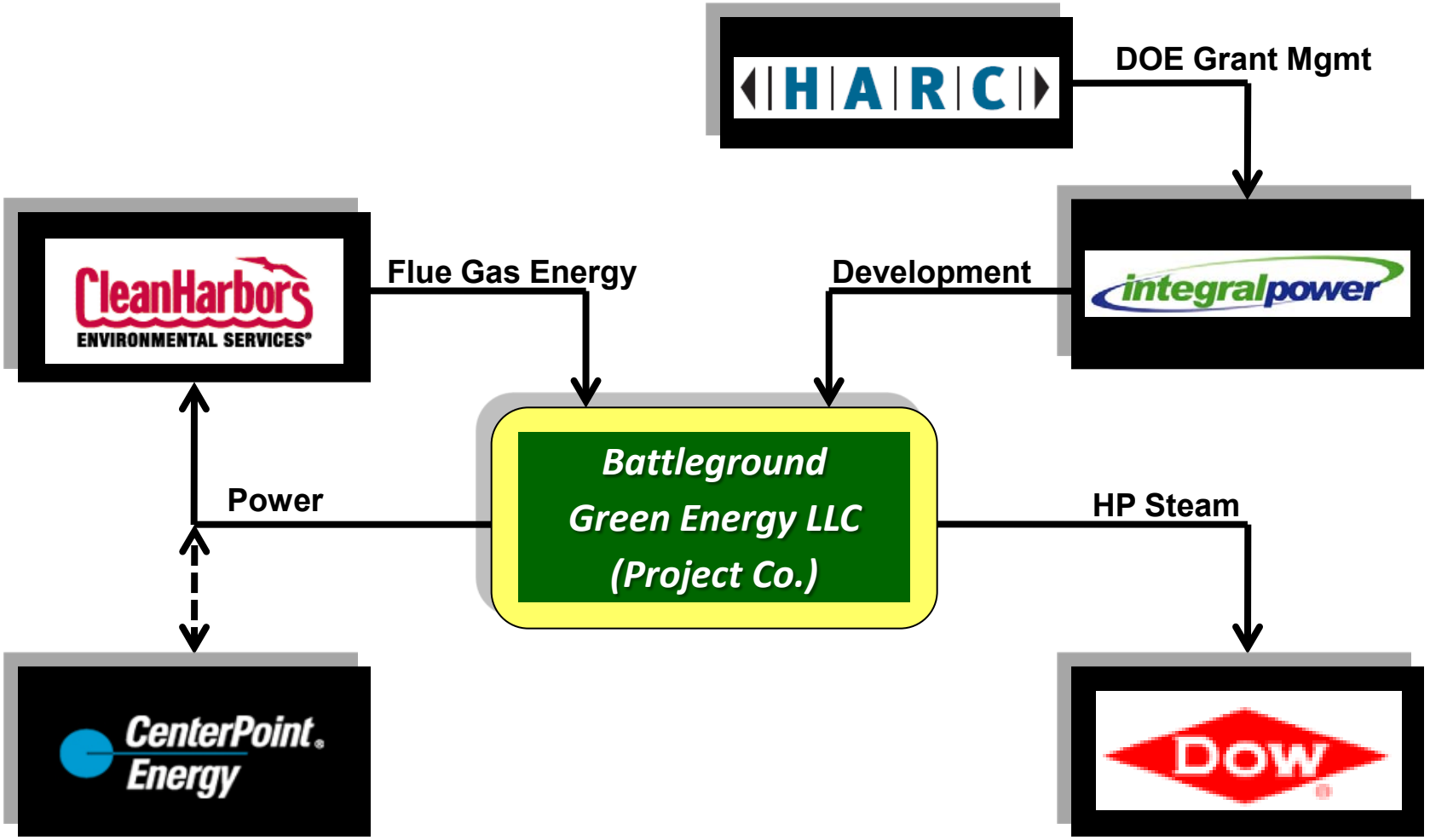
- 88% availability; 6% T&D losses; EPA Emissions Calculator values for eGRID annual coal power plant and natural gas fired boiler

Benefits

Clean Harbors	Annual Benefits ($)	DOW Chemical	Annual Benefits ($)
Water Savings	16,000	Electrical Use Savings	214,000
Cooling Tower Fan Power	54,000	Boiler Fuel Savings (Nat Gas)	456,000
Cooling Tower Maintenance	100,000		
Scrubber Maintenance	100,000		
Recycle Credits (solids only)	300,000		
Increased Throughput Liquids Solids	 120,000 180,000		
TOTAL	870,000	TOTAL	670,000

Commercialization Approach

- Replicable business model for retrofit and new construction markets.



Project Management & Budget

- All Preliminary Development Complete
  - Project engineering
  - Financial analysis
  - Environmental permits (NETL EA and Clean Harbors RCRA permit modification)
- Commercial commodity sales agreements and resolution of equity investor complete by Dec 2011.
- EPC Kick-off Early 2012

Project Budget				
	FY11	**FY12**	**FY13**	**FY14**
DOE Investment	$777,802	1,189515		
Cost Share	320,955	1,679,386		
Project Total	1,098,757	2,868,901		

FY12 represents Budget Period 2 funding

Results and Accomplishments

- Letters of Intent in place with project team members
- Field testing of flue gas chemistry
- Waste Heat Recovery Boiler specifications complete
- Preliminary EPC scoping and specs complete
- Quotations received for WHR boiler and STG
- Clean Harbors permit application ready for filing
- NETL Environmental Audit nearly complete (archeological study ongoing)
- Debt financing outlined (EECBG bonds)
- Project financial modeling complete
- Negotiation of commercial commodity sales agreement terms ongoing, but stalled over ROI for equity holders

Economics

Project Revenue (based on $5.20 /mmBtu natural gas in operating year 1)	
Steam revenue (based on natgas price and 1.2 multiplier)	$ 2.3 million / yr
Power revenue (tied to natgas price with floor of $66/MWh year 1)	$ 1.8 million / yr
Total revenue	$ 4.1 million / yr
Less Operating and Maintenance expenses	($1.4 million / yr)
Income available for capital repayment, debt service and benefits	$2.7 million / yr
Less Debt service (principal and interest)	($1.4 million / yr)
Free cash flow available for distribution and fees	$1.3 million / yr

Project Financing ($ millions)

Source of Funds	Case 1 CH Equity	Case 2 3rd Party	Case 3 All Debt
Integral Power	1	1	1
Clean Harbors	4	0	0
3rd Party	0	4	0
Grant Phase II	1	1	1
Debt	22	22	26
Total Project ($millions)	28	28	28

Project Benefits ($ 000 year 1)

Party	Case 1 CH Equity	Case 2 3rd Party	Case 3 All Debt
Integral Power cash flow incl fees Integral Power plant equity	349 83	386 104	320 95
Clean Harbors cash flow incl fees Clean Harbors plant equity	944 415	572 0	798 477
3rd Party Equity cash flow 3rd Party Equity plant equity	0 0	372 208	0 0
Benefits to IP & CH from Project Revenues	1,791	1,642	1,690

Path Forward

- Provide 6 month 'No-Cost Extension' of DOE Grant through December 31, 2011 to allow additional time to resolve equity financing roadblock and execution of commercial commodity sales agreements (CSA).
  - Letters of Intent in place
  - Preliminary Development complete
  - Financial models complete
  - Draft CSAs under review
  - Debt financing identified using EECBG bonds (Stern Brothers)

- Close of financing by end of 2011 will kick-off EPC execution in early 2012 (Budget Period 2)

Questions?

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